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Location decisions of Japanese new manufacturing plants in China: a discrete-choice analysis

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Abstract This paper adopts a conditional logit model to empirically examine the location choices of Japanese greenfield manufacturing foreign direct investment among Chinese provinces. It is hypothesized that its location decisions in China would be determined by the provinces' market sizes, infrastructure capacities, labor, land, and energy costs, agglomeration effects, labor quality, and policy incentives. A Hausman–McFadden test is conducted to test whether the independence from irrelevant alternatives assumption of the conditional logit model is violated.

JEL Classification F 23 · L 20 · R 30

1 Introduction

China has become the magnet of foreign investors as foreign direct investment (FDI) floods into the most populous country. As one of the first countries to invest in China, Japan has outperformed the USA, becoming China's second largest FDI-sourcing economy behind Hong Kong. In contrast to the flourish of Japanese FDI in China, the research on the location choices of Japanese FDI within China is scarce. The purposes of this paper are then to empirically examine the location determinants of Japanese greenfield FDI among Chinese provinces and to shed light on the location choices of foreign investors in China. Understanding these determinants and choices cannot only enrich the previous studies on the

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intracountry spatial distributions of FDI but also provide economic rationales for public policies that intend to influence the location choices of foreign investors in general and Japanese investors in particular. These policy implications are critical because China's governments are trying to attract FDI into China's western interior areas and to promote their economic growth in light of the success of FDI preferential policies and FDI-led growth in China's coastal region.

2 Literature review

Given the important role of the empirical investigation of FDI spatial distribution within a country, a large number of models and studies have been constructed and carried out. The purposes of this review are twofold. The first is to identify factors that have been found consistently in previous research to influence foreign investors' location decision at the intracountry level. Particular emphasis will be laid on consistency across studies, i.e., to compare results across data sets and methodologies, and to find determinants that arise persistently. In this way, factors identified will be independent of any specific data set or methodology. The other purpose is to identify limitations in previous models and analyses. Understanding and compensating for, if possible, these limitations and their effects allow for more accurate policy analysis. In addition, these limitations can also guide the way for future research. This chapter is organized along methodological lines, that is, aggregate data and methodologies vs disaggregate ones.

Earlier attention on FDI in China was mainly focused on its volume and sectoral characters (e.g., Kueh 1992; Lee and Cheong 1999; OECD 2002; Schroath et al. 1993; Zhang 1994). While limited compared to other assessments of FDI, previous empirical analyses on the location determinants of FDI in China that do exist have been conducted by using both aggregate and disaggregate methodologies and their applicable FDI data sets. In the aggregate approach, ordinary least square (OLS) method is typically used along with either FDI inflow or stock data. This approach assumes that each Chinese city or province in question is able to draw or accumulate any specific volume of FDI in any single year or over years, and that these FDI inflows or stocks are normally distributed across these cities or provinces. In the disaggregate approach, each individual firm's location selection behavior is examined against observable location characteristics such as infrastructure capacity or market potential. Generally, conditional logit model has been successfully used in this firm-level analysis. Compared to the aggregate approach, disaggregate methodology was not applied until recently.

Consensus has developed and evolved in the aggregate studies both at the city and provincial level. At the city level, transportation and communication infrastructure, market size, and policy incentives have been identified as important location determinants for incoming FDI (Gong 1995; Qu and Green 1997; Zhao and Zhu 2000). At the provincial level, a similar agreement has been reached on the positive effects of infrastructure, market potential, and preferential policies (Broadman and Sun 1997; Fu 2000; Fung et al. 2002; Lu 1997; Sun et al. 2002; Wei et al. 1999).

Agglomeration economies are also concluded as a significant factor in the location decisions of FDI in China either at the intercity or at the interprovincial level. Notably, new FDI does not converge spatially to the geographic pattern of

existing Chinese domestic investments, but instead, it follows the patterns of prior FDI stocks (Broadman and Sun 1997; Cheng and Kwan 2000; Qu and Green 1997; Wei et al. 1999). In addition, labor quality is another principal location determinant. High labor quality would significantly draw FDI (Cassidy 2002; Sun et al. 2002; Wei et al. 1999; Yang 2002; Zhao and Zhu 2000).

Congruent conclusions are also reached in disaggregate studies. Chen (1996) first applied conditional logit model to examine the location decisions of foreign affiliations in China and concluded that superior infrastructure endowment would attract foreign investors. Conditional logit model was then employed in other studies, and it is concluded that foreign investors' location choices are highly hinged upon a place's market volume, transportation infrastructure, high-quality labor force, policy environment, and industrial agglomeration (Belderbos and Carree 2002; He 2001; Hou and Zhang 2001; Wu and Strange 2000).

Despite the general consensus on location factors of FDI, the effects of labor cost on the location choice of FDI in China are divided. This discrepancy appears across methodological boundaries and therefore arises independent of specific methods used in the analyses. In line with the conventional wisdom, higher labor cost was found to be a deterrent to FDI (Belderbos and Carree 2002; Cheng and Kwan 2000; Coughlin and Segev 2000a; Fung et al. 2002; Wei and Liu 2001). On the other hand, Broadman and Sun (1997), Chen (1996), and Head and Ries (1996) indicated a statistically insignificant correlation between the geographic distribution of FDI and labor cost. Surprisingly, Zhao and Zhu (2000) identified a positive correlation between high labor cost and FDI attraction.

