

The Economic Impact of Special Economic Zones: Evidence from Chinese Municipalities

Jin Wang*

London School of Economics

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Abstract

How large are the benefits of Special Economic Zones and what are the channels of these benefits? To shed some light on these questions, I collect a unique dataset of Chinese municipality economic statistics from 1978 to 2007 and use it to evaluate the impact of a Special Economic Zone experiment aimed at attracting foreign direct investment. Guided by three predictions from a theoretical model, I find the Special Economic Zone policy: 1) increases per capita foreign direct investment by 58%, mainly in the form of foreign-invested and export-oriented industrial enterprises; 2) does not crowd out domestic investment and domestically owned capital stock and 3) increases total factor productivity growth rate by 0.6 percentage points. The results suggest that creating Special Economic Zones not only brings capital, but also more advanced technology, and provide important policy implications for many developing countries.

Keywords: Special Economic Zones; Foreign Direct Investment; TFP

JEL codes: O16; O47; F21

*Department of Economics and STICERD, LSE. Email: J.Wang2@lse.ac.uk. I would like to thank my supervisor Oriana Bandiera and Tim Besley for their very helpful guidance and encouragement on this project. I also thank Robin Burgess, Greg Fischer, Maitreesh Ghatak, Guy Michaels, Gerard Padro-I-Miquel, Mark Schankerman, Cheng-gang Xu and Alwyn Young for their comments. I thank Joshua Angrist, Steve Pischke and Rajeev Dehejia for helpful advice on propensity score matching, Carsten A. Holz for comments on growth accounting. I am grateful to Junxin Feng for numerous help with the data collection, to STICERD members Madhav Aney, Fernando Aragon, Erlend Berg, Konrad Burchardi, Sónia Goncalves, Sanchari Roy and Sarah Sandford for helpful discussions. All remaining errors are mine.

1 Introduction

Special Economic Zones (SEZs) are contained geographic regions within countries - a demarcated area of land used to encourage industry, manufacturing, and services for export, and are typically characterized by more liberal laws and economic policies than a country's general economic laws¹. From 1979, China has gradually created SEZs in its municipalities with property rights protection, tax breaks and a preferential land policy specifically for foreign investors. This SEZ experiment has transformed China into one of the largest FDI recipients, exporters and foreign exchange reserve holders in the world². Figure 1 displays the significant correlation between the SEZ experiment and FDI outcome in China.

China is a prominent member in the group of countries which have experimented with the SEZs, and many other nations being from Asia to Latin America, Europe and Africa have turned to SEZs to attract foreign capital, boost exports, create jobs, stimulate industry and improve upon existing infrastructure. According to World Bank's latest report on SEZs released in 2008, "by some estimates, there are approximately 3,000 zones in 135 countries today, accounting for over 68 million direct jobs and over \$500 billion of direct trade-related value added within zones." Despite the fact that the SEZs have extensively influenced many countries, to my knowledge, there are no empirical studies on the SEZs using systematic statistical evidence.

In this paper, I exploit the establishment of SEZs in China since 1979, which constitutes a unique laboratory for the study of SEZs, to make three contributions to our understanding of the impact of SEZs on foreign direct investment and other outcomes. To do so, I collected a comprehensive new dataset on Chinese municipalities at which level the Special Economic Zone experiments were carried out. First, I estimate the effectiveness of Special Economic Zones on attracting foreign direct investment, mainly in the form of foreign-invested and export-oriented industrial enterprises. Second, I estimate the effect of Special Economic Zone policy on the

¹Refer to Semil Shah(2008).

²According to Prasad and Wei(2006), over the past decade, China has accounted for about one-third of gross FDI flows to all emerging markets and about 60 percent of these flows to Asian emerging markets. Even excluding flows from Hong Kong to China from these calculations (on the extreme assumption that all of these flows represent "round-tripping" of funds originating in China), China's share in these flows is still around 20% to all emerging markets and 50% of those flows to Asian emerging markets.

domestic investment and capital stock of the municipality. Finally, in addition to physical capital, I also check if the Special Economic Zone brings more advanced technology, i.e. higher total factor productivity growth.

The Chinese central government did not compile detailed information on the year and location of the creation of the SEZs until 2006. In 2008, in order to celebrate the 30th anniversary of "Open Door" reform³, China published brand new economic statistics on municipalities, mainly growth-accounting data. This is the first time that China prepared comprehensive statistics at the municipality level covering main economic indicators between 1978 and 2007. Based on these sources, I construct a new dataset for 326 Chinese municipalities⁴ containing information on GDP, investment, employment, foreign direct investment, exports as well as a digital GIS map of Chinese municipalities which is coded with the year the SEZ is created. This dataset allows me to track the evolution of China's municipality level economies before, during and after the expansion of Special Economic Zones. Information on municipality level GDP, investment and employment are particularly important, because they enable me to identify the channel through which municipalities gain from the expansion of Special Economic Zones (as I describe explicitly below).

To guide my empirical analysis, I develop a simple model mapping the foreign investor location decision to the municipality macroeconomic outcome. I use this model to assess empirically the importance of the Special Economic Zone experiment for productivity, since having FDI increases not only capital stock but also total factor productivity growth (i.e. technology⁵). The conceptual framework generates three hypotheses that drive my three step empirical analysis:

1. Special Economic Zones, by combining private property rights protection, tax break and preferential long-term land use fee, attract foreign direct investment;
2. Special Economic Zones, in the absence of any significant crowding out effect, do not reduce domestically owned capital formation;
3. Special Economic Zones, if bringing more advanced FDI, will boost municipality technology progress, i.e. total factor productivity growth.

³Basically, Open Door reform means liberalization.

⁴My dataset includes 326 out of 333 municipalities in China. Details are given in the data appendix.

⁵An ideal variable to measure prefecture technology is patents. However, there is no well kept statistics on prefecture level patents from 1978 to 2007. Therefore, I use TFP as a proxy.

Because China gradually expanded the Special Economic Zone experiment to its municipalities, I am able to identify the effect by exploring cross time within-municipality and cross municipality within-year variations. Despite the fact that almost all Chinese municipalities (300 out of 326 in my sample) carried out Special Economic Zone experiments by the end of 2007, there are still big concerns about potential endogeneity of the Special Economic Zone granting sequence and the validity of its estimated effects. Therefore, I use three strategies to mitigate this concern. First, I add municipality specific trend to control for unobserved changes in the local economic environment which might be correlated with the timing of SEZ establishment. Second, the potential endogeneity of the timing of SEZ establishment might make the municipalities that carried out the SEZ experiment later an unsuitable comparison group to those granted the SEZs earlier and consequently cast doubt on the validity of the estimated effects. I collected data on geographical location, industrial condition and human capital, based on which the State-council of China granted Special Economic Zones to municipalities in earlier years. This allows me to match municipalities which experimented with SEZs earlier to municipalities which experimented with SEZs later that are comparable in these indicators considered relevant for the outcomes under analysis. In this matching exercise each municipality which had SEZs in earlier years is matched with its closest counterpart which had SEZs in later years along these three dimensions. This approach implies that I am comparing early treated municipalities to late treated municipalities that are similar in terms of these three indicators before the Special Economic Zone experiment was carried out in China. Third, to prevent the results from being largely driven by the municipalities which had SEZs in earlier years and potentially had the most serious selection problem, I also examine the estimates restricting my sample to those municipalities which had SEZs in later years.

This paper contributes to the literature on special economic zones⁶, as well as a large literature on estimating the economic impacts of foreign direct investment⁷.

⁶According to Aradhna Aggarwal, Mombert Hoppe and Peter Walkenhorst(World Bank), current work on SEZs are mainly case studies including Willmore(1996) on Export Processing in the Caribbean; Kung(1985), Ge(1999) and Park(1997) on detailed descriptions of SEZ policy in China; Rolfe et. al(2004) on incentives of Kenyan Special Economic Zone; Aggarwal(2005) on Comparative Analysis of Special Economic Zone performance in India, Sri Lanka, and Bangladesh, etc.

Litwack and Qian(1998) develop a theory for a transition economy(China) under which an unbalanced development strategy that favors special economic zones.

⁷Some papers view the benefit of FDI as important source of capital stock using country level

My work to empirically examine the Special Economic Zone experiment under a cross-municipality framework is an important complement for current research on Special Economic Zone performance which are mainly case and theoretical studies⁸. My paper evaluates the impact of FDI brought by the SEZs at the municipality level and so builds a bridge between country level and firm level studies. Empirical work using cross country data have suffered from an omitted variable problem since different countries are characterized by very different institutional and cultural features, which may well correlate with foreign direct investment. Meanwhile, research using firm level data could provide cleaner estimates under a stronger identification strategy and pin down accurately how foreign multinational firms interact with domestic firms. However, these studies can say little about macro-level impact of foreign direct investment on the domestic economy. Because this paper uses variation within Chinese municipalities, many of the institutional, cultural, and policy variables that confound the relationship between the Special Economic Zone experiment and macroeconomic outcomes at the country level are held constant, which increases the inferential validity. Another advantage of my study is that I can say more about the channels of causation from a macro-economic perspective. In particular, I can distinguish between the effects of the Special Economic Zone experiment operating through increasing foreign owned capital in the municipality, and those operating through boosting total factor productivity growth.

There are of course disadvantages regarding my estimates on the Special Economic Zone experiment. China's Special Economic Zone experiment is a combination of private property rights protection, tax breaks and a preferential land policy for foreign investors. It is therefore difficult to separately identify the elasticity of foreign direct investment with respect to private property rights protection, tax reduction and land use fee discount⁹.

data, such as Whalley and Xin(2006), McGrattan and Prescott (2007), Desai, Foley and Hines Jr.(2009); other work focused on FDI as important sources of technology spillover, for example, Coe, Helpman and Hoffmaister(2008) use cross-country data to estimate the impact of domestic and foreign R&D capital stocks on TFP; Liu(2008) used a large panel of Chinese manufacturing firms to the effect of FDI on domestic firm TFP. Hale and Long(2007) using a firm-level data set on China, fail to find evidence of systematic positive productivity spillovers from FDI.

