How do socioeconomic and urban form factors affect the spatial distribution of coworking spaces? The case of Shanghai, China

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A thesis
submitted in partial fulfillments of
requirements for the degree of

Master of Urban Planning

University of Washington
Spring 2021

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Programs Authorized to Offer Degree:

Built Environment

University of Washington

Abstract

How do socioeconomic and urban form factors affect the spatial distribution of coworking spaces? The case of Shanghai, China

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Abstract

As an important incubator of start-up firms and SMEs, coworking spaces can provide affordable office spaces of various sizes and lease structures with a community and synergy base atmosphere. The economic slowdown caused by COVID – 19 had a significant impact on coworking spaces, by limiting the exponential growth seen in recent years. However, the needs of flexible offices when more companies are shifting to remote-first workforces are growing, which helps fuel the continuous disruption of the typical office buildings with bigger office spaces and lengthier lease structures. Shanghai, as the economic center of China, is one of the first cities to recover after COVID – 19. In 2021, 37 new coworking spaces joined the large coworking market in Shanghai before April, which shows the potential and positive prospect of it.

The thesis focuses on the location pattern of coworking spaces in Shanghai, answering the questions: “can the current sites cover all of the major customers of coworking spaces?” and “what are good locations for new coworking spaces in the future?”. We will first introduce the overall history and location of coworking in Shanghai, and then test its correlation with socioeconomic and urban form structure. The major findings of the study are: (1) coworking spaces tend to cluster in high-dense areas of companies, especially the top 5% of large enterprises ranked by registered capita; (2) coworking space density has significant correlation with companies in accommodating and catering industry, finance, education, and health and social work. It also has positive correlation with rental and business services and culture, sports and entertainment industry (3) coworking spaces tend to cluster in areas with high ratio of commercial land, and also shows a trend of clustering in areas with high residential trend; (4) coworking space density has positive correlation with road density and subway station density.

Acknowledgement

These two years of graduate school are very special for me. I spent most of the time in China studying from home. I left Seattle in a hurry in March, 2020, didn't have a chance to say goodbye to teachers and friends, and didn't have the opportunity to see the beautiful cherry blossoms on the UW campus. I suffered a lot from the time differences and loneliness of studying remotely during this period. However, this gives me a chance to spend much time with my family. I haven't been together with them for so long after high school.

I would first like to give my thanks to my advisor Diana, who constantly answered my questions, helped me adjust the curriculum and communicate with professors, to make my study plan more suitable for my schedule in China and to help me relieve my stress. Thank you also to my thesis committee members, professor Sofia Dermisi and Rachel Berney, who gave me a lot of ideas to helped me enrich my thesis and craft a relatively complete story about coworking spaces in Shanghai with my curiosity, and also be willing to adapt to my time as much as possible in every review meeting. Thanks to Rebecca Walter who taught me comprehensive ArcGIS skills in her Data Modeling class, which is very helpful in my thesis work. Thanks to my boyfriend Haoran Xu, who gave me much advice on the data cleaning work on processing the two million pieces of data of Shanghai enterprises. Thanks to my mother, who as a school teacher, shared with me her experience on article writing, although she doesn't have knowledge in coworking and planning. Thanks also to other professors and my classmates, who gave me support in various ways and encouraged me.

Last, I would like to give my sincere thanks to the University of Washington. I met many good teachers and classmates here and learned a lot from them. Although I haven't been at UW for

long, the culture and atmosphere of UW continue to influence me, and I believe it will benefit me for life. I miss UW's beautiful campus and free learning environment. I will continue my work and life with this beautiful memory in the future.

Preface

My interest in coworking started from my summer internship in China Merchants Shekou Industrial Zone Holdings CO., LTD. I participated in the planning and design work of the Haimen Luxury Cruise Industrial Park there. The development of this industrial park is based on the cruise ship manufacturing plant adjacent to it. It aims to provide production sites, office space and corporate services for small and medium-sized cruise ship production related enterprises. A shared office building specially designed for the incubation of small businesses in the park. The open office space design and start-up business services are in line with the concept of coworking. However, in the process of deepening the plan, we found that despite the advantages of the industrial base, few related small and micro enterprises have the willingness to settle in due to the remote location of the park. At the same time, I also learned about the impact of Covid-19 on the office market. During this process, I began to think about the underlying factors which determine the location of the coworking spaces. What kind of industry is more suitable for the form of coworking spaces? What is the impact of the pandemic on coworking spaces?

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Chapter 1 Introduction

1.1 Background

The concept of coworking has increased exponentially since 2005 when it first launched. By 2020, Coworker (an online portal dedicated to coworking) reported the existence of over 13,000 verified locations worldwide, located in 170 countries (Coworker, 2020). The popularity of coworking space is bringing a new working possibility for individuals, start-ups, and SMEs, which can provide them with not only affordable and flexible working space, but also service and amenities. DuPriest (2019) categorized coworking spaces into three typologies: "the first type of coworking spaces act as '***social entrepreneurship and start-up incubators***' with a supportive role and closer ties to social and urban issues, the second type of coworking spaces act as '***coffee and cowork incubators***' providing cafes with shared workspaces, the third type of coworking spaces act as '***real estate business incubators***' and are mainly a commercial product responding the demand for flexible office spaces." (DuPriest, 2019)

COVID-19 has magnified the challenges of coworking spaces. Coworking spaces can serve as incubators for SMEs which are impacted by the pandemic so much that need to restart, and the needs of coworking spaces by individuals who don't want to work at home may grow when more companies are shifting to remote-first workforces. However, the coworking space as an industry itself has been impacted significantly by the pandemic. How would the sites and distribution patterns evolve in the future after the economic recovery is still unknown.

1.2 Study Area

Shanghai, as one of the largest cities in China, has dense population and industrial base, which provide a good background for the growth of startup firms and individuals. According to Coworker's statistics, Shanghai has 119 coworking spaces of the total 326 coworking spaces in China by April, 2021. These coworking spaces are located in the dynamic urban environment in Shanghai, and play different roles in different city areas. The dynamic urban environment and the significant amount of coworking spaces in Shanghai provides a good foundation for the research. The core city districts are the central city area of the city of Shanghai, and also the most dense and complex place in Shanghai.

In Shanghai Master Plan (2035), the system for urban public activity centers in Shanghai includes four hierarchies (Figure 1): ***City center (central activity area), city sub-center, local***

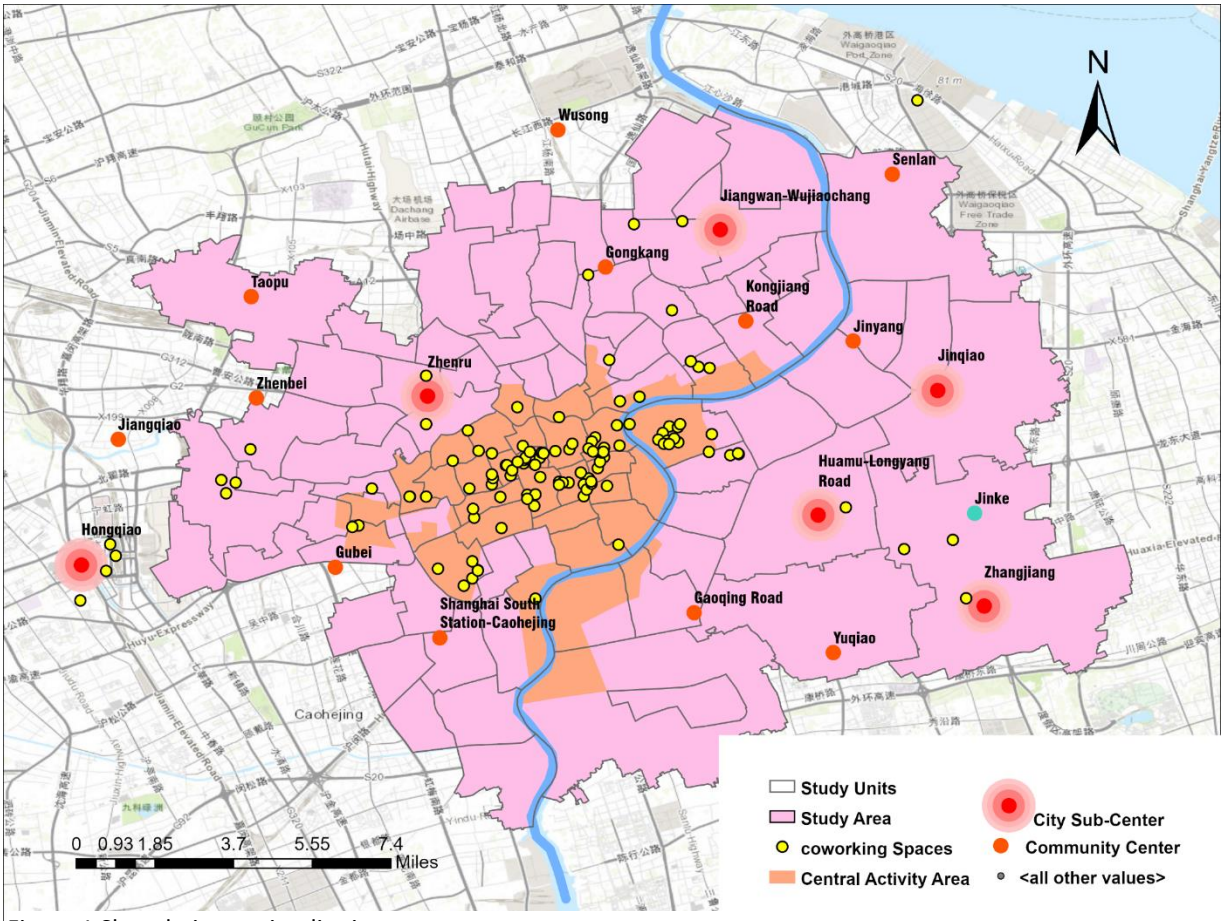

Figure 1 Shanghai core city districts map

center, and community center. Eight districts in Shanghai are defined as the core city districts out of the total sixteen. The core city districts accommodate most of the city functions. One-third of the population in Shanghai lives here. Most of the coworking spaces are located in the core city districts in Shanghai. In order to study the location characteristics of coworking spaces more accurately, this article narrows the study area to the core city districts. The study unit of this research is the street block groups (subdivision of neighborhoods). The dependent variable is the density of coworking spaces in each unit, and all the independent variables (influential factors) will be examined at this level.

1.3 Objective

Studying what factors influence the location of coworking spaces we can better understand why they locate in the areas they do. The development of coworking spaces after the market change from COVID-19 can be predicted with a comprehensive understanding of the factors influencing them. And also, by analyzing the influential factors and the current coworking space locations, a gap between the “suitable” areas and blank coworking spaces located may be seen, and it can help guide such incubators to locate in the areas with demand; at the same time, some outliers located in “unsuitable” areas may also be seen, which can let us further think about what other factors can promote the development of coworking spaces.

Chapter 2 Literature Review

2.1 The role of coworking spaces for individuals, companies and cities

Significant amounts of research have been conducted to describe the role of coworking spaces and their functions as incubators for startup firms (Figure 2).

Coworking spaces are designated as a “third place” besides home and office to improve the individual’s work efficiency and knowledge interaction in team works. Markel (2015) found that coworking promotes a collective, community-based approach to the organization of cultural and creative work, and he regards coworking spaces as a new form of urban social infrastructure enabling contacts and collaborations between people, ideas and connecting places. His research focused especially on the role of hosts to facilitate interaction by providing services and platforms. Parrino (2015) chooses two maximum-variation case studies from the viewpoint of the kinds of proximity that they involve and studies the role of the physical co-presence of coworkers in facilitating the transmission of knowledge. In their empirical study the author used figures and maps to show the isolated geographic proximity and knowledge exchange among individuals. This study underlines the importance of elements of organizational and social proximity in stimulating collaboration among coworkers and in promoting exchange of other forms of knowledge. On the other hand, researchers such as Blagoev et al. (2019) challenge the understanding of coworking spaces as neutral containers for independent work, showing how coworking spaces incorporates the disposition of becoming organizational. However, the study by Jakonen (2017) et al. researches three cases of coworking as affectual assemblages. They conclude that encounters do not necessarily take place in coworking places because encounters are avoided and even neglected by precarious workers since their primary interest is always on

their own work, which challenges some previous findings on office space design, cooperation and community building.

From a macro level, coworking spaces are investigated in the context of urban areas, and are assessed on their distribution characteristics and economic and cultural value for both local community and large city areas. Jamal (2018) conducted a survey of 10 coworking spaces with a study area of seven mid-sized cities, based on a local economic development framework, emphasizing “collaborative partnership of many community groups”. The author categorized interviewee’s comments in four themes: Downtown locations matter; Coworking is revitalizing downtowns and fostering local economic development; Coworking fosters entrepreneurship and innovation; Partnership is essential to create success. The author concludes that the coworking spaces in mid-sized cities have similarities to those in large cities, and can leverage the knowledge economy and foster local economic development to help revitalize their ailing downtowns. Zhao (2020) et al. examines the economic and socio-cultural implications of the coworking trend for smart cities, their ecosystems and the use of urban public spaces by interviewing thirty-four providers and users in Australia. The authors find that coworking spaces are important in building communities and developing social and cultural ties, and provide a breeding ground for entrepreneurship. Their findings also indicate that coworking spaces are likely to contribute to urban mobility and sustainability because users want to commute from home to coworking space conveniently. This study emphasizes coworking is a product of smart cities and it can also contribute to the key elements of smart cities of collaboration, openness, and community engagement. Brown (2017) researches coworking with a background that a project aimed at establishing new creative CWS in city-center locations across SE England is implemented. The study cautions against the use of coworking space as “quick fix” urban

renewal tools, with little indication that the benefits of coworking reach beyond immediate members or that linkages are easily established between coworkers and local communities. The article also indicates while coworking space managers play a key connecting role, also ensuring coworker complementary and compatibility, the coworker profile ultimately influences outcomes. DuPriest (2019) investigates the location patterns of coworking spaces, the effects of coworking spaces on the local and urban context, and potential opportunities for the creation of local economic development. This article indicates that the effects of coworking spaces are mainly related to their temporary transformation of public space through practices, such as accelerator and incubation programs, evening and night activities, and revitalization of old or empty buildings and spaces. The author categorizes the coworking spaces based on the potential impact generated on local economic development: the first type of coworking spaces act as "social entrepreneurship and start-up incubators" with a supportive role and closer ties to social and urban issues, the second type of coworking spaces act as "coffee and cowork incubators" providing cafés with shared workspaces, the third type of coworking spaces act as "real estate business incubators" and are mainly a commercial product responding the demand for flexible office spaces.

Most of the studies of coworking spaces use qualitative methods, such as desk research, mainly because of its diversity and heterogeneity. However, Cheah and Ho (2019) conduct a quantitative study on 258 young tenant firms operating in 13 coworking spaces in Singapore. The authors use space creativity and social climate as dependent variables, opportunity recognition and exploitation as mediating variables, and business model innovation as independent variables. These variables are measured using multi-item constructs scored on a five-point Likert scale, and tested by confirmatory factor analysis in MPlus 7.0. The article indicates that the space creativity

of coworking is positively related to the business model innovation, and tenant firms' opportunity recognition and exploitation process positively mediates the relationship between the dependent and independent variables.

