Agglomeration, Backward and Forward Linkages: Evidence from South Korean Investment in China

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Abstract

With a firm-level dataset, we study the location decision of South Korean multinationals across China's regions. Our conditional logit estimates confirm agglomeration effects along industry and along national lines. We add an upstream and downstream (backward and forward) linkage effect. We find that the presence of upstream and downstream South Korean affiliates significantly increases the likelihood that a South Korean multinational invests in a particular region. However, linkages that do not differentiate by nationality do not seem to matter much. As such, our analysis of investors' location choice brings together two perspectives: linkages and agglomeration along national lines.

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1 Introduction

The distribution of South Korean affiliates across Chinese provinces is very uneven and is also more concentrated than the overall distribution of foreign affiliates in China. As Figures 1 and 2 indicate, four regions out of 26 cover roughly about 75 percent of South Korean affiliates in China. Moreover, this pronounced pattern is not limited to China. As a matter of fact, if you turn to the U.S., another large country with many regions, you find that almost 60 percent of South Korea's affiliates are concentrated in one state: California. In this paper we investigate these patterns of clustering of multinationals along national lines for South Korean affiliates in China, and we want to better understand what determines this type of agglomeration. That affiliates of multinationals cluster along national lines is a well-known phenomenon that has also been observed in other countries. It has triggered empirical work, among others, by Head, Ries and Swenson (1995) that has been particularly influential. This type of work is suggestive of the impact that agglomeration externalities along national lines may have on a firm's decision to locate in a particular region. While the evidence of agglomeration is abundant, however, it is not always clear what exactly is driving the agglomeration. In this paper, we investigate the role that the availability of backward and forward linkages can play in location decisions.

[Figure 1 and 2 here]

Important for the approach that we take is the work of Amiti and Javorcik (2008). Amiti and Smarzynsak find that forward and backward linkages are an important determining factor for multinationals from any country to invest in one of China's regions. Building on an economic geography model, they find that foreign firms choose to locate in the regions where they can easily supply their intermediate goods to others or purchase intermediate goods from other firms.[1] To operationalize the upstream and downstream links, the authors use input-output tables that were advocated long ago by Hirschman (1958) and they interact these with total (local and foreign) re-

gional industry outputs. In their analysis, Amiti and Javorcik (2008) thus focus on total (local and foreign) industry output and do not separately consider the linkages through multinationals.[2]

In our study of South Korean investment decisions across Chinese regions, we combine the approach of Head et al. (1995) and Amiti and Javorcik (2008). We let the presence of South Korean firms in China affect the location decision of South Korean multinationals in three ways. In addition to the regular agglomeration effect that is captured by the number of South Korean affiliates in nearby industries, we use input-output tables to investigate the extent to which the presence of South Korean upstream or downstream affiliates in nearby industries increases the probability that a South Korean multinational will invest in a particular Chinese region. At the same time, we explicitly compare and contrast these linkage effects with the ones from the total number of upstream and downstream companies in an industry irrespective of their nationalities. In doing so, we insert a national dimension into the analysis of Amiti and Javorcik (2008) and a linkages dimension into the work of Head et al. (1995). Interestingly, we find that linkages along national lines matter most for South Korean investors. However, the linkages at the industry level that do not differentiate by nationality do not play much of a role.

FDI has been among the fastest growing international indicators and its growth toward China and other emerging economies has been at the heart of many discussions about globalization. Increasingly, the full scale of the reorganization of production across national borders has become apparent and so are the many different ways in which this takes shape. Since the 1980s when the first formal theories of multinational activity were developed, empirical support has been found for the traditional explanations for multinational activity.[3] There is evidence that multinationals indeed relocate production to save transportation costs and to gain direct access to large markets. Multinationals have also been found to open up affiliates in order to jump tariffs or to move parts of their production to where resources are cheap. The work on geographic agglomeration that emphasizes how a multinational's location decision depends on the decisions of other multinationals addresses the concern,

however, that the traditional factors do not exhaustively explain the full range of multinational activities and the allocation decisions that firms make.[4]

Firms are known to cluster in one geographic area.[5] Since Alfred Marshall, it has been pointed out that there could be different types of external economies to rationalize the geographic clustering of firms. Clustering may bring about knowledge and technology spillovers, the increasing availability of specialized labor and a growing pool of specialized input providers. Agglomeration also takes place when firms invest abroad. Foreign investors are more likely to choose locations where there are many local firms, since their presence may suggest the mentioned external economies. Interestingly, however, in the case of foreign direct investment, investors often agglomerate around investors from the same country of origin. In their study of the location decision of U.S. firms in Ireland, Barry, Görg and Strobl (2003) argue that investors may exhibit a tendency to imitate each other's location choice due to uncertainty. Since foreign investors face greater uncertainty than local firms in the host country, they may interpret the presence of firms from their home country as a positive signal of the location's attractiveness. It is this characteristic of foreign investment, in particular, that we investigate.

In the empirical literature, agglomeration is typically interpreted as a positive relation between a measure of the number of companies in a particular location and the probability that investors choose that location, which is why the particular path of history matters and why there is persistence in location decisions. We hypothesize that the presence of more downstream or upstream establishments makes it more likely that investors choose a particular location, which is quite intuitive. It suggests less costly access to suppliers and buyers. Moreover, the hypothesis could be consistent with earlier findings by Belderbos and Carree (2002) that smaller firms tend to follow larger firms. In particular, our hypothesis provides the dependence on inputs from other firms as the reason why this might be the case. Needless to say, building clusters has been an integral part of the strategy to attract FDI in countries such as Ireland or Costa Rica (Larrain, Lopez-Calva and Rodriguez-Clare, 2001). Note, however, that the policy implications for attracting FDI may be different when the

presence of upstream or downstream establishments as such is important, irrespective of their nationality, versus when these establishments have to be of the same nationality. If the latter holds, attracting some multinationals from a particular country may help attract others, so there may be a payoff to bilateral strategies that specifically target certain countries. At the same time, if linkages along national lines matter, potential spillover gains could be internalized by affiliates of a particular country, and attracting foreign firms, say, in order to have domestic firms benefit may be a lot harder.

To study agglomeration and its upstream and downstream dimension, we focus on South Korean multinationals and their initial investments in China. There are two reasons for focusing on China. The first motivation is entirely pragmatic. South Korean outward FDI is a recent phenomenon and still relatively limited (especially when compared to outward FDI flows from the U.S. or Japan). Since China attracts most of these new affiliates across regions, and since it has a sufficient number of regions, we have enough observations to investigate the regional allocation decisions. Note, however, that the pattern of agglomeration that we observe in China, seems to follow a similar pattern in the U.S. for which we have far less observations.[6] The second reason why we focus on China, relates to its being, together with the United States, the highest receiver of the world's FDI. Already for this reason is it important to better understand the location decisions in China. Moreover, FDI into China has become one of the premier topics of policy debates in the region. It has fueled anxieties of the "hollowing out of Korea's production base as a result of the rush into China",[7] as the South Korean investment promotion agency *KOTRA* puts it. In this respect, it may be particularly relevant that South Korean affiliates abroad are increasingly active in industries such as machinery, transportation, and electronics. These industries use a wide range of intermediate goods. In addition, they have been associated with international fragmentation of production.[8] Therefore, the availability of linkages may be particularly important for these sectors in the wake of the Asian currency crisis and the increased liberalization of outward FDI in its wake.