⁸The only exception is Wei(1995). He has exploited Chinese city level data from 1980-1990 to examine a reduced-form relationship between the open-door(SEZ) policy proxied by FDI and exports, and Chinese growth. However, his dataset does not report investment, which prevents his study from exploiting a complete growth accounting framework.

⁹Du et. al(2009) examines the impact of economic institutions, including property rights pro-

The next section introduces the historical background of China's Special Economic Zone experiment and provides a brief description on my dataset. Section 3 presents a simple model mapping the foreign investor location decision to municipal macroeconomic outcomes which generates three predictions for empirical testing. Section 4 estimates the direct impact of Special Economic Zones on foreign direct investment related outcomes. Section 5 estimates the effect of the Special Economic Zone experiment on the composition of municipal investments, therefore the impact on the physical capital stock. Section 6 calculates the effect of Special Economic Zones on total factor productivity growth. Section 7 concludes.

2 Background and Data

In this section I discuss some essential features of the Special Economic Zone experiment and the data that I have collected in order to analyze how the municipal economy changed with the SEZs.

2.1 Special Economic Zone Experiment Review

China's administrative system has five hierarchical levels of government: (1) central; (2) provincial; (3) municipal; (4) county; and (5) township. In this paper, I focus on the municipality level where the Special Economic Zone experiment has been carried out.

In the late 1970s, approval was given by the State Council for small-scale SEZ experiments in four remote southern cities, including Shen Zhen, Zhuhai and Shantou in Guangdong Province, as well as Xiamen in Fujian Province. Importantly, given the fact that China started with virtually zero foreign direct investment and almost negligible trade before 1978, these zones were used as a "test base" for liberalization of trade, tax and other policies that were then gradually applied to the rest of the economy. In August 1980 the People's Congress passed the first legal rule on the SEZs: "the Regulation for Guangdong SEZs." This regional law was the first of its kind to be tested, which was drafted with the help of legal experts sent from the central government (Cai et al., 2008). When the experiment was expanded into

tection and contract enforcement, on the location choice of foreign direct investment from a data set of 6,288 U.S. multinationals investing in various China's regions; Devereux and Maffini(2006) summarized the empirical literature on the impact of taxation on the location of FDI.

other provinces, they also adopted and modified this law accordingly¹⁰. The law of SEZs explicitly provides the following policy packages for foreign investors:

1) Private Property Rights Protection¹¹: the SEZs encourage foreign citizens, overseas Chinese, compatriots from Hong Kong and Macau and their companies and enterprises (hereinafter referred to as "investors") to open factories and set up enterprises and other establishments with their own investment or in joint ventures with Chinese. The SEZs guarantee to protect their assets, accruing profits and other rights in accordance with the law. This is a very important commitment by the Chinese government since there was no constitutional protection of private property rights outside SEZs until recently (the 2004 constitutional amendment).

2) Tax incentives: foreign investors can enjoy a reduced rate (15-24%) of corporate income tax compared to 33% paid by domestic firms. They bear virtually zero custom duties and can enjoy duty free allowances for production materials. There are income tax exemptions for foreigners working in SEZs as well¹²;

3) Land use policy¹³: Under Chinese law, all land is under state ownership. Foreign investors may lawfully obtain the rights for land development, use and business. They may also transfer and lease land rights, or put them up for mortgage in accordance with the law within the stipulated purposes and terms of the use. When foreigners invest in projects encouraged by the State for an operation term of more than 15 years, the construction land is exempt from land use fees for five years starting from the day when the enterprise obtains the use right, and the fee is collected at half price in the following five years. The land use right is guaranteed for projects that have a total investment of US \$10 million, or that are technologically advanced and have a major influence on the local economic development despite total investment being below US\$10 million.

¹⁰The Central Government Circular No.50, 1979, Zhongfa (1979) 50. The details of the political decision making process are comprehensively summarized in Xu(2009).

¹¹Besley(1995), Besley and Ghatak(2009): "Property insecurity acts much like a random tax on land, and thus reduct invest incentive".

¹²World Bank(2008) "There has been a great deal of debate regarding the types of fiscal incentives and other privileges at the heart of an SEZ regime. Countries are under pressure to offer a generous package of tax and duty exemptions in order to keep pace with their competitors. The package of fiscal incentives has become almost standardized among zones internationally—corporate tax reductions or exemption; duty-free importation of raw material, capital goods, and intermediate inputs; no restrictions or taxes on capital and profits repatriation; exemption from foreign exchange controls(where applicable); no charges on exports; exemption from most local and indirect taxes; and so on.

¹³Source: the government website of Zhejiang province.

4) Liberal economic and labor laws: there are limited restrictions on foreign ownership. Foreign invested firms have the power to hire and fire their employees.

The government made clear the targets of Special Economic Zones described by 4 principles: "*Construction primarily relies on attracting and utilizing foreign capital; Primary economic forms are sino-foreign joint ventures and partnerships as well as wholly foreign-owned enterprises; Products are primarily export-oriented; Economic activities are primarily driven by market forces*".

Supported by the initial achievements of the first group of SEZs, in 1984, the central government expanded the SEZ experiment to 14 other coastal cities to foreign investment¹⁴. From 1985 to 1988, the central government further included more municipalities along the coastal area into the SEZ experiment¹⁵. In 1990, the Chinese government decided to open the Pudong New Zone in Shanghai to foreign investment, as well as more cities in the Yangzi River Valley. The pattern of granting SEZ status in earlier years is not purely random, according to state-council documents(1980-1990)¹⁶, the central government chose municipalities to be granted with the Special Economic Zones based on better geographical location, industrial condition and human capital.¹⁷ From 1992 to 1994, the State Council has opened a number of border cities and all the capital cities of inland provinces and autonomous regions. In addition, 222 state-level economic zones and 1346 province-level economic zones¹⁸ were gradually established within the municipalities to provide better infrastructure and achieve agglomeration of foreign investors. As a result, a multilevel diversified pattern of opening and integrating coastal areas with river, border, and inland areas has been formed in China. China's Special Economic Zone experiment is described by the World Bank as a unique Zones within Zone case because large opened economic zones (municipalities) hosted small economic zones(state level and province level economic zones) within each municipality's territory. Figure 2 displays the geographic evolution of the Special Economic Zone experiment.

¹⁴Listed north to south: Dalian, Qinhuangdao, Tianjin, Yantai, Qingdao, Lianyungang, Nantong, Shanghai, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang, and Beihai

¹⁵Listed north to south: Liaodong Peninsula, Hebei Province (which surrounds Beijing and Tianjin), Shandong Peninsula, Yangtze River Delta, Xiamen-Zhangzhou-Quanzhou Triangle in southern Fujian Province, Pearl River Delta, and Guangxi

¹⁶Refer to various state council documents issued in 1984,1985,1987,1988,1991,1992,1993 for details.

¹⁷China's development strategy based on location is discussed in Démurger al. etc(2002).

¹⁸State-level SEZs are granted by the central government; Province-level SEZs are granted by provincial governments.

In Table 1, I summarize the four big waves in the SEZs experiment, i.e. 1979-1985, 1986-1990, 1991-1995, 1996-2007. The ratio of municipalities with SEZs starts from 0% in 1978, to 9% in 1985, 24% in 1990, 69% in 1995 and 92% in 2007. The SEZ experiment was expanded from coastal areas, beginning with municipalities with average distance to the coast of 15 miles, and expanding to those municipalities with an average distance of 626 miles to the nearest coast. Also, the SEZs were experimented using industrial more developed areas first, measured by higher average initial industrial output, and later expanded to industrial less developed areas. However, there are no significant statistical differences in human capital across the four groups of municipalities which were granted the SEZs at different times.

2.2 Dataset on Chinese Municipalities

In order to evaluate the impact of Special Economic Zones, I constructed a new panel dataset on 326 Chinese municipalities. The dataset tracks Chinese municipalities on GDP, investment, employment, foreign direct investment, exports as well as a digital GIS map of Chinese municipalities which is coded with its year of opening up and the SEZ establishment. Table 2 displays descriptive statistics for the variables that I use in this paper. The Data Appendix contains more details on the construction of these variables.

2.2.1 Special Economic Zone Index

In the dataset, I have detailed information which captures features of the SEZ experiment:

1. Lists of coastal and inland municipalities which were granted an open special economic area and the timing of granting;
2. Lists of state-level economic and technological development zones/ new and high-technology industrial development zones/Export Processing Zones/ Border Economic Cooperative Zones within municipalities, the size of these zones within the municipality and the timing of granted establishment;
3. Lists of provincial economic and technological development zones/ new and high-technology industrial development zones, the size of these zones within the municipality and the timing of granted establishment.

Being granted the status of open special economic area means the whole area of the municipality is a large SEZ for foreign investors. Being granted the status of state-level or province level economic zones means that within the municipality, certain geographical area is used as SEZs to host foreign investors. In the full sample, some municipalities were granted the status of open special economic areas as well as allowed to establish state-level and province-level economic zones within a certain geographical area inside the municipality in later years, i.e. a large SEZ can contain multiple "specific" zones within its boundaries. For example, some coastal municipalities such as Shenzhen, Shanghai, Dalian, Tianjian and Guangzhou were allowed to construct more and larger zones within the municipality from the central government after they as a whole were granted the status of open economic areas. Most inland municipalities as a whole were not granted the status of open economic area. They just have relatively smaller and less economic zones constructed within its city area granted from higher level governments. Therefore, the intensity of the SEZ experiment differs across municipalities and years. If I use three variables including an opening economic area dummy, accumulated size of state-level economic zones and accumulated size of province-level economic zones to fully explore the intensity of the SEZ treatment, the identification strategy is vulnerable to endogeneity problem, since coastal municipalities granted with more and larger SEZs is highly correlated with its potential in attracting foreign direct investment. In order to alleviate the non-randomness regarding the treatment intensity and provide a much cleaner identification, I instead use a general SEZ dummy¹⁹,

$SEZdummy = 1$, if the municipality as a whole is granted the status of open economic zone area, or a municipality is allowed to establish a state-level economic zone in a certain geographical area within the municipality, or the municipality is permitted to establish a province-level economic zone in a certain geographical area within the municipality;

$SEZdummy = 0$, if otherwise.