Efforts have been devoted to reconcile these conflicting results in terms of the role of labor cost in attracting FDI in China. Zhao and Zhu (2000) elaborated that absolute wage levels can be a misleading indicator for labor costs because they can be associated with various levels of labor productivity. That is to say, high wages could be interpreted either as a sign of high labor cost or as an indicator of a skilled and quality labor force. Following this argument, Cassidy (2002) and Wei et al. (1999) controlled different labor productivities by using so-called effective wages. In so doing, it is concluded that foreign investors avoid Chinese provinces with higher effective wages. Effective wages, which are average wages divided by labor productivity, are the unit labor price that is normalized by labor productivity. Fu (2000) revised the effective wages into effective industrial wages and identified a similar negative correlation between labor cost and incoming FDI at the provincial level in China.

The heated debate on the impacts of labor cost on FDI distribution in China was fueled by He (2001), who found that foreign investors choose Chinese provinces with higher effective wages. This positive relationship between effective wages and FDI attraction is significantly strong even when agglomeration economies of FDI are controlled. He hypothesized that superior labor quality associated with high effective wages would be a potential explanation for the positive correlation. By spatially locating in high-wage areas, foreign investors would tap into larger pools of high-quality labor forces.

With regard to the location choices of Japanese FDI in China, many studies emphasize that Japanese FDI displays a distinctive location pattern, indicating that it may seek unique location factors. Schroath et al. (1993) showed that Japanese

joint ventures tend to be concentrated in China's northeastern regions. They argued that geographic and cultural factors play an important role in this spatial concentration. Qu and Green (1997) suggested that FDI from the USA, Japan, and European countries is interested in city sizes, consumption levels, and infrastructure in its location decisions, while FDI from Hong Kong is generally oriented by cultural and geographic distances. Zhao and Zhu (2000) argued that Japanese FDI pursues resources, while American and European FDI chases higher labor productivity and strong local economic bases. He (2003) suggested that, in addition to Japanese special location preferences compared to other FDI home countries in China, Japanese investors from different sectors may have their own particular location choices. Zhou et al. (2002) investigated Japanese FDI inflows to 190 Chinese cities from 1980 to 1998 and showed that Japanese FDI tends to be agglomerated to prior Japanese subsidiaries. This Japanese nationality-specific FDI agglomeration was also found in Europe and in the USA (Ford and Strange 1999; Head et al. 1995, 1999; Smith and Florida 1994).

3 Research question and hypothesis

Despite insights provided by above empirical studies on location determinants of FDI in China, many of these studies have their limitations. First, many analyses examined the spatial distribution of FDI in China only in the early 1990s (e.g., Broadman and Sun 1997; Cassidy 2002; Chen 1996; Gong 1995; Head and Ries 1996; Qu and Green 1997; Zhao and Zhu 2000). These studies may not be able to capture recent changes of location determinants nor China's current FDI policy incentives.

Second, many previous studies failed to distinguish greenfield investments or new plants from mergers or acquisitions (e.g., Broadman and Sun 1997; Cassidy 2002; Fu 2000; Gong 1995; Sun et al. 2002; Wei et al. 1999; Zhao and Zhu 2000). Little (1978, 1980) argued that the location choices of mergers and acquisitions would be determined and constrained by the few available candidates for mergers or acquisitions. Therefore, greenfield investments or new plants may be more capable of reflecting the real location preferences of foreign investors because, at least in theory, they can be established on any place to satisfy these preferences. Along with Little's reasoning, the examination on the location needs of new manufacturing plants has become the dominant research design in the USA (e.g., Coughlin and Segev 2000b; Friedman et al. 1992; Ondrich and Wasylenko 1993; Luger and Shetty 1985; Woodward 1992).

Third, many prior analyses focused on aggregated FDI flows in general on the assumption that FDI of various sectors would be similarly responsive to the same group of location determinants (e.g., Broadman and Sun 1997; Chen 1996; Fu 2000; Gong 1995; Sun et al. 2002; Wei et al. 1999). This approach may overlook potential sectoral location preferences. In China, FDI in service sectors such as banking, insurance, and real estate is only allowed in designated cities or areas. Since the location choices of service FDI are constrained by China's existing policies, this policy-skewed spatial patterns of service FDI are beyond the scope of

this study. Manufacturing FDI alone, therefore, may be more appropriate for the investigation of location determinants of FDI in China.

In addition, the primary focus on aggregated FDI data may not be able to tease out the "country-of-origin" effect on FDI location factors. The country-of-origin effect means that FDI from different origins may have different labor cost requirements or sensitivities. For example, Fung et al. (2002) indicated that FDI from Hong Kong is more responsive to cost variables than that from the USA. Zhao and Zhu (2000) found American and European FDI generally seeks high labor productivity and strong local economic bases. To better reveal the country-specific location patterns, this paper focuses exclusively on FDI from Japan.

