Total Factor Productivity, Foreign Direct Investment and Entry Barriers in the Chinese Automobile Industry

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Abstract

We explore three questions on FDI: 1) What are the differences in entry barriers for foreign, public and private investors? 2) What are the effects of past productivity levels on future FDI decisions? 3) What is the effect of equity structure on future TFP levels? The empirical results based on a monopolistic competition model and using a firm-level dataset from the Chinese automobile industry suggest that foreign investors face higher entry barriers and react stronger to past TFP levels. FDI is also found to improve future TFP more than others. Finally, WTO accession is found to reduce entry barriers for foreign and domestic private investors while increasing for public investors.

Keywords: Foreign direct investment; Total factor Productivity; Entry barriers; Auto-manufacturing industry; China

JEL Classification Numbers: F21; O14; O47; L62; L10

1. Introduction

"It's like opium. Once you've had it you will get addicted forever ... From central authorities to local governments, everyone has been trying hard to bring in foreign investment. But so many years have passed and we don't even have a one brand that can be competitive in the auto world." Former machinery and industry minister, He Guangyuan, referring to China's industrial policy of requiring foreign car manufacturers to form local joint ventures (Reuters, 2012).

Global Foreign Direct Investment (FDI) flows have increased radically for the last three decades reaching $1.5 trillion in 2011 from a bare $54 billion in 1980. During this period the share of FDI inflows to developing countries also increased significantly reaching $777 billion by 2011 up from $7 billion in 1980. To put this in perspective, developing countries received more than half (51%) of global FDI flows in 2011 while the same figure was less than 14% in 1980. Furthermore, the share of FDI inflows in Gross Fixed Capital Formation (GFCF) of developing countries rose from less than 4% in 1990 to above 10% in 2011 with an average of 10% during 1990-2011. Nevertheless, the distribution of these flows to developing countries has been quite uneven with Mainland China alone accounting for 20% of all inflows during 1990-2011 (UNCTAD, 2014).

In response to the increasing mobility of capital flows there have been numerous studies looking at both the driving factors behind these flows, and their developmental effects on host economies. Overall, FDI flows are expected to have significant long term growth and development effects on host economies through firm and industry level productivity spillovers (Aitken and Harrison, 1999; Haskel et al., 2007). As a result, there has been a gold-rush by almost every government around the world to attract foreign investment through a myriad of financial incentives such as tax cuts, infrastructure subsidies, etc. Moreover, to increase the likelihood of technology transfers, several countries, such as China, encourage or require foreign investors to form joint partnerships with domestic firms upon entry. In 2010 alone 74 countries adopted 149 policy changes affecting foreign investment, of which 68% was for further liberalization or promotion of FDI. The trend, however, appears to be downwards given that in 2000 98% of 150 legislative changes in 70 countries was for further investment promotion and only 2% was for regulation and/or restriction (UNCTAD, 2012). Part of the explanation for this downward trend is possibly the increasing skepticism among policy makers and the general public regarding the growth and productivity effects of FDI. The same skepticism can also be found in an increasingly divided academic research on this topic (Aitken and Harrison, 1999; Chung et al., 2003; Liu, 2008; Huang and Sharif, 2009; Fernandesa and Paunov, 2012). Furthermore, previous research on the question of industry and/or country level entry barriers (Shleifer and Vishny, 1993; Wei, 2000; Alfaro et al., 2009; Kinda, 2010), as well as on the issue of any self-selection bias caused by the cherry-picking of more successful firms by foreign investors (Aitken and Harrison, 1999; Djankov and Hoekman, 2000; Harris and Robinson, 2002; Luo et al., 2008) has been quite heterogeneous and yielded mixed results.

In this paper, we contribute to the literature on FDI by exploring three overlapping questions: a) Are the entry barriers for foreign investors different than those for public or domestic private investors? b) How do past productivity levels affect future foreign investment decisions? c) Once we control for entry barriers and past Total Factor Productivity (TFP) performance, does the equity structure of a firm affects its future TFP levels. We explore these three questions using a rich dataset from the Chinese automobile industry for the years 1998-2007. During the last two decades China has become the biggest recipient of global FDI flows, accounting for 9% of GFCF (during 1990-2011) and allowing for an in-depth analysis of the relationship between FDI and TFP, as well as entry costs. In the empirical analysis, we first recover firm level TFP using a monopolistic competition model and a semi-parametric estimation method based on Levinsohn and Petrin (2003) and Aw et al. (2011) methods. Next, we estimate the unobserved entry barriers and investor selection in a non-linear model using the Generalized Method of Moments (GMM) approach. The empirical results suggest that foreign investors face higher entry barriers than public or private investors. Secondly, in the face of higher entry costs foreign investors are found to be reacting significantly positively and more strongly to past productivity levels. Third, FDI stocks are found to improve future firm TFP levels. Fourth, China's accession to the WTO is found to have reduced the size of entry barriers for foreign and domestic private investors while increasing them for public investors. Last but not least, improved institutional development is found to increase domestic private investment more than foreign investment while causing a reduction in public investment.

The rest of the paper is organized as follows. Section 2 provides a brief literature review. Section 3 describes the data, presents the model for TFP measurement, introduces the empirical model, and discusses the results. Section 4 concludes.

2. Literature Review

Theoretically, the entry of foreign investors into a domestic market depends on the trade-off between pre-entry costs and expected post-entry pay-offs. The pre-entry costs may result from search and information gathering on local market conditions as well as on industry and firm performance. Entry costs also include risks and adjustment costs related to local institutional environment, rules and regulations, etc. In previous research, firms' entry decisions are often analyzed with respect to productivity, which is expected to signal investors' post-entry pay-offs, as well as country risk, which is used as a proxy for entry barriers. Once the entry decision is made, however, the decision itself will affect firms' future productivity dynamics. In the presence of unobserved entry costs, there will be a selection bias by foreign investors as they will tend to choose more productive firms (i.e. cherry-picking) to get higher post-entry profits and recover the pre-entry costs. The same is true for future re-investments once the entry decision is made. As a result, if we ignore the unobserved entry costs we may get a biased result and overestimate the cherry-picking behavior as well as any positive effect of foreign investment on firms' future productivity. That is, foreign firms may display higher productivity growth, perhaps not so much for having better technologies and know-how, but for having chosen higher productivity firms in the first place.

Previous research has found that firms with access to foreign equity have higher productivity, capital intensity, technology, better risk management, know-how, better access to international goods and capital markets, and larger supply of internal finance through their parent companies (Yaşar and Paul, 2007, 2009; Arnold and Javorcik, 2009). However, the net effect of FDI on firm productivity still depends on the type of FDI (i.e. vertical vs. horizontal, and greenfield vs. merger and acquisitions), the local conditions (including the quality of financial system, institutional development, etc.), competition level, and the absorptive capacities of FDI receiving firms (Findlay, 1978; DeMello, 1997; Blomström and Sjohölm, 1999; Aitken and Harrison, 1999; Blomström and Kokko, 2003; Javorcik, 2004; Blalock and Gertler, 2008, 2009; Alfaro et al., 2009; Fernandesa and Paunov, 2012; Xu, Wan and Sun, 2014).

Given the heterogeneous nature of FDI flows, most work on FDI and TFP effects focus on country and industry specific case studies. Using manufacturing firm data in the U.K. Haskel et al. (2007) report a positive correlation between firm level TFP and FDI flows. Likewise, using both manufacturing and non-manufacturing sectors Djankov and Hoekman (2000) find a positive effect of FDI on firm level productivity growth among Czech plants. Caglayan and Demir (2014) also find some evidence that firms with access to foreign equity enjoy higher productivity growth under exchange rate shocks. In the case of China, Fu (2008), Fu and Gong (2011), Fang and Mohnen (2009), and Hong and Sun (2011) find evidence that FDI improves the productivity level of Chinese firms. In contrast, Liu (2008), and Xu, Wan and Sun (2014) argues that FDI does not have a significantly positive and unconditional effect on the productivity of Chinese manufacturing firms. There also exists an ongoing debate within China regarding the actual benefits of Chinese industrial policy requiring foreign firms to form joint-ventures with domestic firms and whether or not it has been successful in fostering technology transfer and productivity growth. In fact, the former Chinese machinery and industry minister was recently quoted saying that the joint-venture requirement worked "like opium" failing to create a productive, innovative and competitive auto-industry in China (Reuters, 2012).

