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Thesis

The effect of diversity and proximity on agglomeration of multinational enterprise: Evidence from Yangtze River Delta in China

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The Effect of Diversity and Proximity on Agglomeration of Multinational Enterprise: Evidence from Yangtze River Delta in China

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Summary

Since the ‘Open door policy’ was implemented, competition between cities to attract foreign investment was becoming more and more crucial. Driven by this trend, local authorities prioritise their city development agenda on attraction of foreign firms to meet the demand from the global economic system. Through the circulation of knowledge flows, technology flows, and capital flows, cities acquire the nutrition from ‘Global pipelines’ and exchange the local knowledge with MNEs. Hence, economic activities and location attributes to some extent determine the spatial agglomeration of multinationals. The agglomeration of multinationals has meaningful implications for local development, because of the huge amount of foreign direct investment (FDI) operation undertaken by MNEs in all industries and services.

This study suggests to combine geographic proximity from FDI location theory and traditional location theory with agglomeration theory to explain the foreign firms’ agglomeration in the sector-region topic. There are some prerequisites need to clarify here. Knowledge flows are assumed to be acquired by co-located firms. Each cluster provides ‘open membership’ (knowledge sharing is transparent and noticed) to each firm. Firms that have higher degree of connectivity (many firms surrounding them) receive more knowledge from the network. In some models, firm size is not regarded as atomistic, and turnover will be used to capture firm-size. Geographically weighted measures are introduced to capture the effect of local clusters on MNE’s agglomeration. Through the use of different analytical techniques, the study examines the effect of diverse local sectors and proximity on the location choice of foreign firms. Furthermore, the study tests the effect in different conditions, with different bandwidths and firms’ turnover. Location factors are also included in the research framework.

This study provide an integrated location perspective on foreign and local firms, hopefully trigger the further discussion on co-agglomeration issues between different disciplines. Specifically, the discussion of logic behind foreign firm’s spatial decision is a contribution to existing knowledge body, such as whether relatedness of technology and different geographical proximity are the determinants to their spatial agglomeration. It also provides an empirical evidence from China to illustrate the emerging phenomena since China has already been the biggest FDI receiver in the world since 2014.

The research identified several findings: (1) significant county clusters are identified based on co-agglomeration of foreign and local firms. There are three significant clusters: Shanghai cluster, Suzhou cluster and Hangzhou clusters. The outlier clusters are different in Jiangsu and Zhengjiang province, there are several isolated significant clusters in northern Jiangsu, but a connected economic block exits in southern Zhejiang. (2) Spatial concentration of relatedness (within sectors) and unrelatedness (between sectors) Foreign firms prefer to locate in local clusters who own the similarity of technology and knowledge with them. What’s more, HT foreign firms tend to locate in HT and medium HT local clusters. (3) One firm’s medicine is another firms’ poison in attracting foreign firms. In the diversity agglomeration, some firms get benefit by co-locating with other firms, but some might be harmed by it. This argument is supported by the empirical researches in Netherlands, the heterogeneity of agglomerations on firm performance are strongly moderated by firms characteristics (Knoben, et al., 2015). (4) The U-relationship between foreign manufactures and local KI services agglomeration and proximity. (5)High speed railway station is strongly related to the locality of foreign firms.

The findings of the thesis will provide policy makers a clear picture of co-agglomeration patterns in Yangtze River Delta. In addition, local governments who adopts policy of encouraging FDI by foreign firms has a reference to conduct their spatial plan in their territories.

Keywords

Agglomeration; Geographic proximity; MNE

Acknowledgements

Abbreviations

ADB	Asian Development Bank
FDI	Foreign direct investment
GCC	Global Commodity chain
GIS	Geographic information system
GPN	Global Production Network
HT	High technology
ICT	Information and Communications Technology
KI	Knowledge intensive
MNE	Multinational Enterprise
OLI	Ownership, Location, Internationalisation

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Chapter 1: Introduction

1.1 Background

Competition between cities is becoming very intensive now. More and more local governments prioritise their city promotions to attract foreign investments to meet the changing demand within the global economic system (Wall et al., 2015). Based on that, the existence of a global firm network embeds and creates economic relationships at different and interrelated geographic scales (Henderson et al., 2002). Hence, economic activities and location attributes to some extent determine the spatial agglomeration of multinationals. The agglomeration of multinationals has meaningful implications for local development, because of the huge amount of foreign direct investment (FDI) operation undertaken by MNEs in all industries and services (McCann and Mudambi, 2005). Policy responses of local municipalities to these potential MNEs are becoming more important determinants of regional growth (McCann and Mudambi, 2004).

Although economic geographers and regional economists treat this topic differently but agglomeration and industrial location theory is their main concern.

Spatial concentration has generally been attributed to economies of agglomeration, but the nature of it is much richer. Duranton and Puga (2004) consolidate many empirical studies and set three dimensions of mechanism to formalise 'Sharing, matching and learning' in agglomeration. Intermediate goods flow between supplies and buyers; labour pooling occurs because of similar technologies between firms; forward and backward knowledge spillovers increase innovation capacity of firms. This mechanism leads to the emergence and maintenance of spatial agglomeration where similar or interlinked firms engage in production (Malmberg, et al., 2000, Page 305). In a broad sense, agglomeration economies could also be treated as urbanisation economies where all the sectors and urban characteristics are aggregated. Cities that provide good public services, have large consumer markets, contain many high-skilled talents and own technology related local firms are more attractive to foreign firms. Nevertheless, establishments of foreign firms compete and cooperate with local firms to some extent updates territorial outcomes.

Orthodox microeconomic location theory solely focuses on the choice of a specific location where their attributes have an influence on the transaction costs and revenue optimisation of firms. Firms in the same location will continuously change their relations with other firms to adjust market demand and their own operation cost, thereby leading to an intense local competition. However, the location theory seems unable to deal with the complexities of MNE location decision whatever it is from regional science (Brown and Rigby, 2011) or 'New Economic Geography'(Fujita and Thisse, 2002) or 'clusters' literature (Porter, 1998) because of MNE' hierarchy organisation itself. What's more, during the internationalisation process, the geographic relocation of activities within MNEs results in the changes of exciting spatial configuration (McCann and Mudambi, 2005), which is minimally captured by economic geography analysis. These are the theoretical challenges coming from the spatial location of MNE.

This study argues one major point: traditional agglomeration and location theory within economic geography is not coherent to analyse the agglomeration of MNE when coming to a more micro-approach, therefore, a diversity and networked proximity perspective is suggested to respond to the challenges from MNE's agglomeration. This study will use Yangtze River Delta in China as empirical evidence to discuss the problems above.

Yangtze River Delta city clusters

Since the late 1970s, Globalisation, marketization and decentralisation happened in the pre-communist's country. Based on the 'using domestic market to exchange foreign technology' strategy, the coastline cities began to absorb considerable transnational industries and huge gap between eastern and western China occurred. Due to the open door policy, China has been the second largest recipient of FDI in the world since 1993 and it has also built many national Export Processing Zones to attract FDI. The relocation of multinationals' assets and fragmentation of production processes progressively promote the trend of urbanisation (Dicken, 2004).

The definition of Yangtze River delta economic zone is regarding Shanghai as the centre, a spatial space covering over 40 administrative cities and counties. It is the earliest and most mature economic zone even larger than the national population and space of Japan and German. It generates 83.0% of total GDP, 95.0% of export revenue and receives 83.8% of actually used foreign capital in 2005 (NDRC, 2006). It is predicted that by 2020, the agglomeration of the residential area and built-up area will surpass the global metropolitan areas like New York, Tokyo, Paris and London, and become the world's biggest economic zone.

In Yangtze River Delta, there are many manufacturing belts consisting of specific clusters and these clusters result in the dominant power of cities in that region. For the policy makers, the aims of attracting foreign investment need to meet the characteristic of local industry patterns, for instance, MNE's spatial behaviours in advanced producer. services are entirely different from primary and secondary industries (Wall and Knaap, 2011). Focusing on the heterogeneity of local industry in Yangtze River delta, the existing gradient distribution of local industry provides alternative options to foreign firms. Tier 1 is Shanghai and Nanjing, with the main industry as heavy Chemical Industry, which is in a post-industrialisation period. Tier 2 is Suzhou, Wuxi, Hangzhou, Ningbo, and Changzhou in which most capital and technology intensive industries located. Tier 3 consists of Nantong, Yangzhou, Zhenjiang, Taizhou, Shaoxing, Huzhou, and Taizhou which are dominated by the majority. Tier 4 is Zhoushan, the manufacturing industries still in the initial period. The table below shows the main industries in Yangtze River Delta.

Table 1. Comparison of main industries in Yangtze River Delta

Zone	Name	Main industry
Shanghai	Zhangjiang (one zone six park)	ICT, Computer, Integrated circuit, Home appliances, Automobiles, Biopharmaceutical, Advanced materials, Laser, Software
	Waigaoqiao	Logistics, Computer, Auto spare parts
	Minghang	Urban mass transit, Power station equipment, SVA
	Songjiang	Computer
	Qingpu	Auto spare parts, Precision instrument, Advanced materials
Jiangsu	Nanjing	ICT, Aerospace, Biopharmaceutical, Advanced materials, Computer, Auto spare parts
	Kunshan, Suzhou industry park, Suzhou High tech	Computer, ICT, Integrated circuit, SVA, Automobiles, Aerospace spare parts, Biopharmaceutical, Chemistry, Mechanical manufacturing
	Wuxi	Electronic and information engineering, Integrated circuit design, Biopharmaceutical, SVA, Auto spare parts
	Changzhou	Mechatronics, Fine chemicals, Biopharmaceutical
	Zhenjiang	Electronica (chemistry, packing, transport and communication facilities)

	Nantong	Advanced materials, New energy, New medicine, Electronic and information engineering, Ship and marine technology requirements
	Yangzhou	Traditional industries (Textiles, Electromechanical)
	Taizhou	Traditional industries (Textiles, Electromechanical, Chemistry, Food and beverage, Light industry, Medicine, Building materials)
Zhejiang	Hangzhou, Xiaoshan	ICT, Integrated circuit design, software, cartoon design, Biopharmaceutical, auto spare parts
	Ningbo, Ningbo dashu	Electric power, Stainless steel, Shipbuilding, automobile, Modern paper making, Mechatronics, Textiles, Oils and Foodstuffs, Plastic, Building materials, Petrochemical
	Jiaxin	Electronic and information engineering, Integrated circuit
	Huzhou, Shaoxing, Zhoushan, Taizhou	Textiles, Mechatronics, light industry, Ship and marine technology requirements

(Source: edited from Lin, Ye, et al., 2010)

1.2 Problem statement

Traditional analysis on the agglomeration of MNEs do not deal with locational issues at national level. In Dunning's 'OLI' paradigm (1993), the location (L) advantages are assumed to be the ability to reach natural resources, key market, and cheap labour physically convenient in host country. However, there is little literature referring to the OLI paradigm in disaggregated geographical terms. When international business economists analyse the location advantages, they normally regard it as a direct component being correlated with ownership advantages and internationalisation advantages, not a separated or isolated concept as economic geographers do. This makes the location decision complicated because it contains the mode of entry, the industry of entry and the location of entry. Uppsala school in international business discipline use knowledge flows as the main connection between clusters dynamics and within multinationals. They emphasis the effect of local cluster network and the embeddedness between multinational' subsidiaries and local economic activities.

The quality of knowledge flows to some extent is determined by geographical proximity. The geographical proximity is defined as the spatial distance between economic actors both in absolute and relative meaning (Boschma, 2005). Porter (1998) and Glaeser (1998) emphasise that the 'cost of transporting knowledge' is important. The internet network indeed increases the complexity of knowledge, to deal with that, face-to-face contact more than ever is needed. Many articles claim that firms that are co-located can benefit from knowledge externalities. McCann and Mudambi (2005) define the characteristics of pure agglomeration as naturally transparent inter-firm relations. Firms in the agglomeration are connected with each other and share knowledge spill-over without any cost, even though they are rivalries. The accessibility to every cluster is open and no barriers exist. This ideal model could be used as a platform to integrate the discussion of co-agglomeration between foreign and local firms.

In empirical researches, a firm is generally treated as an atom in space and it is unsuitable to analysis the MNE which has a hierarchy organisation system. It is surprising that there are fewer articles analysing MNEs' location choice in firm-level given that Sassen (2002) and Taylor (2004) already have mentioned the importance of co-location of foreign HQs and R&D firms with local firms in the same area. The real cause might be the absence of accurate data on detailed units and corresponding methods to detect them (Feser and Sweeney, 2002). Therefore, in order to optimise the impact of FDI on regional economic growth, both MNEs and local authorities need to understand the logic behind the agglomeration of MNEs, where and how they locate investments. In other words, totally understanding the challenges faced as a result of MNE's location choice helps policy makers to predict MNE' decisions based on generic and specific characteristic of their cities. This needs an integration of coherent location theory and agglomeration theory.

1.3 Research objective

This study suggests to combine geographic proximity from FDI location theory and traditional location theory with agglomeration theory to explain the foreign firms' agglomeration in the sector-region topic. There are some prerequisites need to clarify here. Knowledge flows are assumed to be acquired by co-located firms. Each cluster provides 'open membership' (knowledge sharing is transparent and noticed) to each firm. Firms that have higher degree of connectivity (many firms surrounding them) receive more knowledge from the network. In some models, firm size is not regarded as atomistic, and turnover will be used to capture firm-size. Geographically weighted measures are introduced to capture the effect of local clusters on MNE's agglomeration. Through the use of different analytical techniques, the study examines the effect of diverse local sectors and proximity on the location choice of foreign firms. Furthermore, the study tests the effect in different conditions, with different bandwidths and firms' turnover. Location factors are also included in the research framework.

The main objective is:

To find the spatial distribution of foreign and local firms in Yangtze River Delta and their influence on county clusters

To study the effect of local diversity and geographical proximity on the spatial behaviours of foreign firms.

To propose policy recommendations to help city attracting 'right' foreign firms to 'right' place.

1.4 Research question

The Main research question is:

To what extent does sectoral composition of local firms affect the agglomeration of foreign firms, considering spatial externalities and geographic proximity in Yangtze River Delta 2012?

The main research question can be divided into following subresearch questions:

1 What is the characteristic of industry composition of foreign and local firms in different spatial scale?

2 To what extent dose diversity of local firms effect the agglomeration of foreign firms, considering the spatial externalities?

3 To what extent does the foreign firms' agglomeration depends on the geographic proximity to local firms in different sectors?

1.5 Significance and Relevance

Scientific significance:

This study provide an integrated location perspective on foreign and local firms, hopefully trigger the further discussion on co-agglomeration issues between different disciplines. Specifically, the discussion of logic behind foreign firm's spatial decision is a contribution to existing knowledge body, such as whether relatedness of technology and different geographical proximity are the determinants to their spatial agglomeration. It also provides an empirical evidence from China to illustrate the emerging phenomena since China has already been the biggest FDI receiver in the world since 2014.

Policy relevance:

The findings of the thesis will provide policy makers a clear picture of co-agglomeration patterns in Yangtze River Delta. In addition, local governments who adopts policy of encouraging FDI by foreign firms has a reference to conduct their spatial plan in their territories.

1.6 Scope and Limitations

The sector scope

In this thesis, all the raw data is from Orbis database which provides 4-digit industry codes to identify categories of firms. The firm-level data is aggregated into 2-digit level and divided into manufacturing industries and services, the Eurostat aggregation method is adopted to divide manufacturing industries into four groups according to their technological intensity and these are; high-technology, medium high-technology, medium low-technology and low-technology. The services are also divided following a similar approach as manufacturing into knowledge-intensive services and less-knowledge-intensive service and the reason for focusing on the high tech and knowledge intensive industries is because high-tech sectors and enterprises play an important role in increasing productivity of a city.

The geographical scope

The study focuses on 32 cities in Yangtze River delta, including all the cities in Jingsu, Zhejiang province, Shanghai, and 5 cities in Anhui. Since 2012, the national policy already included Anhui province into the city clustering of the Yangtze River delta.

The study examines diversity in different postcode levels, from county level (postcode 4) to neighbourhood level (postcode 6), expecting to get different results from a hierarchical system. Bear

Limitation

Due to the limitation of database, this research only adopts a cross-sectional approach, explaining the structure of the firms in one sample year. The other reason is because statistical models to solve such data are not enough.

Unmatched firms from both databases (Orbis, zip code transferring website) have been deleted having been detected outside the boundaries when using ArcGIS. This systematic error contributes to a limited explanatory power to the co-agglomeration between firms.

The distances are calculated randomly, this method neglects the economic linkages between two co-located firms.

Chapter 2: Literature review

In this chapter, the study reviews the concepts in different academic domains mainly from economic geography, regional economics and international business management and contributes to linking regional agglomeration and multinationals spatial location choice to the central interest of economic geographers, namely that of industrial location theory. In section 1, firm network theory is presented as a platform theory to reveal the reason why cities compete each other to attract foreign investments. Section 2 discusses the multinationals strategy and their influence on destinations' spatial heterogeneity such as spatial externalities. In section 3 this study compares various approaches employed to describe industrial agglomeration and co-agglomeration between manufactures and services. In section 4 geographic proximity is discussed based on location theory. Conclusions are drawn in section 5 and two major points are argued, one is that the local diverse agglomeration and existing multinationals have influence on foreign firms' location choice; the second one is that local diverse agglomeration with geographical proximity matters to the attraction of foreign firms.

2.1 Firm network and city network theory

Dicken (2001) argues the study of global economy from a network approach. He points out three components of Network economies: Firstly, the dynamic formation of network changes by the power between nodes; secondly, network operates in a topological configuration; thirdly, a network has a comprehensive characteristic of geographic embeddedness. More recently, Pumain (2006) explains firm network as:

"*All the networks whatever their spatial magnitude are created, maintained, and destroyed by firms or agencies deploying their assets. These deployments are carried out exclusively with the aim of sustaining or improving the position of firms within a space that is structurally identified and understood at different spatio-temporal scales*" (Pumain, 2006, p. 172)

Figure 1 describes a complexity of firm network. Multinationals increase production value through global value chain which based on the networks in different scale. Four steps of network interaction present a dynamic process in different levels of cities. This part discuss each step as an introduction of concepts in following sections.

In Step (1), urban agents aggregate in city level as clusters. Firms are expected to improve their position in local networks by increasing their productivity. The common hard and soft business environment or institutional resources determine the productivity of firms. Krugman (1990), p.9) argues that productivity is the main meaning of competitiveness. Porter (2000) states competitiveness in his diamond model with these four aspects: (1) factor conditions; (2) demand conditions; (3) related and supporting industries; (4) firm strategy, structure and rivalry. These factors have been regarded as the driving force of clusters. Some policy makers might regard cheap labour as their competitive advantages in the long term. Porter (1998) criticises this competitiveness which is based on cheap-factor competitive advantage. He tends to describe the competitiveness as a "function of dynamic progressiveness, innovation and an ability to change and improve." Due to the emergence of these well-performed clusters, government is expected to provide more high quality public goods to maintain economic growth and implement benefit policies to firms. In addition, these production factors also trigger dynamic adaptation of clusters to their cities through active circulations of human capitals, productive capitals, and knowledge capitals.

In Step (2), cities compete with each other to increase their positions in network economies (Begg, 1992). The competitiveness of cities to some extent is determined by capital flows such as technology flows, knowledge flows and investment flows from networks (Castells, 1999).

Moreover, Kitson et al. (2004) expound the concepts by his own capital model, where competitiveness of a city/region can be determined by many input factors such as productivity of firms (productive capital), education level of population (human capital), institutional resources (social-institutional capital), amenities (cultural capital), accessibility (infrastructural capital), existing knowledge and technology (knowledge/creative capital). Benefiting from their accessibility to these resources, cities expand rapidly and unevenly. Some core cities emerge from this trend and serve as the main HQs (Headquarters) or R&D (Research and Development) destinations. Hence, the fate of cities is intensively tied to their positions in international flows of investment (Alderson and Beckfield, 2004).

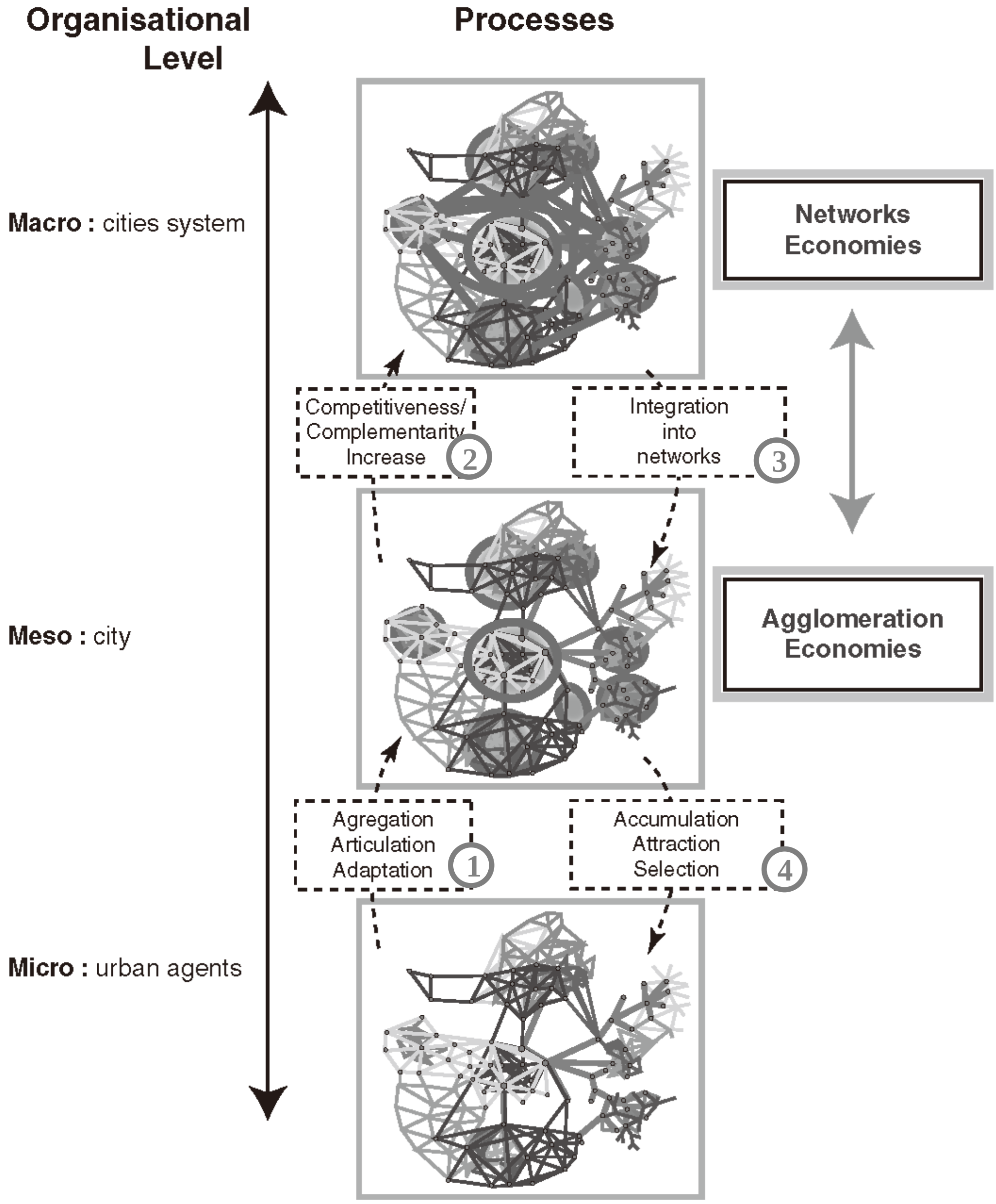


Figure 1. Firm networks embedded with city networks

(Source: Edited from Pumain, 2006)

In 1986, Friedmann published his book the ‘World City Hypothesis’ in 1986 and in it he states that the leading cities in the world promote the integration of global organisation of capital and

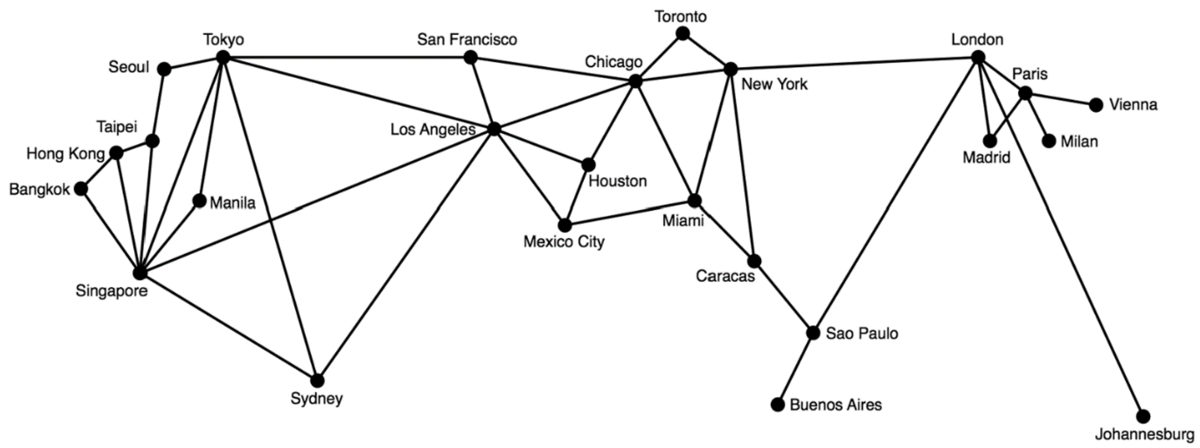


Figure 2. The global map of World Cities

(Source: Neal, 2011)

markets, pushing themselves to a hierarchy system in the world. The cities' network is shown in Figure 2. Sassen (1991) argues that some cities are heavily embedded into the contemporary globalisation waves through the integration of Global Commodity Chain. The presence of London, Paris, and New York proves that global cities have been the destinations of financial hubs and knowledge centres. These world cities have the control functions to the global production and serve as the spatial place of transnational capital and main destination of migration. Both of the two theories above reveal the integration of three markets in global scale: commodity markets; labour markets; and capital markets (Bordo, et al., 2007), which is consistent with the FDI location theory from Dunning.