Finally, aggregated data of FDI flows and the OLS model have dominated in the existing studies on the location patterns of FDI in China. However, the aggregated data and methodology are contradictory to the disaggregated and discrete nature of FDI. Discrete-choice models, which are well grounded on microeconomic utility maximization and feasible to rich empirical specifications, provide a powerful tool to reveal each individual's choices. The discrete-choice models on location choices of FDI have been well developed and successfully employed in the context of the USA (e.g., Coughlin et al. 1991; Coughlin and Segev 2000b; Friedman et al. 1992; Ondrich and Wasylenko 1993; Luger and Shetty 1985; Woodward 1992). New insights would be provided by integrating the discrete-choice models into the analyses on the location choices of Japanese FDI in China.

In sum, this paper focuses primarily on Japanese greenfield manufacturing FDI (JFDI) and its location preferences within China from 1997 to 2002. This research arrangement can incorporate China's latest economic and policy changes and their effects, reduce the distraction of service FDI and mergers and/or acquisitions, reveal the country-of-origin effect, and invite alternative discrete-choice analysis. It is hypothesized that the location decisions of new Japanese manufacturing plants among Chinese provinces would be determined by their market sizes, infrastructure capacities, labor, land, and energy costs, agglomeration effects, labor quality, and policy incentives.

4 Methodology and data

This paper calibrates a discrete-choice model, namely, conditional logit model, with its compatible disaggregate firm-level JFDI data. Discrete-choice models are well grounded on microeconomic utility/profit maximization and are feasible to rich empirical specifications. Unlike aggregate methodologies, e.g., the OLS model, the discrete-choice models empower researchers to reveal each individual choice maker's preferences, some of which may be lost in the aggregate methodologies in their aggregation process of discrete data. Therefore, the disaggregate conditional logit model and its compatible disaggregate firm-level FDI data are used in this paper to better understand the location choices of Japanese investors in China.

4.1 Methodology

This paper employs conditional logit model[1] of McFadden's (1974) to analyze the location factors of JFDI in China. This established modeling approach to location choices assumes that a rational Japanese investor *i* would choose a province *j* for his/her new plant only if this province could maximize his/her profits. Since the forecasted profit of each province is not directly observable, it is further assumed that the anticipated profit is a function of observable characteristics of each province. Mathematically, the forecasted profit of foreign investor *i* in province *j* can be expressed as:

$$\pi_{ij} = X_{ij}\beta_i + \varepsilon_{ij} \tag{1}$$

where X_{ij} refers to the vector of observable location characteristics of province *j*, β is the vector of estimated coefficients, and ε is disturbance terms referring to unobserved characteristics of each alternative. Each ε is assumed to be the independently and identically distributed (IID) extreme value. Therefore, a province *j* is selected by a foreign investor *i* if and only if:

$$\pi_{ij} > \pi_{is}, \text{ for} j \neq s \tag{2}$$

The probability of a Japanese investor *i* choosing a particular province *j* out of *S* potential provinces can be mathematically expressed as follows. The estimation of $\boldsymbol{\beta}$ can be obtained from maximum likelihood method.

$$\Pr ob(j) = \frac{\exp\left(X_{ij}\beta_i\right)}{\sum_{s=1}^{S} \exp\left(X_{is}\beta_i\right)} \tag{3}$$

The IID distributed unobserved utility ε implies an important property of the conditional logit model: independence from irrelevant alternatives (IIA) property. [2] The IIA property specifies that for any investor, the probability ratio of any two alternatives depends only on the attributes of the two alternatives and is independent of other available alternatives. In other words, for any investor, there is no close substitute choices, and omitting any alterative from the choice set will not change the investor's decision. Violations of the IIA assumption, i.e., unobserved utilities ε are correlated, would "necessarily yield counterintuitive forecasts" (Ben-Akiva and Lerman 1985, p. 109). Although it is a strict assumption, the IIA property is regarded as a necessary condition for a good discrete-choice modeling (Train 2003). The reason is because in a good conditional logit model, independent variables should capture all of observable characteristics, thus leaving the disturbance terms ε uncorrelated. To detect the potential violations of the IIA assumption, Hausman and McFadden (1984), McFadden et al. (1977),

[1] Conditional logit model is slightly different from multinomial logit model, although they share the same mathematical expression. The major difference is that the conditional logit model only contains alternative-specific attributes, while the multinomial logit model may include both individual-specific and alternative-specific characteristics. For more information, please refer to Greene (2000).

[2] Commonly cited example to explain the IIA assumption is the red/blue bus paradox. Please refer to Ben-Akiva and Lerman (1985) for more information.

and Small and Hsiao (1985) proposed different statistical tests. The essence of these tests is that the estimated coefficients of a restricted model, in which some alternatives are omitted from the entire choice set, should be statistically identical to those of an unrestricted model that is derived from the whole choice set.

Unfortunately, the IIA assumption, is often violated in the industrial location literature. Many attempts have been tried to remedy this. Coughlin and Segev (2000b), Head et al. (1995, 1999), and Woodward (1992) adopted regional dummy variables, which are in line with American Census divisions, to capture similar unobserved location characteristics within a region. Ondrich and Wasylenko (1993) employed a nested logit model, in which they assumed that an investor would face a hierarchical and staged decision process, i.e., he/she first chooses a region and then selects a state within that region to locate his/her plant. Guimaraes et al. (2003) tried to avoid the IIA assumption by connecting the conditional logit model and the Poisson regression in their computational processes with the incorporation of sectoral variables.