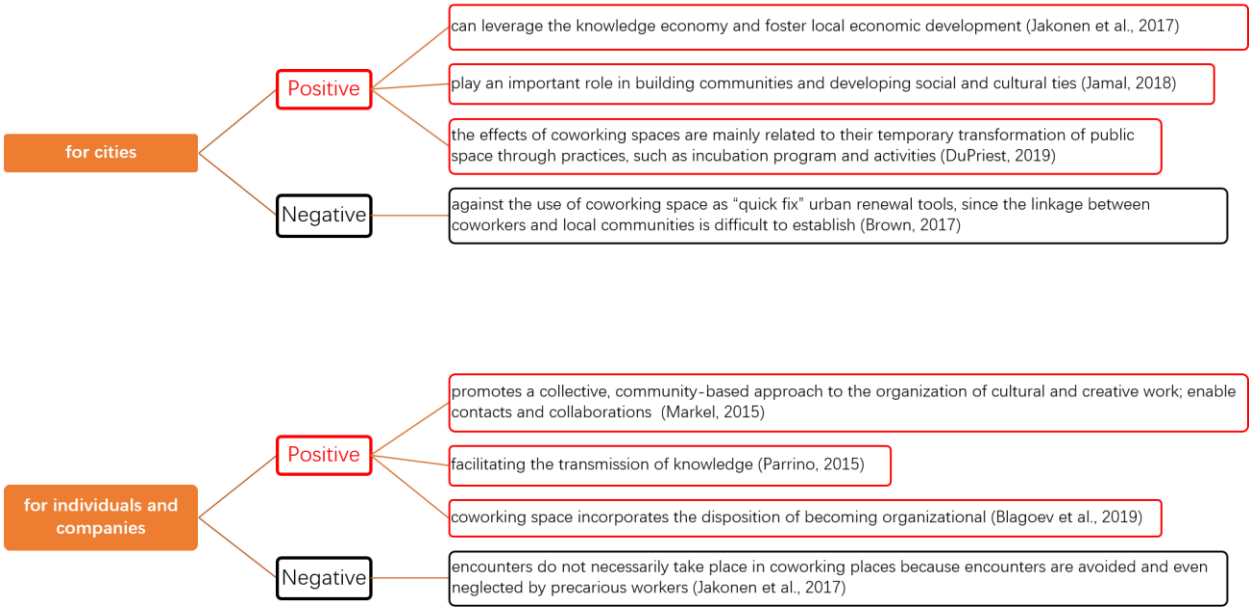

Figure 2 Summary of the role of coworking spaces for individuals, companies and cities

2.2 Impact from COVID19 on office market and coworking spaces

Many media and professional company reports show that coworking spaces have received a serious blow during the pandemic, but there are also voices that show how flexible office needs caused by the pandemic will have a positive impact on coworking spaces in the long-term. New York-based real estate research firm Reis Inc. released a report of U.S. office and apartment vacancy rates. The data showed that U.S. office vacancy rates rose from 17.1% in the second quarter of 2020 from 16.8% in the second quarter of 2019. According to Norman Media Ltd, the global coworking space market size is expected to decline from $9.27 billion in 2019 to $8.24 billion in 2020 at a compound annual growth rate (CAGR) of -12.9%. The decline is mainly due

to economic slowdown across countries due to the COVID-19 outbreak and the measures to contain it. The global coworking spaces market share is expected to recover and reach $11.52 billion in 2023 at CAGR of 11.8%. The demand for coworking spaces droped as the Covid -19 crisis closed many small businesses, said an article in The Economic Times. However, “an increase in enquiries from bigger companies that have given up their offices and now seek flexibility will help soften the blow in the long term”. "Coworking operators have experienced a dramatic boom-bust cycle, and COVID presents some unique challenges for the industry, but the future of real estate will retain many of the key elements that helped fuel this disruption. Space will be fast, flexible and fun.” said Scott Homa, Head of Office Research, Americas, JLL.

A few articles studied the impact of Covid - 19 on start-up firms. Younger workers (Blundell et al., 2020) and firms with poor sustainability performance have more negative association between Covid - 19 (Bose at al., 2021). Apedo-Amah et al. (2020) found “smaller firms are disproportionately facing greater financial constraints”. OECD, SME and Entrepreneurship Papers reviews that “the COVID-19 crisis has had a profound impact on SME access to finance”, although “the pre-crisis financing environment was broadly favorable for SMEs and entrepreneurs”.

Some researchers studied Covid - 19’s impact on the different sectors of the economy in China by analyzing the data on the stock market. He et al. (2020) finds that “transportation, mining, electricity & heating, and environment industries have been adversely impacted by the pandemic”, but “manufacturing, information technology, education and health-care industries have been resilient to the pandemic” in the Chinese Stock Market. These resilient industries are more related to coworking spaces, showing optimistic signs for the recovery of coworking.

The literature review structure on the impact from COVID19 on office market and coworking spaces is summarized in Figure 3.

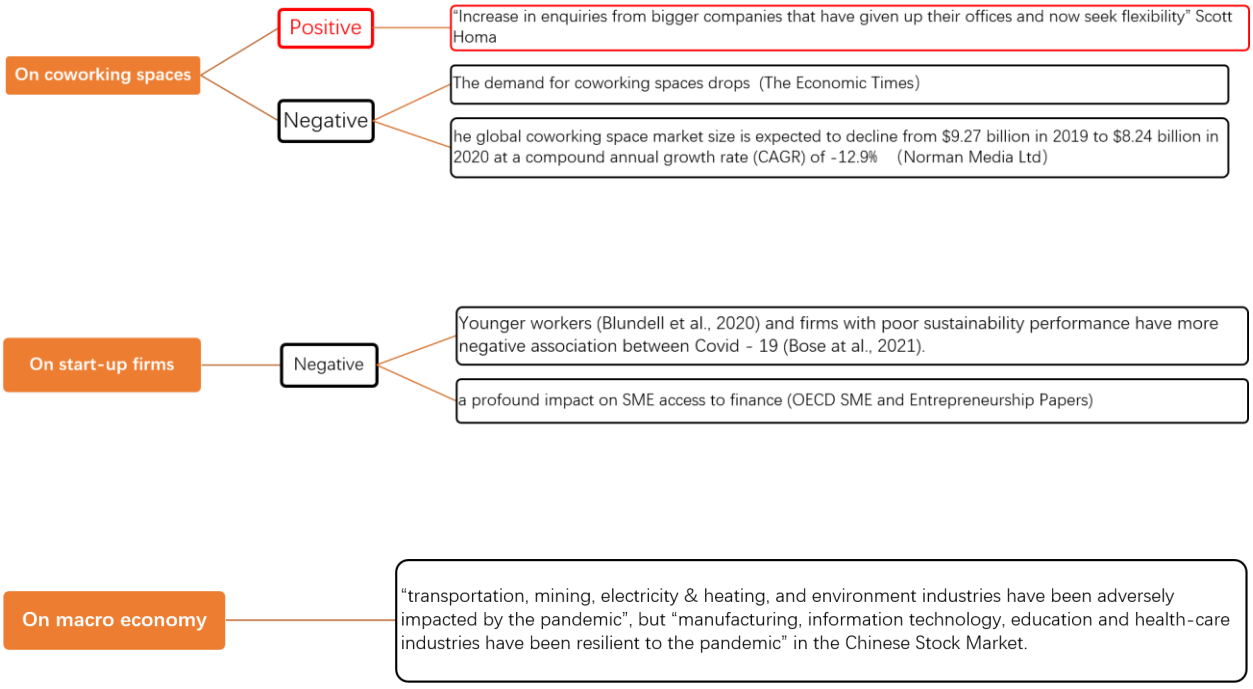

Figure 3 Summary of impact from COVID19 on office market and coworking spaces

2.3 Count Modeling used in location research

At present, no literature is found studying the location of coworking spaces. However, there is some literature studying the location decision of start-up firms and R&D institutes, which also have reference value to the location study of coworking spaces.

The earlier research about location decision has been dominated by two modeling approaches: discrete choice modeling and count modeling. Count modeling "considers the territory as the unit of analysis, and investigates how location attributes can influence business location decisions in the form of the count of businesses in each territorial unit." (Bhat et al, 2014) The advantages of

count modeling are that it can analyze all the characteristics of territorial units, and it is appealing especially when the number of territorial units is large.

Bhat et al. (2014) used count modeling to analyze the new firm locations, considering variables including agglomeration economies/diseconomies, industrial specialization indices, human capital, fiscal conditions, transportation infrastructure, and land development characteristics. Sun (2011) did research on the location of foreign research and development (R&D). Sun uses count modeling, too. But she expends the count of R&D to the R&D staff and the amount of R&D spending. It is a macro study and the territorial units in the research are the provinces in China. Sun uses market demand, talent supply, labor cost and infrastructure as independent variables. Moeller, K. (2018) researched the correlation between firms and amenity density also using the count modeling. Beyond using the count of firms, Moeller also divides firms by different knowledge-based service industries.

The literature review about the count Modeling used in location research is summarized in Figure 4.

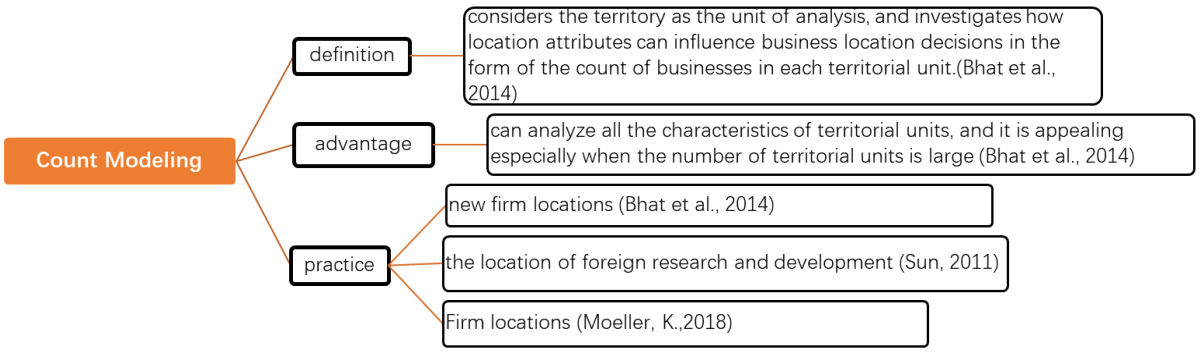

Figure 4 Summary of count Modeling used in location research

Chapter 3 Coworking Spaces in Shanghai

3.1 Development history

Shanghai had 119 coworking spaces until April, 2021. Seeing figure 5, the number of coworking spaces in Shanghai increased exponentially in 2017, and the number of new coworking spaces dropped sharply in 2020 when the market was impacted by COVID 19 hugely. Thirty-seven more coworking spaces are registered on Coworker in 2021, which shows a positive sign of market recovery. The British based company, Regus recently opened 25 coworking spaces from the total 37 new co-working spaces opened in Shanghai having a lion market share. This is the first time Regus has come to Shanghai. Wework also owns 26 places in the total 119, and The Executive Centre owns 9 of them. Most of the coworking spaces belong to a coworking chain and have at least 2 places, and 20 of them are independent.

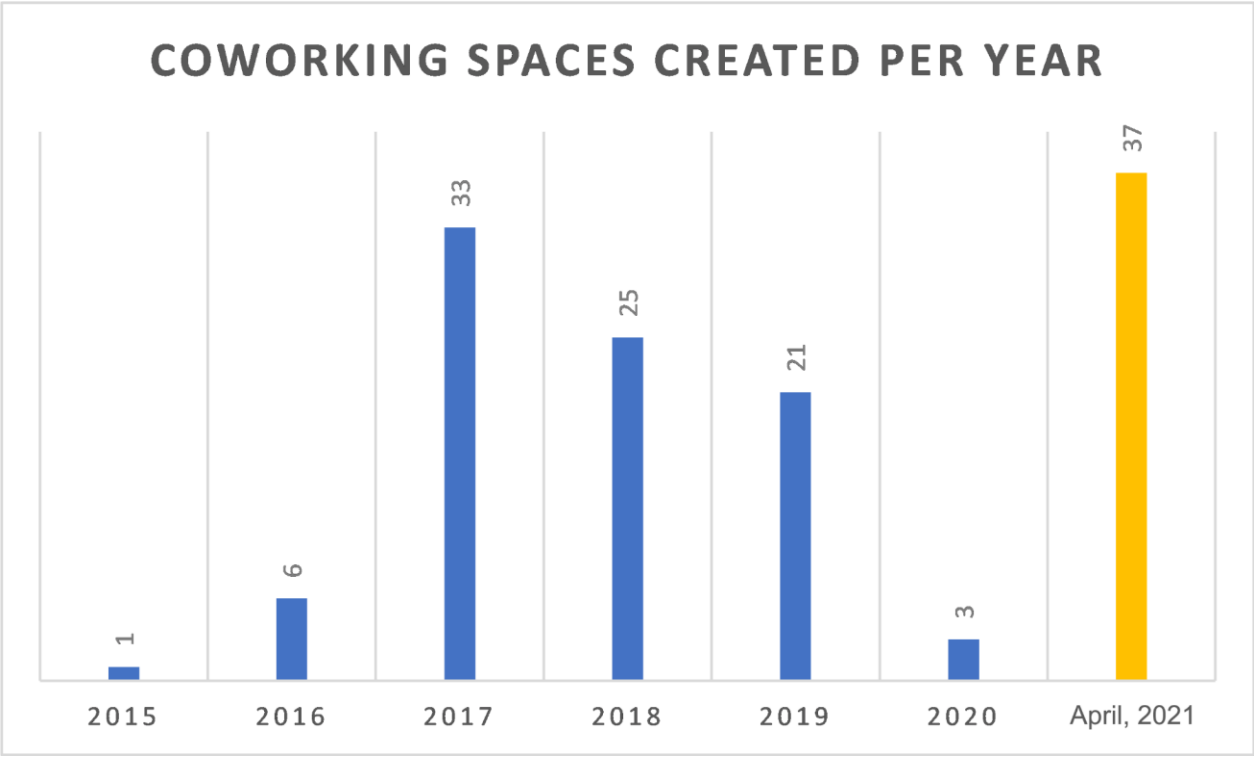

Figure 5 Coworking Spaces Created per year

75.6% of the coworking spaces are located in the central activity district of the city, and 94.9% of them are located in the core city districts. Figure 6 shows the coworking spaces by their opening year: the ones opened before 2016 are all in the central activity district; beginning from 2017, the coworking spaces began to expand to other areas in and outside the core city districts.

By 2018, the distribution area of coworking spaces has basically been fixed. In 2020, no coworking space chose new markets. In 2021, pioneer coworking spaces appeared in the Waigaoqiao Free Trade Zone in the northeast of Shanghai and the southern riverside area. New coworking spaces also chose unexplored markets in the northwest and east of the central city. It can be seen that the shared office has a certain trend of expanding outward from the city center.