In Step (3), given that the existence of hierarchy city system, multinationals leverage their local territories where 'local buzz' (social network and high trust) is intensive through global pipelines (knowledge transferring channels) to get local knowledge back to HQs. Moreover, interfirm knowledge creation at local levels keep local clusters lively, out-looking and dynamic (Bathelt et al., 2004). Hence, such a geographical co-agglomeration of similar and related economic activities triggers integration of cities into networks.

In Step (4), the local self-organised processes of economic agglomerations are progressively formed by accumulation of foreign investment. MNEs knowledge network can generate two advantages: (1) using knowledge created from anywhere in their network; (2) integration between knowledge source and host location (McCann and Mudambi, 2005). Geographical proximity matters during this process because firms need face-to-face interactions (Bathelt et al., 2004).

The typological firm network connects urban agents in different spatial scale. The products and services act as mediators to lead the formation of Global Production Networks from which multinationals and local firms collaborate together. (Coe, Hess, et al., 2004).

2.2 Multinationals and foreign direct investment

2.2.1 FDI location theory

Nowadays, attracting FDI is a prioritised agenda among policy makers in municipalities because some FDI top destinations have already shown their prominence in city competitiveness. FDI is a combination of a series of specific assets of companies. MNCs carrying FDI by mergers, acquisitions, and Greenfield investment to integrate their commodity chains and improve efficiency in the host country. All of these cross-border operations contribute to comprehensive interactions between MNCs and local firms. (Amin and Thrift, 2002; Henderson, Dicken, et al., 2002).

FDI location theory focuses on the monopoly advantages of multinationals and location advantages of domestic countries. Based on Dunning's OLI paradigm (1993), OLI represents ownership advantages (O) when firms have controlling power over their subsidiaries on production or operation; location advantages (L) for locating branches in a host country so as to access cheap raw materials, labour force, and special policies on tax or tariffs; internalisation advantages (I) obtaining net benefits from wholly owned subsidiaries rather than from contracted or licensing firms.

There are two kinds of FDI, the first is horizontal while the other one is vertical foreign investment (Navaretti, Venables, et al., 2004). The horizontal FDI operates the same firm's activities in a host country to gain increased sales, strategic advantage, and lower transport cost (Burger, et al., 2012). Vertical foreign investment are locality of economic activities based on internal hierarchy system.

Related to OLI theory, Dunning (1993) states four types of motivations for multinationals to investing abroad which include seeking natural resource, seeking new market, seeking efficiency, and seeking strategic assets.

- Natural resource FDI depends on the abundance of the local natural resource.
- Marketing seeking FDI relies on the large domestic markets or special tax breaks such as sales and marketing branches.
- Efficiency seeking FDI focuses on an intensive labour market and cheap land rent, for example the assembling industry.
- Strategic asset seeking FDI depends on the high-level assets like human capitals and knowledge capitals.

The locality of FDI also attributes to specific geographical agglomeration in local region. Many empirical researches show the pulling effect of local agglomeration economies. He and Liu (2006) use 1999-2004 foreign investment panel data to study the determinants of FDI distribution. The statistic results imply that the spatially agglomerated clusters and having strong intra-industry relatedness industries are more attractive to FDI. Meanwhile foreign investments strongly show their tendency to intensive high technology industries. The determinants of FDI location choice are various in the urban context, not only is it domestic agglomeration that matters, Quality of life, urban amenities, specialised urban networks and city size also contribute to the attraction of firms (Van Oort and Atzema, 2004). The accessibility to high-speed railway stations, airports and government administration offices leads to a high growth in regional innovation because of the improvement of efficiency of knowledge flows. Better transport infrastructures are benefits to the firms in that they stimulate the mobility of production factors and decrease the transition costs.

2.2.2 Spatial heterogeneity and spatial externalities of FDI

Hymer (1972) combines Chandler's Structure flows strategy theory and Weber's industrial location theory to explain the corresponding relations between organisation of enterprises and their spatial attributes. It means different branches of multinationals have a recognisable spatial hierarchy distribution, for example, the HQs tend to concentrate in some core cities like New York or London, the regional HQs prefer to locate in some regional centres within the nation, and the production units are normally distributed in or between the developed and developing

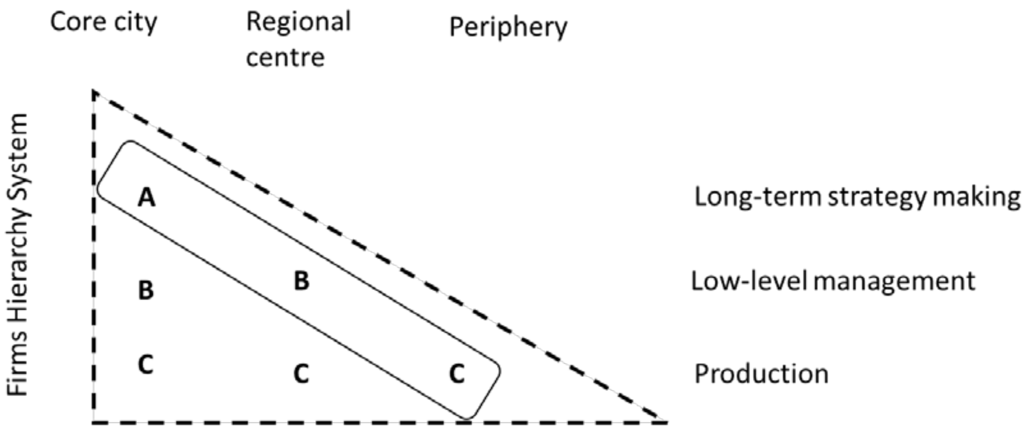


Figure 3. The spatial strategy of multinationals

(Source: Hymer, 1972)

countries.

From the picture above, it is easy to distinguish core cities having more diversified activities compared to periphery ones. In a core city, firms adjust their organisational structure associated with long-term and short-term strategies. According to Castells' Space of Flows theory (1996), the location choice of foreign firms could also be regarded as variety of flows to cities with respect to its productivity, agglomeration, and institutional context. Some cities are more competitive in attracting foreign firms (Potter and Watts, 2011).

In the spatial econometric models, the spatial variables comprise market potential and spatial lag variables. The market potential variables represent the weight sum of GDP in neighbourhood cities to one city. The weighted matrix is built on the function of geographic distance between two cities. The coefficient of the variables can be used to test the capability of attracting FDI to one city market, in other words, whether the proximity to customer market will increase the FDI. Spatial lag variable is the weighted sum of FDI in surrounding cities, the weighted matrix is the same in the measure of market potential variable. The coefficient of spatial lag captures the influence of weighted FDI in geographically proximate cities to the attraction of FDI in one city (Blonigen, et al., 2007).

2.3 Agglomeration theory

2.3.1 Different types of agglomeration

In New Economic Geography theory, knowledge spillover has been estimated from global agents to local receivers vertically, nevertheless, externalities can be transformed through the spatial agglomeration horizontally. There is no denying that foreign investment has a strong influence on the local production network, the linkages between foreign firms and local firms normally are stronger than the ones between domestic enterprises in China (He and Wang, 2010).

Normally, the classical approaches build the structure of a competitive general equilibrium to explain how firms maximise their productivity under a perfect competition context with respect to resource constraints (Arrow and Debreu, 1954). However, the model doesn't take the location factor in to account. In others words, the spatial heterogeneous effect is not captured by the model and also it ignores the probability of scale economies. Krugman (1991) introduces the new models to solve above problems and his models are more efficient in dynamic processes explanation (Fujita and Thisse, 2002). In empirical researches, due to constraints of explanatory power of modelling in economic externalities between firms, the black box of agglomeration hasn't been unfolded until the last decade (McCann and van Oort, 2009).

Marshall (1890) explains that firms depend on economic externalities to share knowledge and technology spillovers. These externalities are generally acknowledged to comprise labour market pooling, existence of specialised suppliers and the emergence of knowledge spillovers (Burger, Van Oort, et al., 2009). There are three typologies of agglomeration economies that have been developed by Hoover (1948), which are economies of scale inside the firms, location economies between the firms, and urbanization economies beyond the firms (Gordon and McCann, 2000). Jacobs (1970) states that urbanisation and economic scale is the prerequisite of development through people continuing to generate local products within the same centres. Glaeser et al. (1992) concludes the variety of firms and competition between them stimulated the employment growth in industries, which means to some extent knowledge spillovers might be shared between inter-sector industries, consistent with the theories of Jacobs, but not in the local specialisation of Marshall's theory. Therefore, the existence of urbanisation externalities actually makes different industries adjacent to each other. Industries that are sensitive to transport costs would obviously locate together in the city. When the industry grows larger, the raise of the wages helps to stimulate the growth of other unrelated industries in that city to meet the higher demand. Hence, the growth rate of different clusters and their variety are positively correlated (Glaeser, et al., 1992). Porter (1991) states that the concentration of firms benefits to productivity of industries and the city.

There are many hypothesis surrounding the knowledge externalities and one of them proposed by Jacobs (1970), who argues that diversified urbanisation economies lead to a higher growth rate. The new growth theory shows that not only related (within sectors) but also the unrelated diversity (between sectors) could have been used to examine the Jacobs externalities as diversity portfolio (Jacobs, 1970). In the long-term economic run, Pasinetti (1993) argues that if a regional economy doesn't absorb new sectors to change the economic structure and get rid of the redundant as well as pre-existing sectors, the economic growth will ultimately enter into stagnate. These adjustments of economic structures spatially imply that the older sectors transfer to the periphery of urban or rural areas. Hence, policy makers need to take the local and foreign investment into account to strengthen the inter-firm and intra-firm linkages. Recently, more attention has been given to the heterogeneous distribution of local firms and foreign firms. The substantial interactions include many aspects such as sub-contracting to local firms, shaping technological strategic alliance, getting access to the local market, tapping into skilled labour force, taking advantages of local institutional resources. All of these interactions promote the urban dynamics and make it more flexible and efficient. In turn, the locality of multinationals allows them to reach the social networks. In the micro level, the face to face contact also has a positive influence on the collaboration between foreign firms and local firms as a communication technology (Storper and Venables, 2004). The involvement of actions of firms and people ends in agglomeration in "sharing, matching, and learning" (Duranton and Puga, 2004).

The debate on 'whether Marshall Externalities or Jacobs' Externalities is right?' has been discussed in previous literatures which have shown that both of them are important to firms' productivity (Van Oort and Atzema, 2004); Neffke, Henning, et al., 2011). Some advocators argue that the new insight from institutional economics and evolutionary economic geography was underestimated, especially in the eye of orthodox economic thought. On the specialisation side, cities or counties organise their production around a specific product or service to generate economies of scale. In China, Anshan is the same with Pittsburgh in USA, both of them are steel industry orientated. In these cities, normally the main production is dominated by monopoly companies. Likewise, similar technologies, skilled labours and raw materials shared in the clusters could increase the productivity of local firms. The negative effect of this strategy is the vulnerability of comedy chain. For example, due to the declining exchange rate of RMB and shrinking market overseas in the recession, many specialised manufactories and trading brokers bankrupted which heavily hit the local economics. On the diversity side, Henderson et al. (2003) state that Jacobs' externalities results in higher growth rates when knowledge spillover occurs in similar industries. The approach from institutional and evolutionary geography criticises the conceptualisation of diversity by raising industrial relatedness (Boschma and Martin, 2010). McCann and Van Oort (2009) advise to emphasise the institutional effect in the studies of knowledge spillover. Boschma (1999) argue that local externalities also occurs in terms of embeddedness between variety and inner environment.

Empirically, more and more studies use firm-level data to evaluate the effect of agglomeration economies on firm's establishment. Rigby (2002) uses the plant-level data from the Longitudinal Research Database of the US Bureau of the Census to assess the changes of productivity across the US metropolitan areas affected by the agglomeration economies. Henderson (2003) finds that regional employment growth induces a slight increase of productivity in high-tech industries. Case study about German knowledge-based clusters shows that the more knowledge resources to be given to firms, then they enjoy a faster growth than the region embedded with less resources (Audretsch and Dohse, 2007). Braunerhjelm and Borgman (2006) prove that labour productivity has statistically positive relationship with interdependent and joint-space industries. Baldwin et al. (2008) find similar results for the effect of own industry size on firm productivity in five manufacturing sectors in Canada.

2.3.2 Co-agglomeration of foreign and domestic firms in different sectors

The micro-heterogeneity of economic activities should be taken into account when analysing the individual firm's impact from economic geography perspective (Ottaviano, 2011). Industries cluster spatially to reduce transport and transaction costs is revealed, however, the spatial patterns of services concentrate and disperse at the same time on the regional level, which suggests a different pathway to understanding their spatial behaviour (Coe and Townsend, 1998).

The entry of industry multinationals affects the average productivity of domestic firms because of the increasing intensity of competition from the input of production factors to product market and this might squeeze out domestic firms. In the process of operating their assets in the foreign markets, multinationals are likely to be highly productive, because they need to be strong enough to overcome the challenges from entry of a foreign market in terms of difference in language barriers, policy and customer behaviour (Helpman, Melitz, and Yeaple, 2004). For example, the R&D branches always locate nearly to the local CRM consultancy to detect the changes of consumers' preference.

Empirically, based on the data from Annual Survey of Industrial Firms in 2005, He and Wang (2010) find that foreign enterprises are more concentrated than local firms in manufactures are. What's more, the co-agglomeration of intra-industry and the co-agglomeration of foreign and domestic enterprises is significant (He and Wang, 2010). Other scholars take another approach to study whether specialisation and diversity improve the regional productivity (Xi et al., 2015) Inter-city collaboration exists between services and industries. Due to the size and development of the city, it is hard to find many efficient suppliers or buyers in production. Hence spatially, some productive demand from industries has to be satisfied by knowledge intermediaries generated by the services in the neighbouring cities (Hsieh et al., 2015) and in turn, their products benefits the neighbourhoods as well. Advanced producer services are the suppliers of immediate goods and industries are their clients as well. Evidence from France shows that services choosing to locate in a higher density of technology area enhance employment growth (Combes, 2000). Hence, the production network of high-tech industries and knowledge-intensive services construct across the administrative boundaries. From the statistics results of China input and output, the immediate demand from technology intensive sectors to knowledge intensive services distribute evenly in financial services, business consultancy and IT services. When the technology density stimulate to some degree, more innovative and segmented services are needed, diversified service clusters provide the complementary products to their industrial clients. Knowledge intensive services will co-locate with industries for the reduction of transition cost and providing face-to-face services. However, in the information era, some knowledge-intensive services might co-locate with other knowledge-intensive services to tap into human capitals. In addition, larger local firms in a good position where it is easy to get access to resources are more attractive to foreign firms.

2.3.3 Bridge economic clusters and urban spatial policy

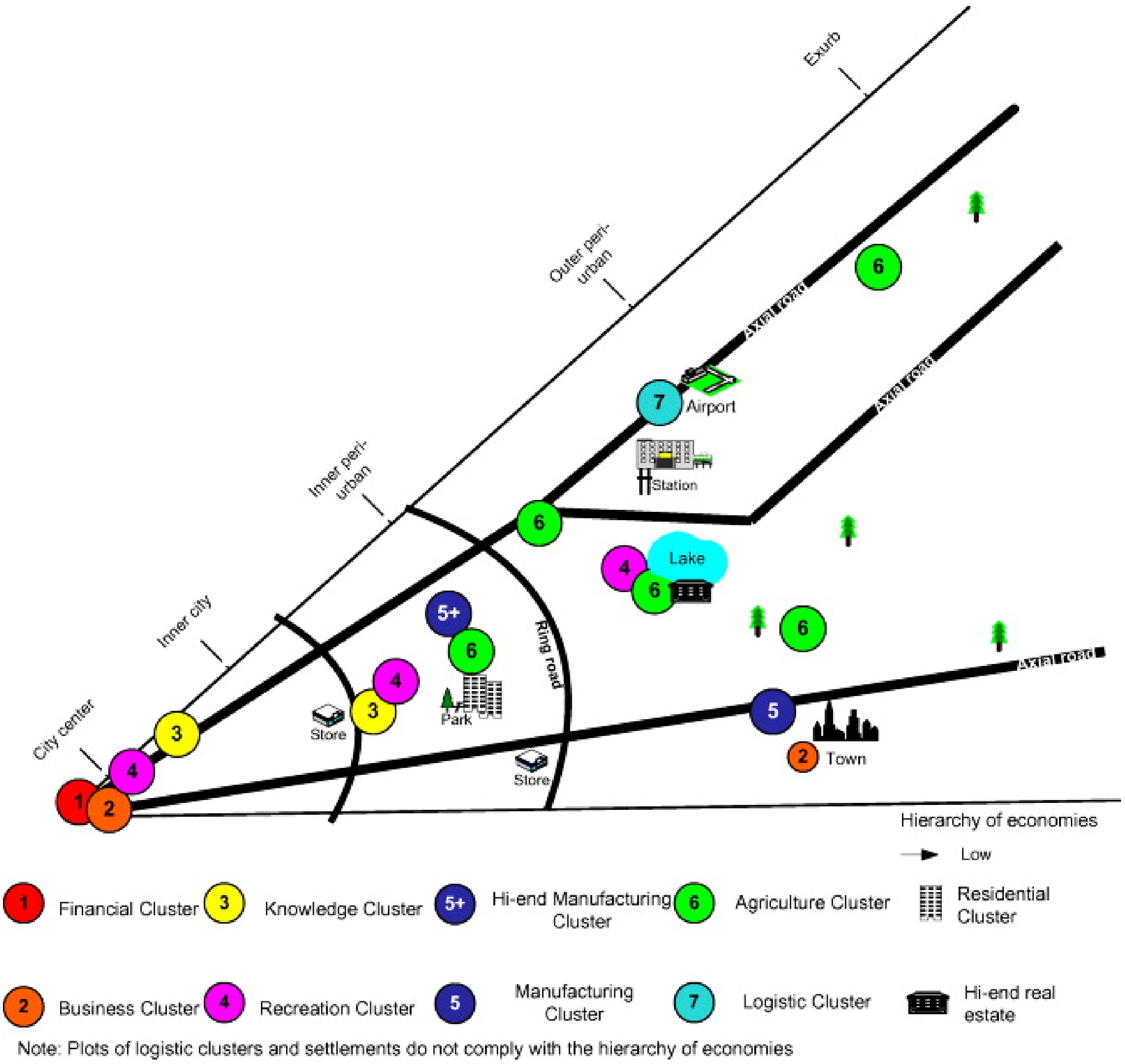


Figure 4. Sketch of economic clusters in a city

(Source: Yang, 2015)

Economic clusters normally consist of similar firms in a specific category (in 2 NECV. 2 2-digit level) like knowledge-intensive sectors, high-medium manufactory sectors where competition, collaboration, and synergy happen. In the spatial policy context, different clusters are prone to different spatial patterns, (Table 2). Financial services are primarily dominant in the CBD area or sub-centre area (Phelps, 2004). In some metropolitan area, like Shanghai in China and Amsterdam in Netherlands, the financial services initially are relocated into a second city core-Pudong district and Amsterdam South. In some, science parks, the creative, design and machinery clusters will gather together to share knowledge and cooperate to produce common products. Moreover, the ICT or hi-tech manufactory are always adjacent to education clusters. The strong empirical evidence is the Silicon Valley near Stanford University in the U.S. In Yang's latest article we can find the distribution of economic clusters from the city centre to inner city, inner peri-urban, outer peri-urban, and suburban. The distinct characteristic is that the financial cluster, business cluster, recreation cluster and knowledge cluster concentrating on the city centre. This phenomena implies that there is a high-degree variety on the city centre, and what's more, considering the types of jobs in the city centre, more relate to advanced produce services. The variety between these clusters are believed to be higher than manufacturing clusters, moreover, urban amenities contain the hardware and software factors. Hardware includes infrastructures, green space, water, high speed railway lines, and internet bandwidth. Software could be determined by the heritages, cultural environment, and life styles. Some intellectually intensive services like ICT prefer to locate in vivid environments where knowledge spill-over is possible, for intense, in Silicon Valley (Saxenian, 1996).

Feser and Sweeney (2002, pp. 226-227) suggest that the existence of conflicts in clustering theories pushes policy makers to raise any initiatives from their own supporting empirical research. However, the real problem is accurate data at a lower scale and a more advanced methodology that can dynamically integrate the driving factors in the urban context.

Spatial–economic characteristics of main economic clusters.							
	Financial clusters	Business clusters	Knowledge clusters	Recreation clusters	Manufacturing clusters	Agriculture clusters	Logistic clusters
Main agglomeration factors	Path dependency , face-to-face contacts , favourable location and geographical proximity	Business competition , face-to-face contacts , vibrant business environment , favourable location	Knowledge spillover , face-to-face contacts	Social factor , incl. life style and culture , pleasant/unique environment	Industrial traditions and resource advantages , global trade and labour division , industrial specialisation	Efficiency of agricultural production , scarcity of land	Accessibility and quality of infrastructure
Main economic activities	Banks , insurance companies , financial markets , accounting services	Management , professional , particularly IT services , consulting , advertisement and media industries	A synergy of universities and industries , or creative services related to culture and knowledge	Hotels , restaurants , cafes , street life , nightlife , and recreational shopping	Large scale production with a supplicated web of suppliers and supporting agencies	An agricultural complex with farming , food production and tourism	Multimodal transport and distribution centres of regional or national importance
Location	City centre	City centre or sub-centres	Inner city , edge city or peri-urban	Inner city , edge city or peri-urban	Urban fringe , transport corridor	Peri-urban or exurban	Transportation notes (air , sea , road , rail)
Embedded linkages with cities	Financial system	Business environment , cooperation of firms	Supportive institutes and talent	Convergence of culture and (up-) middle class	Strongly dependent on the other clusters	Strongly dependent on the other clusters	Logistic systems

Table 2. Main Economic clusters and their local factors

(Source: Yang, 2015)

2.4 Location (proximity) theory

Location theory mainly focuses on how to select the optimal locations to operate production process, considering various local characteristics and land inputs. Hayter (1997) summarises three types of location theories.

1) Neo-classical theory. Given that, firms own all the information they need and behave rationally, they can maximise their profit by satisfying their production demand.
2) Behavioural location theory. Information asymmetry has been taken into consideration compared to Neo-classical theory.
3) Institutional location theory. This theory suggests firms' social network with their buyers, suppliers and government.

Although the importance of agglomeration economies in city-region has been discussed, it is important to understand that all the spill-overs only work in a micro level. In other words, the geographically proximate relations and firm's performance convey the nature of agglomeration. Boschma (2005) classifies five aspects of proximity in which cognitive, organisational, institutional, social and geographical proximity lead to partnerships between firms. Here only Geographic proximity, technological proximity, and institutional proximity are discussed.

Geographic proximity and Technological proximity

Economic geography theory manifests that agglomeration and geographical proximity can improve cluster performance by generating increasing returns and foster regional growth (Potter and Watts, 2011). This is because lower geographical proximity between firms increases the potential interactions between them and reduces exposure to risks when isolated. Firms are more productive when they embed into a common communicative context in a similar geographic place (Balland, 2012). Moreover, for theorising studies of bilaterally traded services, the physical distance between two countries affects the volume of trade of services and products. To the local firms they have to rely on the multinationals to build relationships with foreign companies with respect to the too high trade cost. (Burger, Martijn J., et al, 2014). Francois (2010) also states that the local presence of MNEs stimulates the transactional distance of trade between countries. This attribute of organisations could influence the possibility to collaborate with local firms (Cassiman and Veugelers, 2002). Some articles point out that the possibility of knowledge spill-over and collaboration between MNEs and local firms is due to their heterogeneous attributes such as age and size (Cassiman, B., ; Veugelers, R., 2002).

Institutional proximity

Barca et al. (2012) and Van Oort & Bosma (2013) state the whether place- or people-based policy debate in the European country cases. It is argued that agglomeration might trigger the firm's productivity if the mobility of the people is encouraged, individual income is increased. The geography-led policy assumes that the interactions between different firms and their spatial linkages are necessary for employment, hence many urban policies actually base in these statement. To investigating the interactions between firms, a more detailed and specific geographic context should be taken into consideration with respect to institutional proximity and geographical proximity. This thesis is based on the concept of proximity, which has been shown to be an insightful analytical device.

2.5 Conclusion

To sum up, the focuses are two streams of factors in determining the location of foreign firms, the domestic agglomeration and geographic proximity. The economic agglomeration might reinforce the density of externalities within economic activities. The distance between firms is crucial because the distance decay results in a reduction of knowledge quality and potential contact opportunities (Keller, 2002).

Globalisation is not just vertical linkages between global scale and local space, it is more related to horizontal connections between local agents and outsiders (Marston et al, 2005). From the 1970s, scholars started to take the exogenous variables into account when analysing regional growth. Foreign direct investment and multinationals have been treated as proxies of global power in the network theory (Dicken, 1976). With the line of literature on Global Value Chain and Global Commodity Chain (Gereffi, 1994), and space of flows (Castells, 1999), the rise of Global Production Network (Dicken, 2008) theory moves forward to an embeddness approach in international cooperation. Nevertheless, Globalisation and localisation exist at the same time, but globalisation doesn’t mean the accumulations of multiple spatial layers, it shows a complexity in the neighbourhood level. As the pipeline of high-tech knowledge from the external environment, FDI has been regarded as the main driving force to improve the local innovation system. The recent studies from Zhou et al. (2010) indicate that the rise of local-clusters in medium high-tech industry-semiconductor is not dependent on foreign firms, but from other dynamic elements such as technology spill-over from the national funding research, and memberships from the semiconductor organisations. This local buzz supply’s plenty of nutrition to the domestic firms.

