Paper for presentation at the 21st CEA Annual Conference, Oxford, July 2010.

Swapping Market Access for Technology Spillovers?

Tax Incentives and Foreign Direct Investment in China[1]

Ziliang Deng [a] [2] Rod Falvey [b] & Adam Blake [c]

[a] School of Business, Renmin University of China, China

[b] School of Business, Bond University, Australia

[c] School of Services Management, Bournemouth University, UK

Abstract

Tax incentives have been adopted worldwide to attract foreign direct investment (FDI). However whether tax incentives can promote FDI productivity spillovers remains unknown. We develop a static computable general equilibrium (CGE) model of China to explore it. Three market structures are incorporated, namely perfect competition, monopolistic competition with homogenous firms, and with heterogeneous firms. The results suggest that abolishing differential tax system leads to weaker FDI spillovers in the short term. Nonetheless, the reform lifts up the productivity entry threshold for foreign firms, and the surviving domestic firms become more productive and thus more capable of absorbing productivity spillover.

Keywords: tax incentives, foreign direct investment (FDI), productivity spillovers, computable general equilibrium (CGE) modelling

JEL Classifications: H25, F21, O33, C68

Word count (text, endnotes, references and tables): 9,500

[1] Deng's research was sponsored by the UK-China Scholarships for Excellence (2005-2009). The authors are grateful to the constructive comments and helpful suggestions from Edward Balistreri, Jun Du, Xiaolan Fu, Sourafel Girma, Yundan Gong, Honglin Guo, Aoife Hanley, Beata Javorcik, Richard Kneller, Shantong Li, Chris Milner, Jeffery Round, Thomas Rutherford, David Tarr, Chengqi Wang, Shujie Yao, Zhihong Yu, Fan Zhai, Xiaobo Zhang. Earlier versions of the model in this paper have been presented at the 19th Chinese Economic Association (UK) Annual Conference (Cambridge, April 2008), 7th GEP International Postgraduate Conference (Nottingham, April 2008), the 11th Annual Conference on Global Economic Analysis (Helsinki, June 2008), the University of Oxford-China Centre for Economic Research Conference (Oxford, September 2008), and seminars at Keele University (December 2008, March 2009).

[2] Corresponding author. School of Business, Renmin University of China, Haidian District, Beijing 100872, China. Tel: +8610 8250 0498; Fax: +8610 8250 9169. Email: ziliang.deng@ruc.edu.cn

1. Introduction

Corporate tax incentives has been a policy instrument widely adopted by many countries in the world to attract foreign direct investment (FDI), as FDI may arguably enhance productivity and economic growth in the host countries. Among various forms of corporate tax incentives for FDI, the most common ones are (a) tax holiday which grants newly-established firms a time period of corporate tax exemption; (b) statutory corporate tax reduction which is applicable to non-resident investment; (c) special investment allowance which can be deducted from the taxable profit; and (d) investment tax credit which offsets the taxes payable. (Organisation for Economic Co-operation and Development, 2001)

Tax incentives have been especially popular among the vast developing economies and the economies in transition, as those economies are relatively in shortage of capital and backward in technological development. According to a survey in 1995 which covers 8 economies in transition, all of the economies adopted various forms of tax incentives to attract FDI (Organisation for Economic Co-operation and Development, 1995). Preferential tax treatments are not just common among developing countries. Another global survey covering 40 developing and transition economies and 5 developed economies from all regions of the world (with North America excluded), almost 85 per cent of the countries surveyed offer tax holidays or statutory corporate tax reductions for specific types of foreign investment (United Nations Conference on Trade and Development, 2000). Tax competition over statutory profit tax rates for mobile profit has also been widely existing among the OECD countries in the last twenty years

(Devereux et al., 2008), and differential taxes are observed in the vast population of industrialised economies. Devereux et al. (2002) find that the governments of the EU and G7 countries have been particularly keen to attract highly profitable investment projects carried out by multinational firms that may 'generate positive externalities' through technological spillovers (pp. 483-484). Devereux et al. (2002) argue that large-scale multinational firms might have more resources to lobby for preferential taxes than their local rivals. Their research shows that the effective average corporate income tax rate for projects earning positive economic profits has fallen over the 1980s and 1990s, and the tax reforms performed in those countries have generally reduced the tax rates on highly profitable investments by more than on less profitable investments.

As we can see, differential corporate taxes over foreign and domestic firms is a policy instrument adopted worldwide, in part reflecting the desire of policy makers to benefit the host economies with the productivity spillovers potentially embodied in FDI. However it has yet been empirically scrutinised in the literature whether discriminative tax incentives can really promote the technology transfer and productivity spillovers in host countries. This research offers insights into this issue using a computable general equilibrium (CGE) model. Specifically, it assesses if harmonising profit taxes over foreign and domestic firms has a negative impact over FDI productivity spillover effects. This research takes the Chinese economy as a case study and assesses the impact of the 2008 corporate income tax reform on FDI productivity spillover effects. The CGE framework under perfect competition is developed by Deng et al. (2009) and is here extended to incorporate two alternative market structures, namely monopolistic competition with

homogeneous firms (Dixit and Stiglitz, 1977) and with heterogeneous firms (Melitz, 2003), so that we can cast a light on how the interplay between foreign and domestic firms affects the episodes. Studying FDI spillovers under three market structures within a CGE framework is methodologically novel in the literature. More importantly it helps us to obtain some results which are potentially interesting to both policy makers and academic researchers.

During the last three decades of 'reform and opening-up' policy implementation, China has become an attractive FDI destination because of its enormous labour supply and low labour cost, relatively stable political and economic environment, and pro-FDI policies (Deng et al., 2007). As a result, FDI inflows to China increased dramatically from 0.9 billion dollars in 1983 to 92.4 billion dollars in 2008. Since 1993, China has been the largest FDI host among the developing countries. The centrepiece of Chinese FDI policies was to attract foreign capital, promote export, accumulate foreign reserves, and very importantly, to enhance technology transfer and spillovers, that is, 'swapping market access for technology' (Long, 2005). Most foreign-invested enterprises (FIEs) [3] only needed to pay profit tax at an actual rate of roughly 15 per cent in the first seven years of operation. In contrast, the statutory corporate income tax rate of domestic firms was as high as 33 per cent. The benefits accompanying the influx of foreign capital have been enormous. However some imperative problems related to the differential corporate taxes also emerged that include, among others, astonishing amount of fake FDI, crowding-out effect caused by FDI, vulnerability of domestic firms in services, weak international competitiveness of domestic firms, and the potential loss of fiscal revenue[4]. In 2008, the

Chinese government abolished the preferential tax treatment which had been granted to FIEs for almost three decades.

The impact of this reform over the FDI productivity spillover effects is assessed with CGE simulations in this research. The results suggest that the removal of the tax incentives hampers the FDI productivity spillovers in that it weakens the foreign presence, which is vital for FDI productivity spillovers. Nonetheless, if we take into consideration the dynamic pattern of firms' productivity, the tax reform only temporarily lowers the FDI productivity spillover effects. The tax harmonisation lifts up the productivity entry threshold for foreign firms, and the surviving domestic firms also become more productive and thus more capable of absorbing productivity spillovers after the market reshuffle. Therefore the tax harmonisation can probably promote the speed and magnitude of spillovers in a dynamic perspective.

The remainder of this paper is organised as follows: the next section outlines the tax incentives employed to attract FDI in China, the costs and benefits of the differential corporate taxs. Section 3 provides an overview of the CGE model. Section 4 reports the economic effects of the 2008 corporate income tax harmonisation. Section 5 concludes.

2. Pros and cons of differential corporate tax system

2.1. Differential corporate tax system

Various preferential treatments had been granted to the FIEs in agriculture, manufacturing, construction, transportation, producer services (for example, information technology and technical consulting)[5]since the early stage of 'reform and opening-up' policy implementation in China in the late 1970s and early 1980s.

The most controversial treatment was the differential corporate income tax rates. According to the *Income Tax Law for Enterprises with Foreign Investment and Foreign Enterprises* passed in 1991 (abolished in 2008), foreign-invested firms should pay profit tax at the statutory rate of 30 per cent. However, any enterprise with foreign investment scheduled to operate for a period of not shorter than 10 years shall, from the year in which it begins to make profits, be exempted of income tax in the first and second years and be qualified to claim a 50 per cent reduction in the third to fifth years. That is to say, manufacturing FIEs only needed to pay income tax at an actual average rate of roughly 15 per cent in the first seven years of operation. In contrast, the statutory corporate profit tax rate of domestic firms was as high as 33 per cent. The differential tax system was abolished by China's Parliament and the new tax rate for both domestic firms and FIEs have been harmonised to be 25 per cent since January 2008. Nonetheless, FIEs established before 16 March 2007 can still enjoy the tax holidays during a five-year interim period, that is, from 1 January 2008 until 31 December 2012.

