RELATIONSHIP AMONG SHOPPING MALL, RETAIL STORES, AND CUSTOMERS IN SUBURBAN MALLS

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Abstract

In this thesis, I have constructed a model in which three distinct actors are in a complicated relationship and sought three answers to the following three main questions. The first one is about the analysis of customers' purchase decisions under the condition of not having information about prices of goods and valuations for that goods before traveling the shopping mall. The second one is related to the analysis of the price decisions of two similar retail stores in the case of charged rental contracts managed by the shopping mall. The last one is the analysis of the determination of parking fee that is known by the customers in advance and of optimum rent contracts including fixed and percentage rent. It is found that the equilibrium parking fees are always less than the marginal cost of supplying parking spaces, which implies that the mall determines the parking fee as a loss leader. The second result is that the price of goods are determined at the monopoly prices even if they sell a similar type of products, which the market tends to compete. And the last result is that shopping mall must implement positive percentage rent toward stores to increase its profit, which perfectly complies with data related to rent leases in shopping centers.

ŞEHİR DIŞINDA BULUNAN AVM'LERDE MÜŞTERİLER, MAĞAZALAR VE AVM ARASINDAKİ İLİŞKİ

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Özet

Bu tezde, üç farklı aktörün karmaşık bir ilişki içerisinde bulunduğu bir model kurulmaktadır. Aktörler arasındaki bu ilişkilere dayanarak üç temel sorunun cevabı aranmaktadır. İlk soru AVM (alışveriş merkezi)'yi ziyaret etmeden önce ürün fiyatları ve bu ürünler hakkındaki değer biçmeleri eksik olan müşterilerin satın alma kararlarının incelenmesiyle ilgilidir. İkinci soru, AVM tarafından kiralandırılan ve aynı tip sayılan iki tane perekande satış mağazasının ürünlerini fiyatlama kararının incelenmesidir. Ve son olarak da müşteriler tarafından bilinen park yeri ücretlerinin AVM tarafından belirlenmesi ve AVM'nin en uygun kira sözleşmesini belirlemesinin incelenmesidir. Denge park ücretlerinin her zaman için park yerlerinin marjinal maliyetinden düşük olduğu bulunmuştur. Bu durum şunu belirtmektedir; AVM'ler kendi karlarını arttırmak için park fiyat ücretlerini zarar lideri olarak belirler. İkinci sonuç pazarın rekabete yönlendireceği aynı tip ürün satan iki mağaza olsa bile, bu mağazaların ürün fiyat seviyesinin tekel fiyat seviyesinde belirlendiğidir. Son olarak AVM mağazalara karşın verilerle tam uyumlu pozitif yüzdelik kira uygulamalıdır

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1 Introduction

Shopping mall is a particular form of building in which many stores located side by side to ensure some certain goods that are mostly desired by customers. These might be called as "a modern type of bazaar place" in many aspects. There are over than 100,000 shopping malls only in the US according to annual surveys conducted in 2015 references. All of these provide parking spaces for visitors irrespective of being a buyer,[1] and most of them determine parking fee level as free.[2] Even though we know that all services provided by the private sector are priced out and also parking is costly to supply, how can we categorize this parking for free? Even if not chosen as free, the parking fee is always determined at the level which is less than the marginal cost of supplying a parking space (Ersoy, Hasker, and Inci, 2016).[3] That is to say, we note that the mall as in other models always determines the parking lot price as loss leaders. It is our first concern that will be examined in this paper. Another concern will be elaborated in our model is about rental contracts charged to stores by shopping mall's management. Needless to say, the shopping mall cares about the net rental revenue collected from stores that are assigned a space to expose their goods. However, if not formed wisely, these contracts make rental revenue underpriced, which might then end up with inadequate rent income for malls. So, we come to our second concern: How are lease contracts being constructed in order to make a maximum profit especially by adopting percentage rent strategy? Lastly, we are concerned about the determination process of prices of goods sold at stores located in malls. In our model, we assume that two identical stores are targeting the same customer mass endeavor to sell their goods. To put it all in simple terms, they are competing for the same market. However, we find that the price level that is directly affected by the rent cost occurs the level higher than competitive price. It is carried out at the monopoly market price. Our last concern is as follow: How can stores determine the price level maximizing the sales volume in the presence of charged to rent contracts?

Based on the studies and the figures in the literature, we would like to seek relation-

[1] They allocate 4 to 6 parking spaces for 1000 square feet of gross leasable area, which means that an amount of area allocated for parking is larger than the amount of area assigned for stores.

[2] In a survey made by the International Council of Shopping Centers and Urban Land Institute (2003), 94% of shopping malls set no parking fee, and only 2 % of malls declared that they set a parking fee for parking lots. and rest of the shopping mall (%4) did not want to give an answer.