We use a relatively new dataset of South Korean FDI in China for the empirical

analysis. Different from other datasets, ours is not limited in time span or scope, which is, of course, related to the fact that China only opened up to South Korean FDI fairly recently. The data covers all South Korean investment in China between 1988 and 2004. The advantage of studying the distribution of FDI within a country rather than across countries is that country-specific factors can be taken as given. In addition, we can study firm location at a less aggregate level, which is particularly relevant for agglomeration issues. The challenge of empirical research on agglomeration is then to properly control for alternative explanations that may explain the presence of clusters of affiliates such as comparative advantage or government incentives to attract foreign investors. In our preferred specification, we include region-time-specific effects. We also include a specification with region-specific effects in addition to wages, a region's market potential, a measure for regional skill quality as well as controls for China's policy initiatives to attract FDI such as the foreign trade zones that have been created with the explicit objective of attracting FDI.

Our study most closely relates to the work of Head et al. (1995) who, together with Wheeler and Mody (1992), were among the first to study agglomeration effects for FDI. In particular, Head et al. (1995) examined the location of Japanese manufacturing investment across the US states in the 1980s. They also use conditional logit estimates that are well suited for an investigation into how the variation in location (state) attributes affects the probability that a multinational will choose to set up an affiliate in a particular state. Moreover, Head et al. (1995)'s specific analysis of agglomeration externalities within vertical *Keiretsu* groupings for Japanese investment in the US paves the way for our more general analysis of forward and backward linkages that probes whether the influence of linkages extends beyond national lines.[9] As a matter of fact, we also investigate if our results are sensitive to whether firms are part of larger *Chaebols*.

We first discuss the approach in the next section before we turn to the data that we use in section 3. In the last two sections, we explain the results and state our conclusions.

2 Empirical Implementation

Conditional logits with the particular place that is chosen by the investor as dependent variable offer a straightforward way to implement location choice models. They allow us to investigate how the characteristics of the various locations affect the likelihood of investors investing in a particular place at the time of the first investment. We follow Head et al. (1995) who builds on McFadden (1974)'s result that logit choice probabilities can be derived from individual firm maximization decisions. In particular, the place that offers the highest expected profitability is chosen as destination. When the production function of the affiliate in a particular place is assumed Cobb-Douglas, agglomeration externalities from other companies in the place, together with other production inputs, will affect a firm's output and profitability in a multiplicative way. In this case, the expected profitability of an affiliate j in place p, Π_{jp}, is a log-linear function of the agglomeration measures and other attributes of the places, which are all captured by the vector X_{jp}.(We drop the time-subscripts for simplicity.)

$$\Pi_{jp} = \beta' X_{jp} + \varepsilon_{jp} \tag{1}$$

If ϵ_{jp} is Type-I Extreme Value random error, following McFadden (1974), the probability that j invests in place p equals the following expression:

$$pr(1_j = p) = \frac{\exp(\beta' X_{jp})}{\sum_p \exp(\beta' X_{jp})} \tag{2}$$

The most common formulation of equation (1) is as follows.

$$\pi_p = \theta_p + \alpha \ln A_p^s + \beta \ln Z_p + \epsilon_p \tag{3}$$

, where θ_p represents place-specific effects, A_p^s stands for agglomeration externalities in sector s and place p, and Z_p represents other attributes of the different places. It could be argued that the geographic borders of provinces are arbitrary. Therefore, we construct a distance-weighted agglomeration variable for each province that also includes the agglomeration variables of the other provinces weighted by their relative

distance.

$$WA_p^s = A_p^s + \sum_{l \neq p}^{P} \left(A_l^s * \frac{Dist_{lp}^{-1}}{\sum_{l \neq p}^{P} Dist_{lp}^{-1}} \right) \tag{4}$$

, where $Dist_{lp}$ is the distance between capital cities. Hence, WA_p^s will be higher where there are many firms nearby.

As indicated, to capture agglomeration, we consider WA_p^s from two different angles. On the one hand, we take it to be the number of Korean affiliates within an industry. On the other hand, we measure the total number of companies in an industry irrespective of nationality (including local Chinese companies) that are already active at the time that an investment decision is made.[10] Including both measures in the conditional logit will allow us to see which of the two types of agglomeration has most traction.

Place-specific effects are captured by place-specific dummies that control for time-invariant factors. These factors capture the geography, the proximity to South Korea, the infrastructure, or the presence of a South Korean expatriate community that all make a place more or less attractive to investors and that may be hard to measure. In addition, we include economic and demographic variables such as a place's education levels, and its average wage rates that vary with the time of investment. These variables are known determinants of multinational activity. Larger markets tend to attract more (horizontal) FDI. Lower wages may be attractive for (vertical) FDI that takes advantage of low production costs to relocate parts of the production process that used to take place in the South Korean parent. We control for the variation in efforts to attract foreign direct investment by including the number of economics zones in the place. Since there is an issue about whether one can appropriately capture all characteristics that vary over time and place, our preferred specification includes place-time dummies. Needless to say, if there exists no agglomeration externality and if all relevant factors that distinguish places are controlled for, the α coefficients

should be zero.

As indicated, we go beyond this baseline specification for agglomeration. Next to the regular agglomeration effect we consider backward and forward linkages, in order to capture the impact of increasing numbers of upstream suppliers of intermediate goods and downstream buyers of such goods. To generate these measures of forward and backward linkages, we use industry input-output tables and combine them with the number of companies in a particular place/industry. For the linkages with South Korean companies, we use the South Korean input-output tables and combine them with the number of South Korean affiliates across the industries in the Chinese regions. For the linkages at the industry level irrespective of nationality, we use the Chinese input-output tables combined with the total number of companies in a particular region/industry that are mostly of non-South Korean nationality.[11] In each case do we capture the strength of forward linkages as follows: $FL_p^m = \sum_n \delta_{mn} A_p^n$, where δ_{mn} is the proportion of sector m output supplied to sector n and $\sum_n \delta_{mn} = 1$.[12] Again, to take into account spatial aspects, we construct distance-weighted forward linkages variables in the following way.

$$WFL_p^m = FL_p^m + \sum_n \delta_{mn} \sum_{l \neq p}^{P} \left(A_l^s * \frac{Dist_{lp}^{-1}}{\sum_{l \neq p}^{P} Dist_{lp}^{-1}} \right) \tag{5}$$

Hence, WFL will be higher in any place where many downstream firms are already located nearby. The variable for backward linkages is analogously represented by $BL_p^n = \sum_m \gamma_{mn} A_p^m$, where γ_{mn} is the proportion of sector m output supplied to sector n and $\sum_m \gamma_{mn} = 1$ and distance-weighted backward linkages, WBL, will be higher where many upstream establishments are already located nearby. As indicated, we will construct these upstream and downstream linkage variables specifically for South Korean affiliates as well as for the total number of companies in an industry irrespective of their nationality. Note that the variables differ by place/sector, since the usage of intermediate goods varies by industry. Rewriting the profitability

equation (3), we obtain equation (6).

$$\pi_p = \theta_p + \sum_{i=\{SK,I\}} \alpha_{ia} \ln WA^s_{ip} + \sum_{i=\{SK,I\}} \alpha_{if} \ln WFL^s_{ip} + \sum_{i=\{SK,I\}} \alpha_{ib} \ln WBL^s_{ip} + \beta \ln Z_p + \epsilon_p \tag{6}$$

The new coefficients α_f and α_b should be significantly positive if an investor chooses a particular place because it has more South Korean (SK) upstream (downstream) affiliates for an industry or, more generally, because the total number of upstream (downstream) companies in this industry is higher irrespective of nationality (I). Note that we purposefully include the linkages as well as the regular agglomeration variables for the South Korean affiliates as well as for all firms irrespective of their destination. In this way, we can see whether the linkage effects that specify why agglomeration should matter add something to the regular agglomeration effects. Similarly, we should be able to figure out whether the South Korean linkages are more or less important than the aggregate industry linkages.