China's FDI policies have been amended various times before the 2008 tax harmonisation reform, but one of their priority targets has never been changed, that is, FDI policies should provide foreign firms with preferential incentives (Prasad and Rajan, 2006) aiming at swapping domestic market access for advanced foreign technology and productivity (Long, 2005). China's laws on FIEs had specific technology requirements even after the removal of the clauses inconsistent with China's WTO commitments in 2001. According to the latest *Law on Chinese-Foreign Joint Ventures*, 'the technology and equipment that serve as the investment of the foreign partner in a joint venture must be

advanced technology and equipment that indeed suit China's needs (Article 5).' Both *Law on Wholly Foreign-owned Enterprises* and *Law on Chinese-Foreign Cooperative Enterprises* also state that the State encourages the establishment of wholly foreign-owned enterprises and production-based Chinese-foreign cooperative enterprises with advanced technology.

==========

Table 1 about here

==========

Table 1 shows the actual corporate income tax rates for state-owned, private, and foreign-invested enterprises in 2004. The tax rates are calculated with the data from *China Economic Census Statistical Yearbook 2004*. The average tax rates of SOEs and private enterprises were 19.5 per cent and 19.3 per cent respectively. However, FIEs only paid income tax at 10.4 per cent, almost half of those of their domestic rivals.

It is observed that there is much variation in these rates. Such a variation is caused by various tax exemptions applicable to some enterprises[6]. Domestic enterprises in some industries collectively pay a tax at a rate higher than the upper limit 33 per cent, which could be caused by accounting errors.

2.2. Benefits of the differential corporate tax system

The preferential tax treatment had potentially encouraged foreign capital inflow to China, especially at the beginning of the marketisation reform in the 1980s when the Chinese market was relatively closed and unknown to the rest of the world. The foreign capital increased the foreign reserves of China and helped it to import advanced equipment and technology[7]. FDI also helped break the monopoly of SOEs and created a more competitive market environment. More importantly, preferential tax treatment had potentially promoted the productivity spillovers from foreign firms to domestic firms via

backward and forward input-output linkages, cross-ownership labour mobility, the export of foreign firms, and horizontal effects (Liu, 2008, Girma and Gong, 2008, Blake et al., 2009).

However the above benefits of such a preferential tax treatment seem to have diminished gradually due to the following two facts. First in recent years China's foreign reserves have been the highest in the world, reducing the necessity of accumulating reserves by attracting FDI simply with preferential tax treatment. Second, in manufacturing sectors, monopoly power of the SOEs has already been greatly restrained. SOEs, private enterprises, and foreign-invested enterprises accounted for 9 per cent, 23 per cent, and 31 per cent of national total output in 2007, respectively[8].

2.3. Problems of the differential corporate tax system

At the same time the costs of the differential tax system increased in recent years. The most critical one was *'round-tripping' FDI*, that is, fake FDI. 'Round tripping' FDI refers to cross-border investment motivated by the more favourable treatment of foreign as opposed to domestic capital. Domestic investors could transfer their capital out of, and then invest back into, the domestic market with a new label of 'FDI'. By 2003, about a quarter of FDI to China had been round-tripping FDI (United Nations Conference on Trade and Development, 2003, pp. 45). Round-tripping investments are unlikely to generate the same productivity spillovers as the "authentic" foreign investments originated from successful western entrepreneurs or institutions with advanced technology and mature management skills. However the former can enjoy a much lower corporate tax rate (15 per cent) for a maximum of seven years. Such tax evasion

behaviour jeopardised market environment and posed unfair competition against domestic enterprises.

The second problem is related to the technology content and origin of FDI. FDI from Hong Kong, Macau, and Taiwan [9] tended to remain in labour-intensive, low-technology manufacturing sectors, for example, textiles and toys. Some of the foreign-invested enterprises did not have any advantage in technological innovation or management skills, and the only leverage they held to beat domestic enterprises was the favourable corporate income tax rate. Empirical evidence suggests that once the presence of FDI in certain sectors exceeds a optimal point, foreign-invested enterprises pose negative impact on the performance of their domestic rivals (Buckley et al., 2007).

The third problem of the preferential taxes is linked to the survival of domestic firms in services in China. The expansion of service sectors normally accompanies industrialisation process in an economy. The percentage of services in China's GDP has been growing from less than 25 per cent in late 1970s to around 40 per cent in 2007. Also the employment in services accounted for 32 per cent of total employment in China in 2007. These two figures in 2007 are still far below those in post-industrialisation economies, which indicate that the service sectors in the Chinese economy are far from being well established. Facing the strong competition from mature foreign multinational firms in service industries, domestic enterprises do need a fair competitive environment where they can survive and sustain. A differential corporate income tax system will however threaten the development of domestic enterprises in service sectors.

The fourth problem is the international competitiveness of Chinese domestic

enterprises and is detrimental to the economic development. The average corporate income tax rate is 28.6 per cent among all the 159 countries (or regions) around the world which have adopted a corporate income tax system. The average rate is 26.7 per cent among the 18 countries (or regions) neighbouring China mainland[10]. A tax rate of 33 per cent on domestic enterprises undoubtedly reduced their international competitiveness. While state-owned enterprises can overcome this disadvantage with easier access to bank loans and land in China's 'socialist market economy', private enterprises generally have to passively accept the worst treatment in China. However private ownership has been arguably the most important source of China's economic miracle during the reform era since the late 1970s (Huang, 2003, Huang, 2008). Such a political pecking order creates a discriminative environment for private enterprises and is therefore a costly institutional hurdle for China's sustainable economic growth.

The final problem is a possible loss of fiscal revenue. Various empirical studies have found a negative relationship between corporate income tax and FDI inflows, that is, with a lower corporate income tax rate on foreign firms, a country can generally attract more FDI (Grubert and Mutti, 1991, Hines and Rice, 1994, Cassou, 1997, Wei, 2000a, Wei, 2000b, Choi, 2003, Ang, 2008). If FDI is very elastic to the preferential corporate income taxes, then a lower tax rate could raise the fiscal revenue from foreign enterprises' taxes. However if FDI is attracted to China more by the cheap labour and raw materials and the market potential in China rather than the tax incentives, then a low tax rate will cause a net loss of fiscal revenue. The total tax revenue, total corporate income taxes, and corporate income taxes paid by the foreign enterprises in China have grown very fast

since early 1990s. The average annual increase rates of total corporate income taxes and corporate income taxes paid by FIEs are 22 per cent and 34 per cent during the period of 1995-2007, respectively, both higher than that of total tax revenue (19 per cent)[11]. These figures indicate that the foreign enterprises performed well in the Chinese market, so a low corporate income tax on FIEs might have caused a loss of income taxes collected from foreign enterprises.

In brief, the recent Chinese market situation shows that the costs of the dual corporate income tax system may have come to exceed the benefits, and thus yielding an optimal time to harmonise the tax rates.

3. The structure of the CGE model

3.1 CGE model under perfect competition

This research on the productivity spillover effects of FDI is conducted in a CGE framework which involves estimating key FDI productivity spillover coefficients with econometric analysis and then implementing simulations of FDI shocks to evaluate the overall impact of productivity spillovers. This subsection provides an overview of the benchmark CGE model under perfect competition (Deng et al., 2009)[12].

This static, single-country CGE model contains 93 industrial sectors (mining, manufacturing, and utilities, in short 'MMU') and 8 non-industrial sectors (that is agriculture and services). The CGE model is aimed at providing a comprehensive measure of the productivity spillover effects of FDI by scrutinizing four spillover channels, with a focus on the MMU sectors.