Despite various types and different names for SEZs, I checked the SEZ law for open special economic area, state-level SEZs and province-level SEZs respectively. There are no systematic policy differences, regarding property rights protection, tax

¹⁹To exploit more variation in the intensity of special economic zone reform, I run regressions on three variables, i.e. open economic zone area dummy, land area of state-level economic zone, land area of province-level economic zones as supplemental evidence. The results are consistent with using single treatment variable, i.e. SEZdummy.

breaks or land use policy, which justify the validity of using a general SEZ dummy to capture this experiment.

2.2.2 Foreign Direct Investment

Data at the municipality level including utilized foreign direct investment, exports and industrial output by foreign invested enterprises are used to capture the direct outcome from the Special Economic Zone experiment.

Figure 3 plots the sample mean of the log of per capita foreign direct investment by year for four groups of municipalities classified based on the timing of the SEZ experiment. It reveals that the SEZ experiment boosts FDI significantly for every group. We observe FDI increasing significantly after each group of municipalities was granted the SEZ status. However, the effect seems to be much stronger for the municipalities which carried out the SEZ experiment earlier. To prevent biased estimates due to the potential selection problem, I use more rigorous methods in the main specification.

2.2.3 Growth Accounting Data

The credibility of statistical data published by China's statistical office is under scrutiny in various studies (Young, 2003; Holz, 2008). Having acknowledged the potential bias, apart from annual revisions to the national income and product accounts data first published in the previous year, China's National Bureau of Statistics has so far conducted two benchmark revisions. The first occurred following the 1993 tertiary (service) sector census with adjustments to 1978-93 tertiary sector value added and, by implication, to the sum of sectoral value added, i.e., gross domestic product (GDP). The second benchmark revision occurred in early 2006, following the 2004 economic census of the secondary sector (industry, construction) and of the tertiary sector using the OECD method. My dataset is based on the latest municipal statistics after these adjustments. Following Caselli (2005) and Young (2003), I have constructed Real GDP, Real Capital Stock, human capital augmented labor and share of labor income.

3 A Conceptual Framework

Foreign Investor Location Decision:

In the context of the Special Economic Zone experiment in China, we need to consider the essential elements foreign investors take into account when they made the location decision. China's National Development and Reform Commission (2007) carried out a survey regarding potential policy changes that most worried foreign enterprises. The results suggest that the incentive package the Special Economic Zone experiment provided, including tax incentives and favorable land policy, were among the key determinants of the location decision by foreign investors²⁰. We assume that a foreign investor can choose among 326 Chinese municipalities or other alternative countries to locate his investment. If the foreign investor decides to invest in municipality i , he maximizes his profits by choosing the level of investment, the quantity of land used as well as the quantity of labor hired in municipality i , $i = 0, 1, 2, \dots, 326$. where $i = 0$ denotes outside option such as investing in other countries. The investor's problem, conditional on investing in municipality i , can be written as follows:

$$\begin{aligned} \underset{L_i, FDI_i, Land_i}{Max} \quad \pi_i &= (1 - \tau_i)(1 - t_i)(pq_i - w_i L_i - R_i Land_i - r FDI_i - F) \\ s.t. \quad q_i &= Q(FDI_i, Land_i, L_i) \end{aligned}$$

where: π_i = profits of the foreign investor if he invests in municipality i ; p = price of the product produced by the investor; q_i = quantity of the product sold; w_i = wage rate in municipality i ; L_i = quantity of labor employed by the foreign investor in municipality i ; R_i = land use fee paid by the foreign investor in municipality i ; $Land_i$ = the land the foreign investor used for production in municipality i . r = opportunity cost of capital for the foreign investor; FDI_i = foreign direct investment by the foreign investor in municipality i ; F = fixed cost of production; t_i = corporate tax rate for the foreign investor in municipality i ; τ_i = probability of expropriation.

²⁰The Foreign Economic Research Institute of the NDRC(National Development and Reform Commission) carried out a survey in 2007 on foreign firms located in Yangtzer River Delta, Pearl River Delta and Areas Around Bohai. The top 5 ranked potential policy changes they worry about is Removing Tax Incentive, RMB Appreciation, Removing Favorable Land Policy, Increased Environmental Requirement and Increased Worker Welfare.

Given the first order condition with respect to investment FDI_i and inputs decisions $Land_i, L_i$, profits π_i^* will be a function of τ_i, t_i, R_i, w_i . The foreign investor will choose the municipality with the highest π_i to locate its FDI. Therefore, we can also model

$$FDI_i^* = f(\tau_i, t_i, R_i, w_i | \{i : \pi_i^* > \pi_j^*, \forall j \neq i\})$$

Provided the policy set of Special Economic Zone experiment including property rights protection, i.e. lower τ_i ; tax breaks, i.e. lower t_i and land fee discount, i.e. lower R_i , it implies an estimating equation of the form leading to empirical step one below:

$$LnFDI_{it} = \alpha + \eta * SEZdummy_{it} + X_{it}\beta + \xi_{it}$$

X_{it} include municipality level control variables which would potentially influence FDI decision in addition to property rights protection, tax rate and land use fee.

Capital Formation:

If the SEZ attracts FDI, it will in turn influence the capital formation process in the municipality. In particular,

$$\begin{aligned} \text{directly, } K_{ift} &= K_{ift-1} * (1 - \text{delta}) + FDI_{it}(SEZ)/\text{deflator} \\ \text{indirectly, } K_{idt} &= K_{idt-1} * (1 - \text{delta}) + DomI_{it}(SEZ)/\text{deflator} \end{aligned}$$

where K_{ift} is foreign owned capital stock, FDI_{it} is foreign owned investment; K_{idt} is domestically owned capital stock, $DomI_{it}$ is domestically owned investment. The interaction between domestic investment and foreign direct investment, i.e. crowding out or crowding in effect will determine the net effect of SEZs on capital formation. This drives empirical step two below:

$$\begin{aligned} LnDomI_{it} &= \phi + \gamma * SEZdummy_{it} + X_{it}\beta + \xi_{it} \\ LnK_{idt} &= \phi + \gamma * SEZdummy_{it} + X_{it}\beta + \xi_{it} \end{aligned}$$

Technological Progress:

A very important policy motive behind subsidizing FDI is that FDI constitutes technologically more advanced capital compared to domestic capital. Based on

Griliches (1986), the municipality aggregate production function can be modelled as

$$Y_{it} = A_i e^{\lambda_i t} (K_{it})^\alpha (H * L_{it})^{1-\alpha}$$

where $K_{it} = (1 + \theta)K_{ift} + K_{idt}$, using $\theta > 0$ to denote higher quality of foreign capital compared to domestic capital; α is the share of capital income in GDP²¹. Y_{it} is real gross domestic output in municipality i at year t ; $H * L_{it}$ is augmented labor in municipality i at year t ; A_i is the time invariant component of total factor productivity in municipality i ; λ_i is the existing TFP growth rate of municipality i .

$$\ln Y_{it} \simeq \ln A_i + \lambda_i t + \alpha \ln(K_{ft} + K_{dt}) + \alpha \theta \frac{K_{ft}}{K_{ft} + K_{dt}} + (1 - \alpha) \ln(HL_{it})$$

Let $S = \frac{K_{ft}}{K_{ft} + K_{dt}}$ denote the share of foreign capital in the total capital stock, in terms of growth rate, we get

$$\frac{\Delta Y}{Y} = \lambda_i + \alpha \frac{\Delta(K_{ft} + K_{dt})}{(K_{ft} + K_{dt})} + (1 - \alpha) \frac{\Delta(HL)}{(HL)} + \alpha \theta \frac{\Delta S}{S}$$

$$\frac{\Delta TFP}{TFP} = \lambda_i + \alpha \theta \frac{\Delta S}{S}$$

If there is any additional contribution $\theta > 0$ due to the presence of FDI as a result of the SEZ experiment, we would conclude that FDI boosts the technological progress in the municipality. This drives empirical step three below²²:

$$\frac{\Delta TFP}{TFP} = \lambda_i + \gamma * SEZdummy_{it} + \varepsilon_{it}$$

To relate the basic model in Section 3 to my dynamic empirical setting, I run three empirical sections (i.e. Steps 1-3). In Step 1, I evaluate the extent to which foreign direct investment responds to property rights protection, tax breaks and the land use fee discount embodied in the Special Economic Zone experiment. In Step 2, I check the effect of the Special Economic Zone experiment on domestic investment and domestically owned capital stock. In Step 3, I examine whether the presence of

²¹The Chinese statistics only reports GDP by the income approach at the provincial level. Therefore, in the paper, I use provincial capital share as the proxy for municipal capital share. In a later empirical section, I compared estimates using provincial capital share and national capital share and show the results are not sensitive to the capital share indicator I used.

²² $\gamma > 0 \iff \theta > 0$

FDI via the SEZs brings technology growth to a municipality.

4 Empirical Step One: SEZs on FDI outcomes

4.1 Identification

The empirical test requires variation in the timing when SEZs were created across my sample of municipalities. As described in Section 2, the timing of the SEZ experiment across the Chinese municipalities provides a significant amount of variation both between and within municipalities during my sample period 1978-2007. I will exploit these different sources of variation in my identification strategy.

4.1.1 Baseline Specification

In the baseline specification, the econometric analysis makes use of the full sample of 326 municipalities. Thus, the effects of the SEZ experiment on the FDI outcome will be estimated both from the cross-sectional variation (municipalities with SEZs versus municipalities without SEZs) and from the within time variation in the SEZ experiment among the 300 treated municipalities. My econometric analysis is based on panel data regressions of the form:

$$Y_{ipt} = \alpha + \beta * SEZdummy_{ipt} + \delta_i + \gamma_t + \varepsilon_{ipt} \quad (1)$$

$$Y_{ipt} = \alpha + \beta * SEZdummy_{ipt} + \delta_i + \delta_p * (t - 1977) + \gamma_t + \varepsilon_{ipt} \quad (2)$$

$$Y_{ipt} = \alpha + \beta * SEZdummy_{ipt} + \delta_i + \delta_i * (t - 1977) + \gamma_t + \varepsilon_{ipt} \quad (3)$$

where Y_{ipt} is the outcome variable including foreign direct investment flow, exports and industrial output of foreign invested enterprises in municipality i of province p in year t . $SEZdummy_{ipt}$ is the key variable indicating the Special Economic Zone experiment. δ_i is the municipality fixed effect. γ_t is the year fixed effect. δ_p is the province fixed effect. $(t - 1977)$ is the trend starting from 1978 which is the beginning of my sample ²³.

