SENIOR RESEARCH

Spatial Competition and Firm Performance: An Empirical Analysis of Retail businesses in Bangkok

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Abstract

Location has been positioning as the key factor determining the success of retail businesses. Despite theoretical propositions in favor of spatial clusters, the net impact of spatial competition on the performance of retail businesses remains nebulous since there exist two underlying counteractive forces, namely agglomeration effects and competition effects. Therefore, the aim of this study is to identify the extent to which effects would dominate and observe the relationship of spatial proximity between similar retail businesses and the firms' performance. Using the data of retailers in Bangkok, the empirical results show that spatial closeness to competitors is associated with a reduction of the firms' revenue and profitability, whereas the firms' net profit margin tend to increase as a result of the competitive pressure. The results conform with several studies, exhibiting negative consequences resulted from spatial proximity to competitors; therefore, policies influencing the location of retailers, such as zoning policy, could potentially affect firms' performance.

Acknowledgement

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1 Introduction

Retail sector has been playing a significant role on how the economy functions, especially in Thailand where retail sector constitutes over 35 percent of the country's GDP (Thaipost, 2018). Providing a channel between producers and end-customers for vast numbers of products, retail sectors have been undergoing a massive transformation to a more digital-oriented; however, consumer spending and purchasing trends are still in the favor of the brick-and-mortar stores, contributing over 97 percent of the total retail transactions (Leesa-nguansuk, 2018). Yet, there is a divide between the two channels, specifically in terms of the extent of differentiation. While retail sectors, in general, are inherently differentiated product markets as retailers offer not just a bundle of goods and services, but at the same time other outputs, namely distribution services as implicit products or qualities of retailers (Betancourt & Gautsi, 1988). Compared to the online counterparts to which location decision is somehow irrelevant, brick-and-mortar sectors could exert market power by exploiting an additional source of differentiation in which the location is different or spatial differentiation. Therefore, setting up a physical retail requires a profound decision on location selection which could affects the degree of spatial differentiation.

Several studies have been attempting to shed light on how physical retailers select their location. Hotelling (1929) proposed the theoretical construction on location patterns of retails to illustrate the spatial nature of retail markets. The study introduced the concept of locational equilibrium between duopoly in a linear city by developing a game in which firms choose their location to maximize their profit. The result suggests that similar businesses tend to converge to the single center point. For this reason, it is likely that retail businesses would cluster together as a result of firms' strategic moves. To justify the proposition, figure 1 shows the concentration of retailers in Bangkok area as measured by GI* hotspot analysis.

Several red areas indicate statistically significant hotspot, meaning that retail clusters prevail in Bangkok area.

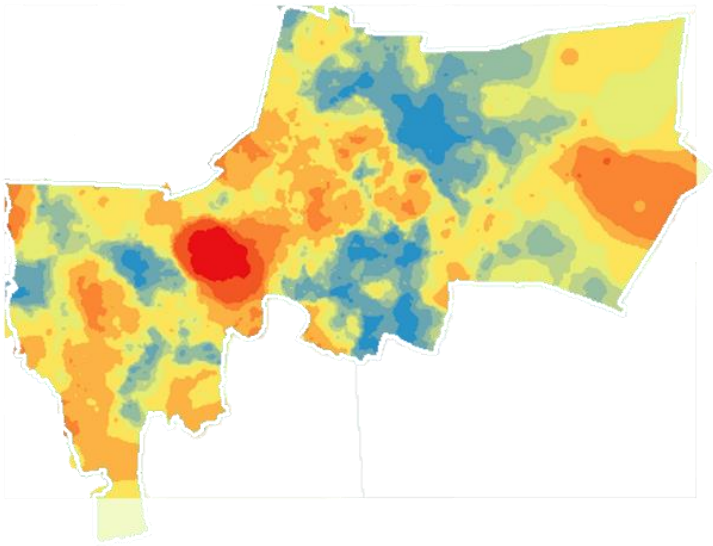

Figure 1: GI* Hotspot Analysis in Bangkok Area

However, such spatial closeness brings about a complex trade-off since there are two underlying counteractive forces, namely agglomeration effects and competition effects. While the former poses positive impacts as clustering could attract more potential customers, the latter adversely affects retails as price competition looms which reduces markups. It remains nebulous and unsubstantiated whether which of these two counteractive forces would dominate. Some studies point out that the degree to which effect would dominate depends on certain factor, such as how customers are distributed (Eaton, 1975), the degree of product differentiation (Ilias-nikiforos, 2018), transportation costs (d'Aspremont, Gabszewicz, & Thisse, 1978). Therefore, the results are still could not be generalized whether locating close to competitors could benefit or worsen retail performance.

The goal of this study is threefold. First, this study aims to take an empirical step towards finding which effects (agglomeration effects or competition effects) would dominate and assessing the net impact of spatial competition and firm

performance as measured by revenue and profitability. Second, this study also tests how retails react to spatial competition in terms of efficiency improvement by assessing the impact on net profit margin. The third goal is to explore heterogeneity of the spatial competition effects by separately evaluate each type of retail businesses.

This study employs a cross-sectional dataset as of 2017 that covers a total of 22,639 observations, including following lists of data. First, location data. This study incorporates point-level data of retails' location and other relevant POI attributes, using geographical coordinates to calculate spatial proximities, including density, average distance, standard deviation and the nearest distance, among retailers and their respective competitors and POI attractions. Second, firms' financials are incorporated as proxies for firm performance and firm internals. The data are sourced from the department of business development (DBD) database by Siametrics Consulting. Third, demographics. The data include sub-district level population density sourced from Bangkok Metropolitan Administration and sub-district level household expenditure sourced from National Statistic Office. Fourth, road-level land price sourced from Bangkok GIS Center. Using the Ordinary Least Squares (OLS) linear regression analysis as an empirical methodology, this study aims to find the relationship between spatial competition and firm performance among the retail sectors.

The results of the empirical analysis suggest that for the whole retail industry, spatial proximities, as measured by density, density, average distance to competitors, standard deviation of distance to competitors and distance to nearest competitors, are associated with a reduction of revenue and profitability of retail businesses as the net impact of spatial competition of firm performance is negative. On the other hand, as competitors get closer, retails' net profit margin tends to increase as the impact of spatial closeness on retails' net profit margin is positive. Interestingly, after testing each type of retail businesses separately, the net impact

of spatial competition on retails' revenue is somewhat sector-specific. For example, grocery stores of which goods and services are less differentiated, the results are found to be negative, meaning that the spatial closeness to competitors correlates with a reduction of revenue. The opposite is true when it comes to fashion outlets of which goods and services are more differentiated.

