FDI and firm productivity in host countries: The role of financial constraints*

Wontae Han†
KIEP

Jian Wang‡
CUHK-Shenzhen and SFI

Xiao Wang§
USTC

Abstract

This paper studies the effect of FDI firms' financial advantages on firm productivity in host countries and examines the related policy implications. If FDI firms face lower financing costs but have higher fixed production costs than local firms, a simple Melitz-type model predicts that FDI firms could have even lower cutoff productivity than local firms, especially in financially vulnerable sectors. The same mechanism will also lower the average productivity of FDI firms especially in financially vulnerable sectors, although FDI firms on average are still more productive than local firms. These predictions are supported by the Chinese firm-level data. Then, we study policy implications in a two-country model that resembles these empirical patterns. The counterfactual policy analysis shows that offering tax benefits to FDI firms could be counterproductive because it attracts FDI firms that are even less productive than local firms. The policy in the host country to improve its financial market efficiency could also hurt the country's welfare because of the interaction between financial market reforms and the distortionary taxes imposed on local firms to finance FDI subsidies.

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†International Macroeconomics & Finance Department, Korea Institute for International Economic Policy, Email: hanwontae@kiep.go.kr.

‡School of Management and Economics, The Chinese University of Hong Kong, Shenzhen and Shenzhen Finance Institute, Email: jianwang@cuhk.edu.cn.

§International Institute of Finance, School of Management, University of Science and Technology of China, Email: iriswx@ustc.edu.cn.

1 Introduction

Multinational companies (MNCs) are usually less financially constrained than local firms in emerging markets and recent studies have examined this financial advantage and how it drives foreign direct investment (FDI) flows and alleviates financial constraints in host countries (e.g., Wang and Wang (2015), Manova et al. (2015), Desbordes and Wei (2017), Bilir et al. (2019), and Alquist et al. (2019), among others). These studies complement previous studies on FDI firms' productivity advantages in benefiting host countries (e.g., Javorcik (2004), Yasar and Paul (2007), Keller and Yeaple (2009), and Alfaro et al. (2013), among others).[1] In this paper, we show that the proper recognition of MNCs' financial advantages has profound implications on our understanding of FDI's effects on the firm productivity in host countries and the effectiveness of FDI policies.

Many emerging markets provide tax and other incentives to attract FDI; the policy is motivated by the belief that FDI can benefit host countries' economic growth by directly introducing new technology and/or managerial skills from MNCs.[2] FDI firms are on average more productive than local firms in host countries. This empirical pattern is consistent with the Melitz-type model with heterogeneous firms (e.g., Helpman et al. (2004)) in which MNCs face a higher fixed cost than local firms to operate in a foreign country. Keeping everything else constant in the model, the higher fixed production cost induces a higher cutoff productivity (and average productivity) for FDI firms relative to local firms. Empirical studies document convincing evidence of technology transfers from FDI firms to local

[1]See Grossman and Helpman (1995) for a review on FDI and technology spillovers. In contrast, Aitken and Harrison (1999) document that FDI has a negative spillover effect on the productivity of domestic firms, though it has a positive effect on FDI firms in firm-level data of Venezuela. The two effects are almost canceled out, leaving a very small overall effect. Using macro-level data, Borensztein et al. (1998) and Carkovic and Levine (2005) find little evidence that FDI has a positive effect on host country's economic growth.

[2]In addition, FDI is also less prone to short-term runs by international investors, which became a very desirable feature following the emerging market financial crises in the 1980s and 1990s. For instance, see Krugman (2000), Aguiar and Gopinath (2005), and Alquist et al. (2016), among others.

firms through technology diffusion, labor turnover, and many other channels. In this case, policies to attract FDI can improve host countries' welfare if MNCs do not fully consider the productivity spillover effects of FDI.

However, the financial advantages of MNCs can cause a tradeoff to the cutoff productivity. MNCs are usually less financially constrained than local firms because of their easy access to international financial markets. Wang and Wang (2015) and Alquist et al. (2019) show empirically that the financial advantage of FDI is an important factor in driving foreign mergers and acquisitions in emerging markets. Although high fixed production costs allow only the very productive FDI firms to compete with local firms, the financial advantages of MNCs work in the opposite direction. In this case, the relative cutoff productivity of FDI firms to local firms will depend on which of the above effects dominates.

We first show this tradeoff in a simple Melitz-type model with financial frictions for local firms, which guides our empirical work with two testable predictions. For simplicity, we assume that FDI firms are financially unconstrained.[3] In contrast, local firms face the financial frictions proposed in Manova (2012). Therefore, financing costs are higher for local firms than FDI firms, although local firms face lower fixed production costs in our model. If the financial disadvantage of local firms is larger than its advantage in the fixed production cost, FDI firms can have lower cutoff productivity than local firms, and this condition is more pronounced in the financially more vulnerable sectors (e.g., sectors that are more dependent on external finance). In addition, the model predicts that the same mechanism will also affect the average productivity of FDI and local firms. Although FDI firms may still have higher average productivity than local firms because MNCs have a flatter tail in their productivity

[3] Relaxing this assumption will not qualitatively affect our results so long as FDI firms are assumed to be financially less constrained than local firms. See Bilir et al. (2019) and Desbordes and Wei (2017) for studies on the effects of host country's financial markets on financially constrained FDI firms. If foreign firms also finance funds in the host country's financial markets, it may exacerbate local firms' financial constraints because of the intensified competition for funds. Harrison and McMillan (2003) find such empirical evidence in firm-level data in the Ivory Coast.

distribution than local firms, the difference in average productivity between these firms will be much smaller in the sectors of high financial vulnerability than the sectors of low financial vulnerability due to low cutoff productivity of FDI firms.

The above theoretical predictions are supported in the Chinese firm-level data from the Annual Surveys of Industrial Production by the National Bureau of Statistics of China. Firm productivity is calculated following Ackerberg et al. (2015) and sector-level financial vulnerability is measured following Manova et al. (2015) and Alquist et al. (2019).[4] To test our first prediction on firms' cutoff productivity, we employ quantile regressions and focus on the results of bottom quantiles of productivity (e.g., 20% or less). We find that in the financially vulnerable sectors (top 25 percentile under the financial vulnerability measures), FDI firms have even lower cutoff productivity than local Chinese firms. For instance, at the 15th percentile, the productivity of FDI firms is usually 6 percent lower than that of local firms under various measures of financial vulnerability. However, no such evidence is detected for the sectors of low financial vulnerability. The OLS regressions are employed to test the prediction on firms' average productivity. We find that FDI firms on average are more productive than local firms in both high and low financial vulnerability sectors. However, the difference is much smaller in sectors of high financial vulnerability than sectors of low financial vulnerability. For instance, under most measures of financial vulnerability, the difference in the high financial vulnerability sectors is less than half of that in the low financially vulnerability sectors in our data. These empirical findings are consistent with our model's theoretical predictions and suggest that the financial advantages of MNCs are an important factor affecting firms' productivity in host countries.

Next, we study related policy implications in a two-country model where FDI firms have financial advantages relative to local ones. Many emerging markets provide tax benefits

[4] The dataset and measures of firm productivity and sector-level financial vulnerability are widely used in the literature.

to attract foreign investment based on MNCs' productivity advantages. However, financial advantage is also an important factor in driving FDI flows. For instance, Alquist et al. (2019) document that easing the target's credit constraints is an important reason for foreign acquisitions in emerging markets. We construct a two-country model to study the effects of FDI tax policies and financial market reform on the aggregate productivity and welfare in the host country when FDI firms have financial advantages over local ones. The model is modified from those in Manova (2012) and Bilir et al. (2019), which were built on the works of Melitz (2003) and Helpman et al. (2004). In our model, FDI firms are on average more productive than local firms in the host country, but have lower cutoff productivity than the local firms due to financial frictions in the host country. We show that the host country's welfare is determined by the aggregate productivity of FDI and local firms, the product varieties available to the households and the transfers from the government to households in the host country.

We first calibrate the tax rates to match the FDI tax policies in China, under which FDI firms pay lower corporate and value added taxes than local firms. Then, we remove the tax benefits of FDI firms while the total government revenues (and transfers to the household) are kept constant. In our benchmark model, the average productivity of local firms and FDI firms in the host country displays a humped shape: it first increases when we raise the tax rate of FDI firms as the cutoff productivity of FDI firms rises with the tax rate. This finding suggests that tax benefits offered to FDI firms actually reduce the average firm productivity in the host country because such policy attracts FDI firms who have even lower productivity than local firms, which is exactly the opposite to the purpose of such policies. Of course, the average productivity and welfare decrease when the host country taxes too heavily on FDI firms because high-productivity FDI firms may exit the host country if the tax rate is too high.

If we interpret taxes broadly as barriers to FDI, our findings highlight the tradeoff in determining restrictions/subsidies for FDI firms in countries with underdeveloped financial markets. On the one hand, emerging markets should remove barriers and even provide additional incentives for high-productivity FDI firms to enter. On the other hand, low-productivity firms may take advantage of the universal subsidies offered to FDI firms, which even decreases the aggregate productivity and welfare of host countries. This is particularly problematic when FDI firms have even lower cutoff productivity than local firms because of their financial advantages. Faced with this problem, some emerging markets such as China have adopted policies to ensure that FDI firms introduce advanced technology and management skills to their countries. For instance, China employed performance requirements to control for the quality of FDI firms and some tax exemptions were only provided to FDI firms that met certain performance requirements before China's accession to the WTO in 2001.[5]

In our second policy analysis, we investigate whether emerging markets can increase welfare by simply improving the quality of their financial markets. The financial market improvement is proxied by a decrease in the default rate in our model, which tends to capture a better quality of financial institutions in screening and monitoring borrowers. We find that the financial market improvement may have to be combined with tax reforms to increase the host country's welfare. The improvement of financial market efficiency reduces the disadvantages of local firms relative to FDI firms. As a result, local firms with lower productivity can enter the market when the host country's financial market becomes more efficient. It reduces the average productivity in the host country, but increases its product varieties. The overall welfare effect depends on which effect dominates. We show that distortionary taxes imposed to finance FDI subsidies in the host country can repress the increase in product varieties such that its welfare even decreases when the financial market efficiency improves.

[5]China had to abandon the policy of performance requirements after 2001 to meet WTO regulations.

Our paper contributes to several strands of literature. First, it is related to the literature that studies the role of FDI in alleviating the effects of domestic financial market imperfections because of MNCs' easy access to foreign capital markets. For instance, Manova et al. (2015) find that foreign affiliates and joint adventures in China perform better than local firm in export, especially in financially vulnerable sectors. Lin and Ye (2018) document that FDI firms in China provide more trade credits than local firms during tight domestic credit periods. They also find that a favorable global liquidity shock can amplify FDI's trade credit provision. We contribute to this literature by examining the effect of FDI firms' financial advantages on firm productivity in host countries. Second, our paper expands the empirical studies on MNCs' financial advantages in driving FDI flows such as Wang and Wang (2015) and Alquist et al. (2019). We provide additional empirical evidence for FDI firms' financial advantages and conduct counterfactual policy analysis in a two-country model. Finally, our study is related to the research on optimal FDI subsidy policies such as Chor (2009) and Han et al. (2020). We contribute to the literature by highlighting the possibility that such policies might attract low-productivity FDI firms, although they are designed to obtain the ones of high productivity. Our study provides a good example of resource misallocation as discussed in Hsieh and Klenow (2009). Financial frictions faced by local firms induce resource misallocation towards FDI firms whose productivity is even lower than local firms and favorable FDI treatment will further intensify such misallocation.

