Location of Foreign Direct Investment in China: A Spatial Dynamic Panel Data Analysis by Country of Origin*

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Abstract

China's emergence as a global trade power is characterized by the dominance of foreign-funded firms in Chinese exports. This paper develops a spatial dynamic panel-data model to explain the salient features of FDI locational and temporal dynamics across Chinese provinces over 1990-2002. While the traditional determinants remain valid when incorporating spatial interdependence and the specification by country of origin, the neighboring-province FDI and GDP show significant impacts on host province FDI. The directions of such impacts are consistent with the FDI motivation of "agglomeration with regional trade platform" rather than "horizontal" as implicitly assumed in the previous works.

JEL classification code: F21; F23; H73; P33

Key Words: Foreign direct investment; Multinational enterprises; Spatial econometrics, China.

1. Introduction

Since 1978, China has utilized over US$680 billion in FDI.[1] The rapid rise of China as a global trade power since the early 1990s has been closely associated with the FDI inflow on such a large scale. The share of exports by foreign-funded enterprises (FFEs) in the total has increased speedily from 26% in 1992 to 50% in 2000 and further to over 58% in 2005 (*China Statistical Yearbook*, 1993-2006). The dominance of foreign firms in China's exports is even more apparent in advanced industrial sectors. For example, while exports of industrial machinery grew twenty-fold in real terms over 1993-2003, the share produced by FFEs in these exports grew from 35% to 79%. The exports of electronics and telecom grew seven-fold in the same period, with the FIEs' share rising from 45% to 74% (Gilboy, 2004). As a consequence of this dominance, China has become known as the "world's factory".

Despite the world's factory at the national level, the regional distribution of FDI 'workshops' has been highly uneven. The locational patterns of FDI have shown great variations by host region and by country of origin. In addition, the degree of geographical concentration of FDI has shown a noticeable decreasing trend, which is in contrast to a steady increase in geographical concentration of Chinese manufacturing industries (Bai *et al*., 2004, 2007; Wen, 2004). This raises an interesting question – what forces have driven such enormous spatial diversity of FDI in China? A better understanding of this question would enrich the knowledge of region-specific incidence of FDI, provide guidance to policymakers in identifying policy priorities and boundaries of policy interventions, and help international investors in formation and modification of their investment strategies.

There has been a sustained effort to develop formal model of MNEs and investigate the factors driving FDI pattern. Two research strands can be distinguished. The first one shows a reliance on a two-country (bilateral) framework. Theoretical works in this strand include the influential Markusen's (1984) 'horizontal' model of FDI, in which FDI is driven by a market-

[1] China in this paper is referred as the mainland China. Data sources: *China Statistical Yearbook* 2006; *China Statistical Abstract* 2007.

access motive to substitute for export flows, Helpman's (1984) 'vertical' FDI model, in which an MNE locates its production process abroad to take advantage of lower factor costs, and the recent effort to provide theoretical underpinnings for the gravity equation (Kleinert and Toubal, 2005). Empirical works in this strand have primarily used data on bilateral FDI activities and relied on dynamic panel data methods in a gravity-type framework, where market size and distance provide the dominant explanatory power.[2]

The second strand puts emphasis on the importance of a third-country effect in the determinants of FDI. For example, Yeaple (2003) and Ekholm *et al*. (2007) set up three-country models of trade and 'complex' MNEs, in which a parent country invests in a particular host country with the intention of exporting the products of the affiliate in the host to the third market. Baltagi *et al*. (2007), on the other hand, develop a model of 'complex vertical' FDI, in which an MNE sets up its vertical chain of production across multiple markets to exploit the comparative advantages of various localities. Empirical works in this strand have primarily focused on US outbound FDI activity and employed spatial panel data estimators in a gravity-type framework (e.g., Blonigen *et al*., 2007; Baltagi *et al*., 2007). Nevertheless, the temporal dynamics as highlighted in the first strand are not present.

In this research, we extend the analytical framework of Blonigen *et al*. (2007) to incorporate the strengths of both research strands. We construct and estimate a spatial dynamic panel-data model, which is capable of capturing both the locational and temporal dynamics of FDI across Chinese provinces for 1990-2002. This modeling structure also allows us to test the extent of 'border effects' between Chinese provinces on FDI locational decisions of MNEs. While the existence of inter-provincial border effect in shaping both regional trade flows and spatial pattern of FDI has been well acknowledged, a rigorous and systematic quantitative assessment has been in

[2] In the literature on location of FDI across Chinese provinces, virtually all pursue this research strand (e.g., Cheng and Kwan, 2000; Sun et al., 2002; and Fung et al., 2002, 2005, among others) with the only exception of Coughlin and Segev (2000), who incorporate the spatial dependence (or third-market effect) into their cross-section regressions.

short supply.[3] Furthermore, in order to detect possible difference in the aggregate behaviors of MNEs across major source economies, we focus on the top five source economies and run the estimation for each of them. Hong Kong, the US, Taiwan, Japan and South Korea are identified as the top five investors in both terms of FDI value and number of projects. During 1992-2002, FDI from these five economies accounted for about 73% of the total utilized inflows and 82% of the total number of projects (*Almanac of China's Foreign Economic Relations and Trade*, 1993-2003).

Our results show that spatial relationships across Chinese provinces matter significantly in determining the regional location of FDI. For all the top five investors, the estimates of both spatial panel and spatial dynamic panel models suggest that host province FDI responds positively to FDI received by neighboring provinces but negatively to GDP of these neighbors. This suggests that at the aggregate level, FDI activities of investors from these five source economies are dominated by combined motivations of agglomeration and regional trade platform under the condition of the presence of significant border effects.

The paper is organized as follows. We first provide an overview of the spatial features of FDI locations in China and then present model development process and hypotheses to be tested with regard to the spatial dynamics. We go on to discuss variables and data, and report estimation results. We conclude by summarizing the research and commenting on future research directions.

2. Spatial Diversity of FDI in China

Table 1 reports the spatial and temporal dynamics of FDI (from all source economies) by three provincial groups for 1990-2003. As shown in the first panel, while the coastal region retained its dominant position in attracting FDI, its share in the national total decreased by 7.4 percentage points from 93.9% in 1990 to 86.5% in 2003. The central region took 7.3 percentage points of FDI share from the coast. The west basically kept the same growth pace with that of the national total. Although the west's share was small, swinging between 1.6% and 4.3%, the

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[3] Yong (2000), Huang (2003), Wedeman (2003), and Poncet (2005), among others, document evidence of persistent or even increasing market fragmentation along provincial borders in China.

cumulative FDI inflow to this landlocked and less-developed region during this 14 year period amounted to US$14.35 billion. To put this number in perspective, India's entire stock of FDI inflow, as of 2000, was only US$17.52 billion. Vietnam, a coastal country which has adopted similar opening policies since the late 1980s as implemented in the coastal region of China, attracted only US$18.37 billion in FDI during 1990-2003.[4] Such observations have led some scholars to argue that the true puzzle is not why this poor, landlocked region does not receive a higher share of FDI; the puzzle is why they have succeeded to get so much (Huang, 2003: 28).

The coefficient of variation (CV) reported in the second panel is calculated across provinces for each of the three regions and for China, respectively. The coastal region experienced a noteworthy decrease in CV by 50% between 1990 and 2003, which suggests a trend of dispersion. In contrast, the central region witnessed an increase in CV by about 50%, implying a tendency towards increased concentration. The CV index in the west region was surprisingly stable. Thanks to the dominant position of the coastal region, the CV index at the national level also decreased significantly.

Figure 1 visualizes the enormous spatial and temporal diversity of FDI location at the provincial level by box plots.[5] Each box presents succinctly the provincial distribution of the FDI inflows in a given year. The chronologically juxtaposed boxes reveal the time series aspects of the panel data, in particular, the persistence of the median inflow and the temporal variations of the distribution. This visualization reinforces the observations we obtain from Table 1. It is academically appealing but also challenging to explain such salient diversity in a consistent modeling framework. This research intends to meet this challenge.