In the first econometric setting, I use the municipality fixed effect to control for time invariant municipality characteristics such as natural endowment and geo-

²³As there are plenty of observations before the treatment (i.e. the SEZ experiment), linear trends are unlikely to pick up the post-treatment trends (Wolfers 2006).

graphical location and the year fixed effect to control for common macroeconomic shocks happening to all Chinese municipalities in a particular year. In the second econometric setting, I use the municipality fixed effect to control for time invariant municipality characteristics and the province specific trend to control for common time varying path of municipalities in the same province. This setting controls for province level factors that potentially influence the timing of SEZ granting. In the third econometric setting, I use the municipality fixed effect to control for time invariant municipality characteristics, the year fixed effect to control for common macroeconomic shocks to all municipalities at year t and municipality specific trends to control for time varying reasons that municipalities were granted Special Economic Zone status. In this case, the identification of the effects of the Special Economic Zone experiment comes from whether such changes lead to deviations from municipality specific trends. Standard errors are heteroskedasticity-robust and clustered by municipality to deal with potential problems of serial correlation (Bertrand, Dufflo and Mullainathan (2004)).

4.1.2 Matching Specification

In the matching specification, the difference with respect to the baseline specification is that I no longer make use of the full sample of late treated municipalities. Instead, I take advantage of the cross-sectional variation found for several socioeconomic measures to restrict the sample of municipalities which were granted SEZs in later years to the ones that more closely match the earlier treated municipalities in indicators considered relevant for the timing of the SEZ experiment and for the outcomes under analysis, as of 1978. This procedure restricts the sample to 247 municipalities that are substantially more comparable in terms of the indicators considered, at the beginning of my sample period.

According to state council documents, by earlier 1990s, the Special Economic Zone experiment was granted mostly in coastal, more industrial developed and more educated areas. The selection criteria are likely to affect the propensity for an municipality to be granted SEZs earlier and are also likely to be instrumental in affecting FDI related outcomes. I create a $D = 1$ if the municipality had Special Economic Zone experiment by the end of 1992, i.e. earlier treated; $D = 0$ if the municipality

carried out Special Economic Zone experiment after 1992, i.e. later treated²⁴. I use per capita industrial output, per capita number of secondary school students in 1978 and distance to the nearest coast to estimate the propensity score based on a probit model

$$\Pr\{D = 1|X\} = \Pr\{D = 1|X = (\textit{industrial output}, \textit{education attainment}, \textit{geographical location})\} = \phi(X'\beta)$$

In the matching exercise, I rank all 326 municipalities based on the estimated propensity score, and for each earlier treated municipality I select its closest later treated municipality as a control group (nearest neighbor approach). In the matched sample, I have 247 municipalities, among which 167 municipalities were granted SEZs between 1979 and 1992 and 80 municipalities were allowed to create SEZs after 1992²⁵. Table 3 displays the probit regression results and the quality before and after using nearest-neighbor matching. Since we do not match the sample conditioning on all covariates but on the propensity score, it has to be examined if the matching procedure is able to balance the distribution of the relevant variables in both the control and treatment group. There are two measures to check whether there remain any differences after conditioning on the propensity score. First, the pseudo-R2: Sianesi (2004) suggests to reestimate the propensity score on the matched sample, that is only on participants and matched non-participants and compare the pseudo-R2's before and after matching. The pseudo-R2 indicates how well the regressors X explain the participation probability. After matching there should be no systematic differences in the distribution of covariates between both groups and therefore, the pseudo-R2 should be fairly low. Table 3a indicates that before matching the Pseudo-R2 is 0.10; after matching, the Pseudo-R2 reduces to 0.03. Second, T-test: Table 3b, the T-test suggests that all three important selection criterias become insignificant after matching, which means there is no systematic differences in the distribution of covariates between the control group(the municipalities which had SEZs in later years) and the treatment group (the municipalities which had SEZs in earlier years). This matching procedure reduces the size of the sample available for econometric analysis, but increases my confidence that I am effectively tracking municipalities

²⁴The matching exercise was implemented based on the advice from Joshua Angrist.

²⁵Refer to Caliendo and Kopeinig(2008) for practical guidance on propensity score matching; Rosenbaum and Rubin(1983) for the principle of matching. I have checked the common support and the balancing properties, which were all satisfied in my matching exercise. Some municipalities in the control group were used more than once in the matching, i.e. matching with replacement.

across time that are more comparable in aspects that are relevant for the effects I want to estimate.

4.1.3 Later SEZs Only Specification

The matching procedure above does not completely eliminate concerns about the existence of unobservable factors that might systematically affect the likelihood of being granted SEZs earlier and also affect the outcome variables of interest. It is possible, for instance, that the municipalities which were granted SEZs earlier could have very different abilities for attracting FDI compared to municipalities which were granted SEZs later on. These specific characteristics might have led them to be granted SEZs earlier on and perform more successfully in FDI absorption. The positive correlation between the SEZ experiment and FDI related outcome observed in the full sample may be wrongly interpreted as capturing the impact of the SEZs, if only the group of earlier treated municipalities drove the main results. To address this concern I restrict the sample available for analysis to the group of municipalities which only had SEZs since 1990s. The sample drops 79 municipalities which were allowed to construct SEZs between 1979 and 1990 and is therefore reduced to a group of 247 municipalities.²⁶

4.2 Empirical Results

Table 4, Panel A, I run a regression using per capita foreign direct investment, which is the first-order target of the Special Economic Zone experiment. In panel B, I run a regression using per capita exports, which is another goal of the Special Economic Zone policy to boost trade related activities. In panel C, I run a regression using per capita industrial output of foreign invested enterprises, which is to confirm that foreign direct investment came to municipalities with the Special Economic Zone experiment to produce and export its product.

Table 4, Panel A, column (1) to (3), the results are robust to baseline specifications. Column (3), after controlling for fixed effects and municipality specific trend, the results suggest that having Special Economic Zone status increases per capita foreign direct investment by 58%. Column (4) reports the estimates for the restricted

²⁶Though in matching, the number of the sample is 247 municipalities as well, the composition of matched sample and later SEZs sample is different.

matched sample. The results still suggest the SEZ experiment increases per capita FDI by 54%. In column (5), when I only use the group of the municipalities which were granted SEZs after 1990, the magnitude of the coefficient slightly decreased, but still suggests a 43% increase due to the SEZ experiment.

Panel B, Column (3) indicates that having the SEZ experiment increases municipality per capita exports by 84%. Column (4) reports the estimates for the restricted matched sample. The result suggests the SEZ experiment increases per capita exports by 81%. In column (5), when I only use the group of the municipalities which were granted SEZs after 1990, the magnitude of the coefficient still suggests a 70% increase in exports due to the SEZ experiment. The estimates confirm the contribution of Special Economic Zone experiment on attracting vertical FDI, which takes advantage of low-cost production in China for products to be exported and which is fueled mostly by China's Asian neighbors²⁷.

Panel C, Column (3) indicates that having the SEZ experiment increases per capita industrial output of foreign invested enterprises by 64%. Column (4) reports the estimates for the restricted matched sample. The result suggests the SEZ experiment increases per capita industrial output of foreign invested enterprises by 69%. In column (5), when I only use the group of the municipalities which were granted SEZs after 1990, the magnitude of the coefficient still suggests a 45% increase due to the SEZ experiment.

4.3 Robustness Check

4.3.1 Placebo Test

To validate the identifying assumption, I estimate the dynamics of FDI related outcome before and after the SEZ experiment. Specifically, I replace *SEZdummy* in equation (4) with the set of year-wise dummy variables which equal to one if n years have passed since the year of having the Special Economic Zone experiment, where $-2 \leq n \leq 2$, and another dummy variable equal to 1 if three years or more have passed

$$Y_{ipt} = \alpha + \sum_{n=-2}^2 \beta_n * D(T+n)_{ipt} + \beta_3 * D(T+3)_{ipt} + \delta_i + \delta_i * (t - 1977) + \gamma_t + \varepsilon_{ipt}$$

²⁷Refer to Whalley&Xin(2006) and Ekholm et al.(2007).

Table 5a reports the estimates on the coefficient of the set of dummy variables. The point estimates suggest that there was no hike or dip before the SEZ experiment took place and that the increase in FDI related outcome started only after the experiment, encouraging the interpretation that SEZs have attracted FDI, increased exports and industrial output by foreign invested enterprises.

4.3.2 Test for Diversion Effect

There are concerns that the foreign direct investment SEZs attract is not from creation effect, but from diversion effect. When the SEZ experiment is in place, foreign investors might change their location decision from neighboring non-SEZ municipalities or neighboring non-SEZ provinces to municipalities with SEZs. If this is the case, SEZs merely redistribute FDI within Chinese municipalities. I therefore run robustness checks with respect to two possible cases.

Case I: Municipalities with SEZs divert FDI from neighboring municipalities with no SEZs, i.e. a change of distribution within the province. Its empirical prediction will be that at provincial level, the number of municipalities with SEZs does not matter for the level of per capita FDI a province attracts. Figure 4 shows that there is a strong positive correlation between the proportion of municipalities with SEZs in the province and per capita provincial FDI, which contradicts the diversion story. Also, I run the following regressions at province level:

$$\begin{aligned}
 Y_{pt} &= \alpha + \beta * RatioSEZ_{pt} + \delta_p + \gamma_t + \varepsilon_{pt} \\
 Y_{pt} &= \alpha + \beta * RatioSEZ_{pt} + \delta_p + \delta_p * (t - 1977) + \gamma_t + \varepsilon_{pt}
 \end{aligned}$$

where Y_{pt} is per capita FDI at province p in year t . $RatioSEZ$ is the proportion of municipalities with SEZs in province p , which is a normalized variable between 0 and 1. δ_p is the province fixed effect. γ_t is the year fixed effect. $(t - 1977)$ is the trend starting from 1978 which is the beginning of my sample. Standard errors are heteroskedasticity-robust and clustered by province to deal with potential problems of serial correlation.