[3] Actually, the parking for free does not imply that customers do not pay any money in exchange for using a parking lot. Frankly speaking, this cost is embedded into prices of goods sold at stores, which have been shown by Hasker and Inci (2014). In other words, by increasing the price of goods, they try to offset the loss sourced from setting a parking fee less than its marginal cost.

ships among owner of the shopping mall, stores that are competing in the same market and customers. By taking this into consideration, we attempt to analyze three primary objectives:

(i) To determine the optimal parking fee in the case of customers who do not know their valuations and the realized prices before visiting the shopping mall

(ii) To find a mechanism that provides positive percentage rent charged to stores by shopping malls; and

(iii) To analyze the price decisions of stores when competing with each other by selling homogenous goods.[4]

2 Literature Review

A substantial amount of study has been done on the subject of researching parking fee decisions of shopping malls and examining price determinations of stores in duopoly markets. Our literature review not only gives a brief summary of related papers but also focuses on articles providing a mechanism that analyzes a rental contract offered to stores by shopping malls. Konishi and Sandfort (2002) construct a model in which retail stores make a decision about whether or not to advertise their products in two different market conditions: monopolistic settings and duopoly settings. Our model is similar to theirs in the sense that we both assume that customers do not know prices of goods sold at stores and their valuations about that goods in advance in both settings. In monopolistic case, they show that the optimal decision made by the retail stores is to select price advertising for only one good despite the fact that the goods sold at that stores are substitutes. It is recognized that the stores prefer the low priced goods to be advertised on this setting so that it attracts more customers to visit the mall, which increases the probability of selling goods. They present, then, the duopoly case. In this market, two firms are selling the same type of commodity in collocation setting in which a customer needs not to pay a search cost so as to travel. The advertising decision made by only one store may lead to the existence of "free-rider" problem. The store which is not advertising the price of the good it sells may highly benefit from advertising decision of the other store. As a result of this, they have concluded that the game played between the retail stores mostly seems "prisoners dilemma" instead of "battle of sexes" which reflects the ultimate finding of their paper.

Some other papers investigate the influence of existence of anchor store (department store) on other stores in a shopping mall located in suburban area. Konishi and Sandfort

[4]This thesis builds on work with Eren Inci and Antonio Russo.

(2003) has an excellent article analyzing on how a positive externality created by anchor store can be explained by developing a mathematical model comprising only one anchor store and many retailers. They, in fact, present the model in which customers know the realized price of goods sold in anchor store, but they do not achieve the prices of goods sold in retailer stores and their valuations on that goods. Just because of this reason, they need to visit the mall for learning how much money they will pay to purchase one good sold in retailer stores. The inference they draw from the model constructed apprehensibly is that the presence of one anchor store can easily compensate losses caused by high competition among stores by relatively increasing "mall traffic" that augments the possibility of selling one good per customer who visits the mall. They also check their results by using numerical examples to compute sensitivity in the case of changes in parameters. They, then, make the model to be more well defined to eliminate problems related to discrete optimization of shopping mall and unfavorable profit equations of retailers.

Brueckner (1993) develops another model to explain allocation problem in shopping malls in the existence of inter-store externalities generated by anchor store for the benefit of itself and other stores. He constructs a model in which each store can create positive externality to other stores based on space allocated by an owner of the mall and stores types. In the article, Brueckner draws a conclusion that in the presence of department store (anchor store) the space allocation problem must be identified by internalizing inter-store externalities to obtain optimal result providing highest profit for the shopping mall. It needs to be noted that the author only assumes inter-store externality as an important factor in customer drawing power, which has been shown to some extent in a paper written by Yuo and Lizieri (2013). The difference between our model and the model constructed by Brueckner is that we will theoretically explain how positive percentage rent can be implemented for earning a more net profit by a shopping mall. In this sense, Brueckner fails to identify the percentage rent as getting a positive value. Instead of taking the positive value as we found out, he finds a negative percentage rent and then called it as the "subsidy" generating higher profit.

Another important paper is "Anchor Stores" written by Konishi and Sandfort (2003). They assume one anchor store and n retail stores that have same features in the model. The model assumes that while anchor store sells low value and normal goods, the retail stores try to sell more specialized goods that create high expected value. Customers have prior information about price and valuations of goods sold at anchor store, but they do not know anything related to price levels and valuations of goods sold at retail stores. That is why anchor store is more known by customers be-

cause of the fact that customers are more familiar with brands sold at that stores. The model also assumes that anchor stores inherently provide substantive externality for all stores by increasing the number of customers visiting the mall. They have shown that these stores have many incentives to collocate even if in the presence of competition between each other. They have also checked their results by making a numerical example.

Eppli and Shilling (1995) build up a model to explain the cross-patronage rate between anchor store and retailer stores from the viewpoint of development opportunities in a large-scale shopping center. Their model differs from the model constructed by Brueckner (1993) in the sense that Brueckner's model takes the mall as given while Eppli and Shilling (1995) seek the opportunities to improve the conditions of a large-scales shopping mall to maximize profit. The model consists of many anchor stores and many retailer stores, whose number of sales is directly based on a measure of leasable rental space. The model gives two important results. The first one is that an increment in cross-patronage rate always brings about augmentation in this type of shopping mall development opportunities. Secondly, if the cross patronage rate goes up, the mall have an opportunity to expand its leasable area to obtain more renting revenues, especially from the anchor stores.

There are also empirical articles concerning about data set of mall store contracts. The first research determining the variables that directly affect shopping center tenants' leases is "The Determinants of Shopping Center Rents" written by Sirmans and Guidry (1992). They use weighted least square estimation method to disclose internal determinants. Therefore, they lay emphasis on "customer drawing power" as a primary factor that influences a rent contract between stores and shopping malls. Upon their article to be published, the general tendency in studying shopping center rents would be turned towards understanding the rent contracts charged to stores creating more customer attraction to malls.

The best-known one is a paper written by Gould, Pashigian, and Predergast (2005). They mainly concern on rental contracts to understand how these are being become dissimilar when charging to anchor stores and retailer stores in a shopping mall. In this empirical study, they are firstly interested in analyzing why the anchor stores pay an only small portion of total rent earned by mall even though they keep hold of over half of total leasable space. They find that the anchor stores are charged small rent because they are creating positive externalities by attracting more customers to the shopping mall, which leads to making more sales for each type of store. Therefore, to be internalized these externalities generated by the anchor stores, they can implement

the following policies: they can either be subsidized or made contractual provisions promoting maximum performance, which provides an explanation in many respects of why anchor stores receive highly rental discounts. Consequently, the results that are coming up with examining data sets perfectly match with optimal allocation of space within the shopping mall.