The remainder of the paper is organized as follows. Section 2 presents a partial equilibrium model and reports the empirical support to the model's prediction. Section 3 describes a general equilibrium model and conducts counterfactual policy analysis. Section 4 concludes.

2 Model Predictions and Empirical Evidence

This section presents a partial equilibrium model of small open economy (SOE) to highlight the role of financial constraints in determining the cutoff and average firm productivity in the host country. We derive two testable predictions and provide empirical evidence from the firm-level data of China to support these model predictions.

2.1 Predictions from an SOE model

In this model, the representative household maximizes a Cobb-Douglas aggregate:

$$Y = \frac{\left(C^H\right)^\nu \left(C^F\right)^{1-\nu}}{(\nu)^\nu (1-\nu)^{1-\nu}},$$

where aggregate consumption, Y, serves as a numeráire. C^H is a CES aggregate of differentiated goods produced by local and FDI firms, and C^F is an aggregate of imported goods, which is exogenously given in this partial equilibrium model. ν captures the consumption home bias toward domestically produced goods relative to imported goods. Each sector has two types of Home firms: domestic firms of mass M and FDI firms of mass M^I.[6] These firms produce differentiated goods in the Home country and are indexed by ω and ω^*. Let Ω and Ω^I be the set of domestic and FDI firms, respectively. The CES aggregate, C^H, takes the form of

$$C^H = \left(\int_{\omega\in\Omega} \left[y^D(\omega)\right]^\rho d\omega + \int_{\omega^*\in\Omega^I} \left[y^I(\omega^*)\right]^\rho d\omega^*\right)^{\frac{1}{\rho}},$$

[6] The mass of firms is exogenous in this simple model. We relax this restriction later in our two-country model when we conduct counterfactual policy analysis.

where $y^D(\omega)$ is output from a Home local firm ω and $y^I(\omega^*)$ is output from an FDI firm ω^*. From the above CES aggregate, we obtain the demand for local and FDI firms

$$y^D(\omega) = \left(\frac{p^D(\omega)}{P}\right)^{-\sigma} \left[\left(\frac{P^H}{P}\right)^{\sigma-1} \nu Y + Y^*\right], \quad y^I(\omega^*) = \left(\frac{p^I(\omega^*)}{P}\right)^{-\sigma} \left[\left(\frac{P^H}{P}\right)^{\sigma-1} \nu Y + Y^*\right],$$

and the aggregate price index

$$1 = P = \left(P^H\right)^{\nu} \left(P^F\right)^{1-\nu}, \quad P^H = \left[\int_{\omega\in\Omega} \left(p^D(\omega)\right)^{1-\sigma} d\omega + \int_{\omega^*\in\Omega^I} \left(p^I(\omega^*)\right)^{1-\sigma} d\omega^*\right]^{\frac{1}{1-\sigma}},$$

where the price index P is given as unity and $\sigma \equiv \frac{1}{1-\rho}$. Y^* is the exogenous foreign demand and P^F is the exogenous price index for imported goods. In the following, we replace the firm index ω and ω^* with its productivity level z and z^*.

Each local firm has to pay a fixed entry cost F^D in labor units before it can draw its productivity, z, from a distribution $G(z)$. Likewise, each FDI firm pays F^I units of labor upon entry before it draws its productivity, z^*, from a distribution $G^*(z^*)$. The fixed entry cost has to be self-financed by firms. After drawing its productivity, each firm can decide whether to produce. If it chooses to produce, it has to pay additional fixed production costs in each period:

$$f = \begin{cases} f^D & \text{for domestic firms,} \\ f^I & \text{for FDI firms.} \end{cases}$$

It is assumed that $f^I > f^D$ holds, reflecting higher operational costs by FDI firms than local firms as discussed in Alquist et al. (2019). If the firm decides not to produce, it exits the market.

We introduce financial constraints to local firms following Manova (2012).[7] A fraction

[7] This particular type of financial constraints is motivated by the fact that smaller firms are usually more credit constrained, which is very common in China. This type of financial frictions mainly deter the entry of small and less productive firms, while other financial frictions (e.g., in Cooley and Quadrini (2001) and Arellano et al. (2012)) may deter the growth of productive firms and/or encouraging the entry of less productive ones.

of the fixed production cost, $\zeta f^D W$, has to be financed externally, where $\zeta \in [0,1]$ is a constant and W is wage. A fraction of the entry cost, $\chi F^D W$, needs to be provided as a collateral for the external finance with $\chi \in [0,1]$. Parameters ζ and χ indicate the sectoral level financial vulnerability. Firms are more financially vulnerable if they are in a sector that depends more on external finance (larger ζ) or has less tangible assets for collateral (smaller χ). Each local firm pays back its loan with an amount of $x(z)$ by a probability of $\lambda \in (0,1)$. If a firm defaults (with a probability of $1-\lambda$), its collateral goes to the lender. The parameter λ usually reflects the quality of financial institutions: a higher λ indicates less frictional financial markets.

Given the demand function, each domestic firm maximizes its expected profit:

$$\pi^D(z) = p^D(z)y^D(z) - \frac{W}{z}y^D(z) - (1-\zeta)f^D W - \lambda x(z) - (1-\lambda)\chi F^D W, \tag{1}$$

where a superscript D denotes domestic firms in Home. The profit maximization of local firms is subject to two conditions. First, the operational profit must be larger than the promised loan payment:

$$p^D(z)y^D(z) - \frac{W}{z}y^D(z) - (1-\zeta)f^D W \geq x(z). \tag{2}$$

Otherwise, the firm will choose not to produce. The second condition states that the bank's expected income is greater than or equal to its costs:

$$\lambda x(z) + (1-\lambda)\chi F^D W \geq \zeta f^D W, \tag{3}$$

where the condition is binding in the equilibrium because the banking sector is assumed to be competitive.

For simplicity, we assume that no financial constraint exists for FDI firms because they can gain access to credits from international financial markets and parent companies. Bilir et al. (2019) assumes that FDI firms also face financial constraints and Desbordes and Wei (2017) documents empirical evidence that FDI firms might require local credit. Our results can be interpreted in a relative term, rather than in an absolute term. We interpret the financial constraint of domestic firms as the wedge between domestic and FDI firms' borrowing constraints.

Substituting out demands and pricing rules in firms' variable profits, we obtain

$$\overline{\pi}^D(z) \equiv p^D(z)y^D(z) - \frac{W}{z}y^D(z) = \frac{1}{\sigma-1}\left(\frac{W}{z}\right)^{1-\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}\left[\left(P^H\right)^{\sigma-1}\nu Y + Y^*\right] \quad (4)$$

for local firms and

$$\overline{\pi}^I(z^*) \equiv p^I(z^*)y^I(z^*) - \frac{W}{z^*}y^I(z^*) = \frac{1}{\sigma-1}\left(\frac{W}{z^*}\right)^{1-\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}\left[\left(P^H\right)^{\sigma-1}\nu Y + Y^*\right] \quad (5)$$

for FDI firms. FDI firms' periodic profits are given by $\pi^I(z^*) = \overline{\pi}^I(z^*) - f^I W$.

Condition for cutoff productivity: Firms choose to produce only when their productivity is above a threshold. Let Z^D be the productivity cutoff of domestic firms. From equations (2) and (3), we can derive the entry condition for a marginal domestic firm:

$$\begin{aligned} \tfrac{1}{\sigma-1}\left(\tfrac{W}{Z^D}\right)^{1-\sigma}\left(\tfrac{\sigma}{\sigma-1}\right)^{-\sigma}\left[\left(P^H\right)^{\sigma-1}\nu Y + Y^*\right] &= (1-\zeta)f^D W + x\left(Z^D\right) \\ &= f^D W + \left(\tfrac{1}{\lambda}-1\right)W\left(\zeta f^D - \chi F^D\right) \quad (6) \\ &> f^D W. \end{aligned}$$

The last inequality is from the assumption that the loan amount is larger than the collateral: $\zeta f^D W > \chi F^D W$.

Let Z^I be the productivity cutoff for FDI firms. The zero-profit condition for a cutoff FDI firm implies that the variable profit of the firm equals the fixed production cost: $\overline{\pi}^I\left(Z^I\right) = f^I W$. Substituting equation (5) to this entry condition, we have:

$$\frac{1}{\sigma-1}\left(\frac{W}{Z^I}\right)^{1-\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}\left[\left(P^H\right)^{\sigma-1}\nu Y + Y^*\right] = f^I W. \quad (7)$$

Dividing equation (6) by (7), we have:

$$\left(\frac{Z^D}{Z^I}\right)^{\sigma-1} = \frac{f^D + \left(\frac{1}{\lambda} - 1\right)\left(\zeta f^D - \chi F^D\right)}{f^I}, \tag{8}$$

where $\sigma > 1$.

It is straightforward from equation (8) that the productivity cutoff of FDI firms is higher than that of domestic firms ($\frac{Z^D}{Z^I} < 1$), if domestic firms do not face financial constraints ($\lambda = 1$). In contrast, if FDI and domestic firms have the same fixed production cost ($f^I = f^D$), financial frictions in the host country will raise the productivity cutoff of local firms above that of FDI firms. The above results indicate that our model has two offsetting effects on productivity cutoffs of domestic and FDI firms. The higher fixed production cost faced by FDI firms ($f^I > f^D$) increases the cutoff for FDI firms, while the financial friction imposed on the local firms ($0 < \lambda < 1$) raises the cutoff for local firms. If the latter effect is stronger than the former, FDI firms can have lower cutoff productivity than local firms ($\frac{Z^D}{Z^I} > 1$).

Proposition 1. *If* $\frac{f^D}{f^I} + \frac{1-\lambda}{\lambda f^I}\left(\zeta f^D - \chi F^D\right) > 1$ *holds, the productivity cutoff of FDI firms is lower than that of domestic firms. The condition is more likely to hold in the sectors that are more financially vulnerable (larger* ζ *or smaller* χ*).*

Proposition 1 is directly from equation (8). Note that $\frac{1-\lambda}{\lambda f^I}\left(\zeta f^D - \chi F^D\right)$ increases with ζ and decreases with χ. Therefore, the sectors that are more financially vulnerable are more likely to meet the condition in Proposition 1. This is the first prediction that we will empirically test in Section 2.2.

Condition for average productivity: Assume that the productivity of domestic firms and FDI firms follow Pareto distributions, given by:

$$G(z) = 1 - (z_{min})^{\eta} z^{-\eta}, \qquad G^*(z) = 1 - (z^*_{min})^{\eta^*} z^{-\eta^*},$$

where $\eta > \sigma$ and $\eta^* > \sigma$. In addition, we assume that $\eta^* < \eta$, which implies a fatter tail for the productivity distribution of FDI firms than domestic firms. This assumption is used to capture the empirical patterns that most FDI is from advanced economies to emerging markets and FDI firms have higher average productivity than local firms.