Table 5b reports the estimates on the coefficient of $RatioSEZ$, which are positive and significant in both specifications. In the second specification with province specific trend, the estimates suggest that when the proportion of municipalities with SEZs in a province increases from 0 to 1, the provincial per capita FDI will increase

by 146%. It indicates that the more municipalities in a province have SEZs, the higher per capita foreign direct investment a province achieves. Therefore, the results I found at municipality level, i.e. SEZs attract FDI, is not mainly driven by the diversion from other municipalities in the province.

Case II: Municipalities with SEZs divert FDI from other provinces with no SEZs, i.e. a change of distribution within China. It's possible that when some municipalities carry out the SEZ experiment, the FDI attracted is diverted from other provinces. The empirical prediction will be that at national level, the number of municipalities with SEZs does not matter for the level of per capita FDI China attracts. This possibility is ruled out by Figure 1, which shows a clear positive correlation between the number of municipalities with SEZs and the FDI China attracts.

5 Empirical Step Two: SEZs and Domestic Capital Formation

In this section, I investigate concerns that foreign direct investment flow will crowd out domestic investment which might reduce the impact of a Special Economic Zone experiment on domestically owned capital stock. The econometric specifications I used in this section to control endogeneity are similar to section 4 (empirical step one).

Table 6, Panel A contains regression on domestic investment at municipality level. Panel B contains regressions on municipal physical capital stock (domestically owned capital stock). Panel A, column (1) to (5), under different specifications, there is no significant evidence suggesting crowding out or crowding in effect of domestically owned investment by the SEZs. The results suggest that each unit of FDI does not come at the price of decreasing domestic investment. Each unit of FDI will contribute to the capital formation process without reducing domestic capital accumulation²⁸. Panel B, column (1) to (5), under different specifications, indicate that having Special

²⁸Yasheng Huang (2003), "the large absorption of foreign direct investment (FDI) by China is a sign of some substantial weaknesses in the Chinese economy. The primary benefits associated with China's FDI inflows are concerned with the privatization functions supplied by foreign firms, venture capital provisions to credit-constrained private entrepreneurs, and promotion of interregional capital mobility. Huang (2003) argues that one should ask why domestic firms cannot supply the same functions. China's partial reforms, while successful in increasing the scope of the market, have so far failed to address many allocative inefficiencies in the Chinese economy".

Economic Zone experiment have no significant effect on domestically owned capital stock, which is consistent with the pattern in domestic investments.²⁹

6 Empirical Step Three: SEZ and Total Factor Productivity Growth

6.1 Empirical Strategy

Following Young (2003), let gross domestic output be a constant return to scale function of capital and labor inputs (human capital augmented)

$$Y = F(K, H * L, t)$$

where the appearance of t , time, as an independent argument denotes the fact that the production function evolves over time due to technological progress.

Totally differentiating and dividing by GDP, we find that

$$\frac{dY}{Y} = \left(\frac{F_K K}{Y}\right) \frac{dK}{K} + \left(\frac{F_{HL} HL}{Y}\right) \frac{dHL}{HL} + \frac{F_t}{Y} dt$$

where F_i represents the partial derivative of F with respect to argument i . With competitive markets, factors are paid their marginal products, so that the terms in parentheses on the right-hand side represent the share of each factor in total factor payments. Total factor productivity growth, the last term on the right-hand side, represents the proportional increase in output that would have occurred in the absence of any input changes and is calculated as a residual item by subtracting the contribution of capital and labor from output growth:

$$\frac{\Delta TFP}{TFP} = \frac{\Delta Y}{Y} - \theta_k \frac{\Delta K}{K} - (1 - \theta_k) \frac{\Delta(H * L)}{(H * L)}$$

Caselli (2005) and Young (2003) use growth accounting to calculate total factor

²⁹I also run regressions on total municipality capital stock and find no strong impact of the SEZs. A supporting fact will be that the average ratio of foreign direct investment to total municipality investment is 0.04 during the sample period(1978-2007). This might explain why we do not observe significant increase in total capital stock by the Special Economic Zone experiment. However, I do get strong results of the SEZs on foreign owned capital stock.

productivity³⁰. A very important step is to estimate labor shares. The most disaggregated GDP data Chinese official statistics provide using the income approach is at the provincial level.³¹ In the main regression, I use the provincial capital share as a proxy for the municipal capital share. As comparison groups, I also use national capital share $\theta_k = 0.4$ reported in Young (2003) and international benchmark in Caselli (2005) $\theta_k = 1/3$ as a proxy for municipality capital share.

If we assume each municipality has a time-invariant level of total factor productivity and its own trend of technology progress, the Special Economic Zone experiment changed the trend of its TFP growing path, then

$$\Delta TFP_{ipt} = \delta_i + r * SEZdummy_{ipt} + \Delta \varepsilon_{ipt}$$

From 1978 to 2007, China also carried out other reforms. To control for common macroeconomic events which might influence the growth rate of TFP, I further add year fixed effect into the regression, i.e.

$$\Delta TFP_{ipt} = \delta_i + \gamma_t + r * SEZdummy_{ipt} + \Delta \varepsilon_{ipt}$$

6.2 Empirical Results

Table 7, column 2, with the most rigorous specification, suggests that having Special Economic Zone status increase total productivity growth by 0.6 percentage points³². To compare this contribution with average TFP growth at municipality level, 2.6% during the sample period, SEZs (therefore FDI) have increased TFP growth rate by 23%.

The regression results from column 4 where I use Young (2003)'s national average capital share $\theta_k = 0.4$, and column 6 where I use Caselli (2005)'s international benchmark $\theta_k = 1/3$, are similar. The fact that the estimates are not sensitive to

³⁰Note that estimating TFP based on estimating a production function is heavily exposed to endogeneity problem. All inputs, including capital and labor, are endogeneous decisions, which are correlated with the unobserved error term. There is no good instrumented variable for them at the municipal level.

³¹See Hsueh and Li (1999) for 1978-95, NBS (2006) for 1993-2004.

³²I have run a placebo test for TFP growth using two dummies indicating one year, two years before the SEZ experiment as well as the reform variable, *SEZdummy*. The coefficients for the two pre-reform dummies are not significant, while the coefficient for *SEZdummy* does not change much.

whether I use the provincial average share or national average share mitigates the concern that using upper level capital share would cause large measurement error.

7 Conclusion

By exploiting the extensive establishment of Special Economic Zones in China since 1979, my paper makes three contributions to our understanding of the impact of special economic zones on foreign direct investment and other economic outcomes. Using a comprehensive and unique dataset on Chinese municipalities from 1978 to 2007, my first contribution is to estimate the effect of Special Economic Zones on attracting foreign direct investment. I find that the policy package, including private property rights protection, tax breaks and land use policy, increases per capita municipal foreign direct investment by 58% in the form of foreign-invested and export-oriented industrial enterprises. While it is possible that Special Economic Zones were deliberately allocated to municipalities on the basis of time-varying characteristics unobservable to economists today, I find little evidence for this potential source of bias to my results using municipality specific trends, matched sample, restricted sample and a placebo test. There are also concerns that the effect of SEZs on FDI might be merely a reflection of diversion effect, i.e. a change of distribution across municipalities. It is ruled out by robustness checks at provincial and national level.

My second contribution is to map foreign direct investment by multinational firms to municipal macroeconomic outcomes. I find that the Special Economic Zone experiment increased municipal foreign owned capital stock and did not crowd out domestic capital(and investment).

My third contribution is to check in addition to physical capital, if Special Economic Zones bring more advanced technology, i.e. higher total factor productivity growth. I find that the Special Economic Zone experiment increased municipality TFP growth by 0.6 percentage points. The results are robust to various capital share proxies. By exploiting a growth accounting framework, my work provides the mechanisms of gains from Special Economic Zones: one channel is through increasing physical capital stock; the other is via boosting total factor productivity growth.

This paper's findings pose several questions for future research. First, among the incentive package Special Economic Zones provided, what is the elasticity of foreign direct investment with respect to property rights protection, tax breaks, land use

policy and other elements respectively? Micro-level surveys on Special Economic Zones can generate promising results on this issue. Second, newly issued data on Special Economic Zones also provides good opportunities to test the fiscal impact of tax breaks specifically for foreign investors on municipal public good provision. Third, further work could be done on evaluating whether the Special Economic Zone policy (i.e. subsidies to foreign investors) raise municipal welfare³³. Therefore, a cost-benefit analysis based on Special Economic Zone policies should be carried out.

³³Refer to Gordon H. Hanson(2001). He presents a simple theoretical model for evaluating FDI promoting policies in G-24 countries.

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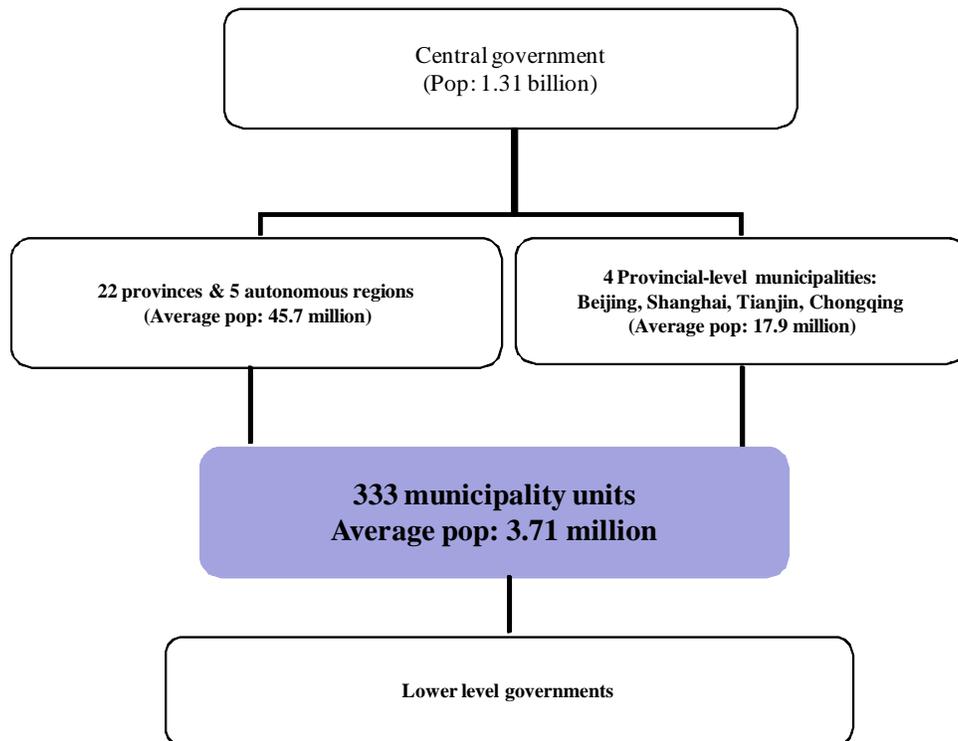
Data Appendix

This appendix provides information (supplementary to that in section 2) on the variables used in this paper.

