Supporting Material is available for this work. For more information, follow the link from the Table of Contents to "Accessing Supporting Material".

Table of Contents

Go Back

Fundamental Analysis of Attractiveness of Shopping Street

Nobuhide TANAKA, Akira UCHINO, Tetsuma FURIHATA
Gakushuin University, Senshu University, Tokyo University of Science

School of Commerce, Senshu University
2-1-1 Higashimita Tamaku
Kawasaki JAPAN 214-8580
Tel. +81-44-900-7953 FAX +81-44-900-7849
uchino@isc.senshu-u.ac.jp

Abstract:
Previously, we have got some research results in order to explain how retailers agglomerate in a city. We compared two simulation results, one condition in a uniform distribution of population, the other radially populated so that we investigated how population distribution affects the spatial structure of retailers' accumulation in a city (2003). These simulation models and other existing studies did not use the attractiveness of shopping streets (areas) effectively in consumer choice because the attractiveness of them includes many elements. Of course although some methods such as Drezner and Drezner (1998) consider the attractiveness of shopping streets (areas), these models did not explain dynamically change under time series. We have been developing our research continuously, but in this presentation we show a new point of view relevant to the attractiveness of shopping streets (areas) using SD models. Here we show our new approach and basic model on shopping street or shopping district in Japan. They are dynamic models of agglomerate retailers, shopping district, in which the attractiveness is an important element.

1. Introduction

We show you simple SD models here. We need to explain why we show them, what kind of significance they have. To begin with, we explain three points.

1. Existing related studies and necessity for a new point of view.
2. Current problems of classical shopping streets[1] in Japan.
3. Our approach and the meaning of our models.

1.1 Existing related studies and necessity for a new point of view

There are several theories on spatial distribution in intra-urban retail trade area[1]. Central Place Theory[2], Circulatory System Theory[3] and Statistical Distribution Theory[4]. They partially explain how retailers are distributed or located in cities. Some of them teach us that the current spatial distribution is quite rational. But they cannot explain how retailers in a city develop dynamically.

There have been developed another series of theories, how consumers select a retail shop when they go shopping. Theories on consumers' spatial activity are Retail Gravitation Model[5], Intervening Opportunity Model[6], Network Model[7]. Especially a Retail Drawing Power Model, a kind of Retail Gravitation Models originally came from Huff's, shows a suitable location of a new retail shop in a city. It is useful in business. These theories can explain retailers' development in a city in some extent.

We have got some research results in order to explain how retailers agglomerate in a city. We compare two simulation results, one condition in a uniform distribution of population, the other radially populated so that we investigate how population distribution affects the spatial structure of retailers' accumulation in a city (Furihata, Uchino, et al., 2003). These simulation models and other existing studies did not use the attractiveness of shopping streets (areas) effectively in consumer choice because the attractiveness of them includes many elements. Of course although some methods such as Drezner and Drezner(1998)[(8)] consider the attractiveness of shopping areas, these models did not explain dynamically change under time series.

Existing studies above are effective in a certain extent to show the retailers' development in a city. However, they cannot explain withdrawal of a retail shop, which has lost sales. Once we open a shop, we are working hard to keep a shop going. When sales are decreasing, we change goods selection, renovate the shop. If some retail shops integrate their effort, they could extend the parking lot; make sheltered side walk; make a bargain sale together. To what degree do we improve the attractiveness of shops when we do these activities? Existing studies have no power at all to explain.

While we have developed a mathematical model using computer simulation that explains how retailers in a city develop, we need another point of view and another model that explains how a retailer practically succeeds in business and how a shop is declining even though their efforts.

