

國立政治大學經濟學研究所
碩士論文

台北市連鎖便利商店之空間分析
The Spatial Differences of Convenience Stores in Taipei



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Abstract

The density of convenience stores in Taiwan has reached the highest ranking in the world, but the firms are still expanding their investment to new convenience stores in the market. However, research which has empirically documented the link between demographic factors and the store density is quite scant. To evaluate the importance of spatial factors in Taiwan's chain convenience store industry, we estimate a model of demographic feature, competitive relationship, and environmental condition to explain how these variables affect the store density in a defined market. We define circle market with 250 and 300 meters radius by using the Geographic Information System and develop Thiessen polygon market as well. Using a Poisson estimation procedure, we find considerable evidence that firms locate their stores in an attempt to catch the demographic characteristics and to gain competition advantages in the market.

Keywords: Chain convenience store, store density, demographic factors, Thiessen polygon, Geographic Information System, Poisson regression

摘 要

截至 2012 年，台灣的便利商店密度高居全世界之首，但是根據公平交易委員會的調查，連鎖式便利商店的數量仍逐年攀升，我們認為消費者的特性和空間差異應為影響便利商店密度分布的關鍵因素。然而，由於資料取得的不易與資料齊全度的不足，目前台灣地區針對地理空間環境因素與便利商店密度的分析文獻屈指可數。本文首先利用地理資訊系統劃分以 250 公尺與 300 公尺為半徑的圓形市場和泰森多邊形市場，再建構一波松分配模型試闡明台北市民政資料、便利商店的競爭資料以及便利商店周圍環境的差異資料對於市場環域內便利商店密度的影響。本研究歸納出台北市便利商店之空間差異造成其分布的顯著影響，證明便利商店業者在展店時確實會考慮新店址之地理環境差異。

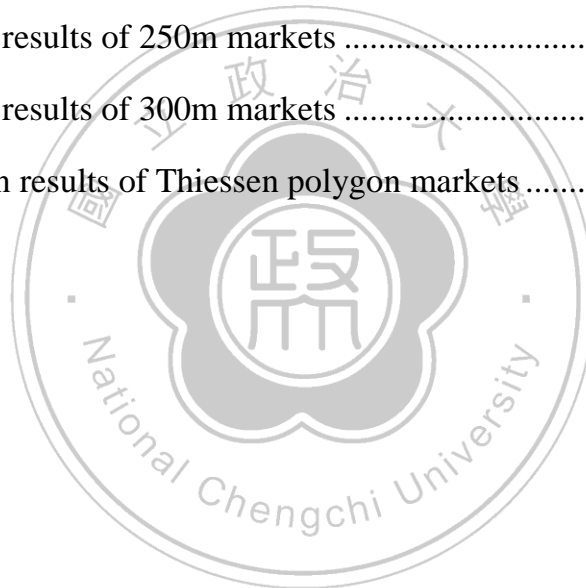
關鍵字：連鎖式便利商店、便利商店密度、民政資料、地理資訊系統、泰森多邊形、波松分配

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1. INTRODUCTION

Recent studies about convenience store industry in Taiwan typically put much emphasis on consumer behavior and business operating process but lack analysis on the influence of demographic factors and store features to store density in a defined area. Tsao (2003), Lee (2002), and Yang (2009) classify the customers of convenience stores into different types and choose one or more specific type to summarize the consumption habits of these customers. By making questionnaire to collect data from the customers they decide, they perform that convenience store play different roles to various consumers and regions and the primary consumption decisions made by consumers are largely controlled by the service and purchasing environment provided by the convenience store itself. Huang (2003) and Tu (2006) performs factor analysis and regression analysis to explore how store image and services provided influence customers' purchasing intention and satisfaction by convenience stores. As seen from the above studies we mention, while considerable attention has been performed in the past to research issues related to consumer behavior and business operating process of convenience stores in Taiwan, literatures on issues of the connections between the demographic factors and the density of convenience stores in a given market are still critically lacking.

The purpose of this study is to examine the store density in individual market in the effect of some important demographic factors and outlet differences, and to set forth explicitly some parameters for looking at the role of dependent variables as well. We create a databank for this study by collecting demographic data from the government institution, store differences data from the official websites of the four leading chain convenience stores

brand, and also the environment situations from Google map website. By constructing a regression model under Poisson distribution, in this study we try to find the spatial differences of convenience stores in Taipei. More specifically, in this paper we present a conceptual framework for linking demographic factors and locational choices of convenience stores, and suggest some theoretical as well as practical implications of this process.

The paper is organized in the following order: In Section 2 we give a brief introduction about chain convenience store industry in Taiwan, showing the overview of chain convenience store industry history and how astonishing it grows recently. In Section 3 we derive a model to identify the influence of demographic factors, competition relationships, and environmental variations to store density. In Section 4 we illustrate the source of our databank and give definition to the markets and variables we take into account in this study. Implements and results to our analysis are discussed in Section 5 and Section 6 concludes.

2. CHAIN CONVENIENCE STORE INDUSTRY IN TAIWAN

Generally, the definitions of convenience store in Taiwan given by Directorate-General of Budget, Accounting and Statistics (DGBAS) and Department of Commerce, Ministry of Economic Affairs are as follows: (i) the store area is between 50 to 230 square meters, (ii) the main commodities sold are food and beverage which should cover half of the total revenue, (iii) the variety of commodities should be at least 1500 classifications, (iv) the business hours should be over 14 hours in one day and also over 340 days in one year, (v) the efficient installations such as cash registers and security systems are required in every store. A convenience store, in simple terms, is aimed at providing convenient goods which can satisfy the instant demand of customers.

From the research made by the Fair Trade Commission, the four leading convenience store chains in Taiwan have a total of 9,916 stores at the end of 2012.¹ Giving the highest density of convenience store in the world, as seen in Table 1, with one store per 0.2756 square kilometers, it is usual to see two convenience stores across the street or within just a few hundred meters of each other in Taiwan. Furthermore, despite market saturation, there was still room for expansion, as shown in Figure 1, the four convenience store chains still reported net increases in their store numbers every year.

As the data are summed up as in Table 2, Taipei city has the highest density of convenience stores in comparison to other main cities in Taiwan. With an astonishing

¹ After FamilyMart took over Nikomart in 2007, 7-Eleven, FamilyMart, Hi-Life, and OKmart became the four leading convenience store chains in Taiwan which held a total 98.69% market shares.

number of 5.27 stores per square kilometers in density, convenience stores may be of crucial importance for understanding the situation of retailing industry in Taipei city. Besides, we can summarize from both Table 4 and 5 that with 1,437 convenience stores located in Taipei city, President Chain Store Corp's 7-Eleven has 704 stores, sharing the largest market share of 49%, followed by Taiwan FamilyMart Co. with 419 stores, market share of 29%, Hi-Life International Co. with 198 stores, market share of 14%, and OKmart Co.'s 116 stores, market share of 8%.

Overview the history of Taiwan's convenience store industry, most of the retailing suppliers are small grocery stores around the corner or on the street at an early stage, and the products offered included groceries and daily necessities which were similar to supermarkets; however, there had been tremendous changes since the chain brand and business model were introduced from Japan and the United States in the 1980s. With the advantages of lower managing and operating costs, extended business hours, and various merchandises and services, chain convenience stores had gradually replaced the small grocery stores in the metropolitan area. Starting from the first convenience store was found², during the early 20 years of the development of chain convenience stores, the principal items being sold were beverages, instant noodles, snacks, tobaccos, newspapers, hotdogs, steamed buns as well as tea eggs which could be on-the-go conveniently. Subsequently, in the last decade, with the development of internet, we have seen a shift in the patterns of management in chain convenience store industry. On one hand, the convenience store retailers kept innovating grab-and-go meals such as packaged sandwiches or *onigiri* (rice balls with various stuffing), *odens* (many different kinds of food boiled in soup), *obento*

² The first chain convenience store in Taiwan, 7-Eleven Chang-An shop, was opened in 1980.