Sample of Municipalities:

The dataset includes 326 municipalities of 31 provinces in China. We combine Fuyang and Bozhou in Anhui province to be one municipality, baicheng and songyuan to be one municipality due to statistical availability. We drop Laibin and Chongzuo of Guangxi Province since they were only established in early 2000s. Due to statistical availability, we treat Tibet a big municipality.

Government Organization Structure in China, 2005



Source: National Statistical Bureau 2006

Statistical Source:

1. 30 years anniversary of opening up Reform statistical books 1978-2008 (Beijing, Chongqing, Fujian, Gansu, Guangdong, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Neimeng, Shandong, Shanghai, Shanxi, Sichuan and Tianjin)
2. 50 years anniversary of People's Republic of China (1949-1999) statistical year-books (Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hebei, Henan, Hunan, Jiangsu, Jiangxi, Liaoning, Neimeng, Shandong, Shanxi, Sichuan, Xinjiang, Yunnan, Zhejiang Province).
3. Province statistical yearbooks(1980s,1990s,2000s)
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Growth Accounting Variable:

1. Deflator for GDP and Investment: Municipal GDP (investment) deflator

The statistical office of most countries estimate real GDP by deflating nominal GDP using separate, independently constructed, price indices. However, this is not the procedure in China. Local statistical bureaus are called on to report the value of GDP in current and constant (base year) prices. The difference between the two series produces an implicit deflator, which is then used to deflate nominal value added. Based on GDP at current price and the GDP index at constant price(GDP index at 1978=100), we calculated the GDP deflator

for most municipalities. For a few municipalities located in Gansu, Anhui, Shaanxi, Jilin and Liaoning Province whose municipality level GDP indices are not available, we use the province GDP deflator as proxy. This prefecture level deflator is for the first time applied to growth accounting work in China's studies and avoid measurement error by using the province deflator.

2. Real Physical Capital Stock

It is calculated based on investment, investment deflator, depreciation rate and average geometric growth rate of investment. Following Caselli(2005), Caselli (2007) and Young (2003), the routine of calculating initial capital stock K_0 is $I_0/(\delta + g)$, Here, we use the initial investment in 1978 as I_0 , because complete investment series before 1978 are not available for most municipalities; Provincial 50 years' statistics only reported investment data in 1952, 1962, 1970, 1975, which make imputing initial capital from 1952 inaccurate. δ is the depreciation rate set at 0.06, g is average geometric growth rate of investment between 1950s and 1978 for municipalities whose the pre78 investment data are available, or the average geometric growth rate of investment between 1978 and 1980 for municipalities whose pre78 investment data are not available. Based on initial capital stock, investment series and GDP deflator, we can get real capital stock in later years K_t using $K_t = K_{t-1} * (1 - \delta) + I_t/deflator$.

3. Labor and Human Capital

Labor (L): employment in the municipality, including corporate and non-corporate sector.

Human capital (H): Based on the Chinese Population Census 1982 and Young (2003), since the 1982 population census did not include municipality level educational attainment statistics, I use province average years of schooling as proxy for municipality educational attainment. Following Hall and Jones (1999), this is turned into a measure of human capital in 1982 through the formula:

$$h = e^{\varphi(s)}$$

where s is average years of schooling, and the function.

$\varphi(s)$ is piecewise linear with slope 0.134 for $s \leq 4$, 0.101 for $4 < s \leq 8$, and 0.068 for $8 < s$. The rationale for this functional form is as follows. Given our

production function, perfect competition in factor and good markets implies that the wage of a worker with s years of education is proportional to his human capital. Since the wage-schooling relationship is widely thought to be log-linear, this calls for a log-linear relation between h and s as well, or something like $h = e^{\varphi_s * s}$. Based on population census and survey 1982, 1990, 1995, Alwyn has estimated China's average LN human capital growth rate to be 0.011 from 1978-1995. I combined human capital in 1982(based on population census 1982) and this growth rate to generate human capital series for all municipalities.

4. Labor and Capital share³⁴

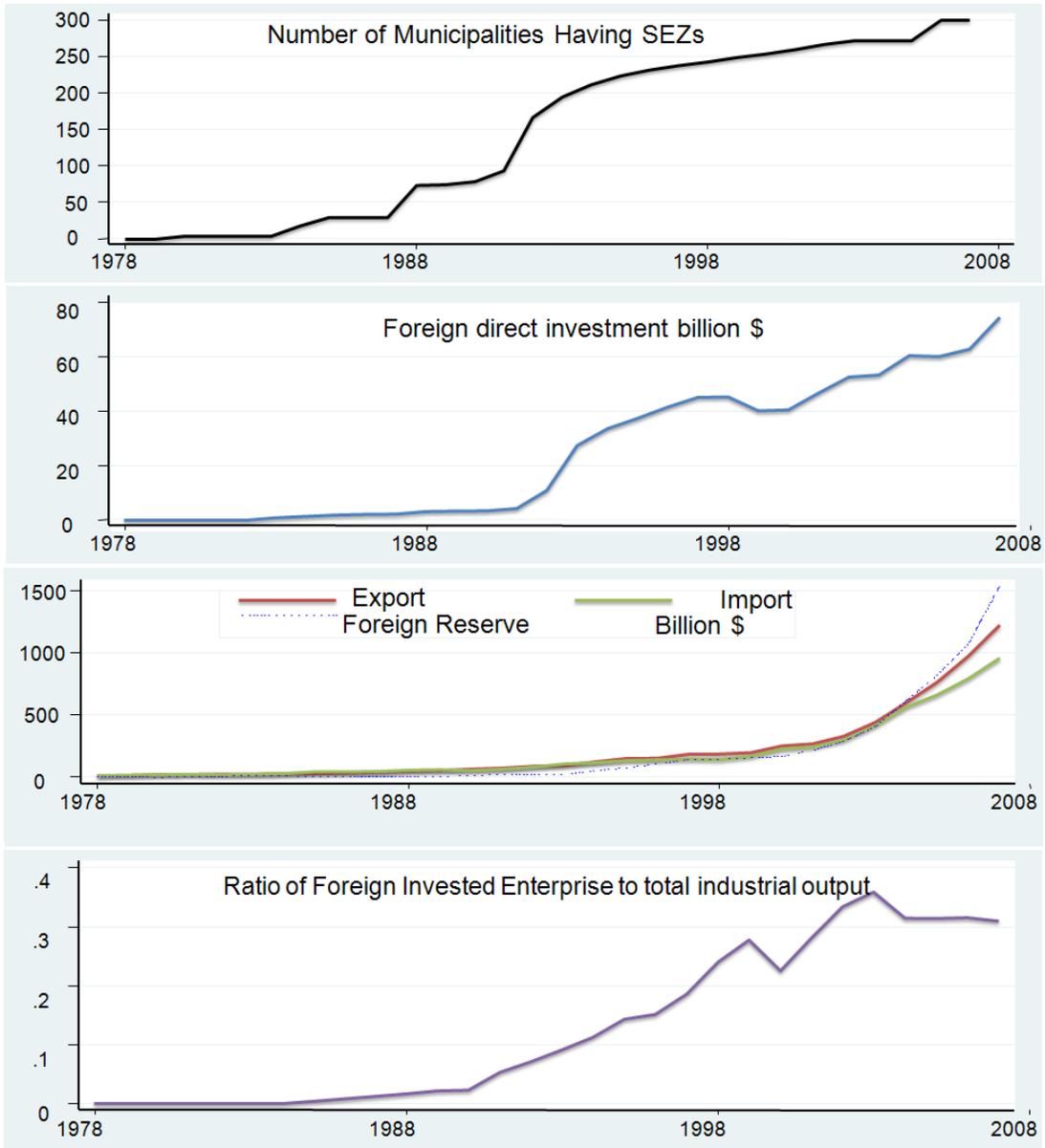
The most disaggregated GDP data Chinese official statistics provided using income approach is at province level. There are four components including Compensation of Employees, Net Taxes on Production, Depreciation of Fixed Assets and Net Operating Surplus. We can directly measure α from the data, but we need to make some adjustments. We define the labor income share as unambiguous labor income divided by GDP net of the ambiguous categories(indirect taxes).

$$\text{Labor Share} = \frac{\text{Compensation of Employees}}{\text{GDP} - \text{Net Indirect Taxes}}$$

This procedure is equivalent to splitting the ambiguous categories between labor income and capital income in the same proportions as in the rest of the economy. The capital share, α , is then $1 - \text{Labor Share}$. Since the income approach reports province statistics from 1978. I used the provincial capital share between 1978 and 2003 to be the capital share. I drop 2004 as there is a big change regarding the statistics on compensation of Employees since 2004.