In our base model, we have modeled the percentage rent along with the fixed rent. Apart from shopping centers, in general, rent is gathered only fixed amount that has no connection with sales volume. For that reason, there is a limited number of papers hypothesizing why shopping malls also add a clause about percentage payment based on their gross income in rent contracts. Benjamin, Boyle, and Sirmans (1990) have proposed that percentage rent is used as an alternative to base rent. It creates fairer implementation on retail stores in collecting rent payments. Brueckner's model (1993) has suggested percentage rent as a tool providing that the retail stores have incentives to cooperate with each other. In other words, Brueckner has modeled that the percentage rent can be adjusted to stimulate retail stores acting as a whole, which leads to being gathered more leasing payments on behalf of shopping mall's owner. An alternative view about a presence of percentage rent in leases has been propounded by Miceli and Sirmans (1995). We know that the contracts only depend on fixed rent include higher risk factors in the sense that when tenant encounters any business risk, failure to pay fixed rent may arise to some extent. Miceli and Sirmans have suggested that percentage rent should be implemented as a way of risk-sharing arrangement. By increasing the weight of percentage rent in leases, the shopping malls can minimize the risk might appear as a form of failure to pay rent. It can be counted as insurance mechanism in some way. Another paper on this issue is written by Wheaton (2000). He totally conflicts with these remarks and puts forward that rent based on a percentage of sales protects retailer's benefits against the opportunistic behavior of shopping mall's owner in the case of clash of interests between tenants and landlords. The percentage rent carried out in our model holds the mixed features of these views.

There exists a little body of papers that have analyzed the economic explanation of how parking fee price is determined by the shopping mall. Our model is also related to parking fee pricing. We know from an article written by Jakle and Scculle (2004) that the total amount of land allocated for parking approximately equals to a multiple of New England states. The first paper in this field is Sutherland's article (1959) titled "Shopping Center Parking Problems". He comes up with factors bringing about main problems in shopping malls. Subsequent articles study parking problems in malls. Hasker and Inci (2014) construct a model in which customers, who are risk-averse,

reach shopping mall only by using a car. In this paper, stores sell a single type of good for simplicity and the mall market structure is not matter regarding whether or not having monopoly power or prices competitively. The last but not the least is that customers must incur the parking fee cost (if positive) in order to visit the mall whether or not that they can find out buyable goods. Given this setup, they explain how the costs of parking fee have been embedded into prices of commodities sold at stores in the shopping mall. According to them, economic reason behind why the parking fee is determined as free is that it encourages the risk-averse customers to visit the mall for searching desired commodities. In our setting, the shopping mall also sets parking fee as a loss leader, which are consistent with the established literature. The important point that must be highlighted is that even though we have found the same result about parking fee decision while Hasker and Inci (2014) take stores and shopping mall as one united entity, we assume that stores and shopping mall are two different entities.

There is one relevant article mainly concentrating on relationship between parking tariffs and turnover, whose volume is directly based on the level of the parking tariff, which is obtained by shopping mall. Mingardo and van Meerkerk (2012) write an empirical article using data sets acquired a survey about 80 malls located in Netherlands. It makes sense to note that a log-linear regression analysis is exerted as a tool of rough econometric calculation. As a beginning, they investigate the truth of a well-known doctrine "no parking, no business". The doctrine clearly places a great emphasis on providing parking areas to customers to obtain higher revenues. Upon analyzing data sets mentioned above, they come up with three theoretical results clarifying the relevance between the space supplied as a form of "parking lot" and the extent of business of a shopping mall. The first and most important one they find is that there is an undeniable and non-negligible relationship between parking fees and revenues obtained by the shopping mall. This outcome might help us to identify our parking fee results will be discussed in the model part of the paper. The second consequence they explore in the whole database is that the parking fee charged to customers do not have any impact on parking turnover of a shopping mall. This result is a direct response to the fundamental question of this article explained above. Once and for all, they find that in regional shopping areas increase in the parking fees end up with an increase in parking turnover.

3 The Model

In this part of the paper, we investigate the relationship among shopping mall, stores, and customers. Our model builds on Konishi (2002). Assume that there is a monopolist shopping mall located in a suburban area. It chooses total rent composed of "percentage rent" and "fixed rent", to be paid by stores. We use subscript r to denote percentage rent, that is, rent paid based on a percentage of gross sales. We use R to indicate fixed rent, that is, paid regardless of the amount of sale. The only way to reach to the shopping mall is to use on their vehicles. The shopping mall supplies parking spaces to customers coming to the mall. Its marginal cost of supplying a parking space is $c_p > 0$. The shopping mall also sets parking fee denoted f, which is widely known. That is to say, before visiting the shopping mall, customers know how much they will pay in return for using parking space, which directly influences the customers' decisions about whether or not to visit the mall.