[Insert Figure 1 and Tables 1-2 about here]

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[4] The FDI data of India and Vietnam are provided online in the Country Fact Sheets of (UNCTAD) (http://www.unctad.org/Templates/Page.asp?intItemID=1465).

[5] The box plot economically summarizes a distribution by the median (the horizontal line within the box), the lower and upper quartiles (the two edges of the box), the extreme values (the two whiskers extending from the box), and outliers (points beyond the whiskers).

While CV index in Table 1 suggests a noteworthy trend of dispersion, a parallel check for each of the leading five source economies reveals a different picture. Regional concentration was much more persistent than what appeared at the aggregated level of all source economies. Table 2 presents top three host provinces for each of the leading five source economies and for all source economies, respectively. For simplicity, the numbers in the table are based on annual average inflow of FDI into the province concerned and for the period as specified in the top row. Three observations can be easily spelled out. First, the shares of the top three had been very high, more than 50% for Hong Kong, Taiwan, South Korea, as are the aggregation of all source countries. Second, for the high inflow period of 1992-2002, the combined shares of the top three were more or less stable for Hong Kong, moderately increased for Taiwan, and significantly increased for South Korea and Japan. Third and more importantly, for 1992-2002, while the set of the top three in the 'all source countries' panel contains four coastal provinces, the combined set of the top three from the other five panels contains eight of the total eleven coastal provinces and there is very limited overlap among the number-one host provinces. To adjust for size differences of the provinces we also employ location quotients (LQ) to further compare the relative concentration patterns of FDI. The league table of the top three provinces in LQ index among the top six in provincial shares of FDI confirms that Hong Kong, Taiwanese and Korean firms are heavily concentrated in Guangdong, Fujian and Shandong, respectively. While Jiangsu has relatively low LQs due to its attractiveness to virtually all investors, the table shows that the key location for Japanese operations is Liaoning and both Japanese and American FDI favor the large municipal cities of Tianjin and Shanghai.[6]

The above observations add a new dimension of diversity to the research – diversity by country of origin. They also suggest that it might be due to the diverse locational focuses of FDI from different source economies in combination with the rapid increase of FDI inflows from other economies than Hong Kong and Taiwan that leads to the noteworthy decrease of CV index in China's coastal region.

[6] This table is available upon request.

3. Model Development

3.1. A Critical Review of the Literature on Location of FDI in China

Much scholarly work has been done on the topic of FDI location choice across Chinese provinces. The most common benchmark specification in the empirical literature has been the 'gravity' model of bilateral FDI activities. Modification to this benchmark setting is adopted to serve variations in research objectives and modeling approaches. For example, Cheng and Kwan (2000) implement a dynamic panel regression for provincial FDI stocks from 1985 to 1995 in a setting of partial stock adjustment model. Their results suggest a strong self-reinforcing effect of FDI, in addition to validating the major predictions of the benchmark gravity model. That is, large market size, good infrastructure, and preferential policy have a positive effect, and wage cost has a negative effect, on FDI stock, although the positive effect of the education variables is not statistically significant.

Sun *et al*. (2002) take into account the big differences in the scale and nature of FDI between 1986-1991 and 1992-1998. They run pooled regressions of provincial FDI inflows for the full sample and the two sub-sample periods and find that the importance of FDI determinants changes across these two periods. Fung *et al*. (2002, 2005) explore possible variations in relative importance of FDI determinants across the same five leading source economies as in this study. They run panel regressions separately for each source economy based on annual contracted FDI values across Chinese provinces for 1991-1997 (*ibid*, 2002) and 1990-2002 (*ibid*, 2005), respectively. While the results in their 2002 article support the gravity model and show higher sensitivity of US and Japanese FDI to labor quality, the results in their 2005 article are more diverse and diverge from those of 2002. Such puzzling divergence could be attributed to the problem inherent in contracted FDI data. While the actually utilized FDI shows a steady growth trend in the sample period of 1990-2002, the contracted FDI jumps up 17 times in 3 years and declines by 55% in the other 4 years. Such wild variations indicate that contracted FDI is a poor proxy for actual FDI inflows in their sample period.

The above and other similar models are done on bilateral country-province pairings. An implicit assumption behind such pairings is that FDI decisions by MNEs in a parent country into a particular host province are independent of their FDI decisions to any other host province. It is clearly a strong assumption and in line with only the horizontal motivation of MNE investment behavior. While horizontal FDI decision is motivated by market access and avoidance of trade barriers such as transport costs and import protection against not only the source country but also neighboring provinces, a vertical FDI decision involves picking the best low-cost host at the expense of other potential host locations and an export platform strategy likewise involves picking the best host province and presumably leaving other neighboring provinces in a shadow of low FDI (Blonigen, 2005). Moreover, agglomeration incentives may arise if there are suppliers in the neighboring provinces and regional trade barriers for intermediate goods are not high.

Coughlin and Segev (2000) apply the spatial regression technique to allow for interdependence of FDI activity (the dependent variable) across host provinces. Their results first confirm the applicability of the gravity model and further suggest that a province’s FDI is positively correlated with FDI into neighboring provinces (a positive spatial lag of either the dependent variable or the error term), which is assigned as evidence of agglomeration externalities. Nevertheless, their regressions are based on a pure cross-section dataset of the sum of total yearly FDI inflows to each province from 1990 to 1997, which results in a small sample size of 29 and a static setting.

3.2. Investment Motivations of MNEs and Spatial Interdependence

There is a large body of literature illustrating different motivations of MNE overseas investment decisions. Each motivation has distinct implications for the spatial relationships in empirical modeling. Blonigen *et al.* (2007) provides a synthesized modeling framework on this. We adapt their framework to the context of China in following subsections. A summary of this adaptation is presented in Table 3.

[Insert Table 3 about here]

When specifying spatial dependence between observations, two types of models are distinguished in spatial econometrics. One is the spatial error model, which incorporates a spatial autoregressive process in the error term and the other is the spatial lag model, which contains a spatially autoregressive dependent variable. In the spatial error model, because the spatial interaction matters in the 'error process' but not in substantive portion of the model, we argue that the spatial lag model is more appropriate for explicitly specifying as completely as possible the impact of nearby observations on the dependent variable so that explicit inferences can be made for spatially lagged variables, which can be dependent and relevant independent variables (Beck *et al*. 2006; Blonigen *et al*., 2007). For example, the estimated coefficient on the spatially lagged FDI characterizes the endogenous relationship between one region's FDI and other geographically-proximate regions' FDI.

As noted in the Introduction, since Markusen (1984) and Helpman (1984), MNE general equilibrium theory in a bilateral setting has suggested two distinctive motivations for FDI – horizontal versus vertical. Horizontal FDI refers to investments in production facilities in the destination market that are designed to serve consumers locally, thus enabling the MNE to save export related trade costs and to avoid import protection policy in the destination markets. The theoretical models of pure horizontal FDI suggest that there would be no spatial relationship between FDI into the host market and FDI into the surrounding regions and also between the host's FDI and the market size of the surrounding regions, because the MNE makes independent decisions about the extent to which it will serve the destination market through affiliate sales or exports. A sufficient condition for such a prediction in the context of FDI location in China is that the level of trade protection between Chinese provinces is as high as that between China and its international trade partners, thereby making exports from neighboring provinces an unattractive option.

Vertical FDI refers to fragmentation of production across different hosts, which is motivated by taking advantage of differences in production costs associated with international and interregional factor price differentials. Firms engaged in vertical FDI locate their production facilities in host region to produce inputs that will be exported to the home country for further processing. Alternatively firms invest in assembly facilities in host region where inputs are imported from production facilities in home country (Helpman, 1984). The theoretical models of pure vertical FDI would predict a negative coefficient for the spatially lagged FDI because the FDI going into the preferred region is at the expense of that going into the surrounding regions. In addition, the market size of the surrounding regions would not matter as outputs of the subsidiaries are exported to the home country.