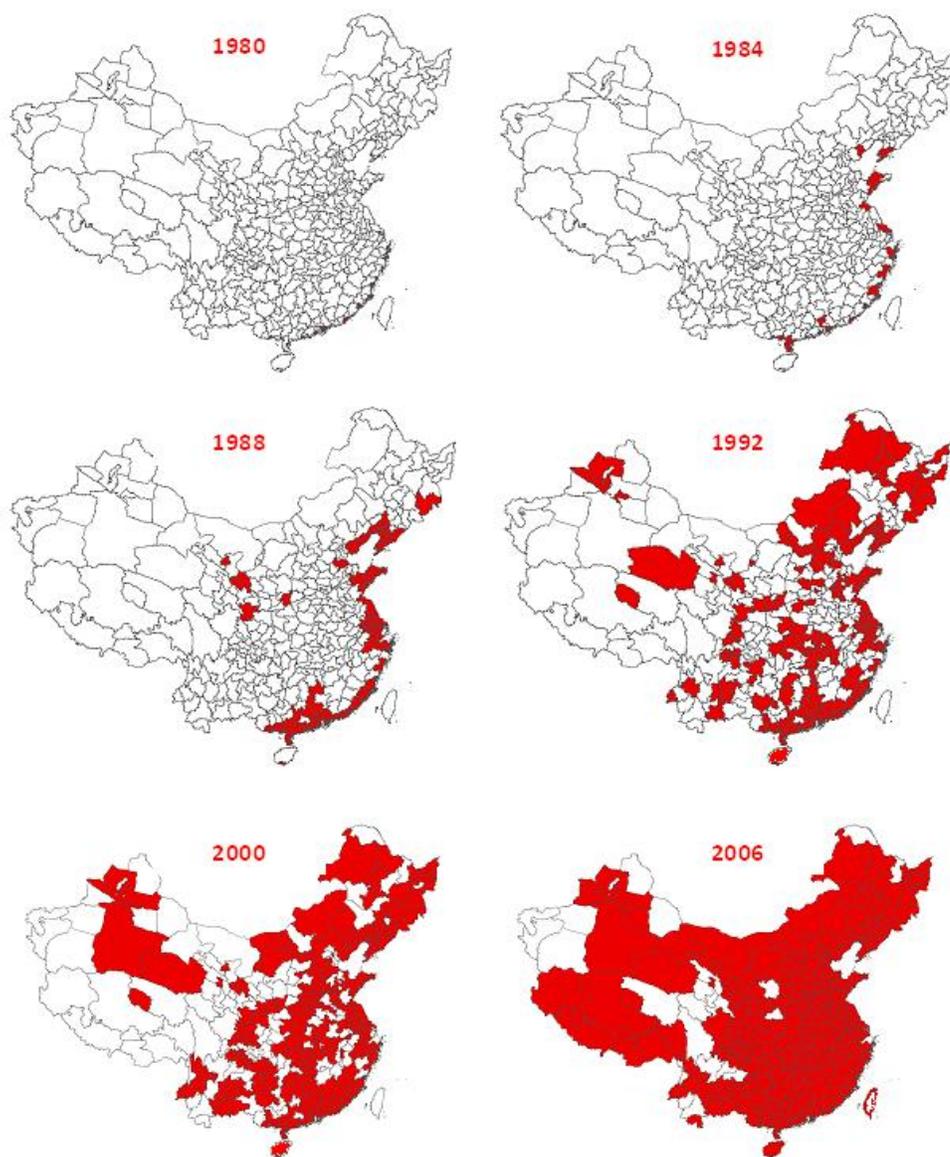
³⁴Refer to The Great Depressions of the Twentieth Century and Holz(2006).

Figure 1 SEZs, FDI and Trade Outcome



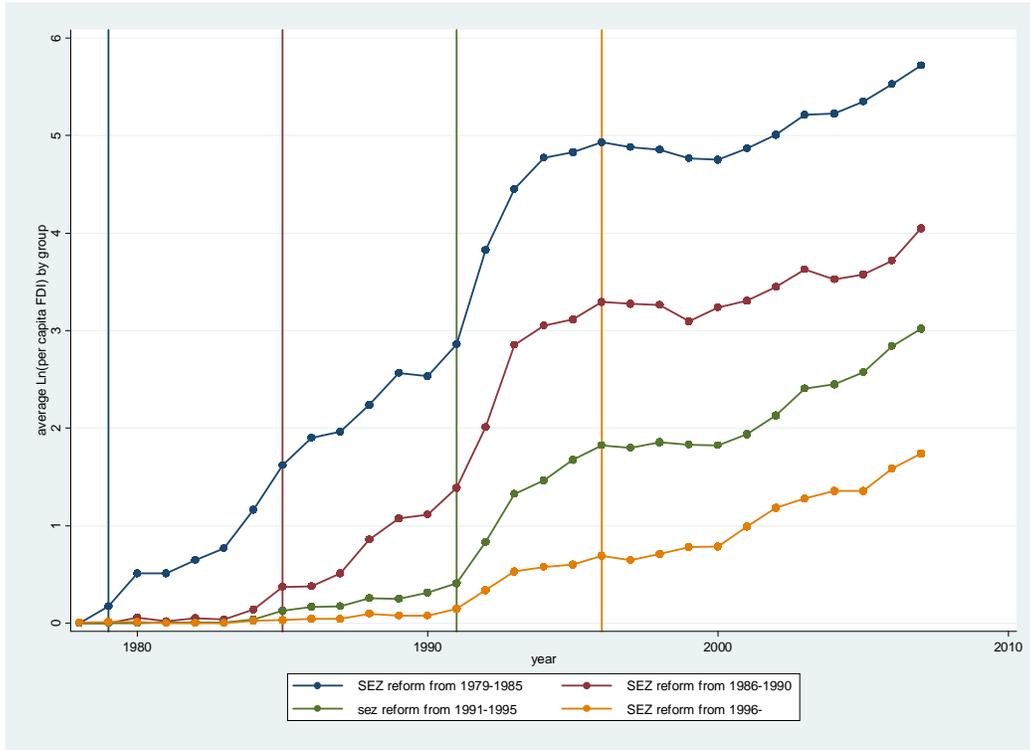
Source: China Statistical Yearbook, 2008; National Development and Reform Commission 2006.

Figure 2 The graph of geographic evolution of Special Economic Zone Experiment



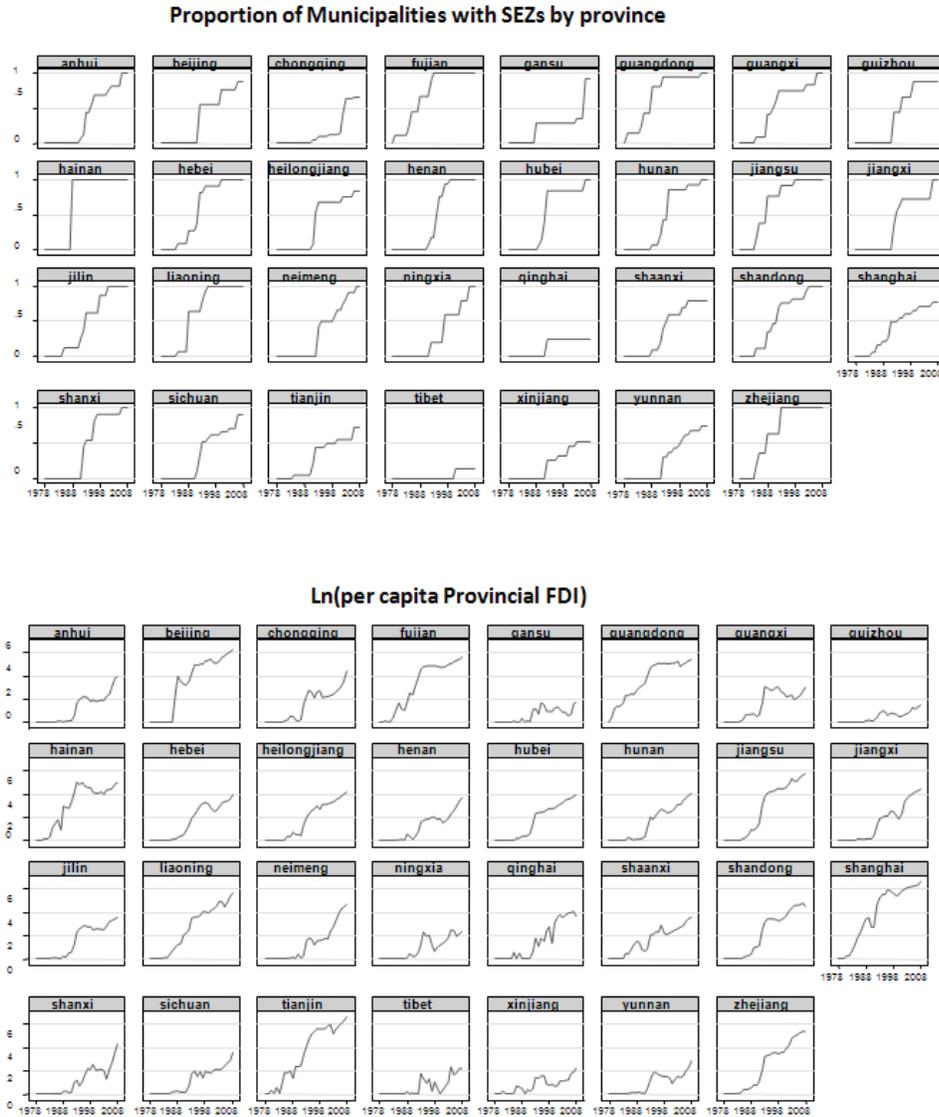
note: if a whole municipality was granted the status of Open Special Economic Zone; or within the municipality, only a certain geographical area was granted to establish state-level economic zones, or province-level economic zones, the municipality was entitled to use preferential policy(including property rights protection, tax break, cheaper land bill, etc) to attract foreign direct investment. Therefore, I define the municipality to be a Special Economic Zone(SEZ) from a general prospective.

Figure 3: Difference-In-Difference Graph of SEZ on FDI outcome



Note: We classify 326 municipalities into four groups based on their timing of carrying out Special Economic Zone experiment. Group 1 is composed of municipalities which were exposed to SEZ reform in early 1980s(1980-1985); Group 2 is composed of municipalities which had SEZ experiment in late 1980s(1986-1990); Group 3 is composed of municipalities which had been granted SEZ experiment in early 1990s(1991-1995); Group 4 includes municipalities which had SEZ reform since late 1990s. The graph displays sample mean of per capita FDI by year by group without controlling any municipality characteristics and macroeconomic shocks.