There are two stores selling an indivisible and homogeneous good.[5] The marginal cost of providing the good in the store is denoted $m > 0$. The prices of goods are denoted by p_i, where $i = 1, 2$. There is a continuum of customers whose preferences are identical, but transportation costs are different. We call them customers, whether they visit the shopping mall or not. Each customer's valuation (willingness to pay) for good i, v_i, is i.d.d. random variable (over customers), distributed uniformly over the closed interval $[0, 1]$. The valuations of goods sold by stores are also stochastically independent. It means that realized valuation of one good does not have any effect on other goods' realized valuations. We should note that customers do not have knowledge in advance how much they are willing to pay for goods, which implies that any customer who visits the shopping mall (incurring transportation cost) discovers her valuations for goods $i = 1, 2$ as two independent uniform distribution drawn (it will be visualized later). Before visiting the shopping mall, they do not know not only the price of good but also their willingness to pay for that good. As we noted earlier, the customers only know in advance how much cost they will incur in order to park their vehicles in parking lots provided by the shopping mall. Upon visiting the shopping mall, the customers can learn realized prices and their valuations for the good. And the last thing must be emphasized is that all customers have the alternative option purchasing nothing, which yields a net negative surplus.[6]

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[5] The goods has no differentiation concerning features, quality levels, and benefits.

[6] The negative net surplus is taken because even if customers do not buy any good from both stores, they still pay parking fee.

As we mentioned before, each customer's valuation of goods is revealed only upon incurring of a transportation cost. We denote transportation cost as $t > 0$. The transportation cost is evaluated in a way to reflect a customer's position relative to the position of the shopping mall. It can be explained as follows: one has to incur a transportation cost depending on how far his home away from the mall. We also assume that t has a uniform distribution over the closed interval $[0, 1]$ (it should be added the following note that the shopping mall is placed at 0, and the customers are uniformly distributed on a line of unit length). Once the transportation cost is incurred, it becomes sunk cost. That is, it cannot be recovered any longer. The result is that any customers whose transportation costs are less than the gross expected utility from shopping at the shopping mall will hit the road to arrive in the mall.

Given this specification, the game is played by the owner of a shopping mall, stores and customers.[7] The timing of events is as follows. The shopping mall first offers the rental contracts to stores specifying percentage rent (r) and fixed rent (R), and it also determines the parking fee (f). Then, by taking into account individual costs of transportation and expected net surplus after incurring transportation costs, customers decide whether or not to travel the shopping mall. It should always be kept in mind that prices are not publicly known. The market size, descriptive of how many customers visit the mall, is also determined at this stage. Upon learning percentage rent and fixed rent, the stores determine price levels for their goods. The final stage is that soon afterward the customers visiting the mall by own vehicle pay a parking fee, f, and incur a transportation cost, t, purchasing decision for each customer is taken place.[8]

Subgame Perfect Nash Equilibrium (SPNE) is the our equilibrium notion. Therefore, we solve the model that is constructed above by "backward induction". We are beginning with the analysis of customer's purchase decision at the next step.

3.1 The customers' purchase decision (Stage 5)

We start off by analyzing the final stage of the game. It should be noted that all decisions about rent levels and price levels made by the stores and the shopping mall are taken as "fixed" at this stage.[9] The purchase decision of customers who have chosen to visit the shopping mall is also examined at this stage. The customers have basically two options: purchasing a good from one store or nothing (the customers can buy

[7] As it is explicitly seen, we do not take the shopping mall and stores as one economic entity.

[8] The realized valuations for each good are decided by nature upon prices are announced by stores

[9] Taking these as fixed is important especially in derivative and integral calculations.

only one good that ensures them the maximum net surplus even if other goods provide positive net surplus). At this stage, it is clearly useful to indicate that the prices set by stores and customers' willingness to pay for goods are unquestionably known by the customers.

The customers solve the following maximization problem:

$$\max[-f, \max_{i=1,2} v_i - p_i - f] \tag{1}$$

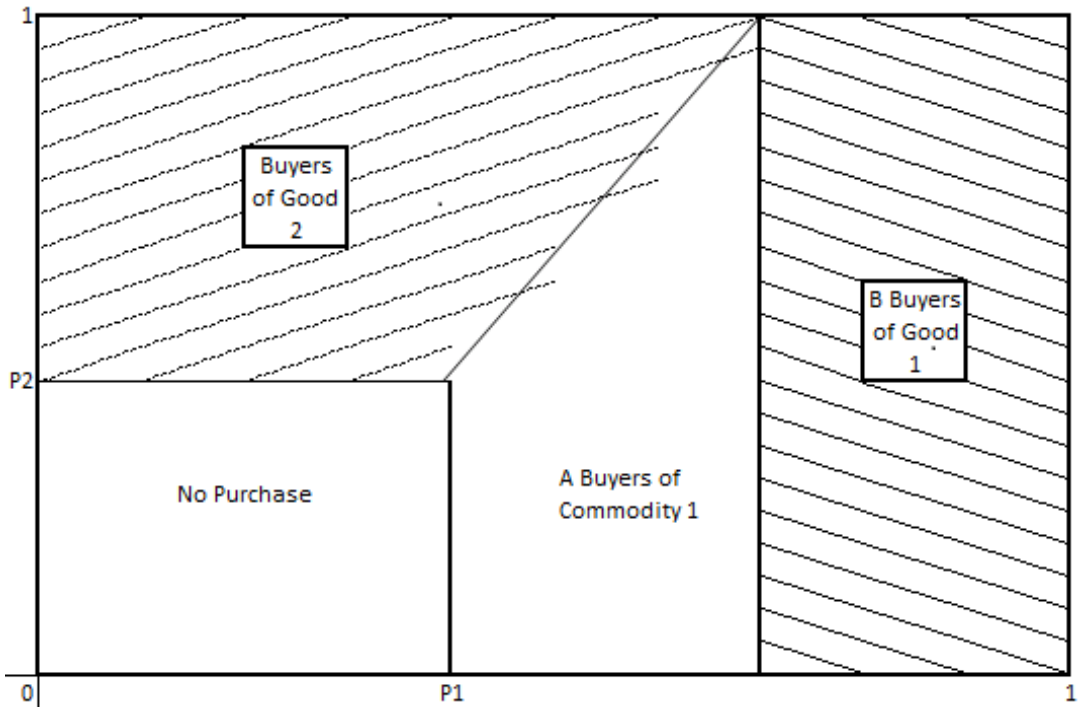
This maximization problem can be explained verbally in such a way that a customer purchases a good that ensures his maximum net surplus or prefers the option of not purchasing any good that gives his negative net surplus (notwithstanding buying nothing, she still pays a parking fee that brings about negative net surplus). Given the prices (p_i, p_j), where $i = 1, 2$, the probability that a customer purchases good i is given by[10]