2.5.1 Criticism

Aggregated data losing detailed information

Empirical studies on agglomeration use aggregated data such as cities or city-industries as the basic reference unit. Hence, these studies provide only limited insights and weak support for the effects of agglomeration economies on firm establishment (Burger, Van Oort, et al., 2011). Recently, some studies from evolutionary economics or network sociology analyse agglomeration mechanisms underlying knowledge spill-over using firm level data. The forms of the knowledge spill-overs can be explained by spinoff firms, labour mobility and R&D collaboration (Burger, Van Oort, et al., 2009). This micro-data helps to open the black box of knowledge of spill-overs. The multilevel model has been regarded as a better tool to explain the firm’s productivity from agglomeration-level and firm-level. By investigating the sample of Dutch firms from 2005 survey conducted by National policy research agency, Knoben et al. (2015) point out that whether firms will benefit from agglomeration depends on firm size, internal knowledge base, and face-to-face contacts and agglomeration factors (urbanisation, localisation, and knowledge density). There is an inverse U-shape interactive relationship between firms’ productivity and above factors.

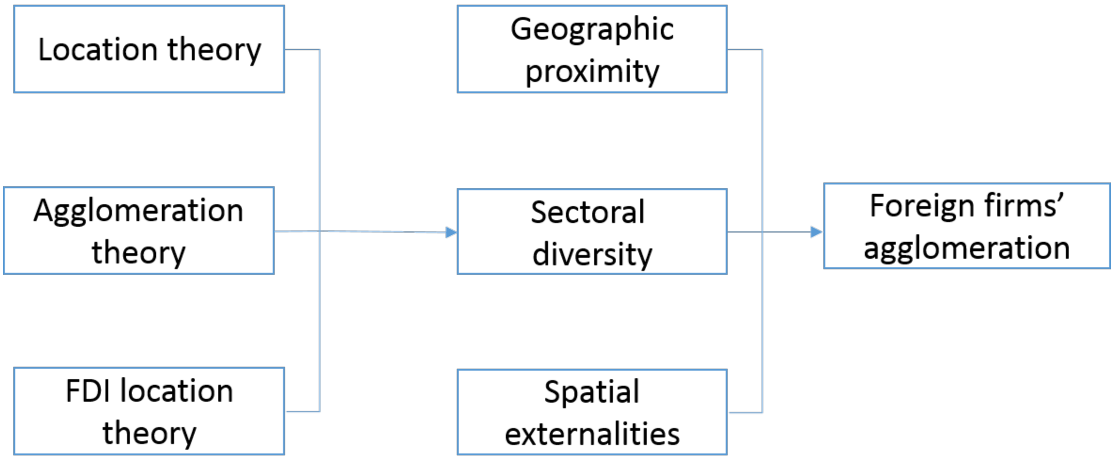
The effect of commercial rent is neglected

Agglomeration is a result of the spatial selection process, and the large firms are left in the high GDP density area because they are more productive. (Baldwin and Okubu, 2008) So it can be stated that the accuracy of the effect of location depends on the choice of location. Such endogenous problems make it complicated to make conclusions at city or regional level.

Geographical proximity is not always necessary

Geographical proximity is not the unique proximity that decides the informal interactions. Technology proximity and organisation proximity also matter in the diffusion of knowledge. Orlando (2002) provides the evidence from R&D sectors that geographic proximity has no effect on the inter-firms spill-overs within narrowly defined technological groups[1], but geographic proximity does decrease the technology spill-over outside of narrowly defined technological boundaries. Other examples from French regions imply that nonlocal relations which means long distance relationships are important in innovation networks as local relations (Rallet and Torre, 2000). Araujo et al. (2013) assesses the importance of geographical proximity in relatively small and economically depressed areas and argue that this proximity is not crucial for their economic performance.

2.7 Conceptual framework



[1] Among the firms considered in this study, for example, those within 100 miles of one another are over three times more likely to be in the same four-digit SIC group than are any two randomly chosen firms. And firms within 50 miles of one another are over four times more likely to come from the same four-digit SIC.

Chapter 3: Research Design and Methods

3.1 Revised Research Questions

This research intends to investigate the effect of sectoral composition and proximity on the agglomeration of foreign firms in manufactures and services by using different spatial-economic models. The research scope is 33 cities in Yangtze River Delta in 2012. The Main research question is:

To what extent does sectoral composition of local firms affect the agglomeration of foreign firms, considering spatial externalities and geographic proximity in Yangtze River Delta 2012?

The main research question can be divided into following subresearch questions:

1 What is the characteristic of industry composition of foreign and local firms in different spatial scale?

2 To what extent does sectoral composition of local firms affect the concentration of foreign firms, considering the spatial externalities?

3 To what extent does the foreign firms' spatial behaviour depend on its geographical proximity to local firms in different sectors?

3.2 Operationalization: Variables and Indicators

In this thesis sector approach is used to aggregate the data and identify firms. All the firms were divided into 9 categories based on the high-tech and knowledge intensive standards. High-tech are defined based on their technology density as several sectors like high-tech manufacturing sector, medium high-tech manufacturing sector and high-tech knowledge-intensive services sector. Knowledge intensive business services are those providing knowledge-intensive products to business. Miles et al. (1995) summarise three characteristics of KIBS: heavy dependency on professional knowledge; transferring information and knowledge as intermediate products to their clients or generating themselves; very competitive. All the classifications are listed in Annex 1. The numbers of firms are used as proxies of agglomeration and the measure of agglomeration is conducted by summing the numbers of domestic firms and foreign-own firms each in manufacturing and service sectors in counties (postcode-4) and neighbourhoods(Ng and Tuan, 2006). Therefore, Y-variables are numbers of foreign firms in high-tech manufacturing, medium-high-tech manufacturing, medium-low-tech manufacturing, low-tech manufacturing, knowledge-intensive market service, high-tech knowledge-intensive service, knowledge-intensive financial service, other knowledge-intensive service and less knowledge-intensive service.

The X-variables include two categories, in location theory, concentration of firms has been used to measure the local agglomeration. Concentration is the aggregated numbers of firms in the industries sectors (Ng and Tuan, 2006). In the agglomeration theory, the concept of geographically weighted local firm's employment is borrowed as proxy of local agglomeration considering the continuous distribution (Jacobs, Koster, et al., 2013). Since employment data is not completed, turnover is used to in its place. In the production function, capital is one of the inputs except land, labour, and entrepreneurship. Turnover could be regarded as one of the inputs of foreign firms, the calculation of that is discussed in the data analysis method section. According to the classification of sectors, museums, social work activities, libraries, and sports activities are included in the other knowledge intensive services, which could also be regarded as soft urban amenities.

Diversity agglomeration index agglomeration index was defined as the Herfindahl index. Herfindahl concentration index could be calculated like $I\_L_{i,j} = (NF_{i,j}/\sum NF_i)^2$, index in region *i* and sector *j*, and $I\_L_i = \sum I\_L_{i,j}$ means the sum of index in different sectors. Thus, the diversity of local firms in region *i* is defined as the squared term of the share of local firm number in sector *j* out of the total population in region *i* (Ng and Tuan, 2006b).

Control variables are listed as:

1 Degree of urbanisation: The degree of urbanisation is measured by the density of population (Tuan and Ng, 2003).

2 Location production: This is measured by GDP/built-up area. This variable is more appropriate than GDP per capita on measuring the geographic influence on economic activity (Ben, 2010).

3 Capital city: This indicator can test whether the capital city begins to squeeze out the heavy industries to the urban periphery and other satellite city.

Urban infrastructures:

4 Airport, high-speed railway stations, and ports: The accessibility to urban infrastructures is important, for instance, if services get closer to a high-speed railway station, it saves lots of time for employees going to another city to attend meetings with clients. Manufacturing firms near ports can reduce the transition cost in logistics. All the indicators are dummy variables, 1=yes and 0=no.

5 Economic zone: Economic zone are used as dummies for a policy-led cluster. The preference is to examine whether the spatial policy works to foreign firms. This variable is dummy variable, 1=yes and 0=no.

It is impertinent to mention here that all control variables within a particular neighbourhood (postcode-6) get the same value from their county (postcode-4) level.

<u>Data Book</u>

Table 3. Y-variables

Name	Description	Source	Unit	Data type
Foreign firms	Numbers of foreign firms in sectors	Orbis, own research	-	count
	Location: postcode	Orbis, own research	-	nominal

Table 4. X-variables

Name	Description	Source	Unit	Data type
Local firms agglomeration	Numbers of foreign firms in sectors	Orbis, own research	-	Count
Local firms location	Postcode	Orbis, own research	-	nominal
Local firms proximity index	Geographically weighted turnover of local firms	own research	-	numeric
Diversity of agglomeration index	Herfindahl index	Orbis, own research	%	ratio
Pop density	Degree of urbanisation	PUMA	-	ratio
GDP density	Density of location production	China city statistical yearbook (2013)	$	ratio
Capital city	Whether is in Capital city (1 = yes; 0 = no)	own research (map.baidu)	-	dummy
Airport	Presence of airport (1 = yes; 0 = no)	own research (map.baidu)	-	dummy
High-speed	Presence of high-speed railway station (1 = yes; 0 = no)	own research (map.baidu)	-	dummy
Port	Presence of Port (1 = yes; 0 = no)	own research (map.baidu)	-	dummy
Economic zone	Presence of economic zone (1 = yes; 0 = no)	own research (map.baidu)	-	dummy

3.3 Data collection methods

This research uses secondary data and the main sources for the date used include the following:

ORBIS for the total population

ORBIS database (compiled by Bureau van Dijk Electronic Publishing, BvD) includes 60 countries firms' information and provides detailed financial information together with contact information of firms such as postcode, city, name, NACE code, and also information their ultimate owners, employment, and turnover. The key financials section divide the firms in different time period by last available year with respect to the known value. The ownership section of ORBIS helps to define the foreign firm by their foreign shareholder's location (outside of home country or located in the home country). In the last part of conditions for foreign shareholder, a shareholder is the ultimate owner of the company who owns one of a direct or total participation greater than 51%.

GIS shape file

The GIS map was from PUMA[2], World Bank. In the dataset, shape files are administrative boundaries of counties whose attributes include total built-up areas[3], nature areas, GDP in county level, population in 2010[4]. The GDP data was integrated to the shape files to facilitate the geo-statistics. GDP data was from the Chinese Urban statistic yearbook in 2012.

Geocode of firm location

The postcode of the firms was transferred to latitudes and longitudes'[5], the information of the geocode was used in mapping locations and calculation of distance between each local firm and foreign firm.

Visual data collection for dummy variables

The published Chinese urban statistic database doesn't cover the county-level data, therefore a visual approach is used to collect control variables from the maps in the website[6]

3.4 Sample Size and Selection

This thesis used a cross-sectional variation in firms' activities in 2012 for two reasons. The 2012 data is more complete than other years in terms of total amount, turnovers and postcode in Orbis. A cross section dataset is normally adopted in spatial econometric model, which allows us to investigate the determinants of location choice of foreign firms from a geographic perspective. The study focuses on four provinces in Yangtze River Delta area: Jingsu, Zhejiang, Shanghai, and Anhui. These provinces are the main foreign investment agglomerated area in China[7], which is ideal to show their impact on the attraction of foreign investment.

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[2] PUMA, or Platform for urban Management and Analysis is a geospatial tool that allows users with no prior GIS experience to access, analyse and share urban spatial data in an interactive and customisable way. http://puma.worldbank.org/

[3]Note that these maps show all built-up areas, regardless of whether they are located in "urban" areas or not. For the purposes of the associated World Bank study, agglomerations of built-up areas that had 100,000 people or more in the year 2010 were identified, and only the land and population in these are counted as "urban" land and population. These agglomerations are made up of one or more administrative boundaries, and can be identified using the "WB_agglom" identifier. All administrative boundaries with the same value for this identifier make up a single urban agglomeration. (Source fromhttp://puma.worldbank.org/)

[4]Population data is based on the Chinese population census in 2010.

[5]The Geocoding process used website: http://www.findlatitudeandlongitude.com/

[6]Data from Website: map.baidu.com

7 It is important to mention that only 6 cities are chosen in Anhui which are next to the Zhejiang and Jiangsu province, because Anhui province was included in the national development policy of city cluster in Yangtze River Delta since 2010, the GDP in the rest of the cities of Anhui are not on the same level of other cities in Jiangsu and Zhejiang.

Eurostat's indicators on high-tech industries and knowledge intensive services by NACE Rev.2 codifications[8] are used. The 4-digitcodes are aggregated into 9 sectors because of a large research population and all the firms in primary industries are excluded because of their dependency on natural resources. The distinction of the 9 sectors is based on the density of knowledge and technology volume. In line with the insights of He and Liu (2006), it is expected that foreign industries prefer to locate with domestic firms with relatedness in technology and KI services to meet their diversity demands. As Duranton and Overman (2005) explain, a postcode is particularly useful for identifying the firms' location. The problem is there are two systematic errors; one is the postcode could be matched to spatial co-ordinates, another is the matched points outside the study region hence a decision had to be made to delete all the mismatched points to minimise the errors. The final statistics are: the number of foreign firms: 19454; the number of local firms: 48584. Other spatial units are 32 cities, 220 counties, and 3125 neighbourhoods. In the first and second part of the study, the dataset is used after cleaning and soring, allowing around 4% system error. In the third part, purposive sampling method is used to detect the most valuable firms' spatial behaviours from the Top 500 foreign firms and Top 2000 local firms in terms of their turnover.

3.5 Validity and Reliability

Validity examines the fitness of measure in research (Anastasi and Urbina, 1997). The variables and indicators were valid because of the consistency of related theories and statistic measures in Chapter 2 or adopted in previous research.

The data is reliable because all the data sources are official and all the firm-level data are published by Orbis while the economic indicators are from China Urban statistic yearbook in 2012. The process of data calculation was consistent and double checking was conducted by different sources.

3.6 Data analysis methods

There were three categories of research methods: Descriptive analysis, spatial analysis and Regression analysis in the study, each directed to a specific research question and method. Spatial analysis used ESDA techniques to identify the co-agglomeration between foreign and local firms. Modelling composed by the spatial-economic model and standard random profit model considering proximity as weight (gravity model).

Part A. Descriptive analysis on industry compositions of both types of firms

In this part, analysis was divided in two sections.

A1. What is the main industry composition of foreign and local firms in three provinces?

Method: Comparable analysis in Tableau[9]

A2. What is the distribution of nine sectors of foreign and local firms in 30 cities?

Method: Histogram analysis in Tableau.

Part B. Spatial analysis on co-agglomeration of foreign firms and local firms

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[8]The methods of codification is in appendix 1.

[9] Tableau 9.0 is a data visualisation software.

In this part we used ESDA techniques to measure spatial co-agglomeration patterns of foreign firms and local firms in county level and neighbourhood level. Identifications of clusters used spatial statistic functions from Geoda and ArcGIS. This part was divided to two dimensions.

B1. Where are the significant co-agglomeration patterns of HT foreign firms with KI local firms and HT local firms with KI foreign firms (postcode-4 level)?

In this part ESDA techniques are used to measure spatial co-agglomeration patterns of foreign firms and local firms at county level and neighbourhood level. Identifications of clusters used spatial statistic functions from Geoda and ArcGIS. This part was divided to two dimensions.

B1. Where are the significant co-agglomeration patterns of HT foreign firms with KI local firms and HT local firms with KI foreign firms (postcode-4 level)?

Method: Bivariate Local Moran'I map in Geoda

Empirical research on agglomeration economies has been divided into different fields. According to Graham (2009), this part could be sorted to 'detection of agglomeration locations in space and delineating the spatial extent of regional clusters'. The existing literature mostly focuses on the global diversity of a specialisation (Duranton and Puga, 2005; Glaeser, Kolko, et al., 2000). Here the 'Where' questions are answered in sectors who co-locate. This ESDA approach is originally from univariate Local Moran'I statistic (Anselin, 1995). The topological unites relationships are determined by means of the spatial weighted matrix. Anslin et al. (2002) propose the Bivariate Local Moran'I to analysis the core variable x to a neighbour variable y as the bivariate. For instance, KI local firms are chosen as the core in region *i*, and count HT foreign firms in region *i*'s neighbouring regions. If there are many local KI firms and foreign HT firms co-locate, in the LISA map, it shows red colour to identify them. With regard to the spatial weighted matrix, the Queen Principle is used.

B2. Where are the significant co-agglomeration clusters of foreign firms and local firms in manufactures and services in neighbourhood level (postcode-6 level)?

Method: Using Local Moran'I to identify the clusters and outliers in ArcGIS

An important decision in using local measures of spatial autocorrelation is the specification of 'inverse distance spatial' weights matrix. This method gives more weight to core units that have more neighbours, which is more accurate than Queen's measure above only counting by adjacent boundaries. The local version of the statistic can be defined as:

$$I_i = z_i \sum_j w_{ij} z_j \tag{1}$$

In formula (1) where Z_i are the deviations from the mean of the variable being considered and W_{ij} is the distance weight matrix for the relationship between location *i* and *j* (Frizado, Smith, et al., , 2007). In ArcGIS, this can be easily analysed using the local Moran'I function in the mapping cluster toolkit. Z-score is used as the mapping value and the Z-score measures the degree of the tendency of clustering in space considering their connectivity to their neighbours. The foreign and local clusters are separately conducted from manufacturing and services clusters to avoid the overlapped results.

<u>Part C. Modelling the diversity and spatial proximity effect on the attraction of foreign firms</u>

In this part, the research focused on to what extent the local sectoral composition and other location attributes affect the agglomeration of foreign firms in different sectors, considering the spatial externalities and spatial proximity. This part is divided into three sections based on different theories. The first specification of model considers the spatial externalities of foreign firms from FDI location theory, the second model builds on the standard gravity model from agglomeration theory. The third one focuses on the elite foreign and local firms and investigates their spatial behaviour in different bandwidth, 1 km, 10 km and 100km based on location theory.

C.1To what extent does the diversity of local firms have influence on the agglomeration of foreign firms, considering spatial externalities?

Method: SLM (spatial lag model) and SEM (spatial error model)

Since the spatial measures move forward to capture spatial dependency and heterogeneity, then traditional OLS model doesn't have enough explanatory power in endogenous problems if a variable has spatial attribute. Anselin (1988) summarises two reasons to explain this situation, the first being the systemic errors for spatial units because of the aggregation step. This step generates the correspondence between spatial units and it inclines to spill-over to neighbourhoods. The second is the spatial interaction leading to a visible dependence at different locations, the observed locations are partially influenced by their neighbours. The first one is related to spatial lag model and the second one is related to spatial error model. The basic model is given as:

$$SLM: Y = \rho WY + X\beta + \varepsilon \tag{2}$$

In formula (2), ρ is the spatial autocorrelation coefficient; W is an $n \times n$ spatial weight matrix, the polygon contiguity matrix is used for this, WY is the spatial weighted dependent variable; $\varepsilon$is the vector of random error.

$$SEM: Y = X\beta + \varepsilon, \varepsilon = \lambda W\varepsilon + \mu \tag{3}$$

In formula (3), ε is the vector of random error, λ is the spatial error coefficient of dependent vector variable in $n \times 1$ cross-section; μ is the vector of random error in standard deviation.

Method: Spatial weight matrix specification (Polygon contiguity, first order)

Normally, $\boldsymbol{W}$ is set by dichotomy based on the Rook criterion of contiguity. The rule defines w_i=1 for the place that has a common side with neighbours vertically and horizontally; w_i=0 for non-neighbouring regions and elements of the principal diagonal. $\boldsymbol{W}$ is known as the geographic spatial weight matrix. In the spatial weighted matrix, Rook weight matrix is used.

The general form of matrix $\boldsymbol{W}$ is as follows:

$$\boldsymbol{W} = \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1N} \\ w_{21} & w_{22} & \cdots & w_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ w_{N1} & w_{N2} & \cdots & w_{NN} \end{bmatrix} \tag{4}$$

Secondly, the aim of row normalization of Rook weight matrix is to standardise $\boldsymbol{W}$, so maximum of spatial effects of neighbouring unit on each unit equals to 1. At the same time it helps to eliminate the external influence of inter-region. After that, $\boldsymbol{W}$ is set as:

$$w_{ij}^{*} = \frac{w_{ij}}{\sum_{j=1}^{N} w_{ij}} \tag{5}$$

$$W_E = \begin{bmatrix} w_{11}^* & w_{12}^* & \cdots & w_{1N}^* \\ w_{21}^* & w_{22}^* & \cdots & w_{2N}^* \\ \vdots & \vdots & \ddots & \vdots \\ w_{N1}^* & w_{N2}^* & \cdots & w_{NN}^* \end{bmatrix} \quad (6)$$

Since the regional maps have four islands which don't have neighbours and it brings errors with the models when calculating the eigenvalues of weights of matrix in Stata, therefore for the Chongming, Dinghai daishan, and Dongtou islands, their nearest island neighbours were counted.

C.2To what extent does the proximity effect of local firms have influence on the agglomeration of foreign firms?

Method: The Standard gravity model is used to calculate the proximity index, it is actually a geographically weighted local firms' turnover. The regression model was negative binominal model because the number of the foreign firms were counted in this section.

To quantify the extent of the effect on agglomeration of foreign firms from different sectors of local firms, a standard random profit framework is applied based on Jacobs (2013). The assumption is that to maximise its profits, firm *i* choose to locate in location *j (a unit of postcode 6 area).*

The proximity index is calculated by Γ_j, which means the MNEs' proximity to local firms in sector *j*. The index is defined as an exponential distance decay function in terms of revenues of local firms (Jacobs, Koster, et al., 2013).

$$\Gamma_{k=\sum_{k=1}^{K} e^{-\delta d_{k\text{k}} * m_k}} \quad (7)$$

In formula (7), d_{kk} is the distance between location$k$ and k, where k=1….K. m_k is the turnover of local firms at location k. δ denotes a distance decay parameter. Similarly, this formula is used to estimate the proximity between 9 sectors, defined as $\Gamma_j, j = 1, \ldots, 54$, like a 6×9 matrix for 6 sectors of foreign firms to 9 sectors local firms. Hence, proximity index is between the random local firm sectors *i* and foreign firms sector *m.* The geographically weighted turnover might have a positive impact on foreign firms' profits because it implies access to different local companies and may facilitate knowledge spill-overs among the geographic interactions. Natural logarithm is used to standardise the values. δconducts the connectivity to nearest neighbourhoods. When δ is 1, the weighted distance is 2.5 km, when δ=2.5, the weighted distance is 1.5km and when δ=5, the weighted distance is 0.5 km. According to the robustness, 1 is chosen for this study. Obviously, location attributes contribute to the attraction of foreign firms, therefore in the model specification, X_k is used to represent the location factors in k.

The profit function of a foreign firms is specified as follows:

$$\max \pi_{ik} = \alpha + \beta_1 \Gamma_k + \beta_2 X_k + \epsilon_{ik} \quad (8)$$

In formula (8), π is the estimated profits of foreign firms *i* choosing location in k. β_1, β_2 are the parameters to be estimated. ϵ_{ik} is a constant. For convenience, ϵ_{ik} obeys the Extreme Value Type I distribution.

$$\prod_{ik} = \frac{exp(\alpha + \beta_1 \Gamma_k + \beta_2 X_k + \epsilon_{ik})}{\sum_{k=1}^{K} exp(\alpha + \beta_1 \Gamma_k + \beta_2 X_k + \epsilon_{ik})}$$

The Formula (9) shows the probability of foreign firms *i* choosing their destinations k. Negative binomial regression can be used for over-dispersed count data, in the dataset, the Γ's conditional variance exceeds the conditional mean, so Poisson model is not applied.

C.3 In different Bandwidths of clusters what types of local firms will attract the foreign firms in manufacturing and services?

Method: OLS regression in different bandwidths.

The top 500 foreign firms and top 2000 local firms are chosen as the samples to do the analysis, because the maximum row of Excel is 1048576. When all the distance data between random two firms is counted, results generated a 2000×500 matrix. Nevertheless, it was important to sort out the distance data and thus vertical array was adopted bringing the final rows to 1000000 in Excel.

$$\begin{array}{cccc} \gamma & A_1 & B_1 & C_1 \\ A_2 & 1 & 0 & 0 \\ B_2 & 0 & 1 & 0 \\ C_2 & 0 & 0 & 1 \end{array} \longrightarrow \begin{array}{l} A_1\ A_2\ 1 \\ A_1\ B_2\ 0 \\ A_1\ C_2\ 0 \\ B_1\ A_2\ 0 \\ B_1\ B_2\ 1 \\ B_1\ C_2\ 0 \\ C_1\ A_2\ 0 \\ C_1\ B_2\ 0 \\ C_1\ C_2\ 1 \end{array} \qquad (10)$$

The study assumes A_1, B_1, and C_1 are foreign firms, A_2, B_2, and C_2 are local firms; γ is distance. Next, the distance is divided based on three distance thresholds (1km, 10 km and 100km), for each bandwidth the selected firms are picked and OLS model is used to analyse.

Chapter 4: Research Findings

Chapter is divided into three section, descriptive analysis, spatial analysis, and regression analysis. Each section is directed to specific subresearch questions. Section 4.1 explains the composition of top 20 industries in local and foreign firms. Section 4.2 uses Geoda and ArcGIS to identify the significant co-agglomeration counties (postcode-4) and industrial clusters (postcode-6) respectively. Section 4.3 conducts regression analysis about diversity and geographical proximity effect on the attraction of foreign firms. First, spatial externalities are taken into consideration in spatial lag model to capture the spatial externalities of FDI; second, geographically weighted local firms' turnover is used to combine the diversity and proximity effect; third, the results are discussed in different bandwidth to show the relations in different spatial scale.

