SHOPPING IN A SEGREGATED CITY

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ABSTRACT

We consider the consequences of introducing a Superstore into a city segregated by income. In this monocentric city, consumers and firms live on a continuous line interval. Our model consists of two types of firms; many high-cost perfectly competitive ”Corner Stores” located throughout the city, and one low-cost ”Superstore” located in the outer part of the city and choosing its price strategically. We look to determine the impact of the low price offered by the Superstore on the welfare of both low and high-income consumers. In addition we consider the impact of city income structure on the pricing decision of firms and monopoly profits. Regarding consumer welfare, we find that low-income consumers that are segregated away from the Superstore may still benefit from its entry into the market. More specifically, the impact of the Superstore on the isolated consumer depends on the sensitivity of the local real estate market to the entry of the Superstore and its choice of price. We also find that a greater disparity in disposable income between the two types of consumers makes it more likely that the Superstore will charge a higher price.

Keywords: Spatial competition; Segregation; Income disparity

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1 Introduction

There are some indications that over the last forty years income segregation has increased in many major U.S. and European cities. Low-income urban households are increasingly more likely to live in predominantly low-income neighborhoods[2] (see Reardon and Bischoff (2011) and Aldridge et al. (2013) among others). There is also evidence to suggest that low-income households are less likely to have access to major supermarkets and large retailers, forcing them to rely on small high-priced corner stores (See for example Alwitt and Donley (1997), Chung and Myers (1999) and Powell et al. (2007)). Greater income segregation along with the emergence of fewer but larger retail stores located away from poorer neighborhoods suggests that access to affordable shopping might be a problem for an increasing number of consumers[3]. In this paper we look to quantify the impact on consumer welfare from being isolated away from large low-cost retailers. We find that the loss to low-income consumers from being segregated away from affordable shopping may be mitigated by the sensitivity of the real-estate market to the price offered by the Superstore. We also find that an increase in the economic disadvantage of the low-income consumers increases the likelihood that the Superstore will charge a higher price and only target wealthier consumers[4].

There has been extensive research into the shopping habits of low-income households and their ability to access affordable quality goods. In the 1990s the U.S. and U.K. saw the emergence of the concept of ”Food Deserts”, or lack of access to cheap and healthy food for low-income families. This has been a contentious political and academic issue and has inspired extensive work (see for example Wrigley (2002) and Guy et al. (2004) in the U.K., Larson et al. (2009) and Gordon et al. (2011) in the U.S.). Most studies focused on ”Food Deserts” have shown that although it is not universally a problem, there is evidence of a lack of access in certain locations, particularly in urban areas. An extensive study into the shopping habits of consumers in the U.K. found that large retailers are moving from town centers to out-of-town locations, Piachaud and Webb (1996). Through a survey of consumer shopping habits, the study argues that low-income families with limited mobility are left with no choice other than to shop at high-priced local stores. In the U.S., research in the late 1990s found that supermarkets and food retailers are not as prevalent in low-income neighborhoods[5], low-income areas in nineteen U.S. cities had 30% fewer stores per capita compared to higher income areas.

[2]Low-income is generally defined as earning 67% of median income, adjusting for local factors

[3]According to the Economic Research Service of the U.S. Department of Agriculture the number of Supermarkets in the U.S. dropped significantly from 1970 to 1990.

[4]By ”economic disadvantage” we mean lower income and higher transportation costs relative to the high-income consumers.

[5]Definition of what is considered a low-income neighborhood varies by research, but in general depends on data taken from the U.S. Census, and ranges from 20% to 30% of a neighborhood's population falling below the U.S. poverty line.

A regional study of Allegheny County, which contains the city of Pittsburgh, found similar results, Dalton et al. (2003). The study found that large supermarkets were on average a lot more accessible in middle to high-income suburban areas of the region. A Minneapolis study found that there was a significant positive relationship between income level and the number of supermarkets in a neighborhood, Chung and Myers (1999). The city of New York conducted a city wide study into the location of supermarkets. The study found that there was a shortage of supermarkets across the city, in particular, lack of access to cheap and healthy food was found to be especially stark in low-income and minority neighborhoods, Gonzalez (2008).

In our theoretical model we consider how the pricing decision of large retailers and Supermarkets (we group both together and refer to them as Superstores) interact with household location and shopping decisions. This paper is not really about the causes of segregation, but rather its consequences. Although we look for equilibrium in the rental market, the resulting city income structure is mostly a consequence of the assumptions of the model[6]. The more important contribution of our paper is a general equilibrium analysis of the consequences of being isolated from affordable shopping. We allow for the possibility that the segregated consumer might still choose to shop at the distant Superstore and look for conditions on our model parameters for various demand outcomes in the segregated city. Previous literature on agglomeration have included factors such as desire for space (see Alonso (1964), Mills (1967) and Muth (1969), collectively referred to as AMM), access to neighborhood specific amenities (see Brueckner et al. (1999) and Lai and Tsai (2008)), high quality education (see Selod and Zenou (2003)), and the desire to locate close to job centers (see Wasmer and Zenou (2002)). In this paper we assume that the only factors impacting consumer welfare are transportation costs, real-estate prices and access to the Superstore. Therefore we take all other factors effecting consumers' choice of location to be uniformly available across the city line.

We develop our spatial model in a semi-general equilibrium framework where households choose where to live and shop while firms simultaneously choose their price[7]. Based on our assumptions there are only two opposing factors that determine household choice of location, and in effect the rental rate across city neighborhoods. Households would like to locate close to work in order to cut down on the cost of commuting, but they would also like to live close to affordable shopping, where they will spend most of their earned income. We offer the consumer the option between convenient, but relatively expensive, shopping available at their local corner store, and more affordable shopping in the outskirts of the city requiring additional transportation costs. We also allow firms to behave strategically, choosing their price while taking into

[6]For an analysis of the role of access to shopping in determining city income structure please see Somekh (2014a)

[7]Using the term "general equilibrium" is not fully accurate since we do not consider the labor market in our model, we take the hiring activities of firms as given. We are considering equilibria involving consumers, producers and the rental market within the city.

account the decision rule used by consumers. Using this framework we consider conditions on various possible demand and supply structures within the city and the resulting levels of consumer welfare and Superstore profits. We are able to show that being segregated away from the Superstore can negatively effect low-income households, but this effect is mitigated by changes in relative rental prices across the city in response to changes in the Superstore's price. That is, conditional on relative income, if there is real competition in the real-estate market across the two income classes, then real estate prices will adjust to make households indifferent between shopping at the Superstore and the high-priced Corner Stores. In no way are we suggesting that our results mean that income segregation does not hurt consumers. But we believe that our results, if proven to be true, could provide alternative policy tools to regulators interested in mitigating the negative effects of gentrification and the isolation of low-income households.

We begin building our theoretical model with a base case that involves a homogenous consumer population.

2 The Model With Homogenous Consumers

For the base case of our model we consider a city containing a homogenous consumer population earning wage w. At first the only option for consumers is to perform their shopping at their local Corner Stores without having to pay any additional transportation costs[8]. We will then introduce a Superstore into the model.

2.1 The City

The spatial representation of our city is given by a straight line interval starting from the Central Business District (CBD) and going outwards[9]. The CBD is where all consumers work[10]. The other end of the city is Farmland, and represents the furthest out any consumer will choose to live. The city is closed such that the population size and composition are exogenously determined. We normalize the geographical and population size of the city to 1, therefore we will not include population density (the ratio of population size to geographical space) in this model[11]. We use $z \in [0, 1]$ to represent the location of any given consumer or firm. The CBD

[8]Equivalently the Corner Stores could be located in the Central Business District of the city, allowing households to shop there after work without any additional transportation costs. We found the "corner" location of the Corner Stores more intuitive, but within our model the two structures are equivalent.

[9]Our choice of a line interval is similar to Brueckner et al. (1999), amongst others, and makes it easier to include rental lines in the model. For a treatment of spacial competition in a circular city or a bi-directional line please see Salop (1979).

[10]Although we call it "work", in a simple sense we are using the CBD as the central location for a majority of necessary economic and social activities other than shopping.

[11]In this model population density would not impact the decisions of firms and consumers.

will be used as the starting point of the line, $z = 0$, and the Farmland will be the outer point of the city, $z = 1$.

Figure 2.1: The City

The retail rental price at any given point in the city is determined by the highest rent any household is willing to pay to live at that point[12]. Similar to Brueckner et al. (1999) and other bid-rent spatial models the rental lines in our city adjust to make consumers of the same type indifferent as to their chosen location. We normalize the rental line by taking the rent at the Farmland as exogenously determined by the external land market, $r(1) = a$, and then allowing the rest of the land market to clear[13]. Throughout this paper we assume that zoning laws limit the Superstore to locating in the outer part of the city and that rents go to landlords, who are absentee[14].

There are two types of transportation cost in our model, the money cost of commuting, t and shopping, g. These are both per-unit costs that need to be multiplied by distance from destination to determine the full cost to the consumer.

For the sake of focusing our question and keeping our analysis simple, we make the following assumptions about our model city:

(i) Only one household can live at any given location.

