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Contagion Effects of the Sequential FDI Trajectory: A Social Network Analysis

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摘 要

本研究藉由社會網絡分析法，研究台灣高科技業廠商到中國大陸連續性投資區位的選擇動機。透過將台灣高科技業廠商投資大陸的連續性行為視為一網絡概念，本研究應用網絡分析中的感染效應來說明台商連續性海外投資行為的網絡擴散效果，分別以凝聚模型來分析廠商下一個投資據點與現有的投資據點之互補性動機，以及透過結構對等模型來說明廠商下一個投資區位與現有投資區位的競爭性考量。研究蒐集 1996 至 2006 年 268 家台灣高科技業廠商到中國大陸的投資路徑與相關財務資料，以及中國大陸各投資區域的總體經濟數據。研究結果發現，台灣高科技廠商的連續性海外投資行為受到地域競爭性動機，以及各區域的其他外商對其投資經驗與基礎建設之影響。

【關鍵字】連續性投資、社會網絡、感染效應

Abstract

This study presents a quantitative method for illustrating the sequential FDI location choices within China by using methodologies derived from social network analysis. This method's numerous techniques and indicators offer many advantages by measuring the link between nodes to demonstrate the structural patterns of a connected system. We employed the 'contagion effect' on diffusions to explain FDI trajectory within a country. It is examined by two different models: the cohesion model, which is based on the diffusion by complementarities perspective, and the structural equivalence model, which is based on the diffusion by competitiveness perspective. We empirically tested a sample data of Taiwanese high-tech firms during the period from 1996 to 2006. Our analytical results showed that the Taiwanese firms' sequential FDI trajectory is influenced by the competitive locations of the same social positions and the regional characteristics of FDI information and infrastructure.

【Keywords】sequential FDI, social network, contagion effect

1. Introduction

Since Dunning pointed out the eclectic theory (Dunning, 1980), numerous studies of international business (IB) have viewed location choice as a critical issue of foreign direct investment (FDI) activities by multination enterprises (MNEs). Recently, the importance of location choices has been much addressed, especially in the rapidly change economies (Chadee, Qiu, & Rose, 2003; Mudambi & Navarra, 2003) since the trade and market liberalization around the world in the last two decades has presented new markets, resources and investment opportunities for MNEs. Therefore, choosing appropriate FDI locations is inevitable for firms to find foreign market opportunities in order to gain and sustain competitive advantage (Ramaswami, 1995). According to Dunning (1993), there are three main drivers for MNEs to curry out FDI activities: resources seeking, markets seeking and strategic assets seeking. These can be divided into two types: the first two drivers are primarily asset exploiting in nature (Galan, Gonzalez-Benito, & Zuniga-Vincente, 2007); that is, the FDI primary purpose is to generate complementary benefits through the use of existing assets. The third driver is a case of competitive perspective whereby the MNEs increase their competitive advantages by adding to their existing assets (Narula & Dunning, 2000). From this background we expect that differences in evaluating the location factors between complementary and competitive perspectives when firms choose their FDI location choices.

Though many investigations have studied location choices of MNEs, most have considered simply a choice between counties (Porter, 1996; Vernon, 1966). Studies of the location choices of foreign firms within the boarder of a given host country is lacking (Swamidass, 1990) and most have focused on developed industrial economics (Coughlin, Terza, & Arromdee, 1991; Mody & Srinivasan, 1998; Taylor, 1993). Until recently, researchers have experienced a growing recognition of the importance of international investment by firms from newly industrial economics (NIEs) in emerging market, especially in China but they still focused on the choices of countries. While the context of FDI in China has drawn increasing attention over these years (Beamish, 1993), a systematic analysis of location effects on the FDI activities within in China is almost non-existent. Therefore, this study focuses on the firms' FDI activities within different regions in China.

Despite increased investigations into location choices of a firm, we found that most of these studies are focus on the initial or single location choices and the characteristics of focused location. Foreign firms do not concentrate their investments in the same area because they appear to accord different weights to various location characteristics. Location

choices are usually the result of an ongoing effort involving various investment concepts. Any static analysis which is based on different samples of cross-sectional data may not capture the dynamic cause effect relationship between investment concepts and existing FDI activities within a specific country (Kotabe, 1993). Consequently, the most important factors in determining the location choices of MNEs are not only the timing and determinants of choice but also the "sequential dynamic process" (Mudambi & Navarra, 2003), which so far has not been undertaken to empirically analyze the sequential FDI trajectory.

Accordingly, the purpose of this study is to focus on the sequential FDI process in different regions within China. We take every region as an industrial cluster and explore the dynamic investment process by using social network analysis approach to answer this essential question: what drives a firm's sequential FDI trajectory in an emerge market?

In the interest of extending empirical research on sequential location choices within a country (China in our case), we examined how firms make decision regarding the sequential FDI process within a country by social network analysis (SNA) method. The intent was to see what role of the network proximity within a special region plays in terms of the aforementioned drivers of complementarities and competitiveness. SNA provides a well-developed set of methods for systematically examining the contagion effects of diffusion within a social structure. Although it is primarily developed by sociology, the indicators and techniques of network analysis are appropriate in order to examine the sequential features of multiple location choices for MNEs. In this study, we employ two models which illustrate the contagion effect, the cohesion model and the structural equivalence model; these indicate the diffusion of location choices made by MNEs. The cohesion model focuses on how complementary resources or locations affect a firm's location choice, and the structural equivalence model focuses on the competitive location strategy.

By using a sample of 268 Taiwanese high-tech firms that have more than one FDI activity active within 20 regions in China, we have attempted to construct a network composed of 20 regions and contribute to the network contagion effect in three ways: first, we shed some light on the effect FDI location decision have on regional perspectives within a country. In addition to traditional location choice research that focuses on the driver and determinants of a single location selection, this study pointed out the sequential FDI trajectory by applying a dynamic perspective. Finally, we introduced SNA measurements and models in order to support the view that social network analysis can be a useful methodology when studying the external mechanisms and internal factors which affect the FDI location choices of MNEs.