3.2 Urban context

Shanghai's long and rich urban development history has created a complex urban spatial form. According to the current distribution of coworking, this study roughly divides the urban context where coworking is located into four categories (Figure 7 – 10): (1) old city areas, which retains the built environment features of the original Shanghai concession. Most of the buildings in old city districts were built around 1920s - 1930s, with small building scales and pleasant street spaces. (2) commercial and business centers, mostly developed after 1995. Shanghai is famous for its multi-center city planning. Most buildings are high-rise office buildings. (3) industry parks. Most of these industry parks are developed together with high-tech industry in recent years. The industry parks are always a mix of commercial, office, research, and manufacturing use. (4) residential area, community center and other mixed used areas. Besides the first three categories, there are some other urban contexts including modern residential community, small-

scaled community center and mixed used spaces. Figure 15 shows the location of coworking spaces by

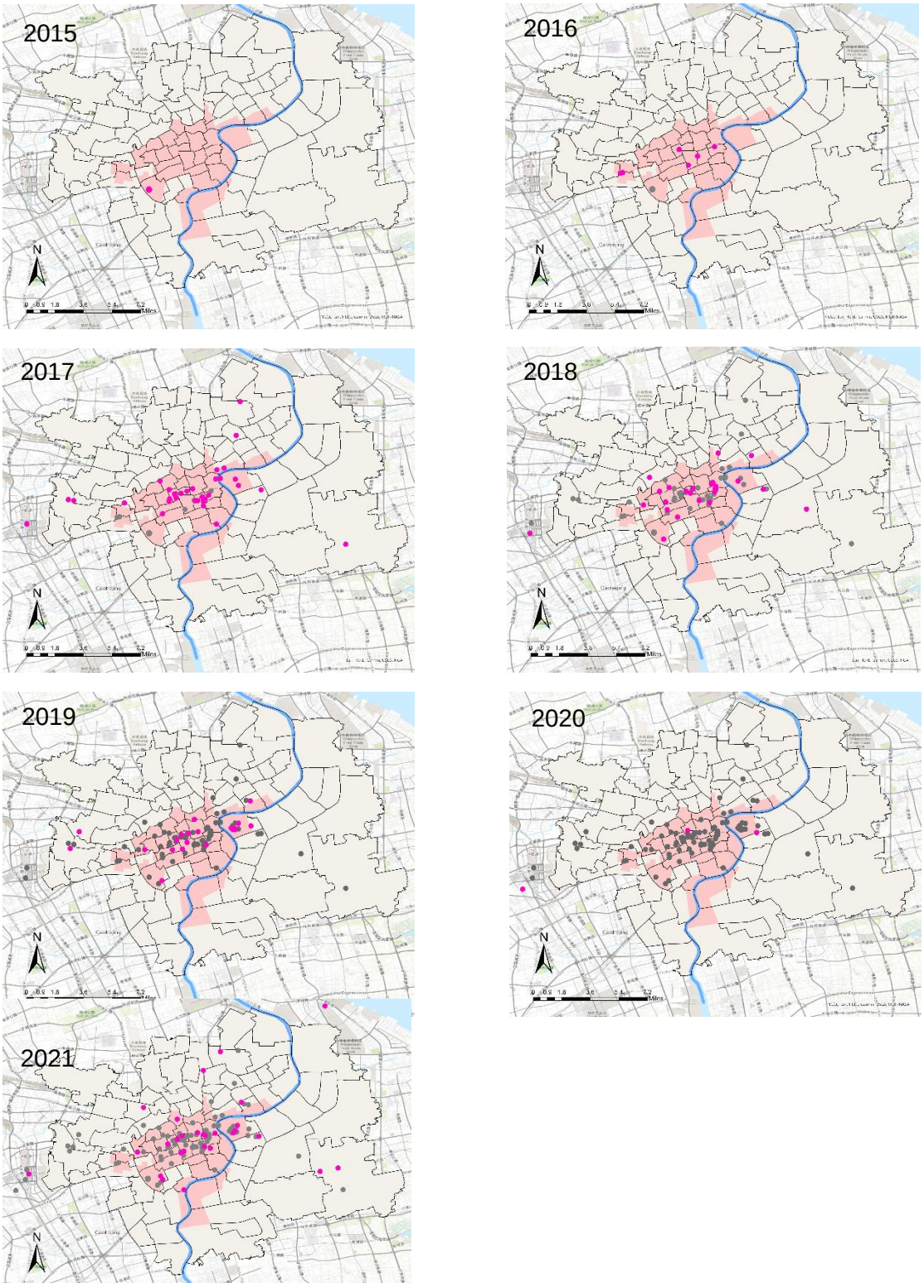

Figure 6 New coworking spaces from 2015 to 2021

its urban context. These four types of urban spatial forms have no clear boundaries. Except for industrial parks, the first three types are all mixed in the center of Shanghai. This is caused by the continuous renewal of the central city of shanghai. The satellite imageries and photos of the four urban contexts are shown in Figure 11 – 14.

Figure 7 Old City Area Urban Fabric

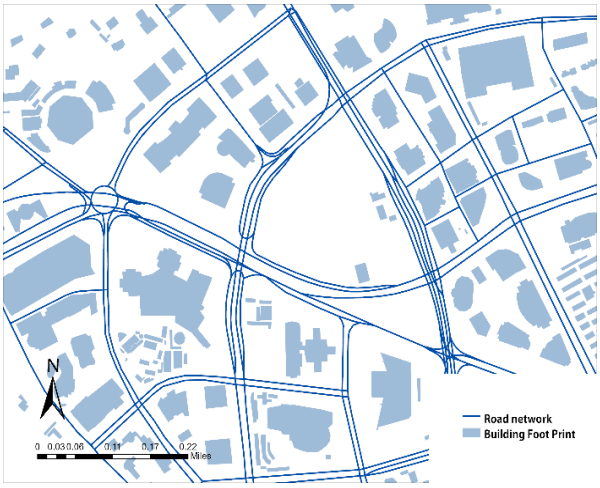

Figure 8 Commercial and Business Center Urban Fabric

Figure 9 Industry Park Urban Fabric

Figure 10 Residential Area, Community Center and Other Mixed use Area Urban Fabric

Figure 11 Old City Area Satellite Imagery and Street View (Source: Baidu Map)

Figure 12 Commercial and Business Center Satellite Imagery and Street View (Source: Baidu Map)

Figure 13 Industry Park Satellite Imagery and Street View (Source: Baidu Map)

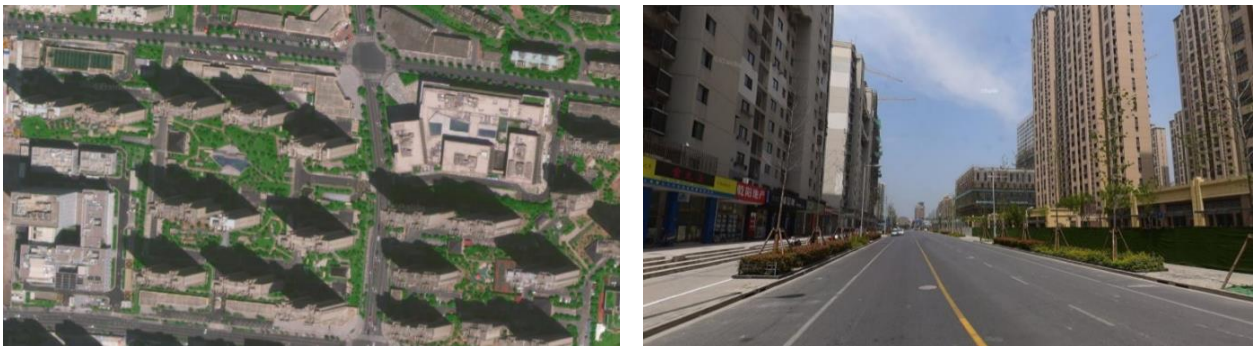

Figure 14 Residential Area Satellite Imagery and Street View (Source: Baidu Map)

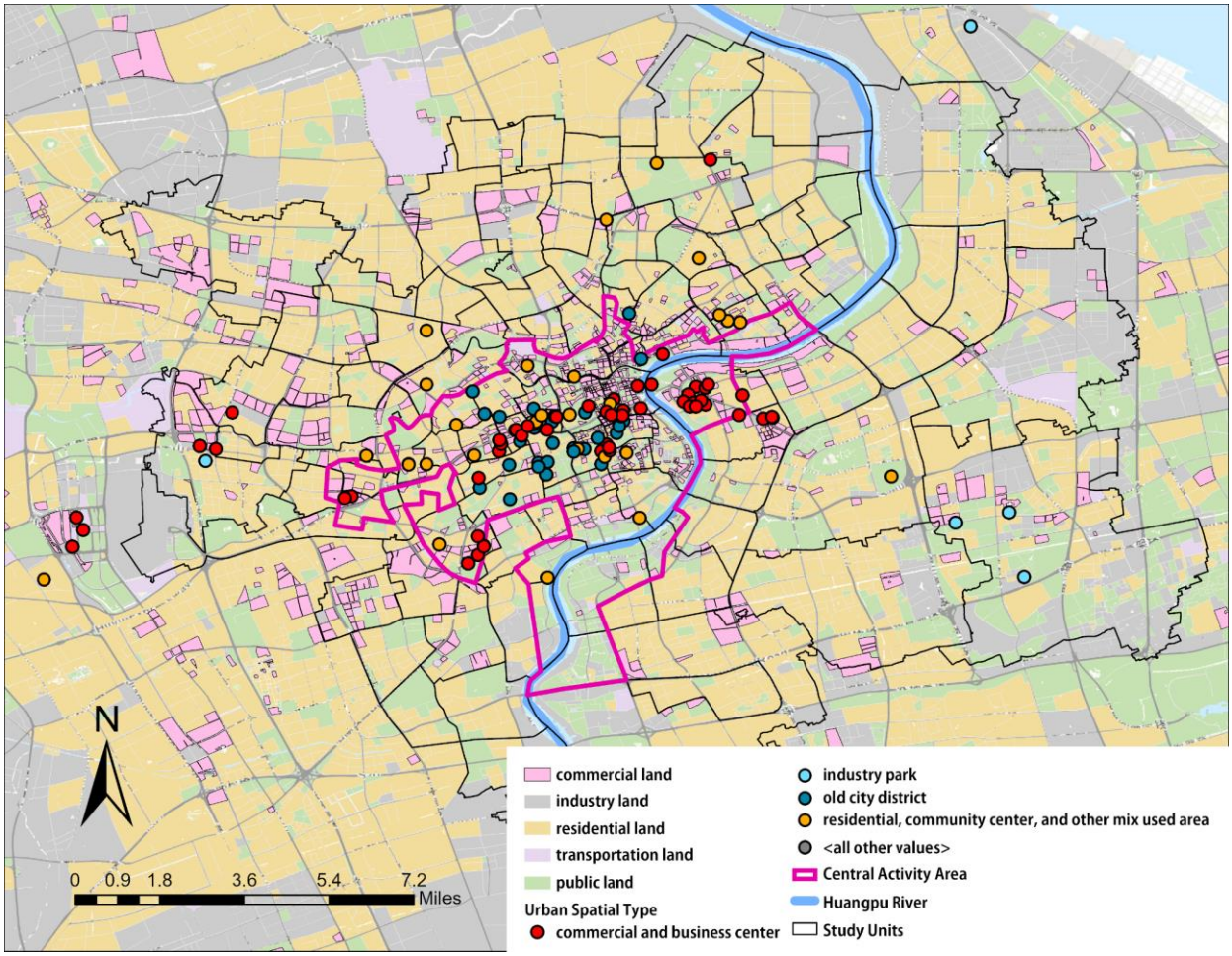

Figure 15 Map of Coworking Spaces by Urban Context

Figure 16 shows the increase of coworking spaces in each urban context by net increase and total number. Coworking spaces in commercial and business areas experience a considerable amount of growth every year. Coworking spaces in old city areas used to keep being the second in the market. However, the net growth is declining year by year, and it has been overtaken by the coworking spaces in residential areas, community centers and other mixed used areas. The reason is that Shanghai's old city space is limited, and some of the old city areas are still being replaced by new urban buildings, so there are fewer options for new coworking spaces. Moreover, the number of coworking in the old city is becoming saturated, and many coworking

companies tend to expand into new markets. The number of coworking spaces in residential areas, community centers and other mixed used areas grows quickly in 2021, which shows a sign of coworking spaces exploring more diverse urban spaces. The coworking spaces in industry parks only take up a small part of the market.

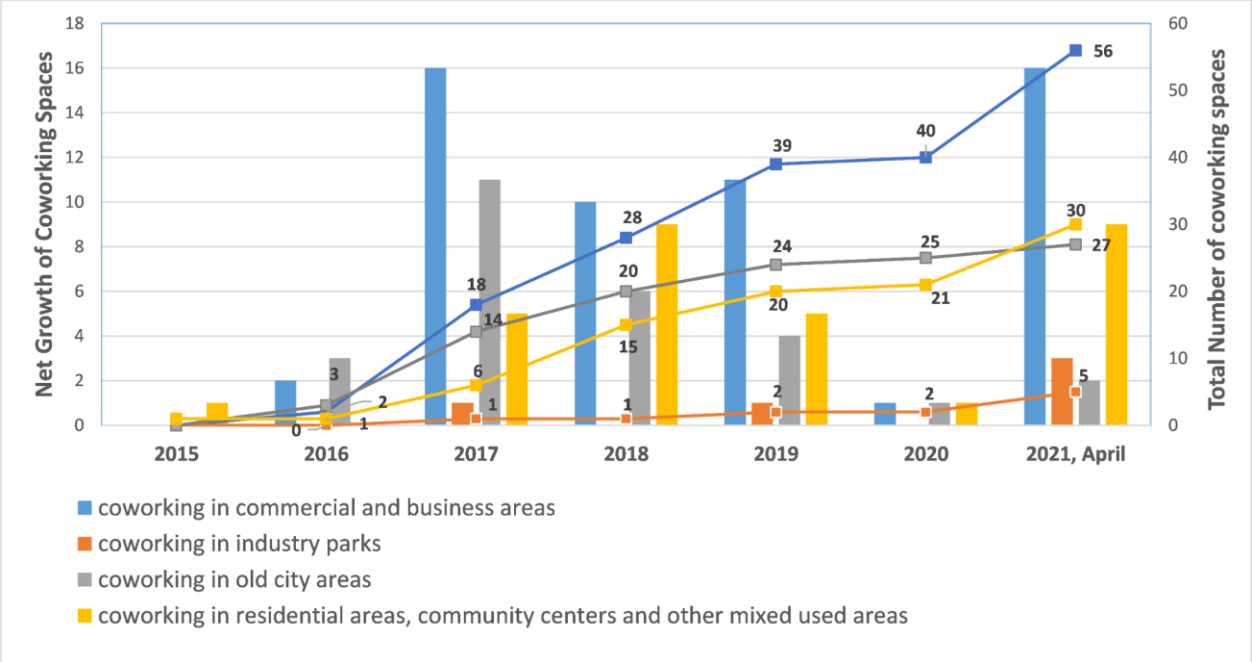

Figure 16 Change of Coworking Spaces by Urban Context

3.3 Coworking Companies

According to figure 17, most of the coworking spaces belong to a coworking chain and have at least two places. Among the top 15 coworking companies in Shanghai, Wework and Regus occupy a considerable part of the market. Regus prefers to choose commercial centers as the coworking location, and it owns 14 coworking spaces located in commercial centers in among its

total 25 sites. Wework has a different location preference, who has more sites in old city areas and residential areas, but only nine in commercial centers.