(ii) Stores do not take up any space, therefore a consumer can live where a firm is located[15].

(iii) The money cost of commuting to work is higher than the the money cost of traveling to the store, $t > g$. This is an intuitive assumption as consumers commute to work daily, while shopping might happen on a weekly basis.

[12]Note that this only refers to the rental price for housing, we do not include commercial rent in our model.

[13]It is necessary to fix rent at some point in the city in order to pin down consumer welfare and Superstore profit. This assumption means that only relative changes in rent matter when we consider the impact of the Superstore. Absolute changes in rent are not as informative because by choosing to fix rent at $z = 1$ we mechanically prevent rent at that location to change in response to changes in the model. We will elaborate on this below.

[14]Rather than zoning laws one might consider a setting where the fixed costs faced by the Superstore decreased significantly with z, forcing the Superstore to locate at the end of the city. Several papers looking at the location choice of firms find that a monopoly retailer would choose to locate at the city boundary (see Lai and Tsai (2008) amongst others).

[15]Note that assumptions (i) and (ii) along with our normalization of the geographical and population size of the city means that in all proposed city structures below households are uniformly distributed across the city line.

(iv) There are no outside options in our model. Consumers must choose where to live and shop given what is available to them in the model.

(v) Firms compete on price.

Households have two decisions to make, where to live and where to shop. Firms also have two decisions to make, whether or not to enter and what price to charge. In each iteration of our model we will consider the conditions for a partial equilibrium for consumers and firms, and then combine our results to determine the general equilibrium outcome of the model. We assume the following strategic interaction for the different actors in the model:

(i) Firms maximize profits taking the strategy of other firms and decision rules of consumers as given.

(ii) Consumers choose where to live and shop taking the price of firms, prevailing rental lines and the shopping decision of other consumers as given.

(iii) Rental prices in equilibrium are such that no consumer would be better off by moving to a new location.

We are assuming that the shopping strategy and location choice of households and competition across firms can be treated as occurring simultaneously. A general equilibrium in our model consists of both of these markets being in equilibrium and no player in the market preferring to move away from equilibrium or moving to an alternative equilibrium. This is a static general equilibrium model without dynamics.

As we stated above, we begin with a city where only Corner Stores exist, with a homogeneous consumer population, all earning wage w. All consumers work at the CBD and will have to commute from their homes to work, requiring them to pay a monetary cost of commuting equal to tz. Consumers shop at their local Corner Store, so do not have to pay any extra commuting costs related to shopping.

2.2 Consumers' Problem When Shopping at the Corner Store

Consumers spend all of their net earnings on one good, x, providing them with utility measured by $u(x)$, which we assume to be strictly increasing. They choose where to live taking the prevailing rent and price charged by firms as given. Therefore, the maximization problem for a representative consumer living at point z and shopping at the Corner Store is given by:

$$\max_{x} \quad u(x|p_c, r(z))$$

$$s.t. \qquad p_c x = w - tz - r_c(z) \tag{2.1}$$

Equation (2.1) is the usual budget constraint, where p_c is the price charged by the Corner Store and $r_c(z)$ is the rent paid by the consumer located at z and shopping at the Corner Store. This constraint is binding by the monotonicity of our utility function. Given that we are only concerned with the consumption of one good and since there is no uncertainty in our model, we can solve directly for the consumers' optimal choice of x. This is analogous to using a linear utility function, which is what we will work with for the rest of this paper. Therefore, the indirect utility from shopping at the Corner Store for our representative consumer is given by:

$$v_c = \frac{w - tz - r_c(z)}{p_c} \tag{2.2}$$

Consumers choose z to maximize v_c. Therefore, given our homogenous consumer population, $r_c(z)$ must be such that the utility level for consumers is constant across the city line. We can rearrange the equation above to solve for the rental rate at any point z on the city line interval while treating v_c as fixed with respect to z.

$$r_c(z) = w - tz - p_c v_c \tag{2.3}$$

We can think of this equation as the "rental indifference line". Since in equilibrium the utility of all consumers is independent of location, we can fix the utility for consumers living in our model city by the utility level of the consumer living at the Farmland, $z = 1$, paying a fixed rent of $r(1) = a$:

$$v_c(z = 1) = v_c = \frac{w - t - a}{p_c} \tag{2.4}$$

Combining equations (2.3) and (2.4) we can rewrite the rental formula along our city line:

$$r_c(z) = t(1 - z) + a \tag{2.5}$$

The rent in our city is a decreasing function of z, as consumers move out towards the

Farmland they are able to save money on rent equivalent to the extra commuting costs they must pay to get to work.

2.3 Consumers' Problem When the Superstore is an Option

Now we will introduce the Superstore into our city model. The Superstore pays a positive fixed cost k for unlimited capacity and a lower marginal cost than the Corner Stores. As we stated above, zoning laws limit the Superstore to locating in the Farmland. Along with positive fixed costs this means that if a Superstore chooses to enter the market, only one will enter. Otherwise we would have a duopoly under Bertrand competition, resulting in negative profits.

The Superstore enters as a monopolist facing a competitive fringe (the Corner Stores). The maximization problem for a consumer living at point z and shopping at the Superstore is:

$$\max_x \quad u(x|p_s, r(z))$$

$$s.t. \quad p_s x = w - tz - g(1-z) - r_s(z)$$

Where p_s is the price charged by the Superstore, $r_s(z)$ is the rent paid when living at z and shopping at the Superstore and $g(1-z)$ is the commuting cost of living at point z and shopping at the Superstore. The resulting utility level is:

$$v_s = \frac{w - tz - g(1-z) - r_s(z)}{p_s} \tag{2.6}$$

Again, since we have a homogenous consumer population, we must have that in equilibrium the utility for consumers must be independent of where they choose to shop and where they choose to live. Solving for $r_s(z)$ in the equation above we can determine the equilibrium rental line faced by consumers that shop at the Superstore:

$$r_s(z) = w - tz - g(1-z) - p_s v_s \tag{2.7}$$

Note that there is only one prevailing rent, $r(z)$, at any given location z, across our city line. In equilibrium this prevailing rent is determined by the upper envelope of the two rental lines in (2.3) and (2.7) (Where we substitute in $v_c = v_s = v$). The distinction between $r_c(z)$ and $r_s(z)$ is related to the role of rental lines in keeping consumers of the same type indifferent between living in different locations across the city. The slope of $r_c(z)$ is $-t$ in order to compensate households living further out in the city for the extra commuting costs to the CBD. The slope of $r_s(z)$ is $-t + g$ since consumers that shop at the Superstore and live further out in the city pay a higher commuting cost to the CBD, but benefit from a lower cost of traveling to the Superstore. The graph below is a representation of what equilibrium rental lines might look like in our city after having introduced the Superstore.

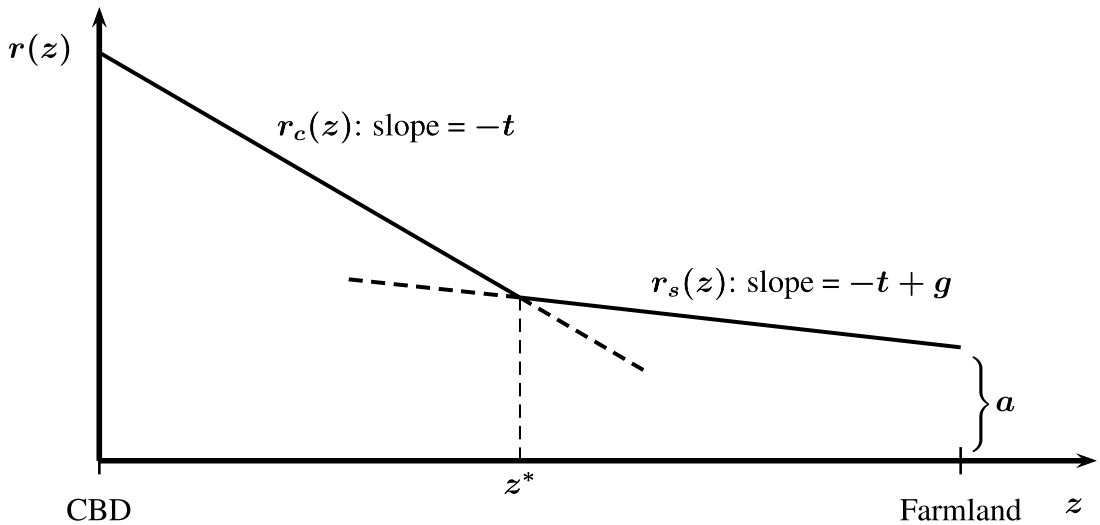

Figure 2.2: Rental Lines

In our analysis below we will use $r(z)$ when referring generally to the prevailing rent at a given location, while using $r_c(z)$ and $r_s(z)$ when discussing equilibrium rent in different equilibrium city structures.

