Productivity Effects of Services Trade Liberalization: Evidence from Chinese Firm-level Data

Yan Zhang*, Yihong Tang†, Christopher Findlay ‡
University of International Business and Economics
University of Adelaide

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Abstract

This paper investigates the impact of service trade liberalization on manufacturing performance through the channel of service outsourcing. Total factor productivity of manufacturing plants which outsource their service tasks to more productive service providers will be accelerated through specialization effect, compositional effect and spill-over effect. I estimate the productivity effects of services trade liberalization by using a panel dataset of Chinese manufacturing firms over period from 1998 to 2007. Due to the geographic schedule of China's service liberalization reform and heterogenous effects of service trade liberalization on different categories of manufacturing firms, I use a difference in difference methodology and find the positive productivity effects for firms located in east China, firms with heavy service usage, foreign invested firms and exporters.

*Yan Zhang, School of International trade and Economics, UIBE, Beijing, China. Phone: +86 (0)10 8490 8606, Email: leaflucy@sina.com. The paper has been supported by Joint PhD Training Programme between UIBE and University of Adelaide.

†Yihong Tang, Professor, School of International trade and Economics, University of International Business and Economics (UIBE), Beijing, China. Email: tangyihong@uibe.edu.cn

‡Professor, School of Economics, University of Adelaide, Adelaide, Australia. Email: christopher.findlay@adelaide.edu.au

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1 Introduction

Service trade liberalization has been a highly controversial subject in the World Trade Organization (WTO). This controversy is exacerbated by the narrow focus of its negative effects of service openness on services industry itself. Yet given the fact that manufacturing industries rely on services intermediate inputs, large gains could potentially be achieved through liberalizing services sectors. Thus the aim of this paper is to investigate the effects of service trade liberalization on manufacturing productivity. This topic sounds more important in China for two reasons. First, China is the "world factory" and famous for the manufacturing products of "made in China"; Second, China has made extraordinarily deep and wide ranging commitments in the services area as part of WTO accession. But, little is known about the productivity effect of China's service trade liberalization for manufacturing industry. I aim to close the gap.

The emerging literature on the relationship between service trade liberalization and manufacturing productivity mainly focuses on the effect of FDI in services on productivity. Fernandes (2007) [18]estimates positive and significant effects of liberalization of finance and infrastructure on labor productivity of downstream manufacturing industries in Eastern European countries. Arnold et al. (2007a)[7] use the presence of foreign service providers, privatization and the level of competition to proxy for service trade liberalization and find foreign entry into services industry is the key channel through which service liberalization contributes to improvement of firm-level manufacturing TFP. Arnold et al. (2007b)[6] find significant and positive productivity effects of banking, telecommunications, and transport reforms on manufacturing firms in India. All these studies capture the dependence of manufacturing on services using industry level data from input-output table. Fernandes and Paunov (2008)[17] use firm-specific time-varying measures of the intensity of service usage and find forward linkage from FDI in services accounts for almost 5% of the manufacturing productivity growth in Chile from year 1992 to 2004. Javorcik and Li (2008)[25]estimate a positive effect of FDI in Romanian retail sector on the TFP of manufacturing suppliers (food industry)to that sector. Arnolda, Mattoob and Narcisoc (2008)[8]show a significant and positive relationship between firm productivity and service performance in communications, electricity and financial sectors by using its variation at the sub-national regional level of Sub-Saharan Africa.

There are two limitations on this research. One is that FDI in services is not the only way for intermediate service inputs to affect TFP in manufacturing. Cross-border trade and service provided through movement of people are also important modes of supply for services trade. Moreover, technology spill-over from foreign service providers to domestic ones and competition-enhanced productivity due to the exit of the less productive firms are also not accounted. Secondly, the reliance of manufacturing on service intermediate inputs is not accurately measured by all these FDI policy indicators. A more direct measure is outsourcing intensity for individual manufacturing firms. Thus another strand of literature is productivity effect of the disintegration of production. When service outsourcing is concerned, most papers emphasize the productivity effects of service (offshoring) outsourcing on TFP in developed country. Amiti and Wei (2006)[3], using industry data, find that service offshoring has a significant positive effect on productivity in the US. Mann (2003)[33] calculates that offshoring in the IT industry led to an

annual increase in productivity of 0.3 percentage points for the period 1995 to 2002 in US. Görg and Hanley (2007)[20] utilize plant-level data for manufacturing industries in Ireland, and find positive effects from international outsourcing, in particular of services inputs. However, these productivity benefits accrue only to exporters. This suggests that plant-level heterogeneity, especially for contacts in foreign markets are important in evaluating the productivity effects of international outsourcing. Positive relationship of services outsourcing and manufacturing TFP is also obtained by Gözig and Stephan (2002) for Germany, Tomiura (2005, 2006)[44][1] for Japan, Girma and Görg (2004)[19] for chemical, electronic, mechanical and instrument engineering industries in UK and so on.

When material outsourcing (imported inputs) and input tariffs are considered, more literature contributes. Feenstra, Markusen, and Zeile (1992)[16] estimate at the industry level, TFP is positively related with the introduction of new inputs in Korea. Yasar and Morrison (2007)[48]find a positive relationship between firm productivity and firm-level imports of materials in a production function framework using data for Turkey. Kasahara and Rodrigue (2008)[28] find that foreign inputs increase plant productivity in Chile by 2.3 percent, and Halpern, Koren, and Szeidl (2005)[23] show that imports contributed 30 percent to growth in aggregate TFP in Hungary during the 1990s. Amiti and Konings (2007)[2]relate manufacturing productivity to trade liberalization, and show that a 10 percentage point fall in input tariffs leads to a productivity gain of 12 percent for firms that import their inputs in Indonesia from year 1991 to 2001. However, It is hard to find a direct and satisfactory measure of service trade barriers (liberalization), like goods tariffs.

The main contributions of my paper are twofold. First, I construct a theoretical model based on Grossman and Rossi-Hansberg (GRH 2008)[22]. The GRH model investigates how the falling cost of skill-labor offshoring affects factor price, and focuses on cost-savings effects of offshoring for developed countries. While, this paper focuses on productivity-enhancing effects of service trade liberalization through service outsourcing for the upstream manufacturing firms in developing country. Second, the reliance of manufacturing on service intermediate inputs is measured by service outsourcing intensity for each of the manufactured firms. Instead of using direct policy indicators for service trade liberalization, I take advantage of the geographic schedule of China's service liberalization reform and heterogeneous effects of service trade liberalization on different categories of manufacturing firms and difference in difference methodology to estimate the manufacturing productivity effect of service trade liberalization.

This paper first derives a theoretical model to analyze the impact of service trade liberalization on manufacturing productivity through the channel of service outsourcing. Given the heterogenous costs of relocating service tasks from home country to host country, service outsourcing is endogenously determined. Service trade liberalization boosts FDI and trade in services, and leads to advanced technology transfer to host country. TFP of manufacturing plants which outsource their service tasks to more productive service providers will be accelerated through specialization effect, compositional effect and spill-over effect.

Inspired by the theoretical prediction, I estimate the productivity effects of services trade liberalization by using a panel dataset of Chinese manufacturing firms over the period from 1998 to 2007. I use a difference in difference methodology to examine the effect of service trade

liberalization on the performance of manufactured through service outsourcing. The approach relies on the geographic schedule of China's service liberalization reform and heterogenous effects of service trade liberalization on different categories of manufacturing firms. The firms located in east China, firms with more service usage, foreign invested firms and exporters are more easily affected by service trade liberalization and more likely to outsource their services tasks to more productive service providers. The main empirical results are consistent with the expectation of theoretical model: services trade liberalization may promote the firm productivity by the channel of service outsourcing. The results are robust to the measures of TFP based on production function estimation following the approach of fixed-effects, Olley and Pakes (1996)[37], Leninsohn and Petrin (2003)[32] and Arrellano-Bond (1991) Generalized Method of Moments estimator (GMM). More specifically, in terms of the TFPGMM, one percent increase of services outsourcing leads to 0.7 percent increase of TFP for east firms; one percent increase of service outsourcing will increase TFP of firms with high services usage by 0.55 percent; one percent growth of service outsourcing will lead to 0.33 percent growth of TFP for exporters; one percent increase of service outsourcing brings to 0.44 percent increase of TFP for western FIEs, and 0.26 percent for Hongkong-Macao-Taiwan FIEs. More robustness checks for difference specification, endogenity problem, more controls for tariffs, industry-heterogenous TFP, and direct policy indicators all strongly support my empirical findings.

The remainder of the paper is structured as follows. Section 2 constructs a theoretical model to analyze how services trade liberalization affects manufacturing productivity through outsourcing of services tasks. Section 3 introduces China's service trade liberalization reforms after the entry into WTO. Section 4 presents the data and empirical methodology. Section 5 discusses the estimation results and provides robustness checks. Section 6 concludes the paper.

2 the Model

Much evidence suggests that technologies across countries are not identical, not only for manufacturing industry, Dollar (1993)[13], Trefler (1995) [45], Davis and Weinstein (2001)[12], but also for the service industry, Inklaar and Timmer (2007)[24]. Advanced technology results from the availability of "firm-specific assets". Markusen (2002, 2009)[34] [35]defines these assets as "the services of knowledge-based assets". Firms in developed countries (f) own firm specific assets, which are missing inputs in developing countries (h).

The model assumes two countries and the technology in country f is superior to country h. The technology differences result in wage differentials. The country with advanced technology has a higher wage rate, while the country with less advanced technology has a lower wage rate. Thus, there is a great opportunity for country f to combine its advanced technology with low-wage labor by reallocating some service tasks to country h. Thus, advanced technology and management could be transferred through establishing a commercial presence (foreign direct investment in services) in country h or through franchising and technology licensing. However, it is costly to reallocate services tasks. Supportive government policies and availability of labor skill in the host country are important determinants.

In this paper, I focus on producer services, (such as transport, finance, insurance, com-

munication and business services),[1] which are important services inputs to goods production. Moreover, most of these services are provided to foreign subsidiaries or domestic firms in host country h, given that most producer services need the proximity of producer and consumer at the same location. [2]

It is assumed that two final manufactured goods(x and y) are produced by two tasks (L-task and K- task)[3]. Based on the model of GRH (2008), the production process is defined in terms of two tasks, and each task requires the inputs of a single factor. One task can be performed by labor, namely L-task, while the other task is performed by capital, namely K-task. The production of a unit of either product $g(g = x, y)$ involves a continuum of L-tasks and a continuum of K-tasks. Without loss of generality, the measure of tasks in each industry is normalized to one. Firms need a_{lg} units of domestic factor l to perform a typical l-task once, for $l = L, K$. a_{lg} is also the total amount of domestic factor l that would be needed to produce a unit of goods g in the absence of services task outsourcing.

Tasks in both sectors can be indexed by $i \in [0, 1]$. Tasks with a greater index can be more readily and economically allocated to a foreign country than those with a smaller index. The index can easily capture the varied effects of service trade liberalization and development of information technology on the individual service task.

Reallocation of services provision to country h makes it possible for country f to take advantage of its advanced technology and low-cost labor in country h, but other costs may be involved. Only if reallocation benefits are greater than the costs, does country f have the motives to reallocate services tasks to country h. The relocation margin is determined by the condition under which the costs of service provision using technology of country f equals the costs of providing these tasks using technology of country h by using the labor in country h.[4]

$$w_h b_{Lg} = \beta t(O_1) w_h a_{Lg} \tag{1}$$

w_j denotes wage in country j, $j = h, f$. $(1 - O_1)$ is the service relocation margin for L-tasks. b_{Lg} is the unit requirement of labor in country h. Notice that $t(i) > 1, t'(i) < 0$, for all $i \in [0, 1]$. β is the shift parameter, which is the proxy for service trade liberalization. With country h adopting service liberalization reforms, β increases and it may reduce the difficulties

[1]Markusen and et. al (1999)define producer services as intermediate inputs, which lower the quality adjusted costs of these services for downstream manufactured industries. Producer services are also produced under conditions of increasing returns to scale. They include "(1) managerial services, which improve organizational and decision-making efficiency. (2) engineering services, which improve technical efficiency and product quality. (3) financial services (not actual trade in capital) which provide expertise in financial management and decision making. (4) marketing services which improve firms' abilities to sell or purchase other goods and services. (5) information services in which the buyer receives some type of information or knowledge not just listed." Transportation are included as well.