Recent research has extended the above bilateral FDI framework by incorporating the effect of the third markets (Yeaple, 2003; Baltagi *et al*., 2007), which has led to the development of alternative motivations for FDI. One of the basic forms of multilateral FDI decision-making is export-platform FDI, in which the MNE chooses the most preferred host for production and uses it as a platform to serve other markets through exports. This form of FDI would imply a negative coefficient on the spatially lagged FDI variable because FDI to the destination market substitutes for FDI to other destination markets. With regard to the prediction on the effect of market size of surrounding regions, the context of China has to be taken into account. China's famous export-processing industry operated in the special economic zones and open cities in the 1980s and early 1990s mainly served overseas markets. This strong export-orientation would suggest an insignificant relationship between FDI and the market size of neighboring regions. Nevertheless, since the mid-1990s and further in the transition to the full implementation of China's 'national treatment' obligations under the WTO, which grant the subsidiaries of foreign companies the status of domestic suppliers in the market, China's export-processing industry has increasingly served the domestic market (Kraemer and Dedrick, 2002; Williamson and Zeng, 2004), moving towards a regional trade platform.

Regional trade platform FDI can be regarded as a natural augmentation of the export platform FDI, in which the outputs of subsidiaries in the host province is largely sold in the host market and surrounding provinces, in addition to exports. The possibility for this form could be supported by the famous policy of 'market for technology' swap, which has been much more effectively promoted since 1992 and succeeded in attracting large number of big MNEs with technological advantages from OECD countries to sell part of their outputs locally (OECD, 2002). A precondition for this form is that regional trade barriers among Chinese provinces are relatively low compared to the international ones. A pure form of regional trade platform FDI would suggest a negative coefficient on spatially lagged FDI variable due to the substitution effect of FDI across alternative destinations, and a positive coefficient on the spatially lagged market size variable as the destination province is used as a platform to serve the market demands of surrounding provinces.

Baltagi et al. (2007) develop a model of ‘complex vertical’ FDI, in which an MNE firm separates out a number of production activities and locates them across multiple regions to exploit the comparative advantages of various localities. These production activities are connected through the trade of intermediate products across its affiliates in different host regions. In this form of FDI with vertical chain of production, the accessibility of supplier networks in the neighboring regions is likely to increase FDI to a particular market. In addition, other cross-region forces such as availability of immobile resources (e.g., natural resources, infrastructure, proximity to big export ports) may generate agglomeration incentive as well. If regional trade barriers for intermediate goods are not high and these agglomeration forces are sufficiently strong, we should expect to see a positive coefficient on the spatially lagged FDI variable. With regard to the market size of surrounding regions, because a higher level of industrial production in neighboring regions would lead to increasing potential for vertical suppliers and industrial production and market size is often highly correlated, we may expect a positive coefficient for the market size of surrounding regions.

If interregional trade barriers are high but still lower than the international ones, a combination of the complex vertical and regional trade platform FDI becomes possible and also more attractive. We term it ‘agglomeration with regional trade platform FDI’. In this scenario, the agglomeration effect would be able to dominate the substitution effect between FDI into the host market and that into the surrounding regions, leading to a positive coefficient on the spatially lagged FDI variable. The MNE firms would also pay much more attention to the market potential of the host region in order to have access to a larger market free of border costs, which may lead to a negative relationship between the host's FDI and the market size of surrounding regions. We will discuss the relevance of this FDI form to China and calibrate its prediction further in the next subsection.

Table 3 summarizes the expected signs of coefficients on spatially lagged FDI and the market size of surrounding provinces if FDI were being driven by each of the behavior forms as we have discussed. However, the observed data at the provincial and source country level are bound to be a mixture of these motivations. Empirical work based on such aggregate data cannot directly test for the existence of one form over the other but is only able to identify the net effect. Despite this limitation, it is possible to find confirmatory evidence of one dominant form of FDI decision-making in the data thanks to the unique sign patterns across the more relevant forms.

3.3. Border Effects across Chinese Provinces

Local protectionism in China is a topical issue for years in both academic and policy arenas. It is widely acknowledged that significant trade barriers have persisted between provinces. The debates concern the extent of market fragmentation and the direction of change. Relying on aggregate data of provincial economic structure, Young (2000) finds increasing similarity in the structure of economic activities across provinces during 1978-1997, implying a rise of local protectionism. World Bank (1994) and Huang (2003) bear out the same thesis of decreasing market integration. On the other hand, using provincial input-output tables of 1987 and 1992, Naughton (2003) shows that the growth of inter-provincial trade in 1987-1992 exceeded that of provincial GDP and foreign trade during the same period, suggesting an increasing market integration. Using industry data of 29 provinces over 1985-1997, Bai *et al*. (2004, 2007) show the degree of industrial agglomeration first decreased and then increased. They suggest that both the forces of market and political appointment system for specialization and forces of local protectionism against specialization were at play.

As pointed out by Poncet (2005), the claim of increasing market fragmentation in China is received with skepticism in the business world because such claims fly in the face of the visibly successful efforts by both foreign MNEs and emerging Chinese corporations to build national distribution networks and supplier clusters and to establish nationally recognized brands. In recognition of the demand for a tangible measurement of the degree of market integration in China, Poncet disaggregates inter-provincial trade flow into 21 comparable industries of tradable goods based on the provincial input-output tables of 1992 and 1997, and then computes all-inclusive indicators of provincial level and industrial level trade barriers for 1992 and 1997 using the border effect method of McCallum (1995). It is found that the tariff-equivalent of crossing a border between a province and the rest of country amounts to 48% and 53% in 1992 and 1997, respectively, being moderately higher than the value of 45% found for the European Union and the Canada-US border in the early 1990s (McCallum, 1995; Head and Majer, 2000). In contrast, parallel assessments on internal trade in the US (Wolf, 2000) and inside Canada (Helliwell, 1997) find tariff-equivalents inferior of 15%, a much lower level. If Poncet's assessment does portray the real border effect between provinces of China, the form of horizontal FDI, which has been implicitly adopted in most of previous FDI models for China, would become less relevant; and the mixed form of agglomeration with interregional trade platform FDI would become more relevant and practically more attractive.

Under the scenario of agglomeration with interregional trade platform, if there is no border costs between provinces except for transportation cost, a MNE is likely to locate in a central region with the largest proximity-weighted surrounding-market potentials, regardless of that this central region might has a relatively small market size. However, if border costs are high between provinces, although not so high as to eliminate the MNE's desire to serve the domestic market from a single province via regional trade, the MNE is more likely to locate in the province with the largest market potential in order to serve the largest market without occurrence of border costs, in spite of that this largest market is not centrally located. In these ways, as border costs rise, the centrally located region with small local market size but large surrounding market potential would stand to lose the most FDI. In contrast, the region with the large market size though smallest surrounding market potential would stand to gain most of FDI. This would lead to a negative relationship between FDI location and the market size of the surrounding region (cf. Blonigen et al., 2007 for a similar discussion).

3.4. Modified Gravity Models with Spatial and Temporal Structure

The benchmark setting of our empirical models is the ‘gravity’ specification, which is arguably the most widely used one in the literature dealing with magnitude of FDI activities across countries or regions in a given country. In an abstract form it can be presented as follows. For each source economy (say, *i*), we estimate

$$FDI_{jt} = \alpha_0 + \boldsymbol{\alpha}_1 \, \textit{Host Variables} + \varepsilon_{jt} , \qquad (1)$$

in which FDI_{jt} is the FDI inflow from the source economy to host province *j* at time *t*, “*Host Variables*” captures standard gravity model variables for the host provinces as we will specify in the next section, and $\boldsymbol{\alpha}_1$ is the vector of coefficients on the ‘*Host Variables*’. All variables with the exception of those relative measures are in natural log as typically adopted in the literature.

An extension of Eq. (1) to include spatial relationship leads to the following specification:

$$FDI_{jt} = \alpha_0 + \boldsymbol{\alpha}_1 \, \textit{Host Variables} + \alpha_2 \, \textit{Surrounding-Market Potential} + \rho \cdot (W \cdot FDI)_{jt} + \varepsilon_{jt} , \qquad (2)$$

where the surrounding-market potential is defined as the sum of inverse-distance-weighted GDPs of all other $k \neq j$ provinces in China; *W* is the matrix of inverse-distance weights and is called the spatial lag weighting matrix, which we will specify in details in the next section; and ρ is a parameter to be estimated, which will indicate the strength and sign of the spatial autoregressive term $W \cdot FDI_{jt}$.

