Imports of Capital Goods and Enterprise Performance: A Firm-Level Analysis in China

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Abstract

Much recent research on openness and productivity has shifted attention away from regions and countries to firms. Most of those studies have focused on exports and productivity. However, there has been no empirical study on the relationship between imports and productivity with firm-level data. This note attempts to help fill this gap using firm-level data in China. Controlling firms' other characteristics, we find that firms with imports of capital goods have higher productivity. It implies that, in a developing country, firms utilizing foreign products, which embody foreign technologies, have better performance than those only using domestic technologies.

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1. Introduction

Recent empirical research on openness and productivity has gradually shifted attention away from regions and countries to firms.¹ This research strategy significantly mitigates the problem of missing variables in the studies based on aggregate data through analyzing the characteristics of the firms in specified industries of a certain country. These recent studies have focused on exports and productivity. However, the relationship between imports and productivity with firm-level data has not been researched extensively. Indeed, as emphasized by Eaton and Kortum (1999), that a developing country's imports of capital goods are the key carriers of international technological spillovers from developed countries. The current paper attempts to help fill this gap.²

This paper extends the existing empirical literature in two main aspects. First, our empirical study is based on firm-level data. This allows us to make inferences by taking into account the heterogeneity among firms. Second, while the existing literature focuses on developed countries, we study a developing country – China.³ China is an ideal subject of study for the purpose of this paper, because its fast economic growth since the early 1980s has been accompanied by tremendous increases in international trade and it has been playing an increasingly important role in the world economy.

2. Data

The dataset analyzed in this paper is constructed from a World Bank survey on Chinese firms for the period of 1998-2000. The survey covers 998 manufacturing firms distributed across five major cities (Beijing, Chengdu, Guangzhou, Shanghai and Tianjin) during the period of 1998-2001. The sampled firms are randomly drawn from five manufacturing sectors (apparel and leather goods, consumer goods, electronic equipment, electronic components, and vehicles and vehicle parts). These five sectors are further

¹ For example, see the survey by Tybout (2003) and Keller (2004).

² The relevant empirical literature to the current study includes Eaton and Kortum (2001), Liu, Burridge and Sinclair (2002), Caselli and Wilson (2004), Lupez and Shnchez (2005), and Narayanan (2006). But none of this literature uses firm-level data.

³ It is commonly argued that the farther a country is away the technological frontier of the world, the more the country benefits from international technological diffusions.

categorized into 14 sub-sectors based on the 3-digit international standard industrial classification (ISIC).

We first define the variable for imports of capital goods. In the survey, each firm was asked the following question: “Did your plant import any machinery/equipment?” Accordingly we construct a dummy variable called “Imports of Machinery/Equipment”, which equals 1 if the firm imported machinery/equipment before or at the sample year and 0 if otherwise.

In our sample, around 40.1% of the firms imported machinery/equipment for the sample period (Table 1).⁴ The survey also provides us with the information of importing source countries, which shows that most imports were from developed economies. Specifically, 52% of the firms imported from Japan, 31.2% imported from the US, 24% imported from Germany, 17.9% imported from Hong Kong, and 13.89% imported from Taiwan. The other importing countries include Italy, UK, Korea, France, Switzerland, Sweden, Belgium, Canada, Austria, Australia, and Singapore.

Table 1 is about here

Six variables are then constructed for firms’ performance and production. Firm performance is measured from three aspects: output, profitability and labor productivity. Output is calculated as sales adjusted for inventory changes, profitability is measured by sales less total cost (profit), and labor productivity is proxied by the ratio of profit to total employees. As shown in Table 1, the average output, profit and labor productivity respectively are 202.2.0 million, 25.1 million and 46.1 thousand RMB in our sample. Furthermore, three input variables are specified in the sample: capital proxied by the value of fixed assets, labor proxied by the number of employees, and the value of intermediate goods. Capital, labor and intermediate goods respectively averaged 94.7 million RMB, 656 workers and 138.6 million RMB with large variations among sampled firms.

⁴ The observation that some firms imported while the others did not can be explained as follows. As demonstrated by Basu and Weil (1998), the advanced technologies, the vast majority of which originated from the research and development of a small number of most developed countries, were designed to fit the economic conditions in developed countries. In other words, because the disparity of economic conditions between developing and developed countries, foreign technologies may be appropriate only to a fraction of the firms in developing countries. As a result, while some firms find it profitable to import, others do not.

In addition, we create two variables – the age of the firm and the state owned enterprises (SOE) dummy – to control the potential age and ownership influence on firm productivity. The sampled firms aged 14.3 years on average in our sample. SOE dummy takes the value of 1 or 0; it equals 1 if a firm is a state-owned enterprise and 0 if not. In our sample, about 19.4% of the firms were SOEs.

3. Empirical Methodologies and Results

3.1. Empirical Methodologies

There are two standard approaches in the existing empirical studies on the effects of the designed variables on firm performance. The first directly estimates total factor productivity (TFP) by standard Cobb-Douglas production function. The second examines the impact of designed variables on a set of performance variables such as profits and labor productivity. We pursue both in the paper.