$$P(p_i, p_j) = \begin{cases} \int_{p_i}^{1-p_j+p_i} (v_i - p_i + p_j)dv_i + \int_{1-p_j+p_i}^{1} dv_i & \text{if } p_i \leq p_j \\ \int_{p_i}^{1-p_j+p_i} (v_i - p_i + p_j)dv_i & \text{if otherwise} \end{cases} \tag{2}$$

The equation identified above is the general equation of the probability that a good purchased in the case of determined stores' prices. The figure in below is a useful tool to make explicit the above equation. The first concept that should be emphasized is that the line represents the following formula: $v_1 - p_1 = v_2 - p_2$. Each customer on this line is indifferent between purchasing at store 1 and store 2. In other words, these customers do not care about to buy a good from either store. The area under the line $(v_1 - p_1 = v_2 - p_2)$ represents the customers who purchase good 1 ($v_1 \geq p_1$ and $v_1 - p_1 \geq v_2 - p_2$). Given that valuations for good $i = 1, 2$ are independent uniform random variables, the areas under the line might be evaluated as the measure of customers purchasing good 1.[11] The areas above the line are the probability of purchasing goods from store 2 whose price level is higher than the price level of goods

[10] Upper case P is used to denote the probability taking values in $[0, 1]$ interval.

[11] The high probability for store 1 equals to $\frac{1}{2} - p_1 + p_2 - \frac{p_2^2}{2}$ when $p_1 \leq p_2$, otherwise, the low probability $\frac{1}{2} - p_1 + \frac{p_1^2}{2} + p_2 - p_1 p_2$.



sold at store 1. The area is written as "No Purchase" gives us the probability of purchasing nothing from both stores because of the fact that the realized valuations are less than the prices for both goods. It is important to emphasize that in spite of the fact that one store chooses its price level higher than the price level of another store, it is still selling the good presented in its store because of differentiation on valuations for each customer. It comes to mean that the customers pay attention not only the price levels set by stores but also the quality of goods, features, and other benefits when taking purchasing decision. For this reason, the competition between both stores is not called Walrasian Perfect Competition. To put it in another way, since the valuations are distributed independently and getting different values for each customer, the variation between their valuations and the realized prices occurs at different levels. For example, assume that a customer whose valuation for commodity 1 is higher than valuation for commodity 2. However, the price of commodity 1 is also higher than the price level for commodity 2. Even if the valuation for commodity 1 is higher, since a difference between the valuation for commodity 2 and the price of commodity 2 is higher, and then the customer will prefer purchasing the commodity sold at store 2.

Since stage 4 is basically the Nature's move, it does not need to be analyzed deeply, so we can skip stage 4 and continue with stage 3 (stores' price decision).

3.2 The stores' equilibrium price decision (Stage 3)

At this stage, customers do not have prior knowledge about prices set by stores before visiting the shopping mall, but they can make reasonable expectations about stores' price policies by the virtue of the fact that customers can be counted as "rational". The customers must decide whether or not to travel to the shopping mall for the purpose of learning their valuations for that goods and stores' prices. This is important because of the following reason: transportation cost becomes sunk cost when visiting the shopping mall. It also should be noted that any change in stores' prices does not affect customers' transportation decision. The underlying reason is that despite the fact that store makes a decision to shrink price level for its good, the number of customers incurring the transportation cost is not affected due to the fact that the customers do not know in advance how much the price level is altered and in which level new price is determined. That is to say; the market size is called "fixed" without considering the price level set by stores. The customers anticipate the prices that are determined by a fixed market size. As a summary, we can say that the market size is called to have "scale effect" and does not have any influence on stores' equilibrium prices in our model. As a result of this, we completely ignore the presence of the market size in writing profit equations of both stores.

We set sight on *symmetric price equilibrium*, bearing in mind that stores set equal prices $p_1 = p_2 = p$. By the reason of the fact that we are looking for a symmetric solution in prices given $v_i - p_i \geq 0$, assume that stores set price p_i where $i = 1, 2$. By taking into consideration the customers who visit the shopping mall, store i's profit per unit demand is written by

$$\Pi_s(p_i) = P(p_i)[(1 - r)p_i - m)] - R. \tag{3}$$

In the above equation, as a relevant remainder, r represents the percentage rent and R refers the fixed rent. We should note that the shopping mall takes gross profit gained by stores by using R. We also have the marginal cost of providing the good denoted by m. The store i is getting revenue $(1 - r)p_i - m$ with $P(p_i)$ probability calculated in stage 5. It also pays fixed rent of R. Then the profit per unit demand is written as above equation.