(lunch box consists of meat, vegetable and rice) and so on; on the other hand, in addition to setting multifunction printer machines and ATMs in the stores to help customers deal with specific affairs, convenience stores have become centers of bill-paying and fee-paying services. Moreover, convenience store retailers were devoted to not only constructing the connections with pre-ordering and on-line shopping services but expanding store area in order to provide parking lots or toilets for customers in recent years. As has been mentioned above, the various operation styles and multiple kinds of services of convenient stores do provide many convenient choices to time-starved consumers who want to get maximizing satisfactions within a limited time when they visit convenience stores.

Referring to “The Current Situation and Future Development of Convenience Store Chains (2011)³⁷” prepared by Commerce Development Research Institute (CDRI), we can basically figure out some essential development trends of convenience store chains in Taiwan:

- (1) Releasing new goods and services: to satisfy the changing preferences of customers and to attract different groups of customers.
- (2) Building private brand: to control costs efficiently and to improve brand imagine of customers.
- (3) Promoting café and fresh meals provided in the stores: to focus on the most profitable merchandise by sales strategies such as discounts for the second item bought or point-collections to get the target rewards in a limited time.
- (4) Expanding the physical store area: to increase the retention times and various consumptions of customers.

³⁷ The present status and future development of chain convenience stores(2011)

(5) Developing the electronic commerce: to stimulate the operating performances by integrating both the physical and virtual storefront.

Table 1. The Density of CVS Comparing to Other Countries in the World

Country	Area (km ²)	Store Number	Density(Store/Area)
Taiwan	35,980	9,916	0.2756
Korea	98,480	20,035	0.2034
Japan	377,835	45,175	0.1196
Thailand	514,000	12,246	0.0238
US	9,631,418	148,126	0.0154

Source: Fair Trade Association; The Association for Convenience & Fuel Retailing; Japan Franchise Association; TAITRA Global Trade Source

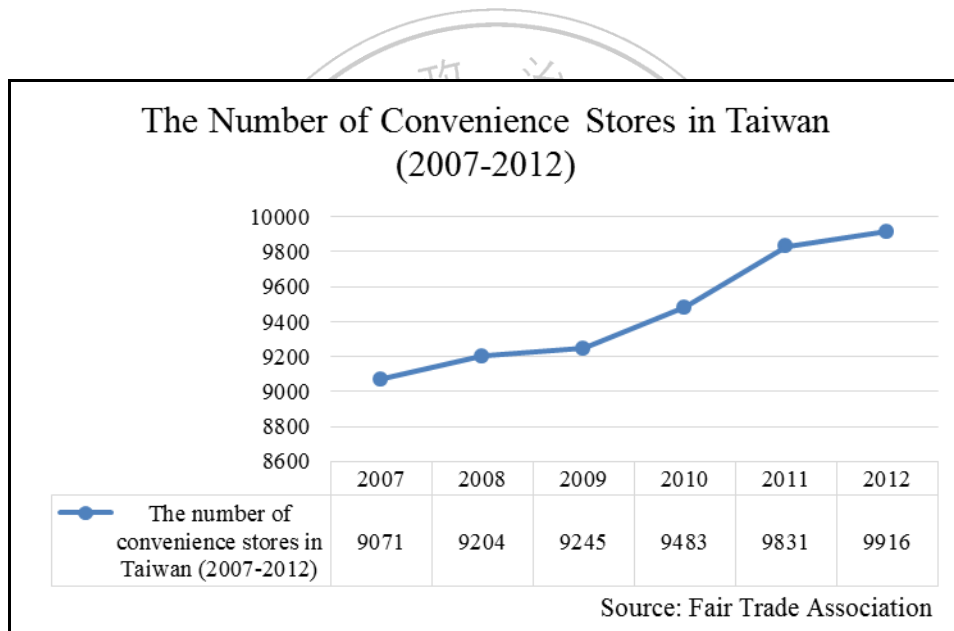


Figure 1. The Number of CVS in Taiwan (2007-2012)

Table 2. The Density of CVS in Different City in Taiwan

City	Area (km ²)	Amount of Stores	Density (stores/km ²)
Taipei City	272	1437	5.27
New Taipei City	2053	1968	0.96
Taoyuan County	1221	1170	0.96
Taichung City	2215	1152	0.52
Kaohsiung City	2946	918	0.31

Source: eTax Portal, Ministry of Finance

Table 3. The Store Numbers of Four Leading Brand in Taipei

Brand	7-ELEVEN	FamilyMart	Hi-Life	OKmart
Store Number	704	419	198	116

Source: Official Website of 7-ELEVEN, FamilyMart, Hi-Life, and OKmart

Table 4. The Market Share of Four Leading Brand in Taipei in 2012

Brand	7-ELEVEN	FamilyMart	Hi-Life	OKmart
Market Share	49%	29%	14%	8%

Source: Fair Trade Association



3. MODEL

As given in the Hotelling model, if a circle market with fixed radius and identical consumers is more competitive, the distribution of firms in this market will be more clustered in order to share the profits. However, Netz and Taylor (2002) suggest that increases in competition will lead to more dispersed locations in the retail gasoline industry, so they construct a model to capture the relationship between market competition variables and store locational patterns. We try to demonstrate an analysis in order to understand what kind of factors or conditions will influence the installation of convenience stores, and thus affect the convenience store density in a defined market.

In this study we carry out three different ways to divide market, and we use the number of convenience stores in the defined market as the index to evaluate market density. Refer to Netz and Taylor (2002), we conduct the following regression model and build Poisson distribution to clarify the effect of the differences of demographic information, store characteristics, and the potential competition to market density:

$$S_i = \beta_0 + \beta_1 C_i + \beta_2 A_i + \beta_3 X_i + \varepsilon_i$$

where i indexes the center store. S_i is the number of convenience stores in the defined market. The three groups of variables include (1) C contains consumers' demographic information in the market, (2) A store characteristics in attribute, and (3) X represents the surrounding environment of degree of competition. ε is an error term of the model which follows Poisson distribution. The introduction of our data and the definition to markets and variables are presented in the next section.

4. DATA

4.1 Data Resource

The data we use in this research include the intersectional demographic data, the store essential information of the top four chain convenience stores, and the neighboring environmental situations of the convenience stores in Taipei city in 2012. Since there is no historical literature about the relationship between demographic data and convenience stores density in Taiwan, we should build a databank for this research first and then we can begin to explore the field about how convenience store firms choose their business locations. In order to build our databank, we spend a lot of time to collect data from the official websites of convenience stores and government institutions and separate the original data into different catalogues.

First, the intersectional demographic data in 2012 come from Taipei City Government, District Administration and Household Registration Office of 12 districts in Taipei city, Department of Budget, Accounting and Statistics and Department of Education of Taipei City Government, Ministry of Finance, Department of Commerce, Ministry of Economic Affairs, and the annual report published by Directorate-General of Budget, Accounting and Statistics of Executive Yuan (DGBAS). The materials we collect from the above references contain total population numbers, male and female population numbers, household numbers, age composition, marital status, average income of taxation entities, disposable income of households, and average consumption of households. Second, the store essential information are arranged from the official websites of 7-Eleven, FamilyMart, HiLife, and

OKmart. The information exposed in the official websites cover the store name, store number, store address, and the service items provided in every store, e.g. toilet, wifi, parking lot, and so on. We also collect information about store features including the size, the width of sidewalk and road, the location of each store from Google map website. Finally, the neighboring environmental situations of all convenience stores in Taipei city are collected from Open Data website of Taipei City Government, which consist of landmarks and supermarkets located around each convenience store.

The purpose of this study is to ascertain the effect of consumers' features and environmental factors in the density of convenience stores in Taipei. To address this issue, we sorted out the database we collected into different variables. The store number of convenience stores are composed of four leading brands—701 shops of 7-Eleven, 416 shops of FamilyMart, 215 shops of HiLife, and 116 shops of OKmart, whereas the volume of demographic variables are related to the extents published by the government, which can be classified into 12 districts, 456 villages, and 9547 neighborhoods.

4.2 Market Definition

The most important factor for chain convenience store industry to succeed is the location of their stores. Nelson (1958) and Applebaum (1968) discuss about how retailers choose their locations while Goodchild (1984) extend this idea to develop issues about consumer behaviour and cost-effectiveness solution which appropriately applied location-allocation models for retailing. Chin-Te Jung and Chih-Hong Sun (2006) integrate essential techniques of geographic information system (GIS), spatial decision support system (SDSS), and spatial data mining (SDM) to convert large databank into useful knowledge; otherwise, Hernández and Bennison (2000) use GIS technology to offer a

framework for retailers to implement to their location decision process. To explore the spatial distribution of chain convenience store firms, how to define market becomes the most crucial issue in our study; once we distinguish the whole area into individual market reasonably, we can figure out the store density and the effect of demographic features and other decisive variables subsequently.