4.1 Descriptive data on industry characteristics

This Orbis database has firm's contact information on postcode and city, but the city names are not standardised well. ArcGIS is used to map all the firms and then aggregate two shape files to give each firm's city, province attribute. Depending on the data available, the static analysis was conducted to compare characteristics of industries and sectors in different spatial scales.

4.1.1 The main industry composition of foreign and local firms in three provinces

	Zhejiang	Jiangsu	Shanghai
Manufacture of textiles	2.917	2.836	155
Manufacture of machinery and equipment n.e.c.	1.731	2.609	880
Manufacture of electrical equipment	1.398	1.634	537
Manufacture of wearing apparel	1.361	1.430	344
Manufacture of fabricated metal products, except machinery and equipment	1.326	1.936	649
Manufacture of rubber and plastic products	1.052	1.065	445
Manufacture of chemicals and chemical products	1.039	2.250	438
Manufacture of computer, electronic and optical products	856	1.420	410
Manufacture of other non-metallic mineral products	742	1.082	239
Manufacture of basic metals	715	1.222	161
Other manufacturing	698	535	206
Manufacture of leather and related products	683	188	89
Manufacture of food products	671	991	231
Manufacture of motor vehicles, trailers and semi-trailers	602	631	278
Manufacture of paper and paper products	510	345	139
Manufacture of wood and of products of wood and cork, except furniture; ma..	274	748	58
Manufacture of furniture	254	114	96
Manufacture of other transport equipment	206	414	126
Printing and reproduction of recorded media	201	154	92
Wholesale trade, except of motor vehicles and motorcycles	165	240	54

Table 5. Top 20 local industries by province

(Source: the author)

Both in Zhejiang province and Jiangsu province, the Manufacture of textiles takes the lead, accounting for 6.33% and 6.16% in the total production. Manufacture of textiles is a conventional industry in this region because of the world-famous handcraft that have been produced there for years The numbers of industries manufacturing machinery and equipment rank at second place with shares of 3.76% and 5.67% respectively. The percentage of industries manufacturing electrical equipment is the same in Zhejiang

(3.03%) and Jiangsu (3.55%), but it is half the number of textile industries. Manufacture of wearing apparel, fabricated metal products, rubber and plastic products and manufacture of chemicals industry in Jiangsu accounts for around 2.5% of the total number and the distribution of the above industries is more even compared to the ones in Zhejiang. In Jiangsu province, Manufacture of chemicals industry ranks the third (4.89%), reaching two times the share in Zhejiang (2.26%). Manufacture of rubber and plastic products accounts for 4.21% in Jiangsu province, almost 1.5 percentage more than that in Zhejiang. In shanghai, the top three industries are Manufacture of machinery and equipment, manufacture of fabricated metal products, and manufacture of electrical equipment. The manufacture of computers, electronic and optical products is 0.89% in the sixth place, which is 3.01% in Jiangsu and 1.86% in Zhejiang.

Basing on the above figures it can be seen that traditional export industries primarily concentrate in Jiangsu and Zhejiang provinces. Manufacture of electrical equipment and manufacture of machinery are large because they need to provide immediate inputs (machine) to other industries. In shanghai, no low-technology firms exist at the top of the list.

	Jiangsu	Zhejiang	Shanghai
Manufacture of computer, electronic and optical products	904	179	82
Manufacture of machinery and equipment n.e.c.	746	270	76
Wholesale trade, except of motor vehicles and motorcycles	607	210	5
Manufacture of chemicals and chemical products	495	200	43
Manufacture of electrical equipment	458	277	44
Manufacture of rubber and plastic products	390	136	46
Manufacture of textiles	380	194	13
Manufacture of fabricated metal products, except machinery and equipment	360	189	50
Manufacture of motor vehicles, trailers and semi-trailers	254	99	25
Manufacture of wearing apparel	231	114	24
Manufacture of basic metals	219	88	10
Manufacture of paper and paper products	179	92	24
Manufacture of other non-metallic mineral products	126	34	20
Manufacture of food products	124	65	23
Other manufacturing	103	72	20
Printing and reproduction of recorded media	98	81	30
Manufacture of other transport equipment	86	38	8
Manufacture of wood and of products of wood and cork, except furniture; manuf..	72	27	3
Manufacture of basic pharmaceutical products and pharmaceutical preparations	46	49	9
Manufacture of leather and related products	35	41	6

Table 6. Top 20 foreign industries by province

(Source: the author)

The table above shows that Manufacture of computers, electronics and optical products accounts for 12.5% of the total foreign industries, and 77.6% of them are concentrated in Jiangsu province, especially in Suzhou. Jiangsu is more attractive than Zhejiang for foreign investment based on the dataset. In Manufacture of machinery and equipment, the percentage in Jiangsu (8.01%) is three times higher than that in Zhejiang (2.39%), ten times that in Shanghai (0.81%). It is interesting to note that in the third place are not the traditional industries. Wholesale trade (except of motor vehicles and motorcycles) in Jiangsu province is 6.61% and lower in Zhejiang, accounting for 2.25%. The reason behind this could be that international brokers follow foreign investments to explore the domestic market or that the multinationals prefer to work with familiar suppliers and their own-country services suppliers also operate overseas offices to work with the subsidiaries (Wei, 2010). The industries in the fourth and fifth places in Jiangsu are industries engaged in the manufacturing of chemicals, and those manufacturing electrical equipment, accounting for 5.31% and 4.92% respectively. The difference in Zhejiang province is that the manufacture of textiles occupies 2.08% in the fifth place. The situation in Shanghai is different from Jiangsu and Zhejiang in Wholesale trade (except of motor vehicles and motorcycles), which does not rank high anymore, and is replaced by Manufacture of fabricated metal products (except machinery and equipment), accounting for 0.54%. The top ten industries in Jingsu, Zhejiang and Shanghai are responsible for 50.7% of the total population in the whole region.

Therefore from the above, the high-technology industry, especially the manufacture of computers and electronics takes the crown in Yangtze River Delta as well as whole sale firms. This suggests that they might act as brokers to link local manufactures to overseas buyers. Other foreign industries' structures are similar to local ones implying the embeddedness of the two is completed.

4.1.2 The distribution of nine sectors of foreign and local firms in 30 cities

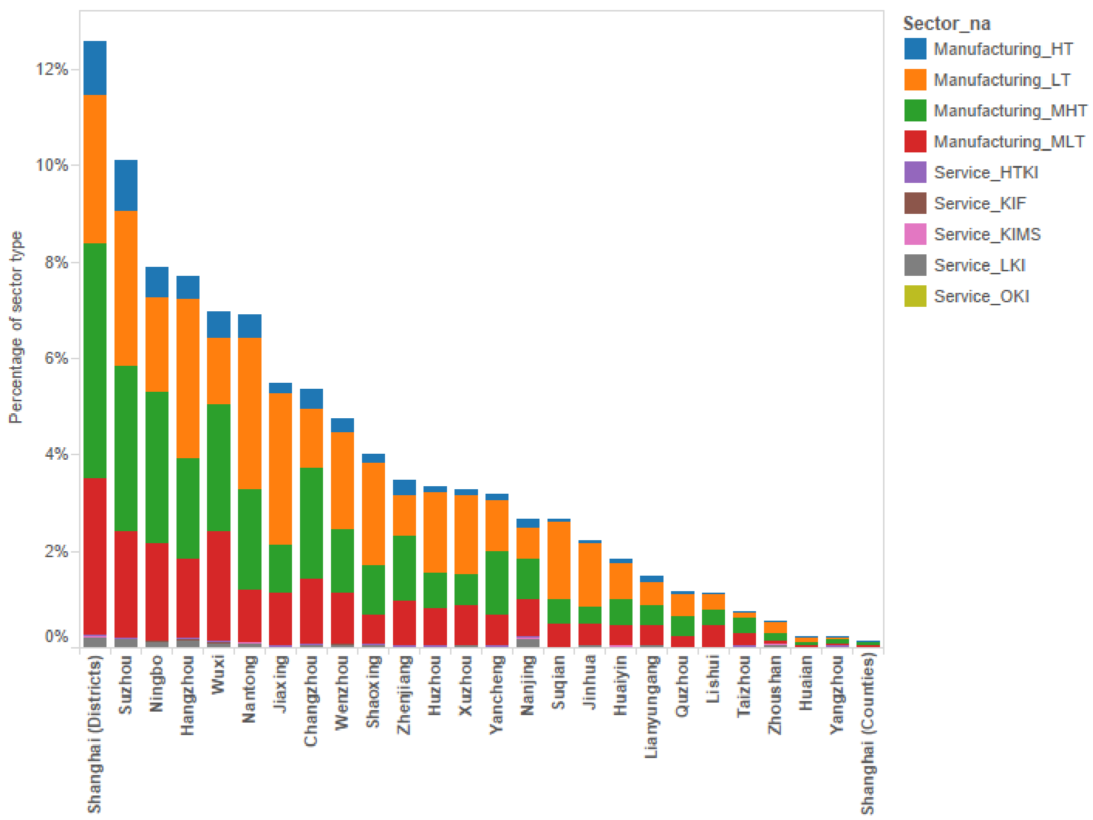


Chart 1. The percentages of local sectors in 26 cities

(Source: the author)

HT: High-tech, MHT: Medium-high-tech, MLT: medium-low-tech, LT: low-tech; HTKI: high-tech knowledge intensive, KIF: knowledge intensive financial, KIMS: knowledge intensive marketing service, LKI: less knowledge intensive, OKI: other knowledge intensive

The above chart shows the distribution of nine sectors in local industries in twenty-six main cities. Shanghai, Suzhou, and Ningbo, Hangzhou, Wuxi and Nantong have a percentage of total numbers of firms above 6%. Yangzhou, Huai'an, Zhoushan have the least number of firms, except Shanghai (Counties). Generally, low-tech, medium-high tech, medium-low tech firms are the majority sectors in these cities, knowledge-intensive services can be barely seen in (Chart 1). In the high tech sector, the top five cities are Shanghai (districts), Suzhou, Ningbo, Wuxi, and Nantong/Hangzhou (in the same place). Shanghai is the most attractive city for technology intensive investment followed closely by Suzhou, the two own almost 32% high-tech firms compared to the other cities. Ningbo, Wuxi, Nantong have the percentage of 9.61%, 8.05% and 6.89% respectively. On the other hand, in the low-tech sector, the percentage of firms in Hangzhou, Suzhou, Nantong, Jiaxing, and Shanghai (Districts) show their dominance over the other cities, accounting for 44.41% in total and 8.7% in average. In the medium high-tech sector, the percentage of firms in Shanghai is 15.17%, 1.5 times larger than that in Suzhou in the second place. In the medium low-tech sector, Wuxi replaces Suzhou in the second place with 9.82% firms, while Hangzhou comes in fifth among cities attractive to medium low-tech sector.

In service, Hangzhou, Shanghai (districts) and Nanjing rank as the top three in the concentration of high-tech knowledge-intensive firms, the firm's percentage accounting for 21.06%, 19.30% and 15.79% respectively. It is clear that the capital city prefers to maintain the knowledge intensive services and drives off the low-profit manufactures to periphery of the cities. Suzhou ranks the second place in knowledge-intensive financial sector and the third place in other knowledge-intensive services and less knowledge intensive services. This shows that in Suzhou industrial parks of different sectors are complementary. In knowledge-intensive market service sectors, Shanghai firms occupy 23.08% given that Shanghai has the largest volume of high-skilled labours and scientific research institutes. In less knowledge intensive sector, percentage of firms is similar in the three capital cities.

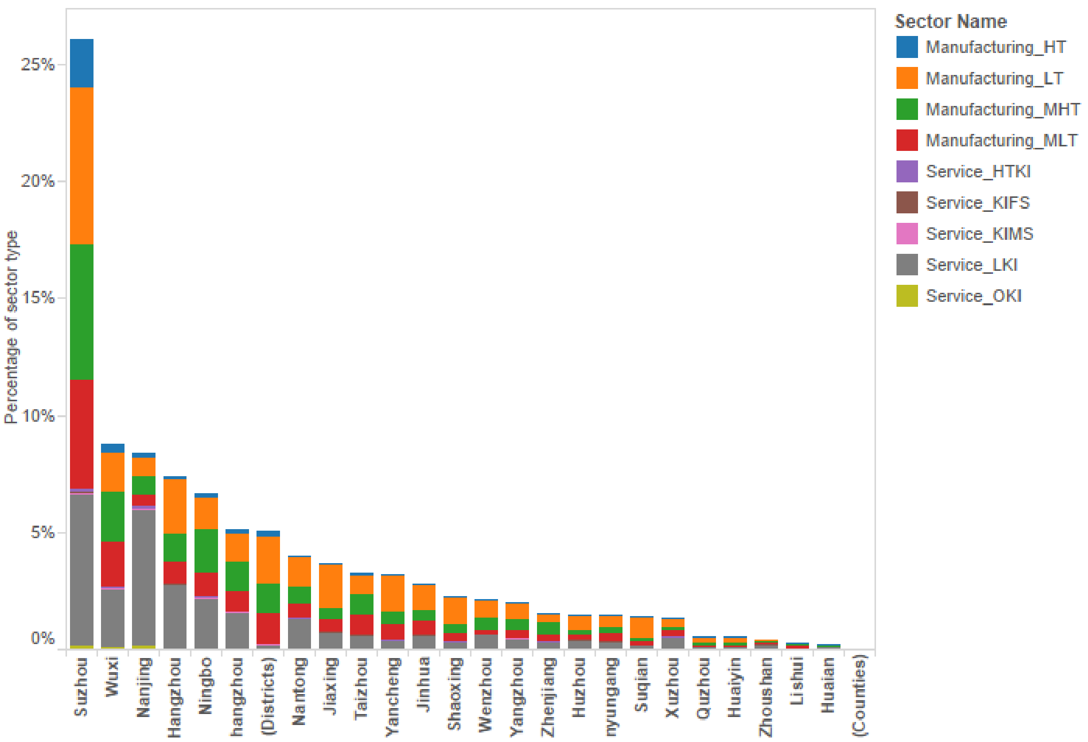


Chart 2. The percentages of foreign sectors in 26 cities.

(Source: the author)

Chart 2 illustrates Suzhou's incomparable advantage over other cities in attracting foreign firms, it owns almost 26.1% of foreign firms in the nine sectors. The second place city Wuxi only attracts 8.74% of foreign firms, accounting for less than 30% of Suzhou' share. Generally, the manufacturing sector is still the most popular, but compared to the local sectors the foreign less knowledge-intensive sector is much larger than the local ones. This shows that multinationals prefer to work with their own trade agencies and have the power to command them to operate their overseas offices. This is clear in low-technology firms like manufacture of food products and manufacture of beverages which cooperate with their international suppliers in less knowledge-intensive sector. In Suzhou, it can be seen that the proportion of manufactures and less knowledge intensive services are distributed evenly. This phenomenon could be attributed to Suzhou New District, which was one of the first industrial parks opened to attract foreign investors from APEC countries. It also served as an export zone for hi-tech related products and services in China[10]. The High-tech sector in Suzhou owns 50.12% share of the total number, in Wuxi and in Shanghai, only accounting for 8.59% and 7.09% respectively. In the medium high-tech sector, Ningbo ranks third place after Suzhou and Wuxi. In low-tech sector, Hangzhou ranks the second after Suzhou and Shanghai (districts). In knowledge intensive service, Hangzhou, Nanjing, Suzhou are the front runners among the city clusters.

In conclusion, high-tech and medium high-tech firms are mainly located in Shanghai, Suzhou, and Hangzhou. In services, Hangzhou, Shanghai (districts), Nanjing rank as the top three cities to absorb high-tech knowledge-intensive firms. The sub-centric cities like Ningbo, Wuxi, and Nantong are also undertaking many medium high-tech industries.

4.2 Spatial analysis on co-agglomeration of foreign and local firms

In this section, LISA maps in county (meso) and neighbourhood (micro) level have been used to identify the co-agglomeration patterns. In county level, this study emphasises the difference of relations of territories resulting from the co-agglomeration of knowledge intensive firms and high-tech firms (measure the foreign and local firms at the same time). In neighbourhood level, each point represents the autocorrelated significant clusters compared to their neighbours (measure the same type of firms). Therefore, first LISA map concerns the distribution of territories and second LISA map concerns the distribution of cluster itself.

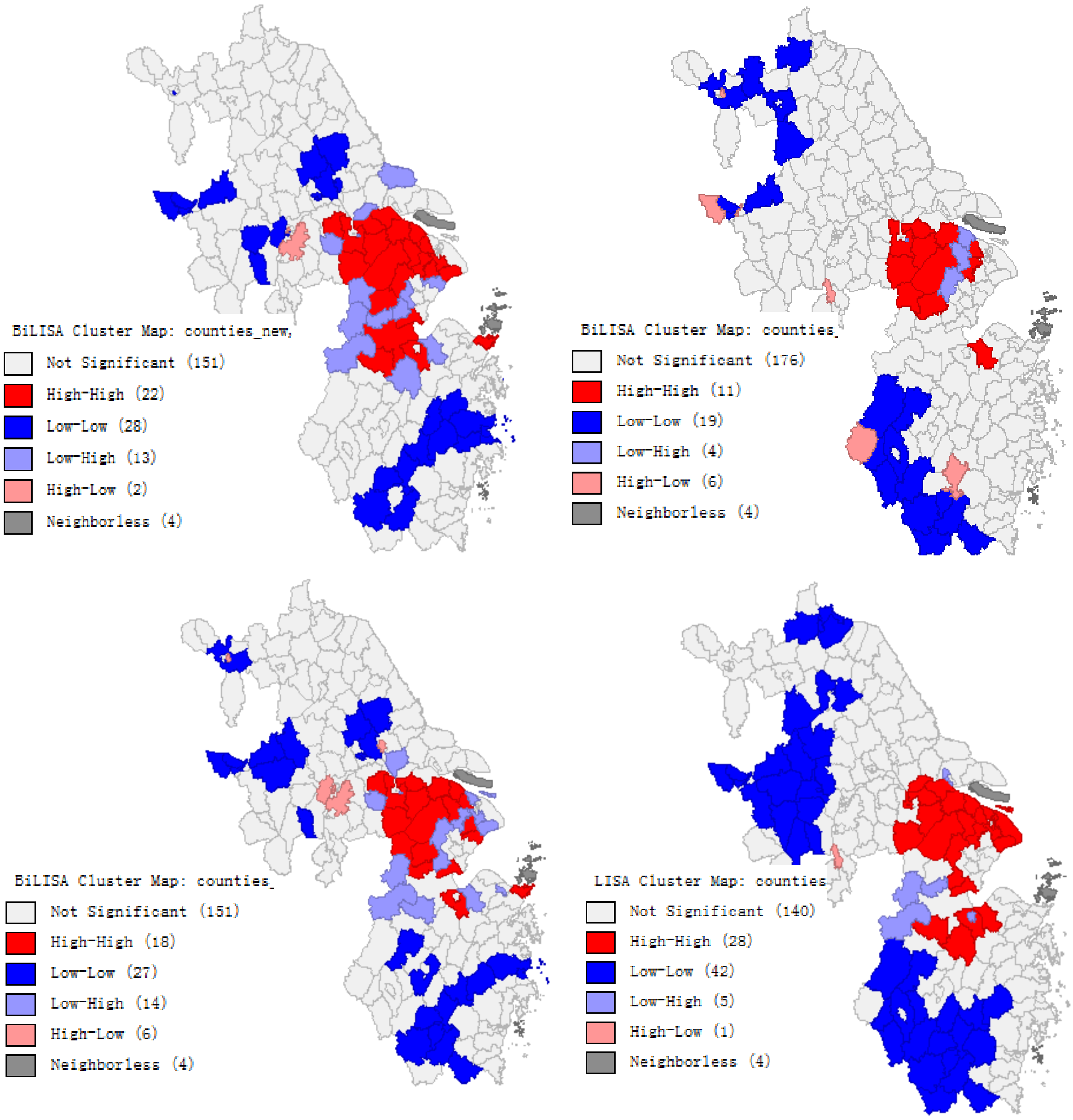
4.2.1 The significant co-agglomeration clusters at county level.

Firstly, we need to clarify why we only choose the co-agglomeration pairs between Firstly, there is need to clarify why the study only focuses on the co-agglomeration pairs between manufactures and services but not in same sector. In this section, the knowledge spill-overs across boundaries are examined, as earlier mentioned in Chapter 2. Knowledge spill-over could spread by the flows of employees, as they are more mobile. This part first looks at the co-agglomeration patterns on county level, and the LISA cluster map is adopted. The research uses GeoDa 1.6.7 to calculate significant co-agglomeration between foreign and local sectors based on z-test ($p \leq 0.05$) and499

[10] Website: http://wn.com/nanjing_daily

permutations. In the above maps (Figure 5), the coloured provinces are all significant core units which have a strong association with their neighbouring non-core units. The explanation of the legend is in Table 7.

Table 7. The explanation of LISA map legend



Category	Colour	Autocorrelation	Interpretation

Figure 5. LISA maps of co-agglomeration of foreign and local clusters at county level

(Source, the author, based on Geoda 1.6.7)

The LISA map of total foreign firms (core) to local firms (upper left), high -tech manufacturing foreign firms to KI local service (core, upper right), and KI foreign services (core) to high-tech manufacturing local firms (lower left). GDP map (lower right) is a reference. Results at 499 permutations, significant level at 0.05.

High-high	Red	positive	Cluster-"I'm high and my neighbours are high"
High-low	Pink	negative	Outlier- "I'm a high outlier among low neighbours"
Low-low	Med-blue	positive	Cluster-"I'm low and my neighbours are low"
Low-high	Light-blue	negative	Outlier- "I'm a low outlier among high neighbours"

(Source, the author)

The GDP map acts as a benchmark for the cluster analysis, it shows economic prosperity in each of the counties. From the spatial distribution, it is clear to that there are three core high GDP clusters and they are the Shanghai cluster, the Suzhou cluster and the Hangzhou cluster. Huzhou acts as a transitional county to bridge the Hangzhou cluster to the less developed area of southern Zhejiang. Another low GDP performance area is located in North West of Jingsu province. Generally, in the above three maps, there is one stable significant co-agglomeration area in high-high category in the central part, which consists of Suzhou, Wuxi, Changzhou, Huzhou districts and their administrative counties like Changhu, Taichang, Jiangyin, Kunshan. In the northern and southern region, there are several counties in low-low category. The High-low category members distribute in the space.

The upper left map, describes the co-agglomeration between domestic and foreign firms in total, there are three high-high agglomerated areas and the three centric counties are Shanghai (districts), Suzhou (districts), and Hangzhou (districts). Besides these three space, some outliers perform as bridges to fill the gap between the above space, and they are Changxing, Anji, Linan, Deqing, Tonhgxiang, and Xiuzhou to connect Suzhou cluster and Hangzhou cluster while county Jinshang connects Suzhou cluster and Shanghai cluster. On the opposite, southern counties like Lisui and Taizhou, northern counties like, Xinghua in Taizhou, Jiangdu and Chaoyu Yangzhou, and east counties like Fengyang in Chuzhou, Fengtai in Huaian are in low-low category.

In the upper right map, KI local services are chosen as the core units and HT foreign firms as their neighbours in surrounding counties. There are two high-high club members, the first is still the Suzhou cluster without Changshu, and the other one is Shanghai cluster which consists of Jiading and Qingpu. Kunshang, Wujiang and Taichang connects the two clusters as light-blue outliers, which shows less local services locating there compared to their neighbours. When compared to the first map, the three of them are significant in co-agglomeration of local and foreign firms, so the amount of foreign firms is not as little as the local services. Kunshang, Wujiang and Taichang are developed counties and famous for their ability to attract foreign investment. One possible explanation for this is that municipalities focus more on manufacturing industries and ignore the development of local services. County Kaihua in Quzhou is the only high outlier in the surrounding low-low club counties, when studying the GDP map, it is the only one county not in the low-low club and the reason for this is that tourism is the main industry in Kaihua. The high rate of coverage of high speed express increases its connectivity to other cities and improves its competitiveness to other city.

In the lower left map, KI foreign services are used as the core units and HT manufacturing local firms as the neighbouring units. The Suzhou cluster still dominates this area and in addition, Songjiang, Jiangding, Haining, and Shaoxing enter into the high-high club as new comers. Shaoxing is famous for its textiles export, the products account for the 60% of the world textiles trade[11]. Huzhou and Fuyang are not as attractive as much as their neighbours to foreign knowledge intensive service. Jiangding and Pukou are the high outliers the reason could be that they are districts in capital city Nanjing, which gives them the privilege of attracting more foreign investment than surrounding counties.

In conclusion, the co-agglomeration patterns consists of three significant clusters: Shanghai counties cluster, Suzhou counties cluster and Hangzhou clusters. The spatial distribution is consistent with their economic prosperity. Some counties act as bridges to connect spatial dispersed counties in the region. Counties in northern Jiangsu and southern Zhejiang are not competitive as much as the ones in the central region. In addition, if the results in part one are combined, it is easy to detect that these clusters are actually foreign investment-led clusters. Wei (2010) defines these kind of clusters in China as exogenous clusters. This means that multinationals take the leading place, and local firms follow with these exogenous 'cores' to agglomerate. Another phenomena is that the numbers of high-high clubs in the second map are lower than that in the third map. The economic growth in east China heavily depends on industries agglomeration. Mutinationals transfer their low-profit process of productuion to China and take advantage of their ownership advantages and distribution channels to enlarge their markets, this implies that local clusters heavily depend on foreign firms. The local services are underdeveloped compared to local industries.