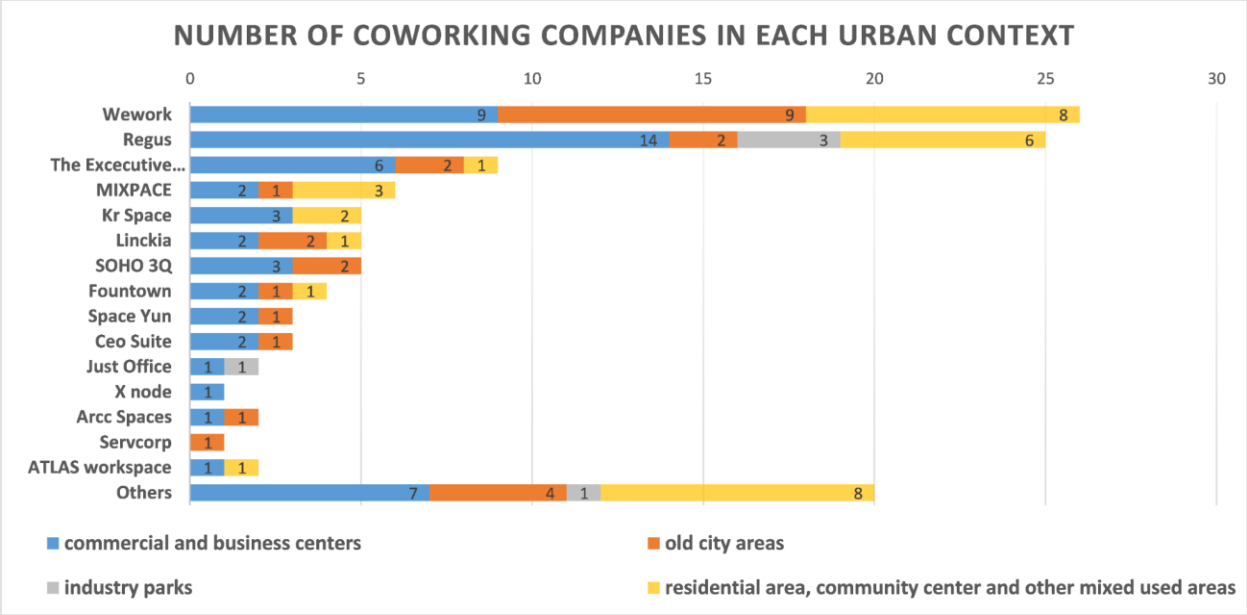

Figure 17 Number of coworking companies in each urban context

Figures 18 - 20 show the distributions of coworking spaces by company size. Regus and Wework, are the two largest companies, with most of their sites in the central activity area, and a small number of sites outside the central area. Compared with Wework, Regus, as a company that has just entered Shanghai,has a more spatial disporsing strategy expanding their distribution to some new remote markets, like Waigaoqiao Free Trade Zone on the northeast boundary of the city of Shanghai, and Zhangjia High-Tech Park at the east. The distribution of small companies with less than two branches is relatively similar to Wework and Regus, having most of the sites in the central activity area, but a considerable part outside it. These small coworking companies are more flexible and diverse in location preference. They can choose to be niche players and pay cheaper rent for their spaces far from the hot market. However, most of the median sized companies with 3-9 branches clustered in the central activity area. They do not have the strength to take the risks of exploring unopened markets like Wework and Regus, and also do not have

the flexibility and low cost of operation of small companies, so most of them conservatively choose the central activity area.

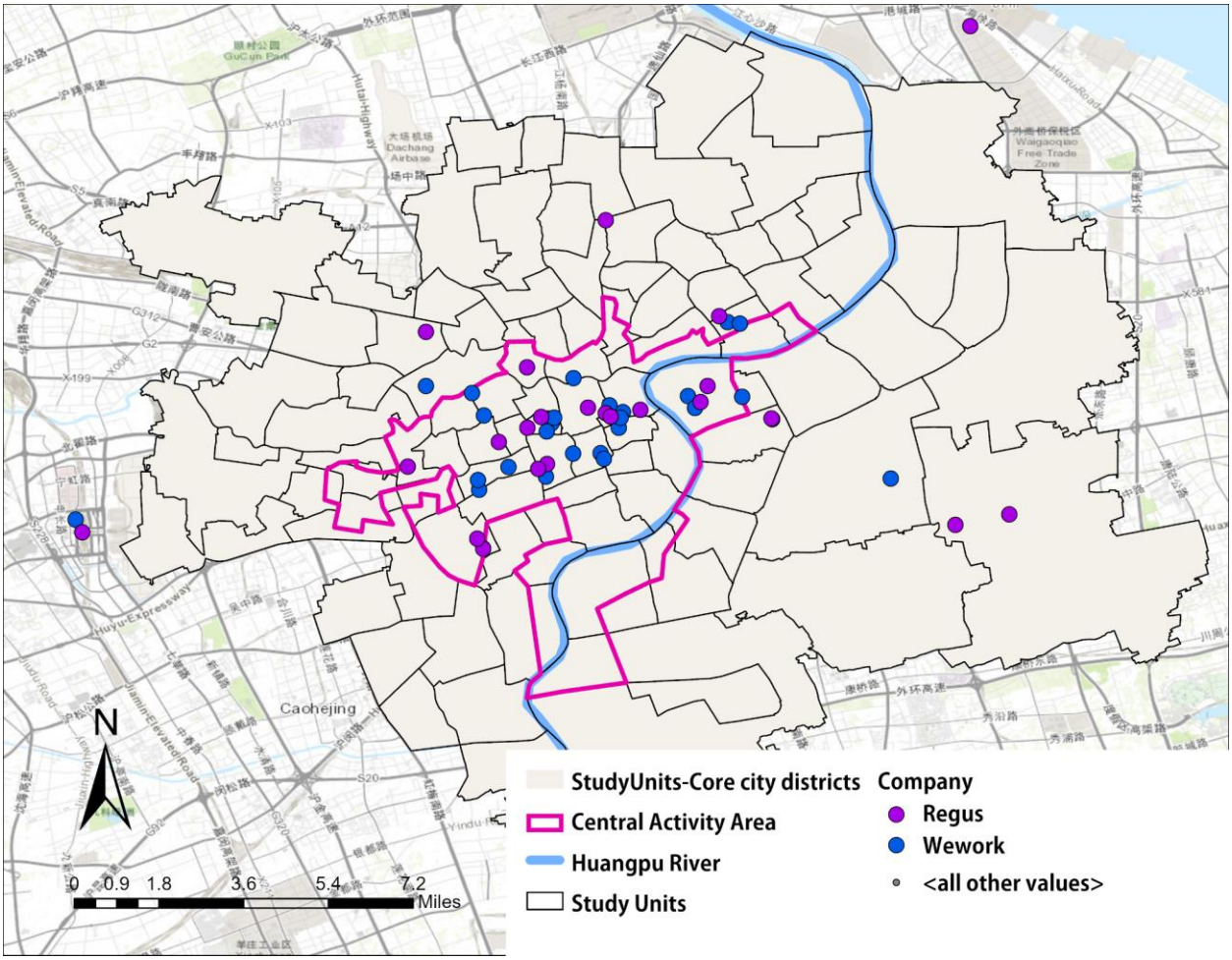

Figure 18 Location distribution of Wework and Regus

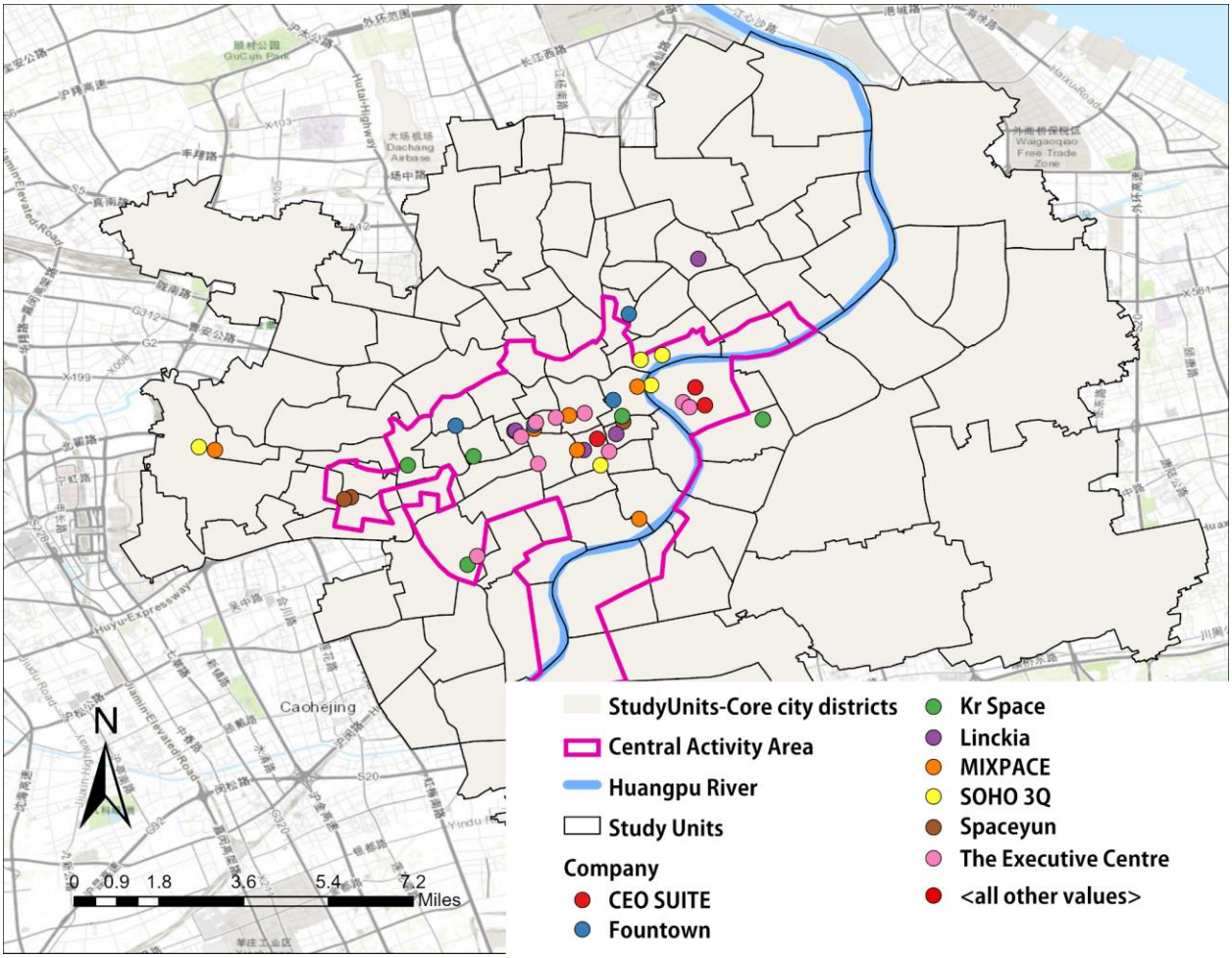

Figure 19 Location distribution of companies with 3 to 9 branches

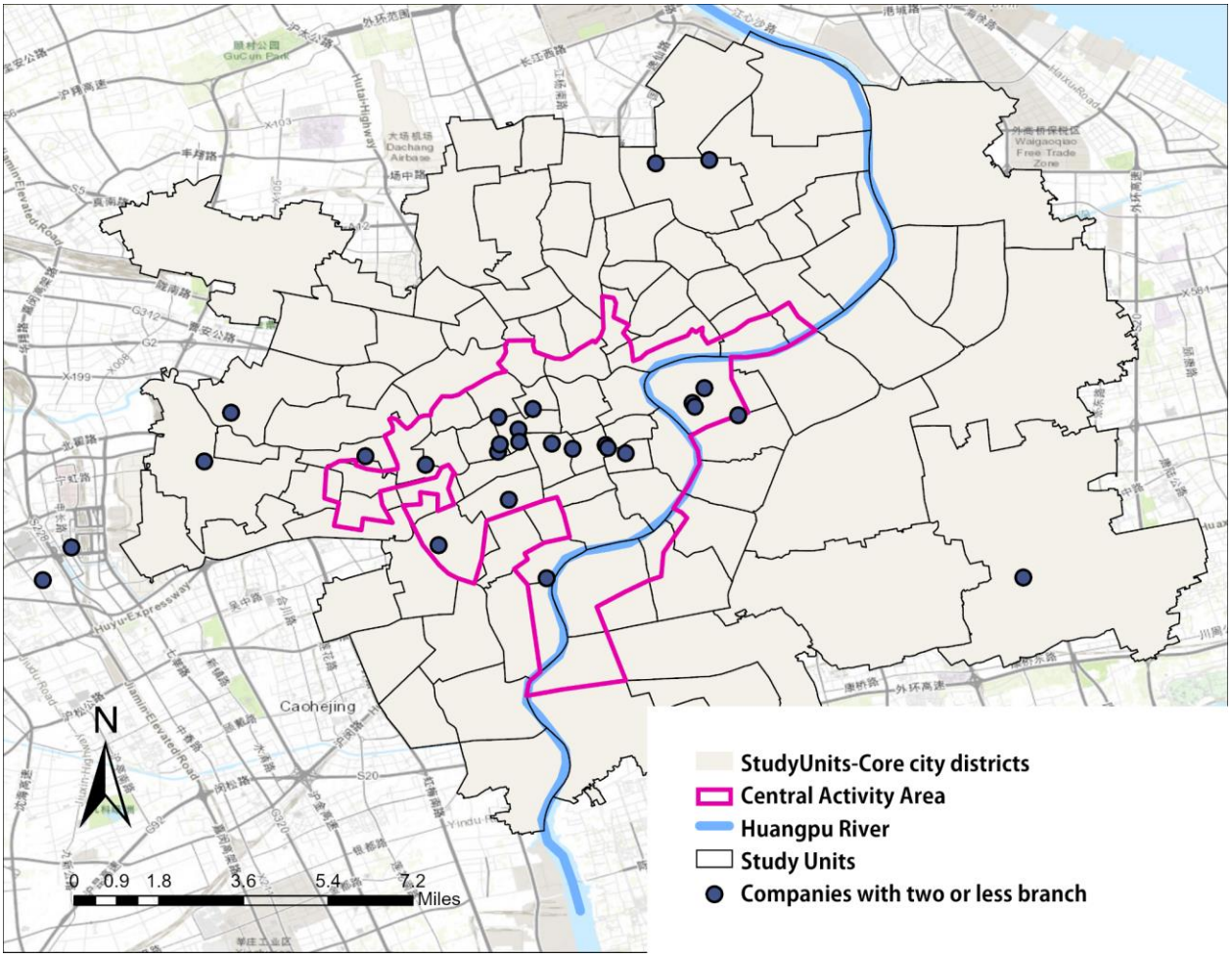

Figure 20 Location distribution of companies with less than 2 branches

3.4 Building Type

Almost all coworking spaces have chosen high-end office buildings. This is partly due to the relatively high-quality working environment in office buildings, and coworking spaces do not need to spend high renovation costs after settling in. Two of the coworking spaces are in residential apartments. Both of them are on the first floor with easy access. Although residential apartments are not a normal choice for coworking spaces, these two places are popular with

individual users for a flexible environment and community sense. A user commented Agora Space in a residential apartment on its website:

“The only coworking space with a community feeling in Shanghai. Been working here for the past 4 years, the fastest internet in Shanghai by far, great events and super welcoming staff, not to mention it’s very affordable. Highly recommended!”