In this research, we used Geographic Information System (GIS) and constructed three frameworks to differentiate market. First of all, because 7-Eleven installed most stores which could be considered as the leading brand in Taipei city, we defined all 7-Eleven stores as the center of each market; that is, we had 701 markets in this framework. Jung, Sun and Lee (2005) integrate the demographic data of Taipei city in 2000 and the industry and commerce census data of Taipei city in 2001, and use spatial association rules and data conversion model to find the spatial relationship between convenience stores and demographic data. Refer to their review of the definition of market buffers, we set 250 meters as the radius of the defined market, and obtained 701 circle markets by using the buffer function of GIS software. In addition, we consulted the definition of the size of convenience stores market in Ministry of Economic Affairs as well, setting 300 meters as the other radius of the defined market, and analyzed the differences of the two length of market radius. Figure 2-3 show the market defining procedures in the GIS system.

However, the market overlapping problems were derived when we took all the 7-Eleven stores as the center of defined markets because the density of convenience stores in Taipei was too high to prevent putting two or more stores into the same market. Kalnins and Lafontaine (2004) offered a sounder theoretical basis for contrastive analysis by making Thiessen polygon. Figure 4 illustrates the process of making a Thiessen polygon. First of all, pointing out all the reference points we set and connect the neighboring points with a

straight line. Then find the middle point of the connection line and draw a vertical line to this middle point. Finally, these vertical lines will constitute some polygons that we call them Thiessen polygons. The unique property of Thiessen polygon is that each polygon contains only one input point, and any location within a polygon is closer to its reference point than to any point in other polygon. Therefore, supposing all 7-Eleven stores in Taipei city to be the reference points and dividing Taipei city into several Thiessen polygon as Figure 5 shows, with each polygon had only one 7-Eleven included⁴, we could solve the market overlapping problem effectively.

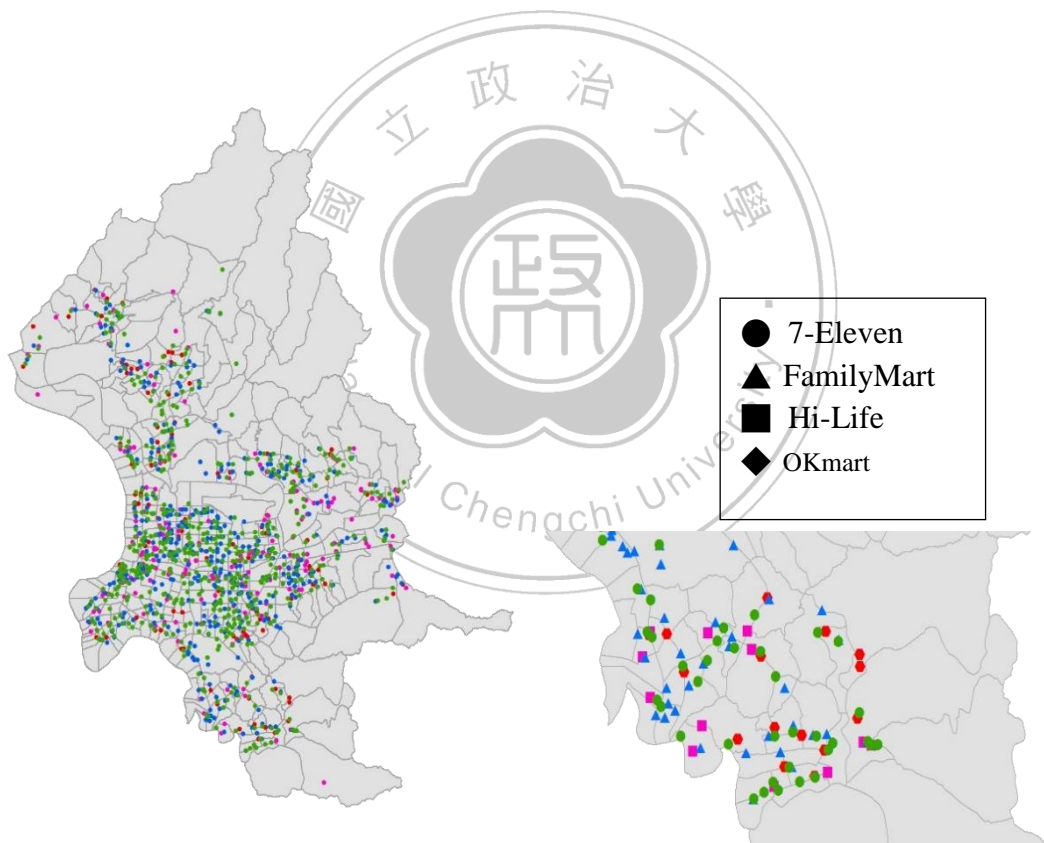


Figure 2. Total chain convenience stores in Taipei

⁴ Hence, there are 701 Thiessen polygons markets in the third way we define markets in our study as well.