3 Data and FDI from South Korea

The data of South Korean foreign affiliates is collected by the Export-Import Bank of Korea that covers the full list of South Korean affiliates established worldwide. Relevant for our analysis are the first-time investments of multinationals in Chinese regions, which started in 1988. Figures 3 and 4 illustrate the dominant trends of South Korean outward FDI into China in terms of the amount invested and the number of newly established affiliates. Before the mid 1990s FDI gradually increased. Since then, there has been a significant outflow. The late 1990s were the only exception. At the time, South Korea was caught in the Asian financial crisis. As for outward FDI going into China, the data shows a significant increase in the number of affiliates established as well as in the amount of FDI since 1988. In particular, there was a dramatic increase in FDI moving into China around 1992 when Korea and China entered into diplomatic relations. Note that there may be some concern

that the investments prior to 1992 were not merely a function of economic interests. Finally, as is clearly shown in Figures 3 and 4, a large percentage of foreign affiliates from South Korea are located in China. As of 2004, more than 50 percent of its new affiliates are established in China.[13]

[Figure 3 and 4 here]

Figures 5 and 6 present the industry characteristics of FDI into China in terms of the number of affiliates. According to Figure 5, more than 80 percent of the affiliates over the entire period are active in manufacturing in China, which is significantly higher than the worldwide share (a bit above 60 percent). This is in line with the perception of China as the world's factory. We also isolate the share of affiliates that are active in machinery, transportation, and electronics. These sectors not only provide and use many intermediate goods from other sectors. In addition they are sometimes identified with international fragmentation of production.[14] Of interest is to see that the share of the affiliates in these industries has increased significantly after it had been relatively stable before 1999. This could contribute to the importance of linkages.

[Figure 5 and 6 here]

China has 22 provinces (excluding Taiwan), 5 autonomous regions (Tibet, Xinjiang, Inner Mongolia, Ningxia, and Guangxi), and 4 municipalities (Beijing, Tianjin, Shanghai, and Chongqing). As Figures 1 and 2 show, the South Korean affiliates in China are quite concentrated and more concentrated than the distribution of the total number of affiliates of any nationality. Four regions account for about 75 percent of the total population of South Korean affiliates. The investments in Guangdong and Jiangsu, for example, amount to more than 40 percent of worldwide investment, while those investments account for less than 12 percent for Korea. Shandong is the premier destination for Korean investment. Interestingly, Liaoning, Jilin, and Heilongjiang seem to be attractive locations for Korean firms, but not for the other coun-

tries. This should perhaps not be so much of a surprise since many Korean-Chinese who speak Korean live in these provinces, which are adjacent to North Korea.[15] Note that this concentration of South Korean affiliates is also found in the U.S., the other large country in the dataset of which we have a regional distribution. Here again, we find a higher concentration among South Korean affiliates than for all the affiliates combined. Almost 60% of Korean FDI is concentrated in California, which is 5 times higher than the world average.[16]

We end up working with 25 regions. Since the five autonomous regions are geographically separate entities and the investments are reported together, we cannot include them in the analysis.[17] At the same time, we merge the data for the municipality of Chongqing with Sichuan Province, since it was separated only in 1997.

We measure agglomeration using the number of Korean affiliates already active in the region in the same manufacturing industry in the year before an investment takes place. The Export-Import Bank of Korea records South Korean outward FDI according to a total of 69 manufacturing industries, which is similar to the Korea Standard Industry Classification (KSIC) 4- digit level. Accordingly, the agglomeration variable for South Korean affiliates is specified for 69 industries. For the total number of companies at the industry level that are overwhelmingly of non-South Korean nationality, we use the data from the China Industry Statistics Yearbook series. The data contains the total number of firms and output according to 18 manufacturing industries. In one specification, we will use both (different) classifications. In another, we will match as closely as we can the Chinese classification with the South Korean data by aggregating Korean data up to 18 (roughly) comparable industries.[18]

When we do the estimation, we will first focus on the period since 1999, before we turn to the entire period after 1992. There are two reasons for doing so. The period since the Asian financial crisis has seen the strongest increase in affiliates from electronics, materials and transportation that are especially relevant for our analysis. More importantly, a data issue complicates the analysis for the entire period. The China statistics department changed the data collection classification between 1997 and 1998. Due to that change, the total number of companies in 1998 dropped to 1/3

of the 1997 data across all the industries. To control for this anomaly, we will interact the aggregation variables with a dummy for the post 1998 years in our analysis when we focus on the entire period since 1992. Finally, to avoid missing values in a log transformation, we add one to this variable as previous studies have done.[19]

When we focus on the supply and demand of intermediate goods by South Korean affiliates, we use the Korean input-output table from the year 2000 to measure firm linkages.[20] To merge input-output tables and Korean FDI data, we have to concord the industry classifications as there is a slight variation between both sources.[21] For example, the input-output table specifies semiconductors (KSIC 3211) and other related devices (KSIC 3219) separately, while in the FDI data set, both industries are classified as semiconductors and related devices. In this case, we combine KSIC 3211 and KSIC 3219 to match the FDI classification. When some industries are more finely defined in the FDI data set than in the input-output table, we adjust the sectors accordingly. In the end, our adjusted input-output table consists of 53 industries. In order to be able to construct the second agglomeration variable at the industry level irrespective of nationality, we rely on the Chinese input-output table 1995, which comprises 15 industries.[22] Finally, in order to construct the linkage variables as described in section 2, we interacted Korean input-output table with the number of Korean affiliates and Chinese input-output table with the number of firms of all nationalities, and also add one to them for the same reason as with the agglomeration variable. While it is not feasible to exactly match the Chinese and South Korean input output tables, we will also present estimates with a more aggregate South Korean input output table of 18 sectors.

We control for regional economic and demographic factors in the estimation in two ways. In our preferred specification, we include time-region dummies. We also show results for an alternative specification that includes some of the known determinants of FDI. It is well known, for example, that a larger regional economy attracts more FDI. At the same time, as Head and Mayer (2004) suggest, market potential is an important factor that may affect an investor's location decision. To control for market potential and a region's size, we include the distance-weighted real GDPs of all regions. We take

the real GDP data from various issues of the China Statistical Yearbook. The distance between regions is measured as the distance between the provincial capitals, which is taken from yahoo.com. We control for the labor costs by including the average level of regional staff and worker wages from the China Statistical Yearbook. Lower wage rates could be more attractive to investors in search of cheap labor. Furthermore, to control for the quality of workers, we include the ratio of high school graduates to the total population. We compute this ratio from the China Statistical Yearbook. Finally, we also consider a variable that reflect the government's role in attracting FDI. We choose the number of the special economic zones (SEZ) in a region that were especially created for foreign companies.[23] There are many different types of economic zones such as Open coastal cities (OCCs), economic and technological development zones (ETDZs), open coastal areas (OCAs), technology industry development zones (TIDZs), bonded zones (BZs), border economic cooperation zones (BECZs), and export processing zones (EPZs). As of 2004, there was a lot of variation in the total number of zones in a region, with Guangdong having as many as 20 economics zones, for example.