On the issue of entry barriers, the heterogeneous firm literature with fixed entry costs and differences in productivity across firms argues that only those firms exceeding a certain productivity or size threshold can engage in investment or trade in foreign markets (Melitz, 2003; Yeaple et al., 2004; Grossman et al., 2006). A majority of empirical studies on this topic find that higher entry and operating costs in the form of corruption, institutional barriers, political and economic risks, higher taxation, language and cultural differences, distance, and other transaction and information costs significantly reduce FDI flows (Shleifer and Vishny, 1993; Wei, 2000; Kinda, 2010). This finding is also often used to explain the so called Lucas Paradox, the fact that capital does not flow from rich to poor countries but the other way around. Alfaro et al. (2009), for example, suggest that improving Peru's institutional quality to that of Australia would quadruple that country's foreign investment inflows.

On the self-selection issue, Aitken and Harrison (1999), Djankov and Hoekman (2000), Harris and Robinson (2002), and Luo et al. (2008) point out the self-selection of more productive firms as an important determinant of FDI. Aitken and Harrison (1999) find that while FDI is likely to flow in more productive plants in Venezuela, there is no robust evidence showing any significant productivity improvement in those plants. In fact they report a significantly negative effect from foreign to domestic firms. Harris and Robinson (2002) also find some evidence showing a decline in plant level productivity after the acquisition by foreign firms in the U.K. It is also suggested that even if foreign firms cherry-pick more productive plants for investment, post-acquisition assimilation problems may delay the realization of any productivity gains. Instead, acquired firms may even display a decline in productivity levels in the short-run (Harris and Robinson, 2002). In contrast, Djankov and Hoekman (2000) find a positive productivity effect from foreign investment even after controlling for the self-selection bias. However, none of these studies take into account the effect of endogenous entry costs on the entry decisions of foreign firms, or the dynamic and bi-directional nature of foreign investment and productivity levels in the presence of such entry costs (Eaton and Tamura, 1994; Ranjan and Tobias, 2007). In the next section, we reconcile these overlapping questions by endogenizing the entry decision and its relationship with firm level TFP and entry costs.

3. Empirical Analysis

3.1 Data

The dataset we employ is a proprietary firm level dataset of Chinese manufacturing firms in automobile industry (SIC 3711) covering all firms with annual revenue above 5 million RMB in current prices, numbering 377 firms and accounting for more than 95% of sectoral output for the period 1998-2007.[1] This dataset is collected and provided by the Chinese Statistics Bureau through annual firm surveys. The Chinese automobile industry is a rapidly expanding sector and for the first time in 2009 China surpassed the US and Japan as the world's largest auto market by volume. Since 1980s, the Chinese government has encouraged foreign companies to invest and engage in joint ventures with Chinese automobile manufacturers, both privately and publicly owned. The data show that the share of foreign and private capital in firms' total paid-in value has increased steadily during the period analyzed, each reaching from below 10% in 1998 to above 20% in 2006.[2] Compared to other Chinese manufacturing sectors, the large percentage share of joint ventures is the prominent feature of the automobile industry as it has been a part of the official industrial policy in China. The data reflect this general trend with more than 95% of observations with foreign equity belonging to firms with a foreign ownership share equal or greater than 10%. However, only 6.5% of sample firms reach the 100% foreign ownership level and there exist large number firms with no foreign investment, suggesting a selection process.

The dataset includes key information from the financial statements of each firm valued in current prices. We have deflated the nominal cost, revenue and profit values by the total manufacturing sector production price index; the fixed asset values and equity investments by the total manufacturing sector fixed asset price index, and wages by the consumer price index (Table 1). Furthermore, we have cleaned the raw data to reduce measurement error by dropping those observations with negative revenues, negative total fixed assets, or with less than 10 workers. Finally, as we need at least two years of consecutive observations to be able to derive the firm level TFP, firms with less than two years of observations are dropped from the sample. The final sample includes 346 firms and 1,021 observations accounting for 90% sectoral output and employment in China. The annual number of firms range from 45 (in 2003) to 224 (in 2007). Of this, the percentage share of firms with foreign equity investment range from a low of 9% of all firms in 2003 to a high of 24% in 2007, with an overall average of 17% during the sample period. Table 1 below presents summary statistics for the sample used in the empirical analysis.[3]

<Insert Table 1 Here>

From Table 1 we see that, consistent with other studies on foreign investment, compared to public or domestic firms, firms with access to foreign equity have a significantly higher mean level of TFP (the measurement of which is discussed in the next section) and value added (R). They are also significantly larger in size, measured by total paid-in capital (*Size*), employment (L), total assets (K), and output (Q). The average size of equity investment per firm is also higher for firms with positive levels of foreign equity. Foreign firms also appear to have a significantly higher profitability rate, measured by total profits to total paid-in capital ratio. On the other hand, they have a lower share of wage payments in value added (s^l). Furthermore, compared to public and private firms, the variation across firms with foreign equity in terms of the level of TFP, size, value added, profitability, employment, total assets, and total wage payments is lower. Looking at the median values we again find a similar picture. Comparing public and private firms, we find that while private firms are smaller in size (measured by total assets, paid-in capital or employment), they enjoy higher productivity and profitability rates. Looking at the ownership structure, we find that the mean (median) shares of foreign, public, and private ownership in total equity (for those firms where they have a positive equity stake) are 0.43 (0.49), 0.731 (0.91), and 0.605 (0.600). For almost half of those foreign firms, the management is based on majority ownership. The minimum share of foreign equity investment is below 1% (0.003%) with a maximum of 100%.

3.2 Recovering Firm Level Productivity

We begin our empirical analysis by recovering the firm-level TFP. Since firms' productivity levels are unobserved, the standard approach in the literature is to use a linear regression to estimate a production function and treat the Solow residual as a measure of TFP. However, due to the lack of firm-level price and quantity information, we need to impose a market structure to re-build firms' production function. Aw et al. (2011), building on Levinsohn and Petrin (2003), offer a practical method to recover productivity without firm-level price or quantity information. Accordingly, the market is assumed to be monopolistically competitive and firms follow a Cobb-Douglas production function with endogenous input choices as in Xu (2008) and Aw et al. (2011). The basic idea here is to impose a market demand structure and derive individual firm's revenue function.

Suppose consumers have a constant elasticity of substitution utility function in Dixit-Stiglitz style, with Q being the market aggregate demand (and that $U=Q$) and q_i being the output for each product variety:

$$U = \left[\int_i q_i^{\rho} di\right]^{\frac{1}{\rho}} \tag{1}$$

The market aggregate price level is given by equation (2):

$$P = \left[\int_i p_i^{1-\sigma} di\right]^{\frac{1}{1-\sigma}} \tag{2}$$

Correspondingly, p_i is the price of each variety and σ, which is equal to $\frac{1}{1-\rho}$, is the elasticity of substitution between different market varieties. Therefore, each firm's market demand function can be written as follows:

$$q_{it} = \left(\frac{P_t}{p_{it}}\right)^{\sigma} Q_t \tag{3}$$

Here, q_{it} and p_{it} are individual firm's output and price while Q_t and P_t are the market aggregated output and price, respectively. This is the standard Dixit-Stiglitz monopolistic competition model. We also assume that each firm follows a Cobb-Douglas production function using capital (K_{it}) and labor (L_{it}):

$$q_{it} = exp(\omega_{it})\left(K_{it}^{\alpha_k} L_{it}^{\alpha_l}\right) \tag{4}$$