Wework Landmark Center is in a two-floor stand-alone building in the old city area, and this is the only one that occupies a building alone. Other four coworking spaces are in industry buildings.

Figure 21 High-end office buildings (Source: coworker)

Figure 22 Residential apartments (Source: Baidu map)

Figure 23 Industrial buildings (Source: coworker)

Chapter 4 Methodology

4.1 Data collection and cleaning

(1) Shanghai Coworking Space List

The focus of this coworking space research is the 119 coworking locations registered on Coworker in Shanghai before April 2021. Coworker provides names, addresses, and joined years of the coworking spaces. The data were manually collected and inputted in Excel, and then transformed into a point shapefile in ArcGIS by Geo-locater, using their addresses.

(2) Shanghai Company List

The company data were downloaded from Emage Database, and updated in 2020. The database includes the company name, address, district, industry, capital and founding date of the total 1,726,457 companies in Shanghai. In order to process such a huge amount of data more conveniently, I extracted one-sixtieth of them as sample data, a total of 23,028 items. All subsequent analysis of company-related data is based on this sample.

The process of extracting samples had two steps: the first step was to sort the list of all companies according to district, and then sort the companies in each district according to capital; the second step was to draw one item out of every sixty items using Python programming. These steps follow the principle of proportionate stratified sampling method, in which each stratum represents the same percentage of the sample does of the whole list. The aim of the proportionate stratified sampling method is to keep the distribution of the features to be analyzed in the data unchanged. As a study about location patterns, the district was seen as the most relevant feature to the research. Company capital is also an analysis object, so it was also considered in the

sampling process. Although company industry is also an analysis object, due to the finer classification of industries, after the first two stratifications, it was considered that the 20 industries are approximately randomly distributed in the data, so industry was not used in the stratified sampling.

After creating the sample list, all items in the sample were transformed into latitude and longitude coordinates based on their addresses, and then geo-processed to point shapefile in ArcMap. Each point carries the information of the corresponding company, and can be used to calculate the density of the company needed using ArcGIS spatial join tool.

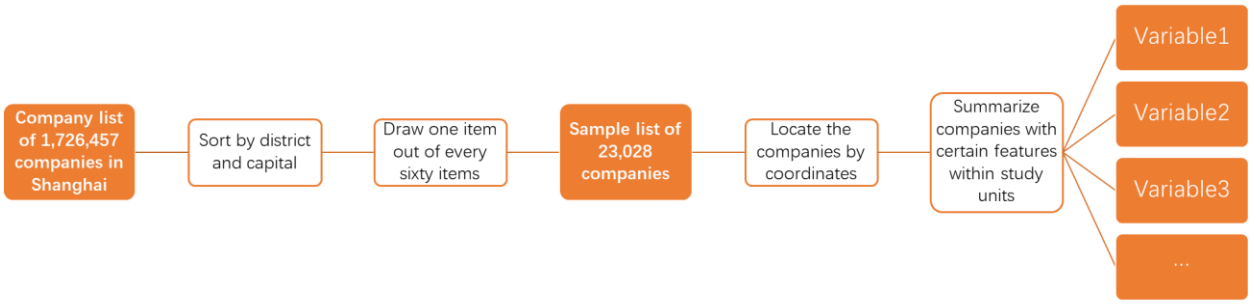

Figure 24 Data cleaning work of Shanghai company list

(3) China's sixth census data

The demographic data used in this study is from China's sixth census data, made public in 2011. Some of the available data is at street group level, such as population age data, but some of them are at district level, bigger than street group. The demographic data is joined to the street group polygon in ArcMap to visualize it, and is directly used in correlation tests in SPSS.

(4) Shanghai land use vector map

The land use polygon shapefile is downloaded from Shanghai Municipal Bureau of Planning and Natural Resources. The land use is divided into five categories: residential land, commercial

land, transportation land, public land and industry land. These five categories don't cover 100% land, the remaining part are lands of roads and rivers. The boundaries of these land units do not necessarily coincide with the boundaries of the street groups. Before using the land use data, each land use type was clipped by the street group polygon for subsequent calculations.

(5) Shanghai road network data and subway station data

Shanghai road network line shapefile and subway station point data are downloaded from CSDN Data. The road network is clipped by the street group polygon in ArcGIS for density calculation. The subway station point data is summarized within the street group polygon for density calculation.

4.2 Variables

(1) Economy Agglomeration

Coworking spaces are mainly used as incubators by startup firms and as alternatives to home offices by working groups, so one of the variables in this study is economic agglomeration. To quantify the economic agglomeration effect, this part will mainly calculate enterprise density. There are three variables in this part: total company density, start-up firm density and top 5% company density.

Total company density

The density of all registered companies in Shanghai can well reflect the degree of economic agglomeration in different areas of Shanghai. Calculating the correlation between coworking

densities and total company densities is to get a general sense of the relationship between coworkings' location distribution and the general economic agglomeration of Shanghai.

Start-up firm density

Startup firms are the major customers of coworking, so the Startup Firm Density is taken into consideration. In China, the definitions of small and micro enterprises are different from different channels. From the perspective of taxation, small and micro enterprises refer to enterprises whose taxable income does not exceed 3 million RMB, the number of employees does not exceed 300, and the total assets do not exceed 50 million RMB. But this definition is too broad for start-ups that use coworking as an office space. Each industry also has a definition of small and micro enterprises in its industry. Generally speaking, small and micro enterprises defined from an industry perspective are those with 5-30 employees. Combining these two definitions and enterprise data information, a start-up is defined as a company with assets within 5 million yuan. In addition, restrictions on the year of establishment have also been introduced to further restrict the definition of start-ups to enterprises within 5 years of establishment.

Top 5% company density

Large companies are often able to drive the economic development in surrounding areas. The distribution of large companies can reflect the economic prosperity of different areas. This study sorted companies according to their registered capital, and selected the top 5% of companies as large companies, and analyzed the correlation between their location distribution and the location distribution of coworking spaces.

(2) Demographic characteristics

More individuals show their needs to use coworking spaces in the work-from-home situation. This study is interested in whether coworking spaces are close to their individual customers. If they tend to be distributed in places with high population density, is this tendency related to age and education level? So this study would analyze the correlation between coworking density with total population density, density of population aged 16 to 65 and high education rate.

Total population density

The population data is from China's sixth census, and it was divided by the study units' areas to obtain the total population density. This variable is used to get a common sense of the relationship between the location distribution of coworking spaces and the distribution of population.

Density of population aged 16 - 65

As alternative working places, coworking spaces are more popular with young people. This article hoped to focus more accurately on the customers of coworking spaces, such as young working people under the age of 40, and better explore whether the location of coworking spaces is close to their target customers. However, due to the limitation of data access, the research subjects can only be focused on the 16 to 65-year-old group. This age group represents all working people, excluding children and retired elderly people, which also has a certain explanatory power.

High education rate

This study is also interested in whether the location distribution of coworking spaces has correlation with education rate. The assumption is that the location distribution of coworking

spaces has positive correlation with high education rate. The high education rate is defined as the rate of the population having a bachelor's degree or higher. Due to the limitation of data access, the education data used is at a neighborhood level, larger than the study units, which will reduce the accuracy of the calculation results.

(3) Urban spatial structure

This research will also explore if the distribution of coworking spaces have a relationship with the built environment in their surrounding areas. The urban spatial structure variables are divided into two parts: land use and transportation. Land use variables include the proportion of each land and the mixing degree of land use. Transportation variables include subway station density and road density.

Proportion of each land use

The land use in the city of Shanghai is divided into five categories: commercial land, residential land, transportation land, public land and industry land. To analyze the correlation between the proportion of each land use and the coworking density can show coworking spaces' urban distribution characteristics: do they tend to be located in residential areas or commercial areas?

Mixing degree of land use

The mixing degree of land use is to show the mixing level of the five land uses. This variable is used to see if the coworking spaces tend to be located in areas with mixed functions rather than correlated with a specific land use.

The mixing degree (H) of land use is calculated using the following function:

$$H = -\sum_{i=1}^{n=5} P_i \log P_i$$

H – Mixing degree of land use
P – Proportion of each land use
i=1 commercial land, i = 2 residential land, i = 3 public land, i = 4 transportation land, i = 5 industrial land

Subway station density

Shanghai's subway system is very developed, with subway stations covering most urban areas. According to a survey of citizens' willingness to travel by public transportation in Shanghai, 82% of interviewees said they would commute by subway. People’s reliance on the subway makes subway station density an important variable to reflect the accessibility of coworking spaces.

Road density

Road density is another factor to reflect the accessibility of the area, and it can also reflect the urban form directly. To analyze the correlation between coworking density and road density is to show the urban form that coworking spaces tend to be located.

Table 1 is a variable dictionary showing the definition, source and public year of the variables.

	Variables	Definition	Source	Year
Economic agglomeration	**Total Enterprise Density**	Density of all enterprises	Emage Database	2020
	Start-up firm Density	Density of enterprises established in 2 years and with registered capital within 5 million RMB	Emage Database	2020
	Top 5% Density	Density of top 5% enterprises ranked by capital	Emage Database	2020
	Agriculture, forestry, animal husbandry and fishery	Density of enterprises in agriculture, forestry, animal husbandry and fishery industry	Emage Database	2020
	Manufacturing	Density of enterprises in Manufacturing industry	Emage Database	2020
	Construction industry	Density of enterprises in Construction industry industry	Emage Database	2020
	Wholesale and retail	Density of enterprises in Wholesale and retail industry	Emage Database	2020
	Transportation, storage and postal industry	Density of enterprises in Transportation, storage and postal industry	Emage Database	2020
	Accommodation and Catering Industry	Density of enterprises in Accommodation and Catering Industry	Emage Database	2020
	Information, software and information technology services	Density of enterprises in Information, software and information technology services	Emage Database	2020
	Finance	Density of enterprises in Finance industry	Emage Database	2020
	Real estate	Density of enterprises in Real estate industry	Emage Database	2020
	Rental and business services	Density of enterprises in Rental and business services industry	Emage Database	2020
	Scientific research and technical services	Density of enterprises in Scientific research and technical services industry	Emage Database	2020
	Water conservancy, environment and public facilities management industry	Density of enterprises in Water conservancy, environment and public facilities management industry	Emage Database	2020
	Resident services, repairs and other services	Density of enterprises in Resident services, repairs and other services industry	Emage Database	2020
	Education	Density of enterprises in Education industry	Emage Database	2020
	Health and social work	Density of enterprises in Health and social work industry	Emage Database	2020
	Culture, sports and entertainment industry	Density of enterprises in Culture, sports and entertainment industry	Emage Database	2020
Demographic	**Total Population Density**	Density of total population	National Bureau of Statistics	2011
	Density of Population aged 16-65	Density of population aged 16-65	National Bureau of Statistics	2011
	High Education Population rate	Rate of population with a bachelor's degree or above	National Bureau of Statistics	2011
Urban Spatial Structure	**Commercial land**	Proportion of commercial land	Shanghai Municipal Bureau of Planning and Natural Resources	2018
	Residential land	Proportion of residential land	Shanghai Municipal Bureau of Planning and Natural Resources	2018
	Industry land	Proportion of industry land	Shanghai Municipal Bureau of Planning and Natural Resources	2018
	Transportation land	Proportion of transportation land	Shanghai Municipal Bureau of Planning and Natural Resources	2018
	Public land	Proportion of public land	Shanghai Municipal Bureau of Planning and Natural Resources	2018
	Mixing degree of land use	Land Use mixed index	Shanghai Municipal Bureau of Planning and Natural Resources	2018
	Subway Station	Density of subway station	CSDN Data	2018
	Road Density	Density of road network	CSDN Data	2018

Table 1 Variable Dictionary

4.3 Count modeling

This study explores the relationship between the location decision of coworking spaces and the following variables: economic agglomeration, demographic and urban spatial structure are tested for correlation with coworking density. The street block groups (subdivision of neighborhoods) is used as the unit (Figure 25). The correlation tests are based on the "count" of variables in each study unit. However, in this study, the count is converted to density to avoid the interference of different sizes of study areas.

The correlation test is based on Pearson Correlation in SPSS, a method to study the linear relationship between two variables, which is a relatively basic correlation test method. In the correlations table, when the significance is less than 0.05, the two variables are considered to be related, and the higher the Pearson index, the more obvious the correlation.

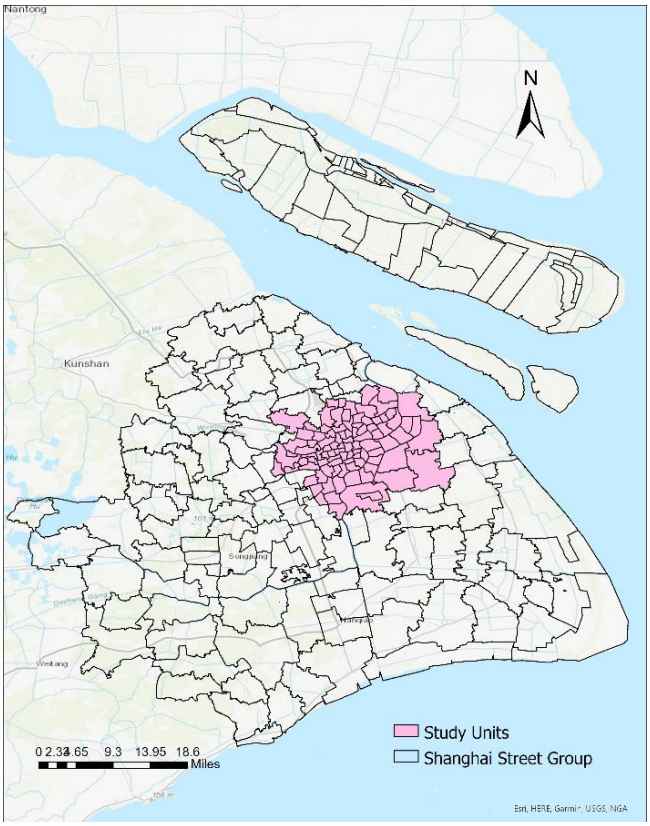

Figure 25 Shanghai Street Group Boundary

Chapter 5 Results

5.1 Economic Agglomeration

Table 2 shows the correlation significance between coworking density and company density. The coworking density has a positive correlation with total company density and the density of the top 5% company, but it doesn't show any relationship with SME density. Figure 26 and 27 show the density of total companies and top 5% companies with coworking sites. The density of total companies and top 5% companies increases based on proximity to the central area. This is expected since the city center is the place where the economy is the most active. However, the density of SME doesn't show a clear trend based on proximity to the city center, shown in Figure 28. This is because not all of the SME can afford the high rent in the city center, and some of them don't need to be located near other companies. SME is dense in several street blocks, some of these street blocks have universities and industry parks, which can provide technology, talents

		Coworking_Density	Company_Density	SME_Density	Top5Company_Density
Coworking_Density	Pearson Correlation	1	.271**	.194	.285**
	Sig. (2-tailed)		.008	.061	.005
	N	94	94	94	94
Company_Density	Pearson Correlation	.271**	1	.150	.073
	Sig. (2-tailed)	.008		.150	.484
	N	94	94	94	94
SME_Density	Pearson Correlation	.194	.150	1	.641**
	Sig. (2-tailed)	.061	.150		.000
	N	94	94	94	94
Top5Company_Density	Pearson Correlation	.285**	.073	.641**	1
	Sig. (2-tailed)	.005	.484	.000	
	N	94	94	94	94

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2 Correlations between coworking density and company density

and good policies for SME. Like Taopu Street on the northwest side, has a big creative industry park that cooperates with a branch of Tongji University nearby, which attracts many SME. This result is out of expectation when considering coworking spaces as “social entrepreneurship and start-up incubators” (DuPriest, 2019).