Table 1 reports the summary statistics for the main variables of our analysis after taking into account spatial aspects. Agglomeration measures the total number of firms in an industry, irrespective of their nationality. Agglomeration by SK affiliates only counts the South Korean affiliates in an industry. Similarly, we have forward and backward linkages involving all the firms in an industry as well as those only involving the South Korean affiliates.

[Table 1 here]

4 Results

Table 2 reports the estimation results for the period after the Asian financial crisis. As mentioned before, this period saw an increase in the share of affiliates from sectors

prone to vertical integration and keen on international fragmentation. At the same time, as far as the total number of firms goes, the data is the most consistent for this period. The results present the estimates of equation (6) that specifies the factors that determine an investor's decision to invest in a particular Chinese region. In all columns, except for the fourth one, the equation includes time-region-specific effects. The first two columns present familiar estimates of equation (6) that have been used in previous studies. The estimates in the first column suggest that firms agglomerate by industry regardless of nationalities. Those in the second column indicate that the decision to invest in a particular Chinese region is determined not only by the agglomeration of companies of any nationality in a given industry, but also in particular by the number of South Korean affiliates in that industry. The coefficients are significantly positive and in the range of previous studies. The likelihood ratio test between the specification in column (1) vs. (2) overwhelmingly rejects the hypothesis that the South Korean agglomeration variables have no explanatory power.[24] Note that the interpretation of the coefficient estimate as the average probability elasticity needs some care in a conditional logit model. It can be shown that the average probability of how any regressor impacts the location choice over all choosers and location choices should be calculated as follows: $(S-1)/S$ times the regressor's estimated coefficient, where S is the number of location choices.[25] Since there are 25 locations in our study, our estimates show that a 10 percent increase in the distance-weighted number of Korean affiliates in one region will increase the probability that investors choose that region by around 10 percent (0.96 x 1.061 x 10).

[Table 2 here]

As argued before, there are various ways to interpret these findings, and it is not clear why firms would agglomerate in a particular location. We therefore add to the regular agglomeration effect the effect due to forward and backward linkages. Moreover, we consider both the agglomeration linkages for South Korean affiliates and the agglomeration linkages at the industry level for companies of any nationality

(including local Chinese companies). In the third column of Table 2, we include the linkage variables that are described in section 2. The regular agglomeration externalities remain strongly positive. The result shows that both forward and backward linkage effects are significant for South Korean establishments. The likelihood ratio test prefers the specification in column (3) that includes the South Korean Linkage variables over that in column (2).[26] As expected, the magnitude of the regular agglomeration effect decreases significantly as forward and backward linkages are included. Interestingly enough, however, the linkage effects at the industry level across nationalities are not significant. This suggests that, while the presence of many companies in an industry matters, the nationality of the establishments is key for the specific upstream and downstream links that are directly aligned with the specific production process.

In the fourth column of Table 2, we drop the time-region effects and include region-specific dummies together with other more traditional determinants of industry location that vary over time. As noted, our measures of market potential, education, and the wage and economic policies meant to attract multinationals all enter with a positive sign. However, only the wage and the number of economic zones are statistically significant. The positive coefficient on the wage runs counter to our initial intuition that multinationals might seek low-wage regions. This may suggest that the wage also picks up the quality/education level of the labor force.

As mentioned, there is an issue about the different classification of the industries according to the Chinese versus the South Korean statistics. The fifth column reports estimates when we (imperfectly) map the South Korean industry classification into its Chinese counterpart and use a more aggregate South Korean input output table. For most part, the results hold up. Only the backward South Korean link loses significance, while maintaining the same sign.

Finally, we focus on the role of *Chaebol* for our results. It is well known that *Chaebol*, South Korea's conglomerates, play a prominent role in South Korea's industrial texture. We want to investigate whether our results are driven by these large corporations. It turns out that they are not. When we drop all the larger corpora-

tions from the sample, all variables of interest retain the same signs and significance.[27] These findings then add an interesting dimension to the existing literature. As Belderbos and Carree (2002) have noted, small firms are followers. What our results show is that smaller firms are followers especially because they go where suppliers of inputs and buyers of their intermediate goods are more plentiful. Moreover, Figure 7 shows that the fraction of big firms in total firms has been decreasing over time, suggesting in addition that initially larger multinationals went abroad.

[Figure 7 here]

In Table 3, we extend the sample. We present estimates for the post-1992 period. We estimate from 1992 onward rather than 1988, since there is some concern that the location choice before the diplomatic relations between China and South Korea were initiated in 1992 may not have been purely for economic reasons.[28] Note that we included early establishments going back to 1988 in the count of firms to construct the agglomeration variables when we estimated the location decision after 1992. The makeup of Table 3 mimics that of the previous table for the time since 1999, and the results largely correspond to those of the more recent period.[29] The main difference is that the estimates are somewhat weaker and less precisely estimated.

[Table 3 here]

The last issue that we address is the robustness of the results. In particular, we investigate the independence of irrelevant alternatives (IIA) assumption that is implied in a conditional logit analysis. In a conditional logit, the relative probability of choosing between two alternatives should not depend on the availability of a third alternative. The IIA assumption hinges upon the identical and independent error terms. As argued by Head et al. (1995), the inclusion of alternative specific constants (in our case, regional dummies) allows for conditional logits in the presence of violations of IIA, as long as investors have uniform perceptions about the substitutability

between states. At the same time, the regional dummies complicate formal testing of IIA since they yield different numbers of parameters across specifications. We therefore compare the estimates of the critical variables of interest as we exclude several regions with the baseline estimates for the full set of choices. When the coefficients and significance levels are relatively stable, we regard the IIA assumption as valid, as is done in the previous studies. We exclude Shandong, three Northeast provinces (Jilin, Liaoning, and Heilongjiang), and three municipalities (Beijing, Tianjin, and Shanghai) in turn in the second and third column of Table 4. Note that the first column for each time period is the standard estimate (4) from Tables 2 and (10) from Table 3 that includes regional variables with region-specific dummies. For reference, Shandong is the location of most Korean firms ; the Northeast provinces are attractive regions for Korean investors since there are many Korean Chinese; and the municipality itself has economic significance. For the period after 1999, the coefficients and significance levels are relatively stable. For the entire period after 1992 we have comparable results that, as before, tend to be somewhat smaller and somewhat less precisely estimated.

[Table 4 here]

5 Conclusion

China, together with the United States, has topped the list of recipients of FDI for a number of years. This has heightened the interest to gain a better understanding of what drives multinationals into China and what explains the local dispersion of multinationals as China is rapidly being integrated in the world economy. With an unpublished data source for all of Korea's affiliates across China's regions, we investigate whether and how agglomeration affects the allocation decision along industry lines and along national lines. In particular, we extend the usual agglomeration analysis and investigate next to the regular agglomeration effect the impact of backward

and forward linkages. Since the work by Hirschman (1958), there has been an active interest in forward and backward linkages. Moreover, the idea of forming clusters of economic activity has been central in the attempts to attract FDI in countries such as Ireland and Costa Rica.