1.2 Current problems of classical shopping streets

You might have an image of Japan as highly developed industrial country. However, Japan is an island country; there are four big islands and more than 3,900 of islands. Most part of her land is mountainous. Mt. Fuji and Kyoto are typical tourist attractions in Japan. But Japan is accumulation of attractions for sightseeing in a way. There are volcanoes and earthquakes in Japan, so that are many hot springs. She has one side a lot of tourist attractions; the other side big cities have a large population and density. Tokyo metropolitan area has nearly 10 million; Yokohama has 3.5 million, Oosaka 2.7 million, Nagoya 2.2 million, the other 9 cities are beyond 1 million.

These big cities are keeping good economic conditions, though they are not developing rapidly because of long stagnation after the bubble bursting. But local small cities are not keeping good conditions. There are a lot of classical retail streets or districts in local small cities. They are suffering from economic stagnation, and moreover most of them are facing slightly decreasing population, having new competitors as large scale suburban shops or shopping centers. Most of typical classical shopping streets or districts in small cities are struggling with these difficulties.

We now need policy making for surviving them, coexisting with new type of retailers, competing fairly. We require new policy making model for classical shopping streets.

1.3 Our approach and the meaning of our models

(1) We have a mathematical model to resolve how an accumulation of retailers in a city are developing and analyze it by simulation. We have considered how retail facilities agglomerate in a city. We compare existing assumption that population distributes evenly to our simulation results that population distribute more realistically. Our model

has been still unique and effective in the spatial hierarchy and distribution problem field. We are improving our model from now on.

(2) But we are critically required to get another approach, another type of model. All possible ways, have been thought out, are not so effective to help classical retail streets. We should struggle to go another way.

(3) We have specific target of retail streets to apply our approach. *Nigata* has 530,000 populations, one of big size local city in Japan. There are two target retail streets or districts there. One is *Bundai District* located very near the Nagoya Japan Rail Station. Despite of adjacent to JR Station, the retailers in the district has been arranging large size parking lots. They have been inviting worldwide brand shops. The shopping district is attractive to not only nearby customers but also ones outside the city. They can go shopping there by train and by car. The other is *Furumachi District*. This district has a long history in *Nigata*, a little bit lack of freshness than *Bandai District*. There is not much to choose between two districts for citizens in *Nigata* when they are shopping by time and distance because two districts are close to each other. Accumulated efforts by every shop and integrated effort by the district efforts are source of the attractiveness of the district. The attractiveness of each district is changing by their effort dynamically. We can compare two districts and we can focus on the attractiveness of shopping districts.

We are studying (1) and (2) (3) separately. This presentation aims at (2) and (3). We are making dynamic model of agglomerate retailers, shopping district, in which the attractiveness is an important element. We can simulate it and get investigation for more practical outcome. Our first trial is making two types of simple models.

The first model is for one shopping district, supposing a degree of the attractiveness, declining attractiveness in process of time, and requiring effort to keep the attractiveness. The second model is containing two competitive shopping districts.

We show a simplest first model using Stella by attached file. The second model will be shown at the next time.

2. Shopping District Models

2.1 Single Shopping District Model

This is the first basic model of Single Shopping District Model. Initial variables are based on *Bandai District* which we are searching for. We calculated retail drawing power in whole shopping districts in *Nigata* Prefecture. We gave relative values in *Bandai District* and *Furumachi District* as initial attractiveness. However this is conceptual model in order to understand how we treat attractiveness in Sopping Districts using system dynamics. And we want to understand how typical classical shopping street or district works in the model.

In this model each shop are not making effort separately. Accumulated effort by agglomerated shops shows investment in the model. It fluctuates in proportion to the sales. Strictly, they start to invest in increasing the attractiveness of the district, when they have recognized that the attractiveness of the district has dropped considerably.

While they continue to invest, they can keep the attractiveness of the district. The attractiveness doesn't fall down sharply when they have enough customers because the increase of customer adds somewhat to the attractiveness. But investment on adding attractiveness is stronger than increasing customers by words of mouth.

This simple model shows a lot of typical behaviors we see in a classical shopping street or district in Japan. Most of the classical shopping streets are going downhill now. A part of them stand still. Suburban big shopping centers and charming complex for shopping at the center of big city are taking away the customers.