The remainder of this study is structured as follows: first, a review of relevant literature is followed by the development of research hypotheses. Following this, the research methodology is described, followed by the empirical results. Finally, our findings are described, followed by the conclusions derived from our research, a discussion of the limitations of the research and possible topics for future study.

2. Theoretical Background

This study explored how social proximity and the characteristics of a region will affect the sequential FDI trajectory of MNEs within a country. We first reviewed the factors determining of location choices and introduced the sequence of location entry. We then explained how to adopt the SNA approach to determine how social positions drive the location choices by acknowledging the network effects of the cohesion, structural equivalence and autocorrelation models.

2.1 Location Choices

Location has been a key consideration for FDI activities (Dunning, 1993; Porter, 1996). The IB literature has a long tradition in examining the nature of some of the determinants for these foreign location choices (Buckley & Casson, 1976; Dunning, 1988; Johanson & Vahlne, 1977). The relevant literature has emphasized market-related factors (Agarwal & Ramaswami, 1992; Buckley & Casson, 1976; Brouthers & Brouthers, 2000), cost-related factors (Loree & Guisinger, 1995; Cheng & Kwan, 2000), host country characteristics (Dunning, 1998; Chung, 2001) and government policy (Dunning, 1998; Delios & Beamish, 1999) as major complementary factors that MNEs should consider before selecting target locations. Recently, international locations have gained additional strategic importance as sources of competitiveness (Dunning, 1998; Dunning & Lundan, 1998; Porter, 1996). Dunning (1993) offered three key determinants for the choices of location for FDI: (1) resource seeking, (2) market seeking, and (3) strategic asset seeking. The first two factors determining location choices tend to benefit MNEs by providing unique or efficient complements to existing assets within a given location. The last driver benefits firms by increasing their competitive advantages by protecting or augmenting that advantage through the acquisition of new assets (Dunning, 1998). These locational preferences of MNEs have lead to subsequent studies identifying the important roles of location factors in FDI.

In this study, drawing on Dunning's (1993) work, we built on two aspects, one based

on the complementary perspective and the other on the competitive perspective, to develop a conceptual framework for explaining the host country factors that determine MNEs location choices. The complementary perspective highlights the influence of factors directly linked to the supply-side benefits of the regions as the main driver of the location choices. In contrast, the competitive perspective tends to emphasize strategic considerations of the conditions within the host country and how they are likely to affect the operations of MNEs.

2.2 The Sequential FDI Trajectory within a Country

Based on learning perspectives, firms learn from previous mistakes and revise their expectation (Johanson & Vahlne, 1977; Tan & Vertinsky, 1996) which in turn increasing the probabilities of their investment within a country in terms of past experiences rather than looking to invest in other countries (Davidson, 1980). Thus, firm's sequential FDI trajectory may influence its next location choice. When firms invest and acquire knowledge within a country, they may have motivation to invest in other regions in the same country. Accordingly, a within-a-country level of location choice needs a more fine-grained analysis of regional differences, and may provide accurate evidence of FDI decisions based upon location determinants.

Every country possesses its political, economic and social conditions. The national characteristics of government regulations, economic growth, employee demographics, technology and infrastructures will affect decisions of FDI activities. However, regions within a country also possess unique characteristics that provide competitive advantage for MNEs' FDI activities (Mody & Srinivasan, 1998; Chadee et al., 2003). In particular, large countries have more diverse economic and social conditions. Entering such foreign markets with cultural and institutional environments that differ from those of the home market involves many risks. Thus, we should recognize that the regional differences within a country may also influence the location of FDI (Mody & Srinivasan, 1998; Taylor, 1993). Recently, some research has shifted from a focus on location choice in different countries to a focus on investigating location determinants a within a single country (Hill & Munday, 1992; Kotabe, 1993).

In addition to the within-a-country level considerations of location, recent studies have also begun to explore how firms choose their FDI locations and what determinants affect their sequential FDI process. Firms have intrinsic disadvantages in competing with local firms in foreign markets. Drawing on the process of internationalization, Johanson and Vahlne (1977) indicated that internationalization of the firm should be interpreted as an

incremental learning process. Investing abroad is inhibited by a lack of knowledge regarding local markets, but such knowledge can be acquired through experience gained from practical operations abroad (Forsgren & Johanson, 1992). From the growth theory perspectives, Jovanovic (1982) also modeled the expansion of firms by using an adaptive learning process. He argued that firms learn about their efficiency more gradually under conditions of uncertainty and thus tend to enter FDI on a relatively small scale, and subsequently increase their investment commitment as their improved efficiency indicates possible success. For this reason, MNEs have to accumulate knowledge in order to survive, and become repositories of skills that are unique and often difficult to imitate (Huzchenreuter, Pedersen, & Volberda, 2007). Market-specific knowledge of particular national markets can be gained from experiences gained in a specific market within a specific country; this knowledge may not be easily transferred to investing in other countries. Each country has its own unique resource endowments and location-specific advantages, which may not be available in the home country. By incrementally developing local operations, MNEs will become familiar with the host country's specific endowments. This will also motivate MNEs to increase investments there in order to explore advantages and augment competitiveness in both its home and host markets (Kogut & Chang, 1991). Thus, more and more MNEs choose to invest serially in a single country (Huzchenreuter et al., 2007).