4.2.2 The significant co-agglomeration clusters at neighbourhood level

This tool in Arcmap presents the statistically significant spatial clusters of high values (Cluster high) and low values (Cluster Low). The z-score of features indicates the significant values of clusters compared to other expected random values. The higher (or lower) the Z score, the more (or less) intense the cluster. What's more, the software will automatically select parameter settings optimised to hot spot results. In the Conceptualization of Spatial Relationships section, the default fixed distance will ensure each feature has at least one neighbour. The distance section will use the Euclidean distance.

Figure 6 describes the spatial patterns of significant clusters between foreign firms and local firms, and the non-significant clusters have been filled as light-grey colour. The map above shows a spatial embeddedness of foreign firms and local firms. Foreign firms concentrate mainly in Suzhou (district) Kunshan, Changshu, Taicang, and Wuxi; some small clusters are located in Hangzhou (district). The agglomeration of local clusters is divided into three parts, the first is the high outliers in Shanghai (district), Kunshan and Changshu, second is Wuxi, Changzhou high clusters with some high outliers in Zhengjiang and third is Hangzhou cluster and few clusters in Ningbo. Their spatial location surrounds foreign clusters.

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[11]Website source: https://zh.wikipedia.org/wikiShaoxing.E7.BB.8F.E6.B5.8E

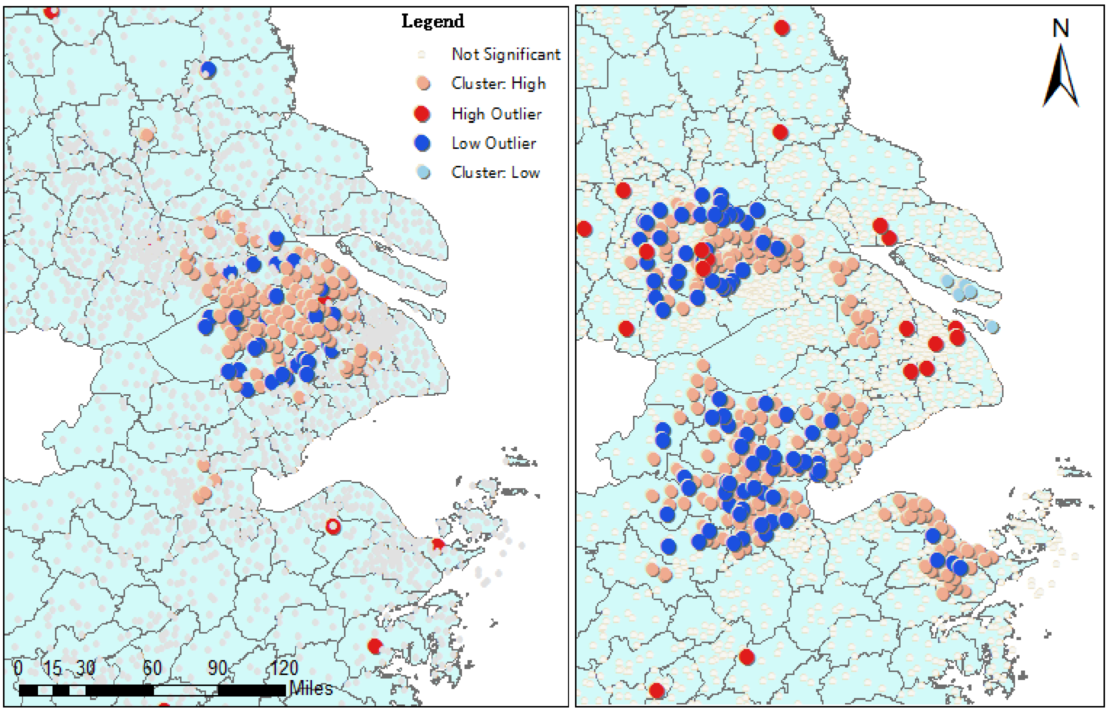

Figure 6 LISA maps of significant foreign and local firm clusters at neighbourhood level

Foreign firm's clusters (left) and local firm's clusters (right)

Figure 7 presents four maps as a comparable view of foreign and local significant clusters in manufactures and services. High-tech foreign firms intensely concentrate in Suzhou, Changshu, Taicang and Kunshang, corresponding to their knowledge intensive services mainly in Shanghai and surrounding counties. Local knowledge intensive services significantly concentrate in three areas, Shanghai, Suzhou, and Hangzhou, but they are not as intensive as much as foreign ones. High-tech local firms concentrate in Suzhou and Nanjing, and some high outliers are distributed between Shanghai and Suzhou, Suzhou and Nanjing. Knowledge intensive foreign services have several easily identifiable 'cores' in Shanghai, Northern Suzhou, Hangzhou, and some coastline counties like Cixi, Zhenhai, and Yingzhou. Many high outliers are distributed in the Northern region, almost in each county. From the collaborative spatial patterns aspects, foreign firms whether in manufactures or services, are more concentrated in high-high club clusters (Shanghai, Suzhou, and Hangzhou). What's more, geographic proximity matters in the location choice of industry and service, services locate in capital cities to access the sufficient urban amenities and skilled labours. Manufactures locate in the policy-led industrial parks to take advantage of benefits from tax reduction. In addition, in almost each county with high outliers of local high technology manufactures, there are knowledge intensive foreign firms that co-locate with them. This points at the fact that foreign services are more flexible in their location strategy, they are not satisfied with their 'home clients' and positively engage in local production with domestic industries. Chen (2008) discusses the spatial evolution of foreign producer services in terms of path dependence and industrial connection in Jiangsu province. The results show that path dependence and industry connection influence knowledge intensive services' location choice in the short term. Martin and Sunley (2006) argue that path dependence and 'lock-in' are place-dependant processes, and as such need empirical spatial research. This can also explain the spatial behaviour of local services. They mainly stay closer to foreign manufacturers. The agglomeration of high-level technology firms is the determinant of their location choice. On the other hand, this might imply their path-dependency to foreign firms.

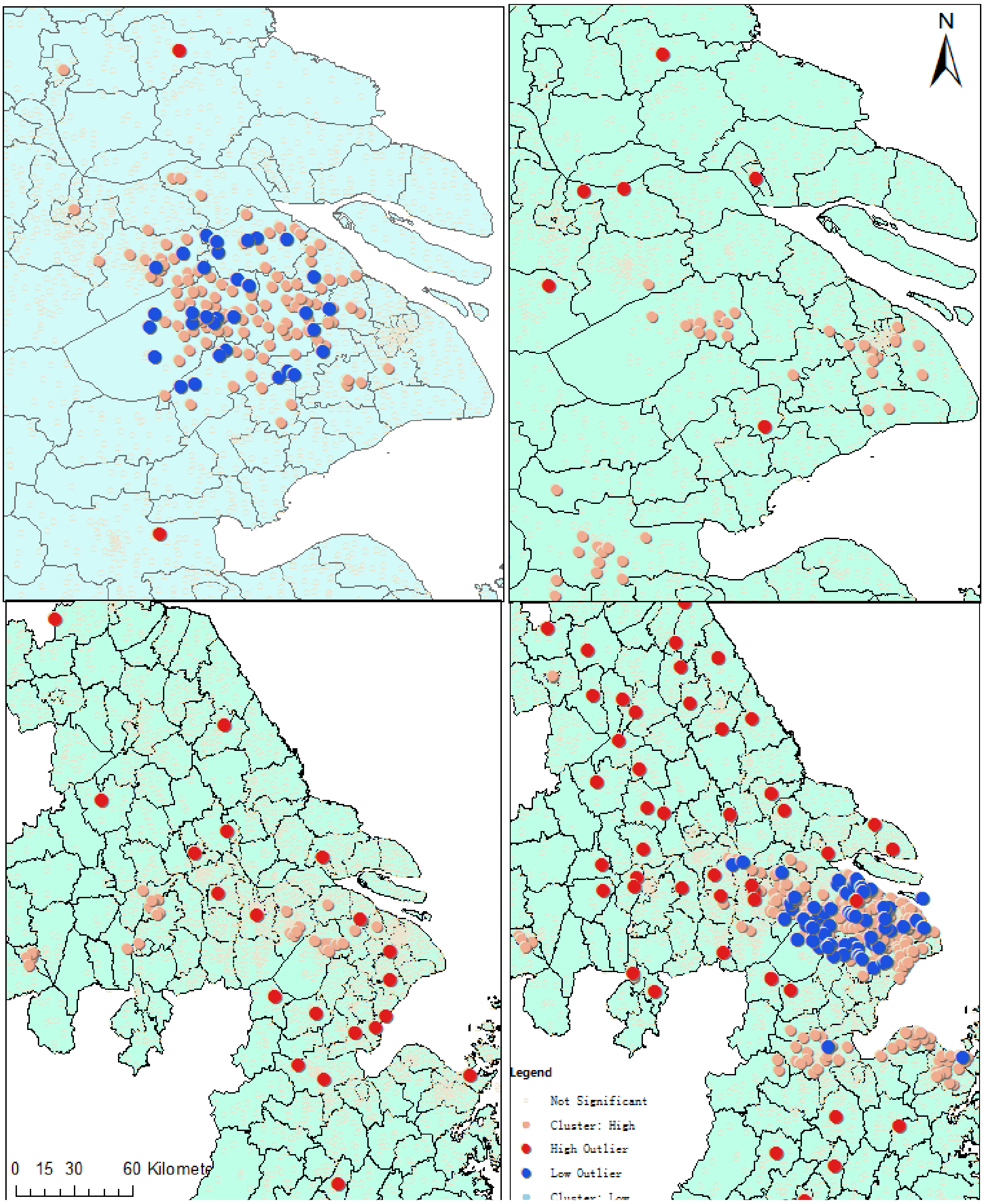

Figure 7. LISA maps of significant foreign and local firm clusters divided by sectors

Four maps in neighbour level, the significant cluster of high-tech foreign firms (upper left), knowledge-intensive local firms (upper right), high-tech local firms (lower left) and knowledge-intensive foreign firms (lower right)

In conclusion, the spatial distribution of foreign firms is uneven. Foreign firms' proximate connection to both foreign and local firms is stronger than their counterparts 'connection.

4.3 Regression analysis of diversity and spatial proximity effect on foreign firms' spatial behaviours.

4.3.1 Diversity effect of local firms on foreign firms' spatial behaviours, considering spatial externalities.

In Part two the study analyses the co-agglomeration between foreign firms and local firms. The significant high value cluster across boundaries suggests the presences of spatial dependency and heterogeneity between each observation. In this part, the study tries to investigate the diversity effect on foreign firms using spatial and sectoral units. This methodology helps to have deep understanding of foreign firms' location choice with an inter- and intra-industry stand. This part is divided into three sections, first, spatial lag model is used to capture spatial externalities based on some empirical researches in line with FDI location theory. Second, a standard gravity model is introduced to measure the proximity effect on foreign firm's concentration with firm-level data. Finally yet importantly, their performance in different distance thresholds is discussed.

The traditional ordinary least squares model fails to explain the endogenous problems in variables with spatial attributes. Hence, the spatial lag model and spatial error model are introduce to overcome this. Multicollinearity test has been done, and the average VIF is 6.7. A list of the variables and their explanations is in Table 8.

Table 8. Abbreviation and explanation of variables

	Categories	Abb.	Name of variables
Dependent variable (Numbers)	Manufactures	F_ht	Foreign firms in high-technology
		F_mht	Foreign firms in medium-high-technology
		F_mlt	Foreign firms in medium-low-technology
		F_lt	Foreign firms in low-technology
	Knowledge intensive services	F_kims	Foreign firms in Knowledge-intensive market service
		F_htkis	Foreign firms in high-tech knowledge-intensive service
		F_kifs	Foreign firms in knowledge-intensive financial service
		F_oki	Foreign firms other knowledge-intensive
	Less KI services	F_lki	Foreign firms in less knowledge-intensive
Independent variables (numbers)	Agglomeration index	I_LF	Herfindahl index of local firms in total
		L_ht	Local firms in high-technology
		L_mht	Local firms in medium-high-technology
		L_mlt	Local firms in medium-low-technology
		L_lt	Local firms in low-technology
		L_kims	Local firms in Knowledge-intensive market service
		L_htkis	Local firms in high-tech knowledge-intensive service

		L_kifs	Local firms in knowledge-intensive financial service
		L_oki	Local firms other knowledge-intensive
		L_lki	Local firms in less knowledge-intensive
Control variables		GDP_Density	Density of total GDP in built up area
		Pop_Density	Density of total population in built up area
		Airport	Dummy of Airport (1=Yes; 0=No)
		Railstation	Dummy of Railstation (1=Yes; 0=No)
		University	Dummy of University (1=Yes; 0=No)
		Port	Dummy of Port (1=Yes; 0=No)
		Economic Zone	Dummy of Economic Zone (1=Yes; 0=No)
		Capital City	Dummy of Capital City (1=Yes; 0=No)

(Source: the author)

4.3.1.1 Spatial model estimation and specification

First the OLS regression is run to get LM (Lagrange Multiplier) diagnostics, LM-lag and LM-error and robust LM diagnostics as reference, then according to the rules from Anselin to decide whether OLS or spatial model is. Anselin and Florax (1995) raise the following rules; first to check the value of Moran'I, if the p-value is significant, then this variable is identified to have spatial dependency. In the LM diagnostics, if LM-lag is more significant than LM-error in statistic, and Robust LM-lag is significant but Robust LM-error is not, then the spatial lag model is used (Artelaris and Petrakos, 2014). In the LM diagnostics, if LM-error is significant than LM-lag in statistics, and Robust LM-error is significant but Robust LM-lag is not, then the spatial error model is used (Artelaris and Petrakos, 2014). Except the R^2 test, Log likelihood, Likelihood Ratio, AIC (Akaike information criterion), SC (Schwartz criterion) has been used for estimation. If log likelihood is bigger, AIC and SC is smaller, then the goodness of fit is better. The process is shown in the Figure 8 below. For each y variable, from high-tech to less knowledge intensive services, its spatial autocorrelation is tested.

4.3.1.2 Results of Model estimation

In Table 9 all the results of LM diagnostics are listed as well as robust LM diagnostics. For foreign firms in high-tech, medium high-tech, medium low-tech, and low-tech, their p-value in global Moran'I is significant at 0.01, 0.01, 0.01 and 0.1 level respectively. Services in knowledge intensive marketing, high-tech knowledge intensive are not significant, hence the OLS results are kept. The p-value in knowledge intensive financial, other knowledge intensive and less knowledge intensive service are significant at 0.05, 0.01 and 0.01 level. Next, for the foreign manufactures in high-tech, medium high-tech, medium low-tech, and low-tech, their Robust LM-lag is significant, but LM-error is not, so spatial lag model is chosen. For the knowledge intensive marketing and high-tech knowledge intensive services the OLS results are maintained. In knowledge intensive financial services, both robust LM-lag and robust LM-error are not significant, the OLS results are used. In other knowledge intensive services and less knowledge intensive services, the spatial lag model is used. All the model choices are listed in Table 10.

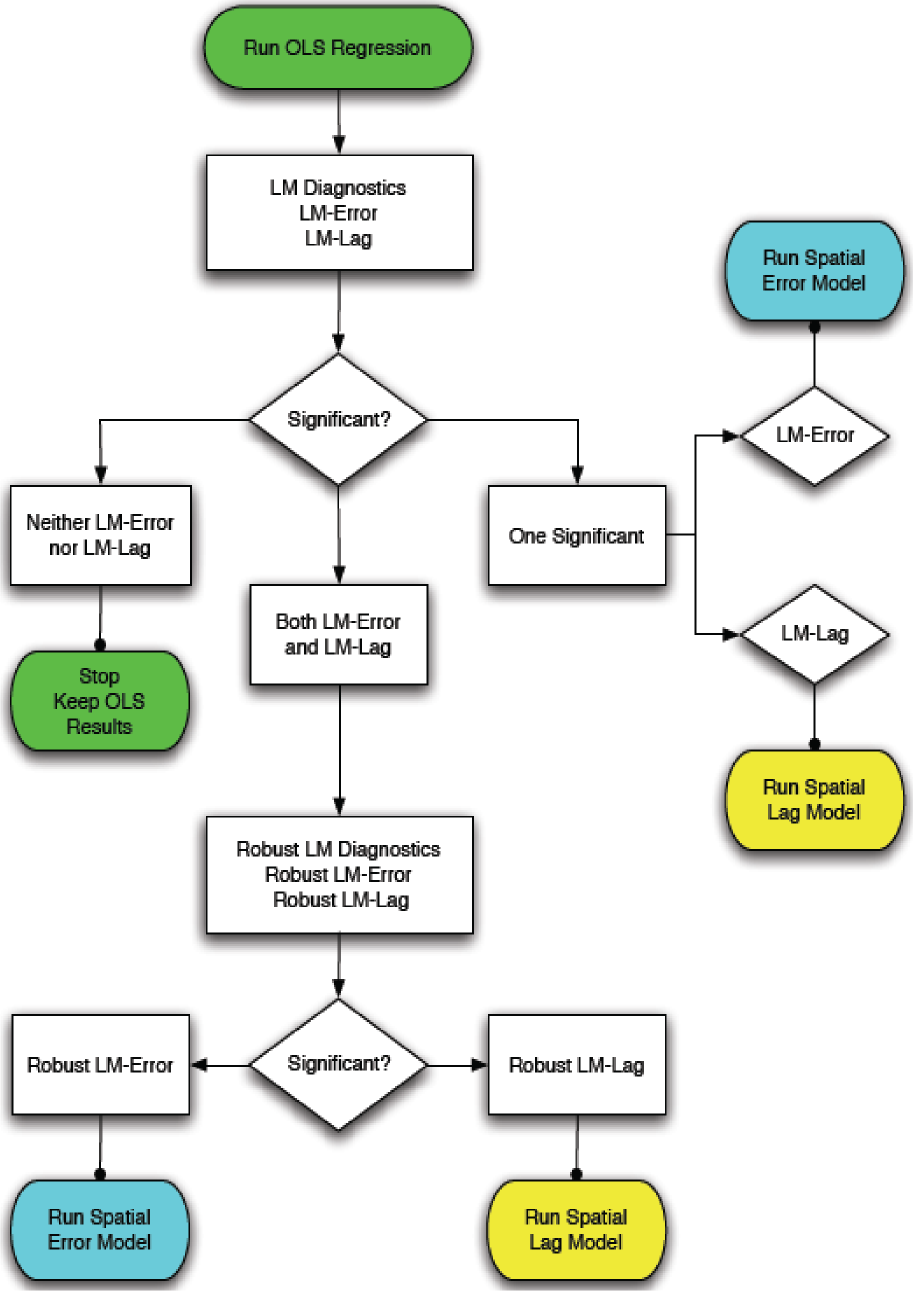

Figure 8. The process of spatial model estimation

(Source: edited from Frizado et al., 2007)

Table 9 The result of spatial autocorrelation test for variety spatial regression model estimation

Dependent Variable	LM(lag)		Robust LM(lag)		LM(error)		Robust LM(error)		Moran' I	
	value	p-value	value	p-value	value	p-value	value	p-value	value	p-value
F_ ht	21.532	0.000	7.570	0.006	15.12	0.000	1.167	0.280	4.438	0.000
F_mht	29.083	0.000	20.262	0.000	10.85	0.001	2.038	0.153	3.840	0.000
F_mlt	21.231	0.000	15.354	0.000	5.951	0.015	0.075	0.785	2.962	0.003
F_lt	10.222	0.001	9.143	0.002	1.514	0.219	0.435	0.510	1.720	0.085
F_kims	0.382	0.536	1.989	0.158	0.011	0.917	1.618	0.203	0.564	0.573
F_htkis	2.164	0.141	0.695	0.405	1.663	0.197	0.193	0.660	-0.868	1.614
F_kifs	2.780	0.095	0.291	0.590	2.758	0.097	0.268	0.604	2.162	0.031
F_oki	13.345	0.000	5.391	0.020	8.135	0.004	0.181	0.670	3.385	0.001
F_lki	34.255	0.000	10.496	0.001	37.42	0.000	10.49	0.001	6.738	0.000

Table 10 the result of variety spatial regression model

Dependent Variable	Log likelihood	AIC	BIC	Model
F_ht	-861.1151	1764.23	1835.496	Spatial lag
F_mht	-786.9891	1617.97	1692.638	Spatial lag
F_mlt	-712.565	1469.13	1543.79	Spatial lag
F_lt	-776.851	1597.72	1672.362	Spatial lag
F_kims	-64.64619	173.292	247.9522	OLS
F_htkis	-45.95282	135.905	210.5654	OLS
F_kifs	-6.588377	57.1767	131.8366	OLS
F_oki	3.279695	37.4406	112.1004	Spatial lag
F_lki	-689.7865	1423.57	1498.233	Spatial lag

*Notes: AIC is Akaike information criterion; BIC is Bayesian information criterion.

4.3.1.3 Model results

Table 11 describes the extent of the impact of local diversity and location attributes on the concentration of foreign firms at county level, considering spatial externalities. First, related sectors are more attractive to others. In model specification (1) - (4), local firms in the same sectors with foreign firms are significant in statistics, especially in the high-tech sector. If other factors stay the same, an increase of one unit of high-tech local firms will cause the number of high-tech foreign firms to change by 0.296 on average. It is noticed that one firm's medicine is another firm's poison. In model specification (2), an area with many medium high-tech local firms is likely to attract more medium high-tech foreign firms, but model specification (1) presents its negative relations to foreign high-tech manufactures, the coefficient is significant at 1% level. Similarly, low-tech local firms are negatively related to both foreign medium high-tech and medium low-tech, but a positive relation with foreign low-tech is found at 1% level in statistics. In service sectors, local knowledge intensive services are negatively related to medium high tech manufactures and medium low tech manufactures. The coefficient in knowledge intensive financial services is higher than other sectors and this is because the commercial rent for financial firms is generally higher to foreign industries.

In the location attributes aspect, local firm agglomeration index has strongly positive relations with foreign medium high-tech, medium low-tech, and low-tech firms but not the high-tech foreign firms. All the coefficients of degree of urbanisation (Pop_D) describe a negative relation to foreign manufactures. This is in line with foreign investment-led cluster policy, government provides lower land rent to foreign firms in the urban periphery where there are less residential households locating there. In contrast, GDP density shows no significant relation with foreign manufacturing firms. High speed Rail stations is strongly related to foreign manufactures as well and this implies that the presence of high speed rail infrastructure plays a big role in attracting multinationals probably because it presents them with opportunities of more reliable transportation at less costs a factor that multinationals consider very important.

In table 12, only the significant relations are described at 1% level. Generally speaking, local agglomeration index is significant at 1% level in model specification (7) and (8). The significant coefficient on local other knowledge intensive services suggests that a 1% increase in the number of firms would raise the concentration of high-tech knowledge intensive services by 0.70%. This results buttresses the argument that IT industries or scientific institutes prefer to locate in life style and culturally vibrant environments where libraries, sports activities, and social work activities are concentrated. Foreign and local firms also co-agglomerate in less KI service sectors where wholesale trade, retail trade, real estate activates rental and leasing activities are included. The airport is the only one significant location factor to foreign high-tech KI service and this shows the high-level requirement of time efficiency for HTKI multinationals.

In conclusion, local and foreign firms tend to co-agglomerate in similar industries than inter-sector industries. This is in line with the studies that revealed localisation economies is more important than urbanisation economies (Barrios, Görg, et al., 2006). The positive effect of high-speed railway station is also in accordance with the discussion in Chapter2. Services are competitive in the same sector, but they are complementary between sectors.

Table 11. The regression results of local diversity effect on foreign manufactures' agglomeration, considering spatial externalities.

	(1) Spatial lag High tech manufacture	(2) Spatial lag Medium high tech manufacture	(3) Spatial lag Medium low tech manufacture	(4) Spatial lag Low tech manufacture
GDP_Density	-0.400	2.452	2.027	1.282
	(1.439)	(2.478)	(1.796)	(2.465)
Pop_Density (ln)	-1.174*	-3.254***	-1.538**	-2.459**
	(0.602)	(1.037)	(0.752)	(1.033)
I_LF	-7,970	57,232***	16,338*	29,126**
	(7,181)	(12,358)	(8,959)	(12,332)
L_ht	0.296***	0.0712	0.0454	-0.0511
	(0.0378)	(0.0651)	(0.0472)	(0.0649)
L_mht	-0.0322***	0.0784***	0.00142	0.00743
	(0.0106)	(0.0183)	(0.0133)	(0.0182)
L_mlt	-0.00855	-0.00601	0.0645***	-0.0264
	(0.0143)	(0.0246)	(0.0178)	(0.0243)
L_lt	0.000313	-0.0447***	-0.0148**	0.0596***
	(0.00533)	(0.00915)	(0.00666)	(0.00947)
L_kims	-0.909	-2.414**	-1.164	-0.124
	(0.664)	(1.139)	(0.826)	(1.134)
L_htkis	-0.756	-2.109**	-1.823**	-0.678
	(0.611)	(1.060)	(0.767)	(1.049)
L_kifs	-1.024	-3.758**	-2.543*	-0.711
	(1.058)	(1.813)	(1.316)	(1.806)
L_oki	0.517	2.671	2.790*	-0.599
	(1.280)	(2.212)	(1.607)	(2.185)
L_lki	-0.0530	0.457**	0.241*	0.243
	(0.112)	(0.192)	(0.139)	(0.191)
Airport	0.990	-1.357	0.135	-2.881
	(1.467)	(2.538)	(1.840)	(2.519)
Railstation	3.910***	8.053***	3.537**	6.341***
	(1.235)	(2.115)	(1.528)	(2.088)
University	1.219	1.240	0.145	1.506
	(0.834)	(1.436)	(1.042)	(1.432)
Port	0.749	-0.0583	-0.0116	2.547
	(0.914)	(1.577)	(1.143)	(1.568)
Economic Zone	1.011	4.088**	2.036*	2.899*
	(0.948)	(1.628)	(1.179)	(1.621)
Capital City	1.541	-4.781**	-1.683	-1.895
	(1.194)	(2.070)	(1.499)	(2.051)
Constant	10.39**	25.13***	11.99*	20.17**
	(5.110)	(8.798)	(6.380)	(8.765)
Log likelihood	-653.206	-772.724	-702.257	-771.819

*Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 12. The regression results of local diversity effect on foreign services' agglomeration, considering spatial externalities.