The CGE model is constructed on an extended input-output (I/O) table for 2002

which is transformed from the original Chinese I/O table. The transformation mainly involves two steps: (1) aggregating original 122 by 122 I/O table into a 39 by 39 table, as data of FDI inflows are only available for those 39 aggregate industries; (2) With data estimated for FIEs, SOEs, and private enterprises, 31 out of the 39 sectors are further disaggregated into 31*3=93 ownership-sectors following the similar strategy of Gillespie *et al* (2001, , 2002). Due to data availability, this research can not differentiate round-tripping FDI from authentic FDI. It is also extremely difficult to find out the exact countries of origin of these round-tripping FDI, and the industry distribution of those fake foreign-invested enterprises in China. This problem might make the later analyses underestimate the real magnitude of productivity spillovers of the "authentic" FDI, especially in some sectors with a relatively concentrated presence of round-tripping FDI. However, aggregating both types of FDIs and then examining the actual spillover effects of such "blended" FDIs rather than "purified" FDI in China, can at least serve the purpose of reflecting the reality in the Chinese economy context. Finally we obtain a 93+8=101 dimension I/O table. This aggregation-disaggregation procedure enables the CGE model constructed on the transformed I/O table to address productivity spillovers from foreign-invested enterprises to state-owned and private enterprises explicitly. Data employed are mainly from *China Input-Output Table*, *China Statistical Yearbook* and *China Industry Economy Statistical Yearbook* for 2002, all of which were published by the National Bureau of Statistics of China ("NBS", 2003a, , 2003b, , 2006).

The value added composite is aggregated from labour and capital with constant elasticity of substitution (CES) technology. The total supplies of labour and domestic

capital are both fixed and the economy is assumed to in full employment. Extra capital can be introduced to the stock of foreign capital in the form of an FDI shock in later counterfactual scenarios. Both labour and capital are imperfectly mobile across sectors, subject to inter-sector elasticity of substitution. Both labour and capital can be further disaggregated, following a constant elasticity of transformation (CET) fashion, into the labour and capital employed by enterprises with different ownerships (FIEs, SOEs and private enterprises) respectively. Value added composite is aggregated with intermediate outputs to generate final output, which is for domestic use and export. Armington aggregation applies over domestically produced commodities and imported commodities.

Government consumption is treated as a standard demand which is similar to private consumption. It does not invest so that it will not crowd out the private investment. Its tax revenue is less than its consumption demand, suggesting a fiscal deficit. The deficit is financed by borrowing money from the private households in the form of "direct taxes", which are measured in this model by a fixed quantity of consumed commodities multiplied by the endogenous commodity prices. The government closure is so designed that the change of welfare, measured by the total amount of consumption goods and services available for the households and government, can be fully attributed to the counterfactual tax reform to be introduced later.

There is a representative domestic agent that is endowed with primary factors, that is labour and capital. With the returns to the labour and capital and the balance of payment, the agent then makes new investment. The remaining part of its revenue is expended over private consumption.

Another agent representing multinational firms is designed so as to capture the capital flow of FDI. This agent manipulates its capital and re-directs the earnings globally. An exogenous increment of total foreign capital originates from the agent's earnings worldwide and takes the form of FDI. These FDI flow to each foreign-invested sector and will thus boost the production of these sectors. This agent also earns returns to capital in other sectors dominated by domestic enterprises as the agent has minor presence in virtually every sector.

3.2 Modelling the corporate income taxes

This model adopts a neoclassical view over the impact of corporate income tax on the investment decision of firms. Every profit-maximising firm uses capital and other inputs in production until the value of marginal product equals the cost of the composite input, so that its optimal demand for capital depends on the rental price of capital as well as the prices of output and other inputs (Mintz, 1995).

The data of the corporate income taxes in 2002 (benchmark year) are not available. We collect such data of foreign-invested enterprises, SOEs, and private enterprises in 2004 instead from the *China Economic Census Statistical Yearbook 2004*, and divide them with total output to obtain the corporate income tax rate:

$$income\ tax\ rate_i = income\ taxes_i \,/\, total\ output_i \qquad (2)$$

where i indexes the sectors in mining, manufacturing, and utilities.

The 2008 tax reform harmonised corporate income tax rates on domestic enterprises (previously 33 per cent) and foreign enterprises (previously 15 per cent) to be 25 per cent. This reform formula can be modelled by deflating the corporate tax rate of

domestic enterprises' output by 24.2 per cent [(25%-33%)/33%= -24.2%], while augmenting the tax rate of foreign enterprises' output by 66.7 per cent [(25%-15%)/15%=66.7%].

Although FDI inflow is treated as an exogenous decision made by the representative agent for multinational enterprises in the model, we do endogenise the FDI flows by linking FDI with such a tax reform[13]. Here an FDI sensitivity parameter is taken from the paper of Wei (2000b)[14] who estimates the responsiveness of FDI inflows to the statutory corporate income tax with a gravity FDI model. The responsiveness of FDI to corporate tax is specified as:

$$\frac{\partial \ln(FDI)}{\partial (tax)} = \frac{\Delta(FDI)}{FDI \times \Delta(tax)} = -0.032 \qquad (3)$$

3.3 Modelling FDI productivity spillovers

The benchmark CGE model is extended to incorporate four endogenous productivity spillover channels, namely backward linkages, forward linkages, exports of FIEs, and horizontal effects.

Suppose $VA_i = TFP_i * G(K_i, L_i)$ (4)

where $G(K_i, L_i) = K_i^{\alpha_K} L_i^{\alpha_L}$. K_i and L_i denote capital and labour used in sector i respectively.

Then TFP can be decomposed into:

$TFP = TFP_{indigenous} + TFP_{spillover}$

where $TFP_{indigenous}$ captures all indigenous factors that contribute the TFP of a representative domestic firm (for example, management skills), while $TFP_{spillover}$ measures the FDI productivity spillover effects.

The TFP and spillover effects can be estimated in two stages:

$$\ln(VA_{i,t})=a_0 + a_K \ln K_{i,t} + a_L \ln L_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$TFP_{i,t} = \exp(a_0 + \varepsilon_{i,t}) = a_1 + \boldsymbol{\beta}^{*}\boldsymbol{SPL}_{i,t} + \zeta_{i,t} \quad (6)$$

where the vector ***SPL*** collectively denotes three FDI spillover channels. It contains four variables: horizontal demonstration, $HZDS_{i,t}$, backward linkages $BL_{i,t}$, forward linkages $FL_{i,t}$, and export concentration of multinational enterprises $EXCO_{i,t}$.

$HZDS_{i,t}$, is the share of FIEs in the gross output in sector *j* at time *t*. $BL_{i,t}$ and $FL_{i,t}$ are horizontal demonstrations weighted by I/O coefficients. They are designed to capture local firm interactions with FIEs as purchasers and suppliers, respectively. The specifications of *BL* and *FL* follow the practice adopted in the literature (Javorcik, 2004, Kneller and Pisu, 2007, Girma et al., 2008, Girma and Gong, 2008):

$$BL_{i,t} = \sum_j (\delta_{i,j,t} * HZDS_{j,t}) \quad (7)$$

$$FL_{j,t} = \sum_i (\delta_{i,j,t} * HZDS_{i,t}) \quad (8)$$

where $\delta_{i,j}$ are I/O coefficients. They measure the percentage of output of industry *i* provided to industry *j* in the total output of industry *i*: $\delta_{i,j} = Y_{i,j}/Y_i$ [15].

The selection of the above two input-output linkage variable as a measure of FDI spillovers has three merits. Firstly, they have been widely applied in many country contexts (China, Lithuania and the UK) in the econometric studies in the literature mentioned above, to examine the correlation between the productivity of domestic enterprises and the FIEs in downstream and upstream sectors. Secondly as *BL* and *FL* are both weighted measures of *HZDS* across a large number of sectors, the independence of *BL*, *FL* and *HZDS* is always observed in the literature. Thirdly, in the

subsequent CGE modelling, both *BL* and *FL* can be modelled as endogenous variables and whole values can change endogenously in counterfactual simulations. This will be discussed in detail shortly.

$EXCO_i$ is the ratio of the export of foreign-invested firms sector i to the total export in sector i, which measures 'export concentration' as another spillover channel.

There are three issues regarding the above econometric model that merit discussion. The first one is the measurement of the labour input. It would be ideal to measure *L* with employment weighted by schooling years. But unfortunately the data of schooling years by ownership-sector are not available.

The second issue is whether or not to include industry dummies to control for potential fixed industry effects. If industry dummy variables are included, equation (6) can be transformed into

$$TFP_{i,t} = \exp(a_0 + \varepsilon_{i,t}) = a_1 + \boldsymbol{\beta} \times \boldsymbol{SPL} + a_i \times DUMMY_i + \zeta_{i,t}$$

then the decomposition of TFP as specified by (5) and (6) will not be confined to be uniform across all industries. In other words, the indigenous part of productivity could vary across industries ($TFP_{indigenous} = a_1 + a_i \times DUMMY_i + \zeta_i$), while the spillover part of productivity takes a uniform specification across industries ($TFP_{spillover} = \boldsymbol{\beta} \times \boldsymbol{SPL}$). Unfortunately this option was not available for two reasons. (a) While for SOEs we have 31 (industries) × 5 (years) = 155 observations, for Private enterprises we only have 31 (industries) × 2(years) = 62 observations. The latter rules out including 30 industry dummies. (b) While our spillover variables (*HZDS*, *EXCO*, *BL* and *FL*, collectively denoted by the vector ***SPL***) for the CGE modeling can change endogenously in

counterfactual simulations (to be discussed shortly), we cannot allow for endogenous changes in industry 'fixed' effects.