The shopping "rule" for a consumer living at a point z would be to shop at the store that would provide it with the highest utility, where it can buy the most of good x after paying for rent and transportation costs. Comparing the two utilities in (2.2) and (2.6) we have that the household located at z would shop at the Superstore if and only if the following holds:

$$1 - \frac{p_s}{p_c} > \frac{g(1-z)}{w - tz - r(z)} \tag{2.8}$$

As we stated above, consumers take the price of firms as given, therefore in making their shopping decision the left side of the above inequality is taken to be fixed. Whether or not a consumer shops at the Superstore depends on the value of the right side of (2.8), which is a function of household location, z. Let us first consider the consumer living at $z = 1$. Plugging $z = 1$ into inequality (2.8) above it is clear that the household living at this point in the city would shop at the Superstore as long as $p_s < p_c$. This consumer does not have to pay any additional transportation costs to shop at the Superstore, so they will shop at the store offering the lowest price. It is easy to see that given positive transportation costs the Superstore would have to charge a price lower than the Corner Stores in order to attract any customers, otherwise all households would be better off shopping locally and not paying the extra cost of traveling to the Superstore. This result, along with the positive fixed costs of entry, means that if the Superstore enters the city it must charge a price below p_c and at the least attract the household living at $z = 1$. Therefore the utility of the consumer living in the outer part of the city, and in turn the utility of all households, is given by:

$$v_s(z=1) = v_s = v_c = v = \frac{w-t-a}{p_s} \tag{2.9}$$

Combining equations (2.7) and (2.9) we can solve for the equilibrium rental line for consumers in our city that shop at the Superstore:

$$r_s(z) = (t-g)(1-z) + a \tag{2.10}$$

Plugging (2.9) into (2.3) we can solve for the equilibrium rental line faced by consumers shopping at the Corner Stores in terms of the price charged by the Superstore:

$$r_c(z) = w - \tfrac{p_c}{p_s}(w-t-a) - tz \tag{2.11}$$

We have that $r_s(z)$ is less steep than $r_c(z)$ (with respect to z), which means that if the two lines cross they would only cross once. There is a point along the city line interval such that the consumers living to the right of that point will choose to shop at the Superstore. This scenario is depicted in Figure 2.2 above. That point in the line, which we will call z^*, is determined by the value of z such that the two rental lines as given by equation (2.11) and (2.10) are equal. Solving for z we have the proportion of consumers that shop at the Superstore:

$$1 - z^* = \frac{1}{\lambda}\left(\frac{p_c}{p_s} - 1\right) \qquad \text{s.t.} \quad z^* \geq 0 \tag{2.12}$$

$\lambda = \frac{g}{w-t-a}$ is a transportation parameter that measures shopping cost as a percentage of the disposable income of the representative consumer[16,17]. The demand faced by the Superstore is determined by the point z^*. As the Superstore increases its price, p_s, the point at which

[16] We define disposable income as earned wages net of rent and transportation costs.

[17] More generally, if we define $\lambda(z)$ as the ratio of g to the disposable income of the consumer living at z, it is easy to show that in equilibrium this ratio does not change with z. So we have that in equilibrium $\lambda(z) = \lambda(1) = \lambda$.

consumers switch from shopping at the Corner Stores to the Superstore increases, decreasing the number of consumers that pay the additional cost to shop at the Farmland.

As we argue above, if the Superstore enters the market it will always choose a price lower than p_c, capturing a positive fraction of the market, that is $1 - z^* > 0$. Alternatively, if $1 - z^* = 1$ the Superstore would be serving the entire market and would not have any incentive to lower its price. This gives us the following range for the Superstore's price:

$$\frac{p_c}{1+\lambda} \leq p_s < p_c \tag{2.13}$$

The Superstore can drive out the Corner Stores from the city by providing a significant price discount relative to the transportation cost needed to commute out to the Farmland, represented here by λ. Interestingly, in low-income communities shopping and commuting costs represent a higher percentage of disposable income, high λ. A higher lambda would decrease the lower bound in inequality (2.13), making it more difficult for the Superstore to drive out the Corner Stores. Though not obvious, this result is somewhat intuitive. Low-income consumers find it relatively more costly to travel to the store with the lower price, forcing those that live too far away from the Farmland to shop at the more expensive, but more convenient Corner Stores. The role of income in the condition in equation (2.13) raises the question of what happens in communities where there are both rich and poor households. We will consider that question in detail in the next section when we introduce heterogeneous consumers into our model.

For now we turn to the choices of p_c and p_s in our current framework.

2.4 Corner Stores

Corner Stores are located all along the city line and behave competitively without any fixed costs or other barriers to entry. Throughout this paper we will assume that the commercial rental market is independent of the housing rental market, therefore the cost structure of the firms in our city is independent of the consumers' rental lines. The Corner Stores face a constant marginal cost, $\bar{c}$, no fixed costs, and compete on price, therefore in equilibrium their price must be equal to their constant marginal cost, $p_c = \bar{c}$.

We can plug this price into the indirect utility from equation (2.4) to determine consumer welfare in our base case model with the Corner Stores as the only option:

$$v_c = \frac{w - t - a}{\bar{c}} \tag{2.14}$$

2.5 The Superstore's Problem

The Superstore faces a fixed cost k and a constant marginal cost, $\hat{c}$. We assume that the marginal cost faced by the Superstore is lower than that of the Corner Stores, $\hat{c} < \bar{c}$. As we stated above, the Supertore takes the price of Corner Stores and the shopping rule of the consumers as given. The Superstore's maximization problem is given by:

$$\max_{p_s} \quad \pi_s(p_s|p_c, r(z)) = \theta(p_s|p_c, r(z))v(p_s|p_c, r(z))[p_s - \hat{c}] - k \tag{2.15}$$

$$s.t. \quad \theta(p_s|p_c, r(z)) \leq 1$$

Here $\pi(p_s|p_c, r(z))$ is the profit of the Superstore as a function of its choice of price, taking the price of the Corner Stores and the rental lines in the city as given. $\theta(p_s|p_c, r(z))$ is the proportion of consumers that shop at the Superstore. In the Superstore's profit function the proportion of consumers that shop at the Superstore, and how much they buy, $v(p_s|p_c, r(z))$, are both dependent on the price of the Superstore. In our analysis that follows, we take $k \to 0$ trivially, since any positive level of fixed costs would deter an additional Superstore entering the market.

Taking the derivative of the objective function in (2.15) with respect to price we have the first order condition (FOC) for profit maximization for the Superstore[18]:

$$\frac{\partial \pi_s}{\partial p_s} = \left(\frac{\partial \theta}{\partial p_s}v + \frac{\partial v}{\partial p_s}\theta\right)[p_s - \hat{c}] + \theta v = 0 \tag{2.16}$$

The Superstore would raise its price until the additional revenue from a higher price is exactly offset by the loss of intensive and extensive demand from the city's consumers. The sensitivity of extensive demand (θ) and intensive demand (v) to changes in price, along with the cost advantage of the Superstore, will determine the choice of price by the Superstore, and in effect its level of market penetration.

2.6 Equilibrium Analysis

We will now consider the general equilibrium outcome in the base case of our city model. We combine the results from the Consumers' problem and the firms' maximization problems in order to determine the price and profit of the Superstore, as well as the rental lines and resulting utility for the consumer population.

[18]It is straightforward to show that the second order condition for maximization is satisfied at the unique stationary point of the Superstore's profit function.

As we argued in our analysis of the consumers' problem, the utility for a representative consumer shopping at the Superstore is given by $v = \frac{w-t-a}{p_s}$. Taking the derivative of this function with respect to the Superstore's price we solve for how intensive demand changes with price: $\frac{\partial v}{\partial p_s} = -\frac{v}{p_s}$. We also have that the proportion of consumers that shop at the Superstore is given by the equation (2.12) above, therefore in equilibrium $\theta = 1 - z^*$. Differentiating this with respect to the Superstore's price and then substituting in $p_c = \bar{c}$, we have how extensive demand changes with price in equilibrium:

$$\frac{\partial \theta}{\partial p_s} = \frac{\partial (1 - z^*)}{\partial p_s} = -\frac{\bar{c}\, v}{g\, p_s} \tag{2.17}$$

Before we go on to explicitly solve for the Superstore's price we can substitute our equations for $\frac{\partial v}{\partial p_s}$ and $\frac{\partial \theta}{\partial p_s}$ into the first derivative of the Superstore's profit function in (2.16) to get an image of the shape of the Superstore's profit as a function of it's choice of price.

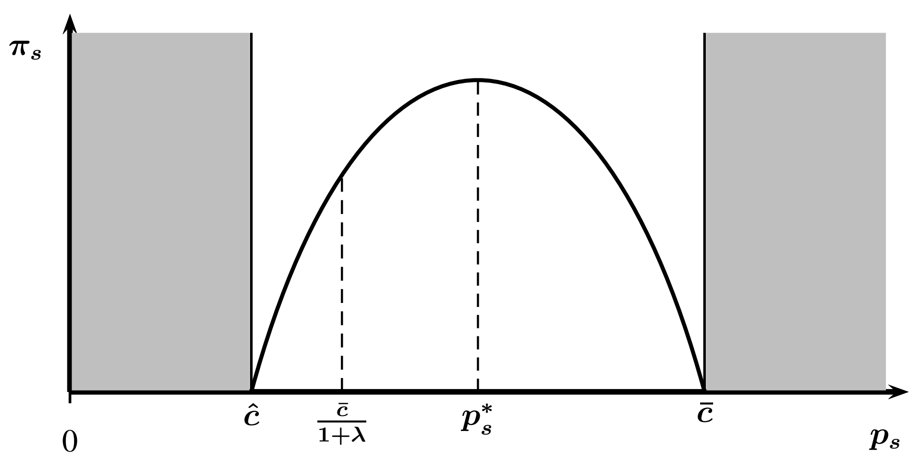

Figure 2.3: Superstore's Profit

The profit curve in figure 2.3 is drawn assuming an interior solution, the optimal price p_s^* is above the cutoff point identified in equation (2.13). If we had drawn the figure so that the cutoff point was above p_s^* then we would have had a corner solution: the Superstore would have chosen $p_s = \frac{\bar{c}}{1+\lambda}$ and captured the entire market.