	(5) OLS market KI service	(6) OLS High-tech KI service	(7) OLS financial KI service	(8) Spatial lag Other KI service	(9)Spatial lag Less KI service
GDP_Density	0.0367	-0.0163	0.00355	-0.0251	-0.973
	(0.0606)	(0.0539)	(0.0306)	(0.0420)	(1.582)
Pop_Density(ln)	-0.0211	0.0249	-0.0371	0.0108	-0.0715
	(0.0366)	(0.0364)	(0.0319)	(0.0261)	(0.666)
I_LF	-1,441**	-740.5	1,124***	-391.0	25,019***
	(641.8)	(781.0)	(412.7)	(668.8)	(7,916)
L_ht	0.00103	-0.00514	-0.00347	-0.00376	-0.0650
	(0.00300)	(0.00500)	(0.00244)	(0.00241)	(0.0416)
L_mht	0.00143	0.00119	-0.00104*	0.000906	0.00241
	(0.00137)	(0.000959)	(0.000535)	(0.000792)	(0.0117)
L_mlt	0.00138	0.00168	0.000252	0.000249	-0.0279*
	(0.00111)	(0.00145)	(0.00101)	(0.00108)	(0.0158)
L_lt	-0.000501	-0.000970*	0.00114**	-0.000796**	-0.0118**
	(0.000405)	(0.000570)	(0.000471)	(0.000385)	(0.00585)
L_kims	0.0418	-0.0331	-0.00666	0.0149	0.782
	(0.0689)	(0.0448)	(0.0241)	(0.0461)	(0.728)
L_htkis	-0.0308	-0.0869	0.0284	-0.0118	-0.569
	(0.0436)	(0.0601)	(0.0253)	(0.0541)	(0.663)
L_kifs	0.00270	0.0508	0.142	-0.187*	-1.223
	(0.0952)	(0.123)	(0.0950)	(0.110)	(1.165)
L_oki	-0.227**	0.707***	-0.0459	0.171	3.446**
	(0.114)	(0.129)	(0.0847)	(0.151)	(1.389)
L_lki	0.0267**	0.0217**	-0.00643	0.0336**	1.007***
	(0.0124)	(0.0108)	(0.00706)	(0.0138)	(0.122)
Airport	0.000483	0.332**	-0.0782**	0.0444	-2.583
	(0.163)	(0.141)	(0.0381)	(0.111)	(1.611)
Railstation	0.0698	-0.00828	0.0378	0.0626	-0.640
	(0.136)	(0.101)	(0.1000)	(0.0613)	(1.340)
University	0.0702	0.0480	-0.00218	0.0387	1.487
	(0.0863)	(0.0598)	(0.0420)	(0.0432)	(0.918)
Port	-0.0440	-0.0289	0.0543	-0.0662	-0.368
	(0.0662)	(0.0531)	(0.0649)	(0.0470)	(1.007)
Economic Zone	-0.0908	-0.0834	0.0477	0.0287	1.179
	(0.114)	(0.0591)	(0.0452)	(0.0445)	(1.037)
Capital City	0.0782	-0.0520	0.0135	-0.0311	-2.340*
	(0.0954)	(0.0893)	(0.0628)	(0.0587)	(1.314)
Constant	0.269	-0.239	0.372	-0.118	-1.469
	(0.308)	(0.319)	(0.275)	(0.235)	(5.664)
R2/log likehood	0.250	0.817	0.442	0.562	-675.422

*notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

4.3.2 The proximity and diversity effect of local firms on foreign firms' spatial behaviours

Koster et al. (2013) and Van soest et al. (2006) argue that knowledge and technology spill-over only works within relative scales. Cities, or counties are too large to measure the proximity effect. Hence, according to agglomeration theory, the model was revised to a standard gravity model and in this model, distance is used as a weighted parameter to local firm's turnover, and it is assumed that foreign firms which prefer to maximise their profits locate with large firms nearby, which provides local knowledge and specialised labour force. The explanation of variables is listed in Table 13.

Table 13. Abbreviation and explanation of variables

	Categories	**Abb.**		**Name of variables**
Dependent variable (Numbers)	Manufactures	F_ht		Foreign firms in high-technology
		F_mht		Foreign firms in medium-high-technology
		F_mlt		Foreign firms in medium-low-technology
		F_lt		Foreign firms in low-technology
	Knowledge intensive services	KI services	F_kims	Foreign firms in knowledge-intensive market service
			F_htkis	Foreign firms in high-tech knowledge-intensive service
			F_kifs	Foreign firms in knowledge-intensive financial service
			F_oki	Foreign firms other knowledge-intensive
	Less KI services	F_lki		Foreign firms in less knowledge-intensive
Independent variables	Manufactures	Γ Proxi_ht		Proximity to local firm in high-technology
		Δ Proxi_mht		Proximity to local firm in medium-high-technology
		Θ Proxi_mlt		Proximity to local firm in medium-low-technology
		Λ Proxi _lt		Proximity to local firm in low-technology
	Knowledge intensive services	Π Proxi_kims		Proximity to local firm in Knowledge-intensive market service
		Φ Proxi_htkis		Proximity to local firm in high-tech knowledge-intensive service
		Ψ Proxi_kifs		Proximity to local firm in knowledge-intensive financial service

		Ω Proxi_oki	Proximity to local firm in other knowledge-intensive
	Less KI services	ζ Proxi_lki	Proximity to local firm in less knowledge-intensive
Control variables		GDP_Density	Density of total GDP in built up area
		Pop_Density	Density of total population in built up area
		Airport	Dummy of Airport (1=Yes; 0=No)
		Railstation	Dummy of Railstation (1=Yes; 0=No)
		University	Dummy of University (1=Yes; 0=No)
		Port	Dummy of Port (1=Yes; 0=No)
		Economic Zone	Dummy of Economic Zone (1=Yes; 0=No)
		Capital City	Dummy of Capital City (1=Yes; 0=No)

(Source: the author)

We use negative binomial regression to estimate the coefficients of proximity.

$$F_x = \beta_1 + \Gamma\beta_2 + \Delta\beta_3 + \Theta\beta_4 + \Lambda\beta_5 + \Pi\beta_6 + \Phi\beta_7 + \Psi\beta_8 + \Omega\beta_9 + \zeta\beta_{10} + X\beta_{11} + \epsilon \qquad (11)$$

The results in Table (14) are consistent with Model 1, within a short distance, local firms and foreign firms in the same sectors have significant relations. Doubling the weighted turnover in local high-tech firms increases the number of foreign high-tech firms by 3.5 percent. In addition, local firms in 'related' sectors also attract similar foreign firms. For instance, local firms in high-tech and medium high tech sectors are positively related to high-tech foreign firms; local firms in medium high tech and medium low-tech sectors are positively related to foreign medium high-tech firms. The main composition of foreign HT sector is manufacture of computers, electronics and optical products (12.51%) and manufacture of pharmaceuticals industry (1.12%). Local HT is manufacture of computers, electronics and optical products (5.84%) and manufacture of pharmaceutical industry (1.10%). Local medium HT sector is manufacture of machinery and equipment n.e.c. (11.34%), manufacture of chemicals industry (8.10%), and manufacture of electrical equipment (7.75%). Foreign high-tech firms significantly locate with specialised local industries, where they can maximise their advantages with high technology thresholds. Another possible explanation is that they want to acquire local knowledge and enjoy spill-over backwards. Foreign medium high sectors mainly focus on manufacture of machinery and equipment n.e.c. (11.73%) and manufacture of electrical equipment (8.37%), they show tendency to a diverse environment possibly seeking to provide intermediate inputs to local firms. This suggests the level of technology in one firm might determine its spatial behaviours with local firms within or between sectors. Related variety matters in knowledge spill-over in short distance (Frenken, Van Oort, et al., 2007). A negative relation of concentration of low-tech local firms with foreign manufacturing firms is present other than low-tech foreign firms. Specification (2), (3), (4) suggest the commercial rents in

CBD might be above the capability of foreign firms who are not in high-tech sector, because local knowledge intensive financial services normally locate in central area of cities. There are less statistically significant relations between foreign manufacturing concentration and local services. This implies the weakness of local services.

In Specification (1)-(4), the location factors are in general conceivable. Foreign firms' location choice is strongly correlated to High speed railway stations and Ports. The capital city is negatively related to foreign firm's co-location behaviour.

In Table (15), specification (5) is not fitted, it suggests foreign KI services' clients such high-tech knowledge manufactures and medium high-tech knowledge manufactures are not in the same place. Doubling the weighted turnover in low-tech local firms increases the number of less KI foreign firms by 6.2 percent. The top three foreign industries in less KI services are wholesale trade (8.83% out of total amount), retail trade (0.48%), and warehousing and supporting activities (0.28%). The top three local low-tech industries are manufacture of textiles (12.84%), manufacture of wearing apparel (6.81%), and manufacture of food products (4.11%). Foreign firms specifically provide their complementary products to their clients given that this region is famous for textiles export products. This finding is consistent with the results in the ArcGIS maps, in that foreign KI services act as a high outlier distributed in the whole region. They are likely to provide services to local low-tech and less KI firms.

From the data in local less KI services, wholesale trade is at 1.00%, warehousing at 0.21% and retail trade at 0.12%, showing their less competitiveness to foreign firms in numbers.

Table 14. The regression results of local diversity effect and proximity on foreign manufactures' agglomeration.

(Dependent variable: the number of foreign firms by sectors per PC6-location)

VARIABLES	(1) High tech manufacture	(2) Medium high tech manufacture	(3) Medium low tech manufacture	(4) Low tech manufacture
GDP_Density	0.651	0.654**	0.578*	0.809***
	(0.406)	(0.332)	(0.335)	(0.301)
Pop_Density (log)	-0.189	-0.0157	-0.0420	-0.144**
	(0.123)	(0.0750)	(0.0800)	(0.0714)
Γ Proxi_ht (log)	0.0515**	0.00677	0.00128	0.0119
	(0.0206)	(0.00841)	(0.00954)	(0.00840)
Δ Proxi_mht (log)	0.141***	0.128***	0.0683***	0.0412***
	(0.0246)	(0.0134)	(0.0149)	(0.0131)
Θ Proxi_mlt (log)	0.00350	0.0361***	0.0533***	0.00499
	(0.0242)	(0.0124)	(0.0149)	(0.0125)
Λ Proxi _lt (log)	-0.0511**	-0.0392***	-0.0413***	0.0421***
	(0.0214)	(0.0110)	(0.0120)	(0.0115)
Π Proxi_kims (log)	-0.00341	0.00217	0.00261	0.00147
	(0.00280)	(0.00148)	(0.00163)	(0.00138)
Φ Proxi_htkis (log)	0.00209	0.00102	0.000146	0.000915
	(0.00287)	(0.00135)	(0.00136)	(0.00119)
Ψ Proxi_kifs (log)	0.000921	-0.00159**	-0.00405***	-0.00241***
	(0.00141)	(0.000769)	(0.000876)	(0.000704)
Ω Proxi_oki (log)	0.00274	0.000525	0.00221**	0.00120
	(0.00201)	(0.00104)	(0.00112)	(0.00100)

ζ Proxi_lki (log)	0.0111	0.00377	0.00675*	0.000737
	(0.00706)	(0.00345)	(0.00388)	(0.00330)
Airport	0.00506	-0.159*	-0.106	-0.155
	(0.151)	(0.0953)	(0.101)	(0.101)
Highspeed	0.452***	0.313***	0.398***	0.181**
	(0.136)	(0.0838)	(0.0902)	(0.0805)
University	-0.0475	-0.0536	-0.233***	-0.105
	(0.139)	(0.0779)	(0.0834)	(0.0758)
Port	0.415***	0.122*	0.197***	0.0752
	(0.122)	(0.0687)	(0.0748)	(0.0674)
Economic zone	0.0241	0.0679	0.0506	0.0965
	(0.130)	(0.0753)	(0.0840)	(0.0767)
Capital city	-0.417***	-0.342***	-0.307***	-0.331***
	(0.140)	(0.0855)	(0.0927)	(0.0845)
Constant	0.729	-0.293	0.223	1.112*
	(1.055)	(0.644)	(0.688)	(0.606)
Log likelihood	-864.79149	-2299.9468	-1547.764	-1854.5744
Observations	3124	3124	3124	3124

*Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 15. The regression results of local diversity effect and proximity on foreign services 'agglomeration.

(Dependent variable: the number of foreign firms by sectors per PC6-location)

	(5)	(6)
VARIABLES	**KI service**	**Less KI service**
GDP_D	0.201	-1.201*
	(2.978)	(0.616)
Pop_D *(log)*	-0.00482	0.413***
	(0.323)	(0.102)
Γ Proxi_ht *(log)*	0.0204	-0.0175
	(0.0720)	(0.0238)
Δ Proxi_mht *(log)*	-0.102	0.102**
	(0.135)	(0.0460)
Θ Proxi_mlt *(log)*	0.0429	-0.0285
	(0.101)	(0.0361)
Λ Proxi _lt *(log)*	0.00619	0.0909***
	(0.0819)	(0.0304)
Π Proxi_kims *(log)*	0.000965	-0.000388
	(0.0117)	(0.00256)
Φ Proxi_htkis *(log)*	-0.00380	-0.00165
	(0.0140)	(0.00245)
Ψ Proxi_kifs *(log)*	0.00204	0.000839
	(0.00855)	(0.00148)
Ω Proxi_oki *(log)*	0.00363	0.00386**

	(0.0122)	(0.00190)
ζ Proxi_lki *(log)*	0.00855	0.0193**
	(0.0314)	(0.00781)
Airport	-0.492	-0.252
	(0.739)	(0.181)
Highspeed	0.521	-0.131
	(0.557)	(0.139)
University	0.367	0.182
	(0.397)	(0.135)
Port	-0.0517	0.0993
	(0.483)	(0.122)
Economic zone	-0.233	0.0733
	(0.419)	(0.139)
Capital city	0.0770	-0.0400
	(0.486)	(0.153)
Constant	0.352	-4.088***
	(2.905)	(0.892)
Log likelihood	-79.928067	-1003.2184
Observations	68	387

*Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

4.3.3 Under different bandwidths, the effect of local diversity on foreign firms in manufacturing and services.

In this section, the proximity effect on elite foreign firms and local firms is to be discussed, and also examine whether the embeddedness of these industries and services is better than the general results. The gravity model is not used in section three because sample firms are selected in defined bandwidths. Gravity model normally takes the total population as analysis base.

Within the threshold 1 km, the numbers of foreign firms are 197, accounting for 39% of the total size of 500; the proportion of the local firms is 28%. In specification (1), local knowledge intensive marketing services statistically have strongly negative impact on total foreign firms. From the dataset, there is only one firm in this sector known as Zhe Jiang Sunshine Packaging Industrial Co., Ltd which engages in Engineering activities and related technical consultancy. Combining with specification (2), it might imply that products provided by the packing company have already satisfied the existing foreign firms' demand. The highly significant co-location between high-tech KI local services and foreign manufactures conveys their awareness of embeddedness with each other. One of the local companies is Zhejian Gyosemade Pharmaceutical Company Limited, this is in line with empirical studies that pharmaceutical companies will collaborate with manufacturing companies in the same industry to acquire clients. Population density is positively significant to foreign manufacturing firms at 0.05 level because of the pooled employment market. Within the 1 km threshold, the homogeneity of labour market contributes more to attracting foreign firms than the general urbanisation development. Obviously, the urbanisation in the provincial capital cities of Yangtze River delta is nearly completed and they are not the primary destinations because these cities are restructuring their economy and begining to squeeze out heavy industries to other satellite cities. In specification (3), one unit of high speed railway station increase leads to a 44.9% rise in foreign services. The high speed train only stops at high speed railway stations which actually connects all the city hubs in China. Figure 9 presents all firms' geo-locations.

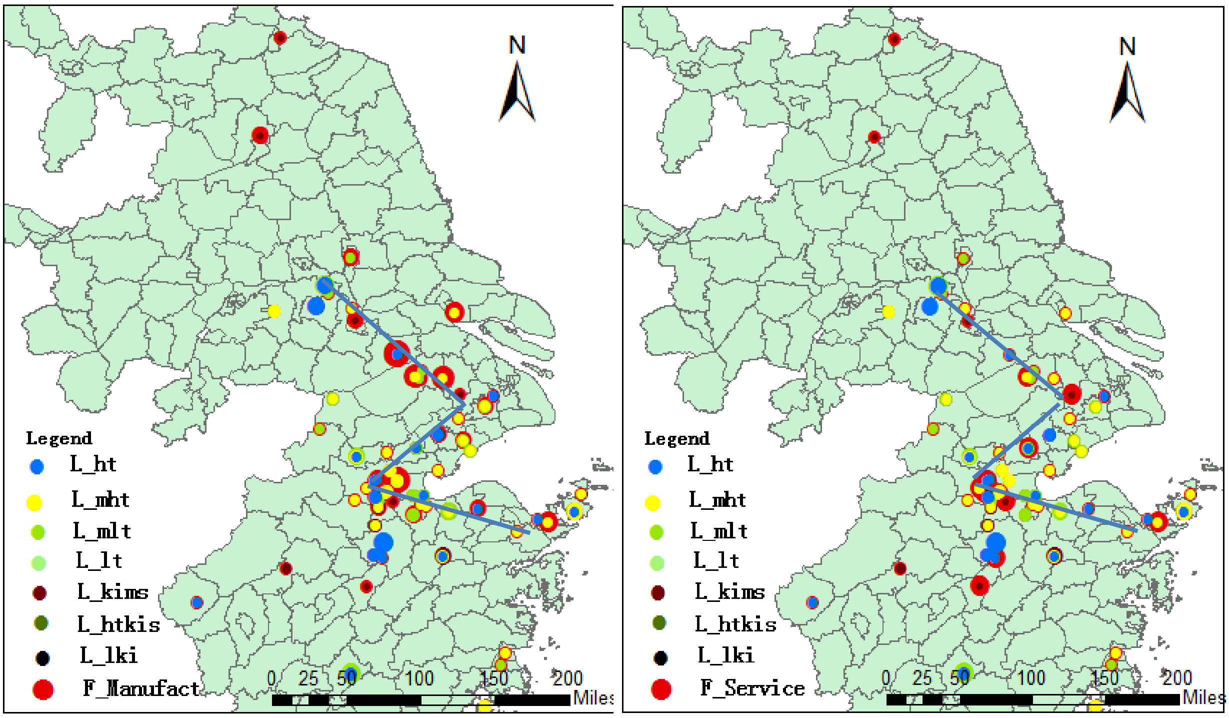

Figure 9. Maps of sectorial local and foreign firms' location

Maps of sectorial local firms with manufacturing (left) and service foreign (right) firms

Table 16. The regression results in bandwidth 0-1 km.

VARIABLES	Numbers			Value
	(1) Total	(2) Manufacture	(3) Service	(4) Manufacture
High-tech manufactures	0.261	0.268	-0.00657	0.266**
	(0.287)	(0.288)	(0.0627)	(0.112)
Medium ht manufactures	-0.0880	-0.0579	-0.0301	0.00338
	(0.172)	(0.173)	(0.0376)	(0.0712)
Medium lt manufactures	-0.00179	0.00903	-0.0108	0.0329
	(0.147)	(0.147)	(0.0321)	(0.0579)
Low-tech manufactures	-0.00644	-0.0150	0.00855	-0.0611*
	(0.0858)	(0.0861)	(0.0188)	(0.0360)
KI marketing Services	-9.884***	-9.764***	-0.120	-1.337
	(2.958)	(2.969)	(0.647)	(1.145)
High-tech KI Services	9.549***	9.791***	-0.242	1.673*
	(2.170)	(2.178)	(0.475)	(0.858)
Less KI Service	-0.685	-0.768	0.0836	0.0345
	(1.063)	(1.067)	(0.232)	(0.453)
Airport	1.771	1.805	-0.0334	0.846*

	(1.089)	(1.093)	(0.238)	(0.453)
Highspeed Railstation	0.654	0.205	0.449**	0.249
	(0.904)	(0.907)	(0.198)	(0.424)
University	-0.449	-0.430	-0.0197	0.0375
	(0.817)	(0.820)	(0.179)	(0.375)
Port	1.027	0.977	0.0498	0.370
	(0.701)	(0.704)	(0.153)	(0.280)
Economic zone	0.747	0.934	-0.187	0.321
	(0.905)	(0.908)	(0.198)	(0.379)
Capital city	-2.689***	-2.756***	0.0675	-1.056***
	(0.904)	(0.907)	(0.198)	(0.356)
Pop_D *(log)*	1.839**	2.023**	-0.184	0.356
	(0.916)	(0.919)	(0.200)	(0.410)
GDP_D	-13.62	-14.31	0.685	-1.738
	(8.868)	(8.902)	(1.940)	(3.984)
Constant	-12.86*	-14.51*	1.651	10.33***
	(7.479)	(7.508)	(1.636)	(3.308)
Observations	67	67	67	56
R-squared	0.473	0.474	0.188	0.509

*Notes: In specification (1), (2) and (3), the dependent variable is number of firm. In specification (4), we take the log of turnovers as dependent variable. Robust Standard errors are between parentheses.
*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.1 level

The map above describes an existing 'Z' line of firms along with highly competitive city clusters. Shanghai–Nanjing–Ningbo expressway and high-speed railway penetrate three provinces space across Shanghai, Suzhou, Nanjing, Changzhou, Zhenjiang, Hangzhou, Ningbo and Jiangxin. High valued foreign firms mainly concentrate along the Z line area and local firms follow their location strategies.

In Table 15, there are no significant relations between the two types of firms. One possible explanation is the radius of a county beyond the concentration. However, the location factor of the airport generates positive relations to foreign manufactures and services. 10 km is just the distance from the firm's location to the airport.

In Table 16, at the100km bandwidth, the High-tech KI services shows significant at 0.01, 0.05 and 0.1 level in specification (1), (2) and (4). Except for Foreign Service, the high-tech KI services increase the numbers and revenues of foreign manufacturing. One unit increase of low technology manufacturing business causes 7.9% decrease of foreign manufactures turnover, this shows the potential competitions in the intra-sector industry. The out-contract business from multinationals will temporally decrease their profit, the medium low technology firms can decrease the foreign services. When the firms' detailed information are checked; half of them are in Zhenjiang province, engaging in rubber and plastic products, basic metals industries and so on. All of these industries are labour intensive businesses. However, there are many local less knowledge intensive services providing warehouse and transportation business. Hence, the competition might induce the scarcity of land in Zhenjiang in that case. Universities have a positive influence on foreign manufactures' numbers and values, the explanation for this might be that proximity to university is not as sensitive as the target markets and knowledge spill-over from other organisation might happen in a large spatial pattern. There is a negative relation between foreign firms and national economic zone. Most of the National economic zones have been set up for two decades. Considering the local protected policy, the entry of multinationals might not be easy.

In conclusion, there is a U-shape relation between local High-tech KI services and foreign manufactures within three distance thresholds. They are significant in the 1km bandwidth, becoming insignificant in the 10km bandwidth and then significant again 100km bandwidth.