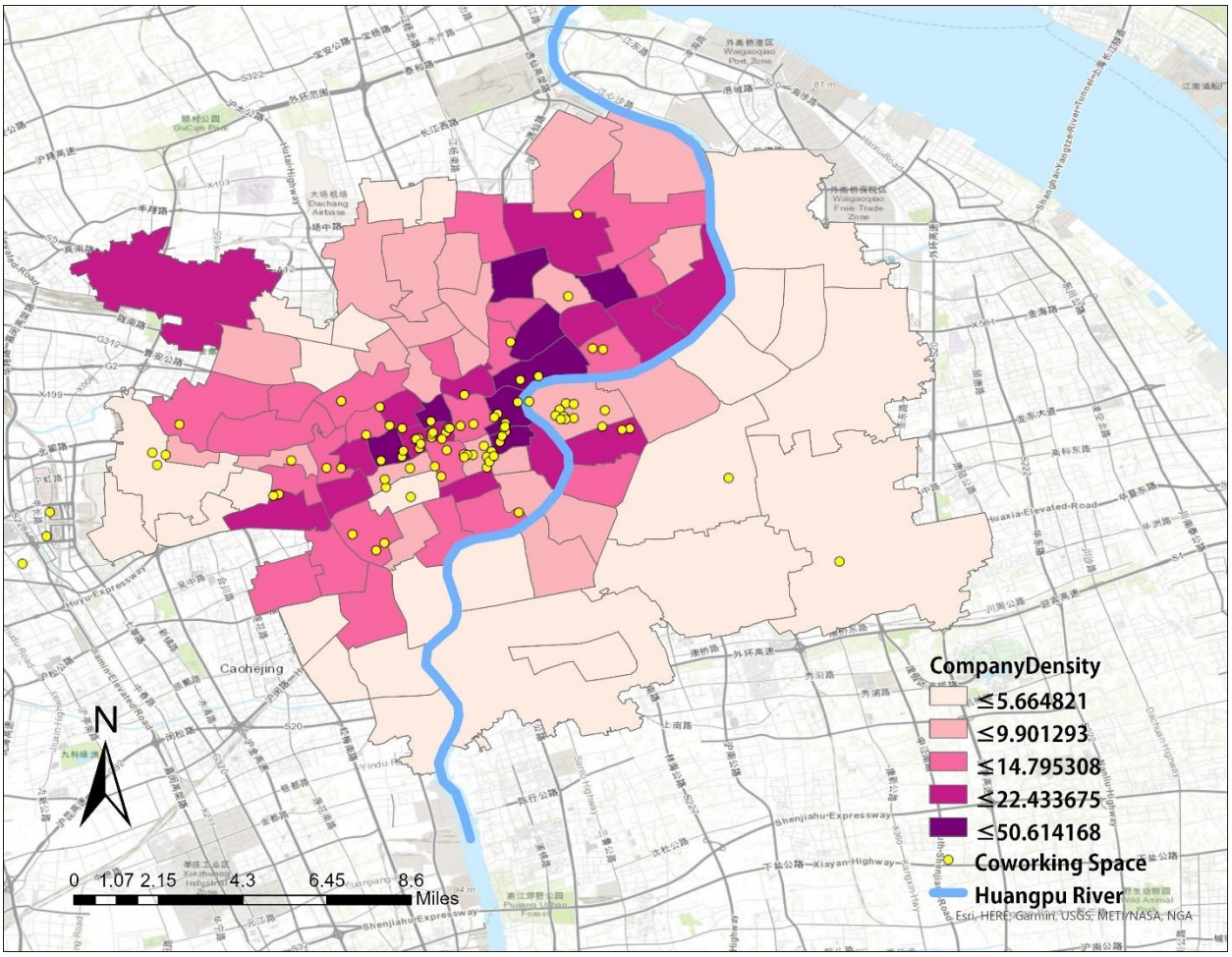

Figure 26 Distribution of total company density

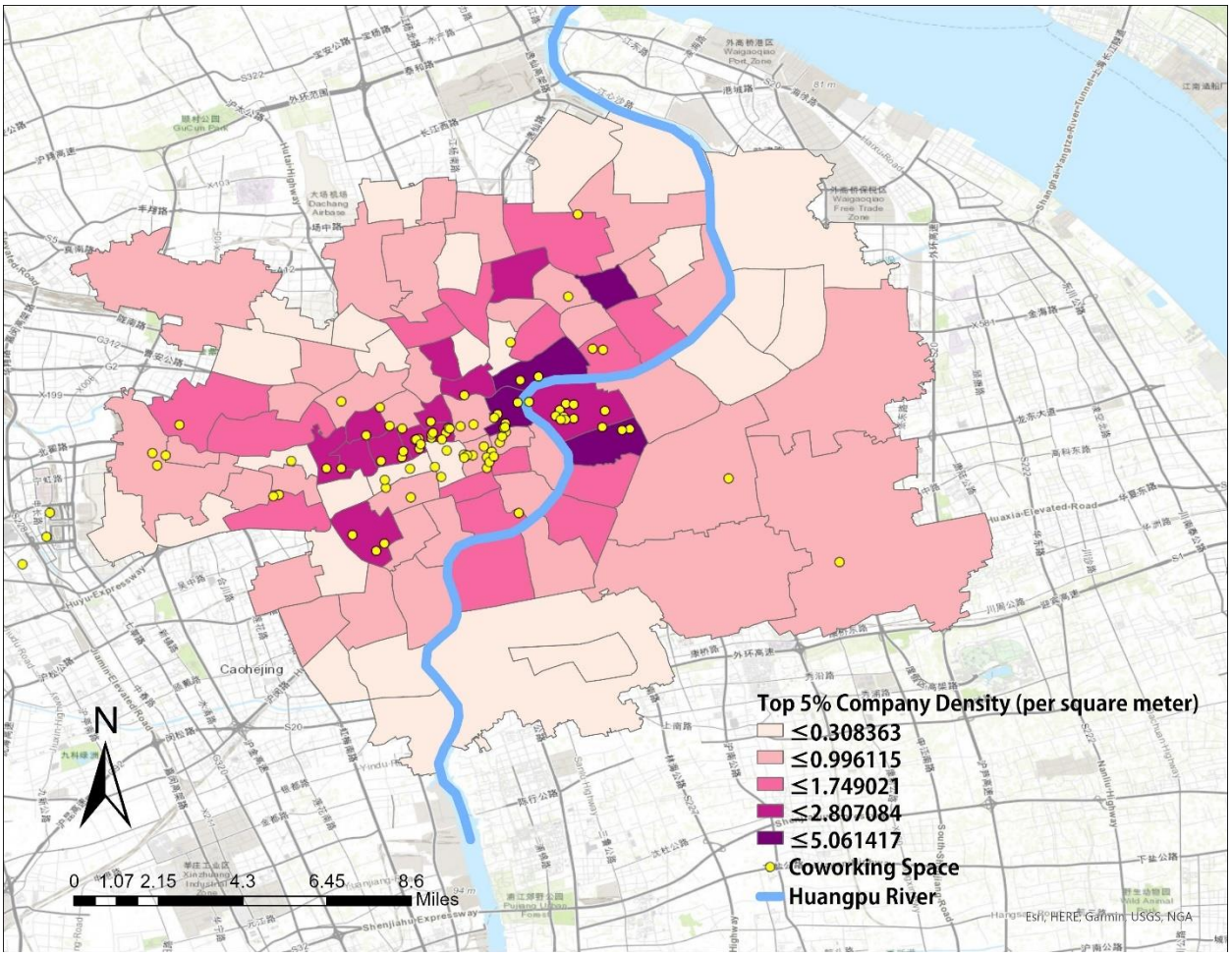

Figure 27 Distribution of top 5% company density

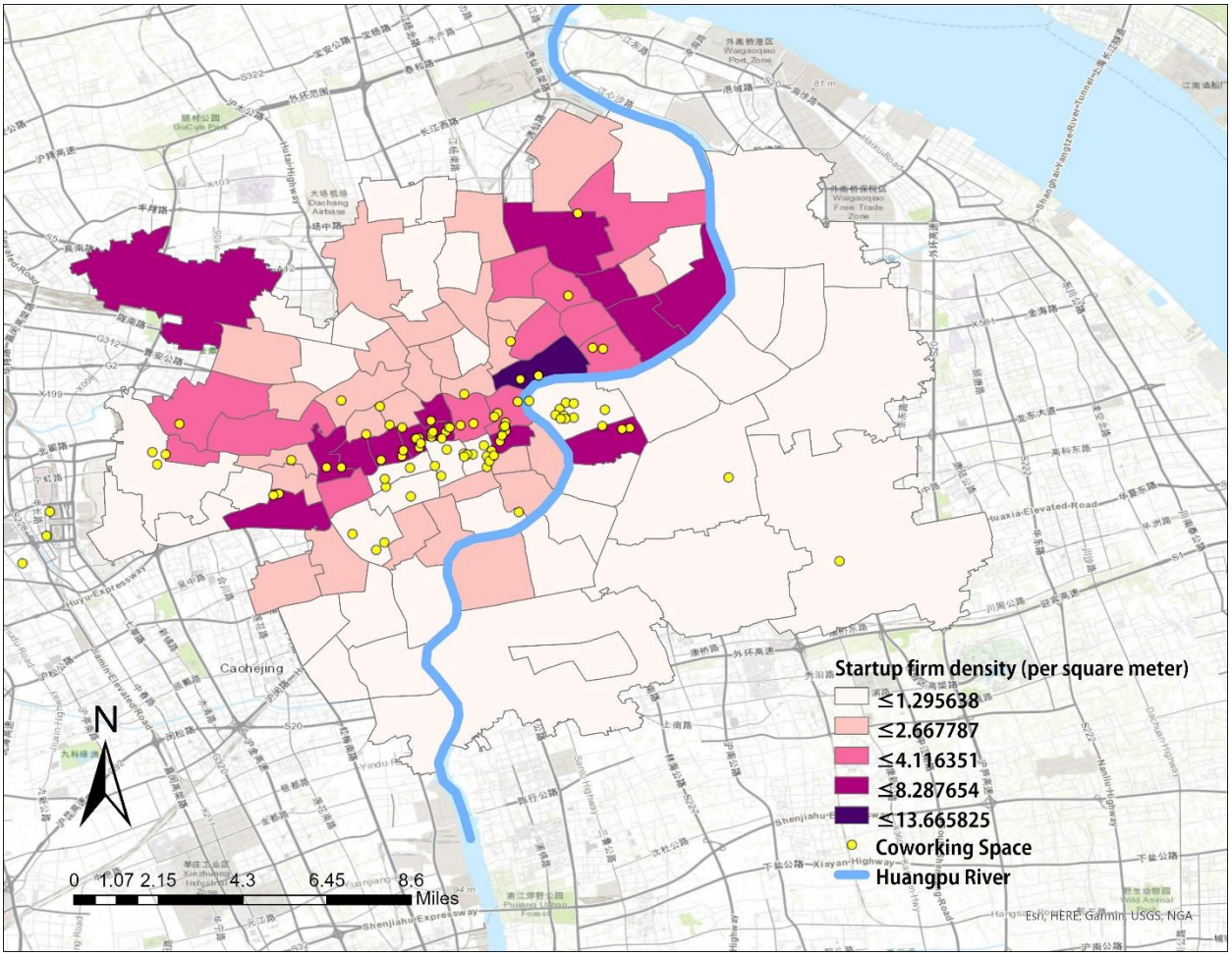

Figure 28 Distribution of startup firm density

Table 3 shows the correlation between coworking spaces density and the company density of each industry. The coworking density shows high significance on the positive correlation with companies in accommodation and catering industry, finance, education, and health and social work. It also has positive correlation with rental and business services and culture, sports and entertainment industry. This result does not mean that these industries are the main customers of coworking spaces. The correlation between them may be caused by their common preferences of converging towards the city center. However, the coworking density does not have correlation with information, software and information technology services, nor with scientific research and technical services as expected. These two industries are considered as least dependent on offline work. The irrelevance may be the result that most of these high-tech companies are located in high tech industry parks far away from the city center. And some advantages of coworking spaces like community sense and accessibility are not attractive to them.