The first two approaches are only partial solutions because they still assume that the IIA assumption holds among alternatives within the same region. This assumption is not always valid, although Ondrich and Wasylenko (1993) showed that alternatives within a nest are independent from each other. The last approach, due to the integration of sectoral variables, may create extra difficulties in data collection. In addition, some location variables may be dropped out in the computation process, thus losing choice-related information that could be obtained from a data set. This paper, along with the first approach, will use five regional dummy variables to control similar unobserved location characteristics. To test the robustness of the conditional logit model, a Hausman–McFadden test will be conducted to explicitly detect whether the IIA assumption is violated.

4.2 Data

Compatible to the discrete conditional logit model, this paper uses disaggregate firm-level JFDI data, which is available from *Kaigai Shinshutsu Kigyou Souran* (Japanese Overseas Investment). *Kaigai Shinshutsu Kigyou Souran* is an annual publication of Toyo Keizai Inc (2003) on the basis of its yearly survey on Japanese overseas subsidiaries all over the world. In its 2003 edition, 764 new Japanese manufacturing affiliates in China in the period of 1997–2002 are listed. In addition, detailed information of each affiliate is also provided on the city and province where it is located, the year when it was founded, its major business, and whether it is a greenfield investment or from mergers or acquisitions. In the period of 1997–2002, six provinces received no Japanese new manufacturing plants, so these six provinces are excluded from the choice sets (see Table 1). The dependent variable is then a province's probability of being chosen out of the 25 Chinese provinces by Japanese investors.

Market size As one of the most important location determinants of FDI in China, market size has been measured in two approaches. The first approach assumes that incoming FDI would focus primarily on the provincial market rather than the national one. Fu (2000) argued that the provincial market potential approach is appropriate because of China's highly segmented markets resulting from Mao's

Table 1 Provincial distribution of new Japanese manufacturing plants in China from 1997 to 2002

Beijing	22	Henan	7
Tianjin	33	Hubei	1
Hebei	17	Hunan	2
Shanxi	0	Guangdong	115
Neimengu	2	Guangxi	0
		Hainan	1
Liaoning	46		
Jilin	4	Chongqing	6
Heilongjiang	4	Sichuan	8
		Guizhou	2
Shanghai	190	Yunnan	1
Jiangsu	172	Xizang	0
Zhejiang	54		
Anhui	5	Shaanxi	7
Fujian	20	Gansu	0
Jiangxi	2	Qinghai	0
Shangdong	42	Ningxia	1
		Xinjiang	0

Source: *Kaigai Shinshutsu Kigyou Souran*

developmental strategy. Along with the provincial approach, indicators of market size include provincial gross domestic product (GDP) (Cassidy 2002; Fu 2000; Fung et al. 2002; Sun et al. 2002), provincial gross national product (GNP) (Broadman and Sun 1997; Coughlin and Segev 2000a), provincial income per capita (Chen 1996; Sun et al. 2002), and provincial GDP growth (Wei et al. 1999). On the contrary, the other approach believes that foreign manufacturing affiliates are able to serve not only their provincial markets but also the entire national market. He (2001) used a gravity market accessibility index as a proxy of the national market capability faced by a foreign subsidiary. This paper uses provincial GDP as a proxy of market size. A positive sign is expected.

Infrastructure capacities In the prior literature, the coverage of infrastructure varies. Some studies focus exclusively on transportation infrastructure (Broadman and Sun 1997; Cassidy 2002; Chen 1996; Fung et al. 2002; He 2001; Head and Ries 1996; Zhou et al. 2002). Telecommunications and postal services are also considered in other analyses (Fu 2000; Gong 1995; Wei et al. 1999; Zhao and Zhu 2000). The most favored infrastructure measure is a density indicator, which is the ratio between a province's infrastructure capacities to its geographic size. This paper adopts transportation density as an indicator and expects a positive sign.

Costs Three cost variables will be used in the analysis. The first one is labor cost. The major difference in a number of previous labor cost measures is how labor productivity is controlled. Broadman and Sun (1997), Chen (1996), Fung et al. (2002), Sun et al. (2002), and Zhao and Zhu (2000) used average wages without controlling labor productivity. Coughlin and Segev (2000a) and Head and Ries (1996) also used the average wages, but they introduced a separate variable to

control different labor productivities. Cassidy (2002), He (2001), and Wei et al. (1999) employed the effective wage, which is the ratio of average wages to labor productivity, as their indicator of labor cost. Fu (2000) replaced the effective wage by effective manufacturing wages. Effective manufacturing wages will be employed, and a negative sign is expected.

The second cost variable is land cost. Land cost, one of the classical factors in industrial location literature, has been surprisingly left out in the analyses on the location determinants of FDI in China. This paper integrates land costs into its empirical analysis to test whether high land costs deter incoming JFDI. Since the average provincial land costs are not available, this paper uses average provincial house prices as an indicator of land cost. This approach would be valid since land values contribute to a dominantly large portion of house prices. A negative sign is expected due to the deterrent effects of high land costs.