The paper consists of four main sections and is organized as follow. Section 2 provides a literature review on spatial competition and associating impact on firm performance. Section 3 presents details of data incorporated in this study as well as research methodology. Section 4 illustrates the empirical results and their interpretation and intuition. Lastly, section 5 provides a conclusion and discussion of the paper and suggest related policy implications.

2 Literature Review

There exist numerous literatures studying retails' location decision since the seminal study of Hotelling (1929) on spatial competition. The study proposed the principle of minimum differentiation, illustrating that it is rational for producers to homogenize their products to that of competitors. Especially in retail sector, although the sector is known as inherently differentiated markets (Betancourt & Gautsi, 1988), retailers would be less spatially differentiated as a result of their strategic move to maximize their profit. Irmen and Thisse (1998) also advocated such observation by pointing out that a multi-characteristics firms choose to maximize differentiation in the dominant characteristics and refrain from differentiating on other aspects. Therefore, spatially, firms are more likely to coalesce at the market center. Moreover, the observation is in line with the results from Forbes (1972) who developed a framework for retail structure based on the Central Place Theory, indicating that retailers, specifically specialty stores, tend to cluster in larger cities.

On the other hand, several studies argued that with a difference in model assumptions, such observation could vary. d'Aspremont, Gabszewicz, & Thisse (1978) modified an assumption of linear transportation costs in the traditional Hotelling's model to be a quadratic function and found a contrasting result, suggesting that firms are better off by setting apart as far as possible from their competitors. Siem (2004) also developed am empirialcal model on firm entry in the retail video market in the US and found that firms are incentivized to differentiate spatially as rivalry between firms could be associated with a loss in margins.

As aforementioned literatures showed two contrasting results regarding location decisioins of firms, specifically retails, no consesus has been reached on the direction of an impact of such decision. Retails are encountering trade-offs between two underlying counteractive forces, namely competition effects and agglomeration effects (Chisholm & Norman, 2012).

2.1 Agglomeration Effects

Proponents of agglomeration effects have been presenting the concepts of economic cluster which emeliorates firms performace. The proposition of economic clustering by Michale E. Porter (1998) refers to a geographical concentration of various types of businesses both vertically and horizintally that potentially generates spillovers resulted from competition and cooperation. Consequently, the advocates believe spatial proximity between firms would benefit firm performance.

First, spatial closeness between firms could attract more customers. When firms cluster, they form an attractive space of goods and services for customers to find products they need (Ilias-nikiforos, 2018); hence, enhencing the attractiveness to customers. In addition, locating close to cluster means that firms are exposed to the area where foot traffic is concentrated; therefore, increases an opportinity for firms to reach new customers (Schulz & Stahl, 1996).

Second, cluster is considered as an important source of competitiveness as it provides an access to talented exployees, specialized information, infrastructure and public goods (Porter M. E., 1998). Specifically in retail industry, input and output sharing among members in a cluster seems to play the most promonent role on promoting competitiveness.

Several literatures provide empirical evidences in favor of benefits of clustering on firm performance. Ilias-nikiforos (2018) found out that the effects of retail clustering on shopping externalities in the Netherlands are positive for average retailers. In addition, spatial proximity among firms also enhance the level of productivity which, in turn, positively affects financial performance as presented in the study by Jennen and Verwijmeren (2010). 2.2 Competition Effects

Spatial proximity among businesses could potentially incur negative impacts on firm performance. While firms choose to locate near the competitors to snatch

their customers, they still have to weigh the consequences of such decision as spatial closeness could lessen the degree of spatial differentiation; therefore, exalting the degree of price competition (Chisholm & Norman, 2012). The scenario aggravates when firms do not take into account the reduction imposed on rivals' revenues when they relocate, leading to an excessive merket provision of the products (Davis, 2010). Putting together, these two opposing conditions with which firms are facing could be refered to how firms compete for shares in the given market; thus, capturing competition effects.

There have been various empirical studies, indicating that competition effects dominate the agglomeration effects. Specifically, spatial rivalry among firms heightens the degree of price competition. For example, Syverson (2007) studied an impact of spatial competition on the price of ready-mixed concrete in the US. The results imply a reduction of average prices when the markets become denser, banishing ineffienct firms out of the market. Similar outcome was also found in an empirical work of Knight and Schiff (2012) on spatial competition and cross-border shopping in state lotteries sector. They found a negative relationship between optimal prices and the degree of competitive pressures. Therefore, the literatures pointed out that when firms are less spatially differentiaed, price competition looms and reduces their markups which, in turn, negatively influences their performance. Besides, Sang (2007) also found an immense subtitution effect by firms' rivals in retail gasoline markets in the US. When a retail gas station increases their price, approximately 60 percent of loss of sales are captured by the competitors within 0.1 mile radius. Moreover, there was an empirical evidence showing a negative impact of spatial competition on the quantity of goods and services sold by firms as positted by Chisholm and Norman (2012). The study assessed the effect of spatial rivalry on motion-pictures exhibition markets and found an evidence suggesting that theater attendence is negatively associated by proximity to the nearest competitors. All in all, adverse impacts of spatial

proximity among firms lie in not only price but also quantity of firms' goods and services which could potentially worsen their revenue.

3 Data

3.1 The Datasets

The author commissions a market study of Bangkok metropolitan area. The study encompasses various data into the analysis. The first dataset involves financial information of retail businesses in Bangkok, including revenue, net income, total assets and registered capital, as of the year 2017. The data are sourced from DBD Datawarehouse by Siametrics Consulting. The dataset contains a total of 22,639 retailers, covering seven broad types of retailers as classified by Department of Business Development, Ministry of Commerce, namely convenience stores, grocery stores, gas stations, electronics stores, construction material stores, book stores and fashion-related stores.

The second dataset is location data of retail outlets and POI attractions, including geographic coordinates based on precise longitude and latitude. The retails' address is geocoded by Siametrics Consulting. In addition to outlet locations, the study also incorporates the locations of POI attractions, including public transportations (BTS, MRT, Airport Rail link), main roads, financial institutions (Bank branches and ATM), department stores and community. The shapefiles of public transportations, main roads, department stores and community are sourced from Bangkok GIS Center, and the geographic coordinates of ATM machines and bank branches are provided by Siametrics Consulting.