Next, we follow Aw et al. (2011) to recover firm level productivity. First, we change the production into logarithms:

$$lnq_{it} = \omega_{it} + \alpha_k lnK_{it} + \alpha_l lnL_{it}$$

Let R_{it} be the revenue of firm i at year t, we can use the industry price index P_t to convert R_{it} into real revenue $R_{r,it}$:

$$lnR_{it} - lnP_t = lnp_{it} + lnq_{it} - lnP_t \qquad (5)$$

Once we plug in the expressions for the right hand side variables, we get equation (6):

$$lnR_{r,it} = \frac{1}{\sigma} lnQ_t + \left(1 - \frac{1}{\sigma}\right)\omega_{it} + \left(1 - \frac{1}{\sigma}\right)\alpha_k lnK_{it} + \left(1 - \frac{1}{\sigma}\right)\alpha_l lnL_{it}$$

(6)

Since labor is the only variable input, the profit maximization problem becomes the following:

$$\max_{L_{it}} \ \pi_{it} = p_{it}q_{it} - wL_{it} \qquad (7)$$

After we plug in firms' inverse demand function that is $p_{it} = P_t Q_t^{1/\sigma} q_{it}^{-1/\sigma}$, and the profit function becomes:

$$\pi_{it} = P_t Q_t^{1/\sigma}\left(exp(\omega_{it})\left(K_{it}^{\alpha_k} L_{it}^{\alpha_l}\right)\right)^{1-1/\sigma} - wL_{it}$$

(8)

Then the first order condition with respect to labor yields equation (9):

$$\alpha_l \left(1 - \frac{1}{\sigma}\right) P_t Q_t^{1/\sigma} q_{it}^{1-1/\sigma} = wL_{it}$$

(9)

Given that $p_{it}q_{it} = P_t Q_t^{1/\sigma} q_{it}^{1-1/\sigma}$, we get the following:

$$\alpha_l \left(1 - \frac{1}{\sigma}\right) p_{it}q_{it} = wL_{it}$$

Denote s_{it}^l as the labor wage cost in the total revenue, that is the labor share (i.e. $(wL_{it})/(p_{it}q_{it})$):

$$s_{it}^l = \alpha_l \left(1 - \frac{1}{\sigma}\right)$$

Then we can use s_{it}^l, which is observable in data, to substitute α_l. Finally, we estimate the empirical model as in Klette (1999):

$$lnR_{r,it} = \beta_0 + \beta_q lnQ_t + \beta_k lnK_{it} + s_{it}^l(lnL_{it} - lnK_{it}) + x_{it} + \epsilon_{it} \qquad (10)$$

Here

$$\beta_q = \frac{1}{\sigma}, \beta_k = \left(1 - \frac{1}{\sigma}\right)\gamma, x_{it} = \left(1 - \frac{1}{\sigma}\right)\omega_{it}$$

Particularly, $\gamma = \alpha_k + \alpha_l$ measures the returns to scale. The error term, which is unobservable to us, contains two parts: the productivity x_{it}, and an idiosyncratic part ϵ_{it}. However, since the unobserved productivity term, x_{it}, is correlated with capital stock K_{it}, the ordinary least square estimation is likely to be inconsistent and biased (Olley and Pakes, 1994). Here we follow Levisohn and Petrin (2003) to specify x_{it} as a function of capital stock, lnK_{it}, and intermediate cost, lnM_{it}, that is $x_{it} = x(lnK_{it}, lnM_{it})$. Our empirical model above can then be rewritten as:

$$lnV_{it} = \beta_q lnQ_t + \phi(lnK_{it}, lnM_{it}) + \epsilon_{it} \tag{11}$$

Here

$$lnV_{it} = lnR_{r,it} - s_{it}^{l}(lnL_{it} - lnK_{it})$$

and

$$\phi(lnK_{it}, lnM_{it}) = \beta_0 + \beta_k lnK_{it} + x(lnK_{it}, lnM_{it})$$

Moreover, the productivity x_{it} is assumed to follow a first order Markov process

$$x_{it} = E\left[x_{it} | x_{i,t-1}\right] + \xi_{it}$$

We use a third-order polynomial to approximate $\phi(lnK_{it}, lnM_{it})$. In the estimation stage we use firms' total value added to measure revenue, and employ total intermediate input and total capital as two proxies for the productivity. Our estimation steps can be found in the Appendix.[4] The firm level TFP distribution, as shown in Figure 1, displays similarities with previous research on this topic. First, the long left tail in Figure 1 suggests that we have a large number of relatively less productive firms in our sample. Secondly, the TFP dispersion is quite high with the 10th percentile of *lnTFP* being 2.351 as opposed to 4.586 at the 90th percentile with an interquartile range to mean ratio of 0.635 and a coefficient of variation of 0.239. Third, the autocorrelation coefficient is significantly large being at 0.895 between time *t* and *t-1*. To evaluate the relative heterogeneity of firms based on their ownership types, Figure 2 plots the TFP distributions by Kernel densities for the three ownership types. The distributions for these three types of firms reflect high levels of across-plant and across-ownership-type heterogeneity within the same industry. In Figure 3 we present simple scatter diagrams plotting the firm level TFP with respect to foreign, public and private equity ownership levels. Accordingly, while we observe a positive correlation between all three types of ownership and the TFP variable, the relationship appears to be quite noisy in the case of private ownership. In the next section we explore whether these unconditional positive correlations continue to hold once we take into account other determinants of foreign, public and private investments and TFP, including the entry barriers.

<Insert Figures 1 - 3 Here>

3.3 Entry Cost, Selection Bias, and FDI Premium

Having set the model, we now turn to explore the three key questions of this paper: 1) Are the entry barriers for foreign investors any different than those for public or domestic private investors? 2) What are the effects of past productivity improvements on future foreign investment decisions compared to public or domestic firms, and whether these effects persist after controlling for entry barriers? 3) What is the effect of equity structure on future TFP levels and whether we observe any productivity gains from foreign equity investments once we control for entry barriers?

In Equation (12) we first explore the effect of past TFP levels on future equity investments without taking into account the entry costs. Accordingly, we expect firms, in particular foreign firms, to react positively to TFP improvements. To reduce the risk of reverse causality we use lagged values on the right hand side of the equation.

$$ln(Investment_{it} + 1) = \beta_0 + \beta_1 lnTFP_{i,t-1} + \beta_2 lnSize_{i,t-1} + \epsilon_{it}$$

(12)

where *i* and *t* refer to firm *i* and time *t*, respectively; *Investment* refers to (one plus) *foreign*, *public*, and *domestic private* investors' total stock of equity investments;[5] *TFP* is the total factor productivity measured as described in the previous section; and *Size* is measured by total paid-in equity. Given the presence of zero observations in investment levels, we use the Tobit sample selection method to address the missing observation problem, as has been commonly done in previous research, and run three separate regressions for each type of investors (Fang and Mohnen, 2009).[6]

Based on previous studies, we expect foreign firms to display cherry-picking behavior, captured by a positive and significant β_1. Particularly, given their better operational skills and know-how, foreign firms might be better at picking up the likely winners, and they may also react more strongly to past TFP improvements. On the other hand, domestic private investors have first-hand knowledge and experience in the operations of domestic firms and industries, as well as in the institutional environment (as they are usually former managers or employees of public companies). Consequently, domestic investors might actually be better at picking up the likely winners. Public sector investors, however, may be the least successful ones in this game not only because of the nontransparent and centrally planned nature of these investment decisions, but also because of other unobservable considerations, including lobbying or strategic factors, the central planners may have in their decision making. That is, the future productivity potential of firms they invest in may not be the top criteria in their investment selection. Furthermore, it is possible that the Chinese public authorities, following a specific industrial policy programme, may invest in the less productive firms so as to make them more productive before divesting from these companies (Rodrik, 2008). In contrast, public investors may also have better information than foreign or private investors as they have access to insider information that is not available to others.