Substituting for $\frac{\partial v}{\partial p_s}$ and $\frac{\partial \theta}{\partial p_s}$ in the FOC above and solving for p_s we have the interior solution to the Superstore's problem. As we might expect the Superstore's choice of price is a function of the marginal costs of the two types of firms:

$$p_s^* = \bar{c}\left(\frac{2\hat{c}}{\bar{c} + \hat{c}}\right) \tag{2.18}$$

$\hat{c} < \bar{c}$ by assumption, therefore the term in the parenthesis is a positive fraction less than one. We have that $p_s < p_c = \bar{c}$, as we expected. Surprisingly, equation (2.18) does not include consumer income and transportation costs. This is because when we have a homogenous consumer population, w, t and g, have a multiplicative effect on the Superstore's profits, so do not impact its choice of price. When we introduce consumers heterogeneous in income, transportation costs and consumer income will impact the Superstore's price as well as its profits.

Plugging in our derived price into the equation for z^* in (2.12) above we can solve for the portion of the consumers that choose to shop at the Superstore:

$$1 - z^* = \begin{cases} \frac{1}{2\lambda}\left(\frac{\bar{c}-\hat{c}}{\hat{c}}\right) & \frac{\bar{c}-\hat{c}}{\hat{c}} < 2\lambda \\ \\ 1 & \text{Otherwise} \end{cases} \tag{2.19}$$

Which is always positive, therefore the Superstore will enter the market and attract a proportion of the consumer population. As long as we have that $\frac{\bar{c}-\hat{c}}{\hat{c}} < 2\lambda$ the Superstore does not capture the entire market and there is room for Corner Stores in the city. The difference between the costs of the two types of firms must be low relative to the extra commuting cost required to shop at the Superstore. This is in line with what we would expect in practice. In cities with large discount stores and low transportation costs it would be less likely that we would find a Corner Store.

Substituting in p_s^* from equation (2.7) above into the Superstore's objective function in equation (2.15) we have the resulting level of profits for the monopolist:

$$\pi_s = \frac{g\hat{c}}{4\lambda^2\bar{c}}\left(\frac{\bar{c}-\hat{c}}{\hat{c}}\right)^2$$

The profit of the Superstore is positive, and an increasing function of the marginal cost of the Corner Stores, $\frac{\partial \pi_s}{\partial \bar{c}} > 0$ (and decreasing with the marginal cost of the Superstore). Profits for the Superstore decrease when the transportation costs in the city increase ($\frac{\partial \pi_s}{\partial t} < 0$, $\frac{\partial \pi_s}{\partial g} < 0$). This is an interesting result, usually transportation costs would impact a business' profits directly through increasing their variable costs of bringing supplies to the stores. Here we have demonstrated that stores can also lose out from high transportation costs due to a decrease in demand, brought on by a decrease in the purchasing power of the consumer. Big discount stores, or Superstores, can mitigate the effect of high transportation costs on their market share through helping reduce those costs for their customers. One example is when companies such as Tesco (U.K.), Ikea and Walmart (U.S.) provide free buses that take customers from city centers out to their more remote store locations.

Now we consider the impact of the entry of the Superstore on the rental market. The rental rate in the city without the Superstore is given by equation (2.5). When we introduced the Superstore the rental line for consumers shopping at the Superstore is given by equation (2.10), which is clearly less than or equal to the old rental line for all values of z. Substituting p_s^* into (2.11) we have the new rental line for consumers shopping at the Corner Stores:

$$r_c(z) = w - \frac{g}{\lambda}\left(\frac{\bar{c}+\hat{c}}{2\hat{c}}\right) - tz \tag{2.20}$$

Which we can show to be below our old rental line for all values of z. In figure 2.4 below the grey area represents the loss to the absentee landlords due to the entry of the Superstore.

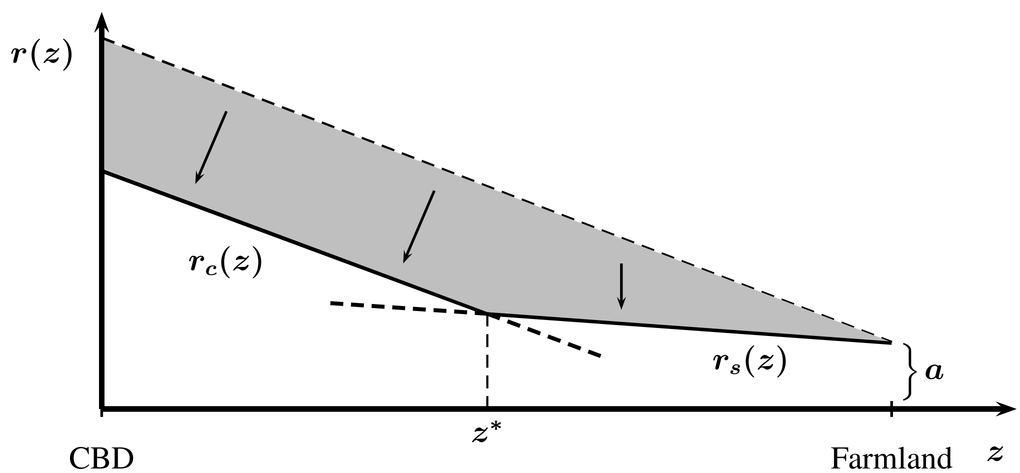

Figure 2.4: Superstore's Impact On Rental Lines

Introducing the Superstore into the model drives down rental costs across the entire city except for at the Farmland, where rent is determined by the world market. Within our model the absolute change in the rental line is not informative[19]. The key to the above result is that the entry of the Superstore has led to the retail rent in the Farmland to increase **relative** to the rest of the city. This is in line with empirical work showing the positive impact of Superstores on retail rent (see for example Des Rosiers et al. (1996) and Pope and Pope (2012)).

Finally, we determine the impact of the Superstore on the welfare of the consumers by comparing the indirect utility of the consumer population in equation (2.14) with the indirect utility after we introduce the Superstore in equation (2.9). Plugging in our calculated p_s^* into equation (2.9) we solve for the consumers' utility after the Superstore enters the market:

[19]Within this model the absolute change in rent depends on the choice of anchor point for the rental lines. In this case we chose to fix rent at the Farmland and let the rest of the retail market clear. If we had fixed any other point in the city the change in absolute rent would have been different from above, but the change in relative rent would have remained the same. We discuss this point a bit more in our analysis of consumer welfare below.

$$v = \frac{(\bar{c} + \hat{c})(w - t - a)}{2\bar{c}\hat{c}} = \frac{g(\bar{c} + \hat{c})}{2\bar{c}\hat{c}\lambda} \tag{2.21}$$

Subtracting the utility to consumers before and after introducing the Superstore we can quantify the change in individual consumer welfare due to the Superstore:

$$\Delta v = \frac{g(\bar{c} - \hat{c})}{2\bar{c}\hat{c}\lambda} \tag{2.22}$$

The positive impact of the Superstore on consumers is an increasing function of the cost differential between the two types of firms and the purchasing power of the consumers themselves (λ). Within this model the positive impact of the Superstore is independent of whether or not a household is a customer of the Superstore. The consumers that shop at the Superstore benefit directly from a lower price, while those that continue to shop at the Corner Stores benefit from lower relative rents. The important result here is not the positive absolute change in welfare, but rather that the impact of the Superstore is felt equally by the entire consumer population, irrespective of where they shop. We will see a similar mechanism when we introduce heterogenous consumers below. The increase in consumer welfare is slightly misleading and is driven by our assumption that the rent at the Farmland is fixed. If we had fixed the rent at the CBD instead, the rent at the Farmland would have increased in response to the Superstore and the welfare of the entire consumer population would have remained unchanged. This leads to an interesting result where the positive impact of a Superstore's entry on the consumer population depends to some extent on the price elasticity of the land market in the city. This is an area we would like to explore further in future work. For the sake of our current analysis we need to fix the rent at some point in the city line, and assuming that the price in the Farmland is exogenously determined seems at least as plausible as any other alternative.