Correlations

		Coworking_Density	Agriculture, forestry, animal husbandry and fishery	Manufacturing	Construction industry	Wholesale and retail	Transportation, storage and postal industry	Accommodation and Catering Industry	Information, software and information technology services	Finance	Real estate	Rental and business services	Scientific research and technical services	Water conservancy, environment and public facilities management industry	Resident services, repairs and other services	Education	Health and social work	Culture, sports and entertainment industry
Coworking_Density	Pearson Correlation	1	-.046	.193	.116	.094	.040	.669**	.065	.274**	.077	.236*	-.093	-.084	.145	.268**	.453**	.221*
	Sig. (2-tailed)		.659	.062	.267	.369	.704	.000	.534	.007	.462	.022	.371	.418	.165	.009	.000	.032
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Agriculture, forestry, animal husbandry and fishery	Pearson Correlation	-.046	1	-.036	.018	.047	-.019	-.012	.067	-.022	.075	.061	.213*	.764**	.009	-.042	-.053	-.029
	Sig. (2-tailed)	.659		.734	.866	.655	.858	.905	.521	.831	.474	.557	.039	.000	.928	.687	.610	.780
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Manufacturing	Pearson Correlation	.193	-.036	1	.248*	.398**	.235*	.398**	.319**	.162	.200	.310**	.162	-.042	.021	-.025	-.067	.193
	Sig. (2-tailed)	.062	.734		.016	.000	.022	.000	.002	.119	.053	.002	.119	.688	.843	.808	.522	.062
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Construction industry	Pearson Correlation	.116	.018	.248*	1	.494**	.605**	.251*	.489**	.158	.367**	.535**	.459**	.083	.165	.312**	-.096	.230*
	Sig. (2-tailed)	.267	.866	.016		.000	.000	.015	.000	.129	.000	.000	.000	.427	.113	.002	.357	.026
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Wholesale and retail	Pearson Correlation	.094	.047	.398**	.494**	1	.599**	.285**	.614**	.476**	.490**	.701**	.407**	.113	.084	-.024	-.023	.340**
	Sig. (2-tailed)	.369	.655	.000	.000		.000	.005	.000	.000	.000	.000	.000	.279	.424	.821	.827	.001
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Transportation, storage and postal industry	Pearson Correlation	.040	-.019	.235*	.605**	.599**	1	.215*	.632**	.256*	.469**	.675**	.234*	-.054	.112	.032	-.070	.227*
	Sig. (2-tailed)	.704	.858	.022	.000	.000		.037	.000	.013	.000	.000	.023	.605	.284	.758	.503	.028
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Accommodation and Catering Industry	Pearson Correlation	.669**	-.012	.398**	.251*	.285**	.215*	1	.172	.317**	.216*	.363**	-.007	-.058	.175	.200	.296**	.340**
	Sig. (2-tailed)	.000	.905	.000	.015	.005	.037		.097	.002	.036	.000	.950	.578	.091	.053	.004	.001
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Information, software and information technology services	Pearson Correlation	.065	.067	.319**	.489**	.614**	.632**	.172	1	.357**	.478**	.672**	.472**	.062	.181	.077	.007	.380**
	Sig. (2-tailed)	.534	.521	.002	.000	.000	.000	.097		.000	.000	.000	.000	.552	.081	.460	.944	.000
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Finance	Pearson Correlation	.274**	-.022	.162	.158	.476**	.256*	.317**	.357**	1	.439**	.444**	.156	-.031	.009	-.006	.218*	.190
	Sig. (2-tailed)	.007	.831	.119	.129	.000	.013	.002	.000		.000	.000	.134	.765	.933	.954	.035	.067
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Real estate	Pearson Correlation	.077	.075	.200	.367**	.490**	.469**	.216*	.478**	.439**	1	.477**	.188	.054	.125	-.095	.073	.090
	Sig. (2-tailed)	.462	.474	.053	.000	.000	.000	.036	.000	.000		.000	.069	.609	.228	.362	.483	.387
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Rental and business services	Pearson Correlation	.236*	.061	.310**	.535**	.701**	.675**	.363**	.672**	.444**	.477**	1	.491**	.047	.163	.355**	.122	.524**
	Sig. (2-tailed)	.022	.557	.002	.000	.000	.000	.000	.000	.000	.000		.000	.652	.116	.000	.241	.000
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Scientific research and technical services	Pearson Correlation	-.093	.213*	.162	.459**	.407**	.234*	-.007	.472**	.156	.188	.491**	1	.209*	.031	.277**	-.040	.389**
	Sig. (2-tailed)	.371	.039	.119	.000	.000	.023	.950	.000	.134	.069	.000		.043	.764	.007	.703	.000
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Water conservancy, environment and public facilities management industry	Pearson Correlation	-.084	.764**	-.042	.083	.113	-.054	-.058	.062	-.031	.054	.047	.209*	1	-.017	-.077	-.099	.000
	Sig. (2-tailed)	.418	.000	.688	.427	.279	.605	.578	.552	.765	.609	.652	.043		.872	.463	.344	.998
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Resident services, repairs and other services	Pearson Correlation	.145	.009	.021	.165	.084	.112	.175	.181	.009	.125	.163	.031	-.017	1	.302**	.016	.250*
	Sig. (2-tailed)	.165	.928	.843	.113	.424	.284	.091	.081	.933	.228	.116	.764	.872		.003	.881	.015
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Education	Pearson Correlation	.268**	-.042	-.025	.312**	-.024	.032	.200	.077	-.006	-.095	.355**	.277**	-.077	.302**	1	.028	.294**
	Sig. (2-tailed)	.009	.687	.808	.002	.821	.758	.053	.460	.954	.362	.000	.007	.463	.003		.791	.004
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Health and social work	Pearson Correlation	.453**	-.053	-.067	-.096	-.023	-.070	.296**	.007	.218*	.073	.122	-.040	-.099	.016	.028	1	.120
	Sig. (2-tailed)	.000	.610	.522	.357	.827	.503	.004	.944	.035	.483	.241	.703	.344	.881	.791		.248
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
Culture, sports and entertainment industry	Pearson Correlation	.221*	-.029	.193	.230*	.340**	.227*	.340**	.380**	.190	.090	.524**	.389**	.000	.250*	.294**	.120	1
	Sig. (2-tailed)	.032	.780	.062	.026	.001	.028	.001	.000	.067	.387	.000	.000	.998	.015	.004	.248	
	N	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3 Correlations between coworking density and company density by industry

5.2 Demographic

Coworking spaces density doesn't show any correlation with demographic features. The total population density and the population aged 16 to 65 is not the highest in the city center. Thiscan be attributed to the type of land use of the city center which is commercial land, and the residential density is not high in the old city areas. Although the high education ratio data is not at street group level, it can be seen that it is the lowest in the city center.

Correlations

		Coworking_Density	High_Edu_ratio	PopDensity	Age15to65Density
Coworking_Density	Pearson Correlation	1	-.159	.063	.058
	Sig. (2-tailed)		.125	.552	.581
	N	94	94	93	93
High_Edu_ratio	Pearson Correlation	-.159	1	-.006	-.017
	Sig. (2-tailed)	.125		.954	.872
	N	94	94	93	93
PopDensity	Pearson Correlation	.063	-.006	1	.998**
	Sig. (2-tailed)	.552	.954		.000
	N	93	93	93	93
Age15to65Density	Pearson Correlation	.058	-.017	.998**	1
	Sig. (2-tailed)	.581	.872	.000	
	N	93	93	93	93

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 Correlations between coworking density and demographic characteristics

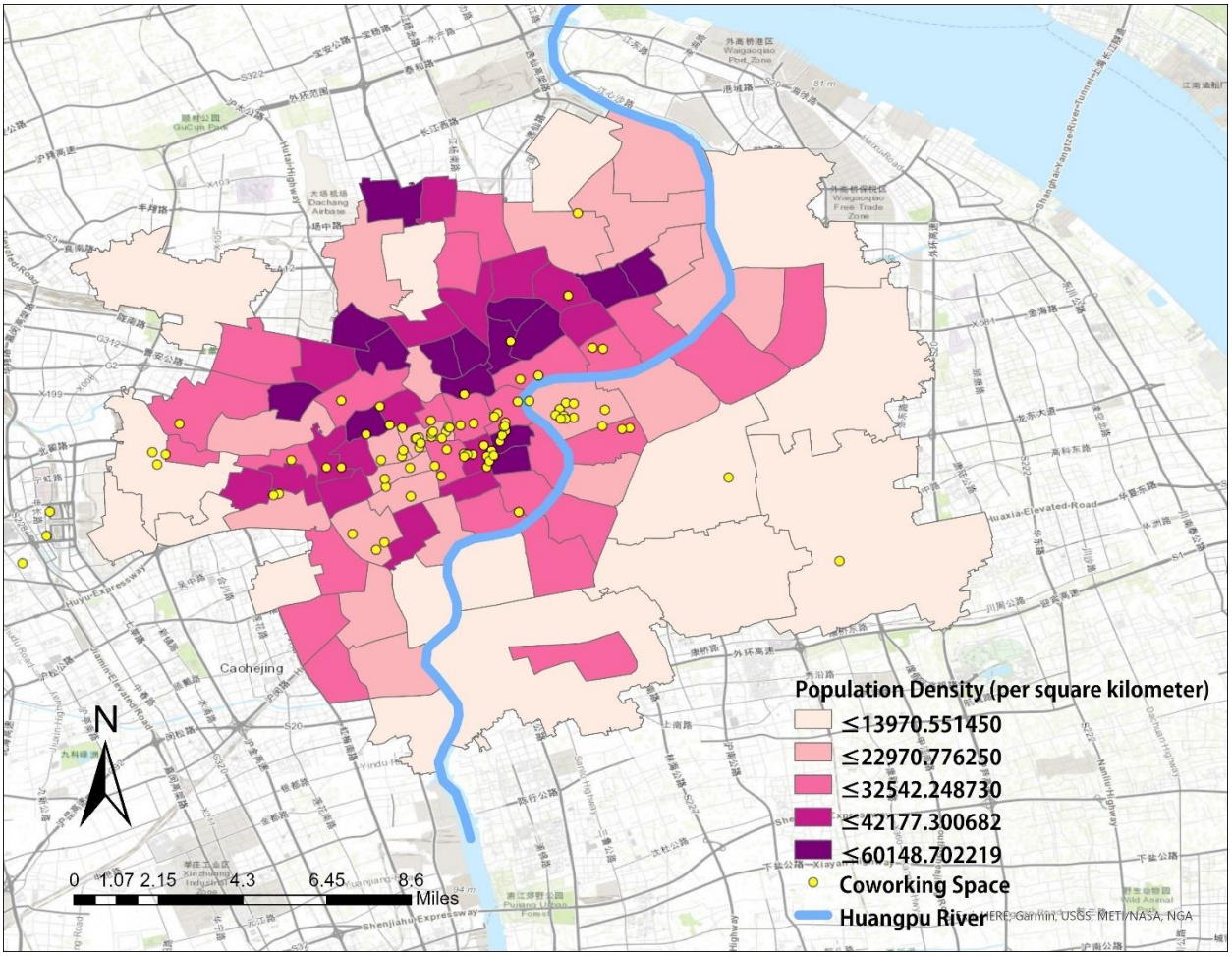

Figure 29 Distribution of total population density

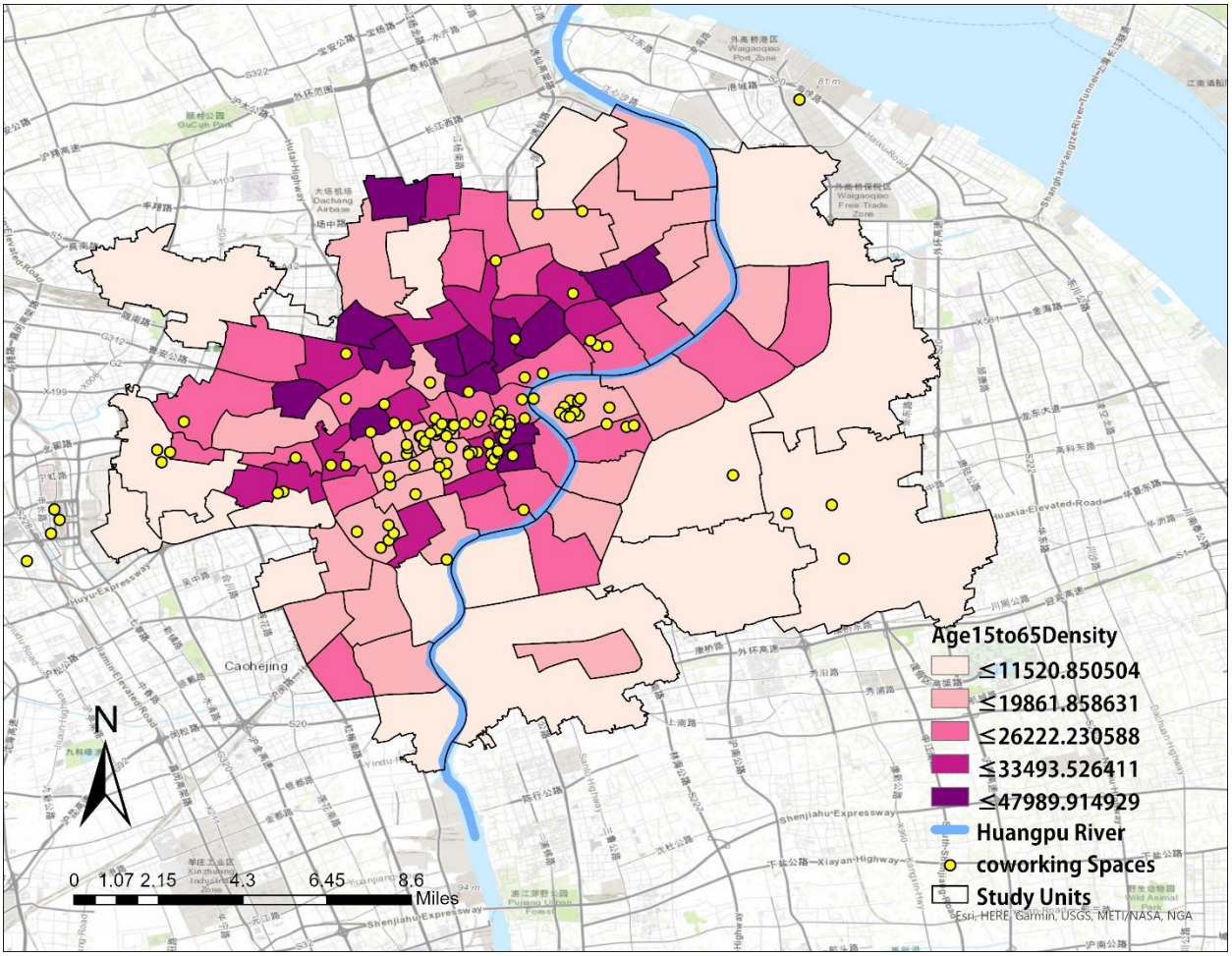

Figure 30 Distribution of density of population aged 16 to 65

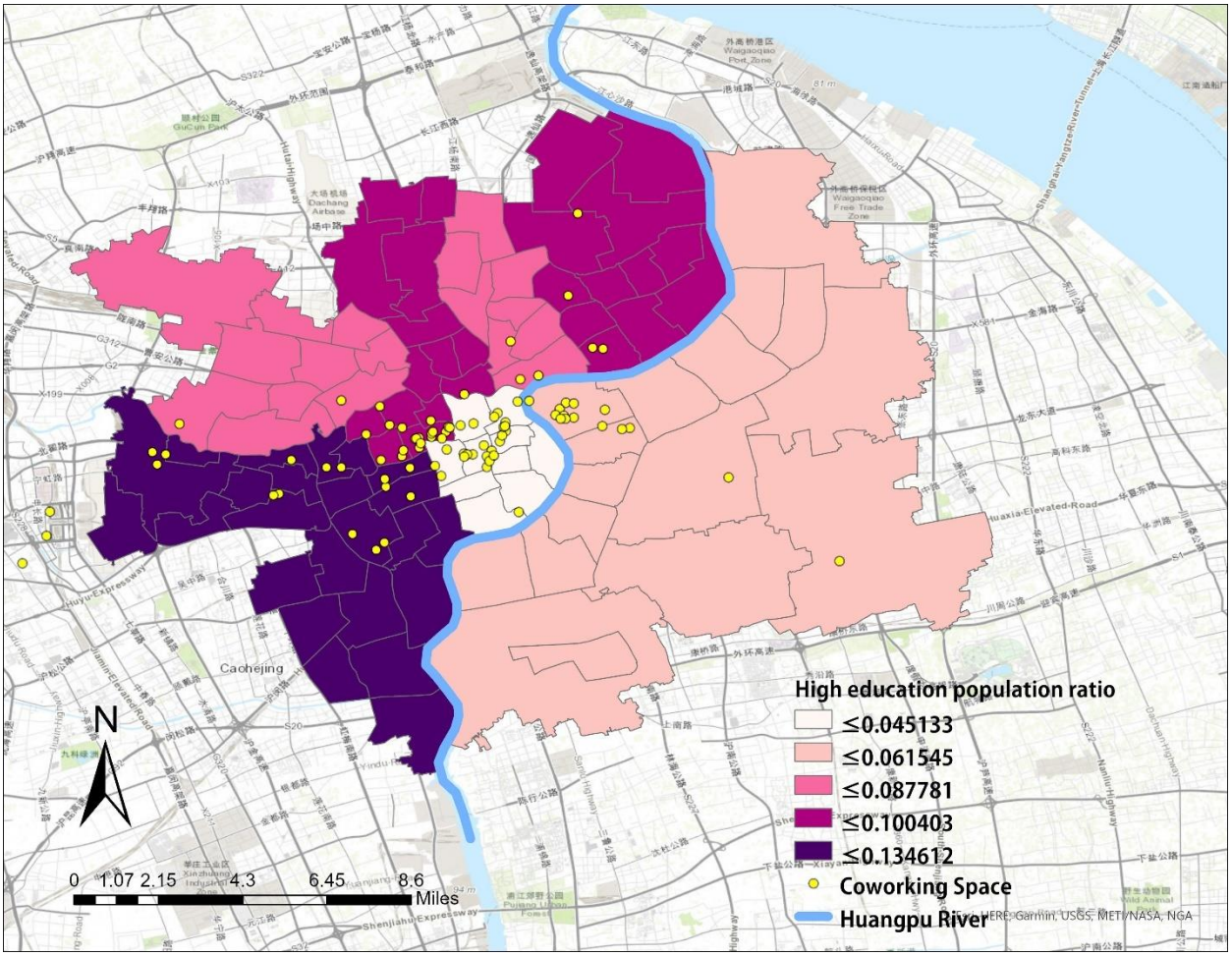

Figure 31 Distribution of high education population rate

5.3 Urban Spatial Structure

Table 5 shows the correlation between coworking space density and urban spatial structure features. It shows that the coworking density is high and positively correlated with commercial land density, road density and subway station density. Coworking spaces also show positive correlation with residential land density. This result reflects that coworking spaces tend to be located in areas where commercial and business are concentrated, which is consistent with the positive correlation between coworking density and company density in the industry sector. The positive correlation between coworking density and residential land is also expected. More coworking spaces tend to settle in residential areas but not just commercial areas today, this shows a trend in the diversified development of coworking spaces.