Studies from an organizational learning perspective also emphasize that a firm's subsidiaries in host countries can help to enhance its knowledge base, capabilities, and competitiveness through experiential learning (Barkema & Vermeulen, 1998; Delios & Henisz, 2000; Zahra, Ireland, & Hitt, 2000). Tan and Vertinsky (1996) indicated that the uncertainty of associated with FDI will be reduced over time, and as a result of international investment experiences. Drawing on the sequential investment in the U.S. by Japanese electronics firms, Chung and Song (2004) pointed out that firms tend to invest the same locations that they have previously invested in, in order to explore the experiences and to gain competitive advantages. Additionally, geographic diversification scholars argued that MNEs can obtain economies of scale and scope (Caves, 1982) from sequential expansion, especially within a country. Investment within a single country helps firms reduce fluctuations in revenue by reducing investment risks over different countries (Kim, Hwang, & Burgers, 1993); it can reduce costs and increase revenue by increasing a firm's market power over its suppliers, distributors, and customers. It may also lower costs by enabling arbitrage of difference in input and output markets (Hennart, 1982). Thus, market-specific experiences from a sequential investment trajectory will influence the firm's decision

pertaining to foreign location choices.

Not only are investigations of FDI within-a-country lacking, but empirical studies devoted to sequential FDI trajectories within a country are also rare. Prior studies have focused on the sequence in which a firm moves from one country to another. This study instead emphasizes the location choice within a country from a social network perspective, exploring the influences of contagion effects and local effects.

2.3 Sequential Location Choices from Social Network Analysis Perspective

SNA derived from graph theory, attempts to describe the structure of relations between given entities, and applies quantitative techniques to produce relevant indicators and results for studying the characteristics of a whole network and the position of individual within the network structure. Following this concept, this study aimed to explain the sequential FDI trajectory within a country by using a SNA approach. This is based on a diffusion process focusing on similarities of network position (Harkola & Greve, 1995) in order to explore the structural characteristics of FDI locations within a country. One of the essential characteristics of a sequential FDI trajectory within a country is the nature of its multiple location choices, as each focal firm develops its own investment path. By using the measurements of a SNA approach, we consider all the investment locations in China as a network structure, where the regions are treated as nodes and the amount of foreign investment is considered as a series of links.

Furthermore, this study elucidates the diffusion process of sequential FDI trajectory within a country, in particular through contagion effects. In R&D management studies, contagion effects arise from people proximate in social structure and using one another to manage the uncertainty of innovation (Burt, 1987; Harkola & Greve, 1995; Degenne & Forse, 1999) which is based on the interpersonal synapse when innovation is transmitted. They emphasize the interaction between the developer and the user of new technology to enhance the development process (Harkola & Greve, 1995) and indicate the social influence of interaction on the diffusion process. In this paper, we consider sequential FDI trajectory within a country is a diffusion process which is a series of location decisions influenced by a social proximity system over time. Since the measurements and models of SNA are highly appropriate for applications exploring the diffusion behaviors (Burt, 1982, 1987; Harkola & Greve, 1995), we believe that the application of the social contagion effect can still correspond to a study of sequential on FDI trajectory.

And there are two criteria used to examine which social structural circumstances lead

one actor's behavior to motivate that of another in adopting a similar behavior: cohesion and structural equivalence (Burt, 1992; Degenne & Forse, 1999). The cohesion model explains that the social proximity of a previous actor influences the likelihood of a potential actor's subsequent adoption of decisions as a result of their direct interaction (Harkola & Greve, 1995). The structural equivalence model indicates that actors possessing the same network position will be affected by each other. An actor will quickly adopt an innovation after perceiving to be structurally equivalent to it has adopts it (Burt, 1982). Accordingly, in this paper, we indicate a sequential FDI trajectory is a series of location choice resulting from the focal firm's experiences and the source of industrial information. Choosing a FDI location is risky and uncertain. Studies have indicated that imitation among different firms may be driven by a similar or successful firms' entry into new markets as a means of avoiding FDI risk and uncertainty (Haveman, 1993). Following the behaviors and strategies of similar firms can provide focal firms with more solid and convincing resource use patterns. Therefore, we have employed the cohesion model to explain that when a focal firm decides to choose its next FDI location, it will follow its direct interaction or information coming from its complementary partner; otherwise, a focal firm will perceive its network position as maintaining a competitive advantage. Therefore, in this study, we employed SNA to examine the social contagion effect of two models that make them socially proximate, such that the investment of MNEs in one region would trigger firms to invest in other regions.

3. Hypotheses Development

3.1 FDI Location Choice: The Complementary Perspective

Applying the concept of complementary assets (Teece, 1986), complementary location choice may explain as the following location choice needed to support the successful of previous location choice, rather than make location decision independently. The location choices of firms have generally been the domain of economic geography. In accordance with this theory, specific efforts have been made to identify the factors that lead to the clustering of economic activity in a particular space. This is seen as an outcome of the benefits of the availability of specialized local resources, labor, suppliers, shared knowledge and collective learning, that have become embedded in a particular locality (Scott, 1998). Agarwal and Ramaswami (1992) pointed out that when firms choose their overseas investment strategies, they consider the factors of ownership advantages, geographic advantages and internalization advantages. The most important factor is geographic location because this will shape market advantages. Most geographic location advantages are inherent; they have

specific influences on transactions, specialization and growth. Once a firm chooses a specific geographic location, it will be difficult to change the decision; therefore, it is crucial for a firm to choose an appropriate geographic location.

Isard (1960) pointed out that firms choose FDI strategies in order to obtain optimal production conditions and reduce production cost. Successful outcomes will influence other firms to invest in the same locations with identical investment modes; these locations will then become agglomeration economies. The industrial cluster is a kind of agglomeration economies (He, 2003); meaning firms in the same or related industries operate in the same region. The industrial cluster affects price factors by means of area differentiation (Knarvik & Tvedt, 2000) and influences the process differentiation and the technology development of an industry in order to obtain competitive advantages. Firm within the industrial cluster will share the benefits, such as increasing the volume of production, reducing production cost, having economics of scale advantages. Thus, forming such scale and regional economics will reduce costs, and attract more investment from supply chain partners for investment overseas.