Specifically, the empirical model from the first approach can be written as:

$$\ln(\text{Output})_{it} = \alpha_0 + \alpha_1 \ln(\text{Capital}) + \alpha_2 \ln(\text{Labor}) + \alpha_3 \ln(\text{IntermediateGoods}) + \alpha_4 \text{IMPORT}_{it} + \alpha_5 X_{it} + \alpha_6 \text{CityD} + \alpha_7 \text{SectorD} + \alpha_8 \text{YearD} + \varepsilon_{ijt} \quad (1)$$

where i and t denote individual firm i and time t respectively, and ε is the error term. Import is the measures of imports of machinery/equipment. X is a vector of firm characteristics such as age and SOE dummy in our regressions. And CityD, SectorD and YearD are the city, sector and year dummies respectively, which are used to control for variations across cities and sectors, over years.

The empirical model from the second approach is as follows:

$$\ln Y_{it} = \alpha_0 + \alpha_1 \text{IMPORT}_{it} + \alpha_2 \ln(\text{Capital}) + \alpha_3 X_{it} + \alpha_4 \text{CityD} + \alpha_5 \text{SectorD} + \alpha_6 \text{YearD} + \varepsilon_{ijt} \quad (2)$$

where i and t denote individual firm i and time t respectively, and ε is the error term. Y stands for firm performance measured by profit and labor productivity respectively. Capital is used to control for the size of the firm, X is firm characteristics including age and SOE dummy, and CityD, SectorD and YearD are the city, sector and year dummies respectively.

We estimate Equations (1) and (2) by using robust regression method, which down-weighs the sample outliers to make the estimation less sensitive to measurement errors. We also apply White-corrected standard errors to deal with potential heteroskedasticity. For the sake of brevity, the coefficients of the city, sector and year dummies will not be reported in the result table.

3.2. Empirical Results

Table 2 provides the regression results on the relationship between imports of capital goods and firm performance.

Table 2 is about here

Model 1-3 shows that imports of machinery/equipment are positively and significantly associated with a firm's output, profit and labor productivity. In a modern world with uneven development, most of the technological creation is generated in rich countries. For example, the largest seven industrial countries accounted for 84% of the world's research and development spending in 1995 (Keller, 2004). The poor countries, however, can benefit from the technological spillovers across national borders. As technologies are often embodied in capital goods, a firm can obtain new technologies through importing machinery, which enhances its productivity. This finding is consistent with those in the existing studies based on aggregate data (e.g. Eaton and Kortum (2001), Caselli and Wilson (2004)). The main difference between our empirical study and the existing literature is that we use firm-level data, while the existing literature uses cross-country data. Thus, the current paper complements the existing literature.

Furthermore, we consider that a firm's imports of machinery/equipment in the past may have a lagged impact on its productivity. To examine this hypothesis, we lag the variable of imports for one year and repeat the regression analysis. The results are presented in Model 4-6 of Table 2, which suggests that lagged imports are also significantly and positively associated with firm performance.

Table 1. Summary Statistics

Variables	Unit	Mean	Stdev.
Imports of Machinery/Equipment	Dummy (0-1)	0.401	0.490
Output	Million RMB	202.212	1296.321
Profit	Million RMB	25.173	675.761
Profit per Employee	Thousand RMB	46.120	399.213
Capital	Million RMB	94.734	418.911
Labor	Worker	656.497	1258.162
Intermediate Goods	Million RMB	138.586	883.869
Age	Year	14.292	15.896
SOE Dummy	Dummy (0-1)	0.194	0.396

Table 2. Regressions on the Relationship between Firm Performance and Imports of Machinery/Equipment

Dependent Variables:						
	Ln (Output)	Ln (Profit)	Ln (Profit / Labor)	Ln (Output)	Ln (Profit)	Ln (Profit / Labor)
	(1)	(2)	(3)	(4)	(5)	(6)
Imports of Machinery/Equipment	0.081** (0.033)	0.281*** (0.074)	0.202*** (0.078)			
Lag (Imports of Machinery/Equipment)				0.078* (0.041)	0.284*** (0.089)	0.219** (0.094)
Ln (Capital)	0.104*** (0.013)	0.688*** (0.019)	0.214*** (0.018)	0.110*** (0.016)	0.706*** (0.022)	0.234*** (0.021)
Ln (Labor)	0.204*** (0.020)			0.205*** (0.025)		
Ln (Intermediate Goods)	0.650*** (0.018)			0.650*** (0.022)		
Ln (Age)	-0.059*** (0.017)	-0.173*** (0.042)	-0.255*** (0.043)	-0.07*** (0.022)	-0.240*** (0.050)	-0.300*** (0.050)
SOE Dummy	-0.235*** (0.044)	-0.431*** (0.099)	-0.803*** (0.102)	-0.22*** (0.053)	-0.397*** (0.121)	-0.765*** (0.125)
Constant	1.934*** (0.105)	1.729*** (0.208)	0.597*** (0.201)	1.965*** (0.125)	1.787*** (0.247)	0.611** (0.238)
Observations	2718	2265	2259	1877	1571	1569
Adjusted R-Squared	0.89	0.57	0.27	0.90	0.59	0.29

Note: 1) ***, ** and * denote 1%, 5% and 10% significant level respectively.

2) The numbers in the brackets are white-corrected standard errors.

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