Next, in equation (13) we expand equation (12) and introduce a proxy for institutional entry barriers, measured by the average institutional country risk index named *ICRG* (International Country Risk Guide) developed by the Political Risk Services.[7] Accordingly, the *ICRG* consists of the following risk indicators: government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religion in politics, law and order, ethnic tensions, democratic accountability, bureaucracy quality. It ranges between 0 and 100, the latter reflecting the least riskiness. Given that foreign investors need to overcome significant entry barriers such as the institutional operating environment, legal and regulatory hurdles, economic and financial environment, etc., we may expect increasing risk to deter foreign investment more than other forms. However, given the presence of significant entry incentives and subsidies offered by the Chinese government to foreign investors in auto-industry, *ICRG* may actually not have a significantly negative effect on foreign entrants in this industry. In contrast, domestic private firms may face higher institutional hurdles as they do not receive the same type of preferential treatment from the Chinese government as foreign investors do.

$$ln(Investment_{it} + 1) = \beta_0 + \beta_1 lnTFP_{i,t-1} + \beta_2 lnSize_{i,t-1} + \beta_3 lnICRG_{i,t-1} + \epsilon_{it} \quad (13)$$

Table 2 presents the results from estimating equations (12) and (13).[8] Past productivity levels have a significantly positive effect on future *Foreign*, and to a lesser extent, *Private* equity investment decisions, reflecting the selection of more productive firms. In contrast we either find a negative or insignificant effect of this variable in the case of Public investment decisions. As discussed earlier, this may be because of a particular industrial policy whereby public authorities invest in less productive firms (Rodrik, 2008), or a selection problem, perhaps caused by the effective lobbying efforts of losers, on the side of public investors (Baldwin and Robert-Nicoud, 2007). *Size* appears to have a positive effect on investment decisions of foreign and public sector investors, while the opposite is the case for private investors. The size bias of foreign and public sector investors can be explained by their larger size, scale and capital intensity. Private firms, on the other hand, are late entrants in this game and the public sector might be playing a leading role here in directing domestic investors to smaller size firms. When we control for entry barriers using the *ICRG* variable as in equation (13), we find that institutional risk is a deterrent for foreign (though at a statistically insignificant level), and particularly for private investment decisions in China. Accordingly, institutional development is likely to stimulate domestic private firm entry (and expansion) into the auto industry significantly more than foreign firm entry or expansion. As discussed earlier, one possible explanation for this asymmetric effect is the preferential treatment of foreign investors by the Chinese government as a part of their industrial policy in auto-industry. In contrast, improving institutional environment is found to have a negative effect on public sector investment decisions, probably reflecting the loss of comparative advantage of public sector investors. It is also possible that as the institutional quality in China improves there may be less of a need for the central planner to intervene in the market to complement private sector investments.

<Insert Table 2 Here>

As discussed earlier, the models used in estimating equations 12-13 assume that the censored point is exogenously determined as the entry costs cannot be identified endogenously in a regular Tobit model. Yet, based on our analysis in section 2 the investors' decision to enter and expand or not is determined by the entry costs, which need to be identified endogenously. That is, the observed investment is likely to follow the following decision process:

$$\text{Observed Investment} = \begin{cases} \text{Zero; if desired investment} < \textit{entry cost} \\ \text{Desired investment} - \text{Entry Cost; other wise} \end{cases}$$

Eaton and Tamura (1994) and Ranjan and Tobias (2007) address this endogeneity problem with a generalized gravity model using a constant term, which enters the left hand side of the original equation non-linearly to control for the entry cost. Accordingly, entry costs such as institutional infrastructure need to be accounted for endogenously in a threshold model where the trade and financial flows become a positive quantity only if they exceed some threshold.[9] Following their approach, we modify equation (12) to include an entry cost term on the left hand side as follows:

$$ln(Investment_{it} + \gamma_0 + 1) = \beta_1 lnTFP_{i,t-1} + \beta_2 lnSize_{i,t-1} + \epsilon_{it} \qquad (14)$$

Here, the coefficient γ_0 captures the entry cost, which is time invariant and measures the industrial entry barrier. As in equation (13) the variable TFP_{t-1} and its estimated coefficient β_1 captures the selection process as well as the effects of firms' past productivity performances on future re-investment decisions by different investors. *Size* controls for size effects on investment decisions. We estimate equation (14) (and those hereafter) for foreign, public and private investment separately using the two-step GMM method to control for endogeneity and simultaneity bias caused by the relationship among investment type, TFP and size variables, and employ the most recent two lags of independent variables as instruments. Throughout the paper we report the two step robust weighting matrix to control for errors that are independent but not necessarily identically distributed.

The estimation results based on equation (14) are presented in Table 3 below. Accordingly, foreign investors do indeed face a significantly higher entry cost (γ_0), averaging 307 thousand RMB (around \$48 thousand in August 2012 exchange rates of 6.36, or \$38 thousand using the average exchange rate of \$8.16 during 1998-2007). On the other hand, the entry costs for public and private investors are either very small or negative. That is the entry cost for public investors is estimated to be 1,170 RMB, which is around \$143 on average during 1998-2007, and that of private investors is -1 RMB, which is around 20 cents on average. The estimated coefficients are consistent with our conjectures. We expected the public sector investors to face little or no entry barriers given that China is a command economy. On the other hand, private investors may have more information on the local market and institutional infrastructure (especially given that many are former government employees or managers), which may explain the negative, even if very small, entry barrier they face. The results also provide support to our estimation methodology here given that the earlier linear introduction of an institutional entry cost in equation (13) yielded a significantly negative coefficient estimate for private investors in Table 2. We should note, however, that the entry cost measured by γ_0 here is more comprehensive and includes all observable and unobservable entry costs. Therefore, it is possible that unobservable entry premiums for private firms might be greater than the negative institutional barriers for private firms captured in equation (13).

<Insert Table 3 Here>

A significant and positive β_1 (on TFP_{t-1}) for foreign and domestic investments implies a strong selection effect, suggesting that, unlike public investors, foreign and private investors are better at investing in more productive firms (even though the coefficient on private investment is only marginally significant). Finally, the coefficient for the *Size* variable is positive and significant for foreign and public investors, indicating a firm size bias in the selection process whereby foreign and public sector investors are more likely to invest in larger firms. For private investors, on the other hand, we do not detect any significant size effect, which may result from the fact that the central and local governments have only gradually allowed private investors to enter this sector, and only into smaller size firms. This may perhaps explain why private investors face a lower entry barrier but fewer incentives to choose better performing firms. Regarding the negative (though insignificant) selection effect among public firms, it might be due to the inefficient selection decisions of the central planners regarding which firms to invest in, or their particular industrial policy considerations.

Next, using a dynamic specification in equation (15) we look into the effects of ownership type on the future productivity performance of auto-industry firms. Based on previous research on the topic, we expect a significantly positive effect of foreign investment on the future productivity performance of firm *i*. The effects of domestic private and public investments, however, are less clear and depend on the level of efficiency and knowledge spillovers. We also expect a significant dynamic adjustment effect. Size, on the other hand, may have a positive or negative effect on TFP depending on economies or diseconomies of scale. Like in the investment equation (14), we estimate equation (15) using the two-step GMM method to control for endogeneity and simultaneity bias, and employ the most recent two lags of independent variables as instruments.

$$lnTFP_{i,t} = \alpha_1 lnTFP_{i,t-1} + \alpha_2 ln\left(Investment_{i,t-1} + 1\right) + \alpha_3 lnSize_{i,t-1} + u_{it} \quad (15)$$

Table 4 presents regression results based on equation (15) and suggests that there is a significantly positive (yet economically small) effect of foreign equity investment on firms' future productivity levels. However, the same is not true for public or private investors whose effects are found to be either insignificant (and negative) or significantly negative, respectively. Furthermore, the results suggest that there is significant path dependency in firm productivity levels (as shown by a significantly positive dynamic effect) and that larger firms are significantly more productive than others.