The third issue is whether or not to include year dummy variables to control for the effect of CGE benchmark year (2002). Again the limited data on Private enterprises (for two years only, 2005 and 2006) preclude this.

Equation (5) and (6) are econometrically estimated with industry-level panel data. We can then calculate the ratio of TFP caused by spillovers over total TFP.

$$NTFP = \frac{TFP_{spillover}}{TFP_{total}} = \frac{\hat{\boldsymbol{\beta}} \times \boldsymbol{SPL}}{\hat{\alpha}_1 + \hat{\boldsymbol{\beta}} \times \boldsymbol{SPL}} \tag{9}$$

where $\hat{\boldsymbol{\beta}} \times \boldsymbol{SPL} \equiv \hat{\beta}_1 BL_{i,t} + \hat{\beta}_2 FL_{i,t} + \hat{\beta}_3 HZDS_{i,t} + \hat{\beta}_4 EXCO_{i,t}$.

In the CGE modelling, the share of FIEs in sectoral output ($HZDS_i$) and the share of FIEs in sectoral export ($EXCO_i$) will be both *endogenously* determined in counterfactual experiments. Backward linkages (BL_i) and forward linkages (FL_i) are also endogenously determined by equation (7) and (8), respectively. Therefore, the share of productivity spillovers is also *endogenous*, as specified by equation (9). Thus we can transform equation of value-added production into

$$VA_{i,t} = \Theta_i \times TFP_{i,t} \times K_{i,t}^{\alpha_K} L_{i,t}^{\alpha_L} \tag{10}$$

where $\Theta_i = \frac{TFP_i}{\overline{TFP0_i}}$, $\overline{TFP0_i}$ denotes the benchmark TFP ($\hat{\alpha}_1 + \hat{\boldsymbol{\beta}} \times \overline{\boldsymbol{SPL}}$) and TFP_i denotes endogenous TFP value ($\hat{\alpha}_1 + \hat{\boldsymbol{\beta}} \times \boldsymbol{SPL}$). In this way we can model the FDI productivity spillovers *endogenously*. In the benchmark scenario, Θ_i=1, so that the above equation simplifies to $VA_{i,t} = TFP_{i,t} \times K_{i,t}^{\alpha_K} L_{i,t}^{\alpha_L}$.

The CGE model is built on the China I/O table for 2002, so the FDI spillover

parameters β are estimated for the years around 2002 to make the parameters compatible with the I/O table. Main data sources of estimations are *China Industrial Economic Statistical Yearbooks* (*CIESYs*) and *I/O*. The available *CIESY*s around the year of 2002 are for the years of 2001-2003 and 2005-2006. National Bureau of Statistics of China (NBS) releases I/O tables every five years and the latest one is for the year of 2002. So the I/O table of 2002 is employed to calculate all the I/O coefficients ($\gamma_{j,k}$ and $\eta_{k,j}$) for the years of 2001-2003 and 2005-2006.

==========

Table 2 and 3 about here

==========

Table 2 and 3 report the econometric estimation of productivity and spillovers, respectively. As shown by Table 3, there is a significant relationship between the productivity of domestic enterprises and FDI. Both SOEs and private domestic firms benefit from spillovers from foreign-invested firms in upstream and horizontal sectors, and the coefficients for private enterprises are larger and more statistically significant. This difference could be caused by the relatively weak absorptive capacity of SOEs that undertake less R&D activity and employee training, as suggested by Girma and Gong (2008). Neither SOEs nor Private enterprises benefit from the contacts with the FIEs in downstream sectors (coefficients for *BL* are not significant). The reason for this could be that the potential benefit of backward linkages is counterbalanced by the increased competition among domestic enterprises in the upstream sectors triggered by the FIEs in the downstream sectors.

Finally, it seems that the export of MNE affiliates has no effects on improving the productivity of SOEs. Private enterprises are even negatively affected by the MNE

exports. The latter makes little sense as an "export spillover" and may reflect industry characteristics that is FIEs have a higher share of exports in industries where domestic firms have relatively lower TFP.[16] Because this effect can vary endogenously in our simulations, we retain it but note that it may not be picking up a spillover as such.

Based on the above econometric estimation, we calculate that the average contribution of FDI productivity spillovers to the overall TFP of SOEs and private enterprises (calculated with equation (9)) are 22 per cent and 20 per cent, respectively. The estimated significant and insignificant, and positive and negative spillover coefficients will be carried forward into the CGE modelling as specified by equation (10).

3.4 Extension to accommodate monopolistic competition

Monopolistic competition (Dixit and Stiglitz, 1977) is incorporated in a way similar to how it is applied in trade liberalization scenarios (Harrison et al., 1997, Francois and Roland-Holst, 1997, Blake et al., 1999). Under monopolistic competition, the product of a firm within its group is highly, but not perfectly, substitutable for the product of another firm. Therefore each firm has a limited monopoly power and faces a downward rather than horizontal demand curve. Goods are produced by firms with a fixed cost and a constant variable cost. Each firm collects mark-up above the marginal cost so that the fixed cost is compensated by the mark-up.

3.5 Extension to incorporate firm heterogeneity

Recent empirical research has shown that firms differ much in productivity and only the most productive firms can engage export and overseas investment (for example Girma et al., 2005). When trade liberalisation occurs, the most productive firms are attracted by the expanded overseas market potential and will produce more and engage in

export, leading to stronger competition for a common pool of labour in their home country. This pushes up labour cost and drives the least productive firms to exit. So firms with high productivity survive the trade liberalisation and grow larger by absorbing the resources released from the exiting firms. Thus the aggregate industry productivity becomes higher thanks to the resource reallocation effect of trade under firm heterogeneity (Melitz, 2003).

Similar episode will happen in the context of FDI tax incentives, but with more complications. Its theoretical model and programming details are provided by Deng and Falvey (2010). When FDI tax incentives are introduced to a host economy, on the one hand, more productive capital flows into the economy and intensifies the competition for labour, which drives labour cost to be higher. However on the other hand, capital becomes cheaper and the intermediate products (especially those produced by the foreign-invested enterprises) might become cheaper, which is instead favourable for the survival of firms. The net effects of the above two contradicting powers may vary in different sectors. Similarly, when FDI tax incentives are removed, the net effect on FDI spillovers is also uncertain.

An option for incorporating heterogeneous firms into a standard 'representative firm' CGE model is to decompose the whole CGE model into a partial equilibrium (PE) module and general equilibrium (GE) module . This option has been adopted here. In each sector, firms are heterogeneous in that they produce differentiated goods and are different in productivity. Every firm incurs fixed cost and variable cost in production. The aggregate economy is calibrated in the GE module as we discussed in previous subsections, while firm behaviour is determined in the PE module. In the PE module each firm takes a *free* draw (no entry cost) of productivity from a Pareto distribution[17],

sets a price, and generates output. Key variables are selected to transmit *information* recursively between PE and GE modules. PE and GE modules recursively recalibrate to the new *information*. This sequential re-calibration process continues until all variables common to the PE and GE are consistent, that is the discrepancy between the variable values obtained from the (*N-1*)th and *N*th iterations is at a trivial level.

4. Assessment of the tax harmonisation: counterfactuals and results

4.1. Counterfactual design

The experiments conducted in this section are aimed at evaluating whether a removal of preferential corporate income tax treatment will dampen the FDI productivity spillover effects. The simulations are situated under three different market structure assumptions, namely perfect competition, monopolistic competition, and firm heterogeneity.

Four types of tax reforms are simulated. In the first scenario there are no FDI productivity spillovers, and only the corporate income tax rate on foreign firms increases by 66.7 per cent (hereafter 'single-sided reform without spillovers'). In the second scenario there are no FDI productivity spillovers, the corporate income tax rate for foreign firms increases by 66.7 per cent, and the tax rate for domestic firms decreases by 24.2 per cent (hereafter 'integrated reform without spillovers'). In the third scenario there are FDI productivity spillovers, and only the corporate income tax rate for foreign firms increases by 66.7 per cent (hereafter 'single-sided reform with spillovers'). In the fourth scenario there are FDI productivity spillovers, the corporate income tax rate for foreign firms increases by 66.7 per cent, and the tax rate for domestic firms decreases by 24.2 per

cent (hereafter 'integrated reform with spillovers').