The price p^* is evaluated a *symmetric equilibrium price* if it satisfies succeeding equation, $\Pi(p^*, p^*) \geq \Pi(p_i, p^*)$ for any $p_i \geq 0$ set by the stores $i = 1, 2$. Then, we have the following proposition

Proposition 1. *The symmetric equilibrium store price p^* is unique and implicitly*

defined by the following equation:

$$p^* = -1 - \frac{\sqrt{2}\sqrt{(r-1)(r-1-m)}}{r-1}. \tag{4}$$

Proof of Proposition 1. The proposition mentioned above is proved in here. A Nash equilibrium (p_1^*, p_2^*) can be assessed in this context like below:

$$\begin{aligned} \Pi_1(p_1^*, p_2^*) &\geq \Pi_1(p_1, p_2^*) \qquad \text{for} \quad p \in [0,1] \\ \Pi_2(p_1^*, p_2^*) &\geq \Pi_2(p_1^*, p_2) \qquad \text{for} \quad p \in [0,1] \end{aligned} \tag{5}$$

The symmetric Nash equilibrium must be providing as the following equation:

$$\begin{aligned} \frac{\partial \Pi_i}{\partial p_i} =& \frac{\partial \Pi_j}{\partial p_j} = \frac{1}{2}(p_1 - 1)(-3 + 2m + p_1 - 4p_2 + 2r) \\ =& m(1 - p_1 + p_2) - \frac{1}{2}(1 + 3p_1^2 + 2p_2 - 4p_1(1 + p_2))(r-1), \end{aligned} \tag{6}$$

where $p_i = p_j = p$

Then by rearranging the equivalence properly, we can find the *symmetric Nash equilibrium* (p^*) satisfying the above equation is

$$p^* = -1 - \frac{\sqrt{2}\sqrt{(r-1)(r-1-m)}}{r-1}. \tag{7}$$

p^* is the unique best response to p^* and called as the unique *symmetric Nash equilibrium* because of the fact that $\Pi_i(p_i^*, p_j^*) \geq \Pi_i(p_i, p^*)$ for any $p_i \in [0,1]$.[12]

3.3 Equilibrium market size (Stage 2)

We have obtained the equilibrium prices set by stores at the previous stage. Now by taking into account the equilibrium price $p^*(p_i)$ calculated at the previous stage, the customers must decide whether or not to visit the shopping mall. This is because the customers need to be sure that those goods they intend to satisfy their expectations or desires. One can reach this information only through one channel, but it is costly

[12] $\Pi_i(p_i, p_j)$ is strictly quasi-concave.

because of transportation cost and parking fee.[13] When we aggregate each customer's decision by considering whether or not they visit the mall, the number of the customers who visits the shopping mall will be found out. Our analysis is entirely dependent on the results found at stage 5. We can formalize a customer's expected utility from the shopping mall at prices (p_i,p_j) as follows (We can assume that $p_i \leq p_j$)[14]:

$$E(\max\{-f, v_i - p_i - f, v_j - p_j - f\}) = \int_{p_i}^{1-p_j+p_i} (v_i - p_i + p_j) \times (v_i - p_i - f) dv_i + \int_{1-p_j+p_i}^{1} (v_i - p_i - f) dv_i + \int_{p_j}^{1} (v_j - p_j + p_i) \times (v_j - p_j - f) dvj + \int_{0}^{p_i} (p_j) \times (-f) dv_i. \quad (8)$$

Firstly, we clarify the functions of mathematical operators used at above equation for better understanding. Integration serves for the purpose of yielding the expected payoff over all realizations v_i. In our model, it is important to note that each customer has an option to purchase nothing. So, even if a customer decides not to purchase any good offered by both stores, he still pays the parking fee (f), which leads him to get negative surplus. It is crucial to note that the customer buys a good i only when $v_i \geq p_i$ and $v_i - p_i \geq v_j - p_j$ are satisfied. To be more precise, the first two terms starting with integration reflect the condition in which a customer purchases good 1 and the third term starting with integration states the condition in which a customer purchases good 2, but the last term represents the case where a customer does not purchase any goods sold in both stores because of not providing positive payoff after being bought. In other words, the customers do not find any buyable good in both stores specified according to the last term. However, in each case, the parking fee must be paid independently of purchasing or not purchasing a good.

In order that a customer prefers visiting the mall, this condition must be satisfied; his expected gross surplus is greater than or equal to his transportation cost. That is, if a customer's transportation cost t is lower than $E(\max\{-f, v_i - p_i - f, v_j - p_j - f\})$, he will decide to visit the shopping mall. We know that the transportation costs vary according

[13] These customers can be assumed to have insufficient information about some traits of goods. In our model, to solve this issue, they must see the good in stores.

[14] It can be assumed such that $p_j \leq p_i$.In each case, the formulation gives us the same result.

to distance from the shopping mall. It increases if a customer is located further away from the shopping mall. Then, we need to assure that a customer whose transportation cost $t^*(p_i, p_j) \equiv E(\max\{-f, v_i - p_i - f, v_j - p_j - f\})$ to be indifferent between travelling and not travelling the shopping mall. Then, the market size ($\mu(p_i, p_j)$) is computed as follows:

$$\mu(p_i, p_j) = \int_0^{t^*(p_i,p_j)} dt = t^*(p_i, p_j). \tag{9}$$

That is,[15]

$$\begin{aligned}\mu(p_i, p_j) = &\int_{pi}^{1-p_j+p_i} (v_i - p_i + p_j) \times (v_i - p_i - f)dv_i + \\ &\int_{1-p_j+p_i}^{1} (v_i - p_i - f)dv_i + \int_{p_j}^{1}(v_j - p_j + p_i)\times \\ &(v_j - p_j - f)dvj + \int_0^{p_i}(p_j) \times (-f)dv_i.^{16}\end{aligned} \tag{10}$$

The market size identified above as a form of an equation is always getting positive numbers regardless of the price level set by the stores and the parking fee determined by the shopping mall. Importantly, it is easily shown that the less parking fee is determined, the more customers can be attracted so as to visit the shopping mall, which apparently leads to increase the purchasing probability of any good sold at both stores.