Prior studies have showed that firms are likely to locate new plants close to those similar with industrial activities (Head, Ries, & Swenson, 1995). In particular, the benefits of industrial clustering for the semiconductor industry have been focused on the semiconductor industry in the Silicon Valley (Porter, 1990). The benefits of industrial cluster resulted from informal local information spillovers (Jaffe, Trajtenberg, & Henderson, 1993; Almeida & Kogut, 1997) and a highly qualified and highly flexible local labor market.

Consequently, when firms consider their location choices abroad, they are influenced by local industrial cluster and their supply chain partners. It's difficult for firms to change their location at random because of hold-up costs. Therefore, when firms are concerned about choosing the best sequential investment location, they prefer to choose places that offer support, i.e. the locations receive materials to process or are well positioned to sell the final product. In order to overcome the liabilities of foreignness and to reduce uncertainty, when firms choose a new location within a country, they prefer to track down locations which already support the same or related industry types.

The cohesion model focuses on socialization between ego and alter (Burt, 1987, 1992), predicting how social proximity of previous and potential users can influence the possibility of potential users, eventually deciding to locate close to existing, similar industrial sites (Harkola & Greve, 1995; Degenne & Forse, 1999). The more frequent and empathic the communication between ego and alter, the more likely it is that alter's behaviors will trigger

ego's. The process of social influence is considered as a function of social proximity, or communication between ego and alter, where cohesion explains the social influence (Mizruchi, 1993). Individuals who are confronted with ambiguous information about one thing rely on trusted people to discuss its merits (Harkola & Greve, 1995). The process of social influence is fostered by face-to-face interaction and short communication channels through intermediaries (Friedkin, 1984); thus, information is diffused by interaction in cohesive social groups. In this study, we take each region as an industrial cluster which is composed of a focal firm's suppliers, customers and competitors. The cohesive effect means that when a focal firm concerns itself with complementary resources and skills, its location choice strategy will be influenced by its suppliers, customers or competitors. Therefore, the cohesion model can argue that spatial proximity affects the location and suggest the following hypothesis:

Hypothesis 1: The firm's sequential FDI trajectory is influenced significantly and positively by complementary determinant.

3.2 FDI Location Choice: The Competitiveness Perspective

Studies on the socialization process have long focused on direct contact and interaction among people. Lorrain and White (1971) proposed an alternative idea to predict people's behavior: structural equivalence. It highlights competition between the ego and alter (Burt, 1987; Degenne & Forse, 1999). The more similar ego's and alter's relations with other persons are (i.e., the more that alter could substitute for ego in ego's role relations, the more intense ego's feelings of competition with alter will become), the more likely it is that ego will quickly adopt any behavior perceived to make alter more attractive as the object or source of relations. As defined by Lorrain and White (1971), two people are structurally equivalent, if they have identical ties to and from all others in the social system. Unlike the cohesion model, the structural equivalence model predicts that two people identically positioned in the influential communication flow use each other as a frame of reference for subjective judgments, leading them to make similar judgments even if they have no direct communication with each other (Burt, 1982; Koka, Prescott, & Madhavan, 1999).

Burt (1983) provided two theoretical arguments for expecting similarity among structurally equivalent actors. One is the socialization argument suggesting that actors share similar behaviors because they tend to interact with other similar actors in the same manner. Therefore, they face similar socialization by acting on similar information, requests, demand and so on. The other is a symbolic argument which explains that actors are likely to model

themselves on each other, that is, to put themselves in each other's position before demonstrating particular behaviors. Since the social context and the information obtained by the actors are identical, they arrive at similar conclusions leading to shared perceptions and opinions (Galaskiewicz & Burt, 1991). Under such conditions, social actors may seek to cope with uncertainty and ambiguity by imitating the attitudes and behaviors of those with whom they are in contact, resulting in further similarities in attitudes (DiMaggio & Powell, 1983).

According the preceding described, in this study, the sequentially equivalent locations can be viewed as those that have the same tangible and intangible assets, information and conditions. Because they possess similar resources, structurally equivalent regions compete with each other (Koka et al., 1999). From the learning perspective, with each entry firms learn from past mistakes and revise their expectations. They attain related knowledge from the invested location, especially when investing abroad. In order to reduce uncertainties and increase the operation's efficiency, when firms choose investment locations, they tend to invest in places similar to those where they have successfully invested in the past.

Yu and Ito (1988) pointed out the concept of oligopolistic reaction contributions to explain a firm's FDI activities. In an oligopolistic industry, firms are few enough to recognize the impact of their actions on their rivals (Caves, 1982), because they are mutually interdependent, they avoid intense competitions. Knickerbocker (1973) investigated competitive behavior in FDI and proven that imitative behaviors occur in concentrated industries; therefore, the oligopolistic reaction on FDI for firms in the same country should be taken into account when determining location choices. Regarding a firm's location choice decision, if the locations are structurally equivalent, in order to obtain the oligopolistic advantages, a firm will choose to extend its investment to those locations to avoid losing bargaining power. According to the argument of structural equivalence, this study thus hypothesizes:

Hypothesis 2: The firm's sequential FDI trajectory is influenced significantly and positively by competitiveness determinant.