Further, the demographic data are incorporated into the study, including sub-district level of population density and household expenditure. The data of population density are obtained from Bangkok Metropolitan Administration, and the data of household expenditure are sourced from the National Statistical Office. Lastly, the study also accounts land price into the analysis which is provided by Bangkok GIS center.

3.2 Data Manipulations

First of all, to obtain measures for spatial competition, I calculated proxies for spatial proximity for each retailer in a particular category, including density, average distance to competitors, standard deviation of distance to competitors and distance to the nearest competitors. I assumed that retailers in the same category are competing within the radius of 1 Km; therefore, I drew a 1 Km radius from the firm's location for every firm in the study as shown in figure 2.

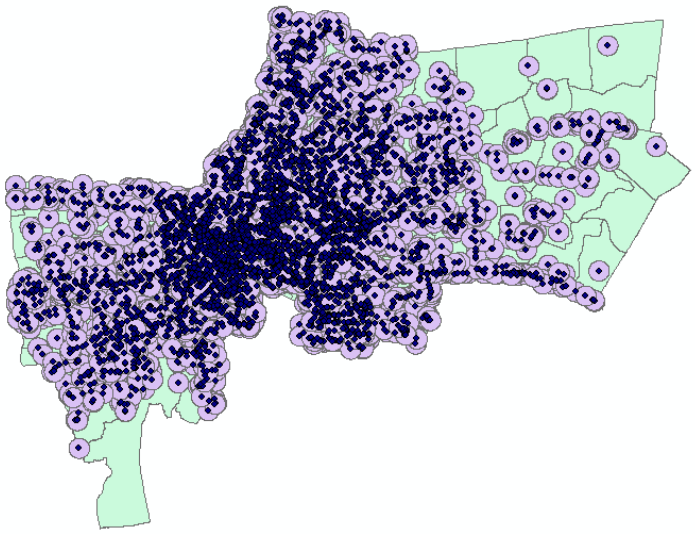

Figure 2: A process of drawing 1 Km radius from firm's location to calculate spatial proximity

After that, I calculated the measures that represent spatial proximity between ratailers in the same market. First, I included the density which is a count of competitors within the 1 Km radius. It is presented by the number of blue points shown in figure 3. The measure captures the density of competitors that compete by sharing the market with the retailer; thus, it is expected that the higher number of the density measure, the higher the degree of spatial competition. Moreover, I also calculated the average distance to competitors by take an average of the distance from the firm's location to every competitors in the same category within the 1 Km radius. Graphically, it is represented by an average of the length of the blue lines shown in fugure 3. Intuitively, spatial competition becomes more intense

as the average distance decreases, meaning that the competitors stay closer to the retail outlet. In addition, I also calculated the standard deviation of the distance to competitors to capture the distribution of the competitors within 1 Km radius. In this case, as shown in figure 3, it is calculated by take a standard deviation of the length of the blue lines. Intuitively, when the standard devaition of distance lessens, the competitors are more concentrated, and vice versa. The effect of spatial competition on retail might be related with not just an overall proximity measures to competitors but the nearest competitors; therefore, I also included the distance to the nearest competitor from each retail business, as represented by the shoertest line in figure 3. Furthermore, competition level is also determined by the market strucutre or market concentration; therefor, to account for this, I constructed HHI indices for each retailers in the 1 Km radius.

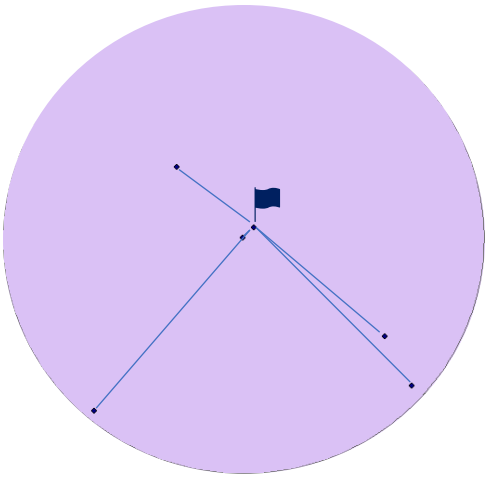

Figure 3: Proximity Measures Calculation

Besides proxies for spatial closeness between retailers, I also include a proximity measure from each retail's location to the POI attractions to capture foot traffics or the number of passersby in the area at which the outlets are located. First, I calculate the distance to the nearest public transportations whether the BTS statation, the MRT station or the Airport Rail Link station. I also calculate the distance to the main roads and community from each retail's location. In addition, in terms of access to financial institutions, I calculate the number of ATM machines and bank branches within the 1 Km radius from the firm's location

separately. I also calculate the density of shopping malls in the same manner as the aforementioned POI.

In order to capture the characteristics of people living nearby, the study also encompasses the demographic aspects, including population density and household expenditure. However, the smallest level of these data available are sub-district level. To proceed on this, I created 1 Km^2 grids covering the whole area of Bangkok as shown in Figure 3, then calculated the proportion of area that each grid falls into each sub-district and take a weighted average to find grid-spacific values of population density and household expenditure.

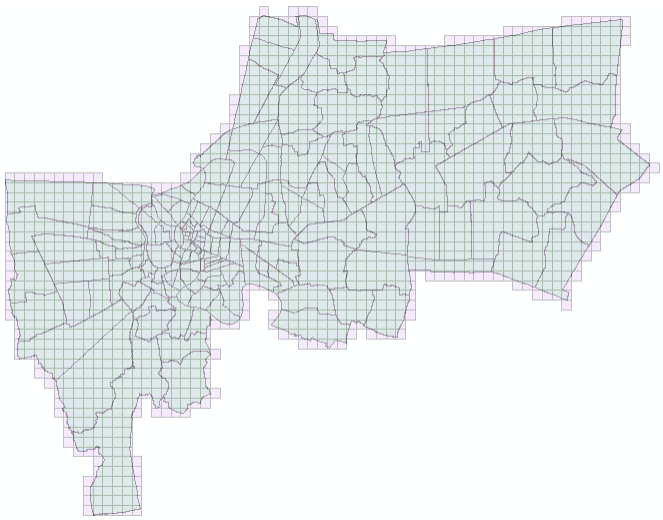

Figure 4: 1 Km^2 grids covering the whole area of Bangkok

Lastly, to account for rent expense for retailers, the land price data indicate the land price of each partcular road in Bangkok. Therefore, I choose the price of land associated with the nearest road from each firm's location.