We find that forward and backward linkages interacted with the presence of other Korean affiliates in China play a significant role in determining the location of Korean FDI in China. At the same time, however, the general forward and backward linkages at the industry level, irrespective of nationality, do not seem to matter much. These findings are fairly robust and not driven by the South Korean *Chaebol*. Our results imply the presence of multinationals from one country of origin attracts other firms that country. From a policy perspective, this seems to imply a bilateral approach. Indeed, if the objective of the Chinese government is to attract more multinationals, it may be worthwhile to target specific countries. At the same time, our findings also imply a note of caution. With clustering along national lines, potential spillovers are likely to be internalized among the affiliates from one and the same country. Consequently, if generating spillovers for the local industry is part of the reason for attracting foreign companies, our results indicate that this may be a difficult objective to realize. Interestingly enough, recent research by Girma and Gong (2008) and Girma, Gong and Görg (2008) indicates that there have been limited spillovers from FDI in China on its state-owned enterprises, which is consistent with our analysis.

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Notes

[0]Lead footnote:An earlier version of the paper benefited from presentations at the Univ. of Nottingham, the Texas Econometric Camp, and the Darden Business School of University of Virginia. The usual disclaimers apply.

[1]Görg and Strobl (2002) also study agglomeration effects and linkages in Ireland. Following Markusen and Venables (1999), they investigate the extent to which the presence of multinationals affects entry of indigenous firms in Ireland, and how the location choice is affected by downstream linkages.

[2]In robustness checks, Amiti and Javorcik (2008) find that the number of foreign firms in a region also plays a role, in addition to the total linkage effects.

[3]Helpman (1984) is a key theoretical paper on vertical integration that has labor-intensive parts of production relocate to low-wage countries; Brainard (1997) and Markusen (1984) emphasize horizontal integration and distance for which exports and affiliate production are substitutes. Carr, Markusen and Maskus (2001) provides empirical evidence of horizontal multinational activity. Yeaple (2003) and Hanson, Mataloni and Slaughter (2005) are two papers that document vertical links. More detailed surveys of the literature are found in Navaretti and Venables (2004) and Markusen (2002).

[4]A recent survey by Blonigen (2005) emphasizes the need to go beyond the traditional theories of the multinational.

[5]See Porter (1998).

[6]For a limited set of observations we have evidence from South Korean affiliates across U.S. states that confirms regional clustering along national lines. Also, esp. forward linkages seem to matter for location decisions of South Korean multinationals.

[7]See, Economist, August 25, 2001.

[8]See Hanson et al. (2005).

[9]Head, Ries and Swenson (1999) extend their previous analysis as they explicitly control for more factors that characterize the different regions - a key concern in conditional logit analysis. Blonigen, Ellis and Fausten (2005) find agglomeration effects across both horizontal and vertical *Keiretsu* groupings. However, their analysis of Japanese multinationals is across countries, rather than states.

[10]Because of a change in the Chinese data collection, see p.13, we cannot simply subtract the number of South Korean firms from the Chinese firms. However, since the number of South Korean establishments is small compared to the total number of companies in an industry, the industry agglomeration variable corresponds roughly to the non-South Korean companies.

[11]We assume that the link with Korean establishments are reflected in the Korean IO table while

that with non-Korean ones in the Chinese IO table. As a robustness check, however, we use either the Korean or the Chinese IO table for both cases and the results do not depend on it.

[12]Consumer demand can be a factor in considering forward linkages. It is not straightforward to construct such a variable, however, because consumer demand will be expressed in monetary terms while the current linkage variable is based on the number of establishment. Therefore, we will include market potential as a control variable in some of the specifications.

[13]If we compare the data for China and the U.S., we find that while the volume of FDI to the U.S. is significant and comparable to China in later years, the flows go to far more affiliates in China compared to the U.S., which is why China is better suited for a study of regional clustering compared to the U.S.

[14]Hanson et al. (2005) find strong vertical FDI activity in industries such as machinery, transportation, and electronics.

[15]As we will not use worldwide FDI in our conditional logits, but rather the number of companies from other nationalities in a particular region/industry irrespective of their nationality, we want to note that the correlation between the regional distribution of worldwide FDI and that of overall manufacturing output is, as one would expect, fairly high at 74 percent.

[16]When we construct a $Herfindahl$ index to measure the concentration of affiliates across states, the pattern for China and the U.S. is comparable. There is a higher concentration for South Korean vs. total foreign affiliates across states in both cases: The $Herfindahl$ indices for South Korean affiliates in China and in the U.S. are respectively 0.182 and 0.338; for total foreign affiliates we find 0.129 in China and 0.043. in the U.S.

[17]The investment into those regions is less than 10.

[18] The 18 industries are general industry machinery, other machinery, non-metal mineral, textile, synthetic fiber, food, grain-mill products, beverages, instruments, automobile, electronic and electrical machinery, electronic and communication components, primary metal, fabricated metal products, printing and allied products, coke and petroleum, chemical and drug.

[19]An easy way to rationalize this is to argue that the investing firm does take its own presence in the region into account as it decides whether to invest in a region. We follow Head et al. (1995).

[20]Since the industry shares do not change much during the sample period, the 2000 table is used for all years. Alternatively, one could use the IO tables that were published with 5-year intervals. A drawback of going that route is that the classification also changes over the time period.

[21]The input-output table is published by the Bank of Korea, while the FDI data come from the Export-Import Bank.

[22]We also used the table published by World Bank, which is based on GTAP 4 database. Input-output coefficients are fairly stable and analysis using either table produced the similar results.

[23]Cheng and Kwan (2000) provide evidence of the significant role of special economic policy.

[24]The test statistic is 249 and the critical value at 0.005 level is 8.

[25]See Head et al. (1995).