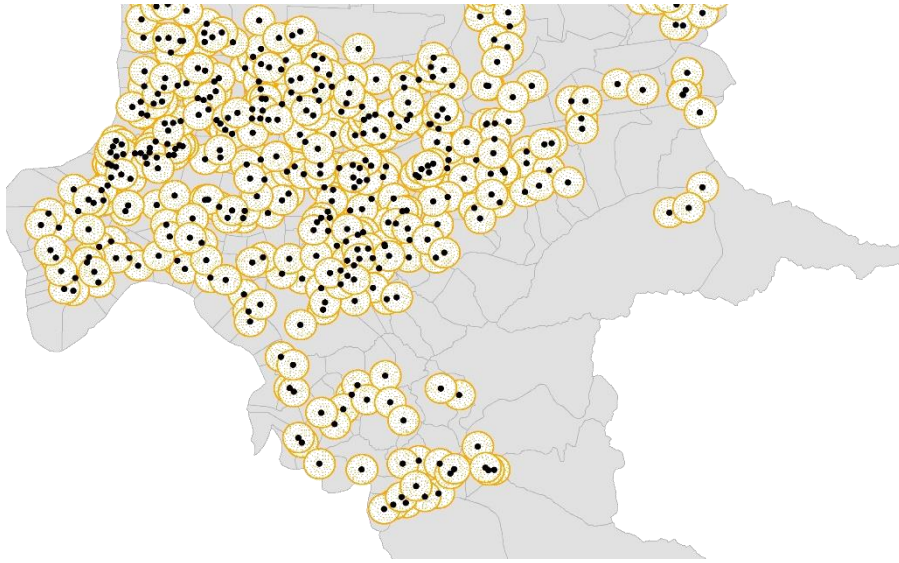


Figure 3. Buffering markets using 711 stores as center with defined radius

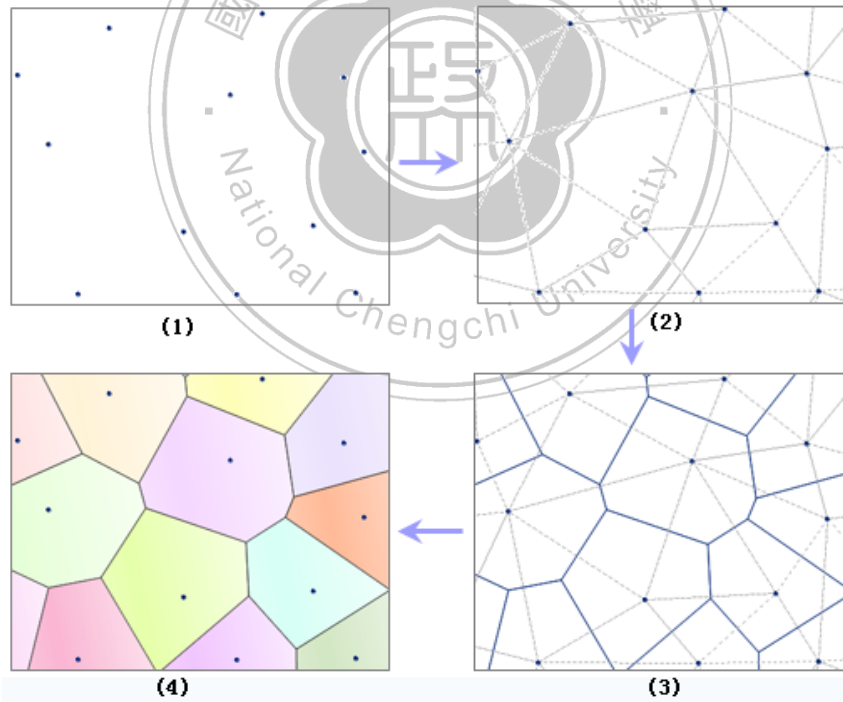


Figure 4. Definition of Thiessen polygon

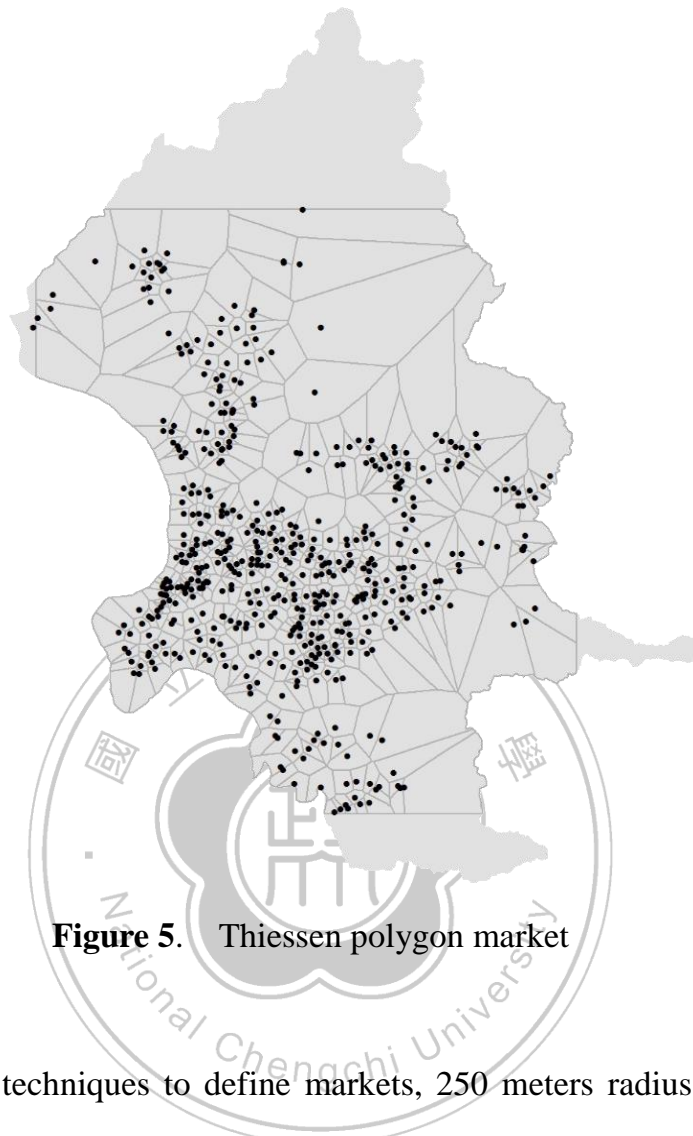


Figure 5. Thiessen polygon market

We develop three techniques to define markets, 250 meters radius buffering market, 300 meters radius buffering market, and Thiessen polygon market, and implement them to our analysis after.

4.3 Variables Definition

We tried to address the impact of demographic variables, differences between stores, competition relationships on the convenience store density in Taipei in this research. The detailed definition of each variable used in this model would be explained as follows.

4.3.1 Store numbers

In order to catch the extremely high convenience store density in Taipei, we use the number of convenience stores in the defined market as the index to evaluate market density; therefore, we calculate the four brands of convenience stores inside each defined market to be the dependent variable in this model.

4.3.2 Population

We suppose that the population live in the defined market should be the principal customers to the convenience store, which will influence the new store opening decisions made by firms; hence, according to Doctor Jung, Doctor Sun, and Doctor Lee suggested, we collect the population data published by the regional household registration office and consider the neighborhoods level populations of the center 7-Eleven store as one variable in the model.

4.3.3 Household size

We supposed that how many people in one family was one of the key factors that would affect the demand of convenience stores in the market; in other words, the size of family would determine the willingness of habitants to consume in the convenience stores and further affect the store numbers in the defined market. Hence, we defined the household size variable as total population numbers divided by total registered household numbers and implied it into our model.

4.3.4 Male ratio

To figure out whether the sexual differences in each market would be an obvious factor

that impacted the density of convenience stores, we calculated the percentage of male population numbers to clarify the assumption.

4.3.5 Average age, the ratio of young population and elder population

Since purchasing daily necessities in the convenience stores is a new trend among people lived in Taiwan, we believed that the age composition would be a key point to determine the operation of new stores in defined markets, thus influence the density of convenience stores. We collected the age data from District Administrations in Taipei and derived the average age of population and calculated the ratio of population under 15 years old and over 65 years old as variables related to age distribution in this model.

4.3.6 Education years

According to the annual statistics report published by Department of Education, Taipei City Government, we could get the graduated or studied but no degree population numbers. We assume people who graduated from the specified level of school got the full standard educational years and people who did not graduate but ever enrolled the specified level of school got half of the standard educational years to construct the average educational years of population by calculating weighted average years.⁵

⁵ To put it differently as an illustration, people who graduated from elementary school would obtain 6 years as his/her educational years while people who had enrolled elementary school but did not graduate would obtain 3 years as his/her educational years; people who graduated from junior high school would obtain 9 years as his/her educational years while people who had enrolled junior high school but did not graduate would obtain 7.5 years as his/her educational years; people who graduated from senior high school would obtain 12 years as his/her educational years while people who had enrolled senior high school but did not graduate would obtain 10.5 years as his/her educational years; people who graduated from college would obtain 16 years as his/her educational years while people who had enrolled college but did not graduate

4.3.7 Married ratio

The marital status might have impact on the store number of convenience store because we assumed that people who did not live with his/her family would have more chance to buy food, beverage or other daily necessities in a convenience store since the package of commodities in other physical channels were too large to utilize by one person. Due to this reason, we arranged married ratio in the defined market by dividing married population into total population.

4.3.8 Average income of taxation entities and average consumption of households

Obtained from National Taxation Bureau of Taipei, Ministry of Finance, we arranged the income and consumption data of 12 districts in Taipei city as our independent variables.

4.3.9 Competition and square of competition

In order to determine the competition relationships among different chain convenience store brands, we calculated the 7-Eleven store ratio of total stores included in a specified market as the variable which described the competition situation of this region. Though it has different meanings to one market with 2 7-Eleven stores over total 4 convenience stores and the other market with 1 7-Eleven store over total 2 convenience stores, because of the

would obtain 14 years as his/her educational years; people who graduated from two-year specialized school would obtain 14 years as his/her educational years while people who had enrolled two-year specialized school but did not graduate would obtain 13 years as his/her educational years; people who graduated from five-year specialized school would obtain 17 years as his/her educational years while people who had enrolled five-year specialized school but did not graduate would obtain 14.5 years as his/her educational years; people who graduated from graduate institute would obtain 18 years as his/her educational years if he/she studied master degree, 23 years if he/she studied doctor degree ,whereas people who had enrolled graduate institute but did not graduate would obtain 17 years as his/her educational years if he/she studied master degree, 20.5 years if he/she studied doctor degree.

limitations of data collection, we can only assume these two conditions are the same in our regression model. Besides, taking account of the findings from Huang. (2014), we make the square of competition variable to see the nonlinear relationship between store density and competition.

4.3.10 Service ratio

The fragmentation of convenience stores had gradually gone from convenient goods to service-oriented commodities; therefore, there are many kind of services provided by different brand of convenience store recently. To capture this feature of convenience stores, we try hard to create a service index that could explain these differences of each store. In the beginning, we try to separate the services items into the same classifications and check whether the four brands of convenience stores offer that kind of service or not; however, since the open information on the official website were limited and we have no access to get more detailed data about the service conditions in each store, we can only use the existing data to build a relatively reasonable variable to catch the service differences between different stores. As a result, we take the provided service items of each store divided by total service item provided by its brand, and get an index to present the service differences in each store in the market.