<Insert Table 4 Here>

In equation (16) we combine equations (14) and (15) and explore both the effects of foreign, public and private investments on firms' future productivity levels, and the heterogeneous entry cost and cherry-picking in a system equation setting.[10] In equation (16) the entry cost is set to be equal in both equations (note that γ_0 enters non-linearly here), and the correlation between the two error terms is accounted for. The *TFP* variable controls for the self-selection behavior in the first equation, and the path dependency (as well as incomplete adjustment) in the second equation. The *Investment* variable, on the other hand, explores the effect of ownership type on future firm productivity. The *Size* variable also plays different roles in these two equations. In the first equation, the paid-in value reveals the preferences of different investors, while in the second equation the paid-in value captures the size effect on productivity rates.

$$\begin{cases} ln\left(Investment_{i,t} + \gamma_0 + 1\right) = \beta_1 lnTFP_{i,t-1} + \beta_2 lnSize_{i,t-1} + \epsilon_{i,t} \\ \quad lnTFP_{i,t} = \alpha_1 lnTFP_{i,t-1} + \alpha_2\, ln\left(Investment_{i,t-1} + \gamma_0 + 1\right) \\ \qquad\qquad\qquad\qquad + \alpha_3 lnSize_{i,t-1} + u_{i,t} \end{cases} \tag{16}$$

We estimate equation (16) using the system GMM method as before and the results are shown in Table 5. Similar to Table (3) we find that the entry cost is significantly higher for foreign investors in the Chinese automobile industry than for public or private investors. On average, foreign firms are found to have faced around $38,501 (314.3 thousand RMB) entry cost during the period analyzed. This is an economically significant amount as it corresponds to 4% of average annual FDI flows in the sample, and 1% of re-investments in existing foreign firms. Moreover, it exceeds the annual real total profits of 19% of firms with foreign equity participation in the sample. In contrast, we do not detect any economically or statistically significant entry cost for public or domestic private investors. Secondly, β_1 (on TFP_{t-1} in the first equation) is positive and significant this time only for foreign investors suggesting that they are more likely to choose and invest in higher productivity firms, causing a selection bias. On the other hand, we fail to find such a selection effect in the case of public or private investors. Regarding the size effect, while we find that foreign and public investors tend to choose larger firms, it appears to be an insignificant determinant of private investment decisions. Turning to the second equation, even after controlling for the entry costs, we continue to find a significant TFP premium from foreign investment to future firm productivity. The effect is not only statistically but also economically significant (and is almost five times larger compared to the single equation estimation in Table 4). Accordingly, a ten percent increase in foreign investment appears to improve TFP by 0.14%. In contrast, we do not observe any such effect in the case of public or private investments. Regarding the *Size* variable, we do not detect a robust effect of firm size on future TFP performance.

<Insert Table 5 Here>

3.4 Robustness analysis

In this section we test the robustness of our results using a variety of sensitivity tests. First, we check whether the WTO accession of China in late 2001 had any effect on entry costs for foreign firms, as well as on the selection process based on past TFP performance. This will also work as a sensitivity test to our earlier findings in so that we will examine whether the WTO accession and following increase in FDI flows to China bias any of our earlier findings. If our earlier discussion and empirical findings were correct we should expect foreign investors, and to a lesser extent, private investors to face a lower entry cost after the WTO accession as China needed to harmonize its rules and regulations with those of WTO. Public investors, on the other hand, should now face a higher entry cost after WTO entry as some of the entry advantages they enjoyed before are eliminated or curtailed. In order to control for any change in the entry cost for foreign investors after WTO, in equation (17) we re-estimate equation (16) including a time dummy, WTO, set equal to one for each year before 2002. Therefore, we expect a negative coefficient on γ_0 for foreign and private investors, and a positive one for public investors.

$$\begin{cases} ln\left(Investment_{i,t} + \gamma_0 + \phi_0 WTO + 1\right) = \beta_1 lnTFP_{i,t-1} + \beta_2 lnSize_{i,t-1} + \epsilon_{i,t} \\ lnTFP_{i,t} = \alpha_1 lnTFP_{i,t-1} + \alpha_2\, ln\left(Investment_{i,t-1} + \gamma_0 + \phi_0 WTO + 1\right) \\ \qquad + \alpha_3 lnSize_{i,t-1} + u_{i,t} \end{cases} \tag{17}$$

As before we use the GMM method to estimate equation (17) and report results in Table 6. Consistent with previous results, we continue to find a significantly positive entry cost for foreign investors. Furthermore, we observe a significant reduction in entry costs for foreign investors after the WTO accession of China. Accordingly, the entry cost appears to have fallen from an average of 551.5 thousand RMB ($67,561) to 279 thousand RMB ($34,182) after 2002, which is a significant reduction, both statistically and economically. Moreover, the entry cost is found to be still significant even after the accession, as shown by the joint significance of γ_0 and ϕ_0 at the 5% level. We should point out that while the marginal effect WTO accession (ϕ_0) appears to be insignificant in statistical terms, it is economically quite significant accounting for almost a 50% reduction in entry barriers for foreign firms. Turning to domestic private investors, we find a small and statistically insignificant entry cost, which also appears to have fallen after the WTO entry. In contrast, the entry cost for public investors, which is found to be insignificant prior to WTO accession has increased significantly afterwards, equaling around $772 (6,299 RMB) on average. Turning to the selection effect, we continue to find that foreign investors are significantly better at investing in productive firms than public or domestic investors. Furthermore, after controlling for the entry cost, we continue to find a significant TFP premium from foreign investment in Chinese automobile industry.

<Insert Table 6 Here>

Next, given the large number of zero observations in investment levels in the sample, we employ the Heckman sample selection model (estimated using the maximum likelihood method clustered at firm level) to control for the self-selection issue with *ICRG* variable entering as the independent variable in the selection equation. Intuitively, we expect foreign firms to invest more when the country has a better institutional environment (i.e. higher ICRG ratings). Accordingly we rewrite equation (14) as follows:

$$\begin{cases} ln\left(Investment_{i,t}+1\right) = \beta_0 + \beta_1 lnTFP_{i,t-1} + \beta_2 lnSize_{i,t-1} + \epsilon_{i,t} \\ Prob(ln\left(Investment_{i,t}+1\right)) > 0) = \Phi(lnICRG_{i,t-1}) \end{cases} \tag{18}$$

In equation (18) the second equation is the selection part where the *ICRG* variable controls the truncated distribution of the dependent variable in the main equation. The results, which are shown in Table 7, confirm our earlier findings. First, consistent with regression results in Table 2 we find that *ICRG* has a significantly positive effect in the selection equation for domestic private investors, and to a lesser extent for foreign investors (which appears positive but statistically insignificant). Consistent with these findings, its effect on public investment decisions is significantly negative showing a reduction in public investment levels as the institutional environment improves. Second, even after controlling for the limited distribution of investment in the main equation, we still find a TFP selection effect on FDI, as shown by a significantly positive TFP coefficient (0.210). We, however, do not detect any selection effect from past TFP levels on public or private investments.

<Insert Table 7 Here>

Furthermore, as an additional robustness test we replaced the level of foreign, public, and private investments with their percentage shares in the total paid-in capital of each firm. The idea is that perhaps it is not the level of investment but the ownership share of each type of investor that matters for entry decisions, cherry-picking and future productivity performance. In equation (16), adding the entry cost to the realized investment levels turns the ownership ratios to desired, as opposed to realized, ownership rates. The (unreported) regression results are qualitatively quite similar to those from before and are available from authors upon request. Last but not least, to test the sensitivity of our results to outliers, we eliminate those observations at the lower and upper 1% tails based on firm size. The (unreported) results again confirm our earlier findings.