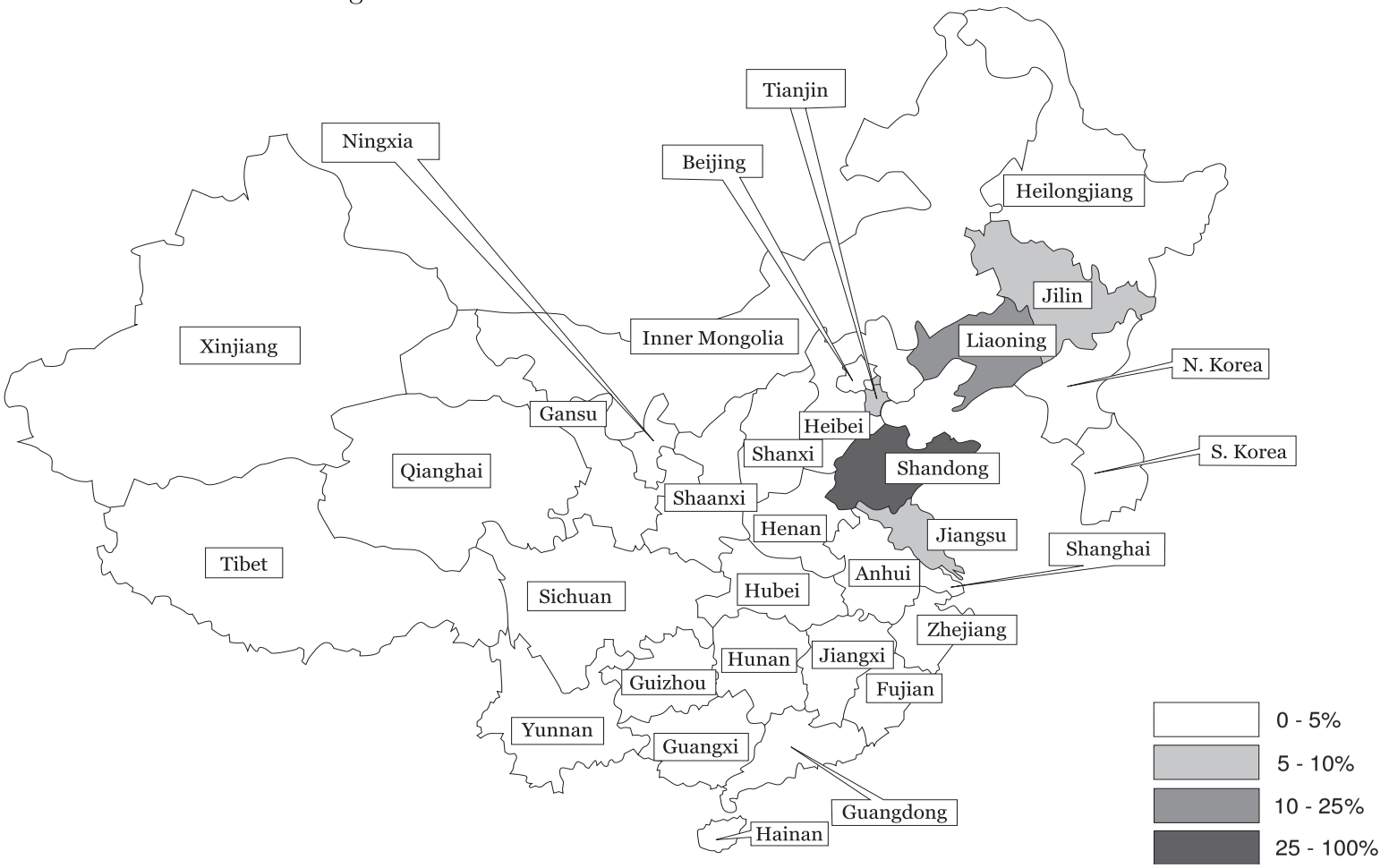
[26]The test statistic is 37 and the critical value at 0.005 is 15.

[27]In the survey, the investing firms declare themselves large or not. Some 8 percent is large.

[28]It turns out that estimates for the entire sample, starting from 1988 are qualitatively the same, but somewhat weaker. Alternatively, one could argue that the early years of the data set are not of major interest to uncover agglomeration effects, since there were no South Korean affiliates in 1988.

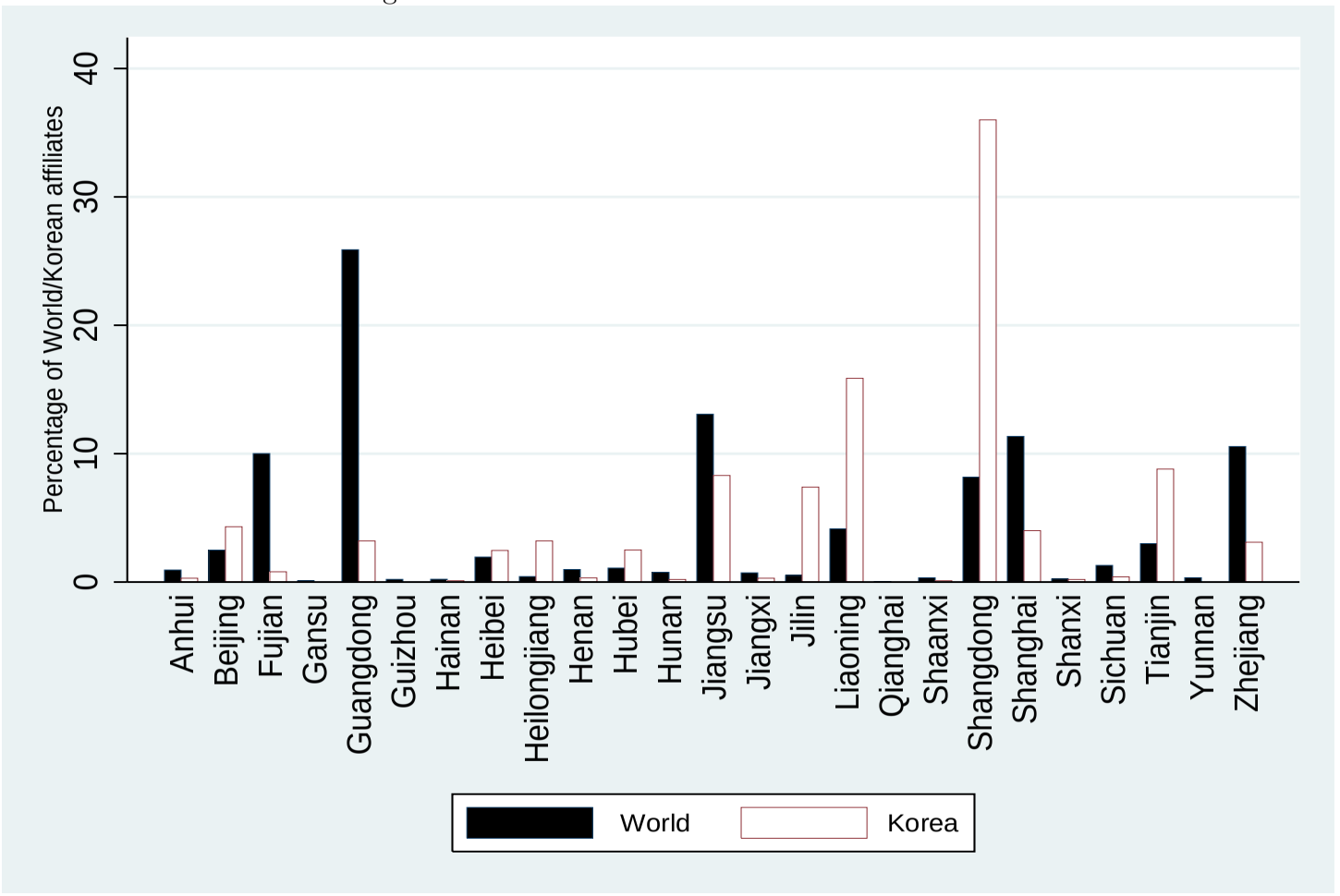
[29]The likelihood ratio tests comparing the specification in column (7) vs. (8) and (8) vs. (9) prefer column (8) and (9).