4.3.11 Store size, Road width, Sidewalk width and Corner

We collect the practical situations of convenience stores in Taipei city by searching Google map website and perform four types of variables from the information. First of all, we distinguish the size of convenience store into small, middle and large, three kinds of degrees, and give these three degrees number 1, 2, and 3 which stands for the different size

of each store. Secondly, we observe the driveways of the road built in front of each store, and record the number of driveways to represent the width of the road. Thirdly, we also observe the sidewalks in front of each store and classify them into four levels. If there is no sidewalk in front of the shop, we give number 0, and then 1, 2, 3 sequentially by the width of sidewalk. Finally, whether each store located on the corner or not can be seen obviously in the Google map website, so we take this as one variable to see the influence.

On the other hand, we classify different brand of shops into three parts, center stores, 7-Eleven but not center stores and all the other three brands stores to separate the variant impacts on store density. We calculate the distance between each store and the center in each defined market and use the inverse number as the weight of each store. Multiplying store size, road width, sidewalk width and corner by the weight of each store, we can gain the weighted variables that we want to use in our model.⁶

4.3.12 Landmarks

The landmarks lied in the market would be an important factor that influenced the density of convenience stores since the stream of consumers around the landmarks would be higher. We adopted elementary schools, junior high schools, senior high schools, colleges, MRT stations, railway stations, Taiwan high speed railway stations, airports, hospitals, and the most famous spots voted by tourists around the world in Taipei as the main landmarks we tried to explore, whereas we calculated the number of landmarks in the defined market to be the landmark variable.

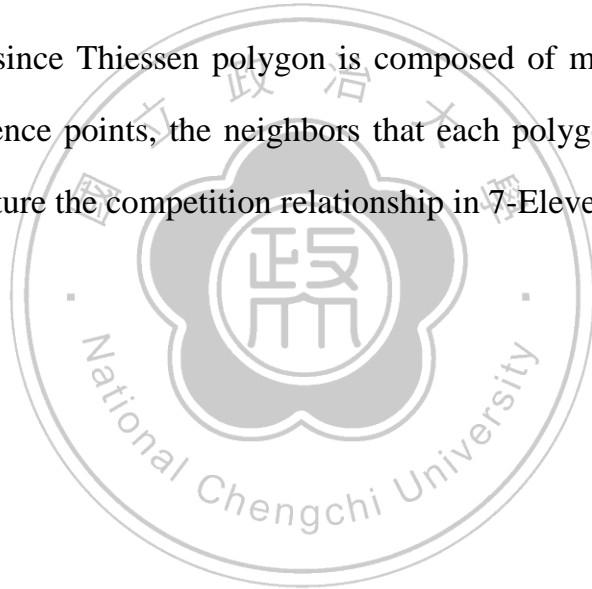
⁶ For example, if there is a Hi-Life shop with small size, six driveway on the road, middle sidewalk, locates on the corner of the block and the distance to center store is 10 meters. The variable store size will be $1*1/10=0.1$, road width will be $6*1/10=0.6$, sidewalk width will be $2*1/10=0.2$ and variable corner will be $1*1/10=0.1$.

4.3.13 Supermarkets

Because the commodities sold and the target customers in the supermarket were similar to the convenience stores roughly, we take the number of supermarket located in one defined market into account. The brands of chain supermarket we consider are Palmart, Simplemart, Welcome, and Matsusei.

4.3.14 Perimeter, surface area, and neighbors of Thiessen polygon

While using Thiessen polygon method to differentiate markets, every polygon will have different perimeter and surface area which can be considered as decisive variables in our model. In addition, since Thiessen polygon is composed of many vertical lines to the connections of the reference points, the neighbors that each polygon has can be observed, and this variable can capture the competition relationship in 7-Eleven for us.



5. RESULTS

5.1 Descriptive Statistics

Table 6 provides the list of descriptive statistics of the data used in this study. As shown in Table 6, the average population of the neighborhood where each 7-Eleven store located are 303 people, with male population proportion is about 47.75%. The average household size is 2.57, that is, in the specific buffering area we defined, there are approximate 2.57 people lived in one registered house. The average age of population is about 41.4 years old, with the youth population proportion under 15 years old is 14.34% and the elder population proportion over 65 years old is 13.50%, illustrating that people in the defined market are middle-aged population in large part, and the labor force is relatively high. Besides, the average educated years of people in the specified buffering area are 13.5 years, which indicates that most of the habitants have received the twelve-year public education program and have graduated from junior high school on the average. The married ratio in the defined market is 45.4%, showing that about half of the population are lived with their spouses. In addition, the average income of taxation entities is about 0.74 million new Taiwan dollars and the average consumption of households is about 0.98 million new Taiwan dollars in the twelve districts of Taipei city.

As for all the store characteristic variables, the competition relationship variable is defined as the number of total 7-Eleven stores divided the number of total convenience stores in the specific buffering market, and the mean of this ratio are different in the two radius we set and presented in Table 6 and Table 7. Since both means in different market radius are over 0.5, we can figure out that 7-Eleven kept leading advantage in store number

competition in the defined market in Taipei city. The mean of service ratio provided in each convenience store is approximate 0.39, which illustrates that there are still rooms for increasing services in each store because the items provided are less than half of the total service projects designed in the head office. The store size, the width of roads and sidewalks in front of the store, and whether the store is located at the corner of the block are also included in these category, and the descriptive statistics of these variables are shown in both Table 6 and Table 7 as well.

The surrounding environment situation variables include the number of landmarks and supermarkets located in the buffering market we defined. The descriptive statistics of these variables are presented in the following two tables, which are different depending on the two market radius we assumed. The mean of landmarks is about 1.37 in 250 meters radius and 1.95 in 300 meters radius, which presents that almost all the market we defined has at least one landmark inside, the chain convenience store industry likely prone to install their stores near landmarks.

Table 8 shows the descriptive statistics of Thiessen polygon markets, because we use 7-Eleven stores as referring points as well, most part of variables would have the same statistics comparing to circle buffering markets. The distinct variables added in Thiessen polygon method are the perimeter and surface area of the polygon, and the number of neighboring polygon. As disclosed in Table 8, the average perimeter of Thiessen polygon in Taipei city is 0.1958 kilometer, the mean of area is 0.3125 square-kilometer, and the average neighbors to each polygon is 5.83.

Table 5. Descriptive statistics of 250m markets

variables	mean	std. dev	min	max
population	302.1840	154.9711	11	2112
household size	2.5684	.3294	.1860	3.1463
male ratio	.4775	.0161	.4245	.5568
average age	41.3573	2.4320	34.6551	48.0666
under 15 years old ratio	.1434	.0354	.0783	.2627
over 65 years old ratio	.1350	.0293	.0606	.2526
average educational years	13.4886	.7672	11.1887	15.7205
married ratio	.4540	.0243	.3329	.5120
average income	.7358	1.2588	0.4950	1.2480
average consumption	.9799	.9414	0.7614	1.1357
competition relationship	.6251	.3765	.1111	1
service ratio	.3886	.1345	0	.8000
center size	1.7903	.8230	0	3
center road width	3.3538	1.9901	0	11
center sidewalk width	2.3766	.9700	0	8
center corner	.4650	.4991	0	1
711 not center size	.0192	.0227	0	.1935
711 not center road width	.0369	.0539	0	.5368
711 not center sidewalk width	.0256	.0320	0	.2902
711 not center corner	.0044	.0071	0	.0967
non 711 size	.0336	.2685	0	.0922
non 711 road width	.0563	.2739	0	.1845
non 711 sidewalk width	.0468	.2725	0	.1384
non 711 corner	.0219	.2661	0	.0461
landmark	1.3723	1.6239	0	10
supermarket	.4194	.6915	0	3