4. Conclusion

In this paper we have explored three overlapping questions regarding FDI flows to the Chinese auto-industry that are: 1) are there entry barriers for foreign investors, and if so, are they any different from those for public or private investors? 2) Do foreign firms react differently to past TFP improvements than public or private investors? 3) How do foreign equity investments affect future productivity levels compared to public or private investments? To answer these questions, we first recovered firm level TFP using a monopolistic competition model and a semi-parametric estimation method. Second, we estimated the unobserved entry barrier and investor selection in a non-linear model using the GMM approach. The empirical findings suggest that foreign investors do face significantly higher entry barriers than public or private investors. Furthermore, the WTO accession of China is shown to have reduced the size of entry barriers for foreign and domestic private investors while increasing them for public investors. Nevertheless, even after the WTO accession, entry barriers remained high and significant for foreign investors. Second, compared to public or local private investors, foreign investors are found to be better at selecting, and further investing in, more productive firms. Third, after controlling for the self-selection process, foreign investments are found to improve future productivity levels at statistically and economically significant levels. Overall, it appears that the selective industrial policy of Chinese government in auto industry has been successful with regard to firm level productivity enhancement. While it is true that foreign firms choose and re-invest in firms with better past productivity performance, they also help improve the future productivity levels of those firms, an observation that our statistical tests fail to support in the case of public or domestic private investors. Furthermore, it is also expected that further reductions in entry and operating barriers for foreign firms will encourage FDI flows to firms at the lower end of productivity distribution, and thus help improve both firm and industry level TFP in Chinese auto industry. Our findings also raise several new questions for future research. First, in the face of entry barriers and self-selection process, what is the degree of intra and inter-industry spillovers from foreign investments? Second, are the entry barriers endogenous to the industry type and are they heterogeneous across different industries?

Endnotes

[1] SIC 3711 includes firms “primarily engaged in manufacturing or assembling complete passenger automobiles, trucks, commercial cars and buses, and special purpose motor vehicles which are for highway use” (USHA, 2014).

[2] The surveys report two additional categories of investors (with comparatively small weights), which are those from Macau and Hong Kong, and the collective ownership variable belonging to towns and villages). Given the difficulty fitting these two categories into either domestic or foreign investors or public we decided to leave them out of our empirical analysis. As a result the sums in Figure 1 do not add up to 100%.

[3] The number of observations included in the regression analysis is lower due to the use of a dynamic specification and variable lags as instruments in the GMM estimation. Furthermore, the difference between the number of observations for the aggregate TFP measure and those for subgroups arises as the TFP averages for the latter refer to cases with positive observations.

[4] The estimation is done in Stata 12.1 using Levinsohn and Petrin (2003) methodology.

[5] Here and in later specifications we add one to the level of *Investment* given the presence of zero levels of *foreign*, *public* and (domestic) *private* stock of equity ownership.

[6] In the literature ownership types are usually classified either by the majority equity shareholders, or based on a benchmark threshold level of ownership. Since we have more than two types of ownership and that we are interested in exploring the relationship among entry costs, TFP, and equity structure, we do not divide firms based on an ex post benchmark level of equity ownership and include them all in a single equation. The commonly used dummy variable approach in the literature requires the choice of a cutoff point for each type of investors, such as 10%. In that case it is quite difficult to come up with a classification system to designate a firm that receives, for example, 10% foreign investment, 10% private and 80% public investment. Moreover, the dummy variables will capture time-variant shifts in ownership structure only if these are above or below the cutoff points. For example, in the case of a 10% threshold rule, if a firm increases its foreign equity share from 11% to 12%, this won’t be reflected in the dummy variable measurement. If we use a continuous variable at levels and include them in a single equation, then the issue will be the correct identification as all three types of investments can increase or decrease by the same amount at the same time. Furthermore, the specification of entry cost variable poses a serious challenge as it is practically impossible in a reduced form setting to estimate three separate entry costs for each type of investors all at the same time. Therefore, in all our estimations we use the level of equity investment by the three types of investors to identify a firm's having access to foreign, public, and private equity capital and then run three separate regressions for each.

[7] We should point out that while there is sufficient variation in this variable, which ranges between 62 and 70 with a standard deviation of 3.19, it is cross-section invariant. However, our TFP measure already accounts for the effects of macroeconomic changes. Furthermore, the ICRG measure is intended to capture the reaction of foreign, public, and private investors to a common time-variant shock to institutional

structure.

[8] The numbers of observations in each regression analysis are equal across three groups as they are based on the same firms with a level equity ownership being equal or greater than zero.

[9] Different from the standard gravity model, Eaton and Tamura (1994) assume non-homogeneous relation between the dependent and independent variables. Particularly, for dependent variable *V*, the logarithm of a_v+V_{it} , where a_v is an intercept variable, is "linear homogenous in the logarithm of independent variables" (p.490). As their dependent variables are censored below zero, a positive value of a_v implies a minimum threshold value (entry cost) before positive values of *V* are observed.

[10] Estimating the TFP part of equation (16) alone would cause several problems, including: a) an identification issue as we need to identify α_2 and γ_0 simultaneously, using the variation in investment; b) an endogeneity problem regarding the realized, as opposed to the *optimal* level of investments, as well as the *TFP* effect.

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Appendix

Our empirical estimation methodology is as follows:

- Construct lnV_{it}

$$lnV_{it} = lnR_{r,it} - s_{it}^{l}(lnL_{it} - lnK_{it}) \tag{19}$$

- Estimate the following model via OLS and get $\hat{\beta}_q$:

  $$lnV_{it} = \delta_0 + \beta_q lnQ_t + \sum_{i=0}^{3}\sum_{j=0}^{3-i}\delta_{ij}(lnK_{it})^i(lnM_{it})^j + \epsilon_{it}$$

  (20)

- Construct the non-parametric term $\hat{\phi}_{it}$

$$\begin{aligned}\hat{\phi}_{it} &= ln\hat{V}_{it} - \hat{\beta}_q lnQ_t \\ &= \hat{\delta}_0 + \sum_{i=0}^{3}\sum_{j=0}^{3-i}\hat{\delta}_{ij}(lnK_{it})^i(lnM_{it})^j\end{aligned} \tag{21}$$

- The prediction for x_{it} comes from the estimator of β_k:

$$\hat{x}_{it} = \hat{\phi}_{it} - \hat{\beta}_k lnK_{it} \tag{22}$$

- Using the expression of $\hat{x}_{it}$ above, estimate $E[x_{it}|x_{it-1}]$, which is assumed to be a third-order polynomial, to capture $\hat{\beta}_k$:

$$\hat{x}_{it} = \gamma_0 + \gamma_1\hat{x}_{it-1} + \gamma_2(\hat{x}_{it-1})^2 + \gamma_3(\hat{x}_{it-1})^3 + \xi_{it} \tag{23}$$

- Using $\hat{x}_{it}$ and $\hat{\beta}_q$, construct firm level productivity $\hat{\omega}_{it}$:

$$\hat{\omega}_{it} = \frac{\hat{x}_{it}}{1-\hat{\beta}_q} \tag{24}$$

<Insert Table 8 Here>

Figure 1: Firms' Productivity Distribution

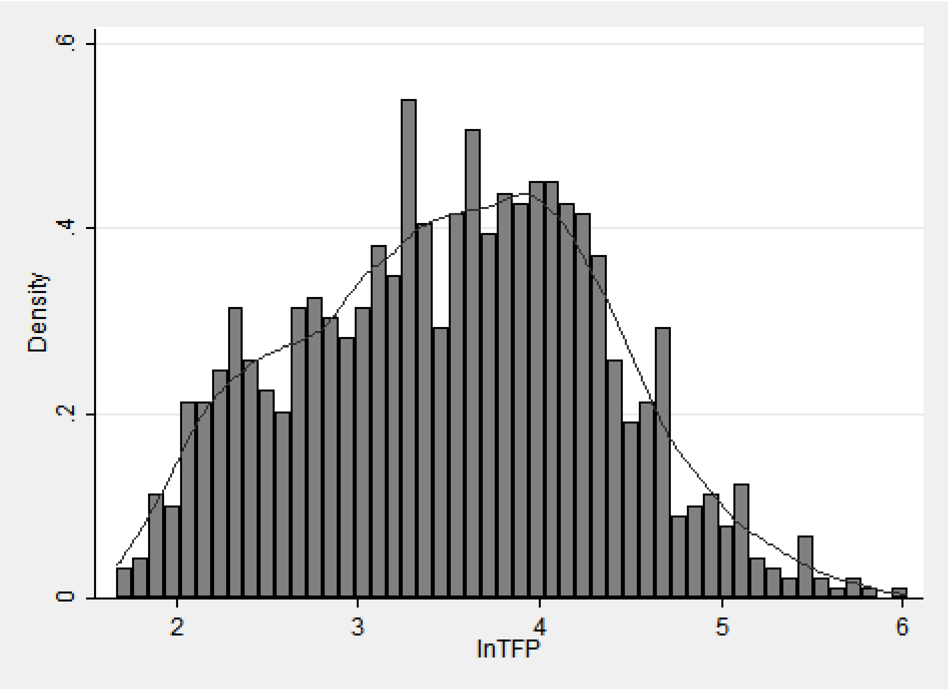
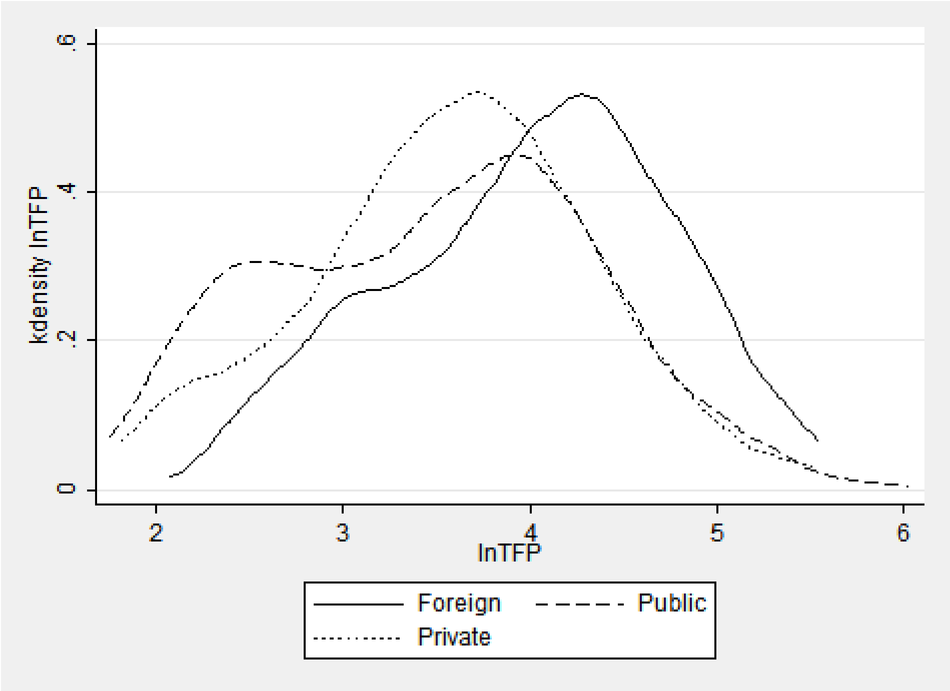


Figure 2: Kernel Densities Based on Ownership Structure



Notes: Kernel density estimates of the distribution of TFP for firms with a positive level of *Foreign*, *Public*, and *Private* equity investment.

Figure 3: TFP versus Ownership Type

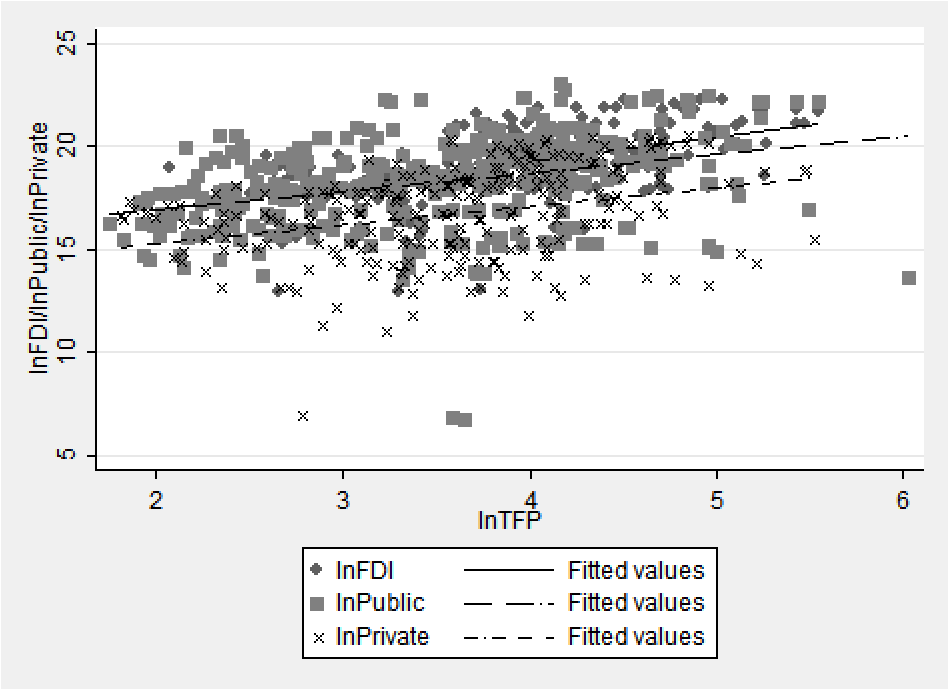


Table1: Summary Statistics

Variable	Obs	Mean	Median	Std.Dev	Min	Max
lnForeign	203	19.291	19.353	1.713	12.966	22.689
lnPublic	393	18.243	18.373	2.115	6.753	23.067
lnPrivate	249	16.698	16.724	2.201	6.904	20.469
lnICRG	1,021	4.198	4.209	0.049	4.131	4.251
lnTFP	1,021	3.522	3.573	0.84	1.674	6.035
Foreign	203	4.006	4.094	0.748	2.078	5.548
Public	393	3.486	3.577	0.855	1.755	6.035
Private	249	3.578	3.614	0.766	1.812	5.523
lnSize	1,021	18.251	18.303	2.282	6.791	23.382
Foreign	203	20.308	20.441	1.686	12.966	23.383
Public	393	18.717	18.873	2.144	6.791	23.383
Private	249	17.654	17.647	2.391	11.053	22.681
lnR	1,021	12.703	12.78	2.245	7.131	18.104
Foreign	203	14.699	15.248	1.929	8.689	18.104
Public	393	13.009	13.1	2.253	7.341	18.104
Private	249	12.49	12.623	2.347	7.733	17.83
lnL	1,021	6.737	6.863	1.598	2.773	11.51
Foreign	203	7.707	7.842	1.378	3.219	11.38
Public	393	7.284	7.209	1.488	3.219	11.51
Private	249	6.448	6.458	1.928	3.296	11.51
lnK	1,021	12.893	12.861	2.126	6.752	18.066
Foreign	203	14.774	15.099	1.704	9.056	18.056
Public	393	13.482	13.363	1.945	6.752	18.066
Private	249	12.426	12.238	2.443	7.862	18.066
Profitability	1,021	-114.074	0.043	2,802.30	-82,973	26.729
Foreign	203	0.421	0.19	1.01	-5.798	4.896
Public	393	-296.812	0.015	4,514.30	-82,973	9.158
Private	249	0.38	0.148	1.946	-9,582	26.729
s^l	1,021	0.07	0.037	0.101	0.001	0.858
Foreign	203	0.04	0.025	0.051	0.001	0.51
Public	393	0.087	0.046	0.117	0.001	0.858
Private	249	0.05	0.033	0.082	0.002	0.75
lnV	1,021	13.119	13.114	2.073	7.85	18.249
Foreign	203	14.968	15.365	1.781	9.538	18.25
Public	393	13.522	13.407	2	8.942	18.25
Private	249	12.794	12.877	2.27	7.85	18.103
lnQ	1,021	6.259	6.346	0.503	5.211	6.789
Foreign	203	6.365	6.346	0.439	5.211	6.79
Public	393	6.067	6.233	0.567	5.211	6.79
Private	249	6.366	6.346	0.433	5.211	6.79
lnM	1,021	12.504	12.561	2.244	4.532	17.771
Foreign	203	14.463	15.033	1.938	8.868	17.771
Public	393	12.832	12.895	2.219	7.661	17.771
Private	249	12.26	12.314	2.362	7.388	17.598

Notes: *Foreign*, *Public*, and *Private* refer to the (log) (one plus) level of real investment by foreign, public and private investors in thousands RMB, respectively. The subset values for *Foreign*, *Public*, and *Private* refer to aggregate averages for those firms that have a positive value of equity capital from one of these sources. *TFP* is Total Factor Productivity; *Size* is real paid-in capital in thousands RMB; *ICRG* is the ICRG risk index, *R* is real total value added in thousands RMB; *L* is number of workers; *K* is real total assets in thousands RMB; *Profitability* is real total profits divided by real paid-in capital; $s^l = (totalwagepayment)/(totalvalueadded)$; $lnV = lnR - s^l * (lnL - lnK)$; *Q* is aggregate output; *M* is real total input in thousands RMB.