[2]Producer services are differentiated by firm and possibly by firm nationality, which means these services are generally customized to some extent and they are not generally good substitutes for the services of other firms or firm with different nationalities. Thus, Empirical research as Yamori (1998), Moshiran (1997), Raff and Ruhr (2001)[39]and Kolstad and Villanger (2004)[30] have shown that FDI in producer services tends to be market seeking and is positively correlated with prior FDI in the manufacturing industry.

[3]There may be still other tasks that are performed by detailed categories of labor

[4]To simplify the model, only L-tasks can be reallocated to country h.

and losses of technology transfer from country f to country h.

2.1 Country h – host country

I use Cobb-Douglas production function and constant return to scale to produce x and y in each country. x is L-labor-intensive product and y is K-intensive product, given that $1/2 < \alpha < 1$. In the presence of service outsourcing and service trade liberalization, the unit production function for the firm in country h is

$$B_x(1+s(O_1))(\int_0^{O_1} b_{Lx}di + \int_{O_1}^1 a_{Lx}\beta t(i)di)^{\alpha} b_{Kx}^{1-\alpha} = 1$$

$$B_y(1+s(O_1))(\int_0^{O_1} b_{Ly}di + \int_{O_1}^1 a_{Ly}\beta t(i)di)^{1-\alpha} b_{Ky}^{\alpha} = 1$$

B_x and B_y denote the total factor productivity (TFP) coefficients required to produce x and y without service outsourcing in country h . Substitute (1) into the unit production function, we get

$$B_x(1+s(O_1))\Omega^{\alpha} b_{Lx}^{\alpha} b_{Kx}^{1-\alpha} = 1$$

$$B_y(1+s(O_1))\Omega^{\alpha} b_{Lx}^{1-\alpha} b_{Kx}^{\alpha} = 1$$

$$\Omega = 1 + O_1 - \int_0^{O_1} t(i)/t(O_1)di \tag{2}$$

The fraction of L-tasks $(1-O_1)$ is contracted to outsider services providers with higher productivity (outsourcing tasks), while the remaining fraction of L-tasks O_1 $(0 \leq O_1 \leq 1)$is performed by manufactured firms in host country (in-house tasks). Ω is service outsourcing-enhanced productivity. Since $t'(i) < 0$, $\Omega > 1$ for $0 < O_1 < 1$. Note that $dO_1/d\beta < 0$ (as we will prove below), $d\Omega/dO_1 = t'(O_1)\int_0^{O_1} t(i)di/t(O_1)^2 < 0$. That means service trade liberalization increases service relocation margin and TFP of manufacturing production. $s(O_1)$ is a proxy for measure of compositional effect and technology spill-over effect. s is a decreasing function of O_1. [5]

Unit cost for goods g is

$$\Omega b_{Lg} w_h + b_{Kg} r_h$$

The price equation is

$$p_h^g = (\Omega b_{Lg} w_h + b_{Kg} r_h)\mu_h^g$$

r_h is the capital price in country h; μ_g $(1/\mu_g < 1, g = x, y)$is profit-price ratio.[6] According to cost minimization and price equation, we get

$$b_{Lx} = \frac{\left(-1+\frac{1}{\alpha}\right)^{(-1+\alpha)\alpha}(1-\alpha)^{-(-1+\alpha)^2}\alpha^{(-1+\alpha)^2}\left(-\alpha+(-1+\alpha)\Omega\right)^{-1+\alpha}\left(-1+\alpha-\alpha\Omega\right)^{1-\alpha}}{P_h^{-1+\alpha}B_x^{\alpha}B_y^{1-\alpha}(1+s)\Omega} \tag{3}$$

$P_h = P_h^x/P_h^y$ is the relative price in country h

[5] if service relocation margin is 1, there is no spill-over ($s(1)$=0).

[6] we assume that the profit-price ratio is the same for both goods, $\mu_h^g = \mu_h$. And it applies to country f as well, $\mu_f^g = \mu_f$.

2.2 Country f – source country

The unit production function in country f is

$$A_x(1+s(O_1))a_{Lx}^{\alpha}a_{Kx}^{1-\alpha}=1$$

$$A_y(1+s(O_1))a_{Ly}^{1-\alpha}a_{Kx}^{\alpha}=1$$

We assume that country f can keep its technology advantage by using the profits from the reallocation of service tasks in country h. Thus, TFP is $(A_g(1+s(O_1))$ in the presence of relocation of service tasks in country h. Unit cost for goods g is

$$a_{Lg}w_f+a_{Kg}r_f$$

The price equation is

$$p_f^g=(a_{Lg}w_f+a_{Kg}r_f)\mu_f^g$$

According to cost minimization and price equation, we get

$$a_{Lx}=\frac{P_f^{1-\alpha}\left(-1+\frac{1}{\alpha}\right)^{-(-1+\alpha)^2}(1-\alpha)^{(-1+\alpha)\alpha}\alpha^{-(-1+\alpha)\alpha}A_x^{-2+\alpha}A_y^{1-\alpha}}{1+s} \tag{4}$$

$P_f=P_f^x/P_f^y$ is the relative price in country f.

2.3 Services trade liberalization, services reallocation margin and productivity

According to equation (1), service relocation margin $(1-O_1)$is endogenously determined. Substitute equation (3) and (4) into (1), I get

$$(-\alpha+(-1+\alpha)\Omega)^{-1+\alpha}(-1+\alpha-\alpha\Omega)^{1-\alpha}=A\beta t\Omega \tag{5}$$

$$A=\alpha^{(-1+\alpha)^2}A_x^{-2+\alpha}A_y^{1-\alpha}B_x^{\alpha}B_y^{1-\alpha}$$

Derivative equation (5) and obtain

$$dO_1/d\beta=\frac{At\Omega}{F_1d\Omega/dO_1+F_2d\Omega/dO_1-A\beta\Omega dt/dO_1-A\beta td\Omega/dO_1}$$

$$F_1=(-1+\alpha)^2(-\alpha+(-1+\alpha)\Omega)^{-2+\alpha}(-1+\alpha-\alpha\Omega)^{1-\alpha}$$

$$F_2=(-\alpha)(1-\alpha)(-1+\alpha-\alpha\Omega)^{-\alpha}(-\alpha+(-1+\alpha)\Omega)^{-1+\alpha}$$

If $(F_1+F_2-A\beta t)\frac{d\Omega}{dO_1}<A\beta\Omega\frac{dt}{dO_1}$, $\frac{dO_1}{d\beta}<0$. Since $\frac{d\Omega}{dO_1}=\frac{dt}{dO_1}\frac{1+O_1-\Omega}{t}$, the condition is simplified to : if $\frac{(F_1+F_2)(1+O_1-\Omega)}{A(2\Omega-1-O_1)}>\beta t$, $\frac{dO_1}{d\beta}<0$. This condition means if the aggregated benefits of service relocation are greater than the costs, service liberalization increases the margin of service relocation. In the appendix, I assume a linear form : $t(i)=a+bi$, a is the fixed cost and

$b(b < 0)$ is the variable cost for reallocation of services L-tasks[7]. This setting is in line with the analysis by Jones and Kierzkowski (1999)[27]that service links (tasks)have increasing return to scale. Thus, $dO_1/d\beta < 0$ if $0 \leq O_1 \leq 1$ and $1/2 < \alpha < 1$. [8] See Appendix A for the proof.

Proposition 1 *Services trade liberalization in the host country increases TFP of manufacturing firms which outsource their services tasks.*

TFP in host country h is $B_g(1 + s(O_1))\Omega^{\alpha}$ if services trade liberalization and services outsourcing exist. Since $\frac{d(1+s(O_1))\Omega^{\alpha}}{d\beta} > 0$ and $(1 + s(O_1))\Omega^{\alpha} > 1$, $(B_g(1 + s(O_1))\Omega^{\alpha}) > B_g$. Thus services trade liberalization leads to improvement of TFP in manufactured firms. This positive relationship results from at least three channels. (1) specialization effects. Services trade liberalization, especially the elimination of barriers to market access and national treatment increases FDI in services and foreign sales of services to manufactured firms located in host country h. Furthermore, advanced technology spill-overs from FDI in services within services sectors take place, when the entry or presence of multinational corporations increases the productivity of domestic firms which provide services tasks in a host country. "Spill-overs may take place when local firms improve their efficiency by copying technologies of foreign affiliates operating in the local market either through observation or by hiring workers trained by the affiliates" , Javorcik (2004)[26]. Another kind of spill-over occurs if multinational entry leads to more severe competition (pro-competition effect) in the host country market and forces local firms to use their existing resources more efficiently or to search for new technologies (efficiencies from adopting best-practice technologies), Blomstrom and Kokko (1998)[9] and Konan and Markus (2005)[31]. Thus, manufactured firms engaging in outsourcing of services tasks have access to intermediate inputs with higher quality in the local services market. Increasing outsourcing of services tasks may result in a boost in productivity for manufacturing firms.

(2)Compositional effect. When firms decide to outsource services, they relocate the less efficient services tasks, so production could then concentrate on the in-house activities that it does more efficiently. Hence, manufacturing firms would be able to relocate resources to the more efficient production tasks, thus the average TFP increases due to a compositional effect. For an average manufacturing plant, it is likely that producer services tasks are an activity it performs relatively inefficiently (compared with the other production stages), as the main concern of the plant is to produce manufactured output.

(3)Spill-over effect from outsourcing producer services to manufactured firms includes three aspects: restructuring, learning externality and variety, Amiti and Wei (2006). First, the remaining workers in manufacturing may become more efficient if services offshoring makes it possible for firms to restructure in a way that pushes out the technology frontier. This is more likely to arise from outsouring of producer services, such as computing, information and engineering services, rather than outsourcing of material inputs. Secondly, efficiency gains might arise as firms learn to improve the way activities are performed by outsouring services. For example, a new software package or management consulting can improve the average productivity of workers.

[7] a¿-b, which guarantees the cost of service relocation is positive.

[8] The relative price of two goods is the same in both country, given that the manufactured goods are freely traded between two countries.

Third, productivity might increase due to the use of more variety in producer services, Ethier (1982)[].

3 China's services trade liberalization

3.1 China's WTO commitments and implementations

"Taken at face value, the commitments that China has taken on in the services area as part of WTO accession process are simultaneously extraordinarily deep and wide ranging"(Whalley 2003)[46]. China has made relatively broad commitments upon its accession to the WTO under the framework of the GATS as a developing country and approached the level of the developed countries. The commitments cover 10 out of the 12 major GATS service categories and 100 out of the 160 minor categories. Among 26 basic groups of service sectors, China made commitments to 22 sectors except R&D, postal services, health and social services and recreational services, see table 1.[9]

During five year phase-in period (2002-2007), China had gradually implemented deregulation reforms based on WTO commitments. Geographical schedule is an important feature of China's services liberalization, see table 2. The geographical schedule makes firms located in east China have access to more productive services providers.

With the end of the phase-in period, China has fully opened most services markets to international competition from foreign service providers in a series of key areas: distribution, telecommunications, financial services, professional business and computer services, motion pictures, environmental services, accounting, law, architecture, construction, and travel. Fan (2009)[14] calculates China's services trade restrictiveness index (TRI) for main services sectors (pre- and post-WTO), based on comprehensive sources of implementation of WTO commitments and China's deregulation polices in services. The results are very striking in that TRI for distribution sectors reduces from 0.6925 to 0.2375; TRI of fixed line (telecom) reduces from 0.8696 to 0.6422, TRI of mobile (telecom) reduces from 0.8896 to 0.6166; TRI of insurance sector reduces from 0.8367 to 0.4103; TRI of banking services reduces from 0.7428 to 0.2436.

3.2 China's FDI and trade in services

One direct measure of the performances of services trade liberalization is the development of FDI and imports in services. After accession to WTO, China's FDI and imports in services [10] have shown an incredibly rapid growth. Inwards FDI in services increased dramatically from 2001 to 2007. The average annual growth rate is about 18.7%. In 2006, the growth rate is 33.7%, and it

[9] A specific commitment in a services schedule is an undertaking to provide market access and national treatment for the service activity in question on the terms and conditions specified in the schedule. When making a commitment a government therefore binds the specified level of market access and national treatment and undertakes not to impose any new measures that would restrict entry into the market or the operation of the service.

[10] Data of China's trade in services comeS from "China's Services Trade Development Report 2007[36]

Table 1: WTO Commitments

Service sector	C	Service sector	C
Professional		Computer and related	
—legal			
—accountancy		R&D	
—taxation		Other business	
—architectural and engineering		Communication	
		—postal	
—medical		—courier	
Financial			
—insurance		Telecommunication	
		—value added	
—banking and other		—basic	
Transport		Distribution	
—maritime transport		Environmental	
—air transport		Health and social	
—road transport		Tourism	
Construction		recreational	
Education		Audiovisual	
	commitments		No Commitments

Source: WTO

is 55.5% in 2007. According to National Economics Industry Classification Standard, Inwards FDI by sectors is shown in Figure 1.