Table 6. Descriptive statistics of 300m markets

variables	mean	std. dev	min	max
population	302.1840	154.9711	11	2112
household size	2.5684	.3294	.1860	3.1463
male ratio	.4775	.0161	.4245	.5568
average age	41.3573	2.4320	34.6551	48.0666
under 15 years old ratio	.1434	.0354	.0783	.2627
over 65 years old ratio	.1350	.0293	.0606	.2526
average educational years	13.4886	.7672	11.1887	15.7205
married ratio	.4540	.0243	.3329	.5120
average income	.7358	1.2588	0.4950	1.2480
average consumption	.9799	.9414	0.7614	1.1357
competition relationship	.5590	.1942	.1250	1
service ratio	.3886	.1345	0	.8000
center size	1.7903	.8230	0	3
center road width	3.3538	1.9901	0	11
center sidewalk width	2.3766	.9700	0	8
center corner	.4650	.4991	0	1
711 not center size	.0231	.0229	0	.1295
711 not center road width	.0443	.0541	0	.6840
711 not center sidewalk width	.0308	.0314	0	.2873
711 not center corner	.0053	.0065	0	.0546
non 711 size	.0273	.0319	0	.2905
non 711 road width	.0536	.0590	0	.4241
non 711 sidewalk width	.0423	.0518	0	.4284
non 711 corner	.0137	.0157	0	.1141
landmark	1.9501	2.0295	0	10
supermarket	.5820	.8251	0	4

Table 7. Descriptive statistics of Thiessen polygon

variables	mean	std. dev	min	max
population	302.1840	154.9711	11	2112
household size	2.5684	.3294	.1860	3.1463
male ratio	.4775	.0161	.4245	.5568

average age	41.3573	2.4320	34.6551	48.0666
under 15 years old ratio	.1434	.0354	.0783	.2627
over 65 years old ratio	.1350	.0293	.0606	.2526
average educational years	13.4886	.7672	11.1887	15.7205
married ratio	.4540	.0243	.3329	.5120
average income	.7358	1.2588	0.4950	1.2480
average consumption	.9799	.9414	0.7614	1.1357
competition relationship	.6128	.2974	.1111	1
service ratio	.3886	.1345	0	.8000
perimeter	.1958	158.2420	.0141	1.4861
area	.3125	717.3199	.0006	1.2000
neighbor	5.8302	1.3871	3	12
center size	1.7903	.8230	0	3
center road width	3.3538	1.9901	0	11
center sidewalk width	2.3766	.9700	0	8
center corner	.4650	.4991	0	1
non 711 size	.0299	.5433	0	.0903
non 711 road width	.0546	.3195	0	.2001
non 711 sidewalk width	.0501	.2226	0	.1764
non 711 corner	.0332	.3769	0	.0412
landmark	.8231	1.2795	0	9
supermarket	.3310	.6899	0	5

5.2 Regression Results

5.2.1 Circle markets with 250 meters radius

In light of concerns about the relationships between the consumers' features, the competition within stores, surrounding environments and the convenience store density in the defined buffering market area, in this study we used 250 meters and 300 meters as market radius, and also Thiessen polygon method to define markets, respectively. Poisson regression model is applied in this research. Table 8 presents the regression results of 250 meters market, and contains four models. Model 1 and 2 report estimation results using the

sample of the average income of taxation entities while model 3 and 4 report estimation results using the sample of the average consumption of households. In addition, we add the quadratic term of competition into model 2 and 4 to see the nonlinear relationship influences to the model.

From the aspect of demographic variables, we find considerable evidence that household size, male ratio, average age, youth population proportion and elder population proportion have significant influences in all the four models we set. The size of households has a negative effect on store density, indicating that when the more members in one household in the defined market, because the products sold by convenience stores are in small packages and with higher prices, it is relatively difficult for a large family to afford, the less demands are derived from the potential customers in a buffering area, which results in the lower convenience store density. The ratio of male population in a defined market also has a negative impact on store density; that is, men have less demand to convenience stores than women. The probable reasons why females are more likely to consume in a convenience store may be as follows: First, the goods and services provided by convenience stores are with delicate packages and developed with new trends in the society, taking winter period limited strawberry flavor commodities as an example, and these fashion items would attract females more. Second, chain convenience stores put calorie signs on all the foods and beverages they sold to remind consumer who is going on a diet (most of the time are females) of the nutrition they take in. Last but not least, the collecting activity promoted in recent years plays an important role as well since the presents given by convenience stores are well-designed and have cute appearance to attract females more.

Of those variables related to population ages, the average age is positively correlated to store density, which shows that if the age structure in the market is built by middle-aged

people, the demand of convenience stores would increase, leading to higher density of stores; it is probably because Taipei city is a commercial metropolitan area, the office workers and commuters have greater preferences to convenience stores which can provide instant services and never close in a whole day. Moreover, the youth population and elder population ratio play opposite effects on the store density. With the changes to purchasing habits in recent years, young groups prefer to wander around the convenience store and do some purchases in their leisure time, hence the convenience stores with more innovative and fashion goods will be their best choices; however, for those consumers who are older in the market, the attraction of convenience stores is relatively low, which yield lower density in the defined market.

Married ratio in general have a negative correlate to store numbers in Model 1 and 2. If the married ratio in the buffering area is high, the household composition is always more than two people, thus the influence would be the same as the household size variable. No significant correlation was uncovered from population number and educational years. We suppose that the number of population may have positive impact on store density before we start to run the regression model because more people will result in higher demand intuitively; however, the result displayed in our research turn down our suggestion. This outcome may probably happen since we take only the population in the neighborhood of center 7-Eleven located into account. The negative influence of educational years to store density disclose that the consumption behavior to convenience stores depends on how the consumers need the instant goods and services instead of on how they are educated.

Consumption expense and average income show a striking effect of store density in their own model. The average consumption of households has a positive relationship to store density means that if the consumption expenses of population in the market get higher,

the proportion to consumption in convenience stores would be probably higher as well; therefore, the convenience store in the market would reach a higher number relatively. On the other hand, the average income of taxation entities has a negative impact on store density in the defined market, which can be inferred that the more income the household earns, may not necessarily lead to larger purchasing power to convenience store, since the high-income family may tend to buy daily necessities, foods and beverages which are more expensive to ensure the qualities.

As regards to variables about store competition, the findings indicate that both competition relationship and service ratio are negatively correlated to store density. The higher the number of 7-Eleven stores, the total convenience stores in the defined market seems to be less on account of the leading market power of 7-Eleven. The more services provided by the center of the market, the fewer stores will expand in the buffering area because the service function the center plays may control the market. In addition, among those variables about the size and location of the store, and the width of the road and sidewalk in front of the store, only four variables are relevant to store density —the size of both 7-Eleven stores but not the market center and other brands, the width of sidewalk of center store, and the location of other brands in the market. We suppose the store characteristics variables would have important influences to our model, but the results are partly different from our expectations, since just few of variables we set in the model are significant; we may make great efforts to create a new way to search data in the future in order to improve the variables used in this model. The square of competition variable has no correlation in the 250 meters radius model.

Finally, in the perspective of surrounding environment variables, landmark numbers increasing results in more convenience stores will be constructed in the market area; to put

it differently, since landmarks in the specific buffering attract many people, there are more demands for one-time purchasing to the near convenience store, the number of stores should increase to share the market. However, supermarket numbers and convenience store numbers were shown not to be significantly related, and it may be because the target consumers and the goods they aimed are separated with one another.