Table 1 shows the descriptive statistics for all variables that I used throughout the analysis. In addition, the descriptive summaries of each retail category are shown in the appendix.

Table 1: Descriptive Statistics

Variables	Observations	Mean	Std. Dev.	Min	Max
Revenue (in ten thousand THB)	22,639	5660	37000	0.6	1150000
Net Profit (in ten thousand THB)	22,639	156	2830	-12600	150000
Total Assets (in ten thousand THB)	22,639	3680	28300	0	2000000
Registered Capital (in ten thousand THB)	22,639	983	17800	1	2000000
Density	22,639	56	106	1	566
Average Distance (m)	22,639	500	143	4	923
Standard Deviation of Distance (m)	22,639	293	70	7	704
HHI	22,639	3418	2438	0	10000
Distance to Public Transportation (m)	22,639	5109	4713	20	24227
Distance to Main Road (m)	22,639	231	334	0	2482
Distance to Community (m)	22,639	420	315	4	2186
Density of Bank Branch	22,639	16	19	0	88
Density of ATM	22,639	97	101	0	546
Density of Shopping Mall	22,639	1	1	0	7
Population Density (person/km2)	22,639	6576	4232	4	21452
Household Expenditure (THB)	22,639	12704	2283	8639	18932
Land Price (THB/Sq. Wa)	22,639	131332	119082	4700	650000

3.3 Estimation Specifications

As the main empirical questions are to estimate the net impact of spatial competition on the performance of retail businesses, I estimated the relationship using OLS linear regression. In doing so, Equation 1 shows the model specification which incorporates proxies representing firm performance in logged form, including revenue or net income, as the dependent variable, and those representing spatial proximity in logged form, including density, average distance to competitors, standard deviation of distance to competitors and distance to the nearest competitor, as independent variables. The reason for using logged functional form is that measuring the effect in terms of elasticity or a percentage change is more meaningful in terms of interpreting the relationship. I also control for factors that could potentially affect dependent variables, including log of firms' total asset, log of firms' registered capital, log of 1-Km HHI index, log of distance to main roads, log of distance to public transportation, log of distance to community, count of ATM machines, count of bank branches, count of malls, log of 1-Km^2 population density, log of 1 Km^2 grid-level household expenditure and log of land price.

Furthermore, I also construct a model studying the impact on net profit margin by using net profit margin as a dependent variable and incorporate independent and controlling variables as the previous specification as shown in equation 1.

In addition, to study sectoral heterogeneity of retail businesses, I also construct specifications that identify the effect for each sector separately by splitting up each retail category and conduct the analysis. However, it is worth noting that by doing so could worsen the power of regression estimation as a result of an increase in the standard errors of the estimation (Ilias-nikiforos, 2018).

$$Log(y) = \log(density) + \log(dist) + \log(SD) + \log(nearest) + \log(asset) + \log(cap) + \log(HHI) + \log(dist\ to\ road) + \log(dist\ to\ transport) + \log(dist\ to\ comm) + near\_\text{ATM} + \text{near\_Mall} + \text{near\_bank} + \log(\text{pop}) + \log(\text{exp}) + \log(\text{land price}) + \qquad \text{Equation 1}$$

Notes: y is revenue net income, net profit margin

Density is a count of the competitors within a 1 Km radius

Dist is an average distance from the competitors within a 1 Km radius

SD is a standard deviation of the distance from the competitors within a 1 Km radius

Nearest is a distance to the nearest competitors

Asset is the size of total assets

Cap is the size of registered capital

HHI is the HHI index calculated within a 1 Km radius from the firms' location

Dist to road is a distance from the main roads

Dist to transport is a distance to the nearest public transportation

Near ATM is a count of the ATM machine within a 1 Km radius

Near Mall is a count of shopping mall within a 1 Km radius

Near Bank is a count of bank branch within a 1 Km radius

Pop is a measure of 1 Km^2 population density

Exp is a measure of 1 Km^2 household expenditure

Land price is a measure land price

4. Results

In this section, we provide empirical findings for each specification to illustrate an impact of spatial competition on firm performance in various aspects. The results can be summarized as follows.

Finding 1 Spatial proximity is associated with a reduction of firms' revenue and net profitability level.

In the first specification (equation 1), retails' revenue and net income are regressed with proxies representing spatial competition. Table 2 shows the estimation results of OLS regression on retails' revenue. After controlling for firms' internals, foot traffic attractions, demographics and land price as shown in column 8, all of the independent variables that proxy spatial closeness between firms, including density, average distance to competitors, standard deviation of distance to competitors and distance to the nearest competitor, are statistically significant. While log of density and log of standard deviation of distance to competitors are significant at 1 percent significance level, log of average distance to competitors and log of distance to the nearest competitors are significant at 5 percent and 10 percent significant level respectively. The sign of the independent variables implies conformity of the relationship between spatial competition and firm performance. The coefficient estimate of logged density indicates that when there exist more competitors in the radius of 1 Km by 1 percent, on average, retails' revenue tends to decrease by 0.124 percent. In the same way, the estimated coefficients of logged average distance, standard deviation of distance and distance to the nearest competitor also exhibit a comparable relationship. The positive signs of the coefficients indicate the situation when competitors locate closer to the firms or the distribution of competitors become more concentrated around firms' location is negatively associated with a reduction of firms' revenue.