In recognition of the strong self-reinforcing effect of FDI, we incorporate a dynamic dimension into Eq. (2). This leads to

$$FDI_{jt} = \alpha_0 + \boldsymbol{\alpha}_1 \, \textit{Host Variables} + \alpha_2 \, \textit{Surrounding-Market Potential} + \gamma \cdot FDI_{j,\,t-1} + \rho \cdot (W \cdot FDI)_{jt} + \varepsilon_{jt} , \qquad (3)$$

in which $\gamma \cdot FDI_{j,\,t-1}$ reflects the standard temporal autoregressive term.

We do not consider the characteristics of the source economies (e.g., GDP, inflation in US$, labor quality, etc.) for following two reasons. First, these variables only have time-series variations when we opt to run regressions separately for each of the five leading source economies and these variations can be easily dealt with by allowing for time trend or time dummies. Second, in unreported results, we introduce such control variables and find that they are by and large statistically insignificant and do not affect our results in any notable manner.

4. Variables and Data

4.1. Variables

The dependent variable is the annual FDI inflows (in US$ million) from each of the five source economies to every host province of China. [7] Among explanatory variables, '*Host Variables*' include the market size of the host province, level of infrastructure development, distance between the source economy and the host province, package of preferential policies, relative unit labor cost, and labor quality. Following the gravity perspective, market size of the host region would have a positive impact on FDI inflow because it meets the motivation of FDI to look for new markets and to maximize the expected revenue of the investment. Of course there are other forms of FDI which are not necessarily oriented towards the targeted host market. For example, pure vertical or export platform FDI may aim to exploit the factor endowment advantages of the host region irrespective of the market size directly. However, if other FDI forms than these two (cf. Table 3) are more plausible in the context of China, we would expect that the large the market size of a host province is, other things being equal, the more FDI the province should attract. We use the provincial real GDP (in 1990 prices) to capture the market size effect as commonly adopted in the literature.

[7] Host provinces include 26 provinces and 3 provincial-level municipalities (Beijing, Tianjin and Shanghai). Chongqing is treated as a part of Sichuan because it, together with its surrounding counties, was promoted into a provincial status in 1997. Tibet is excluded because of the unavailability of FDI data.

Well-developed infrastructure, particularly with superior transportation options, can improve the effectiveness of MNE operations in the host region and reduce transport costs. The density of various transportation facilities in separation or combination has been used in the literature as a proxy for infrastructure. The proxy we use is measured as the total length of railways, highways and waterways in a province divided by the land size of the province. It is expected that a denser transportation network will lead to larger FDI inflows.

Distance between the home and host economies is typically used as a proxy for trade and transportation costs in the international trade literature. The gravity model of international trade predicts a negative relationship between distance and trade flows. However, when applying this perspective to FDI analysis, distance can be either an impediment or an incentive for FDI (Blonigen, 2005). Distance can be an impediment as managerial and transaction costs normally increase with distance. On the other hand, it could be an incentive for FDI aiming at direct access to the market in the face of trade barriers. This ambiguity is further complicated by the fact that geographic distance may often imply the cultural distance between the source and host economies. For example, the geographic and cultural proximity between Hong Kong and Guangdong, Taiwan and Fujian, and South Korea and Shandong undoubtedly contribute to the strongest FDI association between these three pairs (cf. Table 2). Nevertheless, if the horizontal FDI motivation were not dominant, we would be able to expect a negative relationship between distance and FDI received by the host. Distance we use is the great-circle distance between the capital city of the source economy and that of the host province.

It is well acknowledged that the preferential policy towards FDI is one of the important driving forces behind China's success in attracting FDI. China initially encouraged foreign investors to set up affiliates in designated Special Economic Zones and Open Coastal Cities along the coast line. Later on foreign investors were encouraged to move into newly designated Economic and Technological Development Zones located in the central and western regions. Up to 2005, there were many types of special zones at both the national and local level. Special zones at the national level include 6 Special Economic Zones, 54 Economic and Technological

Development Zones, 14 Open Coastal Cities, 15 Free-Trade Zones, 53 High-Technology Industrial Development Zones and 38 Export-Processing Zones. These zones promote FDI with packages of incentives including exemption or significant reductions of profit taxes, land fees, import duties, and consolidated industrial and commerce taxes, and priority treatment in obtaining infrastructure services (Tian, 2007). Based on a data consistence check across different official sources, we opt to use the sum of the number of nationally recognized Special Economic Zones, Open Coastal Cities, and Economic & Technological Development Zones in each province. In line with the literature we expect a positive coefficient on this policy variable.

The relatively low labor costs in a particular province should provide MNEs with a strong incentive to locate their labor-intensive activities there. Cheng and Kwan (2000) and Fung *et al*. (2002) find that wage or lagged wage have a negative impact on FDI inflows. However, such negative effect is not confirmed by Sun *et al*. (2002) and Fung *et al*. (2005). This ambiguity may be attributed to the observation that low wages do not necessarily reflect low production costs because labor productivity may be low (Carstensen and Toubal, 2004). Taking this into account, the location decision of a MNE depends on the productivity-adjusted labor cost (i.e. unit labor cost) in the host province. Moreover, it is necessary to control for the relative cost difference between the source economy and the host province. Thus, we employ the unit labor costs of the host province relative to that of the source economy, termed the relative unit labor cost, and expect a negative coefficient for it.

Access to skilled labor in the host region is also important. Investment by MNEs typically leads to advancement and innovations in production, management, and marketing activities in the host regions. The transition from the old to the new technology and management practices generate job tasks and operating procedures that are not only different from those of the past but also less defined in the short run. A higher education level generally reflects the capability of employees to process and understand information and to cope with the new tasks and procedures. Consequently, a MNE’s demand for educated labor should be high at least for a transition period until the new procedures are fully implemented (Carstensen and Toubal, 2004). In this paper, we use the ratio of number of students enrolled in higher education in the host province to its population as a proxy of labor quality, the same as in Fung *et al*. (2002, 2005), and expect a positive coefficient on it.

After completing the specifications for '*Host Variables*', we now focus on two spatially lagged variables. As highlighted in Blonigen *et al*. (2007), in order to explicitly examine the spatial dynamics of FDI activities it is important to separate the host region's GDP from the market potential of the surrounding regions. For example, while the host region's GDP is likely to be a significant attractor for both pure horizontal and regional trade platform FDI activity, the market potential surrounding a host region should only have a significant impact on regional trade platform FDI decisions. In addition, both empirical works of Blonigen *et al*. (2007) and ours in this paper clearly reject a common coefficient on host GDP and surrounding market potential, which is the imposed restriction of previous studies when combining these into one market potential variable.

Let W denote a $(N \times N)$ spatial weight matrix describing the spatial arrangement of the N regions concerned and w_{jk} the (j, k)th element of W, where j and $k = 1, \cdots, N$. It is assumed that all w_{jk} are known constants, all diagonal elements of W are zero, and the characteristic roots of W are known. The first assumption excludes the possibility that the spatial weight matrix is parametric. The second one implies that no region can be viewed as its own neighbor. The third presupposes that the characteristic roots of W can be computed accurately using the computing technology typically available to empirical researchers and ensures that the log-likelihood function of the spatial regression models we distinguish can be computed (Elhorst, 2003). In this research the off-diagonal elements of W are first defined as $w_{jk} = 1/d_{jk}$ where d_{jk} is the distance between the capital city of province j and that of province k, with $k \neq j$. This W is then row-normalized so that each row sums to unity.[8] This row-normalized W being multiplied by the vector of provincial GDP leads to the vector of the surrounding-market potential, $W \cdot GDP$, and a similar multiplication by

[8] We experimented with alternative weighting schemes such as the binary contiguity matrix and got broadly similar results to those reported in this paper.

the vector of provincial FDI inflows generates the vector of the spatially lagged dependent variable, $W \cdot FDI$, which can be interpreted as a proximity-weighted average of FDI into alternative provinces.