Table 8. Regression results of 250m markets

Variables	Model 1	Model 2	Model 3	Model 4
Population	-.0001 (.0001)	-.0001 (.0001)	-.0001 (.0001)	-.0001 (.0001)
Household Size	-.1585** (.0736)	-.1603** (.0736)	-.1540** (.0722)	-.1567** (.0732)
Male Ratio	-1.3538* (1.2936)	-1.3287* (1.2931)	-2.1684* (1.2962)	-2.1284* (1.2955)
Average Age	.1733*** (.0604)	.1763*** (.0604)	.2294*** (.0624)	.2317*** (.0624)
Under 15yrs	7.2772*** (2.1853)	7.4453*** (2.1885)	10.4802*** (2.4100)	10.6183*** (2.4125)
Over 65yrs	-8.1098** (3.3263)	-8.1339** (3.3274)	-10.4647*** (3.4320)	-10.4583*** (3.4333)
Education Years	-.0354 (.0441)	-.0322 (.0441)	.0133 (.0447)	.0158 (.0448)
Married	-2.5276** (1.0794)	-2.5560** (1.0790)	-1.2588 (1.2322)	-1.2936 (1.2317)
Consumption	.0004* (.0003)	.0004* (.0003)		
Income			-.0007** (.0003)	-.0007** (.0003)
Competition	-.7216*** (.0767)	-.9126*** (.1495)	-.7199*** (.0769)	-.9187*** (.1490)
Competition2		.1062 (.0687)		.1105 (.0682)
Service	-.2609** (.1293)	-.2583*** (.1293)	-.2451* (.1295)	-.24249* (.1296)
Center Size	.0182 (.0224)	.0174 (.0224)	.0187 (.0223)	.0179 (.0223)

Center Road	.0107 (.0095)	.0114 (.0095)	.0101 (.0095)	.0107 (.0095)
Center Pass	-.0351* (.0209)	-.0353** (.0209)	-.0398* (.0207)	-.0397* (.0207)
Center Corner	-.0353 (.0368)	-.0364 (.0368)	-.0500 (.0367)	-.0508 (.0367)
711 Size	7.8063*** (1.4530)	7.8689*** (1.4536)	8.0952*** (1.4654)	8.1551*** (1.4656)
711 Road	.8296 (.5975)	.8347 (.5976)	.8882 (.5997)	.8895 (.5998)
711 Pass	-.4141 (1.5418)	-.3628 (1.5429)	-.7086 (1.5529)	-6.4449 (1.5540)
711 Corner	-.0035 (2.7782)	.0196 (2.7781)	-.3073 (2.7963)	-.2852 (2.7957)
Non711 Size	2.0252* (1.1092)	2.0634** (1.1083)	2.1161** (1.1052)	2.1529* (1.1062)
Non711 Road	.2552 (.5597)	.2078 (.5603)	.3383 (.5600)	.2858 (.5607)
Non711 Pass	.2374 (.8340)	.1832 (.8350)	.1415 (.8352)	.0865 (.8362)
Non711 Corner	-2.5018*** (.6440)	-2.4375*** (.6451)	-2.5770*** (.6411)	-2.5053*** (.6425)
Landmark	.0276*** (.0106)	.0279*** (.0106)	.0250** (.0107)	.0253** (.0107)
Supermarket	.0174 (.0255)	.0181 (.0255)	.0226 (.0254)	.0231 (.0254)

5.2.2 Circle markets with 300 meters radius

In comparison to the 250 meters market, Table 9 shows the regression results of 300 meters market, including four models, Model 5-8⁷, with the same definitions of Model 1~4 as well.

⁷ Model 5 and 6 report estimation results using the sample of the average income of taxation entities while model 7 and 8 report estimation results using the sample of the average consumption of households. Also we add the quadratic term of competition into model 6 and 8 to see the influences to the model.

We also separate the results of 300 meters market variables into three part, demographic features, competition between stores, and surrounding environment characteristics. The first part of results, which is the features of customers in the defined buffering area, are mostly similar to the analysis of 250 meters market, except household size. The size of households has no significant relationship with store density, meaning that no matter how many people in a household registered, would not influence the number of convenience stores in this region. This might because since we enlarge the radius of buffering area, there are more convenience stores, supermarkets, and hypermarkets included in a market, the effect of household size is eliminated by the market size.

The only two different results of those variables related to store differences between 250 and 300 meters radius market are competition and the square of competition and store density. It can be seen in Model 6 and 8 that competition factor become no relevant to store density; however, the quadratic term of competition has negative relationship to the model. This means that 7-Eleven itself may have advantages to expand the market share in a defined market in the beginning, but with the increase of 7-Eleven stores, the competition advantages would eliminate once the density reach a peak. There are some deviations to store characteristics variables comparing to 250 meters market, such as the width of road in front of center 7-Eleven store and non-711 store, the width of sidewalk of 7-Eleven but not center store, and the location of 7-Eleven but not center store and non-711 store as well.

As for the variables presents surrounding environment characteristics, landmark numbers and supermarket numbers have the same influence as the analysis in 250 meters markets.

Table 9. Regression results of 300m markets

Variables	Model 5	Model 6	Model 7	Model 8
Population	-.0001 (.0001)	-.0001 (.0001)	-.0001 (.0001)	-.0001 (.0001)
Household Size	-.0031 (.0667)	-.0056 (.0667)	-.0100 (.0664)	-.0140 (.0664)
Male Ratio	-2.5092** (1.1723)	-2.4371** (1.1735)	-3.4261*** (1.1753)	-3.3441*** (1.1764)
Average Age	.1547*** (.0532)	.1523*** (.0533)	.2113*** (.0545)	.2084*** (.0546)
Under 15yrs	6.1916*** (1.9242)	6.1488*** (1.9265)	9.4767*** (2.0987)	9.4176*** (2.1020)
Over 65yrs	-6.7743** (2.9305)	-6.6694** (2.9333)	-9.1851*** (3.0054)	-9.0684*** (3.0088)
Education Years	.0013 (.0391)	-.0043 (.0391)	.0490 (.0399)	.0433 (.0400)
Married	-2.1451** (.9752)	-2.1829** (.9755)	-.7877 (1.1048)	-.8123 (1.1056)
Consumption	.0004* (.0002)	.0004** (.0002)		
Income			-.0007** (.0003)	-.0007** (.0003)
Competition	-.8779*** (.1048)	.4072 (.4813)	-.8616*** (.1052)	.4529 (.4809)
Competition2		-1.0678*** (.3909)		-1.0923*** (.3907)
Service	-.2240** (.1135)	-.2252** (.1136)	-.2100* (.1136)	-.2113* (.1137)
Center Size	.0042 (.0194)	.0044 (.0194)	.0052 (.0193)	.0055 (.0193)
Center Road	.0144* (.0082)	.0155** (.0082)	.0134* (.0083)	.0143* (.0083)
Center Pass	-.0437** (.0180)	-.0441** (.0180)	-.0488*** (.0178)	-.0490*** (.0178)
Center Corner	-.0327 (.0317)	-.0291 (.0317)	-.0480 (.0316)	-.0442 (.0316)
711 Size	8.1021*** (1.2443)	7.6073*** (1.2577)	8.1125*** (1.2483)	7.6157*** (1.2612)

711 Road	-.6559 (.5162)	-.5303 (.5188)	-.5145 (.5102)	-.3932 (.5125)
711 Pass	2.7729** (1.3436)	2.5407* (1.3451)	2.4363** (1.3494)	2.2097 (1.3515)
711 Corner	6.2633** (2.4817)	5.9802** (2.4852)	5.6044** (2.4826)	5.3174** (2.4856)
Non711 Size	.7576 (.9381)	.8431 (.9381)	.8619 (.9360)	.9437 (.9358)
Non711 Road	.8625* (.4434)	.8298** (.4436)	.9703** (.4447)	.9397** (.4449)
Non711 Pass	-.1760 (.7059)	-.0888 (.7075)	-.2633 (1.2592)	-.1796 (.7110)
Non711 Corner	.8562 (1.2609)	.7488 (1.2629)	.5788 (1.2591)	.4908 (1.2613)
Landmark	.0294*** (.0076)	.0289*** (.0076)	.0274*** (.0077)	.0266*** (.0077)
Supermarket	.0083 (.0192)	.0065 (.0192)	.0157 (.0193)	.0137 (.0191)

5.2.3 Thiessen markets

The second way we used to define the market is Thiessen polygon method. By using Thiessen polygon, there would be no market overlapping problem in our model because Thiessen used the vertical lines of middle points of the distances between two neighboring stores to develop a polygon, every center 7-Eleven store would have their own market which could not be overlapped by the other store.

In addition to the same demographic variables, competition relationship, and surrounding environment features variables we use in the first market-definition method⁸, variables about the characteristics of Thiessen polygon are also included. Besides, we firstly run the same regression models Model 9-12 as Model 1-4, which are without Thiessen polygon additional variables, perimeter, area, and neighbors. Model 9 and Model 10 report

⁸ Our first method to define market is to draw a circle with 250 and 300 meters as radius.

estimation results using the sample of the average consumption of households while Model 11 and Model 12 report estimation results using the sample of the average income of taxation entities. In addition, we add the quadratic term of competition into model 10 and 12 to see the nonlinear relationship influences to the model. Then we combine all variables together into Model 13 and 14 and run the complete model. Model 13 report estimation results using the sample of the average income of taxation entities while model 14 report estimation results using the sample of the average consumption of households.