3.4 The profit maximizing of the shopping mall (Stage 1)

Finally, we sort out the shopping mall's decisions including setting optimal parking fee; (f^*) and designating equilibrium rent charged to both stores simultaneously. The revenue of shopping mall is composed of three different parts: the percentage rent (r^*), the fixed rent (R^*) (both charged to stores) and parking fee (f^*). The owner of a shopping mall sets the fixed rent (R) to receive all profits in the hands of the stores. Simultaneously, she determines the parking fee to get more revenue paid by the

[15] The market size equation can be written easily by interchanging p_i and p_j.

customers.

The shopping mall's total rent revenue is $2R+[2r(P_i)p_i)]\times(\mu(p_i))$ (market size).[17] It is important in the sense to make sure that when optimal percentage rent is computed, the market size is taken as a "fixed" owing to similar logic mentioned above. For this reason, the shopping mall is not taking the market size into consideration when determining the percentage rent (r). Thus, the shopping mall can force the stores to choose a higher price by setting optimal percentage rent (r^*). Even though there is a competition between stores to sell out as much as the number of customers stores can make sale, they can sell their commodities with a higher price than competitive price because of neglecting the effect of market size on optimal percentage rent.

The parking revenue collected for providing parking space to the customers is computed as $(f-c_p)\times$market size$(\mu(p_i))$ where c_p is the marginal cost of supplying a parking space. We should note that market size is not "fixed" as coming up with the optimal parking fee solution. That is, by cutting the parking fee the shopping mall can increase the market size (the size of customers who come round the shopping mall even if they do not find a buyable good). As a result, the total profit of the shopping mall is as follows:

$$\Pi_m(r,R,p_i)=2R+[2r(P_i)p_i+f-c_p]\times\mu(p_i) \tag{11}$$

Note that P_i is implicit function of v_i, and p_i $\mu(p_i)$ is implicit function of f and m. The first derivative for the shopping mall's profit-maximization equation with respect to r is

$$\begin{aligned}\frac{\partial\Pi_m(r,R,p_i)}{\partial r} =& m\mu(p_i)\frac{6\sqrt{m+(r-1)^2-mr}+2m\sqrt{m+(r-1)^2-mr}}{(r-1)^2\sqrt{(r-1)(r-m-1)}}+\\ &\frac{\sqrt{2}(-4(1+m)+(4+m)r)}{(r-1)^2\sqrt{(r-1)(r-m-1)}}=0\end{aligned} \tag{12}$$

The unique optimal r^* maximizing the above condition is

$$r^*=\frac{2+m+4m^2+m^3-\sqrt{27m^2+18m^312m^4+6m^5+m^6}}{2+4m+m^2} \tag{13}$$

Proposition 2. The *optimal percentage rent,* r^*, is always positive when m gets values the range of [0,1].

[17] Since the model is composed of two similar stores, the rent revenue is multiplied by two.

Proof of Proposition 2. It can be proven by using local extremum theorem. First, we are looking for any extremum point within $(0, 1)$ open interval.

The first order condition of r^* is as follow;

$$\begin{aligned}(r^*)' = &-2(2+m)(2+m+4m^2+m^3-\sqrt{m^2(3+m)^2(3+m^2)})+\\ &(2+(4+m)(1+8m+3m^2-\frac{3m(3+m)(3+m(2+m(2+m)))}{\sqrt{m^2(3+m)^2(3+m^2)}}\end{aligned} \tag{14}$$

The first condition defined as above must be equal zero in order to find the point that gives us local minimum or local maximum point, which will be determined depending upon the sign of the second derivation.

$$\begin{aligned}(r^*)' =&\frac{\partial r^*(m)}{\partial m} = -2(2+m)(2+m+4m^2+m^3-\sqrt{m^2(3+m)^2(3+m)^2})+\\ &(2+(4+m)(1+8m+3m^2-\frac{3m(3+m)(3+m(2+m(2+m)))}{\sqrt{m^2(3+m)^2(3+m^2)}}=0\end{aligned} \tag{15}$$

m^* that sets zero above $(r^*)'$is zero (1).And if we put $m^* = 1$ into r^* it will generate local minimum r^* equals to 0

The second order condition of r^* is as follow;

$$\begin{aligned}(r^*)'' =&\frac{\partial (r^*)'(m)}{\partial m} = \frac{216\sqrt{m^2(3+m)^2(3+m^2)}}{((3+m^2)\sqrt{m^2(3+m)^2(3+m^2)}(2+m(4+m))^3)}+\\ &\frac{m(180(6+\sqrt{m^2(3+m)^2(3+m^2)})}{((3+m^2)\sqrt{m^2(3+m)^2(3+m^2)}(2+m(4+m))^3)}+\\ &\frac{m(36(28+3\sqrt{m^2(3+m)^2(3+m^2)})...))))))}{((3+m^2)\sqrt{m^2(3+m)^2(3+m^2)}(2+m(4+m))^3)} > 0\end{aligned} \tag{16}$$

This shows us that the second-order condition is certainly positive, which makes our m^* is the local minimum point.

It is required to check out boundary points : $0, 1$. We know from the above calculations, $m^* = 1$ is already local minimum point. and if $m^* = 0$, r^* will get 1. Then, it can be easily said that in the closed interval $[0, 1]$ of m, r^* is always getting positive values within the closed interval $[0, 1]$.