Figure 1: Distribution of South Korean investment in China



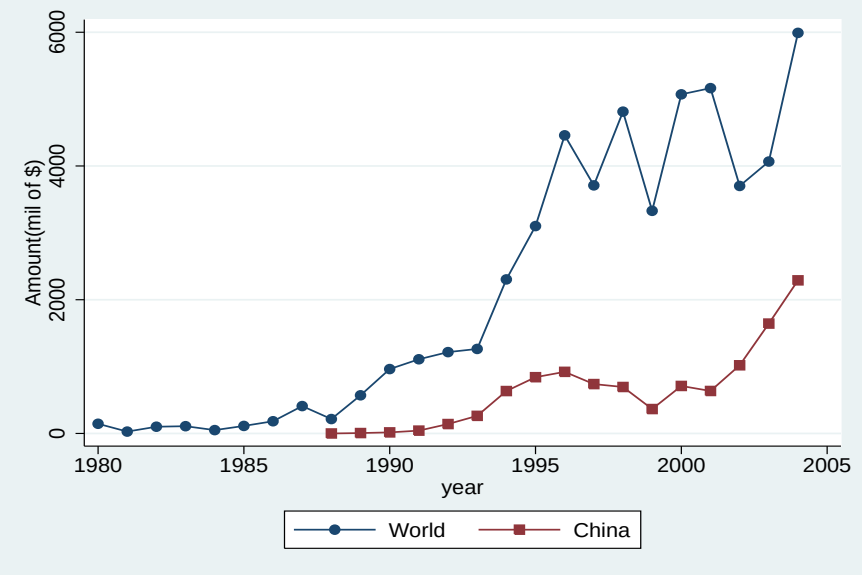
Source: Export-Import Bank of Korea

Figure 2: Distribution of Multinationals in China



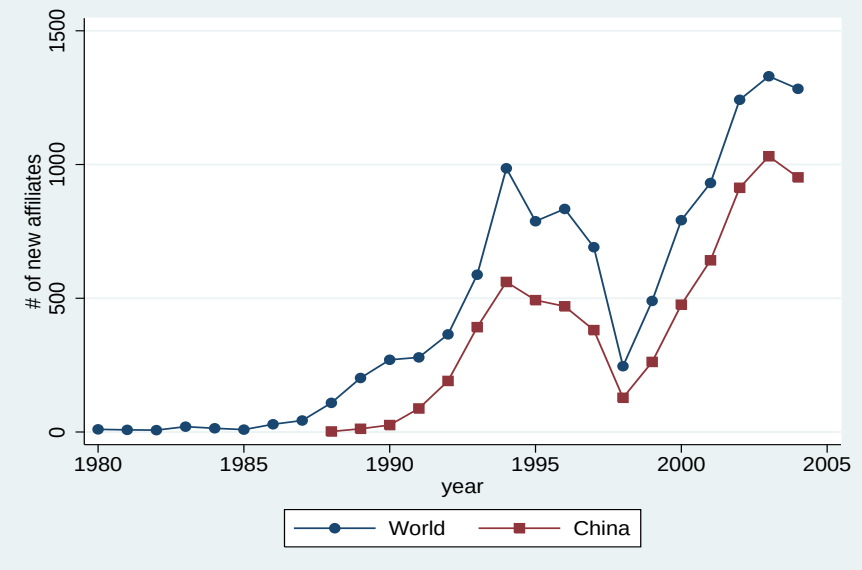
The source for worldwide multinational firms is China Statistics Yearbook 2006. The data for Korea is from Export-Import Bank of Korea.

Figure 3: Amount of South Korean investment to the world and China



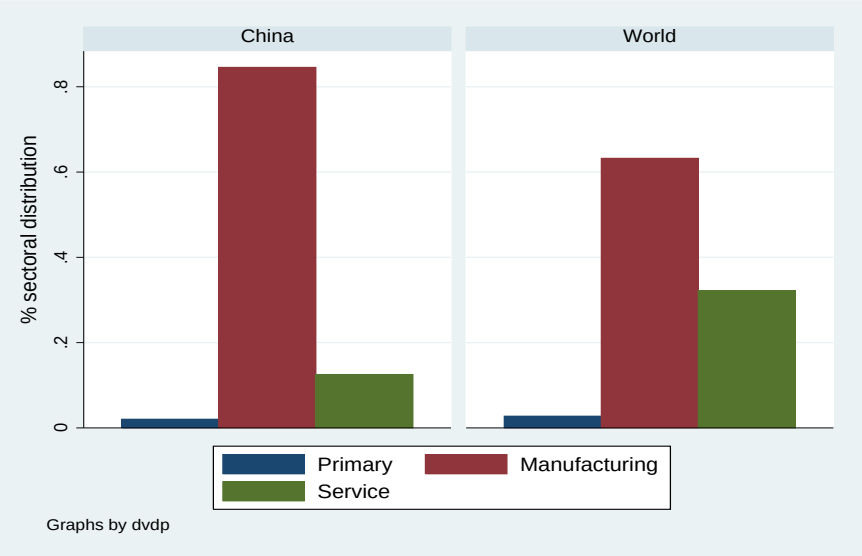
Source: Export-Import Bank of Korea

Figure 4: Number of new South Korean affiliates in the world and China for manufacturing



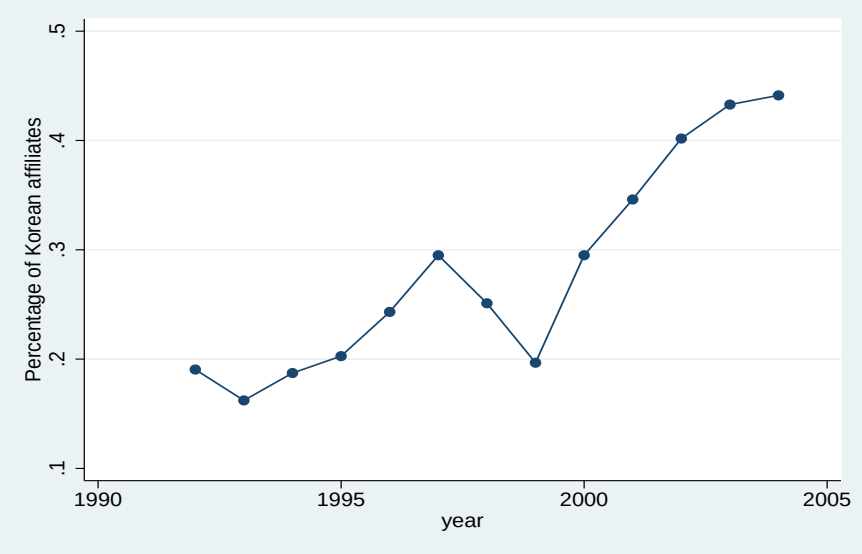
Source: Export-Import Bank of Korea

Figure 5: Sectoral Shares of South Korea's new affiliates in China vs. for the world as a whole, in percent



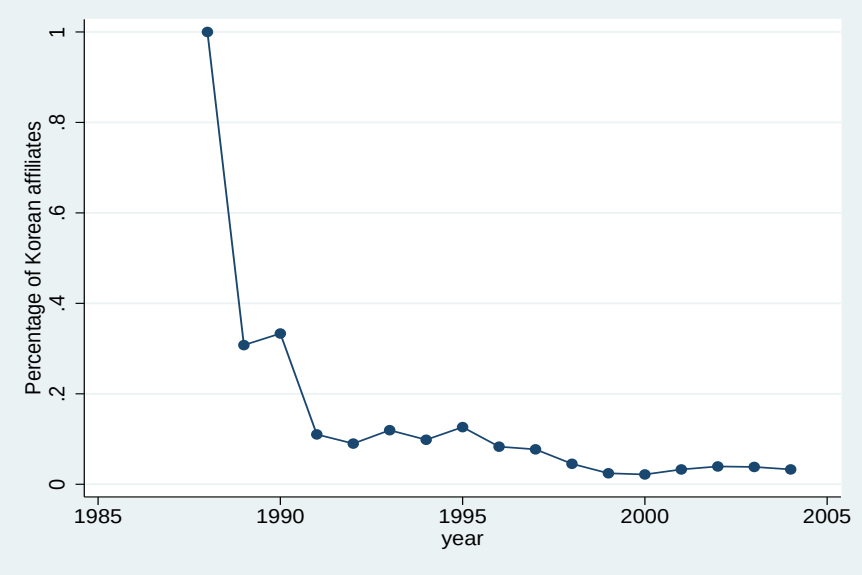
Source: Export-Import Bank of Korea

Figure 6: The share of affiliates in machinery, transportation and electronics in manufacturing



Source: Export-Import Bank of Korea.