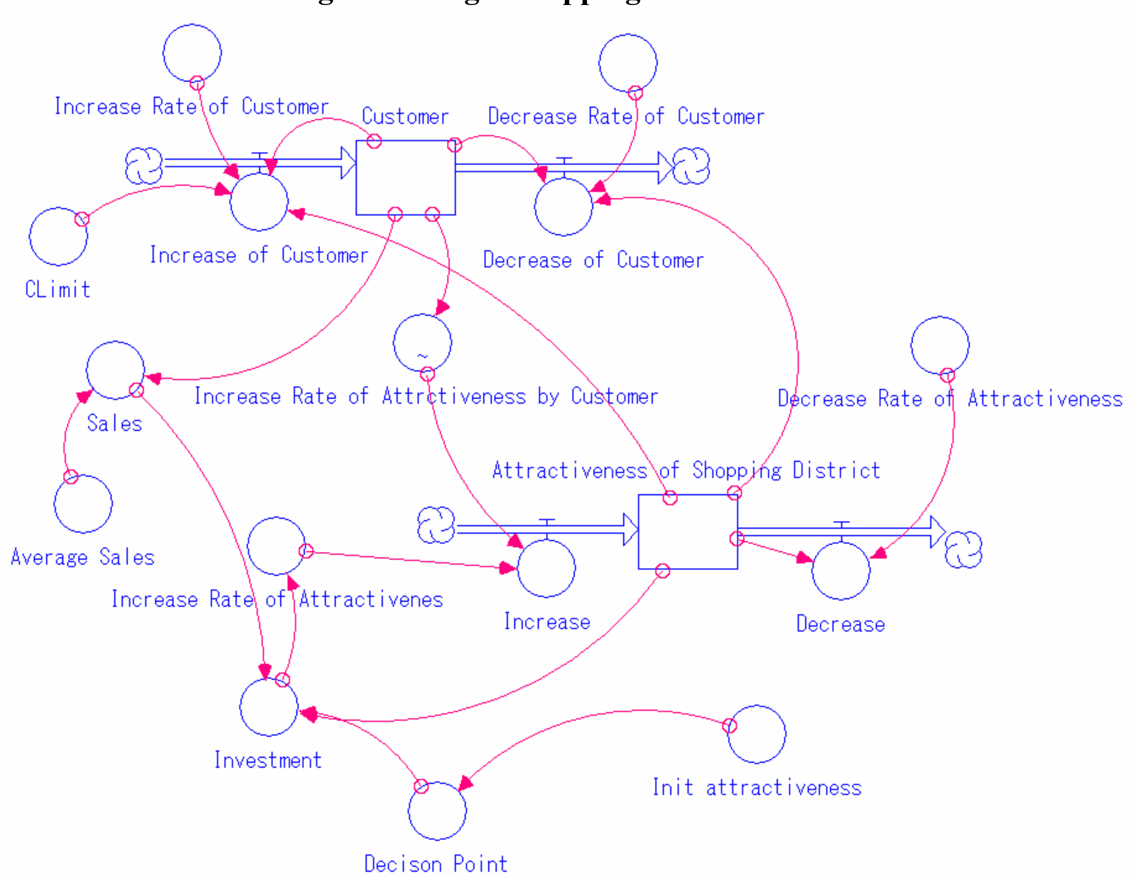
The most important problem is as follows. The retailers in the classical shopping streets or districts do not make effort while they are satisfied with the original condition as long as they feel that their shops are humming and that they keep the attractiveness. Many a small shops, typically running by family business, apply to the case. Shopping streets or agglomerated small shops shows the same tendency.