Proposition 2 shows that percentage rent charged to stores by shopping mall is always positive percentage rate. A certain amount of money based on the percentage

rent rate is paid to the shopping mall for each good sold. That is to say, the stores get $(1-r) \times p_i$ for each good sold instead of getting p_i.

As we mentioned before, the shopping mall needs to determine the optimal parking fee. To find the optimal parking fee, the derivation of the shopping mall's profit maximization problem with respect to parking fee (f) must be taken. In this case, the market size found at the preceding stage is not fixed because the amount of the parking fee directly affects the market size $\mu(p_i)$. The shopping mall is interested in the market size in the sense that she is also getting revenue from the parking fee charged to customers. It is known that if the parking fee decreases, the number of the customers visiting the shopping mall can increase relatively.

$\Pi_m(r, R, p_i) = 2R + [2r(P_i)p_i + f - c_p] \times \mu(p_i)$ is the shopping mall's profit equation mentioned above. Then, the first derivative for the shopping mall's profit-maximization equation with respect to f is given by

$$\frac{\partial \Pi_m(r, R, p_i)}{\partial f} = \frac{1}{243m^2}(243(c_p - 2(2+f))m^2 - 378m^4 - 216m...)) = 0^{18} \tag{17}$$

The equilibrium parking fee (f^*) is

$$f^* = \frac{1}{486m^2}(243(-4 + c_p)m^2 - 972m^3 - 378m^4...))). \tag{18}$$

When the above term is organized, we get this one:

$$f^* = \frac{c_p}{2} - \psi. \quad \text{where } \psi = \frac{1}{486}(-972m^3 - 378m^4 - 54m^5...) - 2. \tag{19}$$

Proposition 3 (Loss leader pricing). The equilibrium parking fee, f^*, is always less than the shopping mall's marginal cost of supplying a parking space, c_p.

Loss leader pricing means that in order to attract more customers, the owner of the shopping mall determines the parking fee level below the marginal cost of supplying a parking space. It is important because the marginal cost of supplying a parking space per the customer who visits the mall is very low, the shopping mall then can set the parking fee as free, which closely matches real life data. By determining the parking fee free, the shopping mall stimulates the customers having a chance to purchase goods presented by stores without being incurred any charge in using parking space.

[18] It is a very long term. For this reason, we do not write the whole term.

4 Conclusion

The aim of this article is to make a contribution to three distinct kinds of literatures related to shopping malls. First, we assume that rent contracts charged to stores are composed of two parts; fixed rent and percentage rent. Rent agreements are designed to induce retail stores more sales. We provide a shred of evidence for this structure of rent contracts by showing that profit of shopping mall can be reached the highest levels. In this sense, the model has highlighted that shopping malls have a strong incentive to determine percentage rent as "positive" to earn more profit. Setting positive percentage rent is in agreement with what is shown in empirical inquiries, especially data shown by Gould, Pashigian, and Predergast (2005). Although it seems sensual to some extent, it needs to be explained to reveal the intuition behind the model. Further papers must expand our results to analyze why shopping malls set positive percentage rent instead of setting negative percentage rent which is found in Brueckner's model. By doing it, a broader theoretical explanation can be done for making sense of the process that determines the sign of the percentage rent.

Second, considering the competitive relationships between retailer stores, we have found that the price levels of goods sold at both stores are determined at the monopoly price level.[19] At first appearance, it might seem strange, but we can present a strong explanation that is compatible with previous articles written by Hasker and Inci (2012). We have shown that the parking fee set by shopping mall is being configured to close zero (free) in order to attract more customers. To compensate loss incurred from providing free parking, the mall forces stores to determine price levels of goods at the monopoly price. That is to say, the shopping mall has embedded the parking costs in the prices of the goods sold at retailer stores. It directly stimulates the prices of retailer stores to increase, and this might explain why the price levels have been recognized very close to monopoly prices. It needs to be noted here that this result is somehow related to where the shopping mall is located. In this paper, it is proved only for suburban shopping malls. In the manner that Hasker and Inci (2014) have demonstrated, urban shopping malls generally may determine parking fees as positive to prevent customers not have the purpose to shop.

Third, we have found parking can be counted as a loss leader for shopping malls located in suburban areas. The parking fee is underpriced, and mostly determined

[19] We have assumed that the customers do not have any prior information about the prices and their valuations. It is important to note that customers do not react perfectly to the change in price levels. They are only making reasonable expectations on how price level might be before visiting the shopping mall.

free, so as to attract more customers to the shopping mall.[20] To be more precise, the observed parking fee is zero. Even if you do not make a payment in return for using parking lot provided by the mall, in fact, the parking cost is totally embedded into the price of goods sold at both retailer stores as we explained above. It is implying that instead of putting parking fee in exchange for to be used parking lots, the shopping malls prefer to increase the price of goods. It is quite logical in this context because the customers already do not learn realized prices without traveling the shopping mall.

We would like to analyze what further topics can be added to investigate depending on the result we have found in this paper. It might be interesting to change the structure of stores in which one can become anchor store that produces positive externality by increasing customer traffic in the mall, and the other one is still retailer store, which would be made a more complicated analysis. It would also be instructive to assume heterogeneous goods, where the price and realization of the good sold at anchor store are known by customers, these parameters for another good is still not known by customers. By doing this, the process of attracting customers to the mall can be altered completely. In this case, we would be concerned how parking cost can be embedded into the prices of anchor store and retailer store. Is there any differentiation in embedding the cost into the prices of diverse stores' goods? Answers to these kinds of questions might be given in following research.

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