All of the above reforms are accompanied with endogenous FDI inflow reduction. From equation (3) we know that the percentage change of FDI inflow follows:

$$\frac{\Delta(FDI)}{FDI} = -0.032 \times \Delta(tax)$$

Based on the model structure and the counterfactual design, we can extrapolate the following propositions. Firstly, all of the four reform formulas reduce FDI inflow, and will result in a lower foreign presence in terms of the proportion of output produced by foreign firms in the total output produced by all types of firms. This will make the channels (that is, backward and forward linkages, export of the foreign enterprises, and horizontal effects) of FDI productivity spillovers shrink, and reduce the magnitude of FDI productivity spillovers.

Secondly, as the output prices of products by foreign enterprises are higher after the reform, the cost of intermediate products used by domestic enterprises will also be higher. The domestic capital stock is assumed fixed in this static CGE model. Facing higher corporate income taxes, the returns to capital and labour of foreign enterprises will be lower. This will consequently lead to a lower price of primary input of domestic enterprises due to the substitutability between foreign and domestic capital. Therefore, the impact of single-sided reform on domestic enterprises will be jointly determined by the above three possible effects, namely a smaller magnitude of FDI productivity spillovers, higher intermediate input costs, and lower primary input costs. But overall, single-sided reform will probably increase the average national tax rate level, and reduce the welfare level.

Thirdly, an integrated tax reform raises the taxes of foreign enterprises while it reduces the taxes of domestic enterprises. This will complicate the net impact of the tax reform on the total output of domestic enterprises in that it can increase the returns to the capital and labour used by domestic enterprises. In terms of the FDI productivity spillovers, the impact of such a tax reform still tends to be negative due to similar reasons. The sign of the national welfare change with an integrated tax reform can not easily be predicted.

Finally, fiscal revenue will also change accordingly. In the model, the other tax rates, that is, the average output overall tax rates, are assumed to be fixed. Due to the nonlinear relationship between tax rate and tax revenue as suggested by the Laffer curve, the sign of tax revenue change can not be predicted in advance either, and the different changing directions of tax rates over domestic (up) and foreign (down) enterprises also leave this an empirical problem.

4.2. Simulation results

Panel (a) (b), (c), and (d) of Table 4 report the results of four scenarios, respectively. By comparing these results, we have obtained the following four main findings:

==========

Table 4 about here

==========

(a) The difference between the scenarios with single-sided and integrated reforms. The economy before the tax reform is already distorted with corporate taxes. Single-sided reform simply raises the tax rate on foreign enterprises, and leaves the economy even more distorted, thus reducing welfare. However the integrated reform not only raises the tax rate on foreign enterprises, but also lowers the tax rate on domestic

enterprises and improves national welfare. The production scale of SOEs and private enterprises are negatively impacted in the single-sided reforms, while positively affected in the integrated reforms.

(b) The difference between the scenarios with and without spillovers. The results are almost the same with or without spillovers. The only difference is the total output of private enterprises in Panel (a) and (c). Their output is negatively affected in the scenario with spillovers while positively affected in the scenario without spillovers. The reason for these seemingly counterintuitive results can be explained by the competition between the SOEs and private enterprises. With a single-sided tax reform, the prices of intermediate inputs are higher while the prices of primary inputs become lower. When there are no productivity spillovers, private enterprises appear to benefit from such a reform. However, when there exist spillovers, SOEs benefit more from the spillovers than the private enterprises do, so that SOEs attract resources from the private enterprises, making the latter lose from the spillovers.

(c) Comparison between the three alternative assumptions about market structure. We need to keep in mind that any structure alone can not reflect the whole picture of an economy. Some industries tend to be perfectly competitive as they produce highly homogeneous products, for example 'petroleum processing and coking', and 'textile'; some industries are more monopolistic competitive as their products are idiosyncratic and the number of firms is relatively small, for example 'transport equipment'; and finally some industries could be closer to the assumption of monopolistic competition with heterogeneous productivity, such as the 'electronic and

electric products' industry hosting a very high level of product variety and the largest population of firms in China. Therefore, the main purpose of spotting the difference between the above three alternative market structure assumptions is not to identify which assumption is 'superior' to the others, but to get a sense of the range of possible outcomes.

The simulations in the scenario of perfect competition can provide results of output, productivity of domestic enterprises, spillovers, welfare, and GDP. Simulations in the scenario of monopolistic competition can provide further details of variety and production scale. Simulations in the scenario of firm heterogeneity capture not only the above variables, but also the productivity changes of both domestic and foreign firms.

The results of the productivity of domestic firms, output, productivity spillovers, welfare, and GDP are similar in the first two market structures. But the results under firm heterogeneity are different to some extent from those obtained in the previous two market structures. For example, in panel (a) and (c), the variety of SOEs and private enterprises are positively affected under monopolistic competition while negatively affected under firm heterogeneity. Similar contrast applies to the changes of scale under monopolistic competition and firm heterogeneity.

Another difference between the scenario of firm heterogeneity and the other two alternative market structures is the change of productivity of domestic firms under the above three scenarios. The productivity change is positive under firm heterogeneity while negative under the other two scenarios. Such an 'inconsistency' can be explained by the different specification of 'productivity'. Under perfect and monopolistic competition,

productivity is denoted by $\hat{\alpha}_1 + \hat{\boldsymbol{\beta}} \times \boldsymbol{SPL}$ in equation (9), so that the productivity of domestic firms is directly dependent *on* the presence of foreign firms. However under firm heterogeneity, productivity is an endogenous variable in the PE (partial equilibrium) module, and it is only indirectly linked with the foreign presence. In this sense, the 'productivity' denoted by $\hat{\alpha}_1 + \hat{\boldsymbol{\beta}} \times \boldsymbol{SPL}$ may not capture the actual information of domestic firms' productivity as fully as the 'productivity' variable under firm heterogeneity.

A comparison of panel (b) and (d) shows differences in total output and GDP. These two variables increase under firm heterogeneity while they decrease under the other two alternative market structures. This is also because the assumption of firm heterogeneity makes the model to capture the productivity changes in a different way. When there are no spillovers (scenario (b)), firm productivity is endogenously modelled under firm heterogeneity and can affect the output and GDP explicitly, while productivity takes the benchmark value of unity under perfect competition and monopolistic competition. When there are spillovers (scenario (d)), as discussed the productivity of domestic firms will decrease under perfect competition and monopolistic competition as it is directly affected by the weaker presence of foreign firms. But the productivity of all firms improves under firm heterogeneity, which is beneficial to total output and GDP.

Finally, total government tax revenue unanimously decreases in the above four scenarios. Although the corporate income tax revenue decreases in integrated reforms, but it increases in single-sided reforms. That is to say, given the model assumptions, a

lower corporate income tax rate over foreign firms indeed reduced the tax revenue collected from the foreign firms.

(d) The relationship between corporate income tax reform and FDI productivity spillovers, that is, the soundness of the strategy 'swapping market access for technology'. As reflected by the 'spillovers' rows in panel (c) and (d), neither single-sided reform nor integrated reform can increase the proportion of the productivity spilt over from foreign firms to domestic firms in total productivity of domestic enterprises, as denoted by equation (9). This is because that, with a higher corporate income tax rate, the output of foreign firms decreases, so that their input-output linkages with domestic firms are also weakened. That is to say, all of the four spillover channels (backward linkages, forward linkages, export of foreign firms, and horizontal effects) shrink, via which FDI productivity spillovers take place. The above result also implies that the original dual corporate income tax system was indeed helpful for the FDI productivity spillovers to occur in that it helped strengthen the foreign presence, which is vital for FDI productivity spillover effects.

However the above conclusion derived from this static CGE model might need to be modified if we situate this episode in a dynamic perspective. First of all, with the integrated corporate income tax reform, the productivity of domestic firms is higher than before under firm heterogeneity in all of the four scenarios. This implies that the domestic firms have acquired better absorptive capacity to exploit the FDI productivity spillovers (Girma, 2005, Blake et al., 2009). Secondly, in scenario (b) and (d), the average productivity of the foreign firms surviving the integrated tax reform is higher. This

implies a greater likelihood of productivity spillovers. Therefore, taking into consideration the changing pattern of productivity under firm heterogeneity, the tax reform will only temporarily lower the FDI productivity spillover effects. They can promote the speed and magnitude of spillovers later, that is, a 'J-curve' effect of tax reform on productivity spillovers may exist.