Figure 1. Customer & Attractiveness,
Two main stocks of the Shopping District Model

Sales → Customer

Facilities → Attractiveness

Figure 2. Single Shopping District Model



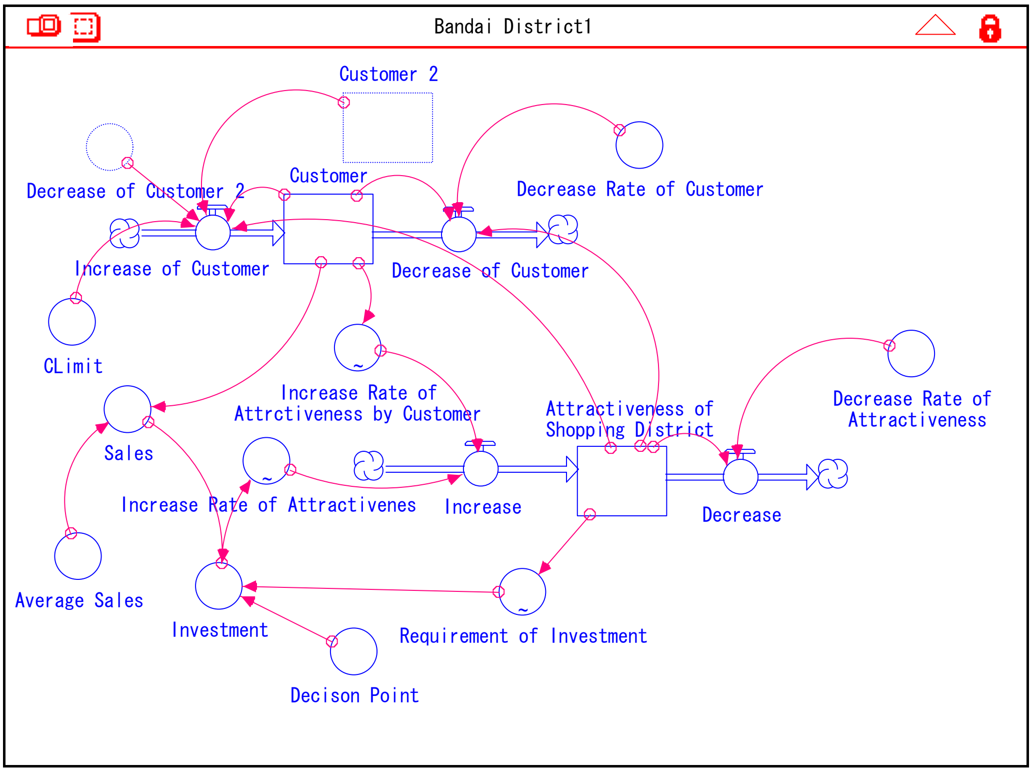
2.2 Competitive Shopping Districts Model