3.3 FDI Location Choice: Comparison between the Complementary and Competitiveness Perspectives

According to social network theories, if contagion effects exist, then the attitude and behavior of individuals should be similar to that of others who are socially proximate to them. The cohesion and structural equivalence models propose two different contagion

mechanisms resulting from the distinguishing explanation of social proximity. The cohesion model argues that the level of social proximity of two individuals depends on the closeness of communication and interaction between them, while the structural equivalence model argues that the level of social proximity of two individuals is based on the extent to which they have identical relations with all other individuals in the network, even if they have no direct communication with each other. The most appropriate contagion mechanism to predict similar behavior between individuals depends on their social context, so the issue is empirical. However, the research results of Burt (1987), Galaskiewicz and Burt (1991), and Harkola and Greve (1995) all demonstrated that behavior is predicted better by network position than by interactions with others. Hence, if Hypotheses 1 and 2 are supposed, the two contagion models can be compared, leading to the following hypothesis:

Hypothesis 3: The sequential FDI trajectory adopted between those firms with the social proximity of structural equivalence is better than that between firms with social proximity of cohesion.

3.4 FDI Location Choice: The Regional Endowment Perspective

Additionally, opinion and behavior are not solely determined by others (interaction effects), but also by reaction to various other constraints and opportunities granted by the actor's conditions (local effects). In sociology, this type of process is typically modeled as an autocorrelation model (Leenders, 2002). Ego's behaviors may meanwhile be affected by discussing with alters, depending upon ego's status, income, education and so on. Thus both interaction and local effects do exert influences in the diffusion process.

Previous of international business literature has investigated the importance of host country characteristics in the internationalization decisions of MNEs (Dunning, 1988; Porter, 1990) that contributed to a firm's decision to locate in a particular geographic location. Dunning (1988) argued that firms will invest in foreign markets because of the ownership, location, and internationalization advantages (OLI). Location advantages include lower input prices, available resources, and other potential benefits derived from the geographic location of investment. In addition, government restrictions such as tariffs and quotas, as well as transportation costs, could provide incentives for FDI. Researchers have indicated that ownership and internalization are less relevant than the location factor (McCann & Mudambi, 2004; Doh, 2005); these two advantages can erode through the transfer and disintegration of production stages in relocating to other countries, while location advantages are still relevant. The location advantages emphasize a broader portfolio

of assets beyond lower input costs, available resources, or savings resulting from tariff avoidance. More specifically, these advantages may include quality workers, infrastructure, as well as cultural similarity.

Some empirical studies on location choice also pointed that companies should consider local characteristics in their location strategy. Drawing on the regional development factors of FDI in British, Hill and Munday (1992) pointed out that local infrastructure influences the FDI preferences of foreign firms. Research on FDI activities in China has also proven that local infrastructure has a positive influence on foreign investment in China (Hou & Zhang, 2001; Zhao & Zhu, 2000). Li (2004) indicated that the local employee is an important consideration in an investment strategy. We also believe that existing FDI information from other companies will influence a firm's investment choices. As investment abroad is very risky and uncertain, a high level of existing FDI could be interpreted as an indicator of less uncertainty, available support industries and human capital (Erramilli & D'Souza, 1995; Demirbag, Glaister, & Tatoglu, 2007). Based on these inferences, we hypothesize that:

Hypothesis 4: ***The firm's sequential FDI trajectory is influenced significantly and positively by local production.***

Hypothesis 5: ***The firm's sequential FDI trajectory is influenced significantly and positively by the FDI information.***

Hypothesis 6: ***The firm's sequential FDI trajectory is influenced significantly and positively by the local infrastructure.***

4. Methods and Measures

4.1 Data and Sample

4.1.1 Data Source

To examine the proposed hypotheses, the study collected FDI information from Taiwanese high-tech companies and information concerning the regional characteristics of China. The main source of FDI information were extracted from the database maintained by the Electronic and Information Technology sector on both stock markets in Taiwan in 2006 (the Taiwan Stock Exchange and the Taiwan Over-the-Counter Securities Exchange). The source of information for the region (i.e. provinces) characteristics of China was the annual publication China Statistical Yearbook 2007. The database is an annual statistical publication, which reports on economic and social development in China. It covers the year 2006 and key statistical data from the past thirty years as well as some historically important years both at the national level and the local level of provinces, autonomous regions and

municipalities directly collected by the Central Government of China (*China Statistical Yearbook 2007*).

Since this study focused on the FDI sequences trajectory of each sample firm, companies that had no foreign expansion were excluded from the analysis. Firms that had only one expansion location were excluded as well. The original data contained 328 firms; however, based on the sampling criteria, only 268 firms were targeted as the representive sample.

The rationale for the focus on Taiwanese high-tech companies as follows. First, Taiwanese high-tech firms have recently experienced rapid growth, with many firms having demonstrated outstanding performance. In regard to the total output of high-tech firms, Taiwan is the fourth largest producer of electronic and information hardware products globally. Compared with other Taiwanese industries, the high-tech industry invested maximally abroad, especially in China. From 1996 to 2006, the total investment ratio of Taiwanese high-tech companies in China is added up to 30% and in 2000, the investment of high-tech firms peaked at 50%. Second, due to increasing costs, competition forced companies in the Taiwanese high-tech industry to invest overseas in order to obtain the low cost labor and materials. On the other hand, since the Chinese government announced their "open door" policy, many MNEs, increasing many Taiwanese firms, increased investment in China. The high-tech industry integrated many segments that composed supply chains. In order to gain related complementarities, Taiwanese high-tech firms had to fellow their suppliers by investing in China. Finally, according to our data, we found that Taiwanese high-tech firms not only invested in China but also invested serially in many regions of China. For example, Foxconn Electronics Inc. invested 42 times in 14 different regions during the period 1990 to 2006. Therefore, for the purposes of this study, Taiwanese high-tech firms comprised a relatively significant sample for the target industry concerning investment abroad.

4.2 Variables and Measures

4.2.1 Dependent Variable

The dependent variable in examining the sequential FDI behaviors is the total amount of Taiwanese firm which invested in China in 2006. The data was collected from the *China Statistical Yearbook 2007*.