4.2. Data

Provincial panel dataset of source-country specific FDI was not available for direct use by researchers before this study. We compiled and consolidated this dataset manually from more than 300 volumes of the *Statistical Yearbooks* and *Social and Economic Statistical Yearbooks* at the provincial level, from various volumes of *Almanac of China Foreign Economic Relations and Trade*, and from the Korea's Overseas Investment Database compiled by Export-Import Bank of Korea.

The Korean database provides complete coverage of Korean FDI in every Chinese province for 1990-2002, which is not available in most of Chinese provincial *Statistical Yearbooks* because these yearbooks typically focus on the top four source economies of FDI. When comparing those available in Chinese yearbooks with those in Korean database, it can be found that Chinese figures are always larger than the Korean ones because the former include also the profit reinvestment of Korean operations and small projects bypassing the Korean FDI registration procedure. We opt for the Korean database for its completeness and consistence. It provides a balanced panel dataset of 377 observations.

Of the remaining 1508 (29×13×4) data-points, Chinese provincial *Statistical Yearbooks* provide consistent coverage of utilized FDI for 962 (64%). For 491 (33%) data points what available are only the figures of contracted FDI from each of the remaining four source economies. To calculate utilized FDI based on these contracted FDI figures, three methods are adopted as reported in the Appendix. After exhausting all calculating possibilities, we obtain an unbalanced panel dataset of 369, 365, 355, and 364 observations for Hong Kong, Taiwan, Japan and the US, respectively. Data for explanatory variables are directly obtained from various sources, which are reported in the Appendix. The Appendix also provides the summary statistics of the variables in our data.

5. Empirical Estimation Results

5.1. Estimation Strategy

The estimations proceed successively from traditional (random effect) panel, dynamic panel, spatial panel, to spatial dynamic panel. We opt for random effect model for Eq. (1) based on two considerations. First, the alternative choice of fixed effect model is at the cost of distance variable, which is fundamentally important for the gravity model. Second, provincial fixed effects can be more effectively dealt with by system Generalized Method of Moment (GMM) estimator in both dynamic panel and spatial dynamic panel settings. The random effect panel is estimated by generalized least square (GLS) estimator.[9]

The dynamic version of Eq. (1) is estimated by system GMM estimator of Blundell and Bond (1998). The system GMM estimator allows the removal of fixed effects via the first-differenced equation and to maintain the distance variable in the level equation, besides the technical gains of additional level moment conditions and increased efficiency. Considering that the consistency of the system GMM estimator depends on whether a selected set of lagged level and first-differenced values of the explanatory variables are valid instruments in the regression, two specification tests are employed. The overall validity of the instruments is tested by the standard Hansen test of over-identifying restrictions, which analyses the sample analogue of the moment conditions used in the estimation process. Because significant second-order serial correlation of the first-differenced residuals indicates serial correlation in the original error terms and therefore misspecification of the instruments, we also test for first-order and second-order serial correlation in the first-differenced residuals. If the original error terms are not serially correlated, there should be evidence of a significant negative first-order serial correlation in differenced residuals and no evidence of second-order serial correlation in the first-differenced

[9] It should be noted that the random effect estimator might generate biased estimations in comparison with the fixed effect estimator, although the latter might be less efficient than the former if both could derive unbiased estimations.

residual. In addition to the validity tests, a finite-sample correction to the two-step covariance matrix as suggested in Windmeijer (2005) is implemented.

The key econometric feature of Eq. (2) is the endogeneity of the spatially lagged FDI variable. To address this problem, we employ the maximum likelihood (ML) method as fully described in Blonigen *et al*. (2007). Because the number of observations may change over time for the panels of Hong Kong, Taiwan, Japan, and US, the year-specific *W* matrixes may have different dimensions in different years for each of these source economies. Consequently, the full weight matrixes, which are the block-diagonal matrix with each block being the year-specific *W*, are different across all five source economies. This may in turn make it problematic to directly compare the estimated coefficients of Eq. (2) across the five source economies.

Eq. (3) is also estimated by system GMM method in a way to take both temporally and spatially lagged FDI variables as endogenous and to incorporate validity tests and Windmeijer's (2005) finite-sample correction. Elhorst (2005) proposes an alternative method. He uses a first-differenced model to eliminate fixed effects (thus also time-invariant variables such as distance) and then derives an unconditional likelihood function. However, to discard distance variable and others with limited time variance such as policy is a cost too high for the purpose of this research. Furthermore, his method does not allow for potential endogeneity of other explanatory variables, which is very likely in our case. In comparison, the system GMM appears to be the best estimator available for the estimation of Eq. (3) because it corrects for the potential endogeneity of market size and surrounding market potentials, and handles fixed effects well without the elimination of distance and policy variables.

[Insert Tables 4-8 about here]

5.2. Results

Results are reported in Tables 4-8, from which a number of interesting findings can be singled out. The first finding is that both the traditional panel and dynamic panel estimations for all five source economies are in line with the major predictions of the benchmark gravity model. The results confirm that investors, though from five different jurisdictions, all prefer provinces that are characterized by large host market size, adequate transportation linkages, preferential policy for foreign investments, short distance between the home and host, low relative unit labor cost, and high labor quality. The results provide only a weak support to the suggestion that host market size and surrounding market potential should have separate impact and thus a weak support to the suggested separation of traditional market potential variable. However, once the spatial dependence of FDI is taken account of, there emerges a uniform strong support to the separation. In all cases of spatial panel and spatial dynamic panel estimations, host market size has a strong positive and significant coefficient with an elasticity range of 0.397-0.833 (noting the variables are in logarithm) but surrounding market potential has a significant and negative coefficient. This finding indicates that spatial econometric modeling does help to reveal the misperception implied in the traditional gravity model of FDI, that is, host market size and surrounding market potential have identical effects on FDI activity.

The second finding is that the spatially lagged FDI has a strong positive and significant coefficient in all spatial panel and spatial dynamic panel estimations, with an elasticity range of 0.593-0.929. The significantly positive coefficient of spatially lagged FDI in combination with the significantly negative coefficient of surrounding market potential suggests that at the aggregate level, FDI activities of investors from all five source economies are dominated by "agglomeration with regional trade platform FDI in the presence of significant border effect" rather than other alternatives as listed in Table 3. While this finding rejects the traditional bilateral perception of FDI activities and supports the proposition of the presence of agglomeration effects (Coughlin and Segev, 2000; He, 2003) and border effects, its uniformity across different source economies is surprising and needs a careful interpretation. First, it would be common that the agglomeration economies derived from the clustering of manufacturing and FDI activities motivate potential investors to follow their pioneers in their location decisions. This nationality agglomeration effect, nevertheless, provides further evidence of the "country of origin" effects in explaining the persistent divergence of FDI locational focuses across different source economies, in addition to the traditional explanations such as geographic proximity, ethnic ties, and historical economic linkages. In more detail, although Hong Kong and Taiwanese firms are the most spatially dispersed, they are still intensively clustered in Southeast China with the core in the Pearl River Delta and Yangtze River Delta, respectively. In comparison, Korean investors particularly favor Shandong Peninsula; the core of Japanese FDI clusters are located in Liaoning Peninsula, the Beijing-Tianjin area and the Yangtze River Delta; and US clusters are centered in the Yangtze River Delta and the Beijing-Tianjin area (Table 2; He, 2003). Second, although the border effect at the aggregate level grants a heavy weight to large market in the benefit-cost calculation of FDI locational decision-making, such border effect at the disaggregate level may cease to exist for certain sectors or products. Therefore, once data at the disaggregate level become available we would expect to obtain a richer set of testing results with respect to the country of origin effects, border effects, and alternative motivations of FDI.