Figure 7: Fraction of affiliates from large multinationals over time



Source: Export-Import Bank of Korea

Table 1: Summary statistics of regressors

Variable	Mean	St. Dev	Min	Max
Agglomeration	6.618	0.819	3.209	8.878
Agg. by SK affiliates	1.821	1.153	0	5.77
Forward Linkages	7.867	0.636	6.254	9.447
Backward Linkages	8.000	0.62	6.335	9.818
For. Link. by SK affiliates	1.644	0.947	0	5.28
Back. Link. by SK affiliates	1.517	0.883	0.003	4.92

Source: Korean data is from Export-Import Bank of Korea and Bank of Korea. Non-Korea data in China is from Chinese Statistical Yearbook and China Industry Statistical Yearbook. All variables are in log term.

Table 2: Estimation after 1999

	(1)	(2)	(3)	(4)	(5) Aggregation	(6) Non-*Chaebol*
Agglomeration	1.061	0.712	0.46	0.53	0.445	0.486
	[0.070]***	[0.073]***	[0.172]***	[0.167]***	[0.177]**	[0.183]***
Agg. by SK affiliates		0.766	0.348	0.315	0.571	0.345
		[0.049]***	[0.087]***	[0.086]***	[0.147]***	[0.091]***
Forward Linkages			0.162	0.214	0.283	0.121
			[0.366]	[0.362]	[0.305]	[0.383]
Backward Linkages			0.066	-0.261	-0.271	0.05
			[0.424]	[0.391]	[0.354]	[0.443]
For. Link. by SK affiliates			0.469	0.563	0.501	0.492
			[0.140]***	[0.135]***	[0.243]**	[0.145]***
Back. Link. by SK affiliates			0.542	0.55	0.206	0.506
			[0.134]***	[0.130]***	[0.244]	[0.139]***
Market Potential				3.491		
				[3.738]		
High School Graduates				0.099		
				[0.610]		
Wage rate				6.946		
				[1.240]***		
Economic Zones				1.649		
				[0.638]***		
Province dummy	no	no	no	yes	no	no
Province & Year dummy	yes	yes	yes	no	yes	yes
No. of choices	25	25	25	25	25	25
No. of investors	4264	4264	4264	4264	4264	4028
Pseudo-R2	0.37	0.38	0.38	0.37	0.37	0.39
Log-likelihood	-8686.2	-8561.67	-8543.01	-8651.49	-8599.23	-7964.03

Source: Korean data is from Export-Import Bank of Korea and Bank of Korea. Non-Korean data is from Chinese Statistical Yearbook and China Industry Statistical Yearbook. Distance is from Yahoo.com. All variables except for dummies are in log term. Standard error is in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 3: Estimation after 1992

	(7)	(8)	(9)	(10)	(11) Aggregation	(12) Non-*Chaebol*
Agglomeration	0.879	0.655	0.481	0.219	0.44	0.587
	[0.097]***	[0.097]***	[0.160]***	[0.132]*	[0.160]***	[0.172]***
Agg. *D(year>= 1998)	0.18	0.066	0.046	0.405	0.091	0.017
	[0.119]	[0.119]	[0.119]	[0.085]***	[0.118]	[0.128]
Agg. by SK affiliates		0.743	0.418	0.507	0.458	0.403
		[0.038]***	[0.067]***	[0.064]***	[0.106]***	[0.070]***
Forward Linkages			0.101	0.05	0.085	-0.162
			[0.304]	[0.297]	[0.264]	[0.322]
Backward Linkages			0.082	0.305	-0.011	0.258
			[0.353]	[0.269]	[0.293]	[0.373]
For. Link. by SK affiliates			0.338	0.205	0.326	0.357
			[0.105]***	[0.097]**	[0.178]*	[0.111]***
Back. Link. by SK affiliates			0.457	0.3	0.316	0.447
			[0.101]***	[0.093]***	[0.189]*	[0.106]***
Market Potential				1.247		
				[0.626]**		
High School Graduates				-0.105		
				[0.226]		
Wage rate				0.074		
				[0.330]		
Economic Zones				0.395		
				[0.148]***		
Province dummy	no	no	no	yes	no	no
Province & Year dummy	yes	yes	yes	no	yes	yes
No. of choices	25	25	25	25	25	25
No. of investors	6863	6863	6863	6863	6863	6307
Pseudo-R2	0.35	0.36	0.36	0.35	0.36	0.37
Log-likelihood	-14260.2	-14061.86	-14042.03	-14319.27	-14145.29	-12715.11

Source: Korean data is from Export-Import Bank of Korea and Bank of Korea. Non-Korean data is from Chinese Statistical Yearbook and China Industry Statistical Yearbook. Distance is from Yahoo.com. All variables except for dummies are in log term. Standard error is in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 4: Robustness

	1999-2004				1992-2004			
	(4)	(13)	(14)	(15)	(10)	(16)	(17)	(18)
Excluding		Shandong	Northeast	Municipalities		Shandong	Northeast	Municipalities
Agglomeration	0.53	0.575	0.758	0.443	0.219	0.266	0.331	0.276
	[0.167]***	[0.198]***	[0.188]***	[0.199]**	[0.132]*	[0.152]*	[0.165]**	[0.153]*
Agg. by SK affiliates	0.315	0.404	0.272	0.249	0.507	0.494	0.506	0.499
	[0.086]***	[0.105]***	[0.100]***	[0.097]**	[0.064]***	[0.079]***	[0.076]***	[0.072]***
Forward Linkages	0.214	0.1	0.194	0.312	0.05	0.204	0.177	-0.022
	[0.362]	[0.452]	[0.392]	[0.432]	[0.297]	[0.369]	[0.343]	[0.349]
Backward Linkages	-0.261	-0.127	-0.643	-0.246	0.305	0.118	-0.522	0.52
	[0.391]	[0.458]	[0.420]	[0.468]	[0.269]	[0.320]	[0.338]	[0.317]
For. Link. by SK affiliates	0.563	0.382	0.623	0.717	0.205	0.197	0.318	0.216
	[0.135]***	[0.163]**	[0.155]***	[0.158]***	[0.097]**	[0.119]*	[0.117]***	[0.110]*
Back. Link. by SK affiliates	0.55	0.636	0.413	0.457	0.3	0.333	0.113	0.289
	[0.130]***	[0.168]***	[0.155]***	[0.146]***	[0.093]***	[0.118]***	[0.114]	[0.103]***
Province dummy	yes	yes	yes	yes	yes	yes	yes	yes
No. of choices	25	24	22	22	25	24	22	22
No. of investors	4264	2571	3583	3464	6863	4400	5312	5570
Pseudo-R2	0.37	0.28	0.43	0.45	0.35	0.28	0.42	0.43

Source: Korean data is from Export-Import Bank of Korea and Bank of Korea. Non-Korean data is from Chinese Statistical Yearbook and China Industry Statistical Yearbook. Distance is from Yahoo.com. All variables except for dummies are in log term. Standard error is in parentheses. All specifications include market potential, wage rate, the ratio of high school graduates, and the number of economics zones. * significant at 10%, ** significant at 5%, *** significant at 1%.