Another cost variable is energy cost. The major consideration to integrate this cost variable into this paper is because of the huge amount of energy reserved in China's middle and western regions. If the energy supply in the coastal areas is very tight, this energy abundance may offer the middle and western regions a competitive advantage in FDI attraction because foreign investors may avoid provinces with high energy prices. The ideal indicator of energy costs may be a weighted average price of different types of alternative energy supplies. But due to data unavailability, this paper constructs an energy scarcity index, which is computed by dividing a province's yearly amount of electricity generation by its annual industrial output. This energy scarcity index would be equivalent to an energy price index if it is assumed that energy prices would increase as its supply becomes scarce compared to industrial output. A negative sign is expected for the energy scarcity index.

Labor quality A variety of measures have been adopted to capture the effects of labor quality on incoming FDI. Broadman and Sun (1997) and Coughlin and Segev (2000a) used the adult illiteracy level as their indicator for labor quality. Sun et al. (2002) measured the relative endowment of skilled workers by the numbers of scientists, engineers, and technicians per 1,000 employees. Wei et al. (1999) employed the number of scientists and researchers in total employment. Cheng and Kwan (2000) used three different labor quality measures, namely, the percentages of the entire population with at least primary, junior high, or senior high school education. This paper revises the measures of Cheng and Kwan (2000), and adopts the percentage of the adult population with at least a junior high school education. A positive sign is expected.

Policy incentives Dummy variables have been widely used to capture provincial differences resulting from preferential policies. Gong (1995) used a dummy variable to capture the impacts of special economic zones (SEZs) on the spatial distribution of FDI. Head and Ries (1996) used dummy variables to measure a wide range of zones, e.g., SEZs, open coastal cities (OCCs), and economic and technology development zones (ETDZs). Wei et al. (1999) employed dummy variables for SEZs and OCCs. Besides dummy variables, Fung et al. (2002) differentiated provinces by their number of SEZs, OCCs, and ETDZs. He (2001) and Zhou et al. (2002) considered the operating periods of various development zones in addition to the numbers of those zones in a province. They argued that the

earlier a national development zone was established in a province, the longer has the province been open to foreign investors. Fu (2000) constructed a policy advantage index that considers various preferential tax rates and different provincial approval authority on FDI projects.

One shortcoming of previous research is that it failed to make a distinction between national and provincial development zones. Compared to the national development zones, provincial zones can be approved and established by provincial governments, and provincial zones can offer quite similar preferential FDI policies (see Table 2). Therefore, the number of provincial development zones in a province is a good indicator to reflect the province's efforts in FDI attraction. With respect to the effects of various policy incentives, this paper uses three variables to capture them. The numbers of national and provincial development zones are used to reflect national and provincial efforts, respectively. In addition, the operating time of the first national zone in a province is also used. All of the three variables are expected to have positive signs.

Agglomeration effects Two potential agglomeration phenomena will be investigated in this paper. One is Japanese nationality agglomeration and the other is nonnationality agglomeration. Japanese nationality agglomeration refers to the

Table 2 The income tax rates concerning foreign enterprises in China's development zones

Different types of foreign enterprises	State regulations (%)	National development zones					Open cities/ areas and provincial development zones (%)
		SEZs (%)	ETDZs (%)	HTIZs (%)	FTZs (%)	BECAs (%)	
Productive enterprises	30	15	15	15	15	15	24
Nonproductive enterprises	30	15	30	30	30	30	30
Knowledge-/technology-intensive projects and projects with a long investment period	30	15	15	15	15	15	15
Export-oriented enterprises with its export value of the year equals or exceeds 70% of its output value	15	10	10	10	10	12	12
Financial institutions with foreign operation capital over $10 million and an operation period of 10 years or more	30	15	15 (approved by the state council)				
Projects concerning energy, transportation, or projects encouraged by the governments	15						

Source: China's Association of Development Zones

agglomeration of JFDI regardless of the geographic distribution of China's domestic investments, while nonnationality agglomeration refers to the spatial proximity of JFDI to China's indigenous firms. A number of variables have been used in previous research to capture agglomeration economies. Head and Ries (1996) used industrial output and the count numbers of industrial enterprises to measure the agglomeration economy. He (2001) used provinces' employment location quotients to capture the pulling force of strong local industrial bases. In addition, he used the number of foreign enterprises in the previous year to capture nationality agglomeration. This paper uses the location quotient of Japanese FDI in each province as the indicator of Japanese nationality agglomeration. With regard to the nonnationality agglomeration, the number of Chinese domestic industrial enterprises of each province is adopted. Both variables are expected to have positive signs.

Regional dummy variables Five regional dummy variables are introduced into this paper to control unobserved characteristics of each alternative. The main purpose of the introduction of these dummy variables is to reduce the chances in which the IIA assumption is violated. However, these dummy variables may not guarantee that the IIA property holds, and therefore, a Hausman–McFadden test is conducted to test whether the IIA assumption is violated. These dummy variables are consistent with China's traditional regional divisions in terms of their geographic proximity. The signs of these regional dummy variables are not certain because of the nature of the unobservable regional attributes.