The third finding is that with the exception of the surrounding market potential, the interpretation of the coefficients on other common variables across two static panel models is largely indifferent qualitatively. A similar observation can be made for both dynamic models. This confirms the basic validation of previous empirical studies of FDI location in China that have not considered spatial interdependence. However, it is also worth noting that due to the omitted variable problem, in all cases both traditional static and dynamic panel models show an upward bias in the coefficients of surrounding market potential variable, and the traditional dynamic models show an upward bias in the coefficient estimations for temporally lagged FDI variable, as compared with the fuller specifications of the spatial panel and spatial dynamic panel. These results show a sharp contrast with the findings of Blonigen et al. (2007), in which they show that omitted variable bias from not modeling spatial dependence is apparently quite small in their cross-country estimations of the US outbound FDI.

A well-known reservation for spatial panel model is that third-market interdependence in gravity model estimation might be adequately accounted for in a traditional panel setting with cross-section fixed effects (Feenstra, 2002). To address this concern without eliminating distance and policy variables, we opt to estimate Eq. (3) using system GMM method. Compared with the results of traditional dynamic panel, in addition to the value added we have discussed above, the spatial dynamic estimations suggest a weaker self-reinforcing effect for Hong Kong, Taiwan, Japan and US.[10] In contrast, compared with the results of spatial panel, the spatial dynamic estimations suggest a statistically stronger nationality agglomeration effect for Taiwan and the US, although marginally stronger one for other three source economies.

6. Concluding Remarks

There is a growing number of theoretical works illustrating why FDI into a host market may depend on the FDI in proximate markets. In contrast most empirical studies have largely ignored the important issue of spatial interdependence. This study reexamines the determinants of the regional location of FDI in China from a spatial econometric perspective. While previous studies have largely treated the endogeneity problem of dynamic panels thanks to GMM estimator, we address the joint problem of spatial and temporal endogeneity as well as omitted variable bias due to spatial interactions. Our analysis covers 29 Chinese provinces over the period of 1990-2002.

We run regressions successively on traditional panel, dynamic panel, spatial panel, and spatial dynamic panel. It is found that the major predictions of the traditional gravity model hold in all estimations. It means that investors from the top five source economies all favor provinces characterized by large host market size, adequate transportation linkages, preferential policy for foreign investments, short distance between the home and host, low relative unit labor cost, and high labor quality. However, the spatial panel and spatial dynamic panel estimations not only show statistically significant impact of FDI and GDP in the neighboring provinces on host province FDI, but also reveal the omitted variable bias from not modeling spatial interdependence. In more detail, these estimates suggest that host province FDI responds positively to FDI received by neighboring

[10] The results for Taiwan need to be interpreted with extra caution because of the significant underreporting in the FDI data. Since the mid-1990s, many Taiwanese investors have used their holding companies in free ports such as Virgin Islands to facilitate their investment in China. Virgin Islands was the second largest source economy for China's inward FDI during 1998-2004 and also the second largest destination of Taiwan's outward FDI during 1999-2004.

provinces but negatively to GDP of these neighbors, and that an upward bias exists for the estimated coefficients on surrounding market potential and temporally lagged FDI variable, respectively, in the traditional panel and traditional dynamic panel models. This set of results holds for all five top source economies and it has three important implications. First, it rejects the misperception implied in the traditional gravity model that host market size and neighboring market potential have identical effects on FDI activity in the host market. Second, it indicates that at the aggregate level, FDI activities of investors from these five economies are dominated by combined motivations of agglomeration and regional trade platform, and furthermore such a combination is a result of adaptation to the presence of significant border effects between Chinese provinces. Third, future changes in the patterns of FDI location in China can be envisaged contingent upon the evolution of market institutions and rules of game across the country.

In terms of policy implications, the nationality agglomeration economies are revealed to be highly attractive to foreign investors from a particular country of origin. Therefore, local governments could establish policy packages or special investment zones within their jurisdictions to attract FDI from specific countries or regions, in addition to upgrading industrial fundamentals and promoting the development of local labor and products market.

This research is limited by the aggregate FDI data at the provincial and source country level. Because of this limitation, we are only able to test the border effect for the aggregate bundle of products and the net effect of alternative FDI motivations rather than the existence of one form over the other. Once data at the industrial level become available, an application of our modeling strategy would able to generate a richer set of testing results.

Appendix on Data Issues

A1. Three Methods to Calculate Utilized FDI Based on Contracted FDI Figures

As indicated in the Data Section, for 491 (33%) data points, we need to calculate utilized FDI based on contracted FDI figures. Three methods are adopted. First, if the ratios of utilized over contracted FDI are available for the neighboring years in the same province, we take the ratio in the “most similar year” or the average of the ratios in the previous and the next years as the ratio for the year concerned and then calculate the figure of utilized FDI for this year using this ratio. Second, if for a sequence of years in the same province there are only contracted FDI figures available, we look for the most similar year-province combination and use the ratio or average ratio of utilized over contracted FDI in this combination to calculate the figure of utilized FDI for the year concerned. Third, for most of years in Shanxi, Jilin, Heilongjiang, Sichuan, Guizhou, Yunnan, and Gansu, both above methods are not applicable. Because they all belong to the inland region, i.e., the Central plus West Regions (cf. Table 1), we use the average ratio of utilized over contracted FDI across the remaining 11 provinces in a given year to calculate the figure of utilized FDI for the province concerned in the same give year. There is an alternative way to this third method. That is to use the ratio of total utilized over total contracted FDI from all source economies in the given year and province, which is available for each of these seven provinces and for each sample year. The cost of this alternative is that it smoothes the variation across these four source economies. We opt to avoid this smoothing.

A2. Data Sources of Explanatory Variables

Variable	Data sources
Market size	Provincial GDP data are from *China Statistical Yearbook* 1991-2003.
Infrastructure	Length of railways, highways and waterways at the provincial level are from *China Statistical Yearbook* 1991-2003 and data on landmass are from *China Yearbook*.
Preferential policy	The website of the China Association of Development Zones (http://www.cadz.org.cn)
Relative unit labor cost	Annual wages in the manufacturing sector and number of employees in the industrial sector are from *China Statistical Yearbook* 1991~2003 (for China), *Taiwan Statistical Data Book* 2000 and 2003 (for Taiwan), and *Yearbook of Labour Statistics* 2000, 2003 (for Hong Kong, Japan, Korea, US) published by *International Labor Organization (ILO)*. Data on GDP of the industrial sector are from *China Statistical Yearbook* 1991~2003 (for China), *Hong Kong Annual Digest of Statistics* 1996, 1997, 2003 and *Hong Kong Monthly Digest of Statistics December* 2003 (for Hong Kong), *Japan Annual Report on National Accounts* 2001, 2004 (for Japan), *Korea National Statistical Office website* (http://nso.go.kr) (for Korea), *Taiwan Statistical Data Book* 2003 (for Taiwan) and *Bureau of Economic Analysis in US Department of Commerce website* (http://www.bea.gov) (for US). All figures are converted to US$ by the official exchange rates for the period. The data on official exchange rates are obtained from *International Financial Statistics* 2000, 2003.
Labor quality	Number of student enrolled in universities and total populations are obtained from *China Statistical Yearbook* 1991~2003.

A3. Summary Statistics of the Overall Polling Data of 5 Source Economies

Variable	Definition	Mean	Std. Dev.	Min	Max
FDI	Logarithm of utilized FDI in US$ million.	2.35	3.66	-6.9	9.14
Host market Size	Logarithm of GDP in 100 million Yuan in host province.	6.77	0.96	4.11	8.86
Infrastructure	Logarithm of the total kilometers of railways, highways and waterways per 1,000 square kilometer of landmass.	3.20	0.89	0.51	4.96
Policy	Logarithm of 1 plus the sum of the number of Special Economic Zones, Open Coastal Cities and Economic & Technological Development Zones.	0.79	0.74	0	2.30
Distance	Logarithm of the distance between source economy and the host province in km.	7.40	0.51	5.01	8.36
Relative unit labor cost	Percentage share of host province’s unit labor cost over source economy’s unit labor cost.	58.9	18.6	24.3	146
Labor quality	Percentage share of the number of students in higher education over total population.	0.38	0.38	0.03	2.78
Surrounding market potential	Logarithm of the sum of inverse-distance-weighted real GDP (in 100 million yuan) across all other provinces than the host.	7.12	0.43	6.20	8.03

Note. Zero value in dependent variable is replaced by 0.001 in order for natural log to work. Distance variable for US is reduced by 10,000 km because we are interested in the variation of this variable across Chinese provinces rather than its absolute measurement.