Table 2: Self Selection and Country Risk

	Foreign		Public		Private	
	(1)	(2)	(3)	(4)	(5)	(6)
$lnTFP_{t-1}$	5.082***	4.718***	-2.738**	-0.933	3.524**	2.907*
	(-1.769)	(1.794)	(1.147)	(1.100)	(1.622)	(1.623)
$lnSize_{t-1}$	7.308***	7.297***	2.509***	2.517***	-2.176***	-2.161***
	(0.835)	(0.836)	(0.436)	(0.413)	(0.574)	(0.570)
$lnICRG_{t-1}$		33.581		-141.828***		80.930***
		(30.368)		(18.514)		(30.196)
Constant	-173.709***	-313.643**	-38.718***	552.158***	11.129	-327.791***
	(16.476)	(128.596)	(7.485)	(76.738)	(9.694)	(126.846)
N	671	671	671	671	671	671
Sigma	21.071	21.025	18.858	17.704	23.588	23.358
Log likelihood	-799.7	-799.1	-1,444.8	-1,414.5	-924.4	-920.6
Prob>chi^2	0.000	0.000	0.000	0.000	0.000	0.000
Left-censored obs	528	528	397	397	516	516
Pseudo R^2	0.104	0.105	0.012	0.032	0.008	0.013

Notes: The dependent variable is the (log) level of total equity invested by foreign, public and private investors, respectively. Regression results are based on the Tobit estimation. For variable definitions, please refer to Table 2. Standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Self Selection with Entry Barriers

	Foreign	Public	Private
	(1)	(2)	(3)
Entry Cost	306,921.605**	1,170.06	-0.998***
	(143,971.82)	(957.701)	(0.017)
$lnTFP_{t-1}$	0.593***	-0.21	1.378*
	(0.150)	(0.178)	(0.780)
$lnSize_{t-1}$	0.642***	0.528***	-0.345
	(0.038)	(0.032)	(0.468)
N	415	415	415
Number of Moments	5	5	4
J-Stat	0.201	0.22	0.09

Notes: The dependent variable is the (log) level of total equity invested by foreign, public and private investors, respectively. *Entry Cost* refers to the entry cost (γ_0) in Eq. (14). Regression results are based on a two-step GMM estimation. Standard errors are reported in parentheses. J-stat is given by the p-values. For other variable definitions, please refer to Table 1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Ownership effect on TFP

	Foreign	Public	Private
	(1)	(2)	(3)
$lnTFP_{t-1}$	0.954***	0.953***	0.964***
	(0.028)	(0.030)	(0.028)
$lnInvestment_{t-1}$	0.003*	-0.0003	-0.005**
	(0.002)	(0.002)	(0.002)
$lnSize_{t-1}$	0.010*	0.011*	0.010*
	(0.005)	(0.006)	(0.005)
N	415	415	415
Number of Moments	4	4	4
J-stat	0.281	0.671	0.562

Notes: The dependent variable is the (log) level of TFP. Regression results are based on a two-step GMM estimation. Standard errors are reported in parentheses. J-statistics is given by the p-values. For other variable definitions, refer to Table 1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Self Selection with Entry Barriers: System Equation

	Foreign	Public	Private
	(1)	(2)	(3)
Entry Cost	314,302.851**	1,161.164	37.962
	(145,507.307)	(951.071)	(125.774)
$lnTFP_{t-1}$	0.596***	-0.223	0.880
	(0.149)	(0.177)	(0.580)
$lnSize_{t-1}$	0.643***	0.530***	0.153
	(0.037)	(0.032)	(0.210)
Second Equation			
$lnTFP_{t-1}$	0.945***	0.955***	0.978***
	(0.028)	(0.030)	(0.032)
$lnInvestment_{t-1}$	0.014**	0.003	-0.002
	(0.007)	(0.010)	(0.005)
$lnSize_{t-1}$	0.002	0.009	0.006
	(0.007)	(0.009)	(0.006)
N	415	415	233
Number of Moments	9	9	9
J-stat	0.403	0.627	0.233

Notes: Two-step GMM results. Standard errors are reported in parentheses. J-stat is given by the p-values. For other variable definitions, refer to Table 1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The number observations in column (3) drop because of using longer (t-3) lags of instruments, which are needed for the validity of instruments selected based on J-test. The unreported regression results based on shorter lags yield very similar results, even though they fail the J-test.

Table 6: Controlling for WTO Accession

	Foreign	Public	Private
	(1)	(2)	(3)
Entry Cost	551,526.164*	79.054	240.23
	(302,374.120)	(119.561)	(798.229)
WTO	-272,477.18	6,219.671*	-234.535
	(249,855.777)	(3,403.646)	(773.481)
$lnTFP_{t-1}$	0.636***	-0.034	0.732
	(0.176)	(0.159)	(0.658)
$lnSize_{t-1}$	0.636***	0.533***	0.128
	(0.042)	(0.033)	(0.242)
Second Equation			
$lnTFP_{t-1}$	0.952***	0.959***	0.975***
	(0.028)	(0.030)	(0.031)
$lnInvestment_{t-1}$	0.014**	0.002	-0.002
	(0.007)	(0.005)	(0.005)
$lnSize_{t-1}$	0.001	0.009	0.007
	(0.007)	(0.008)	(0.006)
Joint Significance	279,049**	6,298.7*	5.694
Number of Moments	9	9	11
J-stat	0.845	0.815	0.369
N	415	415	233

Notes: Standard errors in parentheses. All regressions included size and lagged TFP variables. * p < 0.10, ** p < 0.05, *** p < 0.01. The number observations in column (3) drop because of using longer (t-3) lags of instruments, which are needed for the validity of instruments selected based on J-test. The unreported regression results based on shorter lags yield very similar results, even though they fail the J-test.

Table 7: Heckman Selection Model

	Foreign	Public	Private
	(1)	(2)	(3)
Main Equation			
$lnTFP_{t-1}$	0.210**	-0.019	0.143
	(0.101)	(0.117)	(0.089)
$lnSize_{t-1}$	0.825***	0.928***	0.672***
	(0.054)	(0.054)	(0.043)
Constant	3.581***	1.662**	7.525***
	(1.033)	(0.712)	(0.936)
Selection Equation			
$lnICRG_{t-1}$	1.624	-7.125***	2.728***
	(1.860)	(2.402)	(0.808)
Constant	-7.644	29.771***	-12.246***
	(7.847)	(10.120)	(3.397)
N	671	671	671
Censored Obs	528	397	516
Log Pseudolikelihood	-507.215	-744.983	-603.927
Prob>chi^2	0.000	0.000	0.000

Notes: Heckman selection model with maximum likelihood estimation and clustering at firm level. The standard errors are reported in parentheses. For other variable definitions, please refer to Table 1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: First Stage Results

	lnQ	*lnM*	*lnK*	*N*	R^2
Eq.20	0.063**	0.459	0.793**	1,021	0.968
	(0.025)	(0.501)	(0.382)		

Notes: The results refer to coefficient estimates for equation 20. The (robust) standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.