Given the above productivity distributions, we can derive average productivity for domestic firms ($\widetilde{Z}^D$) and FDI firms ($\widetilde{Z}^I$):

$$\begin{aligned} \widetilde{Z}^D &\equiv \left[\int_{Z^D}^{\infty} z^{\sigma-1} \frac{dG(z)}{1-G(Z^D)}\right]^{\frac{1}{\sigma-1}} = \left[\frac{J(Z^D)}{1-G(Z^D)}\right]^{\frac{1}{\sigma-1}} = \left[\frac{\eta}{\eta-\sigma+1}\right]^{\frac{1}{\sigma-1}} Z^D, \\ \widetilde{Z}^I &\equiv \left[\int_{Z^I}^{\infty} z^{\sigma-1} \frac{dG^*(z)}{1-G^*(Z^I)}\right]^{\frac{1}{\sigma-1}} = \left[\frac{J^*(Z^I)}{1-G^*(Z^I)}\right]^{\frac{1}{\sigma-1}} = \left[\frac{\eta^*}{\eta^*-\sigma+1}\right]^{\frac{1}{\sigma-1}} Z^I. \end{aligned}$$

From the above equations, we have:

$$\frac{\widetilde{Z}^D}{\widetilde{Z}^I} = \left[\frac{\eta(\eta^* - \sigma + 1)}{\eta^*(\eta - \sigma + 1)}\right]^{\frac{1}{\sigma-1}} \frac{Z^D}{Z^I}, \tag{9}$$

which shows that the ratio of average productivity of domestic and FDI firms equals the corresponding ratio of productivity cutoffs multiplied ($\frac{Z^D}{Z^I}$) by a constant, $\left[\frac{\eta(\eta^*-\sigma+1)}{\eta^*(\eta-\sigma+1)}\right]^{\frac{1}{\sigma-1}}$. Given the assumption that $\sigma < \eta^* < \eta$, we have $\left[\frac{\eta(\eta^*-\sigma+1)}{\eta^*(\eta-\sigma+1)}\right]^{\frac{1}{\sigma-1}} < 1$ and $\frac{\widetilde{Z}^D}{\widetilde{Z}^I} < \frac{Z^D}{Z^I}$. As a result, FDI firms can have higher ***average*** productivity than domestic firms ($\frac{\widetilde{Z}^D}{\widetilde{Z}^I} < 1$), even though they have lower ***cutoff*** productivity ($\frac{Z^D}{Z^I} > 1$). Because the average productivity is proportional to the cutoff productivity, similar to Proposition 1, the average productivity advantages of FDI firms relative to domestic firms are smaller in financially more vulnerable sectors.

Proposition 2. *The average productivity of FDI firms is higher than that of domestic firms if* $\frac{\widetilde{Z}^D}{\widetilde{Z}^I} = \left[\frac{\eta(\eta^*-\sigma+1)}{\eta^*(\eta-\sigma+1)}\right]^{\frac{1}{\sigma-1}} \frac{Z^D}{Z^I} < 1$*. This condition can hold even when FDI firms have lower cutoff productivity than domestic firms (*$\frac{Z^D}{Z^I} > 1$*) as in Proposition 1, because* $0 < \left[\frac{\eta(\eta^*-\sigma+1)}{\eta^*(\eta-\sigma+1)}\right]^{\frac{1}{\sigma-1}} < 1$ *under the assumption that* $1 < \sigma < \eta^* < \eta$*. The average productivity advantages of FDI firms relative to domestic firms are smaller in more financially vulnerable sectors as* $\frac{Z^D}{Z^I}$ *increases with financial vulnerability.*

2.2 Empirical evidence from Chinese firm data

In this subsection, we provide empirical support for the predictions in Propositions 1 and 2. Our main dataset contains firm-level data from the Annual Surveys of Industrial Production (ASIP) by the National Bureau of Statistics of China, which is widely used in the literature.[8] We will briefly describe the data and leave the details in Appendix A.1.

2.2.1 Data

The ASIP dataset covers all state-owned and private manufacturing firms with sales greater than 5 million RMB (approximately 600,000 dollars at the exchange rate of 2000) between 2000 and 2007.[9] On average, there are 120,000 firm-level observations each year. The dataset contains detailed information about each firm's balance sheet and income statement, from which we can calculate its FDI share and productivity.

The balance sheet data includes disaggregate-level information on the ownership of capital (e.g., government collective, corporate, special districts, foreign, etc.). Thus, we can calculate the FDI share of each firm, which is measured by the share of capital from Hong Kong, Macau, Taiwan, and foreign countries. Firm productivity is calculated following Ackerberg et al. (2015) and re-scaled around industry productivity mean and divided by industry productivity standard deviation.[10] The dataset also includes basic information on firms, such as registration type, start year, location, operating status, and total employment that can be used to control for firm and location specific characteristics. For instance, the location information of the firm enables us to find out whether it is in a special economic development

[8] Examples of studies using the dataset include Bai et al. (2017), Wang and Wang (2015), Kee and Tang (2015), Manova et al. (2015), Ma et al. (2014), and Lu (2010), among others.

[9] The data truncation may not be a big concern here as 5 million yuan is not a very high threshold. In addition, our empirical results hold for a relatively large number of firms. For instance, our coefficient estimates are significant even at the 15th percentile, indicating that our findings are unlikely mainly driven by the bias caused by excluding some very small firms.

[10] Examples of using this method to calculate the firm productivity include Wang and Wang (2015), Alfaro et al. (2013) and De Loecker and Warzynski (2012), among others.

zone.

In our empirical exercises, we only include firms that enter the market after 2002 because China had strict restrictions on FDI firms before it joined the WTO in 2001. China initially imposed performance requirements on all foreign firms entering the country. Foreign firms were required to meet certain specified goals to qualify for investing in China, such as promoting the country's technologies and exports. Before China joined the WTO, it only opened to foreign investors a limited number of industries that were considered strategically important for China such that the country could benefit strongly from foreign technologies (e.g., automobiles). Therefore, it was difficult for foreign firms with only financial advantages to invest in China because of the performance requirements. The performance restrictions were removed when China joined the WTO in 2001 and more industries were opened to foreign investors. As a result, FDI inflow to China increased dramatically after 2002 (Figure 1) and the newly entered FDI firms may match our model better than those that entered China before 2001.

Five sector-level measures for the financial vulnerability are employed in our exercises following Manova et al. (2015) and Alquist et al. (2019): (i) external finance dependence, (ii) inventory ratio, (iii) R&D ratio, (iv) asset tangibility, and (v) trade credit. Financial vulnerability is positively correlated with external finance dependence, inventory ratio, and R&D ratios but negatively correlated with asset tangibility and trade credit. These five measures are described in Table 1 and calculated from the data of all publicly traded firms based in the U.S.[11] Using the U.S. data ensures that the financial vulnerability measures are not endogenously determined by China's level of financial development. Indeed, these measures are intended to capture the features inherent to the nature of the manufacturing process, which is supposed to be the same across countries.[12] Each financial vulnerability

[11]The raw data of U.S. firms are obtained from Compustat's annual industrial files. More details about these measures are included in Appendix A.1.2.

[12]Consistent with this argument, those measures display more cross-sectoral variations than cross-firm

variable is measured by the median among all firms in the sector and are available for 3-digit ISIC sectors. We match them with the 4-digit Chinese industry code in our dataset. To match firms with financial vulnerability variables, we first map the 4-digit Chinese industry code of each firm to the 3-digit ISIC-Rev.3 industry code according to the contrast table provided by the Ministry of Commerce of China.[13] Next, the 3-digit ISIC-Rev.3 industry code is mapped to ISIC-Rev.2 industry code according to the concordance table of the United Nations.[14] Then, we can match the sector-level financial vulnerability variables with the firms.

The five measures are not highly correlated, which indicates that they capture different dimensions of financial vulnerability. Following Manova et al. (2015), we calculate the first principal component (FPC) of the five indicators and use it as our preferred proxy for each sector's financial vulnerability. Manova et al. (2015) argue that FPC provides a cleaner index of financial vulnerability than each individual measure because the individual measures might be correlated with industrial characteristics unrelated to financial frictions. The FPC index has a positive loading on external finance dependence, inventory ratio, and R&D ratio, and a negative loading on asset tangibility and trade credit. The sign of the loading on each measure is consistent with the implication of the measure of financial vulnerability. In the end, FPC accounts for 45.9% of the variance for all five measures.

2.2.2 Empirical results

We compare the productivity of FDI and domestic firms using the following benchmark model to test the entry condition in our theoretical model:

$$Productivity_{fipt} = \alpha + \beta FDI_{fipt} + \gamma Firmcontrol_{ft} + \gamma_i + \gamma_p + \gamma_t + \varepsilon_{fipt}, \tag{10}$$

variations within a sector.

[13] Matching details can be found at http://www.fdi.com.cn/industry/IndustryEn.html.

[14] Details can be found at: http://unstats.un.org/unsd/cr/registry/regso.asp?Ci=1&Lg=1.

where the subscripts f, i, p, and t refer to firm, industry, location, and year, respectively. The dummy variable FDI_{fipt} equals one for firms whose FDI share is equal to or greater than 10%.[15] The firm controls ($Firmcontrol_{ft}$) include firm size, the export share in total sales and an economic zone dummy indicating whether the firm is located in an economic zone. The fixed effects at the industry, location (province), and year levels are also included, which are represented by γ_i, γ_p, and γ_t respectively. The industry fixed effects can capture the differences across industries such as firms entry costs and policy restrictions on FDI.[16]

The prediction in Proposition 1 pertains to the cutoff productivity of FDI and local firms. Therefore, we need to compare the productivity of FDI and local firms at the bottom of the productivity ranking in each type of firms. To achieve this goal, we employ quantile regressions to show that in financially more vulnerable sectors, FDI firms at the bottom of productivity ranking (around the cutoff productivity) are more likely to have lower productivity than their domestic counterparts.

Panel A of Table 2 reports the results when the financial vulnerability is measured by FPC. In the high financial vulnerability sector (top 25% of FPC), we find that the coefficient estimate of FDI dummy is significantly negative (at the 5% or 1% significance level) for firms at the bottom 20% of productivity, indicating that FDI firms have even lower productivity than local firms. In contrast, the evidence for the low financial vulnerability sector (bottom 25% of FPC) is much weaker, which is consistent with our Proposition 1. In both the low and high financial vulnerability sectors, the coefficient estimate of FDI dummy turned significantly positive for 50% and higher quantiles, thereby suggesting that productivity

[15] We try different definitions of FDI firms, such as changing the cutoff value of the FDI share and using the registration type of the firms. The results remain qualitatively unchanged. Our results also hold up if we use the FDI share in the regression directly.

[16] Given the short sample period between 2002 and 2007 in our data, the policy difference across sectors are relatively stable and should be absorbed by the industry fixed effects. China revised FDI entry policy for some four-digit level sectors (more disaggregated) in 2005 but there was no major change at the two-digit sector level. Adding an interaction term between the industry fixed effects and a dummy of post 2005 does not change the benchmark results qualitatively.

distribution of FDI firms may have a fatter tail than that of local firms.

The above findings also hold for most other measures of financial vulnerability as shown in Panel B of Table 2. In this panel, we report the results of the 15th percentile for the other five measures of financial vulnerability. In four of these five measures, the coefficient estimate of FDI dummy is significantly negative in the high financial vulnerability sector, but not for the low financial vulnerability sector. These findings strongly support the predictions in Proposition 1.

We employ the OLS regressions to test the predictions on the average productivity in Proposition 2. Table 3 shows the coefficient estimates of the FDI dummy in the sectors of low and high financial vulnerability under different measures of financial vulnerability. The coefficient estimate is significantly positive in the sectors of low financial vulnerability under all six measures of financial vulnerability and in the sector of high financial vulnerability under five out of six measure of financial vulnerability. These results suggest that FDI firms are on average more productive than local firms, even though they have lower cutoff productivity than local firms in financially vulnerable sectors. In addition, the coefficient estimate of FDI dummy is much smaller under four out of six measures of financial vulnerability for the sector of high financial vulnerability than the sector of low financial vulnerability, which is consistent with the predictions of Proposition 2. In particular, under our favorite measure of FPC, the coefficient estimate for the sector of high financial vulnerability is less than half of that for the sector of low financial vulnerability, and the difference is statistically significant at the 1% level.