In summary, 11 choice-specific variables and 5 regional dummy variables are used in the conditional logit model to investigate the location choices of JFDI among China's 25 provinces (see Table 3). Preliminary tests suggested that the variable of nationality agglomeration has a significant correlation with the variables of market size and infrastructure. This correlation implies that Japanese nationality agglomeration would take place in provinces with large market potentials and superior infrastructure capacities. Since the positive effects of market size and infrastructure on incoming FDI have been well documented in previous studies, this paper excludes these two variables in the analysis. In so doing, the effects and magnitude of Japanese nationality agglomeration can be correctly revealed.

5 Empirical findings

In the conditional logit model, interpreting estimated coefficients is not straightforward because they are not directly related to marginal effects. This paper adopts average probability elasticity to measure the marginal magnitudes of the estimated parameters. The average probability elasticity is the sum of probability elasticity across all individuals and alternatives (He 2001; Head et al. 1995). The elasticity of the probability of investor i choosing province j with regard to location attribute X_k can be calculated as follows:

$$E_{ij}^{k} = \frac{\partial \Pr ob(j)}{\partial X_k} \frac{X_k}{\Pr ob(j)} = \beta_k (1 - \Pr ob(j)) \tag{4}$$

Table 3 Descriptions of independent variables and their expected signs

Independent Variables	Descriptions	Expected signs	Sources
Market size	Provincial GDP in 1997	+	Statistical yearbook of China
Infrastructure	Provincial transportation densities in 1997	+	
Labor cost	Provincial effective manufacturing wages in 1997	−	
Land cost	Provincial average house prices per square meter in 1997	−	
Energy scarcity	Provincial ratios of electricity amount and total industrial output in 1997	−	
Labor quality	Provincial percentages of adult population with at least junior high school education in 1997	+	
Nonnationality agglomeration	Provincial numbers of Chinese domestic enterprises in 1997	+	
Nationality agglomeration	Provincial location quotients of Japanese FDI in 1997	+	Yearbook of China's foreign economic relations and trade
Length of openness	Operating time of each province's first national development zones up to 2001	+	China's association of development zones (http://www.cadz.org.cn/en/)
Number of national zones	Number of national development zones in each province in 2002	+	
Number of provincial zones	Number of provincial development zones in each province in 2002	+	
Region I	Beijing, Tianjin, Hebei, Shanxi, and Neimengu	?	Statistical yearbook of China
Region II	Liaoning, Jilin, and Heilongjiang	?	
Region III	Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, and Shangdong	?	
Region IV	Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan	?	
Region V	Chongqing, Sichuan, Guizhou, Yunnan, and Xizang	?	
Region VI	Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang	?	

The average probability elasticity of location attribute X_k then can be obtained by summing up all investor i and province j:

$$E^k = \sum_{i=1}^{N} \sum_{j=1}^{25} E_{ij}^k = \beta_k \frac{J-1}{J} = \beta_k \frac{25-1}{25} = 0.96\beta_k \tag{5}$$

where J is the total number of provinces and β_k is the estimated coefficient of location characteristics X_k. The average probability elasticity of location attribute X_k, its estimated marginal effect, is equal to 96% of β_k.

Three model specifications have been tested in this paper (see Table 4). Specification I does not include labor quality in the analysis. The major consid-

Table 4 Statistical results of conditional logit model

Dependent variable: probability of investor i choosing province j						
	Specification I		Specification II		Specification III	
	Coefficients	p value	Coefficients	p value	Coefficients	p value
Labor cost	4.163	0.053	5.175	0.004	4.864	0.008
Land cost	−0.001	0.000	−0.001	0.000	−0.002	0.000
Energy scarcity	−0.246	0.580				
Nonnationality agglomeration	0.000	0.005	0.000	0.001	0.000	0.002
Nationality agglomeration	1.401	0.000	1.382	0.000	0.922	0.000
Length of openness	0.111	0.000	0.112	0.000	0.136	0.000
Number of national zones	0.189	0.000	0.184	0.000	0.164	0.000
Number of provincial zones	−0.014	0.494				
Labor quality					6.075	0.004
Region I	0.425	0.464	0.592	0.193	0.048	0.922
Region II	−1.170	0.031	−1.070	0.022	−1.321	0.005
Region III	−0.424	0.443	−0.301	0.501	0.181	0.701
Region IV	−0.834	0.139	−0.725	0.127	−0.608	0.194
Region V	−0.584	0.198	−0.656	0.142	0.286	0.603
Summary statistics						
Number of observations		764		764		764
Log likelihood		−1,738.8995		−1,739.2398		−1,735.0141
Likelihood ratio		$\chi^2(13)$ =1448.35		$\chi^2(11)$ =1447.66		$\chi^2(12)$ =1456.12
ρ^2		0.294		0.294		0.296
Adjusted ρ^2		0.289		0.289		0.291

eration is to establish a "baseline" situation to connect previous similar empirical estimations. Specification II excludes two statistically insignificant variables, namely, energy scarcity and the number of provincial zones. Labor quality is added in specification III to see whether the integration of labor quality would explain the positive relationship between labor cost and incoming FDI.