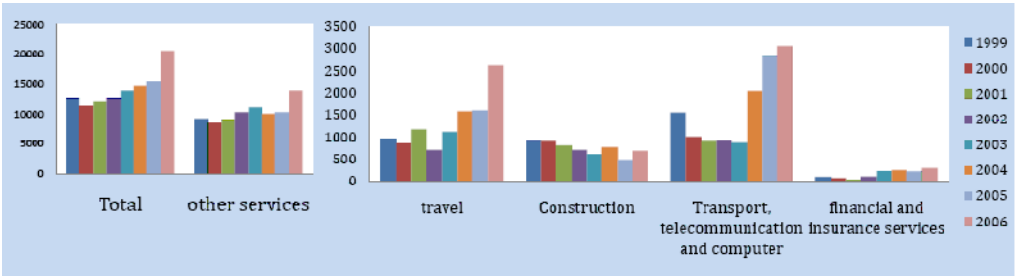

Figure 1: Services FDI by Sectors (100 million US$)

Statistics of services trade have two bases: one is the "International Monetary Fund (IMF) Balance of Payments Manual" (BMP5), which broadly covers service trade of mode 1 and 2, and a significant part of mode 4. The other is "foreign affiliates trade in services statistics" (FATS) for mode 3, which records the value of services provided through foreign affiliates established abroad. [11]Figure 2 and figure 3 show the rapid growth of services imports in main services sectors.

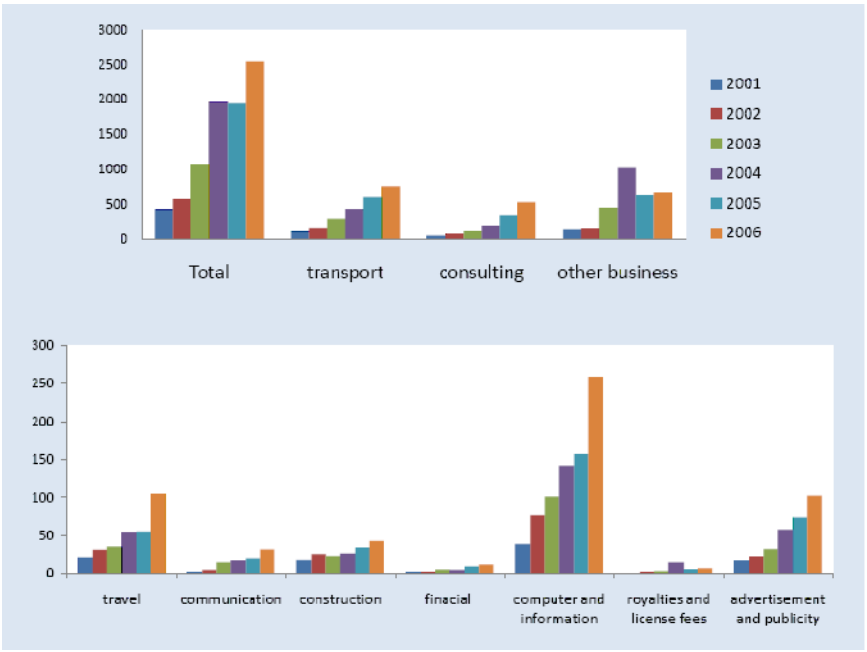

Figure 2: Services Import (FATS) by Sectors (100 million US$)

[11] "General Agreement on Trade in Services" (GATS) defines trade in services using four modes of supply: cross-border supply (mode 1), consumption abroad (mode 2), commercial presence (mode 3) and presence of natural persons (mode 4).

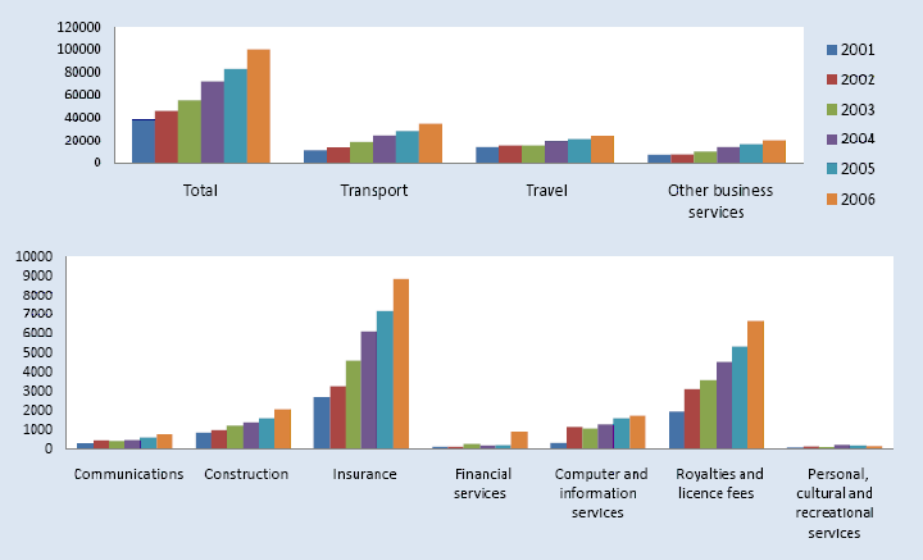

Figure 3: Services Imports (BMP5) by Sectors (100 million US$)

3.3 Services FDI penetration

Services trade liberalization may have heterogenous effect on different regions and different manufacturing industries. Thus, to address this, I calculate policy performance indicators: services FDI cross–region and cross–industry penetration, based on the methodology used by Fernandes and Paunov (2008), Javorcik (2004), Arnold et al.(2007) and Amiti and Wei (2006) and Feenstra (1996, 1999)[**?**][15]. The measure of FDI regional penetration (value and ratio, FDIRV, FDIRR) is given by the value (ratio) of FDI in one region multiplied by tertiary industry composition in each region.[12] r refers to 31 regions, t denotes time (from 1998-2007), FDI_{rt}[13] is the total investment of registered Foreign invested enterprises by region at the year-end.

$$FDIRR_{rt} = (FDI_{rt}/\sum_{r} FDI_{rt}) * (SGDP_{rt}/GDP_{rt}) \tag{6}$$

we can obviously see the regional difference of FDI penetration (mean from year 2002 to 2007) in figure 4, and it is consistent with the geographical schedule.

Services FDI industrial penetration is measured as follows:

$$FDIIR_{it} = \sum_{j}(FDI_{jt}/\sum_{j} FDI_{jt}) * (SIR^{i}_{jt}) \tag{7}$$

Services input ratio (SIR) is calculated using China's 42-sector input-output table of year 2005, 2002 and 1997. I consider five service sectors as producer service inputs to manufacturing : transport and telecommunication, distribution (including wholesale and retail), financial

[12]the data of FDI by sectors on regional level is not available, thus FDIRV is a rough proxy.

[13]All FDI data come from China Statistical Year book (various year) combined by National Bureau of Statistics of China

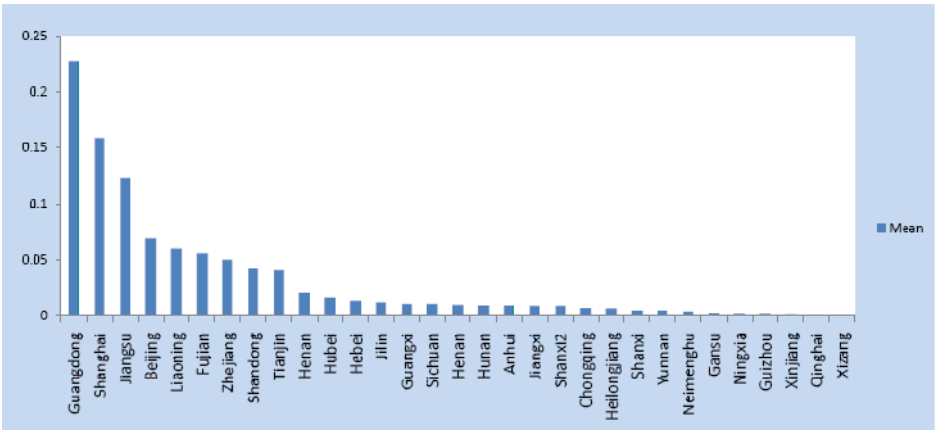

Figure 4: Services FDI regional penetration ratio

services, real estate and other business services. FDI_{jt} is FDI by each service sector. i denotes 24 manufacturing industries, j is 5 services sectors. Figure 5 shows the great differences of FDI penetration for manufacturing industries [14]. Figure 6 also shows the trend of FDI penetration values since the access to WTO.

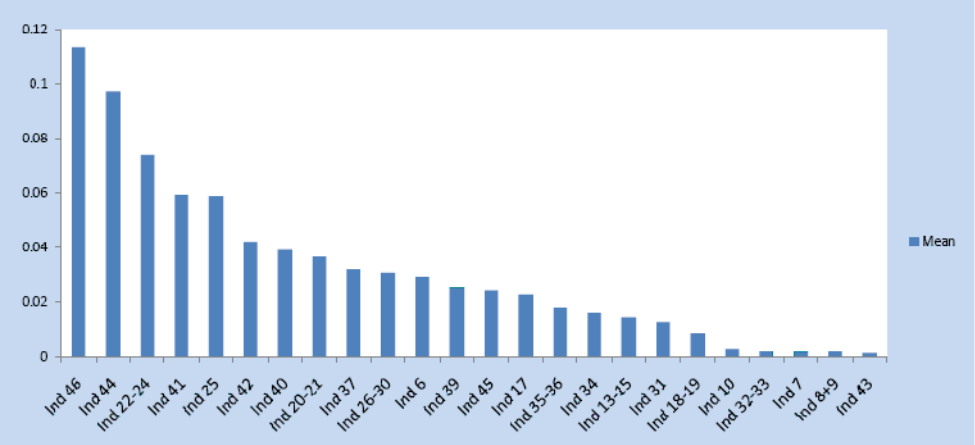

Figure 5: Services FDI industrial penetration ratio

3.4 Productivity comparison of services industry

One of the conditions in the theoretical model is that the productivity of the service industry in home countries (which perform FDI in services)is higher than that of China. With the onset of service trade liberalization in China, the entry of more productive foreign service providers may benefit the upstream manufacturing firms. I calculate labor productivity, which is value added of services industry (sectors) divided by the corresponding employment. Figure 7 shows the huge gap of labor productivity between China and its main service trade (import)partner

[14] see 18 for the references of manufacturing industry code

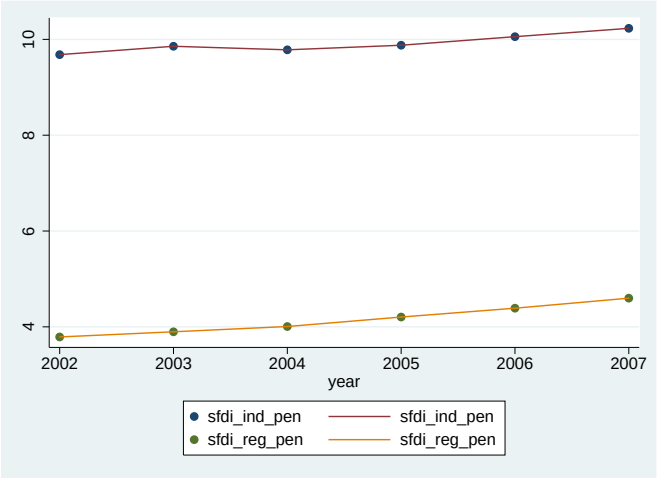

Figure 6: Trend of services FDI penetration

countries (Hongkong, USA, Japan, main OECD countries and et.al). China's labor productivity of total service industry (mean of year 1998 to 2007)is only 48; USA is 614; Japan is 645; Hongkong is 514. [15] Table 3 shows the labor productivity difference between China and USA in disaggregated services sector level. The big gap provides a good opportunity for developed countries to take advantage of their advanced technology or management and invest in China to obtain profits.