Correlations

		Coworking_Density	commercial_land	industry_land	residential_land	public_land	transportation_land	orther_land	Mixing_degree_of_land_use	RoadDensity	Subway_Station_density
Coworking_Density	Pearson Correlation	1	.399**	-.177	-.206*	-.094	.003	.297**	.122	.466**	.352**
	Sig. (2-tailed)		.000	.088	.046	.366	.976	.004	.240	.000	.000
	N	94	94	94	94	94	94	94	94	94	94
commercial_land	Pearson Correlation	.399**	1	-.322**	-.507**	-.189	.185	.445**	.473**	.613**	.262*
	Sig. (2-tailed)	.000		.002	.000	.069	.074	.000	.000	.000	.011
	N	94	94	94	94	94	94	94	94	94	94
industry_land	Pearson Correlation	-.177	-.322**	1	-.309**	.003	.077	-.113	.281**	-.419**	-.542**
	Sig. (2-tailed)	.088	.002		.002	.978	.459	.277	.006	.000	.000
	N	94	94	94	94	94	94	94	94	94	94
residential_land	Pearson Correlation	-.206*	-.507**	-.309**	1	-.445**	-.271**	-.639**	-.802**	-.406**	.138
	Sig. (2-tailed)	.046	.000	.002		.000	.008	.000	.000	.000	.184
	N	94	94	94	94	94	94	94	94	94	94
public_land	Pearson Correlation	-.094	-.189	.003	-.445**	1	-.109	.026	.328**	-.033	-.272**
	Sig. (2-tailed)	.366	.069	.978	.000		.297	.806	.001	.749	.008
	N	94	94	94	94	94	94	94	94	94	94
transportation_land	Pearson Correlation	.003	.185	.077	-.271**	-.109	1	.139	.363**	.258*	.023
	Sig. (2-tailed)	.976	.074	.459	.008	.297		.181	.000	.012	.825
	N	94	94	94	94	94	94	94	94	94	94
orther_land	Pearson Correlation	.297**	.445**	-.113	-.639**	.026	.139	1	.369**	.634**	.356**
	Sig. (2-tailed)	.004	.000	.277	.000	.806	.181		.000	.000	.000
	N	94	94	94	94	94	94	94	94	94	94
Mixing_degree_of_land_use	Pearson Correlation	.122	.473**	.281**	-.802**	.328**	.363**	.369**	1	.271**	-.388**
	Sig. (2-tailed)	.240	.000	.006	.000	.001	.000	.000		.008	.000
	N	94	94	94	94	94	94	94	94	94	94
RoadDensity	Pearson Correlation	.466**	.613**	-.419**	-.406**	-.033	.258*	.634**	.271**	1	.762**
	Sig. (2-tailed)	.000	.000	.000	.000	.749	.012	.000	.008		.000
	N	94	94	94	94	94	94	94	94	94	94
Subway_Station_density	Pearson Correlation	.352**	.262*	-.542**	.138	-.272**	.023	.356**	-.388**	.762**	1
	Sig. (2-tailed)	.000	.011	.000	.184	.008	.825	.000	.000	.000	
	N	94	94	94	94	94	94	94	94	94	94

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 5 Correlations between coworking density and urban spatial structure features

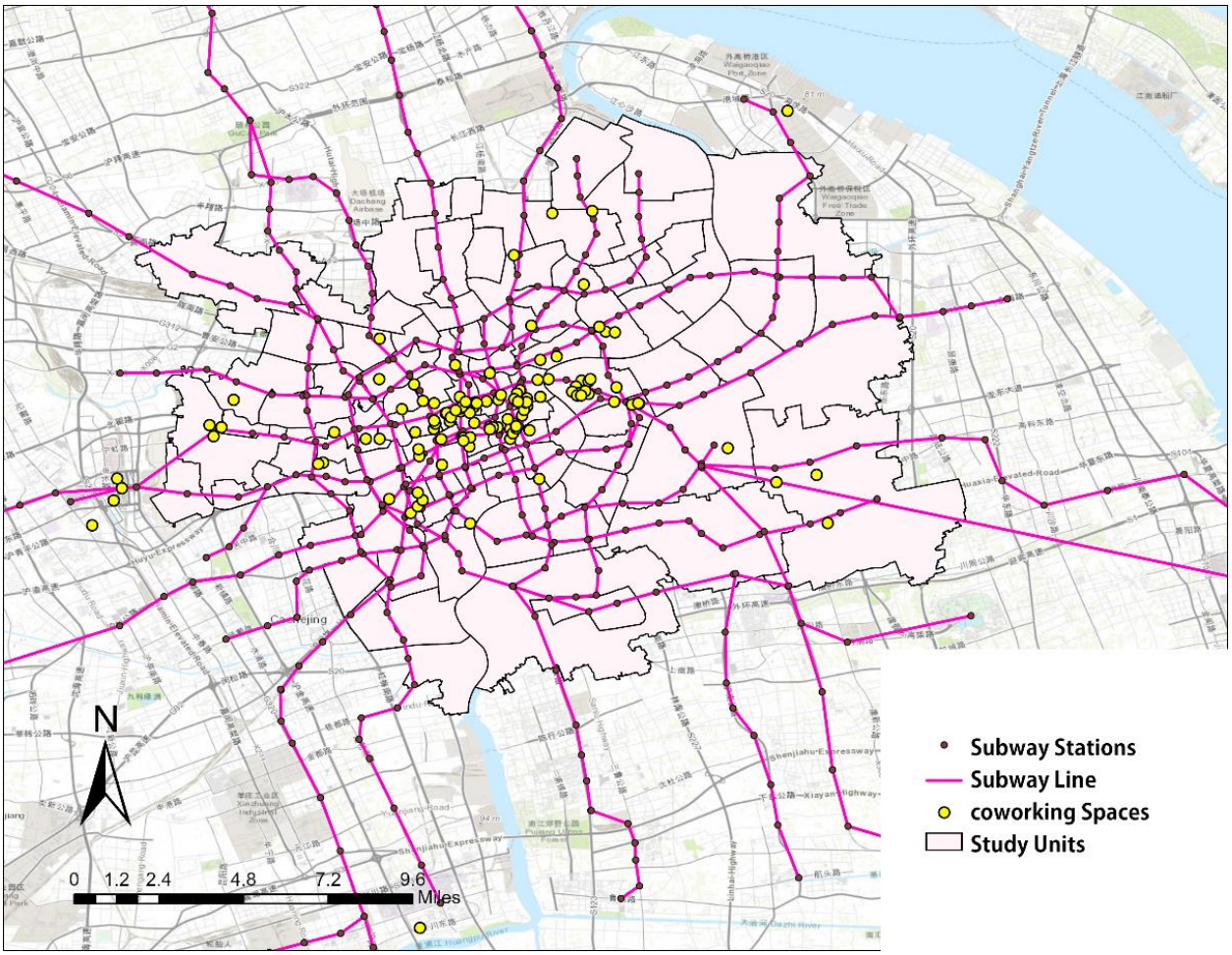

Figure 32 Shanghai subway network

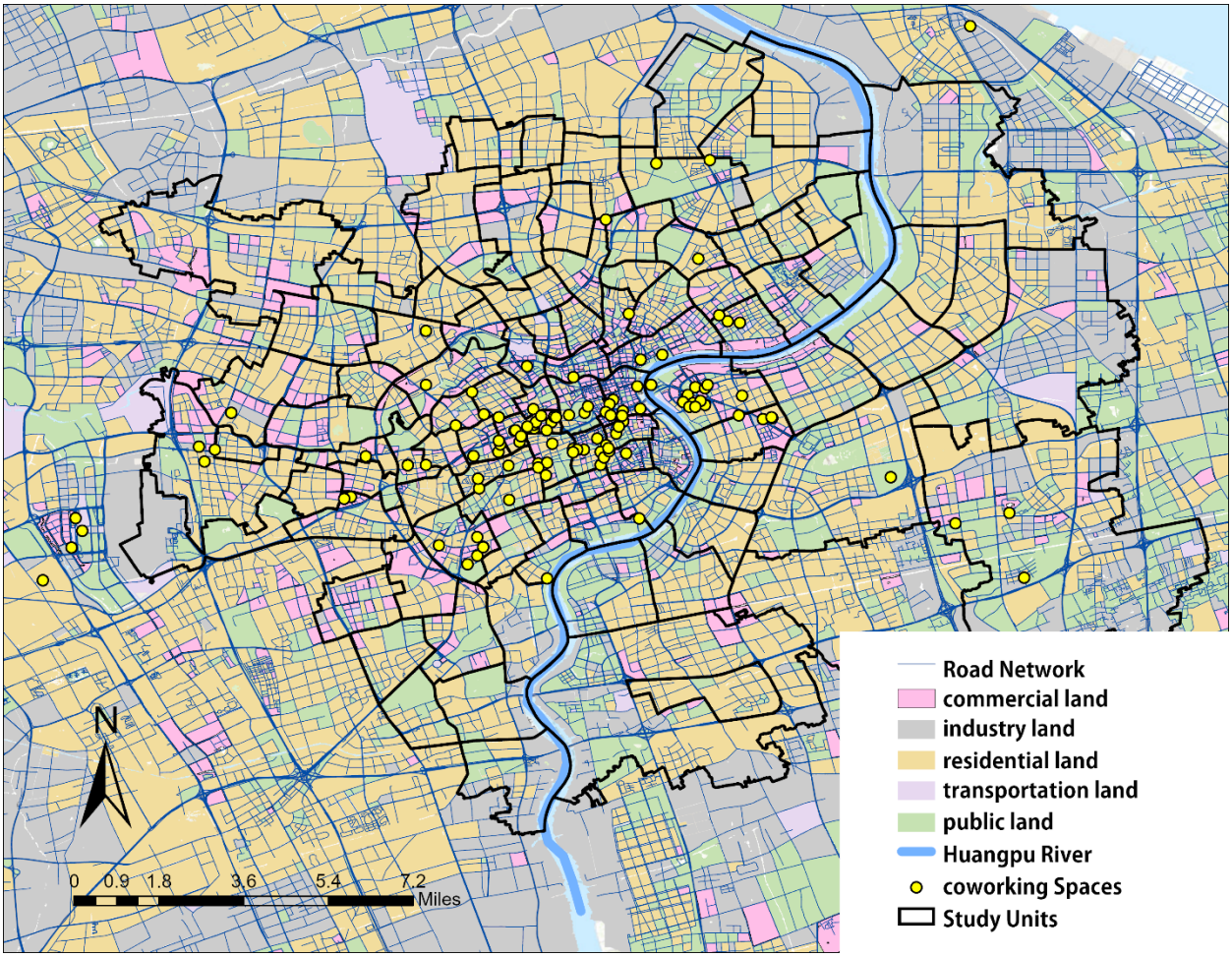

Figure 33 Land use and road network

Chapter 6 Conclusions

The analysis of the development history, urban form, companies and building type of coworking spaces, this study has the following major findings: (1) The distribution of coworking spaces in Shanghai has a trend to expand form the city center outward from 2015, when coworking spaces first appeared in Shanghai; (2) Most of the coworking spaces located in commercial centers in the past, but residential districts are also becoming appealing, which shows the flexibility and needs in more diverse urban forms. (3) Different coworking companies show slightly different preferences on their location decisions, which is caused by the size of companies and also the market positioning of companies. (4) Almost all of the coworking spaces choose to be located in high rise office buildings, but there are a few making different decisions, such as locating in residential apartments.

Based on the correlation assessed, the results show these characteristics of the location decision of coworking spaces: (1) Coworking spaces tend to cluster in high-density areas of companies, especially top 5% companies; (2) Coworking space density has significant correlation with companies in accommodation and catering industry, finance, education, and health and social work. It also has positive correlation with rental and business services and culture, sports and entertainment industry; (3) Coworking spaces tend to cluster in areas with high ratio of commercial land, and also shows a trend of clustering in areas with high residential land ratio; (4) Coworking space density has positive correlation with road density and subway station density, and most of the coworking spaces are located within walking distance of subway stations.

Chapter 7 Discussions

According to the current distribution pattern, coworking spaces tend to be in dense areas of enterprise, commercial land and subway stations which are vital in stabilizing and expanding the small companies utilizing these spaces. However, the results show different status of coworking spaces from the affordable places and the accessibility to public that is envisioned for coworking spaces. We can see the current coworking spaces are closer to the definition of real estate incubators, but far from the definition of startup firm incubators or public facilities based on (DuPriest, 2019). The shared office model can reduce the cost of small businesses and individuals working in high-end office buildings in urban centers, rather than providing absolutely cheap office space. This is also the reason why coworking companies have a stronger preference for the aforementioned areas versus the residential and remote suburb areas. In these areas the rent is cheap already as they are further from the commercial core and therefore, companies can completely lease office space independently.

Coworking spaces can be more local, affordable and accessible in the future. COVID-19 has allowed people to explore flexible office spaces, which provides new ideas for the future development of coworking spaces. Community based coworking spaces is a potential orientation, which means coworking spaces are located in residential communities. They can provide spaces for small firms to start a business, but also provide spaces for remote office work for employees in large companies, making “work form coworking” a new style in the post Covid circumstance. And also, these highly accessible coworking spaces in the community can also be a place for all people working there to communicate and participate in activities. Such community-based coworking spaces are truly threshold less and convenient.

Chapter 8 Limitations

The limitation of this study includes two aspects: data collection and the use of count modeling. In the data collection process, due to the limitation of the access to some data, the variables are not complete or not accurate enough for some features. For example, some demographic data were not collected, including the employment rate in the neighborhood, more detailed age structure and education level, which affected the analysis results. Also, the coworking spaces on the coworker website do not include all the coworking spaces in Shanghai. Searching for coworking on Baidu Maps will reveal more than 1,000 relevant address information. Although this address information also includes study rooms, cafes and conference halls, it also includes a considerable number of shared offices that are not registered on the coworker website. The coworking spaces on coworker is a representative of the coworker in Shanghai. And the use of count modeling also has limitations. Although count modeling is applicable for most variables, it is not suitable for some variables. For example, it is more suitable to use distance measurement for the relationship between coworking spaces and subway stations. But in order to keep the consistency of the data analysis, I still used density relationships in this study.

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