Table 2 Results of The OLS Regression on Revenue

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES				Log of revenue				
log_density	0.087***	-0.096***	-0.097***	-0.120***	-0.130***	-0.130***	-0.126***	-0.124***
	(0.020)	(0.011)	(0.011)	(0.012)	(0.014)	(0.016)	(0.016)	(0.016)
log_dist	0.049	0.037	0.064**	0.054*	0.065**	0.065**	0.060*	0.060**
	(0.054)	(0.031)	(0.031)	(0.031)	(0.032)	(0.032)	(0.032)	(0.028)
log_sd	0.303***	0.139***	0.144***	0.170***	0.152***	0.150***	0.154***	0.154***
	(0.088)	(0.050)	(0.051)	(0.051)	(0.051)	(0.051)	(0.051)	(0.051)
log_nearest	-0.007	0.007	0.008	0.017	0.016	0.016	0.017	0.016*
	(0.019)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.01)
log_asset		1.171***	1.303***	1.298***	1.300***	1.297***	1.295***	1.297***
		(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
log_cap			-0.246***	-0.238***	-0.240***	-0.238***	-0.236***	-0.236***
			(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
log_hhi				-0.086***	-0.086***	-0.084***	-0.081***	-0.080***
				(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
log_dist_to_road					-0.016***	-0.015***	-0.013**	-0.014**
					(0.005)	(0.005)	(0.005)	(0.006)
log_dist_to_trans					0.006	-0.002	-0.000	-0.010
					(0.011)	(0.013)	(0.014)	(0.015)
log_dist_comm					0.000	0.001	0.005	0.004
					(0.016)	(0.016)	(0.016)	(0.016)
near_atm						-0.000	-0.000	-0.000
						(0.000)	(0.000)	(0.000)
near_bank						0.001	0.000	0.000
						(0.002)	(0.002)	(0.002)
near_mall						0.027**	0.025*	0.026*
						(0.014)	(0.014)	(0.014)
log_pop							0.044**	0.049**
							(0.021)	(0.021)
log_exp							-0.243***	-0.229***
							(0.073)	(0.074)
log_price								-0.034
								(0.022)
Constant	12.616***	-3.581***	-2.335***	-1.731***	-1.662***	-1.583***	0.260	0.496
	(0.561)	(0.327)	(0.346)	(0.366)	(0.412)	(0.414)	(0.805)	(0.821)
Observations	22,618	22,618	22,618	22,618	22,618	22,618	22,618	22,618
R-squared	0.001	0.626	0.641	0.642	0.641	0.642	0.642	0.642

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

Similarly, spatial competition also adversely affects firms' net profitability level. As shown in table 3, after constructing specifications in the same manner as table 2, the estimated coefficients in column 8 exhibit somewhat similar results. While logged density and logged average distance to competitors are statistically significant at 1 percent and 5 percent significance level respectively, standard deviation of distance to competitors and distance to the nearest competitor seem not to be significant in this construction. Intuitively, the negative sign of logged density suggests an adverse relationship between retails' net income and the number of competitors in the radius of 1 Km. Likewise, the positive sign of logged average distance to competitors also indicates that the closer the competitors, the greater the negative impact on retails' net income. However, the relative magnitude of change between revenue and profitability is asymmetrical. A reduction in revenue appears to be more radical, compared with a decline in net profit. In other words, net profitability is relatively more stable. Intuitively, the findings imply the predominance of the competition effects over the agglomeration effects, meaning that when similar retailers locate near each other, their revenue and net profitability tend to decline. This might be the case that spatial proximity lessens the degree of spatial differentiation, worsening the ability for firms to exert the market power. Therefore, they compete more on price, which reduces the markups; hence, revenue and net income.

Finding 2 Despite a reduction in revenue and net profit, retails' profit margin increases as spatial competition heightens.

As shown in finding 1, a change in firms' profitability is relatively more stable, compared with that of revenue, thereby increasing net profit margin. Table 3 reports the results of OLS regression on retails' net profit margin. Two proxies for spatial competition, namely logged density and logged standard deviation of distance to competitors, appear to be significant at 5 percent and 10 percent significance level respectively. The estimated coefficients indicate an improvement of net profit margin as spatial competition heightens. In terms of logged density, if the number of competitors increases by 1 percent, on average, retails' net profit margin is expected to increase by 0.4 percent. Likewise, the positive estimated

coefficient of logged standard deviation of distance to competitors suggests that when the competitors become more concentrated around retails' location, their net profit margin tends to increase. Intuitively, such improvement in net profit margin might be the case that as spatial competition looms, retails would pursue an action to maintain relatively stable profitability by optimizing operations, which in turn reduces costs. Therefore, net profit decreases to a lesser extent that revenue; consequently, net profit margin increases.

Finding 3 Homogeneity of the products intensifies the adverse effect of spatial competition on retails' revenue.

As mentioned in section 3, the degree to which effect would dominate is expected to be sector-specific. Competition effects seem to be more radical in the sectors with less product differentiation, whereas the sectors of which products are more heterogenous tend to suffer less from the effect. To validate the proposition, I conduct an analysis for each particular retail category separately. Table 5 shows the results of the regression analysis on retails' revenue when the number of competitors changes. Each column indicates different types of retail businesses: column 1 belongs to convenience stores, columns 2 belongs to grocery stores, column 3 belongs to gas stations, column 4 belongs to electronics stores, column 5 belongs to construction materials stores, column 6 belongs to book stores and column 7 belongs to fashion outlets. The empirical results report negative relationship between revenue and the number of competitors in the sectors of which products are less differentiated, including grocery stores, gas stations and electronics stores. On the other hand, the sectors with more heterogenous products, such as fashion outlets, could benefit from an increase in the number of competitors as the estimated coefficient is positive. This might be the case that agglomeration overtakes competition effect. Intuitively, despite spatial closeness, retails with heterogenous could still exert their market power as a result of product differentiation. In addition, by forming retail clusters, the retail outlets cooperatively enhance their attractiveness by creating a larger goods pool; thereby increasing foot traffic and opportunity to find new customers.

Table 3 Results of The OLS Regression on Net Income

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES				Log of net income				
log_density	0.059***	-0.060***	-0.063***	-0.059***	-0.054***	-0.060***	-0.059***	-0.057***
	(0.015)	(0.010)	(0.010)	(0.011)	(0.013)	(0.015)	(0.015)	(0.015)
log_dist	0.029	0.057**	0.082***	0.083***	0.062**	0.063**	0.068**	0.069**
	(0.041)	(0.029)	(0.028)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
log_sd	0.161**	0.011	0.022	0.017	0.037	0.038	0.036	0.036
	(0.066)	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)
log_nearest	-0.020	-0.003	0.002	0.001	0.003	0.004	0.004	0.003
	(0.014)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
log_asset		0.820***	0.909***	0.909***	0.910***	0.910***	0.910***	0.911***
		(0.007)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
			-	-	-	-	-	-
log_cap			0.178***	0.179***	0.182***	0.182***	0.183***	0.183***
			(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
log_hhi				0.014	0.010	0.007	0.005	0.007
				(0.016)	(0.017)	(0.017)	(0.017)	(0.017)
log_dist_to_road					0.021***	0.021***	0.020***	0.019***
					(0.005)	(0.005)	(0.005)	(0.005)
log_dist_to_trans					-0.026**	-0.018	-0.024*	-0.035**
					(0.011)	(0.013)	(0.013)	(0.014)
log_dist_comm					0.002	0.001	-0.005	-0.006
					(0.014)	(0.014)	(0.015)	(0.015)
near_atm						0.000	0.000	0.000
						(0.000)	(0.000)	(0.000)
near_bank						-0.002	-0.001	-0.000
						(0.002)	(0.002)	(0.002)
near_mall						0.003	0.004	0.006
						(0.013)	(0.013)	(0.013)
log_pop							-0.046**	-0.041**
							(0.019)	(0.019)
log_exp							0.102	0.118*
							(0.068)	(0.069)
log_price								-0.037*
								(0.020)
Constant	11.631***	-0.127	0.788**	0.703**	0.863**	0.812**	0.341	0.613
	(0.416)	(0.307)	(0.311)	(0.331)	(0.373)	(0.377)	(0.742)	(0.756)
Observations	19,232	19,232	19,243	19,232	19,232	19,232	19,232	19,232
R-squared	0.002	0.533	0.546	0.546	0.548	0.548	0.548	0.548