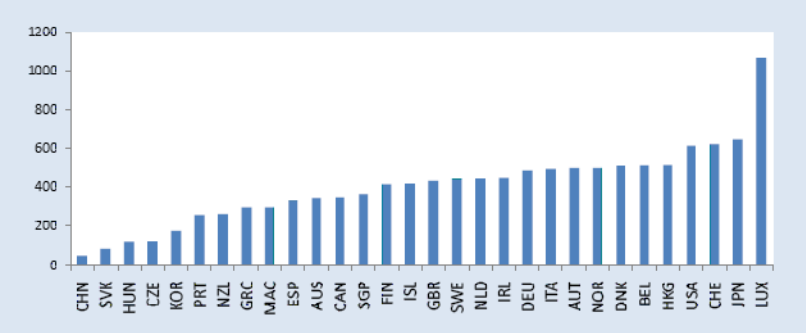

Figure 7: Labor productivity: cross–country comparison

4 Empirical Model

4.1 Description of Data

In order to investigate the relationship between service trade liberalization and productivity, I use plant-level data for manufacturing industries in the Republic of China. The sample used in this

[15]The data of value added (in current US$) and employment in service industry comes from World Development Indicator (WDI). Data of value added of USA in main services sectors are from Bureau of Economic Analysis (BEA). China's data comes from China statistic year book (year 1999-2008)

paper comes from a rich firm-level panel database which covers more than 200,000 manufacturing firms for the years 1998-2007. The data are collected and maintained by China's National Bureau of Statistics (NBS) in an annual survey of manufacturing enterprises. It covers two types of manufacturing firms: (1) all SOEs; (2) non-SOEs whose annual sales are more than 5 million yuan. [16]The database includes more than 100 financial variables listed in the main accounting sheets.[17]

I keep the firms with continuous operation from 1998 to 2007 and drop the observations with missing values for the main variables we have interest in. It leaves us with an unbalanced panel consisting of 287694 plants. Of these, 213382 are located in east China [18], 45480 are foreign enterprises, 124874 are exporters. The main variables of interest are intermediate inputs (material and services). Two proxies for intensity of outsourcing are the value of total and service outsourcing and the ratio of total outsourcing and service outsourcing to gross product of each firm. [19] Service outsourcing is calculated by total inputs minus material intermediate inputs.[20] Figure 8 plots the mean of total outsourcing log value from year 1998 to 2007 and service outsourcing log value from year 2004 to 2007. It is obvious to see the increasing trend of outsourcing in China.

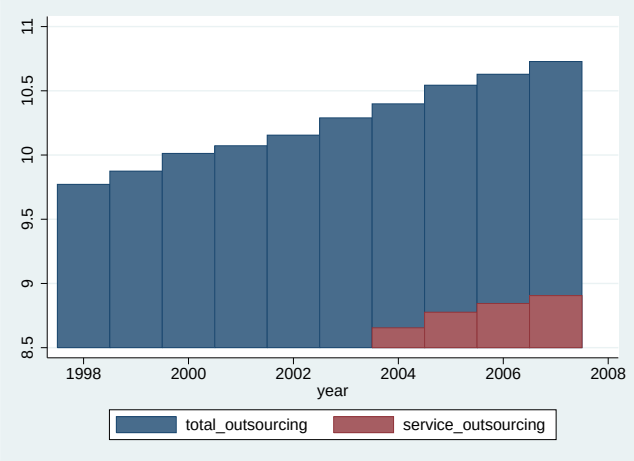

Figure 8: Development of Outsourcing

Given the substantial heterogeneity of units in plant-level data, it is reasonable to expect the plant-level productivity effects of service liberalization to differ depending on plant charac-

[16]Aggregated data on the industrial sectors in the annual China's Statistical Yearbook by the NBS are compiled from this database.

[17]Following Li and Yu (2009), and guided by the General Accepted Accounting Principles (GAAP), I delete observations if any of the following rules are violated: (1) the total assets must be higher than the liquid assets; (2) the total assets must be larger than the total fixed assets; (3) a firms identification number cannot be missing and must be unique; and (4)the established time must be valid.

[18]East China includes Beijing, Tianjin, Liaoning, Shandong, Shanghai, Hebei, Jiangsu, Zhejiang, Hainnan, Fujian and Guangzhou

[19]The data for services outsourcing are available only from year 2004 to 2007.

[20]Services inputs can also be roughly calculated from accounting data, as the sum of services inputs in manufacturing expenses, management expenses, sales expenses and financial costs.

teristics, such as the location, the industrial characteristics of the plant and ownership status. Four criteria are used to distinguish the plants. Firstly, because of the geographical schedule of China's services liberalization reforms, I distinguish the firms located in the eastern China from the firms located in the rest of China.

Secondly, the firms with different services usage may have different reactions to services trade liberalization. According to input-output table (2005) with 42 industries, I distinguish the manufacturing industries with high-services usage from low-services usage. I consider the industry whose services intensity (services inputs/gross production value)is greater than 14 percent as an industry with high-services usage [21]. The firms in theses industries are more sensitive to services liberalization and easily oursourced their services tasks to more productive services providers.

Finally, I distinguish foreign-invested enterprises (FIEs) [22] from domestic plants, the exporters from non-exporters. Antrás and Helpman (2004)[4] and Grossman and Helpman (2005)[21] make the reasonable argument that international outsourcing involves substantial sunk costs. Firms have to search for outsider suppliers, assess their quality and sign the contracts. The business literature explains that these costs include, for example, the costs of travel, transportation and communication, (Rasheed and Gilley 2005[40] and the cost of training and transferring their employees. The outsourcing costs may differ in different types of firms and firms will decide whether to outsource based on the difficulties and costs of outsourcing. In particular, I would expect foreign-invested firms and exporters to face lower costs of outsourcing, especially foreign outsourcing, as they are embedded into international production networks with more foreign contacts than domestic firms ,Görg and et.al (2007)and Sjöholm (2003)[43].

Table 4 presents some statistics on some of the variables. Four interesting findings are obtained. 1) The firms located in east China are more productive, have higher level of services (total)outsourcing and have higher services FDI penetration than the firms located in the west and middle of China; 2) The firms which belong to heavy-services-usage industries are more productive, have higher level of services (total)outsourcing and have higher services FDI penetration than the firms that belong to less-heavy-services usage industries; 3) FIEs are more productive, have higher level of services (total)outsourcing than domestic firms; 4) The exporters are more productive, have higher level of services (total)outsourcing than non-exporters.

In order to get a preliminary idea of the relationship between services trade liberalization and productivity (in term of labor productivity), I decompose the latter in two groups: high (above average) and low (below average) labor productivity, respectively. Table 5 describes average values and intensities of total and services outsourcing and services FDI penetration for these high- and low-productivity establishments. It is obvious that high-productivity plants exhibit higher average outsourcing values and intensities. We also find that a greater proportion of firms in east China, firms with high-services usage, FIEs and exporters are located in the higher-productivity category.

[21]It includes industry 13, 14, 15, 22, 23, 24, 25, 37, 40, 41, 44, 45, 46. See Table 18 for the summary of the number of firms in each industry.

[22]I consider a broad classification of FIEs which include the firms with western foreign invested enterprises and Hongkong/Macao/Taiwan invested firms

4.2 Empirical methodology

In order to investigate the effect of services trade liberalization on plant-level TFP, I estimate production function that includes the effect of services outsourcing and service trade liberalization. Based on theoretical model, the production function which takes a general Cobb-Douglas form is as follows:

$$Y_{it} = A_{it}(O_{it}, \beta_{jt}) L^{\alpha} K^{\gamma} I^{\eta}$$

Where Y is total output, K is capital, L is labor, I is total intermediate inputs and A is technology efficiency parameter, i denotes individual plant. j refers to plants' characteristics, such as location, industry, nationality and export status. β_{jt} captures the heterogenous effect of services trade liberalization on manufacturing plants. A is a function of services trade liberalization (β) and service outsourcing intensity (O). The decisions to outsource service tasks will be determined by the development of service trade liberalization as well, that is, O is a non-linear function of β. I aim to investigate whether service trade liberalization has any effect on TFP by allowing service outsourcing to shift TFP. The estimation takes two steps.

First, I estimate the logarithmic form of production function and retrieve the logarithm of TFP as the residual. The serious econometrics problem with the OLS estimator is that the choice of inputs is endogenous. I employ five alternatives to deal with it. The first approach is a fixed–effects estimator, which works on the assumption that the part of the error term that is correlated with input choices is time invariant. The second is proposed by Olley and Pakes (1996) (in short as OP)[47], which is a semi-parametric approach to address the simultaneity and selection problems. Simultaneity arises when the firm's knowledge of time-varying productivity shocks (unobserved by the econometrician) may affect the use of inputs. Selection bias results from the relationship between productivity shocks and the probability of exit from the market. The simultaneity problems are addressed by using investment as a proxy for unobserved productivity shock and selection problems are addressed by using survival probabilities. The third approach of obtaining TFP is a semi-parametric approach suggested by Leninsohn and Petrin (2003)[38], which solves the simultaneity problem by using intermediate inputs. The fourth method to address the endogenous problems is Arrellano-Bond (1991)[5] Generalized Method of Momments (GMM) estimator, which uses all possible lags of input variables as instruments for unobserved productivity shock. The fifth approach is two-stage Arrellano-Bond GMM estimator to control for the potential endogeneity of outsourcing, such as that more productive firms might self-select to outsource their services tasks or conversely; firms which expect a fall in their productivity growh may increase their level of outsourcing in hope for increasing future productivity. The estimated production function coefficients are reported in Table 6.

Second, I investigate the relationship between TFP and services trade liberalization through the channel of service outsourcing. The estimating specification is

$$TFP_{it} = \gamma_0 + \gamma_1 O_{i,t-1} * \beta_{jt} + \urcorner X_{i,t-1} + d_{rt} + d_{st} + v_i + \varepsilon_{it} \tag{8}$$

The explanatory variables of interest are the interactive term of services trade liberalization and services (total) outsourcing. Because of the heterogenous effects of services trade liberalization on different types of plants, I use a difference in difference approach and compare the TFP

in the firms with different impacts of service trade liberalization. Four zero-one dummies are set to capture the heterogenous impact, and they are dummy for the firms located in east China, dummy for the firms which belong to the industries with heavy-service input usage, dummy for FIEs and dummy for exporters. X is a vector of other plant-characteristics that may impact TFP, such as the size (log of total assets per employee), financial constraints (log of net profits and dummy for government subsidies) and dummies for the ownership of the firms. I lag outsourcing by one period to attenuate endogeneity problems. To control for the uneven economic development across Chinese regions and across different industries, I add time-varying region-year and industry-year dummies (d_{rt}, d_{st}). Plant fixed effects (v_i) are included to account for unobserved firm characteristics, such as managerial mode and ability.

5 Empirical analysis

5.1 Main estimation results

I estimate the model with four dummies first by considering them as the proxies for different reactions to service trade liberalization. The estimated productivity premiums for east located firms, heavy-service-usage firms, FIEs and exporters are all positive and significant, as shown in Table 7A. The decisions for firms to outsource service tasks may also affect TFP. Thus, I have a simple model to account for it. The results in Table 7B show that outsourcing have positive and significant effect on TFP, and the results are robust to four TFP measures [23]. To avoid the endogeneity problem, I use one year lag of total and service outsourcing.

In order to allow for the potential differences in the effect of service liberalization and outsourcing, I use difference in difference methodology by generating interactive terms of outsourcing variables and each of four dummies. The estimation results of equation (7) are reported in Table 8, 9, 10 and 11. For all of the four TFP measures as dependent variables, the coefficients of the interaction are positive and significant in all specification, only the magnitude of the coefficients are different. In terms of the TFPGMM, according to column 1 and 2 of table 11, total outsourcing increases 1%, TFP of firms located in east will increase 4.15%; 1% increase of services outsourcing leads to 0.7% increase of TFP for east firms. according to column (3) and (4)1% increase of service (total) outsourcing will increase TFP of firms with heavy-services usage by 0.55 (0.57) percent. According to column (5) and (6), 1% growth of service (total) outsourcing will lead to 0.33 (1.4)percent growth of TFP for exporters. According to column (7) and (8), 1% increase of service (total) outsourcing brings to 0.44 (2.1)percent increase of TFP for western FIEs, and 0.26 (1.8) percent for Hongkong-Macao-Taiwan FIEs.