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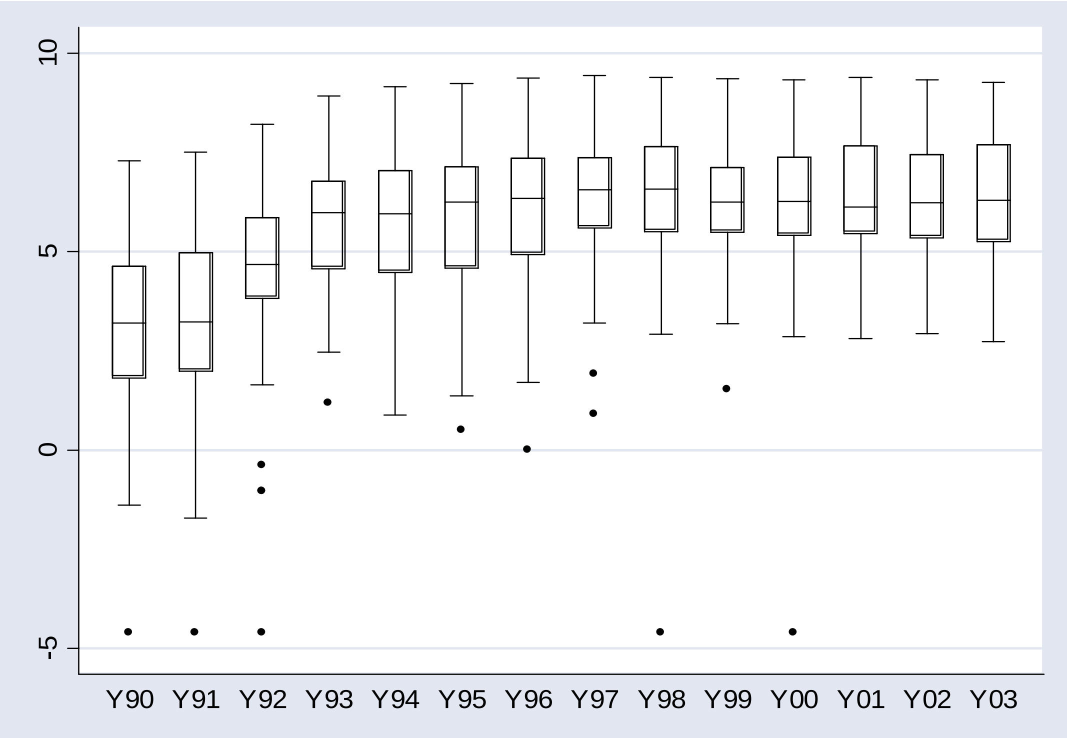
Figure 1. Box plot of utilized FDI inflows in China (1990-2003, in logarithmic scale)



Source: *China Statistical Yearbook*, 1991-2004.

Table 1. Utilized FDI in China by Region

Region		1990	1992	1994	1996	1998	2000	2002	2003
	Amount of investment and share								
Coast	US$ billion	2.97	10.05	29.22	36.87	39.49	35.41	45.87	45.80
	(%)	(93.9)	(91.3)	(87.8)	(88.0)	(87.2)	(87.8)	(87.4)	(86.5)
Central	US$ billion	0.12	0.75	2.61	3.99	4.42	3.70	5.19	5.92
	(%)	(3.9)	(6.8)	(7.9)	(9.5)	(9.8)	(9.2)	(9.9)	(11.2)
West	US$ billion	0.07	0.21	1.43	1.02	1.37	1.22	1.41	1.22
	(%)	(2.3)	(1.9)	(4.3)	(2.4)	(3.0)	(3.0)	(2.7)	(2.3)
China	US$ billion	3.17	11.00	33.27	41.88	45.29	40.33	52.47	52.94
	(%)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)
	Coefficient of variation								
Coast		1.586	1.216	1.014	1.007	0.974	1.054	0.932	0.836
Central		0.620	0.683	0.609	0.520	0.571	0.647	0.776	0.902
West		1.594	1.491	1.721	1.276	1.596	1.530	1.463	1.552
China		2.503	1.976	1.664	1.658	1.605	1.705	1.569	1.454

Note: Coast Region includes provinces of, in the ranking order of FDI inflow scale, Guangdong, Jiangsu, Shandong, Shanghai, Fujian, Zhejiang, Liaoning, Beijing, Tianjin, Hebei, Hainan; Central Region includes Hubei, Hunan, Jiangxi, Henan, Anhui, Heilongjiang, Jilin, Shanxi, Inner Mongolia; West Region includes Sichuan, Shaanxi, Yunnan, Gansu, Guizhou, Qinghai, Xinjiang, Ningxia, Tibet. Chongqing’s figures are added into that of Sichuan for the reason of data consistence.

Source: *China Statistical Yearbook*, 1991-2004.

Table 2. Top Three Host Provinces of FDI from the Leading Five Source Economies and from All Source Economies, 1990-2002 (US$ million, %)

	1990-1991			1992-1995			1996-1999			2000-2002[a]		
Rank	Province	Amount	Share	Province	Amount	Share	Province	Amount	Share	Province	Amount	Share
Hong Kong												
1	Guangdong	1,170.8	47.92	Guangdong	6,326	38.13	Guangdong	8,072	39.38	Guangdong	7,171	36.90
2	Liaoning	403.4	16.51	Fujian	1,755	10.58	Fujian	2,099	10.24	Fujian	1,695	8.72
3	Fujian	191.0	7.82	Shanghai	1,290	7.78	Jiangsu	1,796	8.76	Jiangsu	1,663	8.56
Taiwan												
1	Fujian	194.99	40.92	Fujian	440	18.88	Fujian	898	28.50	Jiangsu	817	23.11
2	Guangdong	89.94	18.88	Jiangsu	415	17.78	Jiangsu	605	19.24	Fujian	618	17.47
3	Liaonong	82.45	10.96	Guangdong	298	12.76	Guangdong	437	13.88	Guangdong	541	15.31
South Korea												
1	Shandong	10.35	35.26	Shandong	158.36	35.27	Shandong	156.33	23.61	Shandong	200.77	28.99
2	Liaoning	6.03	20.55	Liaoning	48.63	10.83	Tianjin	93.68	14.15	Jiangsu	95.51	13.79
3	Hebei	2.94	10.01	Jiangsu	42.55	9.48	Jiangsu	84.45	12.76	Beijing	84.43	12.19
Japan												
1	Guangdong	105.75	23.29	Jiangsu	372.04	18.23	Jiangsu	792.85	20.76	Jiangsu	858.52	20.04
2	Liaoning	103.54	22.81	Liaoning	274.26	13.44	Liaoning	533.42	13.97	Shanghai	665.70	15.54
3	Hainan	56.85	12.52	Shandong	177.16	8.68	Shanghai	431.69	11.30	Liaoning	638.22	14.89
United States												
1	Liaoning	289.02	49.78	Shanghai	360.01	19.44	Shanghai	738.07	19.82	Guangdong	677.44	13.54
2	Guangdong	117.38	20.22	Jiangsu	292.51	15.79	Jiangsu	567.85	15.25	Jiangsu	668.65	13.37
3	Jiangsu	48.94	8.43	Guangdong	160.03	8.64	Fujian	364.09	9.78	Fujian	494.51	9.89
All Source Countries												
1	Guangdong	1,349.3	41.51	Guangdong	7,745	28.47	Guangdong	12,017	27.71	Guangdong	10,592	22.05
2	Beijing	335.8	10.33	Jiangsu	3,315	12.19	Jiangsu	5,839	13.46	Jiangsu	8,523	17.75
3	Fujian	303.8	9.35	Fujian	3,014	11.08	Fujian	4,129	9.52	Shandong	4,311	8.98

Note: [a] 2000-2003 figures for "all source economies".