The first empirical finding is that JFDI displays a nationality agglomeration regardless of China's domestic industrial distributions, geographically converging to previous Japanese FDI. The average probability elasticity of Japanese nationality agglomeration in specification II indicates that a 10% increase in a province's location quotient of Japanese FDI would raise its probability of being selected by more than 13%. However, an increase in the number of China's domestic industrial enterprises, an indicator of industrial strengths of different provinces, has literally no impact on the location distribution of Japanese new manufacturing plants. In specification III, the inclusion of labor quality reduces the magnitude of Japanese nationality-specific agglomeration from 13 to 9% in response to the same increase in Japanese FDI location quotient. This magnitude reduction implies that part of the reason for Japanese nationality agglomeration in specification II would be because Japanese FDI spatially converges together to take advantage of pooled skilled and quality workers.

This Japanese-specific nationality agglomeration echoes previous similar findings. With respect to the degree of the nationality agglomeration, Head et al. (1995) suggested that a 10% expansion of previous Japanese greenfield FDI in an American state would increase its likelihood of being chosen by 5–6%. Japanese investors in China, compared to their counterparts in the USA, seem to be more responsive to the location decisions of previous Japanese affiliations. A potential explanation would be that it is much more difficult for foreign investors to access local information from China than from the USA. Japanese investors, by simply duplicating the previous location choices of Japanese FDI in China, would save time and reduce costs on the information collection of each alternative province. Another possible explanation would be that China has far fewer specialized infrastructures and services for Japanese investors than for the USA, so Japanese investors, through their own spatial agglomeration, must establish and share their desired services or infrastructures that are generally not available in China.

Policy incentives to attract FDI are more effective at the national level than at the provincial level, although these two sets of incentives are very similar. The two variables measuring national policy incentives, the operating time of the first national development zone and the total number of national development zones, are statistically significant and have the right signs. In terms of their influence, a greater number of national development zones would be more effective than a longer open period of a province to foreign investors. This difference may imply that the preferential treatments within the national development zones such as tax concessions, superior infrastructure, and flexible regulations are, to a large extent, confined within their boundaries. The lack of spillovers of the preferential treatments into nonzone areas would be the driving force for increasing demands for national development zones. Compared to national efforts, provincial endeavors to recruit Japanese FDI are not fruitful, as indicated by the statistically insignificant relationship between the number of provincial zones and JFDI attraction. The ineffectiveness of the provincial efforts may further intensify the heated competition to build national development zones.

In terms of the three cost variables, the variable of energy scarcity has the right sign but is not statistically significant. The variable of land cost has the right sign and is statistically significant, but an increase in land costs in a province may only have minimal impacts on its likelihood of being selected. The variable of labor cost is statistically significant but is not consistent with its expected sign. It is suggested that in specification II, a 10% rise of labor cost in a province would increase its probability of being selected by 49.7%. The integration of labor quality in specification III does not change the sign of labor cost, but it does reduce the marginal effects of labor cost. This reduction of the marginal effects of labor cost is consistent with the hypothesis of He (2001) that high labor cost would also be an indicator of superb labor quality. The importance of labor quality in FDI attraction can also be supported by its own strong marginal effects: a 10% increase in labor quality in a province would increase its chances of being chosen by 58.3%.

This paper delineates that the positive relationship between labor cost and incoming FDI would contribute to the previous debate about the effects of labor cost on FDI attraction in two ways. First, consistent with the previous hypothesis, properly controlling labor quality would reduce the positive magnitude of labor cost. Second, this paper systematically integrates assorted variables to control factors that would result in the positive relationship. These control variables include labor productivity, agglomeration effects, and labor quality. The remaining significantly positive relationship between labor cost and incoming FDI warrants future research on this topic.

With regard to the future research, three potential hypotheses are provided in this paper. First, this positive relationship could result from incorrect or inaccurate measures of labor cost variables or those control variables. Second, high wages can also be interpreted as a sign of high quality of life resulting from high income levels. High income levels derived from expensive wages may create and stimulate the demand for superior local amenities such as well-established shopping and recreation facilities, notable school and hospital systems, and crimeless communities. In response to the demand, higher-wage provinces would establish a better quality of life. Geographically locating in those high-wage areas, foreign investors may gain access to the better quality of life, which is not widely available in China. Finally, geographic wage differentials could result from the spatial differences of inflation levels. A high inflation level in a province compared to others would raise this province's wage levels if everything is held constant. High wages, which are caused by a high inflation level, would not deter foreign investors if most of their revenues, which will also be accordingly inflated, come from the same province.

The robustness of the conditional logit model and its estimated coefficients, as discussed, relies heavily on the IIA assumption. To test the robustness of the model in this paper, a Hausman–McFadden test is carried out (see Table 5). The essence of the test is to compare the estimated coefficients of a subsample, in which an alternative is omitted, to those of a full sample. The null hypothesis of the test is that the IIA assumption holds, i.e., the two sets of estimated coefficients are statistically identical. It is evident that in the three model specifications, most of the p values are very high, suggesting that we cannot reject the null hypothesis. Even for the smallest p value, which equals to 0.3231, the null hypothesis cannot be rejected with 68% confidence. In sum, the results of the Hausman–McFadden test do not suggest that the IIA assumption is violated, and the conditional logit model and its estimated parameters are robust.