Data on physical volumes of production and inputs are usually unavailable, so the measures of TFP to capture productivity improvement are forced to make do with information on the values of production, material inputs, and capital stocks. I add profit value of each firm in the estimated equation to control for the upwards bias for TFP. And as suggested by Katayama et al.(2009)[29], difference specification may attenuate the problem. Thus, the first difference

[23]Since TFP with Arrellano-Bond GMM approach and TFP with two-step GMM method are quite similar, I only report the results of the latter.

specifications are estimated and the results are presented in Table 12, 13, 14 and 15. The interactive terms of four dummies and outsourcing measures remains positive and statistically significant for all specifications. [24] The magnitude of service outsourcing is much greater than the level specification. The main empirical results are consistent with the expectation of theoretical model: services trade liberalization may promote the firm productivity by the channel of service outsourcing. The results are in line with some empirical literature. Görg et al.(2007) use Ireland manufacturing plant-level data and find international outsourcing, including both service outsourcing and material outsourcing has positive effect on plant productivity. Moreover, compared with domestic firms, the plants being embedded in international production chain through exporting or being a part of multinationals benefit more from international outsourcing. Amiti and Wei (2006) find that service outsourcing is positively associated with productivity by using US industry data. Kasahara and Rodrigue (2005) and Yasar and Morrison (2007) obtain positive relationship between firm productivity and firm-level imports of materials using data for Chile and Turkey, respectively.

Since producer services, such as transport, distribution and financial services, are important service links to promote trade of intermediate material inputs and fragmentation of production, total outsourcing is a regressor without separating material outsourcing with services outsourcing, and the coefficients are all positive and significant. But in the first difference estimation specification, the coefficients of service outsourcing intensity are much greater than those of total outsourcing. This suggests that the growth of service outsourcing contribute more to the growth of plant TFP.

5.2 Robust checks

5.2.1 Potential endogeneity problem

An econometric concern that needs to be addressed when estimating equation (7) is the endogeneity problem. Estimation will be biased if firms decide to outsource on the basis of any unobserved time-variant productivity differences across firms. The direction of the bias is not quite clear. When there is a fixed cost of outsourcing that induces a self-selection process so that only the most productive firms perform outsourcing, the coefficient on outsourcing will be upward biased. On the contrary, if low productivity firms engage in defensive outsourcing in order to boost their competitiveness, the coefficient on outsourcing may be downward biased. Therefore, I add lag of TFP in the specification, consider outsourcing as predetermined variable and employ the system GMM estimation developed by Blundell and Bond (1998) [10]to correct for the potential endogeneity problems in equation (7), Hijzen et al.(2009). Two-step robust system GMM model is used. The results are presented in Table 16. The interactive terms are positively and significantly related to TFP. Arellano-Bond test for zero autocorrelation in first-differenced errors can not reject the null hypophysis of no autocorrelation for all the specifications. The system GMM estimations point at statistically significant effects of outsourcing and service liberalization on total factor productivity in all specifications. The results are robust to

[24]The measures of total and service outsourcing are taken as the ratio of outsourcing value to gross production value.

the growth of TFP in Table 17 [25] In the level equation of TFP, the lag of TFP has positive effect on current TFP, while in the equations of first-difference of TFP, the lag of ΔTFP is negatively related to current growth. The results are consistent with Görg et.al (2005) and Hijzen et.al (2009)[1]. The benefits from outsourcing may depend on a firmscurrent productivity level, but for firms that have already achieved a high productivity level through outsourcing, the benefits may be smaller since the opportunity for further productivity growth is likely to be small.

5.2.2 Heterogenous industrial TFP

When output and input characteristics are common across plants, the productivity approximations that are used by my paper makes good sense. But in practice, producer-specific productivity measures are more commonly constructed for differentiated product and/or differentiated input industries. As suggested by Katayama et.al (2009), I calculate TFP by using Arrellano-Bond GMM approach for main 36 manufacturing industries according to two-digit SCI 2002, see the estimated coefficients in talbe 18. Based on the new estimation of TFP, I reestimate equation (7). The main results remain robust and the interaction terms are all positively and significantly related to TFP, see table 19. The proxies for outsourcing variables are the ratio of outsourcing to gross production. The coefficients are greater than the baseline results.

5.2.3 Additional controls and Outliers

There may be concern that outsourcing intensity is correlated with omitted variables which have effect on TFP such as tariffs and wage rate. Amiti and Konings (2007) and Adriana Schor (2004)[41] find significant productivity gains from reducing tariffs on final goods and intermediate inputs. Lower output tariffs induce tougher import competition and make firms to be more specialized in their core tasks and outsource the remaining to increase their scale of economy and productivity. Whereas lower inputs tariffs can make firms to join the global integration of production by purchasing cheaper and high-quality foreign input. The demand for service links also boost service outsourcing. Moreover, with the entry of WTO, China's average nominal tariffs have decreased from 16.21 (1999) to 8.86 (2006). Thus, it is necessary to control for tariffs. I calculate two-digit SCI industry tariffs based on the data of China Customs Statistics, see 24. The methodology of transformation from product tariffs to industry-level tariffs are based on Sheng (2003)[42].

It should be emphasized that although firms often engage in outsourcing to reduce costs through lower input prices, the present methodology employing TFP based on real inputs and output does not capture the cost-saving motive of outsourcing. Thus, I add average wage rate to roughly account for effect of cost-savings outsourcing on productivity. Since the industries of production of gas, water and electricity have high service-usage and provide energy for other manufacturing, in this robust test, I treat them as outliers and drop all of these plants. The results with control of tariffs and wage rate are presented in table 20 for first difference specification. Our main results remain robust as all the coefficients of interactive terms are positive

[25] There are not enough observations for service outsourcing because of the short panel.

and significant and the magnitude is greater than without controls. First difference of tariffs is positively related to TFP in all the specifications of total outsourcing but negatively related to TFP in the specifications of service outsourcing. Average wage has positive effect on TFP in all the specifications, which imply outsourcing also aims to reduce the costs.

5.2.4 Policy indicators

Last but not least, I use direct policy indicators of service trade liberalization as regressors to investigate the effect of service trade liberalization on plant-level TFP. China's entry into WTO is a big milestone for China to open its service market to the world and FDI and trade in services grow rapidly after that. Thus, we take service FDI regional penetration ratio and industrial penetration ratio as the performance proxies for service trade liberalization. To take the time lag of policy effect into account, FDI penetration ratios are lagged by one year and two years. I correct the standard errors to account for the fact that the measures of FDI indicator are at the regional level or industry level while the TFP is at the firm level. Failure to correct for such data structure may lead to a downwards bias in the estimated errors. Thus, I perform the correction by clustering standard errors at the region or industry level. The results in table 21 show that FDI in services increase TFP. More specifically, 1 percent increase of FDI regional (industrial) penetration leads to 20.9 (11.4) percent increase of manufacturing TFP. The magnitude of the coefficients of two-year lag FDI penetration is smaller. The results provide robust test for positive effect of service liberalization on manufacturing TFP. They are in line with Fernandes and Paunov (2008), Arnold et.al (2007) and Javorcik and Li(2007). Fernandes and Paunov (2007) use firm-level service FDI linkage measure based on the access of the intensity of usage of various types of services at the plant level and find a positive effect of FDI in services on productivity growth of Chilean manufacturing plants. Arnold et.al (2006)find that allowing foreign entry into services industries is the key channel through which service liberalization contribute to improvement of productivity of downstream manufacturing sectors. Javorcik and Li (2007) estimate a positive producibility effects of FDI in Romania's retail sector (which are proxies for regional FDI performances) on food manufacturing industries.

Further more, to evaluate the effect of service liberalization on manufacturing productivity, I use the standard difference in difference methodology [26]. The year dummy is 1 after the year of the entry into WTO (2002) and before 2002 it is zero. [27]. East dummy or industry dummy with high-service usage capture the difference effect of service trade liberalization on different group of manufacturing, they distinguish the treatment group (east dummy equals to unit or industry dummy is unit) from control group (east dummy equals to zero or industry dummy is zero). The coefficient of year dummy shows the time trend common to treatment and control groups. The coefficient of east dummy (or industry dummy) accounts for average permanent differences between treatment and control. The coefficient of interactive term of year dummy and east dummy (or industry dummy) shows the true effect of entry into WTO. The coefficients of interaction term are highlighted and are positive and significant in all specification with different

[26]The paper of Card and Krueger (1994)[11] is a good example

[27]If the time lag of policy effect is accounted, year dummy could be 2003.

measures of TFP, as shown in Table 22. However, taking WTO dummy as a proxy for service trade liberalization may exaggerate the effect of service liberalization since it can not rule out other policy effects, such as tariffs and other deregulation reforms.

5.2.5 Second difference

I present the results of the second difference specification in table 23. The interactive terms remains positive and significant and magnitude does not change much.

6 Conclusions

This paper constructs a theoretical model to analyze the impact of service trade liberalization on manufacturing productivity through the channel of service outsourcing. Service trade liberalization boosts FDI and trade in services, and leads to advanced technology transfer to host country. The manufacturing plants which outsource their service tasks to more productive service providers will accelerate total factor productivity through outsourcing-enhanced productivity effect, compositional effect and spill-over effect.

I then test the productivity effects of services trade liberalization by using a panel dataset of Chinese manufacturing firms. Based on the geographic schedule of China's service liberalization reform and heterogenous effects of service trade liberalization on different categories of manufacturing firms, I use difference in difference methodology to examine the effect of service trade liberalization on the performance of manufactured through service outsourcing. I find strong empirical evidence to support the theoretical arguments. In particular, service liberalization and service outsourcing leads to a significant increase in total factor productivity of firms located in east China, firms with high service inputs, FIEs and exporters. All these findings are robust to different measures and econometrics specifications.

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Appendix A

If $t = a + bi$ and $b < 0, a > -b$, equation (5) is specified to

$$\frac{\left(-1+\frac{1}{\alpha}\right)^{-1+\alpha}\beta\left(\frac{\left(-1+\frac{1}{\alpha}\right)^{-\alpha}\left(\frac{\alpha}{1-\alpha}\right)^{-\alpha}B_x}{B_y}\right)^{-1+\alpha}(a+bO_1)}{B_x}$$

$$= \frac{2\,(a+bO_1)\left(\frac{\left(-1+\frac{1}{\alpha}\right)^{\alpha}(-1+\alpha)\left(\frac{\alpha}{1-\alpha}\right)^{\alpha}A_y\left(2a+2bO_1+b(-1+\alpha)O_1^2\right)}{\alpha A_x\left(-2a-2bO_1+b\alpha O_1^2\right)}\right)^{-1+\alpha}}{A_x\left(2a+2bO_1-bO_1^2\right)}$$

$$dO_1/d\beta = \frac{1}{a+bO_1}\left(-1+\frac{1}{\alpha}\right)^{(-1+\alpha)^2}(1-\alpha)^{-2(-1+\alpha)\alpha}\alpha^{(-1+\alpha)\alpha}A_x^{2-\alpha}A_y^{-1+\alpha}$$
$$*\left(b\left(-1+\frac{1}{\alpha}\right)^{-(-1+\alpha)^2}(1-\alpha)^{2(-1+\alpha)\alpha}\alpha^{-(-1+\alpha)\alpha}\beta A_x^{-2+\alpha}A_y^{1-\alpha}\right.$$
$$-\frac{4b\left(-1+\frac{1}{\alpha}\right)^{(-1+\alpha)\alpha}(-1+\alpha)^{\alpha}\alpha^{(-1+\alpha)^2}B_x^{-\alpha}B_y^{-1+\alpha}(a+bO_1)(-1+(-1+\alpha)O_1)\,{D_1}^{-2+\alpha}\,{D_2}^{1-\alpha}}{D_3}$$
$$+\frac{2b\left(-1+\frac{1}{\alpha}\right)^{(-1+\alpha)\alpha}(-1+\alpha)^{-1+\alpha}\alpha^{(-1+\alpha)^2}B_x^{-\alpha}B_y^{-1+\alpha}(1+O_1)(a+bO_1)\,D_1^{-1+\alpha}{D_2}^{1-\alpha}}{{D_3}^2}O_1(2a-bO_1)$$
$$\left.+\frac{4\left(-1+\frac{1}{\alpha}\right)^{(-1+\alpha)\alpha}(-1+\alpha)^{\alpha}\alpha^{(-1+\alpha)^2}B_x^{-\alpha}B_y^{-1+\alpha}(a+bO_1)(b+b\alpha O_1)\,{D_1}^{-1+\alpha}D_2^{-\alpha}}{D_3}\right) \quad (9)$$

$$D_1 = -2a - 2bO_1 + b(-1+\alpha)O_1^2 < 0$$

$$D_2 = 2a + 2bO_1 + b\alpha O_1^2 > 0$$

$$D_3 = 2a + 2bO_1 + bO_1^2 > 0$$

$0 \le O_1 \le 1$, $1/2 < \alpha < 1$ so $dO_1/d\beta < 0$.