Irrespective of this limitation, the positive change in consumer welfare brought about by the entry of the Superstore is in line with the empirical findings of Hausman and Leibtag (2007). In their paper they demonstrate that consumers benefit significantly from the entry of Superstores (or what they refer to as Supercenters) into a market. They argue that restrictive zoning laws that do not allow Superstores to enter certain markets can end up hurting consumers, an argument that our results above support. But our results suggest that this positive effect would be mitigated by any increase in rent prices for households that have access to these Superstores.

The entry of the Superstore benefits consumers in the form of higher consumption, leaves Corner Stores indifferent earning zero profits, and leads to the Superstore earning positive profits. The only ”losers” in our model are the landlords who earn lower rents on their property.

3 The Model With Heterogeneous Consumers

In this section we extend our base case analysis by introducing two exogenously determined levels of income. We continue to normalize our city size and population to 1, but now our city will be made up of high-income consumers (type h) and low-income consumers (type ℓ). A proportion, α, of the consumer population are type h consumers and earn high wages, w_h, and $(1-\alpha)$ are type ℓ and earn low wages, w_ℓ. We take α as given. We will assume that the transportation costs of the poor are at least as great as that of the rich ($t_\ell \geq t_h$ and $g_\ell \geq g_h$). This is a key assumption that, as we will see below, assures us the segregated city structure we are looking to analyze. Some theoretical work on segregation assume that the rich have a higher opportunity cost of time, and therefore have higher transportation costs (See for example Brueckner et al. (1999))[20]. Although this assumption seems plausible, we believe that it is also possible for the poor to have greater constraints on their time and a higher monetary cost of transportation, which might offset the time cost of the rich[21]. In this paper we are interested in a segregated city where the poor are located away from the large retailer, therefore we constrain relative transportation costs as above. For an analysis of various equilibrium city structures when relative transportation costs of the the two types of consumers can take any value please see Somekh (2014a).

We continue to assume that $t_i > g_i$ for both types of consumers and add the assumption that these two types of transportation costs vary across consumer type by a constant ratio[22]. As before, we first consider the case where only Corner Stores exist, then we introduce the Superstore. We will continue to use the same strategic setup and definition of equilibrium as in the previous section. The strategy of Corner Stores does not change with the introduction of heterogenous consumers, therefore throughout this section we will continue to substitute $p_c = \bar{c}$ for the price of the Corner Stores, and assume that they will choose whether or not to enter the city optimally. We begin with the consumers, who choose their location and shopping destination, taking the strategy of firms and decision of other consumers as given.

3.1 Consumers' Problem When the Corner Store is the Only Option

When consumers only have the option of shopping at the Corner Stores the city rental lines is similar to what we derived in section 2:

[20] In many spacial models with heterogenous consumers transportation costs are taken to be the same across consumer types (see Lai and Tsai (2008)). Our assumption is slightly more general since we allow for the transportation costs of the poor to be greater than or equal to that of the rich.

[21] LeRoy and Sonstelie (1983) argue that the rich can have access to faster and more expensive modes of transportation, allowing for their combined per-unit transportation costs to be lower than that of the poor.

[22] That is: $\frac{t_h}{g_h} = \frac{t_\ell}{g_\ell}$. Note that these assumptions imply that $t_h - g_h \geq t_\ell - g_\ell$. We will use this condition in our analysis of the consumers' problem below.

$$r_{i,c}(z) = w_i - t_i z - \bar{c} v_{i,c} \qquad \text{for} \;\; i = h, \ell \tag{3.1}$$

As we argued above, the equilibrium utility for consumers within the same income class must be constant with respect to location, $\frac{\partial v_i}{\partial z} = 0$. Therefore the slope of the rental lines with respect to z is equal to $-t_i$, the same as before except that now it depends on consumer type. It is easy to show that since low-income consumers have a higher cost of commuting the only equilibrium structure is where the ℓ-types weakly outbid the h-types in the city center[23,24]. This scenario is depicted in Figure 3.1 below. The reverse would hold if high-income consumers had a higher cost of commuting[25]. To see why this is true let us consider the alternative where the rich live in the center. That would mean that the rich outbid the poor near the CBD, $r_h(0) > r_\ell(0)$. But if this was true and we have $-t_\ell \leq -t_h$ by definition, then that means that the low-income group's rental line is below the high-income rental line across the city, which can not be an equilibrium outcome.

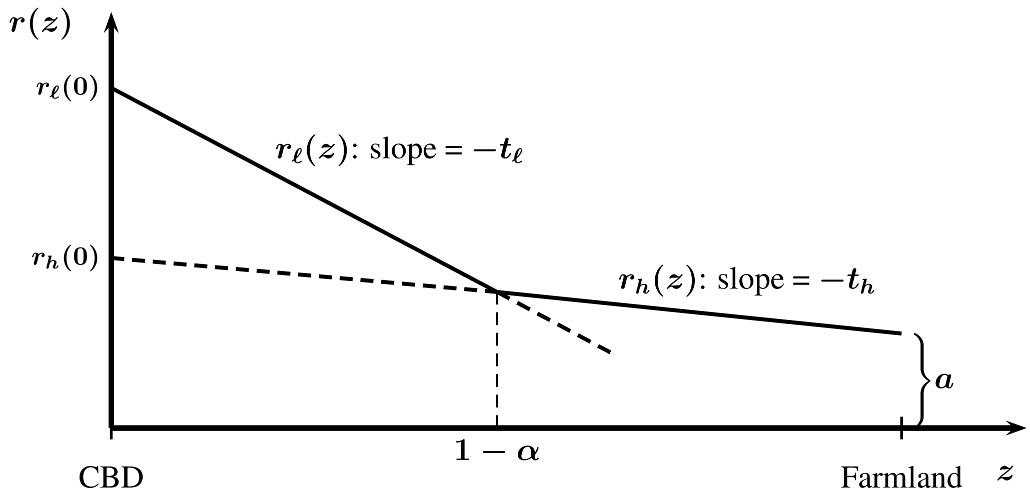

Figure 3.1: Rental Lines

This city structure is similar to the one proposed by Brueckner et al. (1999) when amenities are spread out evenly across the city. The only difference is that we assume that the commuting

[23]If the transportation costs of the two types were equal the rental lines would overlap and the city would be fully integrated. Our results below include this possibility.

[24]The critical role of relative transportation costs at this point is because the only factor impacting the consumer's decision is tho cost of commuting to the CBD. As other papers have argued, factors such as desire for space and access to schooling could mitigate the importance of relative transportation costs. This will also be true in our model when we introduce the Superstore below.

[25]Somekh (2014a) considers different city structures within a similar model where relative transportation costs can vary between the two types.

cost of the rich is less than the poor, leading to the rich living in the outer part of the city even if there are no amenities drawing them there.

Since higher income consumers live in the outer part of the city one of them would live at $z = 1$, and the utility for all type h consumers would be equal to that representative consumer.

$$v_{h,c} \;=\; \frac{w_h - t_h - a}{\bar{c}} \;=\; \frac{g_h}{\bar{c}\lambda_h} \tag{3.2}$$

λ_i is the same transportation parameter we defined in subsection 2.3 above, but it now varies with consumer type[26]. Plugging equation (3.2) into our general rental line in equation (3.1), we can solve for the prevailing rental line in the outer part of the city.

$$r_{h,c}(z) = t_h(1 - z) + a \tag{3.3}$$

Notice that this rental line is identical to the rental line in our base case model except that now transportation costs vary with income. The equilibrium utility of the type ℓ consumer is determined by the point where the rental lines of the two types of consumers intersect, which by construction must be exactly at the segregation point of the city, $1 - \alpha$. All type ℓ households live to the left of the intersection point and all h-types live to the right. This type of segregation is depicted in Figure 3.1 above.

Setting the rental line for ℓ-types in equation (3.1) equal to the rental line for h-types in (3.3) and substituting in $1 - \alpha$ for z we can solve for the equilibrium utility and rental line for low-income consumers when Corner Stores are the only option.

$$v_{\ell,c} = \frac{g_\ell}{\bar{c}\lambda_\ell} + \frac{\alpha(t_\ell - t_h)}{\bar{c}} \qquad\qquad r_{\ell,c}(z) = \alpha t_h + (1 - \alpha - z)t_\ell + a \tag{3.4}$$

We can compare the two utility outcomes by subtracting $v_{\ell,c}$ from $v_{h,c}$.

$$\bar{c}(v_{h,c} - v_{\ell,c}) \;=\; w_h - w_\ell \;+\; (1 - \alpha)(t_\ell - t_h) \tag{3.5}$$

The poor are not able to consume as much of the composite good x, and have a lower indirect utility. Despite being segregated away from the CBD the h-types enjoy greater purchasing power due to their higher income as well as lower transportation costs.

Alternatively we can compare the utility of the two types of consumers in (3.2) and (3.4) with their utility in the base case without a Superstore in (2.14).

[26] Recall that $\lambda_i = \frac{g_i}{w_i - t_i - a}$

$$\Delta v_h = 0 \quad \text{and} \quad \Delta v_\ell = \frac{(1-\alpha)(t_\ell - t_h)}{\bar{c}} \tag{3.6}$$

When the Superstore is not an option higher income consumers are indifferent between a segregated city with two types of households and a rich homogenous city. Low-income consumer are strictly better off in an integrated city, benefitting from the lower transportation cost of the other consumer type, which drives down rental prices relative to the base case.