Table 5 Hausman–McFadden test for the IIA assumption

H_0: the IIA assumption is not violated					
Specification I		Specification II		Specification III	
Omitted alternative	*p* value	Omitted alternative	*p* value	Omitted alternative	*p* value
13	1.0000	2	1.0000	5	1.0000
1	0.9781	19	1.0000	13	0.9996
15	0.8768	7	0.9997	12	1.0000
22	0.9982	10	1.0000	19	0.9837
24	1.0000	14	0.9996	23	1.0000
4	1.0000	5	1.0000	16	0.9999
17	1.0000	12	1.0000	10	1.0000
6	1.0000	3	1.0000	11	1.0000
7	0.9986	22	0.9920	14	0.9999
3	0.9862	11	0.9421	22	0.9993
10	1.0000	4	1.0000	18	0.9994
19	0.8566	17	0.7957	2	0.9306
20	1.0000	1	1.0000	0	1.0000
21	1.0000	8	1.0000	20	1.0000
2	1.0000	0	1.0000	21	1.0000
18	0.9984	20	0.9928	17	1.0000
12	0.9000	23	0.8433	24	0.9946
9	1.0000	21	1.0000	7	1.0000
11	1.0000	9	1.0000	4	0.9999
23	1.0000	15	1.0000	1	1.0000
8	1.0000	18	1.0000	6	1.0000
5	1.0000	6	1.0000	3	1.0000
14	0.7421	16	0.7443	9	0.3231
16	1.0000	24	1.0000	8	1.0000
0	1.0000	13	0.9996	15	0.9572

6 Conclusions and policy implications

This paper empirically examines the location determinants of Japanese manufacturing greenfield FDI in China by adopting the conditional logit model. The Hausman–McFadden test is conducted, advising that the null hypothesis, i.e., the IIA assumption is not violated, cannot be rejected. It is concluded that national policy incentives are more effective than provincial ones in attracting Japanese plants. In addition, Japanese investors tend to locate their new manufacturing plants geographically close to previous Japanese subsidiaries. The spatial closeness of Japanese FDI is independent of the geographic distribution of China's domestic industrial enterprises, displaying a Japanese nationality agglomeration. Japanese investors will avoid provinces with high land costs, but they will surprisingly seek high-wage regions. The integration of labor quality reduces the positive effects of labor cost on JFDI attraction. It is indicated that part of the reason for Japanese investors' preference on high-wage regions is because of their pooled high-quality labor forces. This positive relationship between high wages and JFDI attraction warrants future research. It is hypothesized that the positive relationship may result

from inaccurate variable measures, better quality of life in high-wage regions, and spatial inflation differentials.

These conclusions imply three important public polices for Chinese governments. First, the Japanese nationality concentration suggests that initial Japanese FDI attracts subsequent Japanese investors, thus justifying provincial fiscal incentives on FDI attraction. With the existence of nationality agglomeration, fiscal incentives are no longer a "zero-sum" game even when the benefits delivered by the initial FDI to a province are offset by its aggressive fiscal concessions. This is because, in the long term, subsequent FDI can eventually bring benefits to the province. However, the existence of FDI agglomeration may intensify the war of fiscal inducements simply because each province is willing to make more concessions when a following FDI flow is anticipated.

Second, other than the various fiscal incentives attempting to lure initial Japanese FDI, policies focusing on labor quality would be another good choice. One of the most influential factors identified in this paper is labor quality, that is, a 10% rise of labor quality of a province would increase its probability of being chosen by 58.3%. Policy measures with a clear intention to improve labor quality would eventually be conducive to JFDI attraction. These policy measures may include governmental financial supports on education programs, favorable policies to attract and treat well-educated professionals, and education-related facility constructions. These policy options would be particularly critical to China's middle and western regions to prioritize their limited financial resources and to harness the benefits of FDI on economic growth.

Finally, the positive relationship between the expansion of national development zones and incoming JFDI flow may well justify the strategy of China's economic reform, that is, a variety and vast number of national development zones are established in targeted areas with the intention of attracting and harnessing FDI to promote the area's economy. It is foreseeable that national development zones would play a crucial role in China's recent intention to open the western region and boost its economy.

7 Future research

China's entry to the World Trade Organization (WTO) raises new questions regarding the evolution of China's "open door" policy and China's recent efforts to boost economic growth in its western region. The WTO requires that an FDI host country should provide "national treatment" to foreign investors, i.e., neither foreign nor domestic investment may have preferential treatment. This national treatment requirement poses serious challenges to China's open door policy, which is centered on a variety of development zones and special treatment to foreign investors. Future research is then urgent for potential policy measures consistent with the WTO's national treatment requirement and their implications on the location choices of foreign investment in China.

The recent advances of discrete-choice models relax the IIA assumption in the conditional logit model and pave the road for the flexible specifications of discrete-choice models. Mixed logit model,[3] with the help of simulation techniques, does

[3] Mixed logit model is also called random parameters logit and error components logit.

not rely on the IIA assumption for coefficient estimation (McFadden and Train 2000; Train 2003). In addition, the mixed logit model, unlike the conditional logit model, allows heterogeneous tastes among choice makers regarding a particular alternative attribute. This taste heterogeneity in the mixed logit model can then reveal different reactions toward a change of the alternative attribute, thus making possible policies directed at a particular reaction. Due to the advantages of the mixed logit model over the conditional logit model, future research adopting the mixed logit model is then warranted in the location decisions of foreign investors in China.

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