Our results are robust to various subsamples. For instance, in one robustness check, we exclude FDI firms from Hong Kong, Macau and Taiwan (HMT) because many FDI firms from HMT are owned by Chinese residents and HMT are simply used as a platform to qualify for various benefits for FDI firms in China and to raise funding abroad at a lower cost. Our benchmark findings hold up well in this case and the results are reported in the appendix. In another robustness check, we consider a subsample of foreign firms and state-owned enterprises (SOEs) because SOEs are less financially constrained than private firms in China and the financial advantage of FDI firms may be reduced in this case. As a result, we expect that our benchmark results may be weakened in this subsample. The quantile and OLS regressions results for this subsample are reported in the appendix. At the low percentiles, FDI firms are still less productive than domestic SOEs in the sectors of high financial vulnerability, but the results are only statistically significant for the 10% quantile of financial vulnerability, much weaker than the benchmark results. These findings are consistent with the fact that SOEs are less financially constrained than private firms in China.

3 Policy Analysis in a Two-country Model

In this section, we study the policy implications when FDI firms have funding advantages relative to local firms in a two-country model.

3.1 Model description

Figure 2 shows the model structure. There are two countries, Home and Foreign (H and F), and each country has two sectors. Sector 0 provides a constant returns-to-scale homogeneous good, which serves as a numeráire in each country, while the other sector produces differentiated goods. The two countries are almost symmetric, and we focus on the Home country to describe the model when it causes no confusion. The only asymmetry is that Foreign firms can open subsidiaries in the Home country, while Home firms only operate in their own country. This setup is used to capture the fact that most FDI is from advanced economies to emerging markets. The detailed description of the Foreign country can be found in appendix A.2.

The representative consumer in the Home country derives utilities from the homogeneous good and the aggregate composite of differentiated goods:

$$V \equiv \Phi {C_0}^{\theta_0} {C_1}^{\theta}, \tag{11}$$

where V is the utility function of the Home consumer, C_0 is the consumption of the homogeneous (numeráire) good, and C_1 is the composite consumption of differentiated goods with $\theta_0 + \theta = 1$ and $\Phi \equiv \theta_0^{-\theta_0} \theta^{-\theta}$.

C_1 is a CES aggregator of the composites of domestic and imported goods:

$$C_1 = \frac{\left(C^H\right)^{\nu} \left(C^F\right)^{1-\nu}}{(\nu)^{\nu} (1-\nu)^{1-\nu}}, \tag{12}$$

where C^H and C^F are the composites of Home goods and imported Foreign goods, respectively. Parameter $\nu > 0.5$ captures the degree of consumption bias toward local goods.[17] C^H and C^F are, respectively, the CES aggregators of locally-produced products and imported goods:

$$C^H = \left(\int_{\omega \in \Omega} \left[y^D(\omega) \right]^{\rho} d\omega + \int_{\omega^* \in \Omega^I} \left[y^I(\omega^*) \right]^{\rho} d\omega^* \right)^{\frac{1}{\rho}}$$
$$C^F = \left(\int_{\omega^* \in \Omega^*} \left[y^{D,X*}(\omega^*) \right]^{\rho} d\omega^* \right)^{\frac{1}{\rho}},$$

where $y^D(\omega)$ is a good produced by a Home domestic firm ω and $y^I(\omega^*)$ is a good produced by a Home FDI firm ω^*. Note that the composite of locally-produced goods includes products of both local domestic firms and FDI firms in Home. We refer to local domestic firms as local firms in the rest of the paper when it causes no confusion. $y^{D,X*}(\omega^*)$ is an imported good produced by a Foreign firm ω^*. Ω and Ω^I denote the set of goods produced by the local and FDI firms, respectively, in the Home country. Ω^* is the set of goods produced by the firms in the Foreign country.

[17] The presence of consumption home bias is consistent with the data and also essential to ensure the existence of the unique equilibrium in our model.

Labor is the sole factor of production and is immobile across countries. Given wage W and the transfer from government T, the representative household maximizes its utility subject to the budget constraint:

$$PC = WL + T, \tag{13}$$

where C is aggregate consumption given by $C = \Phi {C_0}^{\theta_0} {C_1}^{\theta}$, which is identical to the utility V. P is the consumer price index and L denotes the labor supply.

Financially constrained Home local firms: There is a continuum of Home local firms, each producing a different variety of Home goods with the production function $y(\omega) = zl(\omega)$, where each firm is indexed by $\omega \in \Omega$, z is the productivity of firm ω, and $l(\omega)$ is the firm's labor input for production.

A local entrepreneur pays F^D units of labor as a fixed cost to draw her productivity z from a distribution of $G(z)$. As is standard in the literature, z follows a Pareto distribution, given by $G(z) = 1 - (z_{min})^{\eta} z^{-\eta}$ for $z \geq z_{min}$, with $\eta > \sigma - 1$ and $\sigma \equiv \frac{1}{1-\rho}$. After observing her productivity, the entrepreneur can decide whether to produce. If she chooses to produce, the firm needs to pay an additional fixed cost for production, f^D units of labor. Otherwise, she exits.

We assume that Home domestic firms are financially constrained as in Manova (2012) and Bilir et al. (2019). A fraction $\zeta \in [0, 1]$ of the fixed production cost, f^D, has to be funded externally, although the firm can finance the variable production cost internally. To borrow the loan of $\zeta f^D W$, Home local firms must pledge a collateral equal to a portion $\chi \in [0, 1]$ of the fixed entry cost F^D (a proxy for tangible assets) and promise to pay back an amount of $x(z)$ in home currency when the loan matures. After observing their revenues, Home domestic firms redeem their loans with a probability $\lambda \in [0, 1]$. The non-defaulting probability λ reflects the quality of financial institutions, such as the effectiveness of contract enforcement or bank's ability of screening and monitoring of borrowers: a higher λ indicates better quality of financial institutions. In the case of default, the bank seizes the collateral $\chi F^D W$ and the defaulting firm must replace it before it can obtain external financing in the future.[18] Firms face an exogenous probability (δ) of exiting the market involuntarily.

The government imposes taxes on firms' profits and revenues, which is captured by the wedges τ_C^D and τ_V^D in the model.[19] Given the above setup, a Home local firm with productivity z chooses price $p^D(z)$, quantity for local sales $y^D(z)$, quantity for exports $y^{D,X}(z)$, labor input $l^D(z)$, and loan payment $x(z)$ to maximize its profit

$$\pi^D(z) = \max \ \ \tau_C^D \left[\begin{array}{ll} \tau_V^D p^D(z) \left(y^D(z) + y^{D,X}(z) \right) & -Wl^D(z) - f^D W + \zeta f^D W \\ & -\lambda x(z) - (1-\lambda)\chi F^D W \end{array} \right], \tag{14}$$

subject to

$$\overline{\pi}^D(z) \equiv \tau_V^D p^D(z) \left(y^D(z) + y^{D,X}(z) \right) - Wl^D(z) - f^D W + \zeta f^D W \geq x(z), \tag{14a}$$

$$\lambda x(z) + (1-\lambda)\chi F^D W \geq \zeta f^D W. \tag{14b}$$

There are two constraints in local firms' profit maximization. First, the firm's operational profit, $\overline{\pi}^D(z)$, must be larger than or equal to the loan payment $x(z)$ as in equation (14a). Second, the constraint in equation (14b) requires the bank's expected proceeds from the debt contract to be greater than or equal to its costs. We assume that the banks operate in a perfectly competitive market. As a result, the constraint in equation (14b) is always binding.

Note that the ex-ante profit before the realization of the defaulting event, $\pi^D(z)$, is different from the ex-post profit of the firm that repays its debt, $\overline{\pi}^D(z)$. The additional cost

[18]Note that the defaulting firms do not exit the market. They stay in operation by replacing the collateral seized by the bank.

[19]Specifically, taxes on the firms' profits and revenues equal to $\left(1-\tau_C^D\right)$ and $\left(1-\tau_V^D\right)$, respectively.

from the financial constraints drives out low-productivity firms that would produce without such a cost. Financial frictions affect neither the optimal pricing of a firm nor its ex-ante profit, which are given by $\frac{p^D(z)}{W} = \left(\frac{1}{\rho}\frac{\tau_L^D}{\tau_V^D}\right)\frac{1}{z}$ and $\frac{\pi^D(z)}{W} = \tau_C^D\left[z^{\sigma-1}\left(\frac{\tau_V^D}{\sigma}\right)\left(\frac{1}{\rho}\frac{\tau_L^D}{\tau_V^D}\right)^{1-\sigma}A - f^D\right]$. In the last equations, A denotes the market demand for the products produced by Home domestic firms:

$$A \equiv \left[\left(\frac{P^H}{W}\right)^{\sigma-1}\nu\theta\frac{PC}{W} + {Q_L}^{\sigma}\left(\frac{P^{H*}}{W^*}\right)^{\sigma-1}(1-\nu^*)\theta\frac{P^*C^*}{W^*}\right].$$

Because financial frictions affect the ex-post profit of a non-defaulting firm, the cutoff productivity for Home local firms, Z^D, depends on the financing cost through

$$\frac{\pi^D(Z^D)}{W} = \tau_C^D\left(\frac{1}{\lambda}-1\right)\left(\zeta f^D - \chi F^D\right). \tag{15}$$

As the degree of financial market imperfection increases, i.e., the non-defaulting probability λ decreases, the cutoff productivity, Z^D, increases as the external financing cost rises. The cutoff local firms have to be more productive to cover the financing cost.

An unbounded pool of prospective domestic entrants into the production exist, and the incumbents exit with an exogenous probability of δ. Due to the free entry condition, the expected life-time operating profit of a potential entrant should equal the entry cost: $\frac{\pi^D(\widetilde{Z}^D)}{W} = \frac{\delta F^D}{1-G(Z^D)}$, where the average productivity of Home local firms is denoted by $\widetilde{Z}^D \equiv \left[\int_{Z^D}^{\infty} z^{\sigma-1}\frac{dG(z)}{1-G(Z^D)}\right]^{\frac{1}{\sigma-1}}$. The mass of Home local firms evolves according to the law of motion: $M = \left(1-G(Z^D)\right)M^E + (1-\delta)M$. There are M^E mass of entrants who pay fixed entry cost to draw their productivity but only $\left(1-G(Z^D)\right)$ fraction of them successfully enter the market after their productivity is revealed.

Financially unconstrained Foreign firms: Foreign firms also bear fixed entry and production costs in the Foreign country, which are denoted by F^{D*} and f^{D*} in terms of Foreign labor. In addition, Foreign firms can choose to establish subsidiaries in the Home country via FDI after paying a fixed production cost f^I in terms of Home labor. FDI firms face a higher fixed production cost every period than Home domestic firms: $f^I \geq f^D$.

The aggregate profit of all Foreign firms in terms of Foreign currency is given by the following:

$$\int_{\omega^* \in \Omega^*} \pi^{D*}(z) d\omega^* + \int_{\omega^* \in \Omega^I} \frac{1}{\epsilon} \pi^I(z) d\omega^*,$$

where $\pi^{D*}(z)$ represents the profit of a Foreign local firm with the productivity z and $\pi^I(z)$ denotes the profit of a FDI firm. ϵ denotes the nominal exchange rate, which is unity in our model.

Foreign and FDI firms are financially less constrained than Home local firms because firms in advanced economies usually have access to the credits from international financial markets and FDI firms can also finance from their parent companies.[20] For simplicity, we assume Foreign and FDI firms face no financial constraint. These firms face a standard profit maximization problem, which we leave to appendix A.2.

Equilibrium conditions and the cutoff productivity tradeoff: The model equilibrium is defined by 18 equations for 18 endogenous variables. To save space, we leave the equilibrium conditions to appendix A.2.2 and only discuss the main results in the paper.