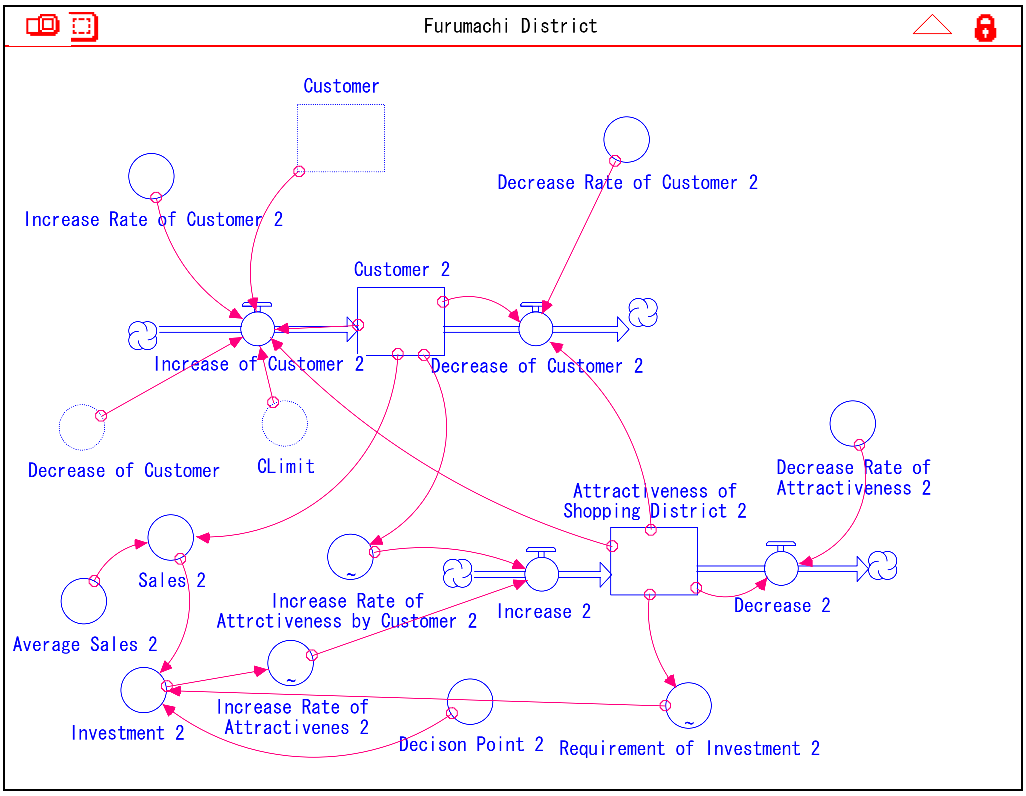
Districts have initial variables based on *Bandai* District and *Furumachi* District. They are close to each other, and distances from customers are almost same. The first version of this model is that decreasing number of customers of one district is increasing number of others. However, they don't link directly. They are linking to each other through calculations below. "_2" means other district.

+"Decrease_of_Customer_2" * "Attractiveness_of_Shopping_District"
"Increase_Rate_of_Customer"

Customers are not limited to certain numbers. Two competitive districts can get more customers within certain range.

Figure 2. Competitive Shopping Districts Model





3. Conclusion and Future Research

In this paper we only show (1) Existing related studies and our research objectives and (2) Two types of SD models. We are struggling to improve basic moles and simulating them. We confirm one basic model of them and put it in the proceeding CD. This is the first step study. If we can step up our models to apply practical decision making, it will be a very fruitful research scheme.

Footnotes

(1) classical shopping streets, districts, intra-urban retail trade area

Retailer shops are commonly classified by the same technical terms. But the situation is slightly different from country to country. There are a few facilities in Japan which we call shopping mall in USA, or shopping center in UK. But classical shopping streets or districts in this paper are slightly different, which sometimes are a mall or an arcade, sometimes line with small shops, department stores, and super market. They expand along the streets, or into a block or blocs in a city. We are discussing them in Japan. We use shopping streets, shopping districts, and shopping or trade area replaceable in this paper.

(2) Central Place Theory

Central place theory originated by Christaller(1966) has been developed in economic geography. This theory was based on classical economic assumptions such as the uniformity of consumers and travel without considering the attractiveness of shopping areas in consumer choice. Nevertheless, it has been widely used to explain the retail hierarchy: a town centre core radiating progressively further out with greater number of district centers, neighborhood centers and finally local centers.

(3) Circulatory System Theory

Circulatory system theory is based on the relationship between transport system and retail centers in urban areas. This theory shows that retail centers configure at the intersection of main arteries, and along the main arteries.

(4) Statistical Distribution Theory

Rogers(1974) presented that spatial distribution of retail facilities(stores) in urban areas conforms the statistical distribution such as a negative binomial distribution.