Table 17. The regression results in Bandwidth 1-10 km

VARIABLES	Numbers			Value
	(1) Total	**(2) Manufacture**	**(3) Service**	**(4) Manufacture**
High-tech	-0.108	-0.123	0.0150	-1.535
	(0.706)	(0.589)	(0.119)	(1.583)
Medium high-tech	0.00927	0.0156	-0.00628	0.396
	(0.381)	(0.318)	(0.0645)	(1.008)
Medium low-tech	0.0289	0.0172	0.0117	-0.273
	(0.442)	(0.369)	(0.0748)	(0.614)
Low-tech	-0.0785	-0.0634	-0.0151	0.00688
	(0.239)	(0.199)	(0.0404)	(0.248)
KI marketing	-1.909	-1.672	-0.238	-
	(5.819)	(4.856)	(0.985)	-
High-tech KI	0.698	0.883	-0.185	0.748
	(2.921)	(2.438)	(0.495)	(4.425)
Less KI	-1.031	-0.830	-0.201	3.993
	(1.630)	(1.360)	(0.276)	(3.465)
Airport	5.439***	4.366***	1.074***	1.005
	(1.704)	(1.422)	(0.289)	(0.743)
Highspeed Railstation	-0.789	-0.656	-0.133	-0.443
	(1.229)	(1.026)	(0.208)	(0.526)
University	-2.791**	-2.345**	-0.445*	-0.299
	(1.353)	(1.129)	(0.229)	(0.574)
Port	0.916	0.819	0.0970	0.760
	(1.143)	(0.954)	(0.193)	(0.495)
Economic zone	2.464*	2.134**	0.330	0.333
	(1.298)	(1.083)	(0.220)	(0.569)
Capital city	-3.966**	-3.269**	-0.697***	-0.631
	(1.530)	(1.277)	(0.259)	(0.520)

Pop_D (log)	4.356***	3.548***	0.808***	-0.0480
	(1.214)	(1.013)	(0.206)	(0.581)
GDP_D	-0.790	-0.648	-0.142	2.618
	(0.677)	(0.565)	(0.115)	(4.122)
Constant	-35.83***	-29.18***	-6.658***	13.40***
	(10.36)	(8.645)	(1.754)	(4.732)
Observations	278	278	278	50
R-squared	0.105	0.102	0.119	0.203

*Notes: In specification (1), (2) and (3), the dependent variable is number of firm. In specification (4), we take the log of turnovers as dependent variable. The omitted variables are the ones didn't pass VIF test. Robust Standard errors are between parentheses.
*** Significant at the 0.01 level
** Significant at the 0.05 level
* Significant at the 0.1 level

Table 18. The regression results in bandwidth 10-100km

VARIABLES	Numbers			Value	
	(1)Total	(2) Manufacture	(3) Service	(4) Manufacture	(5) Service
High-tech	0.0327	0.0211	0.0115	0.299**	-1.001
	(0.0944)	(0.0920)	(0.0166)	(0.117)	(0.676)
Medium high-tech	-0.00938	-0.00585	-0.00353	0.0451	0.900*
	(0.0409)	(0.0399)	(0.00720)	(0.0668)	(0.510)
Medium low-tech	-0.0188	-0.0150	-0.00382	0.0367	-1.716**
	(0.0458)	(0.0446)	(0.00806)	(0.0585)	(0.696)
Low-tech	0.00713	0.00818	-0.00106	-0.0795**	-0.489
	(0.0266)	(0.0259)	(0.00467)	(0.0369)	(0.353)
KI marketing	-0.102	-0.0547	-0.0468	-1.246	
	(0.887)	(0.865)	(0.156)	(1.296)	
High-tech KI	1.360**	1.469***	-0.109	1.655*	
	(0.569)	(0.554)	(0.100)	(0.947)	
Less KI	-0.0931	-0.0875	-0.00561	0.291	10.13***
	(0.178)	(0.174)	(0.0314)	(0.484)	(3.423)
Airport	0.0700	0.175	-0.105	-0.534	-0.463
	(0.650)	(0.633)	(0.114)	(0.669)	(1.123)
Highspeed Railstation	0.798	0.577	0.221**	0.251	1.191
	(0.492)	(0.480)	(0.0866)	(0.523)	(1.029)
University	0.716*	0.688*	0.0285	0.627*	-0.910
	(0.370)	(0.360)	(0.0650)	(0.325)	(0.948)
Port	0.363	0.494	-0.131*	-0.114	-0.196
	(0.385)	(0.376)	(0.0678)	(0.425)	(0.856)

Economic zone	-1.334***	-1.190***	-0.143***	-0.514***	-0.619
	(0.203)	(0.198)	(0.0358)	(0.196)	(0.452)
Capital city	-1.258***	-1.266***	0.00798	0.104	0.417
	(0.350)	(0.341)	(0.0616)	(0.375)	(0.495)
Pop_D *(log)*	0.537	0.284	0.253***	-0.104	0.434
	(0.356)	(0.347)	(0.0627)	(0.310)	(0.543)
GDP_D	-2.232***	-2.012***	-0.220	-2.794	-2.864
	(0.796)	(0.776)	(0.140)	(1.830)	(3.911)
Constant	-2.827	-0.871	-1.956***	14.61***	10.25**
	(2.942)	(2.867)	(0.517)	(2.508)	(4.332)
Observations	692	692	692	237	42
R-squared	0.175	0.162	0.091	0.150	0.341

Notes: In specification (1), (2) and (3), the dependent variable is number of firm. In specification (4) and (5), we take the log of turnovers as dependent variable. The omitted variables are the ones didn't pass VIF test. Robust Standard errors are between parentheses.

*** Significant at the 0.01 level
** Significant at the 0.05 level
* Significant at the 0.1 level

Chapter 5: Conclusions and recommendations

5.1 Introduction

This chapter reviews the research problem and research objectives followed by conclusions and limitations of the thesis. Next, the research questions are answered separately. Lastly the contributions of the thesis in adding to the existing knowledge body are stated and then the research agenda as well as policy recommendations raised.

5.2 Retrospect: research objective

Currently, more attention is paid to the attraction of foreign investments. The logic behind the location decision of MNE is the main interest of economic geographers and policy makers because MNEs are the carriers of FDI and understand and predict MNE’s spatial decision helps to stimulate regional economic growth. This requires a coherent location theory to explain. FDI tends to choose the same or surrounding cities where other FDI locates in. Agglomeration theory emphasises the importance of knowledge and technology spillover facilitating their influence on firm performance in clusters. Microeconomic location theory normally treats firms as isolated points and investigates their relations weighted by proximity. Empirically, the location analysis of MNEs is little, especially in postcode 6 level. This study combine geographically weighted firms’ revenue and their and sectoral composition to examine to what extent the effect of diversity and proximity have influence on agglomeration of MNEs. In addition, the spatial county patterns resulting from co-agglomeration of firms are also included in the analysis.

5.3 Conclusions and Discussion

Based on previous chapters, conclusions from both region and firm’s perspective are made.

5.3.1 Conclusions

(1) Significant county clusters are identified based on co-agglomeration of foreign and local firms

There are three significant clusters in the LISA map (Figure 5, p37): Shanghai cluster, Suzhou cluster and Hangzhou clusters. The outlier clusters are different in Jiangsu and Zhengjiang province, there are several isolated significant clusters in northern Jiangsu, but a connected economic block exits in southern Zhejiang.

The spatial distribution is consistent with their GDP and FDI policy. In Jingsu, province government encourages counties to attract foreign investments, hence, the co-agglomeration economies are fragmented because of the difference of local economic activities and location attributes. In contrast, Zhejiang province tends to develop domestic firms first. Foreign firms in this area actually follow the existing agglomeration and further consolidate it by their own advantages.

Wei (2010) defines the first kind of clusters in China as exogenous cluster which means that multinationals take the leading place in the production. Local firms follow these exogenous ‘cores’ to locate and engage in productions as suppliers.

Specifically, the distribution of foreign services organising county clusters (foreign KI firm is the core, local HT firm is neighbour) is much more even than the local services organising county clusters (local KI firm is the core, foreign HT firm is neighbour). There are knowledge spillovers across administrative boundaries between industries and services and some HT local manufactures receive much knowledge spillovers from KI foreign firms. In contrast, KI local firms seems to provide less knowledge to foreign firms.

This is linked to the FDI location theory in Uppsala school, the internal innovation system of multinational and the local innovation system affect each (McCann and Mudambi, 2005). However, MNEs knowledge network has many advantages that local firms don't have. The most important one is MNEs own HQs to collect the new knowledge created in anywhere of networks and send them back (Figure 10). They treat host location as a source of knowledge. This is consistent with the findings in Figure 7 (p.41) where they act like local knowledge receivers in different territories. The integration of knowledge in local innovation system gives privileges to MNEs in the production. Chen (2008) discusses the spatial evolution of foreign producer services in terms of path dependence and industrial connection in Jiangsu province. The results show that path dependence influences KI services' location choice in the short term. Martin and Sunley (2006) argue that path dependence and 'lock-in' are place-dependant processes, and as such need spatial empirical research. This can also explain the spatial behaviour of local services, they mainly stay closer to foreign manufacturers. The agglomeration of high-level technology firms is a determinant to their location choice. On the other hand, this might imply their path-dependency to foreign firms.

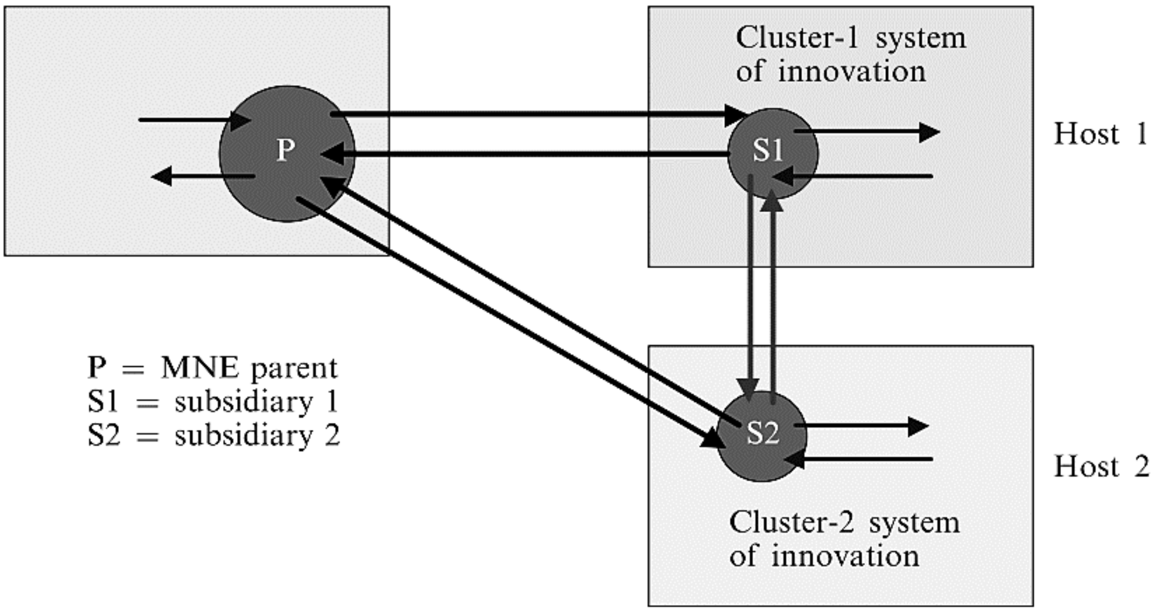

Figure 10. Knowledge flows between MNE and local cluster

(Source: McCann and Mudambi, 2005)

(2) Spatial concentration of relatedness (within sectors) and unrelatedness (between sectors)

Foreign firms prefer to locate in local clusters who own the similarity of technology and knowledge with them. What's more, HT foreign firms tend to locate in HT and medium HT local clusters.

It might imply that both technologies require similar capabilities, being either intangible in nature, such as labour skills, common knowledge and memberships, or tangible, such as necessary facilities (Haussmann and Hidalgo 2010).

Duranton and Puga (2004)'s 'Sharing, matching, and learning' theory also supports this finding. High-skilled labour such as computer programmers have mastered many coding languages or techniques, so they can deal with complex problems as a unit or in a small group. In contrast, low-skilled labour normally specialise in one field or one process of production, hence low-tech local firms locate together to get scales of return. They not only occupy large blocks of land, but also attract more low-tech foreign firms to participate in. Evidence from UK and US wood industries also proves that similar firms will choose to co-locate (Glenn et al., 2010). For the developing counties, specialisation economies in low-tech promote their GDP growth.

However, for the high-tech club members like Suzhou, Hangzhou and Shanghai, low-tech industry is suggested to be transferred to other counties and keep the high competitive ones, because in these counties, Jacobs' externalities actually matters in their urbanisation economies. The new growth theory shows that not only related (within sectors) but also the unrelated diversity (between sectors) triggers the economic growth. In the long-term economic run, Pasinetti (1993) argues that if a regional economy doesn't absorb new sectors to change the economic structure and get rid of the redundant as well as pre-existing sectors, the economic growth will ultimately enter into stagnate.

(3) One firm's medicine is another firms' poison in attracting foreign firms

Low-tech foreign firms choose to locate in low-tech local clusters but other foreign firms show their avoidance to that. Concentration of local KI financial services decreases the number of foreign manufacturing firms except high-tech firms. This is because the expensive commercial rent in the CBD area is not affordable to other medium and low-tech firms. Similarly, Foreign less KI services also prefer to co-locate with less high-tech local firms. They might be international trade brokers to do export business, therefore, they need to get closer to the OEM factories.

In the diversity agglomeration, some firms get benefit by co-locating with other firms, but some might be harmed by it. This argument is supported by the empirical researches in Netherlands, the heterogeneity of agglomerations on firm performance are strongly moderated by firms characteristics (Knoben, et al., 2015).

A smart city spatial planning is coherent with the ecosystem of MNEs and local firm's clusters. For example, in city centre, the main reason of agglomeration of financial companies and IT companies is face-to-face contacts and geographical proximity (Yang, et al., 2015). Urban planners need to maximally optimise the utilities of these commercials. In contrast, knowledge intensive clusters are more flexible in the location choice of cities, what they need is intangible characteristics like social or sports activities or different life styles, hence proximity is not that important to them.

For low-tech manufacturing firms, many of them engage in export business under the global trade network and labour division, they buy the land from government and locate in Urban fringe and transport corridor, therefore, their *relative proximity* to other firms are longer or negatively related to foreign firms in short proximity (Yang et al., 2015).

(4) The U-relationship between foreign manufactures and local KI services agglomeration and proximity

In a Short distance, local high-tech KI services are positively related to high-tech foreign firms. This relationship is not significant for the firms within 10km, but again becomes significant in the distance band of 100km. This empirical evidence might suggest that the inter-county relation to some extent is stronger than inner-county relation.

(5)High speed railway station is strongly related to the locality of foreign firms.

The positive effect of high-speed railway station is in accordance with the discussion in FDI location theory and urbanisation economies. Foreign KI services are positively related to Rail station in the 1km threshold. This suggests its importance in attracting foreign firms and increasing agglomeration economics, especially considering the severe congestion in China.

5.3.2 Limitation of this thesis

This section discusses the reason why the study does not use geographically weighted models to estimate the foreign firm's preference to local agglomeration. The advantages of geographically weighted regression is that it generates the local parameter estimates in each observation, which is more useful to describe the situation in each city than the average and generalised results in other estimation. Huang (2002) uses GWR to investigate the industrialisation in Jiangsu province and finds there is a significant difference between the ordinary linear regression (OLR) and GWR models. In the analysis, GWR was used to conduct the regression in Arcmap, geo-statistics analysis toolkit, but errors always occurred and this is because there is need for a passing model in OLS section first and then conduct GWR with fixed bandwidth. The services were deleted and only the manufactures maintained so that the software could successfully generate the result. However, services are the explanatory variables that are examined with the manufactures at the same time and thus other models had to be used to replace it.

In the thesis, cities are not divided into different groups. According to the empirical evidence from Sun and Zhou (2013), they use 281 cities panel data from 2003-2008 to investigate the relationships between specialisation, variety and regional economic growth. Some literature shows that the specialisation and variety differ in various size of the cities. In mega city, variety has positive effect on the economic growth, but in the medium and small city, variety of industry discourages development. Hence, it is believed that the co-agglomeration patterns in different tiers of cities might differ from the generalised conclusion found in this thesis.

This thesis did not use the employment data to estimate MNEs' profit model because of missing data. Employment data is more conceivable in production function as inputs. In addition, this research did not use the economic linkages between firms. Firms with recognised suppliers and buyers or other business relationships are expected to research in the future.

5.4 The interpretation of the Main Question

To what extent dose diversity of local firms affect the agglomeration of foreign firms, considering spatial externalities and geographic proximity in Yangtze River Delta 2012?

5.4.1 Co-agglomeration of foreign and domestic firms spatially differs across region.

Generally speaking, local traditional export industries still primarily concentrate on Jiangsu and Zhejiang province closely followed by Manufacture of electrical equipment and Manufacture of machinery and equipment.

Foreign high-tech and medium high-tech firms mainly locate in Shanghai, Suzhou, and Hangzhou. Hangzhou, Shanghai (districts) and Nanjing rank as the top three cities to absorb foreign high-tech knowledge-intensive firms.

The spatial embeddedness of the foreign and local clusters are easily observed. Foreign services are more complementary to local manufacturing firms than their counterparts.

5.4.2 The diversity effect on agglomeration of foreign firms, considering spatial externalities.

Local Moran'I results support that spatial externalities exist in foreign manufacturing firms and less knowledge intensive as well as other knowledge intensive firms when foreign firms choose to locate in the same or neighbouring counties. To knowledge intensive firms, spatial externalities might matters in a board sense.

Local and foreign firms tend to co-agglomerate within the similar industries than inter-sector industries. This is in line with the studies that revealed localisation economies to be more important than urbanisation economies (Barrios, Görg, et al., 2006).

5.4.3 The diversity and proximity effect on agglomeration of foreign firms

Significant relations between foreign and local firms are different within different bandwidths.

In the gravity model, considering the weighted proximity is 2.5 km, foreign high-tech firms significantly locate with high-tech local industries, where they can maximise their advantages with high technology thresholds. Another possible explanation is that they want to acquire local knowledge and enjoy spillovers backwards (Zhang et al., 2010). Foreign firms also choose to locate in the local clusters with similar technology level.

In the normal OLS model, three groups of firms are sampled by their proximity.

In bandwidth 0-1 km, an existing 'Z' line of firms along with high-speed railway is founded. Foreign firms' location choice being strongly correlated to High speed railway stations and Ports is because ensure efficient mobility.

In 1-10 km bandwidth, there is no significant co-agglomeration. One possible explanation is that the measured bandwidth is beyond the significant concentration. However, the location factor of the Airport generates positive relations to foreign manufactures and services. In a large distance scale, the concentration of low-tech local firms decreases foreign manufactures' profits. Most of the National economic zones have been set up for two decades and thus considering the local protected policy, the entry of multinationals might not be easy.

In 10-100 km bandwidth, the significant results is the same expect the coefficient is lower.

5.5 An Addition to the Existing Body of Knowledge

This paper contributes to adding a geographic proximity and agglomeration perspective on FDI location theory, proves that some physical local attributes positively related to agglomeration of multinationals and points out the existence of a 'U' shape in the co-agglomeration of local and foreign firms with increase of proximity.

5.6 Further Research implications and Policy recommendation

5.6.1 Further Research implications

This study argues to add a disaggregated perspective to Dunning's (1977) OLI framework which mainly focuses on national level. Given that there is more available data and new statistic methodology, the time is ripe to discuss the agglomeration in a micro level.

However, the findings in the study cannot be generalised because of several limitations. The network between firms was assumed randomly without any economic linkages. Beaudry and Schiffauerova (2009) summarise that the level of geographical aggregation, type of industrial classification, type of sectors analysed, and type of performance indicators used result in different policy initiatives. Further research is advised to seek to quantify the knowledge and technology spillovers in the dynamic innovation systems. In addition, different subsidiaries of MNEs is suggested to be included in the analysis because of the hierarchy of innovation system. Case studies from social network approach is also needed to combine with results only from one geographical proximity dimension.

5.6.2 Policy recommendation

This research helps decision makers to invite 'right' foreign firms in based on the related variety and unrelated variety. Different spatial policies should be applied based on different locations characteristic. For example, they can arrange foreign firms closer to High-speed railway stations or scientific institutes. Industrial parks should be prepared for both foreign and local firms in high-tech and medium high-tech manufacturing sectors.

Local knowledge intensive service are encouraged to relocate inside industrial clusters because of their strong relations with foreign high-tech firms in 1km.

Considering the polycentric patterns of Yangtze River Delta, counties Suzhou cluster, Hangzhou cluster and Shanghai cluster, is suggested to reduce the volume of low-tech manufactures, or restrict the inwards of foreign investment in low-tech sectors to avoid the sprawl of low-profit agglomeration.

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Annex 1: Codification of industries

Sector_type	Sector	NACE2_na
21	manufacturing_HT	Manufacture of pharmaceutical industry
26	manufacturing_HT	Manufacture of computer, electronic and optical products
20	manufacturing_MHT	Manufacture of chemicals industry
27	manufacturing_MHT	Manufacture of electrical equipment
28	manufacturing_MHT	Manufacture of machinery and equipment n.e.c.
29	manufacturing_MHT	Manufacture of motor vehicles, trailers and semi-trailers
30	manufacturing_MHT	Manufacture of other transport equipment
19	manufacturing_MLT	Manufacture of coke and refined petroleum products
22	manufacturing_MLT	Manufacture of rubber and plastic products
23	manufacturing_MLT	Manufacture of other non-metallic mineral products
24	manufacturing_MLT	Manufacture of basic metals
25	manufacturing_MLT	Manufacture of fabricated metal products, except machinery and equipment
33	manufacturing_MLT	Repair and installation of machinery and equipment
10	manufacturing_LT	Manufacture of food products
11	manufacturing_LT	Manufacture of beverages
13	manufacturing_LT	Manufacture of textiles
14	manufacturing_LT	Manufacture of wearing apparel
15	manufacturing_LT	Manufacture of leather and related products
16	manufacturing_LT	Manufacture of wood and of products of wood and cork
17	manufacturing_LT	Manufacture of paper and paper products
18	manufacturing_LT	Printing and reproduction of recorded media
31	manufacturing_LT	Manufacture of furniture
32	manufacturing_LT	Other manufacturing
50	Service_KIMS	Water transport
69	Service_KIMS	Legal and accounting activities
71	Service_KIMS	Architectural and engineering activities; technical testing and analysis
73	Service_KIMS	Advertising and market research
74	Service_KIMS	Other professional, scientific and technical activities
78	Service_KIMS	Employment activities
80	Service_KIMS	Security and investigation activities
60	Service_HTKI	Programming and broadcasting activities
61	Service_HTKI	Telecommunications
62	Service_HTKI	Computer programming, consultancy and related activities
63	Service_HTKI	Information service activities
72	Service_HTKI	Scientific research and development
64	Service_KIF	Financial service activities, except insurance and pension funding
65	Service_KIF	Insurance, reinsurance and pension funding, except compulsory social security
66	Service_KIF	Activities auxiliary to financial services and insurance activities
58	Service_OKI	Reproduction

84	Service_OKI	Public administration and defence; compulsory social security
85	Service_OKI	Education
88	Service_OKI	Social work activities without accommodation
91	Service_OKI	Libraries, archives, museums and other cultural activities
93	Service_OKI	Sports activities and amusement and recreation activities
45	Service_LKI	Wholesale and retail trade and repair of motor vehicles and motorcycles
46	Service_LKI	Wholesale trade, except of motor vehicles and motorcycles
47	Service_LKI	Retail trade, except of motor vehicles and motorcycles
49	Service_LKI	Land transport and transport via pipelines
52	Service_LKI	Warehousing and support activities for transportation
55	Service_LKI	Accommodation
56	Service_LKI	Food and beverage service activities
68	Service_LKI	Real estate activities
77	Service_LKI	Rental and leasing activities
79	Service_LKI	Travel agency, tour operator and other reservation service and related activities
81	Service_LKI	Services to buildings and landscape activities
82	Service_LKI	Office administrative, office support and other business support activities
95	Service_LKI	Repair of computers and personal and household goods

Annex 2: Summary Statistics table

1. Foreign firms' numbers (postcode-6)

Variable	Mean	Std. Dev.	Min	Max
Foreign firms in high-technology	0.467	2.799	0	74
Foreign firms in medium-high-technology	1.181	3.833	0	93
Foreign firms in medium-low-technology	0.650	1.931	0	41
Foreign firms in low-technology	0.812	2.215	0	46
Foreign firms in Knowledge-intensive market service	0.009	0.103	0	2
Foreign firms in high-tech knowledge-intensive service	0.011	0.127	0	3
Foreign firms in knowledge-intensive financial service	0.005	0.079	0	2
Foreign firms other knowledge-intensive	0.006	0.081	0	1
Foreign firms in less knowledge-intensive	0.376	1.952	0	44

2. Local firms' numbers (postcode-6)

Variable	Mean	Std. Dev.	Min	Max
Local firms in high-technology	1.163	2.913	0	45
Local firms in medium-high-technology	5.498	10.191	0	151
Local firms in medium-low-technology	4.022	7.0429	0	88
Local firms in low-technology	5.813	12.992	0	255
Local firms in Knowledge-intensive market service	0.020	0.1795	0	4
Local firms in high-tech knowledge-intensive service	0.026	0.2578	0	7
Local firms in knowledge-intensive financial service	0.010	0.1082	0	2
Local firms other knowledge-intensive	0.005	0.0797	0	2
Local firms in less knowledge-intensive	0.269	1.0188	0	15

3. Control variables

Variable	Mean	Std. Dev.	Min	Max
GDP_Density (log)	8.467	0.717	0	11.126
Pop_Density	0.1346	.3502	0	5.385
Airport	0.1299	0.336	0	1
Railstation	0.1757	0.380	0	1
University	0 .423	0.494	0	1
Port	0.3892	0.487	0	1
Economic Zone	0.3245	0.468	0	1
Capital City	0.1939	0.395	0	1

4. Foreign firms in high-technology manufactures' proximity to local firms

Variable	Mean	Std. Dev.	Min	Max
Proximity to local firm in high-technology	148136	5280575	0	2.93e+08
Proximity to local firm in medium-high-technology	321133.600	5994118	0	2.66e+08
Proximity to local firm in medium-low-technology	181886.800	3505048	0	1.74e+08
Proximity to local firm in low-technology	92558.500	768678.4	0	2.22e+07
Proximity to local firm in Knowledge-intensive market	1128.276	29894.880	0	1478957
Proximity to local firm in high-tech knowledge-intensive	2616.518	62141.950	0	2413738
Proximity to local firm in knowledge-intensive financial	613.043	16320.320	0	550133.100
Proximity to local firm in other knowledge-intensive	260.984	10969.520	0	607674.200
Proximity to local firm in less knowledge-intensive	14953.780	233832.100	0	7038586

5. Foreign firms in medium-high-technology manufactures' proximity to local firms

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
Proximity to local firm in high-technology	255324.400	8007232	0	4.42e+08
Proximity to local firm in medium-high-technology	666218.900	8657864	0	3.04e+08
Proximity to local firm in medium-low-technology	360027.600	4118404	0	1.68e+08
Proximity to local firm in low-technology	329446.300	4402719	0	2.32e+08
Proximity to local firm in Knowledge-intensive market	1710.773	44100.280	0	2233527
Proximity to local firm in high-tech knowledge-intensive	4297.614	104809.300	0	4218483
Proximity to local firm in knowledge-intensive financial	4056.307	186465.900	0	1.04e+07
Proximity to local firm in other knowledge-intensive	798.274	38114.350	0	2126860
Proximity to local firm in less knowledge-intensive	24340.640	276047.800	0	1.06e+07