4.2.2 Contagion Effects

Burt (1987) addressed the theoretical arguments for cohesion and structural

equivalence, highlighting the empirical circumstances in which they could contradict one another; these were then used to re-analyze Medical Innovation, a sociological classic first studied by Coleman, Katz, & Menzel, (1966) and then frequently cited as evidence of social contagion in the diffusion of technological innovation. Burt (1987) proposed a formal theory to derive the predictions of social contagion by cohesion versus structural equivalence, and constructed a general equation for this purpose. This study employs Burt's social contagion model to examine contagion effects in the sequences of location choices among firms. The equation can be formulated as:

$$y_i = \alpha + \beta\left(y_i^*\right) + \varepsilon$$

$$\text{where} \quad y_i^* = \sum_j w_{ij} y_j , \quad j \neq i. \tag{1}$$

$$\text{where} \quad w_{ij} = \frac{\left(proximityitoj\right)^v}{\sum_k \left(proximityitok\right)^v}, \quad k \neq i.$$

Here, y_i denotes the extent to which the investment amount that Taiwanese high-tech firm invested in region *i*; ε is a residual term, and y_i^* represents the investment norm of region *i*, defined as the expected response of region *i* based on the responses of the other regions defining the investment sequence frame of reference for evaluation of region *i*. That is, y_i^* is the expected amount of a firm's foreign direct investment in region *i*, which is calculated from the weighted combination of the y_j of other regions. Weight w_{ij} measures the ratio of region *i*'s proximity to region *j* relative to *i*'s proximity to all other regions, excluding *i* itself, in the studied investment sequence. The extent to which ego is conservation in relying on others is given by the integer value of the exponent ν. Burt (1987) reviewed related research, finding that the ideal value of ν obtained from cohesion norms is 1, and that the value obtained with structural equivalence norms ranges from 1 to 15. Consequently, the extent that contagion affects region *i*'s response to foreign direct investment make β significantly greater than zero (Burt, 1987).

Network analysis uses matrices to represent information concerning the relationship among nodes. The weight matrix *W* represents the contagion effects that are assumed to be present in the investment sequence frame, and can be constructed by either the cohesion

model or the structural equivalence model. Cohesion and structural equivalence models of contagion effects in Eq. (1) can be tested by manipulating the proximity measurement of the weight matrix *W*. If proximity is measured by the value of the sequential FDI trajectory behaviors that firms considered from region *i*'s to region *j*, then w_{ij} operationalizes cohesion, and y_i^* represents the normative response expected from region *i* reflecting the inflow and outflow investment behaviors of the sequential process of region *i*. If proximity is measured in terms of the similarity in each region's relations with regions *i* and *j*, then w_{ij} operationalizes structural equivalence, and y_i^* denotes the normative response expected from region *i* reflecting the investment behavior of the competitive positions of region *i*. The associations between y_i and the alternative definitions of y_i^* indicate the extent to which social contagion has an effect on the inflow-outflow investment process and the extent to which it is driven by cohesion versus structural equivalence (Burt, 1987).

The inflow-outflow table representation of an investment sequential behavior is similar to the topological network models of a social structure (Knoke & Kuklinski, 1982; Burt, 1983). The fact that regions have large sequential investment values among them means that they are cohesive groups within a country, while the fact that regions demonstrating similar characteristics have similar patterns of sequential investment behaviors with firms invested in other regions, indicates that they are structurally equivalent within the industry.

The inflow-outflow table uses a matrix to denote the sequential investment value among regions within a country. The row data represents the sequential trajectory of each region inflow to every other region, while the column data denotes the outflow amount of the investment frequencies from every other region. Hence, if the weight matrix *W* is measured based on the normalization of collected data, the operation corresponding to the study of sequential FDI process behavior represents the contagion effect; if this results primarily from the influence of the relationship of regions, the weighted w_{ij} should be constructed as:

$$W_{ij} = \frac{\left(Z_{ij} + Z_{ji}\right)^{v}}{\sum_{k}\left(Z_{ik} + Z_{ki}\right)^{v}}, \quad k \neq i.$$

Where Z_{ij} denotes the value of investment inflow from region *i* to region *j*, and Z_{ij} denotes the value of investment frequency received from region *i* to region *j*. The summation is the sum of sequential value and investment frequency between region *i* and region *j*.

In the structural equivalence model, two regions are considered as structurally

equivalent if they have identical investment patterns with other regions within a country. Sociologists generally use Euclidean distance to measure degrees of structural equivalence, with zero describing perfectly equivalent network actors, and with the value increasing base on the extent to which two actors are involved in different relation patterns, they are therefore far apart in the social topology of the network (Burt, 1988). Region *i* and *j* are structurally equivalent within a country if the Euclidean distance d_{ij} between their respective country network positions is zero. The Euclidean distance between regions *i* and *j* is formally defined as:

$$d_{ij} = \left[\sum_k \left(\frac{Z_{ij}}{R_i} - \frac{Z_{jk}}{R_j} \right)^2 + \sum_k \left(\frac{Z_{ki}}{C_i} - \frac{Z_{kj}}{C_j} \right)^2 \right]^{1/2}, \quad i \neq j \neq k.$$

Where R_i denotes the sum of sequence across regions in row *i* of the inflow-outflow table, and C_i denotes the sum of received frequencies by region *i* in column *j*. In other words, two regions are structurally equivalent ($d_{ij} = 0$) if they received identical investment frequencies from every other region as inflow investment behaviors ($Z_{ki} / C_i = Z_{kj} / C_j$), and invested identical location modes to every other region as outflow investment behaviors ($Z_{ik} / R_i = Z_{jk} / R_j$) (Burt, 1988). The structural equivalence investment norms can be measured from the above-defined Euclidean distance among regions studied in China. Burt (1982, 1987) defined the weight w_{ij} of the structural equivalence model as:

$$W_{ij}^{SE} = \frac{\left(d\max_i - d_{ij} \right)^v}{\sum_k \left(d\max_i - d_{ik} \right)^v}, \quad k \neq i.$$

Where $d\max_i$ denotes the largest distance between region *i* and any other sector within a country. The proximity of hypothetical region *i* to *j* can be expressed as the extent to which d_{ij} is smaller than dmaxi, that is $d\max_i - d_{ij}$.