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

Table 4 Results of The OLS Regression on Net Profit Margin

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Net profit margin							
log_density	-0.022	0.004	0.092	0.265**	0.645***	0.367**	0.331**	0.372**
	(0.111)	(0.111)	(0.109)	(0.118)	(0.137)	(0.157)	(0.158)	(0.159)
log_dist	-0.905***	-0.904***	-0.638**	-0.550*	-0.472	-0.399	-0.372	-0.360
	(0.307)	(0.306)	(0.301)	(0.302)	(0.305)	(0.305)	(0.306)	(0.306)
log_sd	-0.957*	-0.927*	-0.822*	-0.967**	-0.786	-0.837*	-0.861*	-0.849*
	(0.498)	(0.497)	(0.488)	(0.492)	(0.493)	(0.493)	(0.493)	(0.493)
log_nearest	0.051	0.048	0.108	0.047	0.001	0.014	0.010	-0.002
	(0.106)	(0.105)	(0.103)	(0.105)	(0.105)	(0.105)	(0.105)	(0.105)
log_asset		-0.173***	1.084***	1.097***	1.114***	1.103***	1.107***	1.113***
		(0.060)	(0.070)	(0.070)	(0.070)	(0.070)	(0.070)	(0.070)
log_cap			-2.636***	-2.676***	-2.589***	-2.573***	-2.584***	-2.572***
			(0.113)	(0.113)	(0.114)	(0.114)	(0.114)	(0.114)
log_hhi				0.645***	0.788***	0.814***	0.796***	0.825***
				(0.173)	(0.175)	(0.176)	(0.176)	(0.176)
log_dist_to_road					0.131**	0.171***	0.156***	0.135**
					(0.052)	(0.053)	(0.053)	(0.053)
log_dist_to_trans					0.600***	0.689***	0.691***	0.492***
					(0.110)	(0.130)	(0.135)	(0.147)
log_dist_comm					-0.244	-0.161	-0.179	-0.204
					(0.150)	(0.152)	(0.155)	(0.155)
near_atm						-0.002	-0.004	-0.003
						(0.004)	(0.004)	(0.004)
near_bank						0.047***	0.055***	0.064***
						(0.018)	(0.018)	(0.019)
near_mall						-0.102	-0.080	-0.051
						(0.130)	(0.131)	(0.131)
log_pop							-0.251	-0.145
							(0.199)	(0.202)
log_exp							1.931***	2.227***
							(0.706)	(0.712)
log_price								-0.693***
								(0.209)
Constant	15.196***	17.681***	33.042***	28.380***	19.387***	18.002***	2.437	7.539
	(3.179)	(3.268)	(3.347)	(3.547)	(3.964)	(3.989)	(7.762)	(7.913)
Observations	22,617	22,617	22,617	22,617	22,617	22,617	22,617	22,617
R-squared	0.001	0.001	0.025	0.025	0.028	0.028	0.029	0.029

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

Table 5 Results of The OLS Regression on Revenue (Sector-specific)

Category	Convenient Store	Grocery Store	Gas station	Construction materials	Electronics	Book Store	Fashion Outlets
VARIABLES				Log of revenue			
log_density	-0.047	-0.284*	-2.560***	-0.441**	-0.166	0.075	0.235**
	(0.348)	(0.159)	(0.573)	(0.175)	(0.105)	(0.222)	(0.104)
log_asset	2.185***	1.643***	1.936***	1.992***	1.988***	1.978***	2.139***
	(0.089)	(0.040)	(0.133)	(0.051)	(0.042)	(0.077)	(0.043)
log_cap	-0.799***	-0.509***	-0.853***	-0.586***	-0.738***	-0.675***	-0.684***
	(0.127)	(0.074)	(0.185)	(0.089)	(0.061)	(0.104)	(0.055)
log_hhi	-0.080	-0.836***	-3.564***	0.003	-0.440***	-0.488**	0.011
	(0.360)	(0.181)	(0.612)	(0.187)	(0.101)	(0.193)	(0.079)
log_dist_to_road	-0.042	0.033	-0.091	-0.008	0.015	-0.042	-0.041
	(0.063)	(0.033)	(0.084)	(0.041)	(0.023)	(0.046)	(0.027)
log_dist_to_trans	-0.038	-0.066	0.556**	-0.116	0.148**	0.038	-0.102
	(0.172)	(0.086)	(0.271)	(0.107)	(0.070)	(0.146)	(0.074)
log_dist_comm	-0.021	0.133	0.001	-0.097	-0.025	-0.040	0.145*
	(0.201)	(0.098)	(0.254)	(0.114)	(0.067)	(0.126)	(0.082)
near_atm	-0.004	0.001	-0.007	0.001	0.003	0.000	-0.001
	(0.005)	(0.002)	(0.006)	(0.003)	(0.002)	(0.003)	(0.002)
near_bank	-0.000	-0.009	0.040	-0.009	-0.006	-0.000	-0.005
	(0.023)	(0.011)	(0.030)	(0.015)	(0.009)	(0.016)	(0.009)
near_mall	0.428***	0.068	0.376*	0.053	-0.118*	-0.061	0.064
	(0.137)	(0.076)	(0.195)	(0.100)	(0.069)	(0.115)	(0.064)
log_pop	-0.056	0.150	0.181	0.030	-0.031	-0.186	0.077
	(0.239)	(0.155)	(0.203)	(0.165)	(0.068)	(0.179)	(0.119)
log_exp	-0.401	-1.731***	-1.115	0.221	-0.015	-0.495	-0.277
	(0.858)	(0.433)	(1.210)	(0.545)	(0.318)	(0.625)	(0.399)
log_price	-0.134	0.037	0.222	-0.200	-0.288***	0.077	-0.240**
	(0.246)	(0.126)	(0.359)	(0.152)	(0.089)	(0.199)	(0.115)
Constant	-1.970	18.961***	33.099**	-5.810	0.099	2.189	-6.038
	(8.831)	(4.770)	(13.360)	(5.765)	(3.377)	(6.661)	(4.056)
Observations	1,427	1,398	725	2,549	7,181	2,056	7,282
R-squared	0.360	0.595	0.358	0.429	0.382	0.379	0.369