In the general equilibrium model, FDI firms face a similar tradeoff between the financial advantage and high fixed production cost similar to the partial equilibrium model in Section 2. The cutoff productivity of FDI firms can be lower than that of Home local firms if $\frac{f^D + \left(\frac{1}{\lambda} - 1\right)\left(\zeta f^D - \chi F^D\right)}{f^I} \left(\frac{\tau_V^I}{\tau_V^D}\right)^\sigma > 1$. In case $\tau_V^I = \tau_V^D$, the above condition is reduced to the one in Proposition 1. Because $\sigma > 1$, the condition is more likely to hold when the wedges satisfy the inequality: $\tau_V^I > \tau_V^D$. In other words, FDI firms are more likely to have lower cutoff productivity than Home local firms if their revenue tax rate is lower than that of the

[20]See Bilir et al. (2019), Desai et al. (2007) and Manova et al. (2015) for discussions on FDI firm's financial advantages.

local firms. It suggests that tax benefits to FDI firms in many emerging markets may attract FDI firms whose productivity is even lower than local firms, which is exactly the opposite of what these tax policies are designed to achieve, that is, to attract high-tech and productive MNCs.

3.2 Calibration

We calibrate our model by taking China as the Home country and the advanced economies as the Foreign country. Table 4 presents the parameter values in our calibration and the reasons for choosing these values.

Most parameter values are standard in the literature. Following Bernard et al. (2003), the elasticity of substitution among differentiated goods is set to $\sigma = 3.8$, which implies a price markup of 36%. The exogenous exit probability δ is 10%. The home-bias parameter ν is calibrated to match the empirical ratio of total Home import sales to total Home product sales, 0.163, which is obtained from the Chinese Customs and firm data in 2000. We assume that the Foreign country exhibits the same level of home bias in consumption ($\nu^* = \nu$). The Home labor endowment is normalized to be one and the Foreign labor supply is chosen to match the empirical ratio of total Home export sales to total Home import sales, 0.184.

Following Alquist et al. (2019), we impose additional restriction on FDI. When Foreign multinationals open subsidiaries in the host country, their productivity is reduced by a factor α.[21] The parameter α is calibrated to match the empirical ratio of total Home FDI product sales to total Home product sales, 0.388. We apply the same lower bound for the Pareto distribution of firm productivity in Home and Foreign, which is normalized to be $z_{min} = z^*_{min} = 0.20$ as in Bernard et al. (2007). The dispersion parameter in Home, η, is set to 3.3 as in Bernard et al. (2003) and Bernard et al. (2007). The Foreign dispersion

[21] If a Foreign firm draws its productivity z in the Foreign country, then its productivity is reduced to αz with $\alpha < 1$ when its subsidiaries run in the host country. The parameter α captures operational frictions that MNCs face in the FDI host country.

parameter, η^*, is calibrated to 3.15, such that the average productivity of FDI firms is higher than that of the Home firms, though the cutoff productivity of FDI firms is lower than that of the Home local firms. Figure 3 shows the firm distributions and cutoff productivities in Home and Foreign.

Insert Figure 3 Here

For parameters of financial frictions, we assume that all fixed production costs have to be externally financed ($\zeta = 1$). χ is chosen such that banks can recover 30% of the collateral when firms default and the value of the collateral is 1.2 times that of the total borrowing. In each period, 30% of Home firms default on their debt ($\lambda = 0.70$). The financial market reform is captured by an increase in λ. Even though the literal interpretation of λ is the non-defaulting probability of domestic firms, we take λ as a measure for the imperfectness of Home financial markets in a broad sense. When λ equals one, the local financial market becomes a frictionless one as in the standard models. We choose $\lambda = 0.70$, which is low enough to ensure that the cutoff productivity of FDI firms is lower than that of local firms as we find in the Chinese firm-level data.[22]

The sunk entry cost is the same for Home and Foreign firms, which is equal to two units of labor following Bernard et al. (2007). The fixed production cost of domestic firms in Home and Foreign is set to 5% of entry costs. The fixed production cost of FDI firms is assumed to be higher than that of local firms due to additional transaction costs. It is calibrated to match the empirical ratio of tangible assets between FDI firms and local firms, 1.115, which is presented in Table A.7 in the appendix. The fixed production cost mainly consists of the depreciation of tangible assets, interest expense, and utility costs. Because asset depreciation accounts for most of the fixed production costs, we use the tangible asset

[22]Our results are robust when λ is set below 0.7. When λ is set to a very high value, the cutoff productivity of FDI firms will be higher than that of local firms, which is inconsistent with our empirical findings.

ratio as a proxy to pin down the ratio of fixed production costs between FDI firms and local firms.[23]

Lastly, the wedges in the firms' profit maximization problem are calibrated to match the practice of corporate taxation in China. For Home local firms, we set 33% corporate tax on profits and 17% value-added tax. Since intermediate inputs are absent from firms' optimization problem in our model, the value-added tax is equivalent to the tax on revenues. For FDI firms, we assume 15% corporate tax and 15% value-added tax due to tax incentives to attract FDI. The empirical ratios and corresponding values from our calibration are shown in the Table 5 while the other details are relegated to appendix A.3.[24]

3.3 Counterfactual policy analysis

This section investigates the welfare effect of two policy changes. First, we raise the tax rate of FDI firms in our benchmark model, while keeping the total government revenue constant. In this case, the tax rate of local firms will also change endogenously when we adjust the tax rate of FDI firms. This exercise examines the effect of removing tax benefits offered to FDI firms (or even taxing FDI firms more than local firms) on the host country's welfare. The second exercise investigates the welfare effect of raising λ, which simulates a financial market reform that reduces the financial disadvantages of local firms. In these two exercises, we only compare the equilibrium results of the benchmark model at different parameter values, which represent the targeted policy changes. No dynamic path is considered in our analysis.

[23] We assume the depreciation rate is the same across firms. Our results are robustness to different values for f^I, for instance, between 0.1005 and 0.25, although for larger f^I, reducing FDI tax benefits is less welfare improving. Intuitively, large f^I raises the cutoff productivity of FDI firms, reducing the distortion of FDI subsidies.

[24] The consumption weight on the homogeneous-good sector, θ_0, is fixed at 0.07. We choose this number to maximize the weight on the heterogeneous-good sector, which is the main focus of our counterfactuals, while holding consumption and labor in the homogeneous-good sector positive in the equilibrium: $C_0, L_0, C_0^*, L_0^* > 0$. If the weight, θ_0, is too small or labor endowments, L and L^*, are not large enough, then consumption or labor allocation in the homogeneous-good sector, C_0, L_0, C_0^*, and L_0^*, can be negative, which implies allocations are in disequilibrium.

Welfare is measured by the representative household's utility and the appendix (A.2.1) shows that the utility in equation (11) can be written out as

$$
\begin{aligned}
V &= \Phi {C_0}^{\theta_0} {C_1}^{\theta}, \text{and} \\
C_1 &= \underbrace{\left(\rho \widetilde{Z}^{HF}\right)}_{\text{Productivity Effect}} \underbrace{\left(M^{HF}\right)^{\frac{1}{\sigma-1}}}_{\text{Variety Effect}} \underbrace{\theta\left(L+\frac{T}{W}\right)}_{\text{Income Effect}}.
\end{aligned}
\tag{16}
$$

Since the only purpose of homogeneous-good consumption C_0 in the model is to have a common numeráire across countries and C_0 has a small weight in total consumption, ignoring C_0 in our analysis will not affect our main results. Therefore, C_1 and welfare are determined by the three effects in equation (16). First, welfare is positively affected by the composite productivity (the productivity effect), $\widetilde{Z}^{HF}$, since higher productivity leads to more output for consumption. The second effect (the variety effect) is from the composite mass of firms, M^{HF}, because the consumer loves the variety. The last one is from the income effect of the household, $L + \frac{T}{W}$. The household becomes better off if it receives more transfers from the government, $\frac{T}{W}$.

We study the equilibrium outcome of the three effects to a policy change of our interest and the policy's overall welfare effect in our model. In addition, we explore the factors driving these three effects to develop intuitions behind our results.

3.3.1 Removing tax benefits of FDI firms

The tax benefits offered by emerging markets to FDI firms could be counter productive. The tax benefits are usually offered to attract FDI inflows under the conventional wisdom that FDI firms can promote the host country's productivity. Under certain circumstances, such a policy could be optimal because it boosts a country's productivity by attracting highly productive FDI firms to invest in the country. In addition, previous studies document convincing microeconomic evidence of positive technology spillovers from FDI firms to local firms. We fully acknowledge these positive effects of FDI firms. However, whether the tax benefits offered to FDI firms can achieve their intended goal if FDI firms have other advantages such as low financing costs, rather than advantages in productivity, is less clear.

Figure 4 presents the results when the revenue tax rate of FDI firms is set at different levels (from 15% to 55%). For each level of the FDI tax rate, we endogenously choose the corresponding revenue tax rate of local firms such that government revenues (and the transfers to household) remain the same as in our benchmark model. In each chart, the horizonal axis displays the revenue tax rate of FDI firms and the vertical axis presents the corresponding equilibrium outcome for the variables of interest. For instance, the top-left subfigure shows the corresponding revenue tax rate of local firms when the revenue tax rate of FDI firms is set at a level from 15% to 55%. The tax rate of local firms first decreases because the tax revenue from the FDI firms increases with the tax rate hike on the FDI firms. The government can lower the tax rate of local firms while keeping its total tax revenue constant. However, the higher tax rate will also make more FDI firms exit from the Home country, which reduces the tax base and the revenue. This effect will eventually dominate and the Home government will have to increase the tax rate of local firms once the tax rate of FDI firms exceeds a threshold (33%). Note that the change in the tax rate is more moderate for local firms (between 12.6% and 17.0%), relative to FDI firms (from 15% to 55%) because local firms account for a bigger fraction of total output in the Home country than FDI firms. Keeping the total tax revenue constant, a small change in the tax rate of local firms can offset the effect from a much larger tax rate change for FDI firms.

We find that the tax benefits offered to FDI firms actually reduce the total productivity of the host country ($\widetilde{Z}^{HF}$) in our model. The productivity effect displays a hump-shaped pattern in the left subfigure of the second row in Figure 4: $\widetilde{Z}^{HF}$ first increases if we remove the tax benefits offered to FDI firms and remains true even when we start to tax FDI firms more than local firms. However, $\widetilde{Z}^{HF}$ eventually declines with the tax rate of FDI firms when the tax rate is higher than 33%.

The hump-shaped pattern of the productivity effect is due to two reasons: the increase in FDI firms' cutoff productivity and the change in the market share of FDI firms. Recall that the total productivity of the consumption composite in Home is defined as

$$\log\left(\widetilde{Z}^{HF}\right) \equiv \nu \log\left(\widetilde{Z}^{DI}\right) + (1-\nu)\log\left(\widetilde{Z}^{D*}\right), \tag{17}$$

which states that the total productivity of home consumption bundle is the average productivity of Home firms (both local firms and FDI firms, $\widetilde{Z}^{DI}$) and foreign firms ($\widetilde{Z}^{D*}$). This result is intuitive because the home consumption bundle includes both products produced by Home firms and products imported from Foreign. The tax rate change in Home has a very small spillover effect on the foreign productivity, $\widetilde{Z}^{D*}$, and the consumption bundle is biased towards Home produced goods ($\nu = 0.83$).[25] Thus, $\widetilde{Z}^{D*}$ has a negligible effect on $\widetilde{Z}^{HF}$. We can safely ignore $\widetilde{Z}^{D*}$ and focus our analysis of $\widetilde{Z}^{HF}$ on $\widetilde{Z}^{DI}$.