4.2.3 Autocorrelation Model

Opinions and behaviors are determined not only by the interaction effects, but also by reaction to various other constraints and opportunities granted by the actor's conditions (local effects). In sociology, this type of process is typically modeled as an autocorrelation model of the form. The equation is extended as:

$$y = \alpha + \beta\left(y^*\right) + \gamma(X) + \varepsilon$$

Here, $\gamma(X)$ denotes the intrinsic opinion which actors would display in the absent of social influence. The difference between interaction and local effects is reflected by the autocorrelation part (matrix *W*) and the exogenous part ($\gamma(X)$) (Leenders, 2002).

In terms of $\gamma(X)$, this study adopts *employee, FDI numbers* and *import and export amounts in region i* as variables of local production, FDI information, and local infrastructure. *Employee* is computed as the number of employees within region *i*. *FDI numbers* is a count of FDI firms in region *i*. Similarly, import and export values are defined as the total amount of transport in region *i*, as measured by the natural logarithm. All of these variables were collected from the *China Statistical Yearbook 2007*.

5. Results

Table 1 lists the correlation coefficients for all variables in the regression models whereas empirical results are presented in Table 2. We utilized the Variance Inflation Factor (VIF) to check for multicollinearity among independent variables. The mean VIF values for all models are under 10, indicating that multicollinearity is not a problem in the regression analysis (Hair, Anderson, Tatham, & Black, 1998).

TABLE 1 Pearson correlation matrix

Variables		1	2	3	4	5	6
1	Investment amount	1.000					
2	Cohesion	0.287	1.000				
3	Structural equivalence	0.733**	0.566**	1.000			
4	Local production	0.528*	-0.054	0.403	1.000		
5	FDI information	0.896**	0.450	0.775**	0.672**	1.000	
6	Local infrastructure	0.437	0.246	0.329	-0.026	0.323	1.000

** p<0.001; * p<0.05

The research hypotheses were tested by regression analysis based on the model in Eq. (1). The criterion for supporting the hypothesis was a standardized coefficient of regression analysis significantly greater than zero. Model 3 summarizes the analytical results of the cohesion effect. The first set of hypotheses relates to the relationship among firms based on the contagion effects of cohesion for sequential location choices. As shown in Model 1 and Model 3, the study found that the coefficient is negative and insignificant (t=-0.922, p>0.1), meaning that Hypothesis 1 based on the logic of the cohesion model, was not supported: the decision by a focal firm's sequential FDI trajectory would not be influenced by the

complementary location in a specific region. This result is obviously different to the prior studies that argued that a firm's investment overseas is frequently influenced by the company seeking complementary industries in a certain location (Dunning, 1998; Buckley & Casson, 1976; Globerman & Shapiro, 2003).

In contrast to the cohesion model, the empirical results of Model 1 and Model 3 imply that the structural equivalence model has positive and significant effects on the firm's location choice sequences (t=9.742, p<0.001). It revealed that two regions identically positioned in the similar structural equivalence, and thus functioning as competitors, use each other as frames of reference for subjective judgments. This would affect a firm's FDI trajectory even if they have no direct relationships with each other. Thus, the analytical results support Hypothesis 2.

However, to test whether a firm's sequential FDI trajectory adopted between firms with social proximity of structural equivalence, is more similar than that between companies with social proximity of cohesion, that is, Hypothesis 3, we first have to see whether or not the former two hypotheses' coefficients are significantly greater than zero. As Model 1 and Model 3 show, the cohesion model hypothesis is not as significant as we predicted, it means the structural equivalence model produces a more significant contagion effect than the cohesion model on the sequential FDI trajectory of Taiwanese high-tech firms. This means that when Taiwanese high-tech firms consider their sequential investment locations, they are triggered more by competitive locations with the same social positions than the complementary locations in specific regions.

TABLE 2 Multiple regression model

Variables	Dependent Variable:FDI amount of Taiwanese firms in 2006					
	Model 1		Model 2		Model 3	
	Beta value	T value	Beta value	T value	Beta value	T value
Cohesion	-0.188	-0.965			-0.053	-0.922
Structural equivalence	0.839	4.304***			0.671	9.742***
Production			-0.117	-0.785	-0.005	-0.070
Information			0.918	5.492***	0.338	3.632***
Infrastructure			0.112	0.880	0.129	2.724**
Model F	10.859***		23.018***		126.158***	
P value	0.001		0.000		0.000	
R^2	0.509		0.786		0.972	
Mean VIF	1.473		1.859		2.990	

*** p<0.001; ** p<0.05; * p< 0.1

As described, our results definitely differ from prior empirical studies that investigated a firm's location choice in China. We think there may be three reasons for this. First, unlike previous studies in firm level analyses, our analytical unit is a region, rather than using the firm's perspective to consider why it chose a focal location to invest, we looked within a country to determine the social proximity of companies to compare whether transaction costs or resource availability affects a firm's location choice. The regional perspective is also one of our contributions in this study. Secondly, most of the FDI from the high-tech industry, especially the Taiwanese firms specializing in OEM, suggested that low labor costs represent an important motivation behind their investments (Galan et al., 2007; Cheng & Kwan, 2000). Taiwanese firms are resource seeking; they consider the production costs more than the agglomeration effects. Consequently, if one region can provide the same resources, labor, markets, infrastructure, and political incentives like the region that the firms are already operating in, firms may choose locations, based on the learning effect and restructuring costs. That is, a firm can use its experience to invest in a region that is in the same social proximity in order to reduce the product cost; this may be a good incentive to a firm that seeks cost advantages. Finally, according to geographical proximity and close cultural links between China and Taiwan, Taiwanese firms have fewer entry barriers such as foreignness liabilities and entrance liabilities and adapt to the environment more easily, than do western firms (Chadee & Qiu, 2001). Thus in pursuit of the abundant supply of inexpensive labor in China, companies could disregard the agglomeration and find locations similar to their former locations. As a result, the same social position chosen by Taiwanese firms demonstrates that the structural equivalence model is more effective than the cohesion model.