(5) Gravity Model

The origin of gravity models dates back to well-known `The law of gravitation' proposed by Reilly(1929). A general equation of the models is follows:

$$P_{ij} = \frac{A_j R_{ij}^{-1}}{\sum_{k=1}^{m} A_k R_{ik}^{-1}},$$

where P_{ij} is the probability that a consumer i purchases at a shopping destination j, A_j is the attractiveness of a shopping destination (store) j, R_{ij} is the resistance measure perceived from the consumer i's shopping trip to the destination j such as the distance and time. According to an above gravity model the probability that a consumer i patronizes a shopping destination (store) j is proportional to its attractiveness and inversely proportional to the resistance measure. By the definition of the attractiveness and resistance measure on the above equation, many gravity models are formulated. In the representative model proposed by Huff(1962), for instance, the attractiveness and resistance measure substitute for the retail sales floor area of shopping destination (store) and distance between the origin i and the destination j.

(6) Intervening Opportunity Model

Stouffer(1940) who is a sociologist proposed an intervening opportunity model. The fundamental idea of this model is follows: the probability that a consumer chooses a store proportional to the purchase opportunity served by its store and inversely proportional to the total opportunity from the consumer's origin to its store. This model comes to the conclusion that the distance and time between the consumers' origin and the destination are not fundamental to explain for consumers' behavior but the spatial order of stores is a most important factor.

(7) Network Model

Network model developed by White and Ellis(1971) captures consumers' behavior as flows in network configured by arteries and public transportation. The network consists of nodes such as consumers' origin and the destination(stores) and arcs connected the nodes. This model defines some assumptions to flows in the network, and estimates the outflow(the number of consumers or total sales volume in each stores) based on the inflow(the number of consumers or total expenditure in its consumers' origin).

(8) Assessing the Attractiveness of Shopping Areas

Retail facilities attractiveness is one of the most important factors for models analyzing competition among retail facilities. It is an essential component for determining trade area, estimating market share, consumer behavior and spatial choice modeling, location/allocation of retail facilities, renovation of retail facilities and opening a new retail facility. Several models and approaches have been investigated for determining retail facilities attractiveness. These methods assume that the attractiveness of a retail facility is a composite index of many attributes. These methods require listing and estimation of attributes, assigning weights and constructing a composite attractiveness measure for each retail facility. Drezner and Drezner(1998) proposed an assessing method that infer retail facility attractiveness from only secondary data sources without the above undertaking. The required data sources are consumers' buying power, sales volumes for competing retail facilities and distances from between consumers and retail facilities.

References

Christaller, W. J.(1933) Die zentralen Orte in Soddenutchland, (W.H. Woglom and W.F. Stolper, Trans. Central Places in Southern Germany, Englewood Cliffs, New Jersey: Prentice Hall, 1966).

Drezner, T. and Z. Drezner(1998) On Assessing the Attractiveness of Retail Facilities, Communications of the Operations Research Society of Japan, Vol49, No.4, 2004.(in Japanese)

Furihta, T., A. Uchino, Y. Takahashi and N. Tanaka (2003) Simulation for Configuration of Retail Agglomerations Considering the Interaction between Retail Facilities and the Distribution of Population, Journal of Japan Society of Business Mathematics, Vol.25, No.2, pp.151—163 in Japanese.

Huff, D.L.(1962) Determination of Intra-Urban Retail Trade Areas, Publication of Retail Estate Research Program, Graduate School of Business Administration, Division of Research.

Reilly, W.J.(1929) Methods for the Study of Retail Relationships, University of Texas Bulletin, No.2944.

Rogers, A.(1974) Statistical Analysis of Spatial Distribution, London:Prion Ltd.

Stouffer, S.A.(1940) Intervening Opportunities; a Theory Relating Mobility and Distance, *American Sociological Review*, Vol.5, 845—867.

White, L.A. and J.B. Ellis(1971) A System Construct for Evaluating Retail Market Locations, Journal of Marketing Research, Vol.8, pp.43—46.

Supplemental Information:

Our first model for Basic Single Shopping District contains in the CD Proceedings. The model was made by Stella Version 5.11J. The CD contains stm file by Stella Version 7.03.