$\widetilde{Z}^{DI}$ is determined by the tax rate, cutoff productivity, and mass of local and FDI firms in Home. Note that $\widetilde{Z}^{DI}$ is defined by

$$\widetilde{Z}^{DI} \equiv \left[\frac{1}{M+M^I}\left(M\left(\tau_V^D \widetilde{Z}^D\right)^{\sigma-1} + M^I\left(\tau_V^I \widetilde{Z}^I\right)^{\sigma-1}\right)\right]^{\frac{1}{\sigma-1}}, \tag{18}$$

where $\widetilde{Z}^D$ and $\widetilde{Z}^I$ are the average productivity of Home local firms and FDI firms, respectively. The average productivity of Home firms ($\widetilde{Z}^{DI}$) is the weighted average of local-firm productivity and FDI-firm productivity with the relative mass of these two types of firms being the weight. We show in the online appendix (Section A.2) that the average productivity of local and FDI firms are linear functions of the corresponding cutoff productivity:

[25] The productivity in Foreign actually decreases in the model when the tax rate of FDI firms increases. Please see appendix A.2.2.3 for details.

$\widetilde{Z}^D = \left[\frac{\eta}{\eta-\sigma+1}\right]^{\frac{1}{\sigma-1}} Z^D$, and $\widetilde{Z}^I = \left[\frac{\eta^*}{\eta^*-\sigma+1}\right]^{\frac{1}{\sigma-1}} \alpha Z^I$, where Z^D and αZ^I are the cutoff productivity for local and FDI firms, respectively. As discussed in Section 3.1, the tax benefits of FDI firms reduce their cutoff productivity relative to that of local firms. When we increase FDI firms' tax rate, their cutoff productivity rises substantially as shown in the right subfigure of the second row in Figure 4. In contrast, the cutoff productivity of local firms does not change. As a result, the average productivity of FDI firms increases significantly while the average productivity of local firms only changes slightly, mimicking the patterns of the cutoff productivity of FDI and local firms.

Both the cutoff productivity and the after-tax wedges (τ_V^D and τ_V^I) affect $\widetilde{Z}^{DI}$ in equation (18). For instance, the cutoff productivity of FDI firms increases but the after-tax wedge decreases when the tax rate of FDI firms increases. To understand the overall effect, the right subfigure of the third row in Figure 4 shows the effective productivity measures that augment the average productivity by the after-tax wedges: $\tau_V^D \widetilde{Z}^D$ for Home local firms and $\tau_V^I \widetilde{Z}^I$ for FDI firms. The effective productivity of FDI firms continues to increase with the tax rate even after we take into account the after-tax wedge. The effective productivity of local firms changes only moderately: it mainly traces the after-tax wedge ($\tau_V^D \widetilde{Z}^D$) as local firms' cutoff productivity stays almost constant.

Another important change in our counterfactual analysis is that the market share of FDI firms declines because fewer FDI firms operate in the Home country if a higher revenue tax rate is imposed on these firms. As shown in left panel of the third row in Figure 4. When the market share of FDI firms shrinks, it pulls down the average productivity in the Home country because the effective productivity of FDI firms is higher than that of local firms as shown in the right subfigure of the third row in Figure 4. Therefore, we have two offsetting effects from raising the tax rate of FDI firms. Given the market shares of local and FDI firms, raising the tax rate of FDI firms will increase the aggregate productivity in the Home country as the cutoff and effective productivity of FDI firms rise substantially. However, the decrease in the market share of FDI firms will reduce the average productivity of the Home country. As a result, the aggregate productivity in the Home country shows a humped shape when we adjust the tax rate of FDI firms.

Welfare consists mainly of three components: the productivity effect, the variety effect, and the income effect. The income effect is constant in this exercise. The productivity effect displays a humped shape and the variety effect is concavely increasing. Overall, the welfare also has a humped shape similar to the productivity effect as shown in the last subfigure of Figure 4.

The above analysis highlights a trade off faced by the FDI policy. On the one hand, the policymakers would like to provide tax and other benefits to attract high-productivity foreign firms in order to boost the domestic average productivity. On the other hand, the low-productivity foreign firms will also take advantage of these policies. As we show, the FDI firms could even have lower productivity than local firms if the host country's financial markets are underdeveloped. In this case, some FDI firms with low-productivity are subsidized by taxing high-productivity local firms, which defies the purpose of such policies.

Several previous studies also emphasize the quality of domestic financial sector as a crucial factor for a country to derive the benefits of international capital flows.[26] In particular, Alfaro et al. (2004) document that economies with better-developed financial markets are able to benefit more from FDI to promote their economic growth. They argue that technology spillovers from FDI firms to local firms are financially costly and well-functioning domestic financial markets help local firms with their financing to adopt new technology from FDI firms. Similar empirical findings are also documented in Prasad et al. (2005) and Kose et al.

[26] More generally, the quality of the domestic financial markets plays a critical role for a country to benefit from financial market globalization. See Kose et al. (2010) for a review of these studies.

(2009). In this paper, we explore a different channel through which underdeveloped local financial markets may undermine FDI's benefits to the productivity of host countries. We emphasize that FDI decision depends endogenously on local financial markets: inefficient local financial markets may attract low-productivity FDI firms.[27]

China adopted policies in the 1990s to alleviate the problem of attracting low-productive FDI firms. In the beginning of the 1990s, China had very strong capital controls and several FDI policy measures were adopted to ensure that FDI firms introduced new technology and management skills to China. For instance, China used performance requirements to control for the quality of FDI firms before its accession to the WTO in 2001. Policies, such as tax exemption were also adopted to encourage FDI firms to transfer advanced technology to China before 2001.[28] Thus, FDI firms are more likely to have higher productivity than local firms during this period. However, China went through capital account liberalization in the 2000s by removing restrictions on what sectors foreign firms can invest and also called off the performance requirements.

3.3.2 Financial Market Reform under Tax Distortions

The financial disadvantage of local firms can be attributed to the financial market friction in the Home country of our model. If the financial market is reformed to improve its efficiency, will the reform definitely improve the Home country's welfare? We examine this question by changing the non-defaulting probability of local firms in our model, λ. Financial market efficiency improves when λ increases.

Under the benchmark setup, the Home welfare displays a humped shape when λ increases from 0.5 to 1. Figure 5 presents our results, and the welfare of the Home country measured by the composite consumption is displayed in the top left chart. The composite consumption

[27] Bilir et al. (2019) find that financially advanced economies attract more affiliates of US multinationals, which are usually more productive than FDI from other countries.

[28] See Long (2005) for more details.

exhibits a humped shape, peaking when λ is about 78%. Beyond this point, a further improvement of the Home financial market efficiency can even reduce the country's welfare. This counter-intuitive result can be attributed to the interaction between the financial friction and tax distortions. If we decrease the profit tax of local firms, the humped shape of Home country welfare flattens and the welfare increases with λ. The top-right chart of Figure 5 shows the percent change of consumption relative to the benchmark model ($\lambda = 0.70$) in cases with different profit tax rates of $1 - \tau_C^D$.

The second row of Figure 5 and the left chart in the third row present the three effects that determine the Home welfare: the aggregate productivity, $\widetilde{Z}^{HF}$, the aggregate measure of product varieties, M^{HF}, and the lump-sum transfers to households, $\frac{T}{W}$. When the financial constraints of local firms improve, more local firms with low productivity can now enter the market. As shown in the right panel of row three in Figure 5, the cutoff productivity of local firms decreases with λ, dragging down the aggregate productivity, $\widetilde{Z}^{HF}$. At the same time, the entry of new local firms raises the product varieties, M^{HF}, which increases almost linearly with λ in Figure 5. The lump-sum transfers barely change and have a negligible effect on the welfare. We can ignore this income effect in the analysis below.

Equation (16) reveals that the welfare is a linear function of the aggregate productivity and is a concave function of the aggregate measure of product varieties. As a result, the welfare is a concave function of λ. In particular, it shows a humped shape in our benchmark model because the decrease in the aggregate productivity dominates the increase in product varieties when λ is above 78%.

The aggregate measure of product varieties increases more strongly with λ when the profit tax rate of local firms is set to a lower level. The increase in the product varieties is strong enough to offset the decreases in the aggregate productivity for all values of λ when the profit tax rate is low enough. In contrast, under our benchmark parameterizations, the effects from the decrease in aggregate productivity dominate the increase in product varieties for large λ such that the welfare becomes a hump-shaped function of λ.

To understand the role of the profit tax rate in driving our results, consider the labor market clearing condition in Home:

$$L - L_0 = M\left(\frac{\delta F^D}{1 - G(Z^D)}\right) + Mf^D + M^I f^I + Ml^D\left(\widetilde{Z}^D\right) + M^I l^I\left(\widetilde{Z}^I\right),$$

which states the labor in the heterogeneous goods sector is used for the fixed entry cost of local firms ($M\left(\frac{\delta F^D}{1-G(Z^D)}\right)$), the fixed production costs ($Mf^D + M^I f^I$) and the production of goods ($Ml^D\left(\widetilde{Z}^D\right) + M^I l^I\left(\widetilde{Z}^I\right)$). From the free entry condition in the Home country, we have $\frac{\delta F^D}{1-G(Z^D)} = \frac{\pi^D(\widetilde{Z}^D)}{W} = \tau_C^D\left[\frac{l^D(\widetilde{Z}^D)}{\sigma-1} - f^D\right]$. For a given fixed entry cost, a decrease in the tax rate (an increase in τ_C^D) will reduce the average profit of each local firm, and therefore, the average size of local firms. In other words, the decrease in the Home profit tax rate increases the competition in the Home market. When the average size of Home local firms is smaller, a given increase in λ allows more home firms (or product varieties) to enter the market.

Our results suggest that the financial market reform may have to be combined with tax reform, that is, a reduction in the profit tax, to benefit the economy. Under a high profit tax rate, the Home market is populated by relatively large firms. The financial market reform may not benefit enough firms to guarantee an increase in social welfare.

4 Conclusion

Recent studies have explored the role of FDI's financial advantages in driving FDI flows and alleviating firms' financial constraints in host countries. Convincing evidence that FDI firms can improve export performance of host countries, provide funding (e.g., through trade credit) to financially constraint local firms and relax financial constraints of foreign acquired firms, is documented in the literature. These financial benefits complement the conventional technology benefits that FDI firms bring to host countries, which have been widely studied in the literature.

In this paper, we emphasize that the financial advantages and productivity advantages of FDI firms are interdependent and this interdependence has strong policy implications. The financial advantages may allow FDI firms of low productivity to enter host countries. We show both theoretically and empirically that the financial advantages of MNCs will affect the relative cutoff and average productivity of FDI and local firms. Indeed, the cutoff productivity of marginal FDI firms can even be lower than that of marginal local firms as we show in the Chinese firm-level data. In this case, the policy of subsidizing FDI firms by taxing local firms is highly counterproductive.

We acknowledge that our two-country model of policy analysis abstracts from many well-documented benefits of FDI to host countries such as technology spillovers. A comprehensive welfare evaluation of FDI policies requires a model that incorporates all benefits and costs of FDI flows and the related policies, which we leave for future work.