Just as differences among countries may be critical determinants as to where MNEs decide to locate their overseas activities, there is reason to believe that regional distinctions within a country may also influence the locations of FDI (Taylor, 1993; Mody & Srinivasan, 1998). Models 2 and 3 represent the analytical results of local effects on a region's characteristics, that is, Hypothesis 4, 5 and 6 can be tested. Through observing the standardized coefficient, it appears the FDI information (t=3.632, p<0.001) and the infrastructure (t=2.724, p<0.05) of a focal region may have a positive and significant relationship on corporate investment behaviors. From such results, it is apparent that the local foreign investment environment and available transportation amenities would influence a firm's location choice in China. The results support the previous empirical studies that pointed out that the available physical infrastructure is an important incentive to a firm's FDI

location choices. They indicate that the infrastructure influences MNEs' decisions in estimating the expected cost of operations in a particular region, that is, the cost of moving raw and finished materials to and from production centers (Loree & Guisinger, 1995; Dunning, 1998; Cheng & Kwan, 2000).

Even so, as Model 2 and Model 3 show, the local effect of production is not significant (t=-0.070, p>0.1). This differs from studies that indicate firms seeking low labor costs invest overseas (Cheng & Kwan, 2000; Tahir & Larimo, 2004). We think this discrepancy may be due to our measurement methods. In our study, production was measured by the amount of a focal region's employee, while firms investing abroad for resource seeking, the labor resource means specialized labor that is characterized by individual that make industry-specific human capital (McCann & Folta, 2008). Workers with specialized skills benefit firms seeking efficiency and competitive advantages. Other, studies suggest measuring labor costs according to the average wage of each employee (Coughlin et al., 1991). Thus, in future studies, we suggest that researchers measure productivity by examining specialized workforces or wage costs.

After identifying the main contagion models and local effects, the influence of both can be tested to examine which one has greater influence on location choice sequences. The results show that the standardized coefficient measured by the structural equivalence model is larger than that based on autocorrelation effects (See Model 3). In summary, the study indicated that a firm's location choice sequence behaviors are influenced by structural equivalence effects and by the local effect of FDI information and transportation.

6. Discussion and Conclusions

This study extends the findings related to a firm's sequential FDI trajectory in a new context, the SNA approach. Applying Burt (1987) typology, we examined the impact of the contagion effect (cohesion model and structural equivalence model) and regional characteristics (production, FDI information and infrastructure) on a firm's location choice decisions. It addressed the location issue from a within-a-country perspective by examining the relationships among the regions' social proximity, characteristics and sequential location choices. The contagion effect illustrated by the cohesion model measured the influence of the sequential FDI trajectory by the complementary location within a specific region. Conversely, the contagion effect demonstrated by the structural equivalence model measures the influence of the location with the same social proximity. After analyzing the data of 268 Taiwanese high-tech firms, the study finds that: (1) The complementary location may not

influence a focal firm's location choice; (2) the location at the same social proximity may influence a firm's sequential FDI trajectory; and (3) the local characteristics, FDI information and infrastructure can also have a positive and significant effect on a firm's location decision.

In contrast with other research concerning location choices, we used a different, within-a-country perspective, to investigate how Taiwanese firms evaluate and select their sequential FDI trajectory when they invest in China. We suggest that the same social proximity of a region is a key factor for firms to consider in their FDI strategy. Thus, our findings can also provide local governments with data to assess their social proximity with other regions. In order to attract more foreign investment, local governments should refer to other provinces or cities, especially those at the same social proximity, find out why those regions can attract such investment and try to imitate them, and improve their own regional characteristics to attract investment. Moreover, we think that the SNA approach can apply not only within a country but between countries. It can provide governments with a method to compare their means of attracting foreign investment with those of other countries.

We suggest several issues for future study. First, future research could develop and incorporate more well-defined variables of local effect capable by offering more concrete and specific information about regional characteristics or attractions that might influence a firm's sequential FDI trajectory. Second, this study explored the relationship among the social proximity of regions, regional characteristics and a firm's sequential FDI trajectory from a within a country or regional perspective. We used our empirical results to suggest that regions measure their social proximity to each other and improve characteristics such as workforce, infrastructure and policy, in order to compete with other regions. We suggest that the SNA approach can also be used on a national level. Firms choose investment locations not only within a country but between countries; thus, country governments should determine their strengths and weaknesses by measuring their social proximities with the other countries and improving their characteristics to attract foreign investment.

Finally, this study also has some limitations. First, we adopted a database, the *China Statistical Yearbook 2007*, as our data source, and therefore, the measurements of variables were limited to the data availability. Secondly, while our study sample is representative of the population of high-tech firms in Taiwan, the theoretical model should be tested in other industrial settings to determine the generalization of findings; such efforts will strengthen the external validity of the theoretical model developed and tested in this study. Thirdly, in our study, we used the wholly Taiwanese-owned firms for our sample; we suppose IJV firms

may have different considerations when making the sequential FDI trajectory decision. Thus, we suggest future researches explore whether different entry modes have diverse effects on the location choices determined by using the SNA approach. The contributions of this study will encourage future research related to this important phenomenon.

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