5. Concluding remarks

This research mainly simulates the impact of corporate income tax reform in 2008 on the FDI productivity spillover effect in China. This research addresses an important worldwide policy issue which has yet been empirically assessed in the literature. To test the robustness of our results, we situate the analysis in three alternative market structures, namely perfect competition, monopolistic competition, and more recent firm heterogeneity. Methodologically this is the first in the literature to study FDI spillovers under firm heterogeneity using CGE modelling. Comparing results in three market structures enables us to acquire unique insights.

The results suggest that abolishing differential tax system leads to weaker FDI spillovers in the short term in that it restrains the foreign presence which is vital for FDI productivity spillovers. A higher corporate income tax rate levied on foreign-invested enterprises alone distorts the economy's structure and lowers total output, welfare, and GDP. However an integrated tax reform formula can do a better job by increasing the output level of domestic enterprises and by promoting national welfare. Under firm heterogeneity, the spillover benefit of integrated reform is even more prominent, because the reform can lift up the average productivity of all existing enterprises, and raises the

possibility of productivity spillovers and the absorptive capacity of domestic enterprises. This is more beneficial to the productivity spillovers from foreign-invested firms to domestic enterprises.

The findings in this research are generally in line with those found in the broad literature. For example, the net productivity spillover effects of FDI can promote GDP, national output and welfare, which is analogous to those found by van Meijl and van Tongeren (1998) and Lejour, Rojas-Romagosa and Verweij (2008). Another example is that the tax reform experiments imply that the "swapping market access for technology" strategy was presumably successful in China. This is consistent with the stylised facts regarding this policy collected by Long (2005). However, as this research is methodologically novel and involves new research perspectives, many of its findings do not have their counterparts in the literature to compare with.

As discussed, taking into consideration the changing pattern of productivity under firm heterogeneity, the tax reform will only temporarily lower the FDI productivity spillover effects, and it may promote the speed and magnitude of spillovers later. However to find out the exact nature of this long-term scenario, we will need to further extend this static model to be a dynamic one so that we could treat the accumulation and depreciation of foreign and domestic capital and their subsequent productivity spillover as a dynamic process. This would be an appealing direction worth future research.

Endnotes

[3] Foreign-invested enterprises (FIEs) include all types of enterprises invested by foreign capital, for example solely foreign owned enterprises, joint ventures, co-operative enterprises.

[4] We will discuss the costs and benefits of differential tax treatments in detail in Section 3.

[5] Source: State Administration of Taxation of China. 'Approval on the Fixed-term Income Tax Reduction and Exemption of Foreign-invested Enterprises'. http://www.chinatax.gov.cn/. 11 April 2006.

[6] Both domestic enterprises and FIEs can equally enjoy other various nationwide tax incentives, such as tax exemption or reduction for enterprises that engage in energy and water preservation.

[7] China adopted a series of mercantilist measures to promote exports until its accession into the WTO in 2001. The FDI policies regarding exports required that FIEs should keep a balance of exchange, or make sure the proportion of their domestically made products in the total number of products maintains at a reasonable level, or a certain percentage of their products should be exported. Besides, any FIE with 70 per cent of its total products exported was entitled to claim 50 per cent cut in corporate income tax.

[8] Source: *China Statistical Yearbook 2008*. Beijing: China Statistical Press. 2008

[9] Investment from Hong Kong, Macau, and Taiwan can enjoy the same preferential treatment as the investment from other source economies.

[10] Source: State Administration of Taxation of China (http://www.chinatax.gov.cn/). 27 March 2007.

[11] Ibid.

[12] The model is implemented using GAMS GAMS DEVELOPMENT CORPORATION (2008) *GAMS - A User's Guide,* Washington, DC, GAMS Development Corporation. and its subsystem MPSGE RUTHERFORD, T. F. (1999) Applied General Equilibrium Modeling with MPSGE as a GAMS Subsystem: An Overview of the Modeling Framework and Syntax. *Computational Economics,* 14**,** 1-46.. Due to space limitation, this paper only presents the major features of the model. The detailed discussion of the model under perfect competition is provided in Deng *et al* DENG, Z., BLAKE, A. & FALVEY, R. (2009) A Computable General Equilibrium Model of Foreign Direct Investment Productivity Spillovers in China. IN YUEH, L. (Ed.) *The Future of Asian Trade and Growth*. London, Routledge..

[13] Such endogeneity treatment is similar to the technique adopted in a CGE model evaluating the impact of tax reform on tourism GOOROOCHURN, N. & MILNER, C. (2005) Assessing Indirect Tax Reform in a Tourism-Dependent Developing Country. *World Development,* 33**,** 1183-1200., where tourist arrival is endogenously linked to the tax reform.

[14] Wei's work covers bilateral FDI data from 14 source countries to 53 host economies (including China mainland), while other papers only examine the relationship between corporate income tax and FDI flows of a *single* FDI source country or recipient country GRUBERT, H. & MUTTI, J. (1991) Taxes, Tariffs and Transfer Pricing in Multinational Corporate Decision Making. *Review of Economics and Statistics,* 73**,** 285-293, HINES, J. R. & RICE, E. M. (1994) Fiscal Paradise: Foreign Tax Havens and American Business. *Quarterly Journal of Economics,* 109**,** 149–182, CASSOU, S. P. (1997) The Link between Tax Rates and Foreign Direct Investment. *Applied Economics,* 29**,** 1295 - 1301, ANG, J. B. (2008) Determinants of Foreign Direct Investment in Malaysia. *Journal of Policy Modeling,* 30**,** 185-189.. More importantly, this work is one of the very few papers which specifically estimate the tax responsiveness for the FDI flow to China. Another paper also by Wei WEI, S.-J. (2000a) How Taxing is Corruption on International Investors? *Review of Economics and Statistics,* 82**,** 1-11. which covers 12 FDI source countries and 45 host countries, and a paper by Choi CHOI, C. (2003) Does the Internet Stimulate Inward Foreign Direct Investment? *Journal of Policy Modeling,* 25**,** 319-326. employing the same database of Wei WEI, S.-J. (2000b) Local Corruption and Global Capital Flows. *Brookings Papers on Economic Activity,* 31**,** 303-354., both of which have obtained highly close tax sensitivity values. Thus it is reasonable to employ the parameter (-0.032) in this model to capture

the endogenous link between corporate income tax rate and FDI inflow amount in China.

[15] For example, assume the foreign presences at industry 1, 2, 3 are 10 per cent, 20 per cent, and 30 per cent, respectively. Industry 1 provides its products to itself, industry 2 and 3 with proportion of 40 per cent, 35 per cent and 25 per cent. Then coefficient of backward linkage is BL = 40%*10% + 20%*35% + 30%*25% = 0.185.

[16] It has been suggested that export-oriented FIEs may "cherry pick" the best skilled workers from domestic firms leading to lower productivity in the latter. GIRMA, S. & GONG, Y. (2008) FDI, Linkages and the Efficiency of State-Owned Enterprises in China. *Journal of Development Studies,* 44**,** 728 - 749..

[17] In the literature, Pareto distribution has been found 'compelling' in approximating the real distribution of firm productivity HELPMAN, E. (2006) Trade, FDI, and the Organization of Firms. *Journal of Economic Literature,* 44**,** 589-630.. The values of parameters of Pareto distribution are taken from the literature BERNARD, A. B., EATON, J., JENSEN, J. B. & KORTUM, S. (2003) Plants and Productivity in International Trade. *American Economic Review,* 93**,** 1268-1290, ZHAI, F. (2008) Armington Meets Melitz: Introducing Firm Heterogeneity in a Global CGE Model of Trade. *Journal of Economic Integration,* 23**,** 575 - 604..

References

ANG, J. B. (2008) Determinants of Foreign Direct Investment in Malaysia. *Journal of Policy Modeling,* 30**,** 185-189.

BERNARD, A. B., EATON, J., JENSEN, J. B. & KORTUM, S. (2003) Plants and Productivity in International Trade. *American Economic Review,* 93**,** 1268-1290.

BLAKE, A., DENG, Z. & FALVEY, R. (2009) How Does the Productivity of Foreign Direct Investment Spill over to Local Firms in Chinese Manufacturing? *Journal of Chinese Economic and Business Studies,* 7**,** 183-197.