The results of Thiessen polygon method are shown in Table 10. We will discuss the significant variables individually in Model 9-12 and proceed to illustrate our findings in Model 13 and 14. First of all, in Model 9-12, male ratio is positively correlated to store density, and this has an obvious difference when comparing to the results of circle market definition; men plays an important role on the Thiessen polygon market since they may create more demands to make firms increase the stores in the defined market. Average consumption variable is positively correlated to store density as well, meaning that the proportion to consumption in convenience stores would get higher if the average consumption expenditure in the market is relatively higher, which would drive firms to install more stores in the market. Married ratio, competition relationship, and service ratio have negative effects on store density. Spouses would like to buy packaged commodities instead of single packaging goods because they can share with each other in their family, which lower demands in the defined market and results in the lower convenience store density. The youth population and elder population ratio play opposite effects on the store density in Model 10 and 12, indicating that for those consumers who are over 65 years old, on account of low energies, the attraction of convenience stores is relatively low, which yield lower demands and lower store density in the defined market. Competition

relationship here in Thiessen polygon model is slightly different from the one in the circle market model. Since there is only one 7-Eleven store in a Thiessen polygon market, the competition relationship variable is exactly the reverse number of non-7-Eleven stores; it must have negative correlation theoretically. The more services provided by the center of the market, the fewer stores will expand in the Thiessen polygon area because the center 7-Eleven may nearly completely cover the whole market.

Model 13 and Model 14 contain all variables including those related to Thiessen polygon. In these two models, almost all the other variables have no significant correlation to the model, except for perimeter, area, neighbor, and competition. It can be viewed as these three variables related to Thiessen polygon method can capture some important features of another variables, hence when we add them into our model, the results change generally.

Table 10. Regression results of Thiessen polygon markets

Variables	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Population	-.0001 (.0001)	-.0005 (.0002)	-.0001 (.0001)	-.0001 (.0001)	-.0001 (.0001)	-.0005 (.0001)
Household Size	-.0563 (.1243)	-.0225 (.1269)	-.0539 (.1235)	-.0224 (.1262)	-.0222 (.1279)	-.0023 (.1272)
Male Ratio	1.9188** (2.0499)	.7488** (2.0719)	1.8810* (2.0386)	.7486* (2.0600)	.7357 (2.1326)	.7344 (2.1090)
Average Age	-.0257 (.0901)	.0132 (.0917)	-.0252 (.0900)	.0131 (.0916)	.0126 (.0928)	.0125 (.0926)
Under 15yrs	-.5813 (3.1979)	.6782* (3.2505)	-.5446 (3.1891)	.6719** (3.2383)	.6587 (3.3162)	.6552 (3.2972)
Over 65yrs	.7369 (4.8967)	-.7617* (4.9684)	.7063 (4.8889)	-.7577** (4.9617)	-.7223 (5.0138)	-.7180 (5.0061)
Education Years	.0422 (.0579)	.0104 (.0585)	.0404 (.0582)	.0101 (.0588)	.0107 (.0587)	.0105 (.0591)
Married	-1.1681** (1.6635)	-.2935** (1.6734)	-1.1419** (1.6586)	-.2924** (1.6679)	-.3038 (1.6808)	-.3035 (1.6761)

Consumption	.0002*	.0001*			.0001	
	(.0003)	(.0004)			(.0003)	
Income			.0001	.0002		.0001
			(.0002)	(.0002)		(.0003)
Competition	-1.9239**	-4.8421***	-1.9249***	-4.8420***	-4.8381***	-4.8380***
	*	(.5361)	(.1136)	(.5357)	(.5401)	(.5398)
	(.1137)					
Competition2		2.3477		2.3475	2.3449	2.3447
		(.4225)		(.4222)	(.4243)	(.4241)
Service	-.2080**	-.0803**	-.2039**	-.0798**	-.0801	-.0797
	(.1963)	(.1961)	(.1962)	(.1961)	(.1961)	(.1961)
Perimeter					-.0001***	-.0001***
					(.0004)	(.0004)
Area					.0001***	.0001***
					(.0001)	(.0001)
Neighbors					.0006***	.0006***
					(.0200)	(.2004)
Center Size	-.0051	-.0021	-.0056	-.0222	-.0022	-.0022
	(.0344)	(.0343)	(.0344)	(.0343)	(.0344)	(.0345)
Center Road	.0119	.0048	.0117	.0047	.0047	.0047
	(.0143)	(.0142)	(.0143)	(.0142)	(.0144)	(.0144)
Center Pass	.0074	.0005	.0077	.0006	.0006	.0006
	(.0313)	(.0309)	(.0314)	(.0310)	(.0315)	(.0312)
Center Corner	-.0254	-.0007	.0262	-.0077	-.0077	-.0077
	(.0545)	(.0550)	(.0543)	(.0548)	(.0550)	(.0548)
Non711 Size	-.3913	-.1828	-.3954	-.1835	-.1904	-.1912
	(1.7529)	(1.7389)	(1.7527)	(1.7389)	(1.7147)	(1.7418)
Non711 Road	-.0497	-.1877	-.0467	-.1881	-.1848	-.1850
	(.8614)	(.8676)	(.8612)	(.8673)	(.8725)	(.8720)
Non711 Pass	-.0058	.0809	-.0113	.0803	.0858	.0852
	(1.2072)	(1.2052)	(1.2068)	(1.2071)	(1.2089)	(1.2089)
Non711 Corner	.4314	.2828	.4377	.2844	.2827	.2843
	(1.1616)	(1.1351)	(1.1626)	(1.1362)	(1.1384)	(1.1395)
Landmark	-.0121	-.0050	-.0120	-.0049	-.0052	-.0053
	(.0203)	(.0201)	(.0202)	(.0201)	(.0205)	(.0205)
Supermarket	-.0050	-.0026	-.0046	-.0026	-.0029	-.0029
	(.0378)	(.0378)	(.0378)	(.0378)	(.0387)	(.0387)

6. CONCLUSION

Despite the growing awareness of the development of convenience store, the economic aspect of its locational decisions as a research field has not yet been much explored. On the other hand, although there is a strong assumption of a link between the demographic elements and the business operation of convenience stores, little empirical evidence has been found to establish a prominent relationship between these two variables. In this paper we present the results of demographic factor, competition relationship and surrounding environment variation in convenience store density within a specific market by defining markets in 250 and 300 meters radius circle markets and Thiessen polygon markets. We may reasonably conclude that:

- (1) In 250 meters radius circle markets: household size, male ratio, elder population proportion, married population proportion, average income of taxation entities, competition relationship, service provided ratio, the width of sidewalk of the center 7-Eleven store, and non-7-Eleven stores locate at the corner have negative correlation to store density; while average age, young population proportion, average consumption expenditure, the number of landmark, the size of non-7-Eleven stores have positive correlation to store density.
- (2) In 300 meters radius circle markets: male ratio, elder population proportion, married population proportion, average income of taxation entities, competition relationship, the square of competition relationship, service provided ratio, and the width of sidewalk of the center 7-Eleven store are negatively correlated to store density; while average age, young population proportion, average consumption

expenditure, the number of landmark, the width of the road in front of center 7-Eleven, the size of 7-Eleven but not the center store, the width of sidewalk of 7-Eleven but not the center store, and the width of the road in front of non-7-Eleven stores are positively correlated to store density.

- (3) In Thiessen polygon market: elder population proportion, married population proportion, competition relationship, and service provided ratio have a negative effect on store density; while male ratio, young population proportion, and average consumption expenditure have a positive effect on store density.

Results of this study may represent the most complete documentation to date in obtaining estimates of aspects of demographic factors and store differences to store density in a defined region; however, there are still some deficiencies and limitations in this model for us to amend. For example, the problem of market definition and overlapping, the judgment of Google map observation, or the other demographic data which can explain this model correctly should be included. In spite of the limitations of our conclusions, we believe that the findings from our study are inspiring enough to invite further research on the topic of the economic analysis to convenience stores.

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