Table 2: China's WTO commitments – Geographical Schedule

Sectors	98-2000	2001	2002	2003	2004	2005	2006	2007
Banking services –Geographical limitation for Operation of RMB		4 cities: Shenzhen, Shanghai, Dalian, Tianjin	9 cities: Guangzhou, Zhuhai, Qingdao, Nanjing, Wuhan	12 cities: Beijing, Xiamen, Kunming	16 cities: Shantou, Ningbo, Shenyang, Xi'an	no		
Insurance services		Shanghai, Guangzhou, Dalian Shenzhen, Foshan			Plus other cities 1 [a]	no		
Telecom services –Value-added and Paging Services (Including Internet)		Beijing, Shanghai, Guangzhou	Plus other cities 2[b]	no				
– Mobile Voice and Data service			Beijing, Shanghai, Guangzhou			Plus other cities 2	no	
– Domestic and International Service					Beijing, Shanghai, Guangzhou			Plus other cities 2
Professional Services – Legal Services		cities 3[c]	no					
Distribution – Wholesale	5 SEZs [d]	no						
– Retail	capital cities [e]	no						

[a]Other cities 1 include Beijing, Chengdu, Chongqing, Fuzhou, Suzhou, Xiamen, Ningbo, Shenyang, Wuhan, Tianjin

[b]Other cities 2 include Chengdu, Chongqing, Dalian, Fuzhou, Hangzhou, Nanjing, Ningbo, Qingdao, Shenyang, Shenzhen, Xiamen, Xian, Taiyuan, Wuhan

[c]Cities 3 include Beijing, Shanghai, Guangzhou, Shenzhen, Haikou, Dalian, Qingdao, Ningbo, Yantai, Tianjin, Suzhou, Xiamen, Zhuhai, Hangzhou, Fuzhou, Wuhan, Chengdu, Shenyang and Kunming

[d]Special Economic Zones

[e]Capital cities of all provinces and autonomous regions, independent planning cities

Table 3: Productivity comparison USA and China

China services sectors	1998	1999	2000	2001	2002	Mean
Transport, Storage, Post and Telecommunication	20.61	22.06	26.66	29.29	30.81	25.89
Wholesale and Retail Trade & Catering Services	14.16	14.54	15.61	16.72	17.06	15.62
Finance and real estate	150.13	150.37	161.69	168.49	175.62	161.26
Social Services	30.52	31.35	35.29	39.49	39.92	35.31
Health Care, Sports and Social Welfare	14.38	15.41	16.93	20.00	21.66	17.68
Education, Culture and Arts, Radio, Film and television	11.60	13.38	15.28	17.66	19.75	15.53
Scientific Research and Polytechnic Services	26.45	32.17	35.89	42.59	49.31	37.28

USA services sectors	1998	1999	2000	2001	2002	Mean
Wholesale trade	92.54	97.01	100.76	104.15	107.75	100.44
Retail trade	40.56	41.88	42.46	44.10	46.42	43.08
Transportation and warehousing	65.29	66.51	67.48	67.23	71.41	67.58
Information	119.28	130.17	125.91	131.97	142.85	130.03
Finance, insurance, real estate, rental, and leasing	220.67	229.92	242.55	258.40	267.77	243.86
Professional and business services	59.09	61.19	65.58	69.32	72.42	65.52
Educational services, health care, and social assistance	40.79	41.97	43.46	45.67	47.73	43.92
Arts, entertainment, recreation, accommodation, and food services	27.37	28.55	29.37	29.78	31.13	29.24
Other services, except government	33.02	33.59	35.24	36.44	36.82	35.02

Table 4: Summary statistics

Variables	east	non-east	h-s users	l-s users	foreign	domestic	exporters	non-exporters
employment	536.4253	779.4055	564.1602	617.6502	590.3286	603.1183	831.432	421.0668
	(2301.947)	(3467.621)	(1541.084)	(3083.727)	(1676.814)	(2987.835)	(3407.811)	(1863.506)
capital	73450.77	106188.7	98216.25	73310.29	80819.3	82389.78	107686.3	62135.75
	(631759.8)	(816620.6)	(661019)	(696344.7)	(505975.3)	(750185.4)	(896602.4)	(458632.6)
productivity								
labor productivity	5.22744	4.704534	5.241714	5.013653	5.423246	4.945534	5.150332	5.047922
	(1.08593)	(1.124097)	(1.134128)	(1.103701)	(1.113551)	(1.090515)	(1.083498)	(1.144463)
FE TFP	1.839194	1.790064	1.861289	1.808192	1.896713	1.795336	1.858103	1.802282
	(.3109646)	(.3588432)	(.3549442)	(.3060281)	(.311442)	(.3256269)	(.3198519)	(.3263371)
OP TFP	.8313363	.8276764	.8459589	.8221938	.8550554	.8194407	.8275587	.8325628
	(.272334)	(.3256662)	(.3217187)	(.2666448)	(.273045)	(.2924032)	(.2808194)	(.2917376)
GMM TFP	3.926798	3.835433	3.973369	3.866258	4.052038	3.837125	4.014499	3.817877
	(.5099818)	(.5499959)	(.5611648)	(.4964035)	(.5121605)	(.5128506)	(.5277987)	(.5013012)
GMMts TFP	3.335319	3.292928	3.384497	3.292712	3.440991	3.272595	3.413964	3.255684
	(.4461162)	(.4839476)	(.4931489)	(.4327218)	(.4479164)	(.4507806)	(.4640932)	(.4384778)
LP TFP	2.326815	2.273116	2.342894	2.304525	2.360747	2.291916	2.353503	2.282882
	(.140909)	(.1509334)	(.1524989)	(.139255)	(.1220886)	(.1499418)	(.1345265)	(.1450097)
total outsouring	131565	102450.4	170257.6	99685.33	183349	97725.99	194545.4	69974.53
	(862399)	(701174.1)	(1080492)	(647667.2)	(1070145)	(685223.2)	(1153439)	(415057.9)
services outsouring	30943.01	29689.02	35098.8	27215.11	38931.3	26159.45	38080.89	20606.75
	(325489.1)	(180868.7)	(281599.3)	(190881.4)	(168416.4)	(248364.7)	(222465)	(232453.8)
service FDI reg pen	5.914096	3.537945						
	(.9024413)	(.7204338)						
service FDI ind pen			10.86239	10.09563				
			(.8102197)	(1.027019)				
observations	213382	74311	99303	188390	88431	199262	124618	161810

Table 5: Summary statistics 2

	high labor productivity		low labor productivity	
Share of east firms	0.81489		0.67313	
Share of h-s firms	0.383206		0.309535	
Share of exporters	0.448866		0.420172	
Share of FIEs	0.383853		0.235736	
	Mean	Std. Dev	Mean	Std. Dev
Total outsourcing	217033.6	(1158128)	36930.32	(206064.2)
Services outsourcing	43240.56	(290728.3)	11710.18	(74953.41)
Total o/s intensity	34.43337	(273.1749)	8.940819	(121.5777)
Services o/s intensity	4.678265	(10.57043)	1.683189	(1.919804)
service FDI reg pen	5.603281	(1.220735)	5.01739	(1.400593)
service FDI ind pen	10.3915	(.9904092)	10.33332	(1.054884)

Table 6: Production function estimation results

	(1)FE	(2)OP	(3)LP	(4)GMM	(5)GMM t-s
VARIABLES	lngyzcz	lngyzcz	lngyzcz	lngyzcz	lngyzcz
lngdzch	0.0593***	0.0621***	.02	0.0418***	0.0216***
	(0.000901)	(0.00182)	(.003188)	(0.00245)	(0.00231)
lncyry	0.0832***	0.0563***	.0476274	0.0355***	-8.96e-05
	(0.00117)	(0.000846)	(.0011802)	(0.00315)	(0.00287)
lnzjtrj	0.755***	0.864***	.95	0.594***	0.688***
	(0.000884)	(0.00180)	(.0047337)	(0.00989)	(0.00819)
Observations	286902	1148137	299089	223966	225063

Notes: *, **, *** indicate significant at 10%, 5% and 1%. In the parentheses is standard errors. The unreported coefficients include the variables of age and trend. *lngyzcz*is the log form of gross production, *lngdzch* is log form of total fixed capital, *lncyry* is average employment, *lnzjtrj* is total intermediate inputs.

Table 7: productivity premium and service outsourcing

A

Dependent variable	(1) lnTFPFE	(2) lnTFPFE	(3) lnTFPFE	(4) lnTFPFE
east dummy	0.00288**			
	(0.00119)			
h-s industry dummy		0.0308***		
		(0.00529)		
foreign FIEs dummy			0.0126***	
			(0.00111)	
H-M-T FIEs dummy			0.00828***	
			(0.00113)	
exporter dummy				0.00764***
				(0.000753)
Observations	229679	229679	229679	229679
No. of groups	28621	28621	28621	28621

B

Dependent variable	(1)FE lnTFP	(2)FE lnTFP	(3)OP lnTFP	(4)OP lnTFP	(5)LP lnTFP	(6)LP lnTFP	(9)GMMts lnTFP	(10)GMMts lnTFP
T-O (t-1)	0.0446		0.0307***		0.0546***		0.0443***	
	(0.000477)		(0.000938)		(0.000230)		(0.000282)	
S-O (t-1)		0.00806***		0.0119***		0.00233***		0.00628***
		(0.000632)		(0.00124)		(0.000331)		(0.000389)
Observations	206373	69001	206154	68955	206420	69011	206414	69009
R-squared	0.119	0.025	0.035	0.012	0.360	0.039	0.237	0.036
Number of frdm	28508	26324	28507	6307	28508	26325	28508	26324

Note: All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies,industry-year dummies and firm fixed effect. Random-effect models are used for table A and fixed-effect models for table B. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$.

Table 8: Regression results with interactions (TFPFE)

Dependent variable	(1) lnTFPFE	(2) lnTFPFE	(3) lnTFPFE	(4) lnTFPFE	(5) lnTFPFE	(6) lnTFPFE	(7) lnTFPFE	(8) lnTFPFE
deast*T-O(t-1)	0.0407***							
	(0.000524)							
deast*S-O(t-1)		0.00763***						
		(0.000704)						
dindsi*T-O(t-1)			0.00527***					
			(0.000295)					
dindsi*S-O(t-1)				0.00723***				
				(0.00104)				
dexp*T-O(t-1)					0.0142***			
					(0.000477)			
dexp*S-O(t-1)						0.00403***		
						(0.000871)		
dFIEs-f*T-O(t-1)							0.0188***	
							(0.000842)	
dFIEs-hmt*T-O(t-1)							0.0163***	
							(0.000854)	
dFIEs-f*S-O(t-1)								0.00589***
								(0.00135)
dFIEs-hmt*S-O(t-1)								0.00319**
								(0.00138)
Observations	206373	69001	206373	69001	206373	69001	206373	69001
R-squared	0.106	0.024	0.078	0.022	0.079	0.022	0.022	0.078
Number of firms	28508	26324	28508	26324	28508	26324	28508	26324

Note: All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 9: Regression results with interactions (TFPOP)

Dependent variable	(1) lnTFPOP	(2) lnTFPOP	(3) lnTFPOP	(4) lnTFPOP	(5) lnTFPOP	(6) lnTFPOP	(7) lnTFPOP	(8) lnTFPOP
deast*T-O(t-1)	0.0268***							
	(0.00102)							
deast*S-O(t-1)		0.0114***						
		(0.00138)						
dindsi*T-O(t-1)			0.00429***					
			(0.000568)					
dindsi*S-O(t-1)				0.00959***				
				(0.00205)				
dexp*T-O(t-1)					0.0120***			
					(0.000921)			
dexp*S-O(t-1)						0.00532***		
						(0.00171)		
dFIEs-f*T-O(t-1)							0.00883***	
							(0.00165)	
dFIEs-hmt*T-O(t-1)							0.0116***	
							(0.00162)	
dFIEs-f*S-O(t-1)								0.0117***
								(0.00264)
dFIEs-hmt*S-O(t-1)								0.00604**
								(0.00272)
Observations	206154	68955	206154	68955	206154	68955	206154	68955
R-squared	0.033	0.011	0.029	0.010	0.029	0.010	0.036	0.010
Number of frdm	28507	26307	28507	26307	28507	26307	28507	26307

Notes: All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 10: Regression results with interactions (TFPLP)