BLAKE, A., RAYNER, A. J. & REED, G. (1999) A Computable General Equilibrium Analysis of Agricultural Liberalisation: The Uruguay Round and Common Agricultural Policy Reform. *Journal of Agricultural Economics,* 50**,** 400-424.

BUCKLEY, P. J., CLEGG, J. & WANG, C. (2007) Is the Relationship between Inward FDI and Spillover Effects Linear? An Empirical Examination of the Case of China. *Journal of International Business Studies,* 38**,** 447-459.

CASSOU, S. P. (1997) The Link between Tax Rates and Foreign Direct Investment. *Applied Economics,* 29**,** 1295 - 1301.

CHOI, C. (2003) Does the Internet Stimulate Inward Foreign Direct Investment? *Journal of Policy Modeling,* 25**,** 319-326.

DENG, Z., BLAKE, A. & FALVEY, R. (2009) A Computable General Equilibrium Model of Foreign Direct Investment Productivity Spillovers in China. IN YUEH, L. (Ed.) *The Future of Asian Trade and Growth*. London, Routledge.

DENG, Z. & FALVEY, R. (2010) Foreign Direct Investment Productivity Spillovers under Firm Heterogeneity: A Computable General Equilibrium Model.

DENG, Z., GUO, H. & ZHENG, Y. (2007) How East Asian Industry Transfer Affects the U.S.-China Trade Imbalance: Economic Mechanisms and Policy Implications. *Issues & Studies,* 43**,** 165-197.

DEVEREUX, M. P., GRIFFITH, R. & KLEMM, A. (2002) Corporate Income Tax Reforms and International Tax Competition. *Economic Policy,* 17**,** 451-495.

DEVEREUX, M. P., LOCKWOOD, B. & REDOANO, M. (2008) Do Countries Compete over Corporate Tax Rates? *Journal of Public Economics,* 92**,** 1210-1235.

DIXIT, A. K. & STIGLITZ, J. E. (1977) Monopolistic Competition and Optimum Product Variety. *American Economic Review,* 67**,** 297-308.

FRANCOIS, J. F. & ROLAND-HOLST, D. W. (1997) Scale Economies and Imperfect Competition. IN FRANCOIS, J. F. & REINERT, K. A. (Eds.) *Applied Methods for Trade Policy Analysis: A Handbook*. Cambridge, Cambridge University Press.

GAMS DEVELOPMENT CORPORATION (2008) *GAMS - A User's Guide,* Washington, DC, GAMS Development Corporation.

GILLESPIE, G., MCGREGOR, P. G., SWALES, J. K. & YIN, Y. P. (2001) A Regional CGE Analysis of the Demand and "Efficiency Spillover" Effects of Foreign Direct Investment. IN PAIN, N. (Ed.) *Inward Investment, Technological Change and Growth: The Impact of Multinational Corporations on the UK Economy*. Basingstoke, Palgrave.

GILLESPIE, G., MCGREGOR, P. G., SWALES, J. K. & YIN, Y. P. (2002) The Regional Impact of Foreign Direct Investment: Structure and Behavior in an Ownership-Disaggregated Computable General Equilibrium Model. IN HEWINGS, G., SONIS, M. & BOYCE, D. E. (Eds.) *Trade,*

Networks and Hierarchies: Modeling Regional and Interregional Economies. Berlin, Springer-Verlag.

GIRMA, S. (2005) Absorptive Capacity and Productivity Spillovers from FDI: A Threshold Regression Analysis. *Oxford Bulletin of Economics and Statistics,* 67**,** 281-306.

GIRMA, S. & GONG, Y. (2008) FDI, Linkages and the Efficiency of State-Owned Enterprises in China. *Journal of Development Studies,* 44**,** 728 - 749.

GIRMA, S., GÖRG, H. & PISU, M. (2008) Exporting, Linkages and Productivity Spillovers from Foreign Direct Investment. *Canadian Journal of Economics,* 41**,** 320-340.

GIRMA, S., KNELLER, R. & PISU, M. (2005) Exports versus FDI: An Empirical Test. *Review of World Economics,* 141**,** 193-218.

GOOROOCHURN, N. & MILNER, C. (2005) Assessing Indirect Tax Reform in a Tourism-Dependent Developing Country. *World Development,* 33**,** 1183-1200.

GRUBERT, H. & MUTTI, J. (1991) Taxes, Tariffs and Transfer Pricing in Multinational Corporate Decision Making. *Review of Economics and Statistics,* 73**,** 285-293.

HARRISON, G. W., RUTHERFORD, T. F. & TARR, D. (1997) Quantifying the Uruguay Round. *Economic Journal,* 107**,** 1405-1430.

HELPMAN, E. (2006) Trade, FDI, and the Organization of Firms. *Journal of Economic Literature,* 44**,** 589-630.

HINES, J. R. & RICE, E. M. (1994) Fiscal Paradise: Foreign Tax Havens and American Business. *Quarterly Journal of Economics,* 109**,** 149–182.

HUANG, Y. (2003) *Selling China: Foreign Direct Investment during the Reform Era,* Cambridge, Cambridge University Press.

HUANG, Y. (2008) *Capitalism with Chinese Characteristics: Entrepreneurship and the State,* Cambridge, Cambridge University Press.

JAVORCIK, B. S. (2004) Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages. *American Economic Review,* 94**,** 605-627.

KNELLER, R. & PISU, M. (2007) Industrial Linkages and Export Spillovers from FDI. *The World Economy,* 30**,** 105-134.

LEJOUR, A., ROJAS-ROMAGOSA, H. & VERWEIJ, G. (2008) Opening Services Markets within Europe: Modelling Foreign Establishments in a CGE Framework. *Economic Modelling,* 25**,** 1022-1039.

LIU, Z. (2008) Foreign Direct Investment and Technology Spillovers: Theory and Evidence. *Journal of Development Economics,* 85**,** 176-193.

LONG, G. (2005) China's Policies on FDI: Review and Evaluation. IN THEODORE H. MORAN, EDWARD M. GRAHAM & BLOMSTRÖM, M. (Eds.) *Does Foreign Direct Investment Promote Development?* Washington D. C., Institute for International Economics.

MELITZ, M. J. (2003) The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica,* 71**,** 1695-1725.

MINTZ, J. (1995) The Corporation Tax: A Survey. *Fiscal Studies,* 16**,** 23-68.

NATIONAL BUREAU OF STATISTICS OF CHINA (2003a) *China Industrial Economy Statistical Yearbook 2003,* Beijing, China Statistics Press.

NATIONAL BUREAU OF STATISTICS OF CHINA (2003b) *China Statistical Yearbook 2003,* Beijing, China Statistics Press.

NATIONAL BUREAU OF STATISTICS OF CHINA (2006) *Input-output Tables of China, 2002,* Beijing, China Statistics Press.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (1995) *Taxation and*

Foreign Direct Investment: The Experience of the Economies in Transition, Paris, Organisation for Economic Co-operation and Development.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (2001) *Corporate Tax Incentives for Foreign Direct Investment,* Paris, Organisation for Economic Co-operation and Development.

PRASAD, E. S. & RAJAN, R. G. (2006) Modernizing China's Growth Paradigm. *American Economic Review,* 96**,** 331-336.

RUTHERFORD, T. F. (1999) Applied General Equilibrium Modeling with MPSGE as a GAMS Subsystem: An Overview of the Modeling Framework and Syntax. *Computational Economics,* 14**,** 1-46.

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT (2000) *Tax Incentives and Foreign Direct Investment: A Global Survey,* New York and Geneva, United Nations.

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT (2003) *World Investment Report 2003,* New York and Geneva, United Nations.

VAN MEIJL, H. & VAN TONGEREN, F. (1998) Trade, Technology Spillovers, and Food Production in China. *Review of World Economics,* 134 423-449.

WEI, S.-J. (2000a) How Taxing is Corruption on International Investors? *Review of Economics and Statistics,* 82**,** 1-11.

WEI, S.-J. (2000b) Local Corruption and Global Capital Flows. *Brookings Papers on Economic Activity,* 31**,** 303-354.

ZHAI, F. (2008) Armington Meets Melitz: Introducing Firm Heterogeneity in a Global CGE Model of Trade. *Journal of Economic Integration,* 23**,** 575 - 604.

Tables

Table 1. Corporate income tax rates by sector in 2004 (%).