These results are not meant to suggest that without a Superstore segregation is simply dependent on relative transportation costs. In our simple model we are ignoring some other important factors that contribute to segregation. Most of these factors have been discussed by previous papers, Brueckner et al. (1999) and the AMM models among others. What we are looking to identify in this analysis is the kind of agglomeration pressures that introducing a Superstore into a city can create. What we see at first is that without a cheaper outside option shopping seems to have a neutral effect on household choice of location. Without a Superstore, households shop after work near their homes, so in effect shopping has no additional impact on household location. Now we go on to consider what happens when we introduce a Superstore into our city with heterogeneous consumers.

3.2 Consumers' Problem When the Superstore is an Option

The consumers problem is similar to what we set out in our base case, households can choose to shop at their local Corner Store or pay the additional transportation cost and shop at the Superstore located at $z = 1$. The only difference is that now there are two types of consumers, differing in their income and transportation costs. Therefore we have that the indirect utility and rental line for a type i consumer located at z and shopping at the Superstore is given by:

$$v_{i,s} = \frac{w_i - t_i z - g_i(1-z) - r_{i,s}(z)}{p_s}$$

$$r_{i,s}(z) = w_i - t_i z - g_i(1-z) - p_s v_{i,s} \qquad \text{for} \quad i = h, \ell \tag{3.7}$$

As before we have that in equilibrium the utility of consumers of the same type does not change with location, therefore the gradient of the rental line with respect to z for the type i consumer is equal to $-t_i + g_i$[27].

[27] Recall that our assumptions on transportation costs imply that $t_\ell - g_\ell > t_h - g_h$. This means that as well as having $r_{\ell,c}$ be steeper than $r_{h,c}$ we also have that $r_{\ell,s}$ is steeper than $r_{h,s}$.

In addition, the equilibrium utility for type i consumers shopping at the Superstore must equal the utility for type i consumers shopping at the Corner Stores, $v_{i,c} = v_{i,s} = v_i$. The shopping "rule" that consumers use to determine where to shop is the same as in (2.8) above, except that now income and transportation costs vary with consumer type. Setting the rent lines for shopping at the Corner Stores from (3.1) equal to that of shopping at the Superstore in (3.7) we can solve for the point in equilibrium where type i consumers switch from shopping locally to shopping at the Superstore[28]:

$$z_i^* = 1 - \frac{(\bar{c} - p_s)v_i}{g_i} \qquad \text{for } \; i = h, \ell \qquad s.t. \quad z_i^* \geq 0 \tag{3.8}$$

We still have that the relative transportation costs between the two income groups plays a significant role in the equilibrium form of segregation. As we demonstrate in Proposition 3.1 below, we have restricted our transportation parameters in such a way as to assure a segregated equilibrium structure where the rich live in the outer part of the city, close to the Superstore, and the poor live near the CBD. This will allow us to consider the impact of introducing a Superstore into a segregated city.

Proposition 3.1: *When the transportations costs of high-income consumers is less than or equal to that of the low-income consumers, $t_h, g_h \leq t_\ell, g_\ell$, we must have that in equilibrium $r_\ell(0) \geq r_h(0)$ and $r_h(1) \geq r_\ell(1)$. In other words, when the transportation costs of the poor is at least as high as that of the rich then the rich will always weakly prefer to live at $z = 1$, while the poor will always weakly prefer to live at $z = 0$.*

The intuition for this Proposition is that if the rich have a lower cost of transportation, then the two main factors in our model, commuting and shopping, are both pushing them out to the Farmland. Firstly, as in the previous subsection, lower transportation costs means living closer to the center is less of a factor for them than for the low-income consumers. Secondly, their higher purchasing power means that they stand to gain more from the lower price offered by the Superstore, and therefore would be willing to pay more to live out near the Farmland.

Proof: We can see from equation (3.7) that, taking the Superstore's price and residential rent as given, the purchasing power of the h-types at the Superstore is unambiguously greater than that of the ℓ-types, $v_{h,s} > v_{\ell,s}$. From equation (3.8) we can clearly see that when $v_h > v_\ell$ and $g_h \leq g_\ell$ we must have that the type h consumers switch to shopping at the Superstore at a point closer to the city center than the type ℓ consumers. That is, $z_h^* < z_\ell^*$.

[28]Note that this point is unique when the consumer market is in equilibrium, where no consumers have incentive to change their location and shopping decisions.

Now let us assume the opposite of our proposition, that there exists an equilibrium such that the rich outbid the poor near the CBD, $r_h(0) > r_\ell(0)$, so only the rich would live in the city center. But given the fact that the rich switch to shopping at the Superstore earlier than the poor ($z_h^* < z_\ell^*$) and that the slopes for the rental lines of the poor are steeper than that of the rich, that would mean the rental line for the rich would be higher than that of the poor across the entire city line, the poor would be homeless. But this is not an equilibrium in our model. First of all, the rich have no incentive to strictly outbid the poor across the entire city line since they only live at one location and we have not included housing size in our model[29]. Secondly, we have assumed that there are no outside options for housing, so the poor would have incentive to bid up their rental lines until they are able to live somewhere within the city. As the rental lines for the two types converge, the rental line for the poor living near the CBD would overlap with that of the rich at least as quickly as that of the poor and rich living out in the Farmland, giving us $r_h(0) = r_\ell(0)$, violating our assumption above.

In the same way, if we assume that the poor outbid the rich at the Farmland then their rental line would be above the rich across the entire city, giving the rich incentive to raise their rental lines until $r_h(1) = r_\ell(1)$.

So if the poor have higher transportation costs any equilibrium city structure must involve the poor living at the CBD and the rich living in the Farmland. It is easy to show that the opposite is not true. When the transportation costs of the rich are greater than that of the poor we can not say anything definitive about the switching points of the two types of consumers, z_h^* and z_ℓ^*, as well as qualify any possible city structure. Somekh (2014a) considers in some detail the different city structures that are possible when there are no constraints on the relative transportation costs of the two types of consumers.

From Proposition 3.1 we have that for the consumer market to be in equilibrium we must have a high-income household living at $z = 1$ and shopping at the Superstore. Therefore the utility for all type h consumers is given by:

$$v_{h.s} = v_{h,s}(z=1) = \frac{w_h - t_h - a}{p_s} = \frac{g_h}{p_s \lambda_h} \tag{3.9}$$

The rental line for the high-income consumers shopping at the Corner Stores and the Superstore are respectively given by:

$$r_{h,c} = w_h - t_h z - \bar{c}\left(\frac{g_h}{p_s \lambda_h}\right) \qquad\qquad r_{h,s} = (t_h - g_h)(1-z) + a \tag{3.10}$$

[29]This is a simplifying assumption we make in our model in order to focus on shopping behavior, other papers have considered the impact of space preference on structural outcome, see AMM models.

In the second equation in (3.10) we have that the rental line for the rich shopping at the Superstore, $r_{h,s}$, does not depend on the price of the Superstore. That is because we have fixed the rent at $z = 1$ to a[30]. Changes in the Superstore's price impact the high-income consumers directly through their purchasing power as defined by (3.9), and indirectly through their rental line from shopping at the Corner Stores. As p_s increases the rent the rich are willing to pay to live at the center increases. As we will discuss below, if the Superstore's price becomes high enough a portion of the high-income consumers will switch to shopping at the Corner Stores. Nevertheless, we have that as long as the Superstore chooses to enter the market the utility of h-types and their rental lines will be given by (3.9) and (3.10) above.

The utility and rental lines of the low-income consumers are less straight-forward, they depend on the demand structure within the city, which in turn depends on the Superstore's price. Figure 3.2 below portrays the three "interior" demand structures within our model.

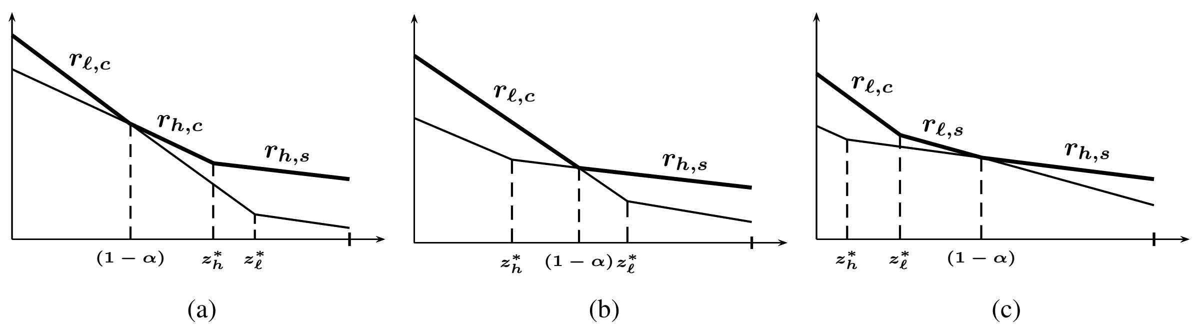

Figure 3.2: Potential City Structures in Equilibrium

By "interior" demand structure we mean cases where at least a portion of the consumer population are shopping at both types of firms[31]. The first case of consumer demand is demonstrated in Figure 3.2a above, where all low-income consumers shop locally at the Corner Stores and high-income consumers are split between shopping at the Superstore and the Corner Stores (The point z_h^* separates the high-income consumers that shop locally from those that travel to the Farmland). In Figure 3.2b the two types of consumers are fully segregated in terms of where they choose to shop. Finally in Figure 3.2c all h-types shop at the Superstore and the ℓ-types are split between the two types of stores (with z_ℓ^* separating them).