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5 Discussion and Conclusion

Channeling goods and services from producers to end-consumers, retail sectors contribute over one-third share of Thailand's GDP. Despite a rise of the online counterparts, brick-and-mortar stores still occupy the predominant positions. With that said, one factor that plays a significant role in determining the success of such sector, is location. However, faced with a complex trade-off, physical retailers stand at the crossroads of deciding whether to locate close to competitors or to set part from them. Intuitively, two forces, namely agglomeration effects and competition effects, are counteracting. While the former one could undermine firm performance as price pressure looms, the firms would be profited from the latter one. As nebulous as it may appear, the consensus regarding the extent to which effects would dominate has yet not been reached.

This research study intends to shed light on assessing the net impact of spatial competition on performance of retail businesses, as measured by their revenue, net profit and net profit margin. The empirical findings suggest that competition effects predominate. In other words, on average, the higher degree of spatial closeness, proxied by density of competitors, average distance to competitors, standard deviation of distance to competitors and distance to the nearest competitors, is associated with a reduction of retails' revenue and net profitability. This might be explained by the fact that locating close to competitors lessens the degree of spatial differentiation; thereby exalting price competition. Nevertheless, despite a reduction in revenue and net profit, there exists a positive relationship between spatial proximity and net profit margin. Suffered from the competition, retails attempt to maintain their profitability level by optimizing operational efficiency, which in turn reduces costs. Consequently, a magnitude of change in net profit is relatively more stable than that of revenue, therefore; improving the net profit margin. Moreover, as showed in this study, the extent to which effects would dominate is sector-specific. Competition effects seem to be more pronounced in the sectors of which products are more homogenous, and vice versa. This could be explained by the fact that, despite spatial rivalry, retails with heterogenous could still exert their market power as a result of product differentiation. Moreover, such scenario would create a larger goods pool, attracting more potential customers which positively affects the firm performance.

Following the findings, it is evident that the role of location greatly influences the performance of retail businesses. Therefore, in terms of policy stance, the results from the study suggest several policy implications. First, the zoning policy that squeezes firms together could bring about asymmetric results on different sectors since the dominance of the underlying counteractive effects depends on the degree to which the products are differentiated. Therefore, a policy to promote product differentiation alleviate the adverse impact of competition effect. Moreover, since optimizing social optimal level of product differentiation requires a trade-off between fixed costs associated with constructing new outlets and transportation costs, spatial competition could be employed as a tool to deter excessive market entry which results a loss of social welfare. This is especially true for the sectors with large capital expenditure of which fixed costs constitute a large portion of the cost structure. Therefore, to cushion the trade off, it is recommended for such firms to reduce their fixed costs by sharing the investment property, such as warehouse etc.

Lastly, there remain issues with possible improvement and further study. First, the extension of the study area beyond the Bangkok area could assure the results of spatial competition and firm performance as some area might possess their unique characteristics that could affect the findings. Moreover, with panel data, we are able to study the dynamism of the impact of spatial competition on firm performance over time.

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Appendix

Descriptive Statistics of The Retail Category

Category 1: Convenience Stores

Variable	Obs	Mean	Std. Dev.	Min	Max
rev	1,563	5510.00	42200.00	1	922000.00
profit	1,563	176.00	4010.00	-60300.00	85100.00
asset	1,563	4960.00	41000.00	10	1170000.00
cap	1,563	2260.00	27300.00	1	1000000.00
density	1,563	28.62892	22.50222	2	112.00
mean_dist	1,563	556.1664	119.5688	34.12754	815.61
sd_dist	1,563	296.804	58.64317	60.6009	667.41
nearest	1,563	197.8331	168.2749	0.4865516	976.84
hhi	1,563	6619.553	2512.321	0	10000.00
dist_to_trans	1,563	5008.348	4573.605	24.717	18902.34
dist_to_road	1,563	238.0341	318.5293	0.0052299	1940.05
near_mall	1,563	0.746001	1.190595	0	7.00
near_bank	1,563	13.27895	16.17598	0	84.00
near_atm	1,563	87.70313	92.3191	0	499.00
population	1,563	6156.9	3640.873	4.15	21451.87
Household Expenditure	1,563	12749.73	2358.403	9196.736	18932.18
Land price	1,563	122607.8	110164	2600	650000.00
dist_to_comm	1,563	419.317	299.6813	13.9514	1962.48

Category 2: Grocery Stores

Variable	Obs	Mean	Std. Dev.	Min	Max
rev	1,750	3660.00	22600.00	1.00	790000.00
profit	1,750	2898.00	863.00	-13900.00	13000.00
asset	1,750	2000.00	9350.00	393.50	150000.00
cap	1,750	475.00	2460.00	9.00	58900.00
density	1,750	13.524	12.30224	2.00	66.00
mean_dist	1,750	502.8901	148.0546	27.67	804.69
sd_dist	1,750	321.8502	88.17426	29.10	700.93
nearest	1,750	345.6373	230.0754	1.11	994.68
hhi	1,750	5137.057	2473.386	0.00	10000.00
dist_to_trans	1,750	4066.954	4270.979	23.08	19394.92
dist_to_road	1,750	227.0636	315.1803	0.06	1899.06
near_mall	1,750	0.832	1.175947	0.00	7.00
near_bank	1,750	16.26971	17.70876	0.00	84.00
near_atm	1,750	105.5286	99.14211	0.00	516.00
population	1,750	6419.829	3625.585	4.15	21451.87
Household Expenditure	1,750	13004.26	2296.813	9196.74	18932.18
Land price	1,750	146658.2	121878.7	6800.00	650000.00
dist_to_comm	1,750	418.8819	261.5436	24.17	1686.86