Source: Database compiled by the authors.

Table 3. Expected Signs of Coefficients on Spatially Lagged FDI and the Market Size of Surrounding Provinces

FDI Motivation	FDI into surrounding provinces	Market size of surrounding provinces	
		Insignificant border effect	Significant border effect
Horizontal FDI	0	n.a.	0
Vertical FDI	-	0	0
Export platform FDI	-	+/0	0
Regional trade platform FDI	-	+	0/-
Complex vertical FDI	+	+	+/0
Agglomeration with Regional trade platform FDI	+	+	-

Note: Predictions are based on a model of a particular type of MNE. They would hold in aggregate data only to the extent that all or a significant share of the MNE operations in the host region are of this particular type.

Table 4. Estimate Results of FDI from Hong Kong [a]

Explanatory variable	Traditional panel	Dynamic panel	Spatial ML	Spatial dynamic panel
Temporally lagged FDI		0.549***		0.166*
Host market size	0.671***	0.317***	0.707***	0.514***
Infrastructure	0.603***	0.294***	0.557***	0.470***
Policy	0.477***	0.237**	0.516***	0.414***
Distance	-0.811***	-0.263**	-0.679***	-0.559***
Relative unit labor cost	-0.050***	-0.013	-0.026***	-0.011
Labor quality	0.376	0.030	0.544***	0.531*
Surrounding market potential	-0.435*	-0.704***	-1.368***	-1.377***
Spatially lagged FDI			0.676***	0.733***
Constant	9.354***	6.560**	10.306***	9.388**
R^2 (overall) / log likelihood [b]	0.713		-538.256	
Wald Chi^2 / F test [c]	543.48***	464.50***	133.84***	300.92***
Hansen test [d]		11.53 (0.173)		24.20 (0.188)
AR(1) test [e]		-2.44** (0.015)		-2.40** (0.016)
AR(2) test [e]		0.56 (0.576)		1.04 (0.300)
No. of observations	369	338	369	338

Notes: [a] * if $p < 0.10$, ** if $p < 0.05$; *** if $p < 0.01$. *p*-values are in parentheses for specification tests.

[b] R^2 for the traditional panel model, while log likelihood for the spatial ML model.

[c] Wald Chi^2 is used for traditional panel and spatial ML models, while F test is used for the dynamic panel and spatial dynamics panel models.

[d] The standard Hansen test of over-identifying restrictions (H0: no over-identification restriction) tests for overall validity of the instruments. Chi^2 are reported.

[e] AR(1) and AR(2) test for first-order and second-order serial correlation in the first-differenced residuals (H0: no serial correlation), respectively. z-statistics are reported. If the error terms are not serially correlated, there should be evidence of a significant negative first-order serial correlation in differenced residuals and no evidence of second-order serial correlation in the first-differenced residual.

Table 5. Estimate Results of FDI from Taiwan [a]

Explanatory variable	Traditional panel	Dynamic panel	Spatial ML	Spatial dynamic panel
Temporally lagged FDI		0.265*		0.077
Host market size	0.649***	0.622***	0.663***	0.660**
Infrastructure	1.083***	0.603**	1.020***	0.770**
Policy	0.488**	0.696***	0.611***	0.421*
Distance	-0.725**	-0.226	-0.499**	-0.445
Relative unit labor cost	-0.052***	-0.022*	-0.028***	-0.006
Labor quality	-0.247	-0.200	-0.184	-0.109
Surrounding market potential	-0.250 [0.307]	0.068 [0.315]	-1.319*** [0.259]	-1.394** [0.548]
Spatially lagged FDI			0.681***	0.929***
Constant	4.420	-4.434	7.158**	6.305
R^2 (overall) / log likelihood [b]	0.637		-649.694	
Wald Chi^2 / F test [c]	409.21***	291.83***	132.02***	108.67***
Hansen test [d]		2.24 (0.525)		10.04 (0.262)
AR(1) test [e]		-2.02** (0.044)		-1.85* (0.065)
AR(2) test [e]		1.68* (0.093)		1.26 (0.206)
No. of observations	365	332	365	332

Note: Same as in table 4.

Table 6. Estimate Results of FDI from South Korea [a]

Explanatory variable	Traditional panel	Dynamic panel	Spatial ML	Spatial dynamic panel
Temporally lagged FDI		0.331*		0.222***
Host market size	0.800**	0.517*	0.833***	0.747***
Infrastructure	0.016	0.234	0.144	0.024
Policy	1.873***	1.292**	1.867***	1.399***
Distance	-3.056***	-2.028***	-2.014***	-1.666***
Relative unit labor cost	-0.055***	-0.040**	-0.040***	-0.015
Labor quality	1.021	1.338**	1.719***	1.401***
Surrounding market potential	0.564	-0.947*	-1.587***	-2.109***
Spatially lagged FDI			0.593***	0.691***
Constant	12.488**	17.227***	19.193***	21.054***
R^2 (overall) / log likelihood [b]	0.612		-884.699	
Wald Chi^2 / F test [c]	279.57***	138.52***	54.92***	253.09***
Hansen test [d]		5.55 (0.136)		3.55 (0.895)
AR(1) test [e]		-2.29** (0.022)		-3.00*** (0.003)
AR(2) test [e]		-0.82 (0.411)		-1.10 (0.272)
No. of observations	377	348	377	348

Note: Same as in Table 4.

Table 7. Estimate Results of FDI from Japan [a]

Explanatory variable	Traditional panel	Dynamic panel	Spatial ML	Spatial dynamic panel
Temporally lagged FDI		0.639***		0.240*
Host market size	0.726**	0.307**	0.731***	0.770**
Infrastructure	1.052***	0.402	1.208***	0.784***
Policy	0.608**	0.242**	0.815***	0.382**
Distance	-1.551*	-0.002	-0.405	0.712
Relative unit labor cost	-0.065***	-0.021	-0.033***	-0.020*
Labor quality	-0.080	0.382**	0.655**	0.655**
Surrounding market potential	-0.517	-1.076***	-1.674***	-1.785***
Spatially lagged FDI			0.596***	0.600***
Constant	12.817*	6.309***	7.994**	5.438
R^2 (overall) / log likelihood [b]	0.612		-717.639	
Wald Chi^2 / F test [c]	240.71***	273.23***	56.11***	70.27***
Hansen test [d]		4.19 (0.898)		14.62 (0.405)
AR(1) test [e]		-2.14** (0.033)		-1.90* (0.057)
AR(2) test [e]		-0.04 (0.986)		-0.06 (0.952)
No. of observations	355	316	355	316

Note: Same as in Table 4.

Table 8. Estimate Results of FDI from US [a]

Explanatory variable	Traditional panel	Dynamic panel	Spatial ML	Spatial dynamic panel
Temporally lagged FDI		0.638***		0.259*
Host market size	0.553***	0.111	0.558***	0.397**
Infrastructure	1.009***	0.421**	1.034***	0.827***
Policy	0.578***	0.242**	0.595***	0.342**
Distance	-0.177	0.159	0.043	0.608
Relative unit labor cost	-0.026***	-0.011*	-0.016***	-0.009*
Labor quality	0.224	0.241	0.472**	0.421**
Surrounding market potential	0.896***	-0.154	-0.651**	-1.232***
Spatially lagged FDI			0.595***	0.714***
Constant	-7.362**	-0.259	-1.002	-0.897
R^2 (overall) / log likelihood [b]	0.689		-605.072	
Wald Chi^2 / F test [c]	559.91***	156.48***	64.33***	142.16***
Hansen test [d]		6.85 (0.445)		16.87 (0.719)
AR(1) test [e]		-2.60*** (0.009)		-2.10** (0.036)
AR(2) test [e]		-1.26 (0.209)		-1.51 (0.130)
No. of observations	364	331	364	331

Note: Same as in Table 4.