The Superstore's price will determine the equilibrium demand structure. As p_s decreases, consumer demand increases from case (a) to (b) to (c), resulting in a non-continuously differentiable demand curve with two kinks.

[30]Recall that only relative rent matters in our model.

[31]There are two "corner" demand structures where either all consumers shop at the Superstore (we will briefly address this below) or nobody shops at the Superstore. We have already argued above that if the Superstore enters the market the second "corner" case is not possible in equilibrium.

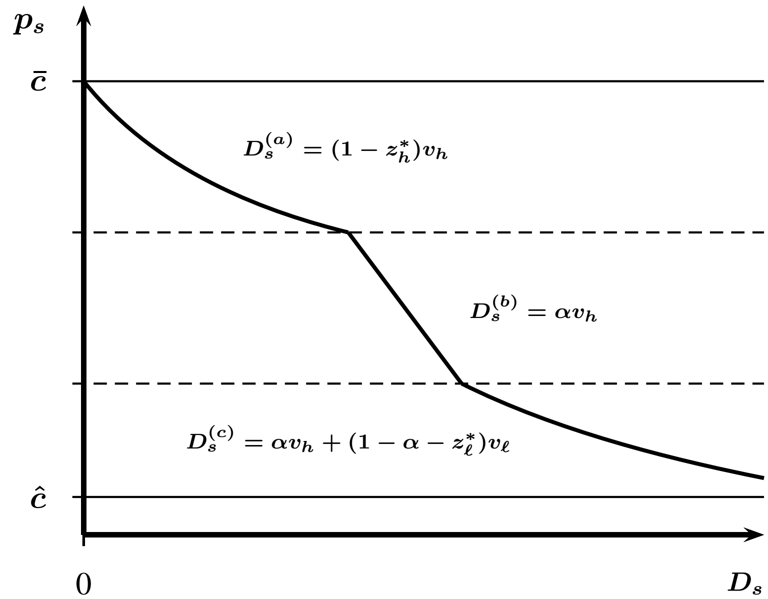

Figure 3.3: Superstore Demand in a Segregated City

We have implicitly assumed that $\hat{c}$ is low enough relative to $\bar{c}$ to allow for the 2nd and 3rd cases of demand. In our analysis of demand below we will more formally define our assumptions regarding the difference between the marginal costs of the two types of firms.

The demand line associated with $D_s^{(b)}$ is straight and drawn more steeply than the other two lines because in that price band demand is only increasing intensively as price decreases (no additional consumers are shopping at the Superstore, only the existing customers are buying more of the good), while in the other price ranges demand is increasing both intensively and extensively (the slopes of the lines are becoming less negative). We will show that the price elasticity of demand along $D_s^{(b)}$ is equal to -1, combined with our assumption of constant marginal costs, this means that along that section of the demand line the Superstore would increase its price until it reaches the kinked intersection between $D_s^{(a)}$ and $D_s^{(b)}$.

Throughout our analysis below the utility and rental lines of the high-income consumers are given by (3.9) and (3.10) above.

3.2.1 Separated High-Income

In the first case of consumer demand, depicted in Figure 3.2a, the Superstore's price is high enough to push the switching points of the two types of consumers beyond the segregation point in the city, $1 - \alpha$. All low-income households shop at the Corner Stores while the high-income consumers are split between shopping locally and shopping at the Farmland. The utility for the low-income consumers is determined by the point where the effective rental line of the poor crosses that of the rich at the segregation point of the city, $1-\alpha$. Setting $r_{\ell,c}$ equal to $r_{h,c}$

and substituting $1-\alpha$ for z we find the utility level and the effective rental line for low-income consumers in terms of the Superstore's price:

$$v_{\ell}^{(a)} = \frac{g_\ell}{\bar{c}\lambda_\ell} + \frac{\alpha(t_\ell - t_h)}{\bar{c}} + \left(\frac{\bar{c}}{p_s} - 1\right)\frac{g_h}{\bar{c}\lambda_h} = v_{\ell,c} + \left(1 - \frac{p_s}{\bar{c}}\right) v_{h,s} \tag{3.11}$$

$$r_{\ell,c}^{(a)} = w_h + (1-\alpha)(t_\ell - t_h) - \frac{\bar{c}g_h}{p_s\lambda_h} - t_\ell z \tag{3.12}$$

The utility of the poor is equal to their purchasing power without the Superstore ($v_{\ell,c}$) plus a fraction of the utility of the rich. Although low-income households do not shop at the Farmland they benefit from the entry of the Superstore; in fact their utility is a decreasing function of the Superstore's price. In this section of the demand line the Superstore impacts type ℓ consumers through their rental line. As the Superstore's price decreases, living near the CBD becomes less attractive, allowing the poor to benefit despite being segregated away from the Farmland.

We can show that as long as the Superstore's price is less than $\bar{c}$ we have that $v_h > v_\ell$ and $z_h^* < z_\ell^*$ in all potential equilibria. The only other condition necessary for this structure to represent an equilibrium in the consumer market is that p_s is high enough to ensure that the switching point of the rich falls at a higher point in the city than the point of segregation, $z_h^* > 1-\alpha$. We have that in order for (a) to represent an equilibrium in the consumer market the Superstore's price must fall in the following range:

$$\frac{\bar{c}}{1+\alpha\lambda_h} < p_s < \bar{c} \tag{3.13}$$

When the poor represent a smaller portion of the population, high α, it is more likely that the Superstore will charge a higher price and only target high income consumers. The high-income consumers might also lose out in this type of scenario. As we will see below, when the Superstore has incentive to target both types of consumers it ends up charging a lower price, benefiting the entire consumer population[32].

3.2.2 Fully Segregated

In this city structure the two income classes are completely segregated, with the rich living out in the Farmland and shopping at the Superstore and the poor living closer to the city center and shopping at their local Corner Store. This scenario is depicted in Figure 3.2b above. The utility and rental line of low-income households are determined by the point where the rental lines for the ℓ-type consumers shopping at the Corner Stores equals that of the h-types shopping at the Superstore at $1-\alpha$. Setting $r_{h,s}$ in equation (3.10) equal to the general equation for $r_{\ell,c}$ in (3.1) and substituting in $z = 1-\alpha$ we have:

[32] We are ignoring the possibility that the local population own the Superstore and obtain a share of the profits.

$$v_\ell^{(b)} = \frac{g_\ell}{\bar{c}\lambda_\ell} + \frac{\alpha(t_\ell - t_h)}{\bar{c}} + \frac{\alpha g_h}{\bar{c}} = v_{\ell,c} + \frac{\alpha g_h}{\bar{c}} \tag{3.14}$$

$$r_{\ell,c}^{(b)} = (1-\alpha)t_\ell + \alpha(t_h - g_h) + a - t_\ell z \tag{3.15}$$

The utility of the low-income consumers depends on the proportion of high-income households in the city, α, but does not depend on the Superstore's price. From (3.9) we have that this is not the case for the welfare of type h consumers. Nevertheless, p_s does impact the poor's welfare indirectly by determining whether or not the city would be in this case of demand in equilibrium. More specifically, the Superstore's price must be low enough so that high-income consumers would prefer not to live in the center or shop at the Corner Stores but high enough not to draw the poor out to the Farmland or to shopping at the Superstore. This requires that the switching points of the two type of consumers fall on either side of the segregation point in the city, $z_h^* \leq 1-\alpha \leq z_\ell^*$, giving us the following range on the Superstore's price:

$$\frac{\bar{c}}{1+\frac{\alpha g_\ell}{\frac{g_\ell}{\lambda_\ell}+\alpha[t_\ell - t_h)-(g_\ell - g_h)]}} \leq p_s \leq \frac{\bar{c}}{1+\alpha\lambda_h} \tag{3.16}$$

The equilibrium condition above is more likely to hold as $g_\ell - g_h$ increases. As we would expect, if it is more costly for the poor to travel to the Superstore relative to the rich it is more likely that they will choose to shop locally. More interestingly, the larger the difference between the transportation parameter λ_i of the two types, the greater the range in (3.16). As the difference in income increases it becomes more likely that demand is fully segregated in equilibrium. As we will show below, this will lead to a higher Superstore price in equilibrium, hurting both types of consumers.