Category 3: Gas station

Variable	Obs	Mean	Std. Dev.	Min	Max
rev	1,016	10200.00	27100.00	1.00	304000.00
profit	1,016	80.00	799.00	-2340.00	21300.00
asset	1,016	2780.00	12400.00	4.00	310000.00
cap	1,016	759.00	3630.00	10.00	78400.00
density	1,016	6.439961	3.588753	2.00	16.00
mean_dist	1,016	423.2634	163.1901	16.02	826.58
sd_dist	1,016	349.6164	110.7143	22.65	700.63
nearest	1,016	480.5416	244.0751	0.49	994.49
hhi	1,016	5333.706	2349.545	1687.11	10000.00
dist_to_trans	1,016	5517.234	4651.457	44.81	17538.94
dist_to_road	1,016	186.3847	290.1323	0.00	1865.54
near_mall	1,016	0.661417	1.071589	0.00	6.00
near_bank	1,016	10.23622	10.51957	0.00	82.00
near_atm	1,016	71.49114	60.62395	0.00	499.00
population	1,016	5730.857	3508.598	4.15	21451.87
Household Expenditure	1,016	12443.16	2291.082	9196.74	18932.18
Land price	1,016	115885.8	88534.51	8500.00	650000.00
dist_to_comm	1,016	435.291	349.5591	10.59	1945.43

Category 4: Electronics Stores

Variable	Obs	Mean	Std. Dev.	Min	Max
rev	3,476	5510.00	41300.00	1.40	1150000.00
profit	3,476	178.00	1920.00	-2220.00	46200.00
asset	3,476	3670.00	23900.00	2.00	509000.00
cap	3,476	717.00	39500000.00	5.00	110000.00
density	3,476	16.72037	11.43855	2.00	61.00
mean_dist	3,476	513.8682	138.1488	5.63	833.92
sd_dist	3,476	314.3987	70.3253	16.88	703.80
nearest	3,476	293.7932	199.0346	0.49	995.32
hhi	3,476	4254.619	2132.657	819.28	10000.00
dist_to_trans	3,476	5103.153	4608.019	23.08	19069.11
dist_to_road	3,476	264.5953	349.0583	0.01	2059.31
near_mall	3,476	0.756329	1.139558	0.00	7.00
near_bank	3,476	12.95426	14.89978	0.00	83.00
near_atm	3,476	86.01438	84.5013	0.00	541.00
population	3,476	6162.95	3336.684	4.15	21451.87
Household Expenditure	3,476	13139.04	2295.936	9196.74	18932.18
Land price	3,476	118339.3	98154.01	6800.00	650000.00
dist_to_comm	3,476	414.6738	289.3861	4.92	1962.48

Category 5: Construction Materials

Variable	Obs	Mean	Std. Dev.	Min	Max
rev	11,326	3570.00	18700.00	2.00	740000.00
profit	11,326	682.00	779.00	-54000.00	29700.00
asset	11,326	2650.00	11500.00	2.00	360000.00
cap	11,326	650.00	6260.00	1.00	500000.00
density	11,326	55.12785	74.03643	2.00	391.00
mean_dist	11,326	525.4023	139.8124	9.98	922.59
sd_dist	11,326	292.8373	59.60274	13.23	696.88
nearest	11,326	206.5162	168.0622	0.49	985.53
hhi	11,326	2303.175	1702.7	213.11	10000.00
dist_to_trans	11,326	5532.571	4915.04	23.08	21603.60
dist_to_road	11,326	222.6497	328.923	0.00	2481.68
near_mall	11,326	0.725234	1.145292	0.00	7.00
near_bank	11,326	14.8341	18.98193	0.00	88.00
near_atm	11,326	86.49912	91.14934	0.00	546.00
population	11,326	6669.096	4753.053	4.15	21451.87
Household Expenditure	11,326	12482.6	2280.773	8639.35	18932.18
Land price	11,326	123582.9	112706.5	5000.00	650000.00
dist_to_comm	11,326	426.3207	333.5591	4.92	2143.55

Category 6: Book Stores

Variable	Obs	Mean	Std. Dev.	Min	Max
rev	2,641	3670.00	31000.00	0.60	918000.00
profit	2,641	168.00	2280.00	-4530.00	70700.00
asset	2,641	4430.00	52700.00	8.00	1160000.00
cap	2,641	496.00	2460.00	2.00	64000.00
density	2,641	14.14729	13.29798	1.00	69.00
mean_dist	2,641	380.6414	111.2892	4.15	733.32
sd_dist	2,641	298.6257	51.9728	7.19	589.42
nearest	2,641	139.6552	157.1984	0.19	896.61
hhi	2,641	3159.997	1971.889	696.40	10000.00
dist_to_trans	2,641	5019.941	4399.082	23.85	19436.53
dist_to_road	2,641	233.7901	321.8949	0.00	2243.56
near_mall	2,641	0.761454	1.162826	0.00	7.00
near_bank	2,641	14.64142	17.13237	0.00	83.00
near_atm	2,641	91.05528	91.91681	0.00	516.00
population	2,641	6518.015	4002.217	4.15	21451.87
Household Expenditure	2,641	12613.9	2232.803	9196.74	18932.18
Land price	2,641	126334.9	113250.8	6800.00	650000.00
dist_to_comm	2,641	397.4418	292.6312	4.30	1867.25

Category 7: Fashion Outlets

Variable	Obs	Mean	Std. Dev.	Min	Max
rev	12,134	4530.00	34100.00	1.30	1080000.00
profit	12,134	165.00	3120.00	-126000.00	150000.00
asset	12,134	3210.00	27200.00	1.50	2000000.00
cap	12,134	879.00	19000.00	1.00	2000000.00
density	12,134	105.194	156.091	1.00	566.00
mean_dist	12,134	471.9686	124.576	67.09	814.38
sd_dist	12,134	259.7476	54.19793	67.96	625.26
nearest	12,134	177.0608	151.0228	0.28	893.07
hhi	12,134	2849.468	2212.188	510.80	10000.00
dist_to_trans	12,134	4538.087	4558.306	20.32	24226.62
dist_to_road	12,134	199.8847	304.0383	0.00	2622.49
near_mall	12,134	1.061563	1.339908	0.00	7.00
near_bank	12,134	20.65741	22.78235	0.00	88.00
near_atm	12,134	123.7196	117.1731	0.00	545.00
population	12,134	7073.089	4308.43	4.15	21451.87
Household Expenditure	12,134	12977.14	2209.666	8966.35	18932.18
Land price	12,134	157244.2	133931.3	4700.00	650000.00
dist_to_comm	12,134	399.8734	299.9033	13.99	2186.01