Dependent variable	(1) lnTFPLP	(2) lnTFPLP	(3) lnTFPLP	(4) lnTFPLP	(5) lnTFPLP	(6) lnTFPLP	lnTFPLP	lnTFPLP
deast*T-O(t-1)	0.0500***							
	(0.000263)							
deast*S-O(t-1)		0.00175***						
		(0.000369)						
dindsi*T-O(t-1)			0.00626***					
			(0.000159)					
dindsi*S-O(t-1)				0.00496***				
				(0.000545)				
dexp*T-O(t-1)					0.0159***			
					(0.000256)			
dexp*S-O(t-1)						0.00372***		
						(0.000455)		
dFIEs-f*T-O(t-1)							0.0239***	
							(0.000452)	
dFIEs-hmt*T-O(t-1)							0.0218***	
							(0.000458)	
dFIEs-f*S-O(t-1)								0.000945
								(0.000705)
dFIEs-hmt*S-O(t-1)								0.000101
								(0.000725)
Observations	206420	69011	206420	69011	206420	69011	206420	69011
R-squared	0.300	0.038	0.165	0.040	0.176	0.038	0.179	0.040
Number of frdm	28508	26325	28508	26325	28508	26325	28508	26325

Notes:All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 11: Regression results with interactions: TFPGMMts

Dependent variable	(1)GMM lnTFP	(2)GMM lnTFP	(3)GMM lnTFP	(4)GMM lnTFP	(5)GMM lnTFP	(6)GMM lnTFP	(7)GMM lnTFP	(8)GMM lnTFP
deast*T-O(t-1)	0.0415***							
	(0.000313)							
deast*S-O(t-1)		0.00600***						
		(0.000433)						
dindsi*T-O(t-1)			0.00545***					
			(0.000181)					
dindsi*S-O(t-1)				0.00573***				
				(0.000642)				
dexp*T-O(t-1)					0.0139***			
					(0.000293)			
dexp*S-O(t-1)						0.00327***		
						(0.000536)		
dFIEs-f*T-O(t-1)							0.0207***	
							(0.000517)	
dFIEs-hmt*T-O(t-1)							0.0180***	
							(0.000524)	
dFIEs-f*S-O(t-1)								0.00442***
								(0.000829)
dFIEs-hmt*S-O(t-1)								0.00261***
								(0.000853)
Observations	206414	69009	206414	69009	206414	69009	206414	69009
R-squared	0.209	0.035	0.135	0.032	0.141	0.031	0.142	0.031
Number of frdm	28508	26324	28508	26324	28508	26324	28508	26324

Notes:All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 12: Regression results with first-difference (ΔTFPFE)

Dependent variable	(1) ΔTFPFE	(2) ΔTFPFE	(3) ΔTFPFE	(4) ΔTFPFE	(5) ΔTFPFE	(6) ΔTFPFE	(7) ΔTFPFE	(8) lnTFPOP
deast*Δ T-O(t-1)	0.0727***							
	(0.00129)							
deast*Δ S-O(t-1)		0.255***						
		(0.0132)						
dindsi*Δ T-O(t-1)			0.0692***					
			(0.00153)					
dindsi*Δ S-O(t-1)				0.154***				
				(0.0158)				
dexp* Δ T-O(t-1)					0.0936***			
					(0.00203)			
dexp*Δ S-O(t-1)						0.292***		
						(0.0229)		
dFIEs-f* Δ T-O(t-1)							0.0390***	
							(0.00256)	
dFIEs-hmt* Δ T-O(t-1)							0.382***	
							(0.00713)	
dFIEs-f*Δ S-O(t-1)								0.313***
								(0.0305)
dFIEs-hmt*Δ S-O(t-1)								0.340***
								(0.0448)
Observations	228074	57263	228074	57648	228209	57648	228209	57648
R-squared	0.056	0.024	0.050	0.008	0.014	0.011	0.019	0.011
Number of firms	29133	28985	29133	29116	29138	29116	29138	29116

Notes:All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 13: Regression results with first-difference (ΔTFPOP)

Dependent variable	(1) ΔTFPOP	(2) ΔTFPOP	(3) ΔTFPOP	(4) ΔTFPOP	(5) ΔTFPOP	(6) ΔTFPOP	(7) ΔTFPOP	(8) lnTFPFE
deast*Δ T-O(t-1)	0.0744***							
	(0.00137)							
deast*Δ S-O(t-1)		0.244***						
		(0.0145)						
dindsi*Δ T-O(t-1)			0.0843***					
			(0.00168)					
dindsi*Δ S-O(t-1)				0.125***				
				(0.0163)				
dexp* Δ T-O(t-1)					0.101***			
					(0.00218)			
dexp*Δ S-O(t-1)						0.304***		
						(0.0253)		
dFIEs-f* Δ T-O(t-1)							0.0442***	
							(0.00275)	
dFIEs-hmt* Δ T-O(t-1)							0.422***	
							(0.00766)	
dFIEs-f*Δ S-O(t-1)								0.337***
								(0.0337)
dFIEs-hmt*Δ S-O(t-1)								0.350***
								(0.0495)
Observations	228074	57263	228209	57617	228209	57648	228209	57648
R-squared	0.069	0.022	0.015	0.128	0.013	0.009	0.018	0.010
Number of firms	29133	28985	29138	29091	29138	29116	29138	29116

Notes:All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 14: Regression results with ΔTFPLP

Dependent variable	(1) ΔTFPLP	(2) ΔTFPLP	(3) ΔTFPLP	(4) ΔTFPLP	(5) ΔTFPLP	(6) ΔTFPLP	(7) ΔTFPLP	(8) lnTFPLP
deast*Δ T-O(t-1)	0.0460***							
	(0.00225)							
deast*Δ S-O(t-1)		0.131***						
		(0.0178)						
dindsi*Δ T-O(t-1)			0.0498***					
			(0.00299)					
dindsi*Δ S-O(t-1)				0.0788***				
				(0.0232)				
dexp* Δ T-O(t-1)					0.0764***			
					(0.00388)			
dexp*Δ S-O(t-1)						0.0649*		
						(0.0340)		
dFIEs-f* Δ T-O(t-1)							0.0428***	
							(0.00491)	
dFIEs-hmt* Δ T-O(t-1)							0.377***	
							(0.0137)	
dFIEs-f*Δ S-O(t-1)								0.104***
								(0.00865)
dFIEs-hmt*Δ S-O(t-1)								0.109***
								(0.00872)
Observations	228102	57386	228102	57386	228102	57386	228102	57011
R-squared	0.005	0.008	0.004	0.007	0.005	0.006	0.007	0.017
Number of firms	29136	29115	29136	29115	29136	29115	29136	28986

Notes:All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. To avoid the endogenity problem, Δ TFPLP is taken as second difference. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 15: Regression results with first-difference (ΔTFPGMM)

Dependent variable	(1)GMM ΔTFP	(2)GMM ΔTFP	(3)GMM ΔTFP	(4)GMM ΔTFP	(5)GMM ΔTFP	(6)GMM ΔTFP	(7)GMM ΔTFP	(8)GMM ΔTFP
deast*Δ T-O(t-1)	0.0700***							
	(0.00122)							
deast*Δ S-O(t-1)		0.272***						
		(0.0117)						
dindsi*Δ T-O(t-1)			0.0737***					
			(0.00147)					
dindsi*Δ S-O(t-1)				0.131***				
				(0.0137)				
dexp* Δ T-O(t-1)					0.0828***			
					(0.00191)			
dexp*Δ S-O(t-1)						0.276***		
						(0.0203)		
dFIEs-f* Δ T-O(t-1)							0.0314***	
							(0.00241)	
dFIEs-hmt* Δ T-O(t-1)							0.323***	
							(0.00671)	
dFIEs-f*Δ S-O(t-1)								0.281***
								(0.0269)
dFIEs-hmt*Δ S-O(t-1)								0.324***
								(0.0396)
Observations	228074	57263	228209	57617	228209	57648	228209	57648
R-squared	0.032	0.024	0.014	0.042	0.011	0.010	0.014	0.010
Number of firms	29133	28985	29138	29091	29138	29116	29138	29116

Notes:All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 16: Dynamic panel: TFPGMMts

Dependent variable	(1)GMM lnTFP	(2)GMM lnTFP	(3)GMM lnTFP	(4)GMM lnTFP	(5)GMM lnTFP	(6)GMM lnTFP	(7)GMM lnTFP	(8)GMM lnTFP
L.lntfpgmmts	.0536529***	.0546514***	.0546703***	.0535756***	.0553062***	.0541149***	0645867***	.0546155***
	(0.0403346)	(.0065945)	(.0444122)	(.0067288)	(.0442548)	(.006819)	(.0437821)	(.006517)
deast*T-O(t-1)	.028698***							
	(.0029472)							
deast*S-O(t-1)		.0049854***						
		(.0008059)						
dindsi*T-O(t-1)			.0049609***					
			(.0005266)					
dindsi*S-O(t-1)				.0038782 ***				
				(.0009235)				
dexp*T-O(t-1)					.0059174***			
					(.0007107)			
dexp*S-O(t-1)						.0034807***		
						(.0009008)		
dFIEs-f*T-O(t-1)							.0154753 ***	
							(.0016222)	
dFIEs-hmt*T-O(t-1)							.0129473 ***	
							(.0016745)	
dFIEs-f*S-O(t-1)								.0020066***
								(.0012187)
dFIEs-hmt*S-O(t-1)								.0019085***
								(.0009892)
Arellano-Bond AR(1)	0.0	0.1471	0.0	0.1505	0.0	0.1499	0.0	0.1510
Arellano-Bond AR(2)	0.7987	–	0.1647	–	0.1805	–	0.2156	–
Observations	164769	41401	164769	41401	164769	41401	164769	41401
Number of group	27298	22439	27298	22439	27298	22439	27298	22439

Notes: All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. WC-Robust Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$. P values are reported for Arellano-Bond test for first and second-order serial correlation.

Table 17: Dynamic panel: Δ TFPGMMts

Dependent variable	(1)Δ GMM lnTFP	(2)Δ GMM lnTFP	(3)Δ GMM lnTFP	(4)Δ GMM lnTFP
L.Δ tfpgmmts	-.3865944***	-.3999229***	-.4076592***	-.3537791***
	(.0144665)	(.0167513)	(.0143549)	(.0156075)
deast*Δ T-O(t-1)	.0738797 ***			
	(.0153604)			
dindsi*Δ T-O(t-1)		.074584**		
		(.0411531)		
dexp*Δ T-O(t-1)			.0831797 ***	
			(.0347087)	
dFIEs-f*Δ T-O(t-1)				.6039344***
				(.0928849)
dFIEs-hmt*Δ T-O(t-1)				.4366405***
				(.0601646)
Observations	123550	123550	123550	123550
Number of group	26431	26431	26431	26431
Arellano-Bond AR(2)(P-value)	0.6167	0.7144	0.5920	0.5719

Notes: All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. WC-Robust Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 18: Estimated production function coefficients, GMMTS

Industry (code of SCI2002)	capital	employment	inputs	firm No
Mining & Washing of Coal (6)	0.0488	0.0616	0.785	5395
Oil and Gas(7)	0.429	0.0585	0.0624	86
Mining & Processing of Ferrous Metal Ores (8)	0.0204	0.0718	0.860	948
Mining & Processing of Non-Ferrous Metal (9)	0.146	-0.0363	0.613	636
Mining & Processing of Nonmetal Ores (10)	0.0398	0.0471	0.604	1737
Processing of Food (13)	0.0236	0.0216	0.639	11407
Manufacture of Foods (14)	0.0259	0.0284	0.695	6083
Manufacture of Beverages (15)	0.0309	-0.00739	0.791	4553
Manufacture of Tobacco (16)	-0.0532	0.0314	0.695	496
Manufacture of Textile (17)	0.0297	0.0182	0.822	19006
Manufacture of Apparel, Footware & Caps (18)	0.0207	-0.0156	0.729	12426
Manufacture of Leather, Fur, & Feather (19)	0.0168	0.00714	0.736	5690
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm & Straw Products (20)	-0.00835	-0.0197	0.701	2422
Manufacture of Furniture (21)	0.0245	0.00542	0.818	2032
Manufacture of Paper & Paper Products (22)	0.0210	0.0112	0.715	7472
Printing, Reproduction of Recording Media (23)	0.0232	0.0203	0.594	5993
Manufacture of Articles For Culture, Education and Sport Activities (24)	.028579	-.0040159	.6748036	4169
Processing of Petroleum, Coking, & Fuel (25)	.0258372	.0498437	.8469876	1711
Manufacture of Raw Chemical Materials (26)	.0155238	-.0036711	.7699521	20656
Manufacture of Medicines (27)	.0213386	-.0469723	.7323604	7565
Manufacture of Chemical Fibers (28)	0.0567	0.0133	0.833	1409
Manufacture of Rubber (29)	0.0370	-0.00528	0.769	3607
Manufacture of Plastics (30)	0.0325	0.00319	0.690	11511
Manufacture of Non-metallic Mineral goods (31)	0.0199	0.000399	0.712	23212
Smelting & Pressing of Ferrous Metals (32)	0.0235	0.0542	0.815	4218
Smelting & Pressing of Non-ferrous Metals (33)	0.0225	0.00781	0.840	3661
Manufacture of Metal Products (34)	0.0317	0.0113	0.699	17079
Manufacture of General Purpose Machinery(35)	0.0194	-0.0444	0.723	21292
Manufacture of Special Purpose Machinery (36)	0.0357	-0.00261	0.675	11716
Manufacture of Transport Equipment (37)	0.0232	0.0451	0.677	13514
Electrical Machinery & Equipment (39)	.0580024	-.0052943	.6883926	9157
Manufacture of Communication Equipment, Computers & Other Electronic Equipment (40)	.0280426	.0405231	.711129	14133
Manufacture of Measuring Instruments, Machinery for Cultural Activity (41)	.0018269	.0615534	.5766619	7569
Manufacture of Artwork (42)	.018114	.03261	.7040473	4298
Power, water and gas (44-47)	.0610465	.1523466	.4822784	20762
Total	.0216243	-.0000896	.6875364	287694