6. Foreign firms in medium-low-technology manufactures' proximity to local firms

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
Proximity to local firm in high-technology	107055.800	3170022	0	1.73e+08
Proximity to local firm in medium-high-technology	287513.200	3092031	0	1.08e+08
Proximity to local firm in medium-low-technology	193175.200	1947155	0	7.06e+07
Proximity to local firm in low-technology	178670.200	2538457	0	1.33e+08
Proximity to local firm in Knowledge-intensive market	733.847	17558.750	0	875301.1
Proximity to local firm in high-tech knowledge-intensive	1561.440	36936.300	0	1428539
Proximity to local firm in knowledge-intensive financial	2232.189	93896	0	5198644
Proximity to local firm in other knowledge-intensive	147.482	5534.385	0	303837.1
Proximity to local firm in less knowledge-intensive	11969.020	140046.800	0	4165694

7. Foreign firms in low-technology manufactures' proximity to local firms

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
Proximity to local firm in high-technology	83080.950	1352364	0	5.97e+07
Proximity to local firm in medium-high-technology	342879.300	4023336	0	1.63e+08
Proximity to local firm in medium-low-technology	192017.300	1508855	0	3.80e+07
Proximity to local firm in low-technology	437089.400	5065038	0	1.66e+08
Proximity to local firm in Knowledge-intensive market	704.622	12721.51	0	467027.9
Proximity to local firm in high-tech knowledge-intensive	1387.106	43560.01	0	2362351
Proximity to local firm in knowledge-intensive financial	2076.399	93264.12	0	5198644
Proximity to local firm in other knowledge-intensive	46.658	1100.089	0	48846.82
Proximity to local firm in less knowledge-intensive	14426.390	112176	0	2239573

8. Foreign firms in less knowledge intensive services' proximity to local firms

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
Proximity to local firm in high-technology	40101.030	705316.200	0	3.58e+07
Proximity to local firm in medium-high-technology	106441.700	969099.300	0	2.50e+07
Proximity to local firm in medium-low-technology	77866.920	884502.800	0	2.68e+07
Proximity to local firm in low-technology	104769.900	1338155	0	5.89e+07
Proximity to local firm in Knowledge-intensive market	1334.914	28542.730	0	1458469
Proximity to local firm in high-tech knowledge-intensive	1608.711	27080.770	0	957754.4
Proximity to local firm in knowledge-intensive financial	26956.190	1395819	0	7.80e+07
Proximity to local firm in other knowledge-intensive	169.645	3194.311	0	132933.5
Proximity to local firm in less knowledge-intensive	21571.340	285472.700	0	8953157

Annex 3: Pearson correlations

(1) The associations of variety between local and foreign manufacturing and service firm's numbers by sector: correlation analysis

ϒLF.FF	FF_ ht	FF_mht	FF_mlt	FF_lt	FF_kims	FF_htki	FF_kif	FF_oki	FF_lki
LF_ht	0.7379*	0.8507*	0.8179*	0.7590*	0.3160*	0.5062*	0.3082*	0.4078*	0.6641*
LF_mht	0.4947*	0.7348*	0.6998*	0.6701*	0.3355*	0.3552*	0.2894*	0.3157*	0.5185*
LF_mlt	0.4757*	0.7068*	0.7022*	0.6662*	0.3088*	0.3358*	0.3404*	0.2852*	0.5037*
LF_lt	0.2721*	0.4351*	0.4313*	0.6646*	0.1039	0.1179	0.5160*	0.0595	0.3908*
LF_kims	0.2768*	0.3998*	0.3600*	0.4506*	0.1893*	0.4210*	0.3841*	0.4076*	0.6588*
LF_htki	0.2951*	0.4233*	0.3741*	0.4264*	0.1239	0.4970*	0.3505*	0.4456*	0.6225*
LF_kif	0.4082*	0.4457*	0.4081*	0.4946*	0.1028	0.6219*	0.4287*	0.4180*	0.7090*
LF_oki	0.2237*	0.2331*	0.2293*	0.2009*	0.0426	0.7162*	0.1156	0.5334*	0.5451*
LF_lki	0.5114*	0.6080*	0.5714*	0.6079*	0.2724*	0.6761*	0.3597*	0.6143*	0.8504*

Notes: *indicate statistical significance at $p < 0.01$

(2) The Associations of spatial agglomerations between local and foreign manufacturing and service firms: correlation analysis

ϒLF.FF	Total
NUM	0.6817*
NUM_D	0.9291*
I	0.4305*

Notes: *indicate statistical significance at $p < 0.01$. Respectively, the correlation (Pearson) coefficients on first row are based on firm density in total firm number (NUM), second row firms' location density per postcode 4 area (NUM_D), and third row spatial agglomeration index (I) between local and foreign firm

Annex 4: Robustness Checks

Robustness Checks of δ

VARIABLES	NBR (δ=1) F_Total	NBR (δ=5) F_Total
Γ Proxi_ht *(log)*	0.00938	0.00840***
	(0.00675)	(0.00171)
Δ Proxi_mht *(log)*	0.110***	0.00719***
	(0.00950)	(0.00236)
Θ Proxi_mlt *(log)*	0.0252***	0.00196
	(0.00926)	(0.00267)
Λ Proxi _lt *(log)*	-0.0102	-0.00721***
	(0.00828)	(0.00253)
Π Proxi_kims *(log)*	0.00170	0.00139***
	(0.00118)	(0.000376)
Φ Proxi_htkis *(log)*	0.00144	0.000166
	(0.00101)	(0.000394)
Ψ Proxi_kifs *(log)*	-0.00190***	-0.000879***
	(0.000618)	(0.000229)
Ω Proxi_oki *(log)*	0.000806	0.000277
	(0.000814)	(0.000337)
ζ Proxi_lki *(log)*	0.00428	0.00190**
	(0.00278)	(0.000761)
Control variables (9)	Yes	Yes
Constant	0.367	1.489**
	(0.489)	(0.618)
Pseudo R^2	0.0926	0.0531
Observations	1,804	1,804

*Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
The reason we choose the delta=1 is because the Pseudo R^2 is higher than the delta=5, which is a more convincing result.

Annex 5: Table regression analysis of foreign firms' turnover in nine sectors

	(1) High-tech	(2) Medium high-tech	(3) Medium low-tech	(4) Low-tech	(5) KI marketing	(6) High-tech KI	(7) KI financial	(8) Other KI	(9) Less KI
GDP_D	1.554**	1.461***	1.952*	1.339***	-5.545	79.27***	7.211	-	1.143
	(0.715)	(0.559)	(1.164)	(0.386)	(9.476)	(18.44)	(395.8)	-	(0.987)
Pop_D *(log)*	-0.450*	-0.286	-0.361	-0.142	0.865	-11.65***	1.730	10.75***	-0.267**
	(0.263)	(0.186)	(0.249)	(0.148)	(1.633)	(3.392)	(51.54)	(1.456)	(0.120)
Γ Proxi_ht *(log)*	0.0933**	0.0907	0.0977	-0.0112	-0.547	-2.747**	-	2.927***	0.0900
	(0.0425)	(0.0694)	(0.0739)	(0.0444)	(1.073)	(1.181)	-	(0.164)	(0.0729)
Δ Proxi_mht *(log)*	0.105***	0.0774**	0.0420*	0.0766***	-0.592	0.321	-0.467	-4.576***	0.147
	(0.0326)	(0.0346)	(0.0236)	(0.0193)	(1.417)	(1.221)	(7.925)	(0.0726)	(0.129)
Θ Proxi_mlt *(log)*	-0.0187	-0.0154	0.00290	-0.0367	0.840	3.496*	-	0.664***	-0.173
	(0.0428)	(0.0543)	(0.0535)	(0.0428)	(0.692)	(1.676)	-	(0.0599)	(0.143)
Λ Proxi _lt *(log)*	-0.106***	-0.0528	-0.0682	0.0399	0.567	-2.984	0.217	-3.279***	0.0128
	(0.0351)	(0.0437)	(0.0605)	(0.0302)	(0.803)	(2.123)	(8.330)	(0.0949)	(0.0649)
Π Proxi_kims *(log)*	-0.00367	-0.00310	0.00653	-0.00504	-0.0544	0.910*	-0.0364	0.0225	0.00695
	(0.00641)	(0.00556)	(0.00623)	(0.00487)	(0.0431)	(0.450)	(1.790)	(0.0164)	(0.00745)
Φ Proxi_htkis *(log)*	0.00283	-0.00429	-0.00393	-0.0138**	-0.0419	0.962*	-0.167	-1.064***	-0.00988
	(0.00502)	(0.00744)	(0.00722)	(0.00607)	(0.182)	(0.514)	(2.053)	(0.0351)	(0.00842)
Ψ Proxi_kifs *(log)*	-0.00139	0.00268	-0.00526*	0.00175	0.0164	-1.732**	0.0610	-1.105***	0.00976**
	(0.00271)	(0.00296)	(0.00298)	(0.00245)	(0.0215)	(0.747)	(1.138)	(0.00333)	(0.00400)
Ω Proxi_oki *(log)*	0.00171	0.00285	0.00277	0.00585	0.0330	0.884	0.0266	1.057***	-0.00582
	(0.00387)	(0.00436)	(0.00466)	(0.00374)	(0.133)	(0.691)	(1.826)	(0.0217)	(0.00565)
ζ Proxi_lki *(log)*	0.0277**	0.00505	-0.00413	-0.00265	-0.0155	0.577	-	4.496***	-0.00369
	(0.0122)	(0.0164)	(0.0173)	(0.0146)	(0.391)	(0.660)	-	(0.114)	(0.0225)
Airport	-0.167	0.203	0.00917	0.0664	-1.870	-4.283**	-4.173	-7.824***	-0.131
	(0.306)	(0.161)	(0.181)	(0.154)	(4.507)	(1.673)	(2.507)	(0.410)	(0.361)
High_RailStation	0.139	-0.336**	-0.142	-0.0463	0.688	-0.745	-	-	-0.0442
	(0.274)	(0.152)	(0.185)	(0.144)	(1.484)	(3.410)	-	-	(0.283)
University	0.377	0.422***	0.360**	0.189	2.320	10.07**	3.395	2.839***	0.419*
	(0.251)	(0.132)	(0.145)	(0.133)	(1.359)	(3.423)	(8.521)	(0.263)	(0.242)

Port	0.728***	0.393***	0.107	0.0735	-1.195	5.039	-4.783	-8.338***	0.496**
	(0.257)	(0.123)	(0.139)	(0.113)	(1.916)	(3.068)	(52.35)	(0.281)	(0.224)
Economic zone	0.0770	0.260*	0.109	0.112	-2.302	3.373	-1.105	-	-0.0860
	(0.253)	(0.142)	(0.160)	(0.142)	(1.452)	(3.381)	(9.025)	-	(0.248)
Capital City	-0.535*	-0.667***	-0.487**	-0.369**	2.525	6.516**	-	-23.86***	0.492
	(0.279)	(0.171)	(0.201)	(0.149)	(1.989)	(2.324)	-	(2.337)	(0.308)
Constant	13.14***	12.57***	12.93***	11.13***	-0.209	96.74***	-2.351	-50.78***	10.97***
	(2.210)	(1.547)	(2.081)	(1.244)	(13.93)	(29.26)	(421.9)	(11.54)	(0.960)
Observations	460	1,125	891	1,022	28	29	17	21	404
R-squared	0.194	0.126	0.087	0.092	0.712	0.819	0.830	0.984	0.133

Annex 6: Counties list

County	County_na	City digit	City_na	Prov	Prov_na
310101	Huangpu	3101	Shanghai (Districts)	31	Shanghai
310103	Luwan	3101	Shanghai (Districts)	31	Shanghai
310104	Xuhui	3101	Shanghai (Districts)	31	Shanghai
310105	Changning	3101	Shanghai (Districts)	31	Shanghai
310106	Jingan	3101	Shanghai (Districts)	31	Shanghai
310107	Putuo	3101	Shanghai (Districts)	31	Shanghai
310108	Zhabei	3101	Shanghai (Districts)	31	Shanghai
310109	Hongkou	3101	Shanghai (Districts)	31	Shanghai
310110	Yangpu	3101	Shanghai (Districts)	31	Shanghai
310112	Minxing	3101	Shanghai (Districts)	31	Shanghai
310113	Baoshan	3101	Shanghai (Districts)	31	Shanghai
310114	Jiading	3101	Shanghai (Districts)	31	Shanghai
310115	Pudongxin	3101	Shanghai (Districts)	31	Shanghai
310116	Jinshan	3101	Shanghai (Districts)	31	Shanghai
310117	Songjiang	3101	Shanghai (Districts)	31	Shanghai
310118	Qingpu	3101	Shanghai (Districts)	31	Shanghai
310120	Fengxian	3101	Shanghai (Districts)	31	Shanghai
310230	Chongming	3102	Shanghai (Counties)	31	Shanghai
320102	Xuanwu	3201	Nanjing	32	Jiangsu
320103	Baixia	3201	Nanjing	32	Jiangsu
320104	Qinhuai	3201	Nanjing	32	Jiangsu
320105	Jianye	3201	Nanjing	32	Jiangsu
320106	Gulou	3201	Nanjing	32	Jiangsu
320107	Xiaguan	3201	Nanjing	32	Jiangsu
320111	Pukou	3201	Nanjing	32	Jiangsu
320113	Xixia	3201	Nanjing	32	Jiangsu
320114	Yuhuatai	3201	Nanjing	32	Jiangsu
320115	Jiangning	3201	Nanjing	32	Jiangsu
320116	Liuhe	3201	Nanjing	32	Jiangsu
320124	Lishui	3201	Nanjing	32	Jiangsu
320125	Gaochun	3201	Nanjing	32	Jiangsu
320201	Wuxi(District)	3202	Wuxi	32	Jiangsu
320281	Jiangyin	3202	Wuxi	32	Jiangsu
320282	Yixing	3202	Wuxi	32	Jiangsu
320302	Gulou	3201	Xuzhou	32	Jiangsu
320303	Yunlong	3203	Xuzhou	32	Jiangsu
320304	Jiuli	3203	Xuzhou	32	Jiangsu
320305	Jiawang	3203	Xuzhou	32	Jiangsu
320311	Quanshan	3203	Xuzhou	32	Jiangsu
320312	Tongshan	3203	Xuzhou	32	Jiangsu
320321	Fengxian	3203	Xuzhou	32	Jiangsu

320322	Peixian	3203	Xuzhou	32	Jiangsu
320324	Suining	3203	Xuzhou	32	Jiangsu
320381	Xinyi	3203	Xuzhou	32	Jiangsu
320382	Pizhou	3203	Xuzhou	32	Jiangsu
320405	Qishuyan	3204	Changzhou	32	Jiangsu
320411	Xinbei	3204	Changzhou	32	Jiangsu
320412	Wujin	3204	Changzhou	32	Jiangsu
320481	Liyang	3204	Changzhou	32	Jiangsu
320482	Jintan	3204	Changzhou	32	Jiangsu
320501	Suzhou(District)	3205	Suzhou	32	Jiangsu
320581	Changshu	3205	Suzhou	32	Jiangsu
320582	Zhangjiagang	3205	Suzhou	32	Jiangsu
320583	Kunshan	3205	Suzhou	32	Jiangsu
320584	Wujiang	3205	Suzhou	32	Jiangsu
320585	Taicang	3205	Suzhou	32	Jiangsu
320602	Chongchuan	3206	Nantong	32	Jiangsu
320611	Gangzha	3206	Nantong	32	Jiangsu
320612	Tongzhou	3206	Nantong	32	Jiangsu
320621	Haian	3206	Nantong	32	Jiangsu
320623	Rudong	3206	Nantong	32	Jiangsu
320681	Qidong	3206	Nantong	32	Jiangsu
320682	Rugao	3206	Nantong	32	Jiangsu
320684	Haimen	3206	Nantong	32	Jiangsu
320703	Lianyun	3207	Lianyungang	32	Jiangsu
320705	Xinpu	3207	Lianyungang	32	Jiangsu
320706	Haizhou	3207	Lianyungang	32	Jiangsu
320721	Ganyu	3207	Lianyungang	32	Jiangsu
320722	Donghai	3207	Lianyungang	32	Jiangsu
320723	Guanyun	3207	Lianyungang	32	Jiangsu
320724	Guannan	3207	Lianyungang	32	Jiangsu
320802	Qinghe	3208	Huaian	32	Jiangsu
320803	Chuzhou	3208	Huaian	32	Jiangsu
320804	Huaiyin	3208	Huaian	32	Jiangsu
320811	Qingpu	3208	Huaian	32	Jiangsu
320826	Lianshui	3208	Huaian	32	Jiangsu
320829	Hongze	3208	Huaian	32	Jiangsu
320830	Xuyi	3208	Huaian	32	Jiangsu
320831	Jinhu	3208	Huaian	32	Jiangsu
320902	Tinghu	3209	Yancheng	32	Jiangsu
320903	Yandu	3209	Yancheng	32	Jiangsu
320921	Xiangshui	3209	Yancheng	32	Jiangsu
320922	Binhai	3209	Yancheng	32	Jiangsu
320923	Funing	3209	Yancheng	32	Jiangsu
320924	Sheyang	3209	Yancheng	32	Jiangsu

320925	Jianhu	3209	Yancheng	32	Jiangsu
320981	Dongtai	3209	Yancheng	32	Jiangsu
320982	Dafeng	3209	Yancheng	32	Jiangsu
321002	Guangling	3210	Yangzhou	32	Jiangsu
321003	Hanjiang	3210	Yangzhou	32	Jiangsu
321011	Guanglin	3210	Yangzhou	32	Jiangsu
321023	Baoying	3210	Yangzhou	32	Jiangsu
321081	Yizheng	3210	Yangzhou	32	Jiangsu
321084	Gaoyou	3210	Yangzhou	32	Jiangsu
321088	Jiangdu	3210	Yangzhou	32	Jiangsu
321101	Zhenjiang(District)	3211	Zhenjiang	32	Jiangsu
321181	Danyang	3211	Zhenjiang	32	Jiangsu
321182	Yangzhong	3211	Zhenjiang	32	Jiangsu
321183	Jurong	3211	Zhenjiang	32	Jiangsu
321202	Hailing	3212	Taizhou	32	Jiangsu
321203	Gaogang	3212	Taizhou	32	Jiangsu
321281	Xinghua	3212	Taizhou	32	Jiangsu
321282	Jingjiang	3212	Taizhou	32	Jiangsu
321283	Taixing	3212	Taizhou	32	Jiangsu
321284	Jiangyan	3212	Taizhou	32	Jiangsu
321302	Sucheng	3213	Suqian	32	Jiangsu
321311	Suyu	3213	Suqian	32	Jiangsu
321322	Shuyang	3213	Suqian	32	Jiangsu
321323	Siyang	3213	Suqian	32	Jiangsu
321324	Sihong	3213	Suqian	32	Jiangsu
330101	Hangzhou(District)	3301	Hangzhou	33	Zhejiang
330122	Tonglu	3301	Hangzhou	33	Zhejiang
330127	Chunan	3301	Hangzhou	33	Zhejiang
330182	Jiande	3301	Hangzhou	33	Zhejiang
330183	Fuyang	3301	Hangzhou	33	Zhejiang
330185	Linan	3301	Hangzhou	33	Zhejiang
330203	Haishu	3302	Ningbo	33	Zhejiang
330204	Jiangdong	3302	Ningbo	33	Zhejiang
330205	Jiangbei	3302	Ningbo	33	Zhejiang
330206	Beilun	3302	Ningbo	33	Zhejiang
330211	Zhenhai	3302	Ningbo	33	Zhejiang
330212	Yinzhou	3302	Ningbo	33	Zhejiang
330225	Xiangshan	3302	Ningbo	33	Zhejiang
330226	Ninghai	3302	Ningbo	33	Zhejiang
330281	Yuyao	3302	Ningbo	33	Zhejiang
330282	Cixi	3302	Ningbo	33	Zhejiang
330283	Fenghua	3302	Ningbo	33	Zhejiang
330302	Lucheng	3303	Wenzhou	33	Zhejiang
330303	Longwan	3303	Wenzhou	33	Zhejiang

330304	Ouhai	3303	Wenzhou	33	Zhejiang
330322	Dongtou	3303	Wenzhou	33	Zhejiang
330324	Yongjia	3303	Wenzhou	33	Zhejiang
330326	Pingyang	3303	Wenzhou	33	Zhejiang
330327	Cangnan	3303	Wenzhou	33	Zhejiang
330328	Wencheng	3303	Wenzhou	33	Zhejiang
330329	Taishun	3303	Wenzhou	33	Zhejiang
330381	Ruian	3303	Wenzhou	33	Zhejiang
330382	Leqing	3303	Wenzhou	33	Zhejiang
330402	Nanhu	3304	Jiaxing	33	Zhejiang
330411	Xiuzhou	3304	Jiaxing	33	Zhejiang
330421	Jiashan	3304	Jiaxing	33	Zhejiang
330424	Haiyan	3304	Jiaxing	33	Zhejiang
330481	Haining	3304	Jiaxing	33	Zhejiang
330482	Pinghu	3304	Jiaxing	33	Zhejiang
330483	Tongxiang	3304	Jiaxing	33	Zhejiang
330501	Huzhou(District)	3305	Huzhou	33	Zhejiang
330521	Deqing	3305	Huzhou	33	Zhejiang
330522	Changxing	3305	Huzhou	33	Zhejiang
330523	Anji	3305	Huzhou	33	Zhejiang
330602	Yuecheng	3306	Shaoxing	33	Zhejiang
330621	Shaoxing	3306	Shaoxing	33	Zhejiang
330624	Xinchang	3306	Shaoxing	33	Zhejiang
330681	Zhuji	3306	Shaoxing	33	Zhejiang
330682	Shangyu	3306	Shaoxing	33	Zhejiang
330683	Shengzhou	3306	Shaoxing	33	Zhejiang
330702	Wucheng	3307	Jinhua	33	Zhejiang
330703	Jindong	3307	Jinhua	33	Zhejiang
330723	Wuyi	3307	Jinhua	33	Zhejiang
330726	Pujiang	3307	Jinhua	33	Zhejiang
330727	Panan	3307	Jinhua	33	Zhejiang
330781	Lanxi	3307	Jinhua	33	Zhejiang
330782	Yiwu	3307	Jinhua	33	Zhejiang
330783	Dongyang	3307	Jinhua	33	Zhejiang
330784	Yongkang	3307	Jinhua	33	Zhejiang
330802	Kecheng	3308	Quzhou	33	Zhejiang
330803	Qujiang	3308	Quzhou	33	Zhejiang
330822	Changshan	3308	Quzhou	33	Zhejiang
330824	Kaihua	3308	Quzhou	33	Zhejiang
330825	Longyou	3308	Quzhou	33	Zhejiang
330881	Jiangshan	3308	Quzhou	33	Zhejiang
330902	Dinghai	3309	Zhoushan	33	Zhejiang
330921	Daishan	3309	Zhoushan	33	Zhejiang
331002	Jiaojiang	3310	Taizhou	33	Zhejiang

331003	Huangyan	3310	Taizhou	33	Zhejiang
331004	Luqiao	3310	Taizhou	33	Zhejiang
331021	Yuhuan	3310	Taizhou	33	Zhejiang
331022	Sanmen	3310	Taizhou	33	Zhejiang
331023	Tiantai	3310	Taizhou	33	Zhejiang
331024	Xianju	3310	Taizhou	33	Zhejiang
331081	Wenling	3310	Taizhou	33	Zhejiang
331082	Linhai	3310	Taizhou	33	Zhejiang
331102	Liandu	3311	Lishui	33	Zhejiang
331121	Qingtian	3311	Lishui	33	Zhejiang
331122	Jinyun	3311	Lishui	33	Zhejiang
331123	Suichang	3311	Lishui	33	Zhejiang
331124	Songyang	3311	Lishui	33	Zhejiang
331125	Yunhe	3311	Lishui	33	Zhejiang
331126	Qingyuan	3311	Lishui	33	Zhejiang
331127	Jingning	3311	Lishui	33	Zhejiang
331181	Longquan	3311	Lishui	33	Zhejiang
340101	Hefei(District)	3401	Hefei	34	Anhui
340121	Changfeng	3401	Hefei	34	Anhui
340122	Feidong	3401	Hefei	34	Anhui
340123	Feixi	3401	Hefei	34	Anhui
340201	Wuhu(District)	3402	Wuhu	34	Anhui
340221	Wuhu	3402	Wuhu	34	Anhui
340222	Fanchang	3402	Wuhu	34	Anhui
340223	Nanling	3402	Wuhu	34	Anhui
340402	Datong	3404	Huainan	34	Anhui
340403	Tianjiaan	3404	Huainan	34	Anhui
340404	Xiejiaji	3404	Huainan	34	Anhui
340405	Bagongshan	3404	Huainan	34	Anhui
340406	Panji	3404	Huainan	34	Anhui
340421	Fengtai	3404	Huainan	34	Anhui
340503	Huashan	3405	Maanshan	34	Anhui
340504	Yushan	3405	Maanshan	34	Anhui
340521	Dangtu	3405	Maanshan	34	Anhui
341102	Langya	3411	Chuzhou	34	Anhui
341103	Nanqiao	3411	Chuzhou	34	Anhui
341122	Laian	3411	Chuzhou	34	Anhui
341124	Quanjiao	3411	Chuzhou	34	Anhui
341125	Dingyuan	3411	Chuzhou	34	Anhui
341126	Fengyang	3411	Chuzhou	34	Anhui
341181	Tianchang	3411	Chuzhou	34	Anhui
341182	Mingguang	3411	Chuzhou	34	Anhui
341302	Yongqiao	3411	Suzhou	34	Anhui
341402	Juchao	3414	Chaohu	34	Anhui

341421	Lujiang	3414	Chaohu	34	Anhui
341423	Hanshan	3414	Chaohu	34	Anhui
341424	He	3414	Chaohu	34	Anhui

Annex 7: County Map