Figure 4 SEZs and Provincial FDI



Note: The graph illustrates the proportion of municipalities with SEZs in each province and Ln(per capita provincial FDI). This is to address the concern that the FDI SEZs attract at the municipality level comes from the diversion effect, i.e. redistribution of FDI across municipalities that have SEZs and those have no SEZs(within the same province). There is a strong positive correlation between the proportion of municipalities with SEZs in the province and per capita provincial FDI, which should be null if it is merely a diversion effect.

Table 1: The Granting Sequence of SEZs

Variables	1978	1979-1985	1986-1990	1991-1995	1996-2007
1. Number of municipalities newly granted SEZs	0	30	49	145	76
2. Number of municipalities with SEZs	0	30	79	224	300
3. Total Number of municipalities	326	326	326	326	326
4. Ratio of municipalities with SEZs	0.0	0.09	0.24	0.69	0.92
5. Average Distance to the coast	-	0.15	1.34	3.75	6.26
6. Average per capita industry output in 1978	-	806	611	429	263
7. Average per capita number of secondary students 1978	-	0.064	0.060	0.066	0.057

Notes: based on the timing of granting SEZs, I classify the sample into 4 groups. The distance to the nearest coast, unit: 100 miles; Per capita industrial output in 1978, unit: RMB; Per capita enrolled secondary school students in 1978, unit: person.

Table 2: Sample Descriptive Statistics

Variables	Number of Observations	Beginning of Available data	End of Available data
a. SEZ experiment			
Special Economic Zone Index	9778	0.00 (0.00)	0.92 (0.27)
b. FDI related outcome			
FDI per capita(US dollar)	9755	0.00 (0.03)	82.79 (162.38)
Exports per capita(US dollar)	9733	2.34 (17.59)	811.60 (2892.22)
FIE industrial output per capita(rmb)	3667	26.16 (232.98)	9930.44 (26940.67)
c. Growth accounting data			
RealGDP per capita(rmb)	9771	389.16 (314.11)	6467.79 (6242.15)
Domestic capital stock per capita	9677	355.96 (890.33)	13691.16 (11257.42)
Foreign capital stock per capita	9667	0.00 (0.04)	1295.41 (2834.58)
Labor (10,000)	9779	126.2 (112.95)	220.08 (174.88)
Average schooling year in 1982	325	5.12 (0.78)	

Notes: Robust standard errors in parentheses. Special Economic Zone index is a dummy variable which indicates whether the municipality carried out the SEZ experiment. Detailed construction procedure is described in the section 2.2.1.

Table 3: Propensity Score Matching: Nearest Neighbor Approach

a. Probit Regression Results	
Variable	Coefficient (std. error)
Industry output78	0.0006*** (0.0002)
Secondarystudent78	-3.0710 (3.3481)
Distance	-0.0930*** (0.0197)
Log Likelihood	-204.11
Pseudo R-squared	0.096
Number of Obs.	326

Notes: Robust standard errors in parentheses. * denotes significant at 10%, ** significant at 5% and *** significant at 1%. Industry78 denotes the per capita industrial output in 1978, unit: RMB; Secondarystudent78 denotes per capita enrolled secondary school students in 1978, unit: person; Distance denotes the distance to the nearest coast, unit: 100 miles.

b. Comparison Before and After Matching							
Variable	Sample	Mean		Percent Bias	Reduction in bias	t-test	
		Treated	Control			t	p> t
Industry78	Unmatched	565.26	307.43	46.0		4.13	0.000
	Matched	565.26	595.22	-5.3	88.4	-0.42	0.672
Secondarystudent78	Unmatched	0.064	0.060	15.8		1.43	0.153
	Matched	0.064	0.065	-3.8	76.0	-0.34	0.734
Distance	Unmatched	2.69	5.06	-60.1		-5.44	0.000
	Matched	2.69	2.91	-5.7	90.4	-0.64	0.526

Notes: Matched denotes the case after propensity score matching is done; Unmatched denotes the case before propensity score matching is done. Treated denotes the group of municipalities which were granted SEZs by 1992; Control denotes the group which have not yet carried out the SEZ experiment by 1992.

Table 4: Step One: the SEZ Experiment on FDI Outcome

Panel A					
Ln(foreign direct investment per capita)					
	Full Sample			Matched	Later SEZ
	(1)	(2)	(3)	Sample	Sample
SEZdummy	0.723*** (0.079)	0.478*** (0.056)	0.460*** (0.053)	0.434*** (0.061)	0.355*** (0.061)
Municipality FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Province Trend	-	Yes	-	-	-
Municipality trend	-	-	Yes	Yes	Yes
Observations	9772	9772	9772	7405	7404
R-squared	0.761	0.845	0.891	0.898	0.845
Panel B					
Ln(exports per capita)					
	Full Sample			Matched	Later SEZ
	(1)	(2)	(3)	Sample	Sample
SEZdummy	0.871*** (0.098)	0.719*** (0.080)	0.608*** (0.082)	0.595*** (0.096)	0.531*** (0.092)
Municipality FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Province Trend	-	Yes	-	-	-
Municipality trend	-	-	Yes	Yes	Yes
Observations	9733	9733	9733	7391	7376
R-squared	0.833	0.877	0.922	0.927	0.898
Panel C					
Ln(Industrial output of foreign invested enterprises per capita)					
	Full Sample			Matched	Later SEZ
	(1)	(2)	(3)	Sample	Sample
SEZdummy	0.307** (0.137)	0.275** (0.124)	0.497*** (0.128)	0.525*** (0.130)	0.375** (0.184)
Municipality FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Province Trend	-	Yes	-	-	-
Municipality trend	-	-	Yes	Yes	Yes
Observations	3667	3667	3667	3055	2604
R-squared	0.906	0.922	0.943	0.946	0.935

Notes: Robust standard errors in parentheses. Standard errors are adjusted for clustering at municipality level. * denotes significant at 10%, ** significant at 5% and *** significant at 1%. Panel A evaluates the effect of the SEZ experiment on per capita FDI; Panel B examines if the SEZ experiment promotes trade; Panel C checks the industrial output by foreign invested enterprises.

Table 5: Step One: Robustness Check

a. Placebo Test			
Variable	Panel A	Panel B	Panel C
	Ln(per capita FDI)	Ln(per capita exports)	Ln(per capita FIE output)
SEZ(-2)	-0.00594 (0.0395)	0.0395 (0.0591)	-0.123 (0.108)
SEZ(-1)	0.0464 (0.0470)	0.125* (0.0696)	0.0215 (0.163)
SEZ(+0)	0.150*** (0.0562)	0.354*** (0.0871)	0.205 (0.210)
SEZ(+1)	0.376*** (0.0678)	0.507*** (0.101)	0.631*** (0.201)
SEZ(+2)	0.445*** (0.0734)	0.630*** (0.112)	0.466* (0.250)
SEZ(3+)	0.880*** (0.0834)	1.024*** (0.123)	0.765*** (0.254)
Municipality FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Municipality trend	Yes	Yes	Yes
Observations	9772	9733	3667
R-squared	0.897	0.925	0.944

Notes: Robust standard errors in parentheses. Standard errors are adjusted for clustering at municipality level. * denotes significant at 10%, ** significant at 5% and *** significant at 1%. SEZ(+n) are dummies denoting n years after the SEZ experiment.

b. Test for Diversion Effect

Variable	Ln(Provincial Per capita FDI)	
RatioSEZ	1.089** (0.415)	0.902** (0.370)
Province FE	Yes	Yes
Year FE	Yes	Yes
Province trend	-	Yes
Observations	961	961
R-squared	0.869	0.948

Notes: Robust standard errors in parentheses. Standard errors are adjusted for clustering at province level. * denotes significant at 10%, ** significant at 5% and *** significant at 1%. RatioSEZ denotes the proportion of municipalities with SEZs in the province.

Table 6: Step Two: SEZ on Domestically Owned Capital Formation

Panel A					
Ln(Real Domestic Investment)					
	Full Sample			Matched	Later SEZ
	(1)	(2)	(3)	Sample	Sample
SEZdummy	0.044 (0.044)	-0.048 (0.039)	0.067** (0.033)	0.087** (0.037)	-0.017 (0.040)
Municipality FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Province Trend	-	Yes	-	-	-
Municipality trend	-	-	Yes	Yes	Yes
Observations	9732	9732	9732	7364	7399
R-squared	0.931	0.942	0.960	0.961	0.960
Panel B					
Ln(Real Domestically Owned Capital Stock)					
	Full Sample			Matched	Later SEZ
	(1)	(2)	(3)	Sample	Sample
SEZdummy	0.027 (0.038)	0.012 (0.033)	0.067*** (0.022)	0.078*** (0.025)	0.023 (0.025)
Municipality FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Province Trend	-	Yes	-	-	-
Municipality trend	-	-	Yes	Yes	Yes
Observations	9669	9669	9669	7301	7379
R-squared	0.958	0.967	0.986	0.986	0.986

Notes: Robust standard errors in parentheses. Standard errors are adjusted for clustering at municipality level. * denotes significant at 10%, ** significant at 5% and *** significant at 1%. Panel A checks the effect of the SEZ experiment on domestically owned investment; Panel B checks the effect of the SEZ experiment on domestically owned capital stock.

Table 7: Step Three: SEZs on TFP Growth

	TFP Growth					
	K share=provincial average (1)	K share=provincial average (2)	K share=national average (3)	K share=national average (4)	K share=1/3 (5)	K share=1/3 (6)
SEZdummy	0.035*** (0.002)	0.006** (0.003)	0.034*** (0.002)	0.006* (0.003)	0.035*** (0.002)	0.007** (0.003)
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	-	Yes	-	Yes	-	Yes
Observations	9440	9440	9440	9440	9440	9440
R-squared	0.071	0.132	0.072	0.132	0.074	0.136

Notes: Robust standard errors in parentheses. Standard errors are adjusted for clustering at municipality level. * denotes significant at 10%, ** significant at 5% and *** significant at 1%. In column 1-2, I use the most disaggregate capital share available, i.e. province level average capital share; in column 3-4, I use Young(2003)'s national average capital share; in column 5-6, I use the international benchmark capital share as in Caselli(2005).