Sectors	SOEs	Private	FIEs
Coal, petroleum and gas	12.8	21.1	1.4
Ferrous metals mining and dressing	19.6	27.2	15.5
Nonferrous metals mining and dressing	20.8	19.1	9.8
Mining of non-metal, other minerals, and other ores	32.2	20.7	23.7
Food, beverage, and tobacco manufacturing	30.3	14.9	14.5
Textile industry	n.a.	20.2	12.7
Garments and other fibre products	24.8	21.2	11.9
Leather, furs, down and related products	n.a.	14.7	13.3
Timber processing, bamboo, cane, palm fibre etc.	29.6	15.2	14.3
Furniture manufacturing	10.0	17.3	8.7
Papermaking and paper products	45.4	20.6	13.2
Printing and record medium reproduction	26.7	23.8	12.4
Cultural, educational and sports goods	47.7	18.5	15.6
Petroleum processing and coking	24.5	20.3	12.4
Raw chemical materials and chemical products	21.3	17.5	10.1
Medical and pharmaceutical products	19.7	17.9	12.5
Chemical fibre	55.7	18.6	13.8
Rubber products	35.7	20.8	13.0
Plastic products	24.6	19.1	12.5
Non-metal mineral products	29.1	20.7	10.3
Smelting and pressing of ferrous metals	24.8	18.9	6.7
Smelting and pressing of nonferrous metals	24.2	19.3	10.9
Metal products	28.2	20.6	11.1
Ordinary machinery	22.7	20.6	12.1
Special purpose equipment	29.2	21.3	9.4
Transport equipment	10.5	19.6	7.8
Electronic and electric products	22.6	19.6	10.3
Instruments, meters, cultural and office machinery	42.0	17.3	10.6
Production of electric power, steam and hot water	21.5	24.8	12.2
Production of gas	45.6	10.9	11.4
Average	**19.5**	**19.3**	**10.4**

Source: *China Economic Census Statistical Yearbook 2004*. Beijing: China Statistics Press. 2006.

Notes: 'SOEs', 'Private', and 'FIEs' denote the corporate income tax rate (=corporate income tax/total profits before tax) of state-owned enterprises, private domestic enterprises, and foreign-invested enterprises, respectively.

Table 2. Estimation of productivity.

Ownership	constant	*K*	*L*	Obs.	R^2
SOEs	0.13 (0.04)***	0.91 (0.02)***	0.09 (0.03)***	155	0.99
Private	1.01 (0.19)***	0.39 (0.06)***	0.70 (0.04)***	62	0.97

Notes: (a) Estimation of equation (5); (b) Standard errors in parentheses. *, **, *** denote statistically significant at 10%, 5%, and 1% level, respectively; (c) 'SOEs' stands for state-owned enterprises; 'Private' denotes domestic private enterprises.

Table 3. Estimation of productivity spillovers.

Ownership	constant	*BL*	*FL*	*HZDS*	*EXCO*	Obs.	R^2
SOEs	0.91 (0.05)***	0.40 (0.42)	0.29 (0.15)*	0.33 (0.17)*	0.04 (0.07)	155	0.31
Private	2.21 (0.32)***	0.15 (2.73)	2.58 (0.97)***	2.88 (1.11)***	-1.74 (0.47)***	62	0.30

Notes: (1) Estimation of equation (6). (2) Standard errors in parentheses. *, **, *** denote statistically significant at 10%, 5%, and 1% level, respectively. (3) "SOEs" and "Private" denote state-owned enterprises and domestic private enterprises respectively. (4) Similar to the results in the literature, the correlation coefficients of *BL*, *FL* and *HZDS* are reasonably low (both below 0.30), so that their independence is justified.

Table 4. Effects of corporate income tax reform (%).

(a) single-sided reform without spillovers

		Perfect competition	*Monopolistic competition*	*Firm heterogeneity*
Output	*All*	-0.17	-0.18	-0.19
	FIEs	-0.72	-0.75	-0.83
	SOEs	0.04	0.04	0.02
	Private	0.05	0.04	0.06
Variety	*All*	*Not applicable*	-0.05	-0.10
	FIEs		-0.67	-0.40
	SOEs		0.09	-0.07
	Private		0.11	-0.05
Scale	*All*	*Not applicable*	-0.02	0.07
	FIEs		-0.11	-0.43
	SOEs		-0.01	0.12
	Private		-0.03	0.15
Productivity	*All*	*Not applicable*		0.02
	FIEs			0.01
	SOEs			0.02
	Private			0.02
Spillovers	*SOEs*	*Not applicable*		
	Private			
Total tax revenue		-0.19	-0.20	-0.21
Corporate income tax revenue		11.87	11.87	11.86
Welfare		-0.40	-0.42	-0.37
GDP		-0.14	-0.16	-0.14

(b) integrated reform without spillovers

		Perfect competition	*Monopolistic competition*	*Firm heterogeneity*
Output	*All*	-0.14	-0.16	-0.02
	FIEs	-0.81	-0.84	-0.95
	SOEs	0.24	0.23	0.08
	Private	0.09	0.09	-0.04
Variety	*All*	*Not applicable*	-0.04	0.03
	FIEs		-0.75	-0.35
	SOEs		0.45	0.18
	Private		0.25	0.07
Scale	*All*	*Not applicable*	-0.02	0.03
	FIEs		-0.11	-0.64
	SOEs		0.04	0.16
	Private		0.03	0.13
Productivity	*All*	*Not applicable*		0.15
	FIEs			0.14
	SOEs			0.16
	Private			0.16
Spillovers	*SOEs*	*Not applicable*		
	Private			
Total tax revenue		-0.12	-0.13	0.08
Corporate income tax revenue		11.89	11.88	11.55
Welfare		0.13	0.12	0.67
GDP		-0.09	-0.11	0.38

(c) single-sided reform with spillovers

		Perfect competition	Monopolistic competition	Firm heterogeneity
Output	*All*	-0.21	-0.22	-0.24
	FIEs	-0.69	-0.71	-0.78
	SOEs	0.04	0.04	0.02
	Private	-0.00	-0.01	0.00
Variety	*All*	*Not applicable*	-0.06	-0.09
	FIEs		-0.63	-0.40
	SOEs		0.08	-0.06
	Private		0.05	-0.03
Scale	*All*	*Not applicable*	-0.03	0.01
	FIEs		-0.04	-0.06
	SOEs		-0.02	0.08
	Private		-0.04	0.06
Productivity	*All*	*Not applicable*		0.00
	FIEs			-0.01
	SOEs	-0.08	-0.09	0.00
	Private	-0.16	-0.18	0.00
Spillovers	*SOEs*	-0.46	-0.45	-0.49
	Private	-0.43	-0.43	-0.46
Total tax revenue		-0.23	-0.24	-0.27
Corporate income tax revenue		11.85	11.85	11.81
Welfare		-0.46	-0.49	-0.48
GDP		-0.19	-0.21	-0.24

(d) integrated reform with spillovers

		Perfect competition	Monopolistic competition	Firm heterogeneity
Output	*All*	-0.19	-0.20	0.10
	FIEs	-0.77	-0.80	-0.89
	SOEs	0.24	0.23	0.08
	Private	0.03	0.03	-0.09
Variety	*All*	*Not applicable*	-0.07	0.05
	FIEs		-0.71	-0.36
	SOEs		0.43	0.20
	Private		0.17	0.10
Scale	*All*	*Not applicable*	-0.03	-0.05
	FIEs		-0.11	-0.58
	SOEs		0.03	0.11
	Private		0.01	0.01
Productivity	*All*	*Not applicable*		0.13
	FIEs			0.11
	SOEs	-0.10	-0.11	0.14
	Private	-0.20	-0.22	0.13
Spillovers	*SOEs*	-0.55	-0.54	-0.59
	Private	-0.51	-0.50	-0.51
Total tax revenue		-0.17	-0.18	-0.00
Corporate income tax revenue		11.88	11.87	11.55
Welfare		0.05	0.03	0.52
GDP		-0.16	-0.18	0.25

Notes: (1) 'productivity' is industry-level productivity, measured by the denominator of fraction (9); (2) 'spillovers' measures how the importance of productivity spillovers in domestic enterprises' TFP changes, as measured by *NTFP* in equation (9); (3) Parameters of Pareto distribution (domestic firms) a=3.4, b=0.2, σ=3.8; parameters of Pareto distribution (foreign-invested firms) a=3.4, b=0.3, σ=3.8. Elasticity of transformation of capital and labour (τ_K, τ_L) = (2.0, 0.5). (4) 'Not applicable' means that the values of the corresponding variables are not obtainable.