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Table 1: Measures of Financial Vulnerability

Variable	Definition†	Higher financial vulnerability if	25th percentile in the data	75th percentile in the data
External finance dependence	U.S. industry median of (capital expenditure-cash flow)/capital expenditure for the period 1980-1999	Higher external finance dependence	-0.27	0.06
Inventory ratio	U.S. industry median of inventory/sales for the period 1980-1999	Higher inventory ratio	0.13	0.18
R&D ratio	U.S. industry median of R&D expenditure/sales for the period 1980-1999	Higher R&D ratio	0.01	0.02
Tangibility	U.S. industry median of fixed asset/total asset for the period 1980-1999	Smaller tangibility	0.20	0.40
Trade credit	U.S. industry median of account payable/total asset for the period 1980-1989	Smaller trade credit	0.05	0.08
First principal component (FPC)	Linear combination of the above five measures	Larger FPC	-0.79	0.79

Note: †–See Kroszner et al. (2007) and Fisman and Love (2003) for details.

Table 2: Results of Quantile Regressions

Panel A: Results for First Principal Component						
	Low financial vulnerability			High financial vulnerability		
Quantile (%)	Coef.	s.e.	No. obs.	Coef.	s.e.	No. obs.
5	−0·106***	0·034	48136	−0·153***	0·026	58895
10	−0·039*	0·023	48136	−0·094***	0·018	58895
15	−0·006	0·018	48136	−0·055***	0·015	58895
20	0·020	0·017	48136	−0·033**	0·013	58895
25	0·033**	0·016	48136	−0·007	0·012	58895
50	0·113***	0·014	48136	0·060***	0·012	58895
75	0·164***	0·016	48136	0·094***	0·013	58895
Panel B: Results of the 15th Percentile for other FV measures						
	Low financial vulnerability			High financial vulnerability		
FV measure	Coef.	s.e.	No. obs.	Coef.	s.e.	No. obs.
R&D ratio	0·006	0·011	102433	−0·075***	0·019	43868
Trade Credit	−0·018	0·014	56139	−0·002	0·015	61354
External Fiance	−0·013	0·018	38673	−0·066***	0·017	48656
Inventory ratio	−0·030	0·019	41304	−0·052***	0·013	66087
Tangibility	0·039**	0·019	46775	−0·061***	0·015	48451

Note: The financial vulnerability in Panel A is measured by the first principle component (FPC). Panel B shows the results of the 15th percentile for other measures of financial vulnerability. The low and high financial vulnerability refers to the bottom and top 25% of each financial vulnerability measure, respectively. The sample includes all firms that entered the market between 2002 and 2007, after China's accession to the WTO. The reported coefficient estimate is for the independent variable of FDI firm dummy. Control variables include firm size, export ratio, economic zone dummy, and industry, province, and year fixed effects. *, ** and *** denote the statistical significance at the 10%, 5% and 1% levels respectively.

Table 3: Results of OLS Regressions

	Low financial vulnerability			High financial vulnerability			χ^2
	Coef.	s.e.	No. Obs.	Coef.	s.e.	No. Obs.	
R&D ratio	0·047***	0·008	102443	0·059***	0·012	43868	0·73
Trade Credit	0·037***	0·009	56139	0·063***	0·010	61354	3·72**
External Fiance	0·027**	0·012	38673	0·011	0·011	48651	1·47
Inventory ratio	0·091***	0·012	41304	0·044***	0·009	66083	9·52***
Tangibility	0·068***	0·012	46775	0·018*	0·011	48442	15·93***
First Principal Component	0·083***	0·011	48136	0·038***	0·010	58895	8·66***

Note: By definition, the low financial vulnerability refers to the bottom 25% of external finance, inventory ratio, R&D ratio and first principle component, and the top 25% of asset tangibility and trade credit. The high financial vulnerability follows the opposite: the top 25% of the first three and the bottom 25% of the last two. The sample includes all firms that entered the market between 2002 and 2007, after China's accession to the WTO. The reported coefficient estimate is for the independent variable of FDI firm dummy. Control variables include firm size, export ratio, economic zone dummy, and industry, province, and year fixed effects. *, ** and *** denote the statistical significance at the 10%, 5% and 1% levels respectively.

Table 4: Calibrated Parameters for the two-country model with financial frictions

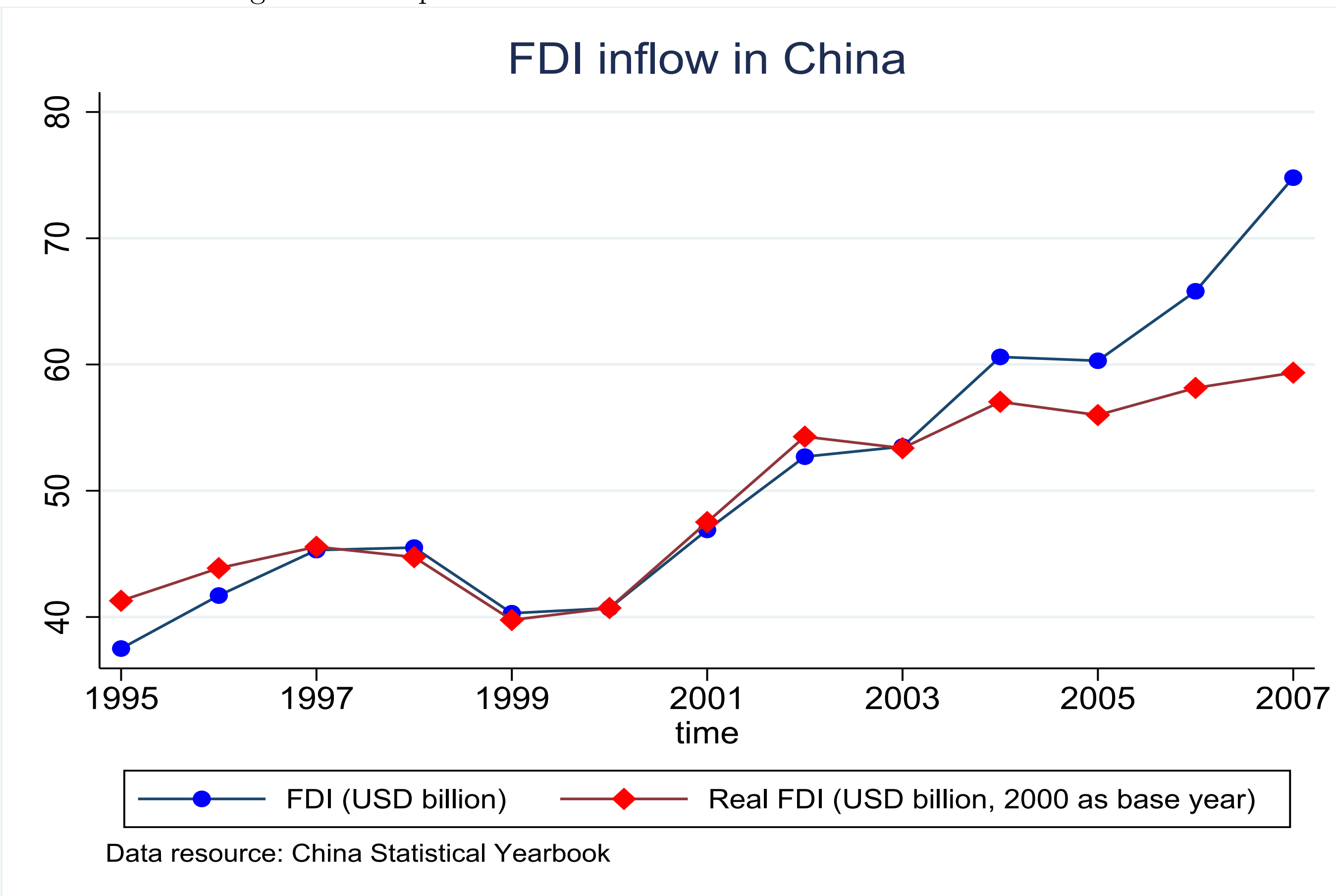
Parameter	Description	Value	Source
$\sigma = \frac{1}{1-\rho}$	Substitutability between differentiated goods	3.80	Bernard et al. (2003): Monopoly markup $\frac{\sigma}{\sigma-1} = 1.36$, i.e. 36.0%
δ	Exogenous exit probability	0.10	10% job destruction per year
ν, ν^*	Home and Foreign consumption bias	0.83	Target $\frac{\text{Total Home Imports}}{\text{Total Home Production}} = 0.163$
L	Labor endowment of Home country (FDI receiver)	1.00	Normalization
L^*	Labor endowment of Foreign country (FDI sender)	1.49	Target $\frac{\text{Total Home Exports}}{\text{Total Home Imports}} = 1.184$
α	Productivity loss of MNCs in the FDI-host country	0.48	Target $\frac{\text{Total Home FDI Production}}{\text{Total Home Production}} = 0.388$, 52% loss in productivity of MNCs in the host country
z_{min}, z^*_{min}	Lower bound in Pareto distribution for Home and Foreign firms	0.20	Normalization: Bernard et al. (2007)
η	Dispersion in Pareto distribution for Home firms	3.30	Bernard et al. (2003)
η^*	Dispersion in Pareto distribution for Foreign firms	3.15	Higher average productivity of FDI firms than local firms
λ	Probability at which domestic firms do not default	0.70	Lower cutoff productivity of FDI firms than local firms, 30% of default probability
ζ	Working capital fraction, i.e. the portion of fixed production costs that the local firm must finance externally	1.00	All fixed production costs must be externally financed.
χ	30% recovery rate times 1.2 leverage ratio	0.02	$30\% \times 1.2 \times \frac{\zeta f^D}{F^D}$: ζf^D is total borrowing and $\frac{1}{F^D}$ for normalization.
F^D	Fixed entry costs for Home firms	2.00	Normalization: follow Bernard et al. (2007) and choose 2 units of labor.
f^D	Fixed production costs for Home firms	0.10	Bernard et al. (2007) : 5% of sunk entry costs
f^I	Fixed production costs for FDI firms	0.11	$\frac{f^I}{f^D} = 1.1150$, the ratio of tangible assets between FDI and local firms
F^{D*}	Fixed entry costs for Foreign firms	2.00	The same value with F^D is assumed.
f^{D*}	Fixed production costs for Foreign firms	0.10	Bernard et al. (2007) : 5% of sunk entry costs
τ_C^D	Wedge on profits of Home local firms	0.67	33% corporate tax on profits of local firms
τ_V^D	Wedge on revenues of Home local firms	0.83	17% value added tax on local firms
τ_C^I	Wedge on profits of Home FDI firms	0.85	15% corporate tax on profits of FDI firms
τ_V^I	Wedge on revenues of Home FDI firms	0.85	15% value added tax on FDI firms

Table 5: Empirical Target Moments for Calibration

Year	$\frac{\text{Total Exports}}{\text{Total Imports}}$	$\frac{\text{Total Exports}}{\text{Total Domestic Sales}}$	$\frac{\text{Total Imports}}{\text{Total Production}}$	$\frac{\text{Total FDI Production}}{\text{Total Production}}$ (Foreign Capital $\geq 10\%$)	$\frac{\text{Total FDI Production}}{\text{Total Production}}$ (Foreign Capital $\geq 25\%$)
2000	1.184	0.2333	0.163	0.388	0.343
2001	1.171	0.2229	0.144	0.400	0.364
2002	1.187	0.2422	0.141	0.411	0.376
2003	1.070	0.2527	0.156	0.432	0.401
2004	1.007	0.2911	0.160	0.468	0.441
2005	1.066	0.2809	0.154	0.461	0.430
2006	1.224	0.3010	0.321	0.471	0.443
2007	1.275	0.2857	0.288	0.457	0.430
Model	1.1840	0.2391	0.1629	0.3881	

All data are from manufacturing sectors. Exports and imports are from Chinese Customs data. Total domestic sales, total production, and FDI production are from Chinese firm data.