Table 19: Robust Test for TFP with industry differences

Dependent variable	(1)GMM ΔTFP	(2)GMM ΔTFP	(3)GMM ΔTFP	(4)GMM ΔTFP	(5)GMM ΔTFP	(6)GMM ΔTFP	(7)GMM ΔTFP	(8)GMM ΔTFP
deast*ΔT-O(t-1)	0.0731***							
	(0.00149)							
deast*ΔS-O(t-1)		0.259***						
		(0.0128)						
dindsi*ΔT-O(t-1)			0.0771***					
			(0.00179)					
dindsi*ΔS-O(t-1)				0.123***				
				(0.0146)				
dexp*ΔT-O(t-1)					0.0928***			
					(0.00233)			
dexp*ΔS-O(t-1)						0.296***		
						(0.0220)		
dFIEs-f*ΔT-O(t-1)							0.0379***	
							(0.00294)	
dFIEs-hmt*ΔT-O(t-1)							0.368***	
							(0.00820)	
dFIEs-f*ΔS-O(t-1)								0.319***
								(0.0292)
dFIEs-hmt*ΔS-O(t-1)								0.341***
								(0.0430)
Observations	228064	57263	228199	57617	228199	57648	228199	57648
R-squared	0.083	0.066	0.062	0.116	0.061	0.054	0.064	0.054
Number of firms	29133	28985	29138	29091	29138	29116	29138	29116

Notes:All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. Standard errors are in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 20: Regression results with control of tariffs and wage (ΔTFPGMM)

Dependent variable	(1)GMM ΔTFP	(2)GMM ΔTFP	(3)GMM ΔTFP	(4)GMM ΔTFP	(5)GMM ΔTFP	(6)GMM ΔTFP	(7)GMM ΔTFP	(8)GMM ΔTFP
deast*Δ T-O(t-1)	0.0778***							
	(0.00162)							
deast*Δ S-O(t-1)		0.247***						
		(0.0143)						
dindsi*Δ T-O(t-1)			0.0857***					
			(0.00258)					
dindsi*Δ S-O(t-1)				.0311604***				
				(0.010991)				
dexp* Δ T-O(t-1)					0.377***			
					(0.00593)			
dexp*Δ S-O(t-1)						0.195***		
						(0.0224)		
dFIEs-f* Δ T-O(t-1)							0.0271***	
							(0.00251)	
dFIEs-hmt* Δ T-O(t-1)							0.392***	
							(0.00841)	
dFIEs-f*Δ S-O(t-1)								0.234***
								(0.0311)
dFIEs-hmt*Δ S-O(t-1)								0.167***
								(0.0421)
$\Delta tariff$ (t-1)	0.00112***	-0.00433*	0.00111***	-0.00401	0.00118***	-0.00426*	0.00150***	-0.00429*
	(0.000394)	(0.00250)	(0.000396)	(0.00251)	(0.000392)	(0.00251)	(0.000400)	(0.00251)
Δ wage (t-1)	$8.41e-06*$	$8.13e-05**$	$8.43e-06*$	$8.15e-05**$	$8.82e-06*$	$8.15e-05**$	$9.43e-064*$	$8.18e-05**$
	$(5.07e-06)$	$(3.73e-05)$	$(5.09e-06)$	$(3.76e-05)$	$(5.03e-06)$	$(3.75e-05)$	$(5.14e-06)$	$(3.75e-05)$
Observations	142497	20624	142497	20624	142504	20624	142547	20624
R-squared	0.05	0.020	0.04	0.010	0.07	0.013	0.024	0.013

Notes:All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies, industry-year dummies and firm fixed effect. Standard errors in parentheses, $***p<0.01, **p<0.05, *p<0.1$

Table 21: Regression of FDI penetration

VARIABLES	(1) lntfpgmmts	(2) lntfpgmmts	(3) lntfpgmmts	(4) lntfpgmmts
FDI regional penetration (t-1)	0.209***			
	(0.0415)			
FDI industrial penetration (t-1)		0.114**		
		(0.0528)		
FDI regional penetration (t-2)			0.208***	
			(0.0442)	
FDI industrial penetration (t-2)				0.0532*
				(0.0281)
Observations	206399	205171	184576	183403
R-squared	0.182	0.136	0.158	0.127
Number of frdm	28512	28405	28386	28283

Notes:All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 22: Policy Difference in difference

VARIABLES	(1) lntfpols	(2) lntfpop	(3) lntfpgmm	(4) lntfpgmmts
dindsi2	-0.00140	-0.0590***	0.0119***	0.0119***
	(0.00257)	(0.00490)	(0.00182)	(0.00268)
dyearwto	0.0238***	0.0226***	0.0242***	0.0224***
	(0.000664)	(0.00129)	(0.000450)	(0.000471)
dwto*dindsi	0.0114***	0.0110***	0.0133***	0.0134***
	(0.00123)	(0.00236)	(0.000831)	(0.000878)
Observations	164966	164826	164996	164995
R-squared	0.377	0.133	0.612	0.587

VARIABLES	(1) lntfpols	(2) lntfpop	(3) lntfpgmm	(4) lntfpgmmts
deast	-0.00787***	-0.0293***	-0.00543***	-0.0132***
	(0.000903)	(0.00175)	(0.000606)	(0.000637)
dyearwto	0.0269***	0.0259***	0.0253***	0.0224***
	(0.000855)	(0.00167)	(0.000552)	(0.000580)
dwto*deast	0.00409***	0.00401**	0.00577***	0.00673***
	(0.000911)	(0.00175)	(0.000616)	(0.000644)
Observations	164966	164826	164996	164995
R-squared	0.377	0.133	0.612	0.587

Notes:All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 23: Regression results of second difference: ΔTFPGMMts

Dependent variable	(1)GMM lnTFP	(2)GMM lnTFP	(3)GMM lnTFP	(4)GMM lnTFP	(5)GMM lnTFP	(6)GMM lnTFP	(7)GMM lnTFP	(8)GMM lnTFP	(9)GMM lnTFP	(10)GMM lnTFP
deast*T-O(t-2)	0.0667***									
	(0.0203)									
deast*S-O(t-2)		0.0779*								
		(0.0442)								
dindsi*T-O(t-2)			0.0641***							
			(0.0205)							
dindsi*S-O(t-2)				0.297***						
				(0.0460)						
dexp*T-O(t-2)					0.0572**					
					(0.0244)					
dexp*S-O(t-2)						0.237***				
						(0.0491)				
dFIEs-f*T-O(t-2)							0.0299			
							(0.0286)			
dFIEs-hmt*T-O(t-2)								0.288***		
								(0.0364)		
dFIEs-f*S-O(t-2)									0.152***	
									(0.0382)	
dFIEs-hmt*S-O(t-2)										0.337***
										(0.0419)
Observations	199114	28539	199024	28353	199114	28542	199114	28542	199114	28542
R-squared	0.056	0.038	0.020	0.034	0.011	0.016	0.006	0.013	0.015	0.010

Notes:All the models include the control for firm size, ownership, financial constraint, region-year fixed dummies ,industry-year dummies and firm fixed effect. Standard errors in parentheses, $***p < 0.01, **p < 0.05, *p < 0.1$

Table 24: Tariffs

	2006	2005	2004	2003	2002	2001	2000	1999
Average	8.86	8.93	9.34	10.32	11.36	14.55	15.68	16.21
Coal Mining and Dressing	4.13	4.13	3.90	3.90	4.13	4.13	4.25	4.25
Petroleum and Natural Gas Extraction	4.77	4.77	4.77	5.23	5.29	6.39	6.36	6.36
Ferrous Metals Mining and Dressing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nonferrous Metals Mining and Dressing	1.34	1.34	1.34	1.42	1.39	1.21	2.00	1.86
Nonmetal Minerals Mining and Dressing	3.63	3.63	3.66	3.67	3.68	3.76	4.40	3.68
Logging and Transport of Timber and Bamboo	0.74	0.74	1.56	0.74	1.23	1.55	1.60	1.60
Food Processing and Manufacturing	15.45	17.58	17.10	20.42	21.80	27.55	28.71	27.54
Beverage Production	21.00	20.44	24.70	29.82	32.76	43.66	46.52	49.22
Tobacco Processing	41.00	41.00	41.00	44.20	48.00	57.00	65.00	65.00
Textile Industry	11.33	11.66	13.30	15.27	17.19	20.58	21.83	23.79
Garments and Other Fiber Products	15.83	15.91	17.70	19.10	21.67	24.28	27.43	30.60
Leather, Furs,and Wool Products Manufacturing	15.02	15.42	15.80	16.14	16.92	20.20	21.59	19.80
Timber Processing , Bamboo, Cane, Palm Fiber and Straw Products	4.75	5.13	4.60	6.16	7.59	11.89	11.14	11.99
Furniture Manufacturing	0.98	1.07	4.50	7.65	11.25	20.47	21.14	21.11
Papermaking and Paper Products	5.70	5.70	7.75	7.80	9.56	14.36	15.30	15.45
Printing and Record Medium Reproduction	3.13	3.13	3.10	3.13	3.76	5.31	5.67	5.91
Cultural, Educational and Sports Goods	15.63	12.02	12.50	14.52	15.79	18.47	19.12	18.73
Petroleum Processing and Coking Products	6.36	6.36	6.40	6.53	6.46	7.41	7.76	9.39
Raw Chemical Materials and Chemical Products	7.04	6.90	6.64	7.28	7.59	9.96	11.13	10.40
Medical and Pharmaceutical Products	4.88	4.81	4.61	4.89	5.95	10.56	11.21	11.27
Chemical Fibers	8.12	8.18	13.02	13.69	16.95	22.35	23.99	25.10
Rubber Products	12.76	12.76	8.56	13.09	13.47	15.20	15.54	15.37
Plastic Products	9.90	8.74	8.85	10.09	11.31	15.76	16.78	16.84
Nonmetal Mineral Products	12.50	13.58	13.66	13.69	15.07	17.77	18.37	17.28
Smelting and Pressing of Ferrous Metals	5.07	5.09	5.24	5.33	5.51	7.85	8.59	18.14
Smelting and Pressing of Nonferrous Metals	5.11	5.11	5.04	5.15	5.23	6.36	7.49	6.81
Metal Products	10.11	10.26	10.77	10.37	11.75	12.12	13.04	13.10
Ordinary Machinery Manufacturing	9.42	9.39	8.90	9.77	10.27	13.77	14.50	14.52
Special Purpose Equipment Manufacturing	6.65	7.40	7.46	7.93	8.66	12.69	13.00	12.90
Transportation Equipment Manufacturing	12.78	13.38	15.95	16.05	17.37	23.84	26.74	26.73
Electric Equipment and Machinery	10.15	10.30	9.97	10.65	11.66	16.12	16.71	16.70
Electronic and Telecommunications	6.92	6.94	7.35	8.40	8.82	5.58	16.37	18.39
Instruments,Meters,Cultural and Official Machinery	8.26	10.01	10.43	10.59	11.40	14.85	15.92	15.89
Other Manufacturing	13.42	13.45	11.15	13.75	14.54	15.81	17.14	19.99