Figure 1: Sharp Increase of FDI Flows in China after 2001



Note: Real FDI is deflated by the price index of capital formation.

Figure 2: Model Structure

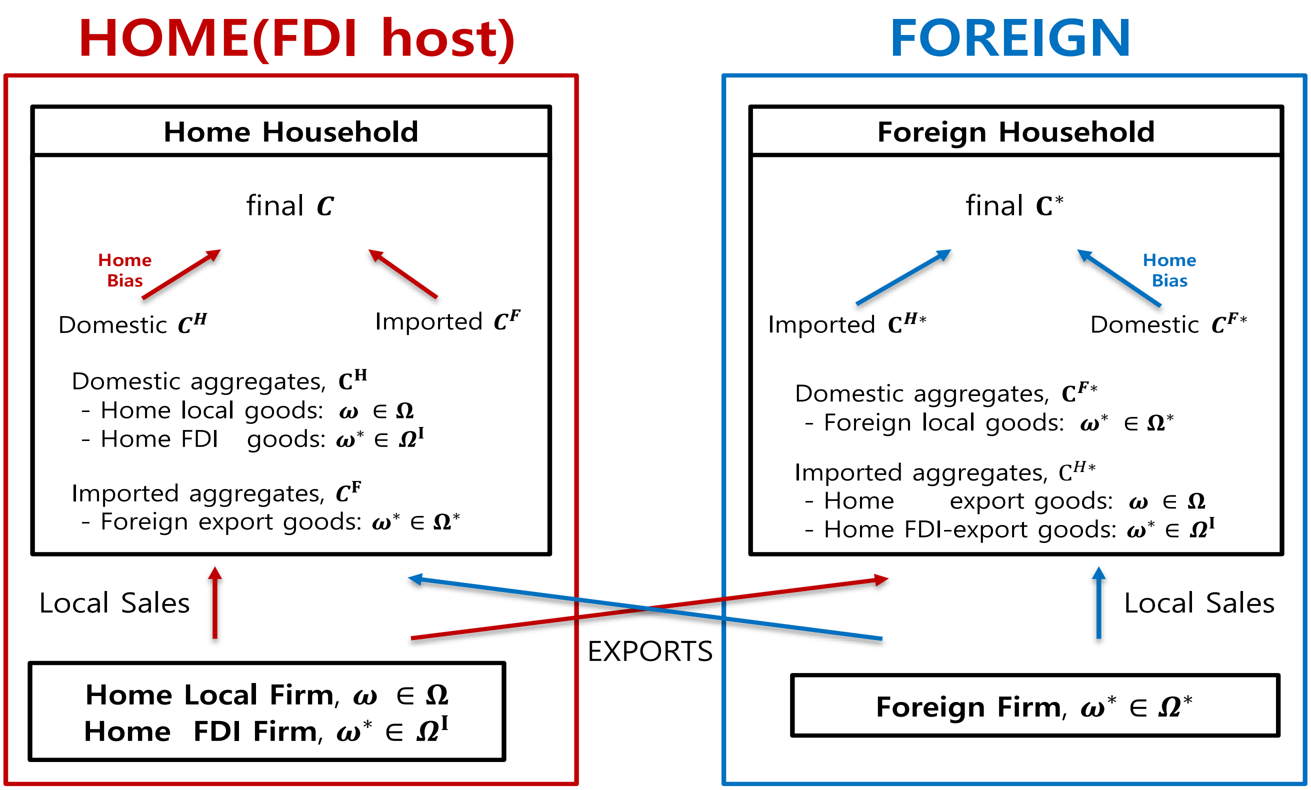


Figure 3: Firm Distribution and Cutoff Productivity

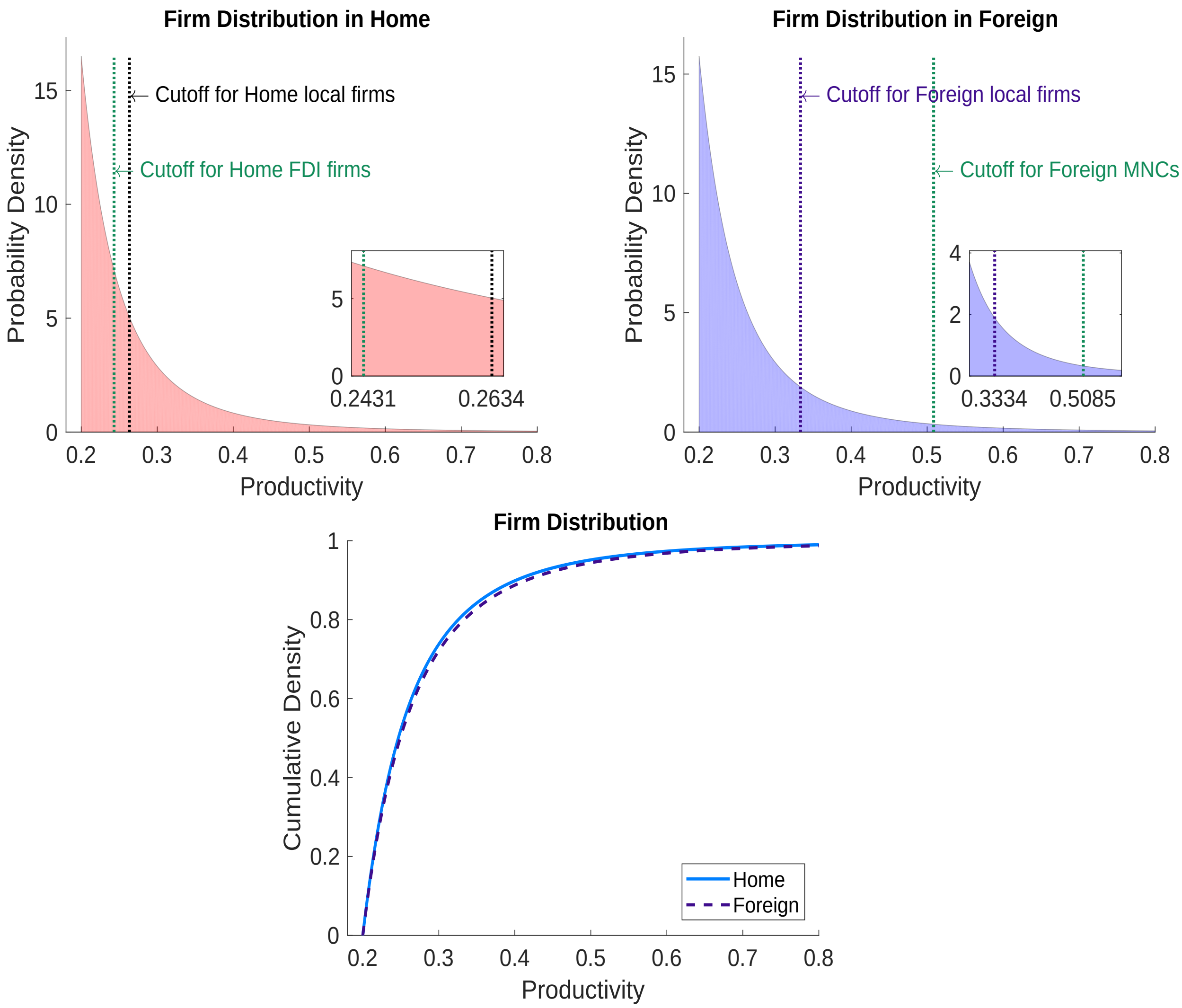


Figure 4: Value-Added Tax Reform with varying τ_V^D under $\lambda = 0.70$, $\tau_C^D = 0.67$, and $\tau_C^I = 0.85$

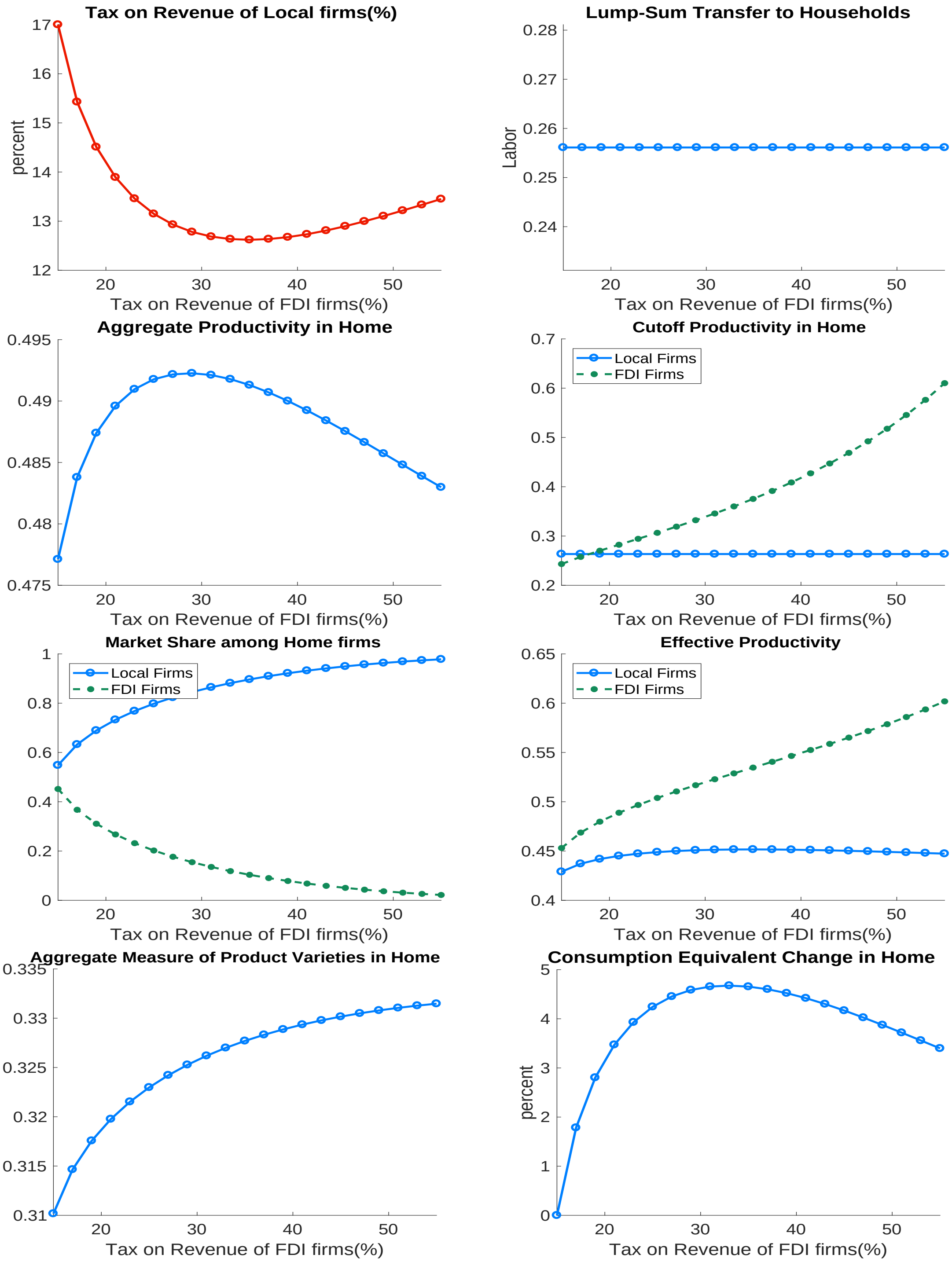


Figure 5: Financial Market Reform under $\tau_C^D = 0.67$, $\tau_V^D = 0.83$, $\tau_C^I = 0.85$, and $\tau_V^I = 0.85$