3.2.3 Separated Low-Income

In the final case of demand the Superstore's price is low enough to push the switching points of the two types of consumers closer to the city center than the segregation point, $1-\alpha$, as in Figure 3.2c above. In this structure the Superstore captures all of the high-income consumers as well as a portion of the poor. The welfare and rental lines for the ℓ-types is determined by where the rental lines for the two types shopping at the Superstore intersect at the segregation point in the city. Setting $r_{\ell,s}$ from (3.7) equal to $r_{h,s}$ and substituting in $1-\alpha$ for z we have[33]:

[33] We leave out $r_{\ell,c}^{(c)}$ here but it can easily be obtained by substituting $v_\ell^{(c)}$ into the general formula in (3.1).

$$v_\ell^{(c)} = \frac{g_\ell}{p_s\lambda_\ell} + \frac{\alpha[(t_\ell - g_\ell) - (t_h - g_h)]}{p_s} \tag{3.17}$$

$$r_{\ell,s}^{(c)} = (1-z)t_\ell - \alpha[(t_\ell - g_\ell) - (t_h - g_h)] + a \tag{3.18}$$

In order for this structure to represent an equilibrium in the consumer market the price of the Superstore must be such that the switching point of the low-income consumers falls between 0 and $1-\alpha$, giving us the following range for p_s:

$$\frac{\bar{c}}{1+\frac{g_\ell}{\frac{g_\ell}{\lambda_\ell}+\alpha[t_\ell - t_h)-(g_\ell - g_h)]}} \leq p_s < \frac{\bar{c}}{1+\frac{\alpha g_\ell}{\frac{g_\ell}{\lambda_\ell}+\alpha[t_\ell - t_h)-(g_\ell - g_h)]}} \tag{3.19}$$

A smaller portion of high-income consumers, α, increases the range above and makes this city structure more likely. We can see this more clearly by taking $t_h, g_h \to t_\ell, g_\ell$, simplifying the range in (3.19) to $\frac{\bar{c}}{1+\lambda_\ell} \leq p_s < \frac{\bar{c}}{1+\alpha\lambda_\ell}$. As we will see below, the left side of (3.19) represents the lower bound for the Superstore's price. At that price the Superstore would attract all of the households living in the city, any further decrease in p_s would only increase intensive demand, leading to lower profits.

3.3 Superstore's Problem With Households Heterogeneous In Income

The Superstore chooses its price taking the rental market and location of consumers as given. The general form of the Superstore's problem is given by:

$$\max_{p_s} \quad \pi_s(p_s|r(z)) = [\theta_h(p_s|r(z))v_h(p_s) + \theta_\ell(p_s|r(z))v_\ell(p_s)]\,[p_s - \hat{c}] \tag{3.20}$$

$$s.t. \quad \theta_h \leq \alpha \quad \text{and} \quad \theta_\ell \in [0, 1-\alpha]$$

$\theta_i(p_s|r(z))$ is the proportion of type i consumers that shop at the Superstore conditional on the rental market. The above set up is in effect a maximization problem with three inequality constraints[34]. Whether or not a particular constraint is binding depends on the city structure and the choice of price by the Superstore. Differentiating $\pi_s(p_s|r(z))$ with respect to price we get the following general form for the Superstore's first order condition (FOC) for profit maximization:

[34] As we have discussed above, if the Superstore enters the market we must have $\theta_h > 0$.

$$\frac{\partial \pi_s}{\partial p_s} = \left(\frac{\partial \theta_h}{\partial p_s} v_h + \frac{\partial v_h}{\partial p_s}\theta_h + \frac{\partial \theta_\ell}{\partial p_s} v_\ell + \frac{\partial v_\ell}{\partial p_s}\theta_\ell\right)[p_s - \hat{c}] + \theta_h v_h + \theta_\ell v_\ell = 0 \tag{3.21}$$

This function is similar to the FOC we calculated earlier except that now we have two types of consumers. Changes in the Superstore's price may effect the proportion of each type of consumer that shop there (θ_i, extensive demand) as well as the amount of the good the consumer buys (v_i, intensive demand).

The Superstore faces a kinked demand curve similar to the one depicted in Figure 3.3 above. For each possible equilibrium below we will present conditions for profit maximization using the FOC in (3.21) as well as by checking potential jumps in the Superstore's price.

3.4 Analysis of Equilibria

At this point we combine the analysis of the consumer market with the Superstore's problem to determine the Superstore's profits and consumer welfare in equilibrium. We also look for the conditions on our parameters for each structure to constitute a general equilibrium outcome within our stylized model. For the rest of our analysis we will focus on the special case where the transportation costs are the same for the two types of consumers, $t_\ell = t_h = t$ and $g_\ell = g_h = g$. As we have seen above, higher transportation costs for the poor serve to exacerbate their disadvantage relative to the higher income group. Yet, even if the poor have the same absolute transportation costs as the rich, these costs will represent a higher portion of their disposable income, as captured by the parameter λ_i[35]. This simplification will help with our exposition below and will not change our results in any significant way[36].

3.4.1 Superstore's Profit

In the first demand structure the poor do not shop at the Superstore, $\theta_\ell = 0$. In addition we have that $\frac{\partial \theta_\ell}{\partial p_s} = 0$ and $\frac{\partial v_\ell}{\partial p_s} = 0$. Only intensive and extensive demand from high-income consumers are changing with marginal changes in the Superstore's price. From our analysis of the consumers' problem we have that in this case of demand $\theta_h = 1 - z_h^*$. Differentiating (3.9) and (3.8) with respect to p_s we have that $\frac{\partial v_h}{\partial p_s} = \frac{-v_h}{p_s}$ and $\frac{\partial(1-z_h^*)}{\partial p_s} = \frac{-\bar{c}v_h}{gp_s}$. Substituting these results into the Superstore's FOC we can solve for the Superstore's price and profit:

[35] Note that we still have $\lambda_\ell > \lambda_h$.

[36] The more general analysis of equilibrium with the poor having weakly greater transportation costs is available upon request.

$$p_s^{*(a)} = \bar{c}\left(\frac{2\hat{c}}{\bar{c}+\hat{c}}\right) \qquad \pi_s^{*(a)} = \frac{g\hat{c}}{4\lambda_h^2\bar{c}}\left(\frac{\bar{c}-\hat{c}}{\hat{c}}\right)^2 \tag{3.22}$$

A similar result to what we calculated for the Superstore in our Base Case. This similarity is not surprising since as in the Base Case the Superstore is targeting a portion of one type of consumer. From our analysis of the consumers problem we have that in this case of demand the Superstore's price must fall in the range in (3.13). Substituting in $p_s^{*(a)}$ we get the following condition on the Superstore's cost advantage over the Corner Stores:

$$0 \ < \ \tfrac{\bar{c}-\hat{c}}{\hat{c}} \ < \ 2\alpha\lambda_h \ = \ \bar{T}_1 \tag{3.23}$$

(3.23) is the necessary and sufficient condition for (a) to represent a general equilibrium. As depicted in Figure 3.4 below, when $\frac{\bar{c}-\hat{c}}{\hat{c}}$ falls between 0 and $\bar{T}_1$ (where $\bar{T}_1 = 2\alpha\lambda_h$), $\pi_s^{*(a)}$ is the greatest potential profit for the Superstore. As long as the Superstore's cost advantage is not too high relative to the proportion of h-types (α) and their transportation parameter (λ_h), the Superstore would enter the market and only target a portion of the rich.

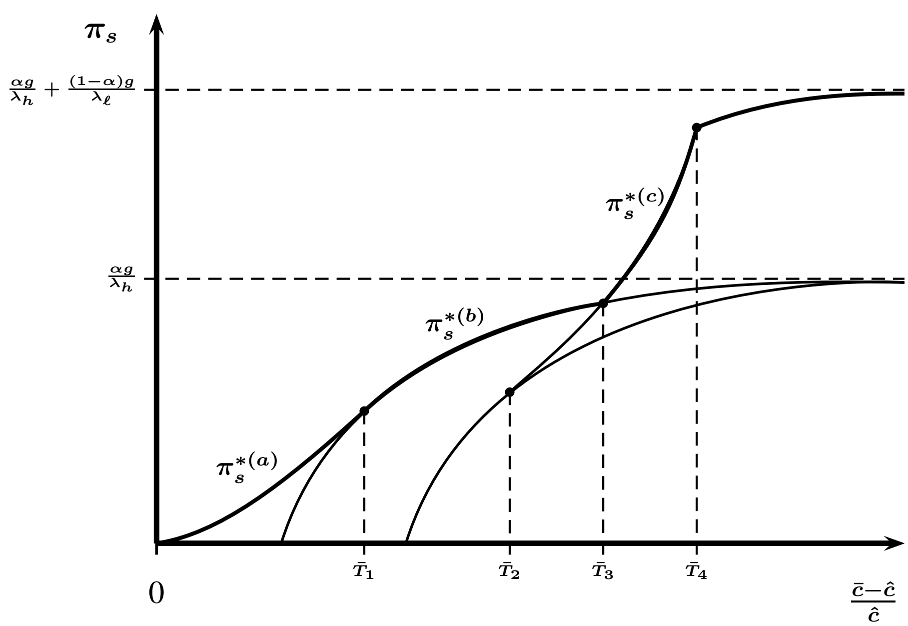

Figure 3.4: Superstore's Profit

From the Superstore's FOC we have that when the cost advantage of the Superstore is greater than $\bar{T}_1$ the Superstore would choose a price low enough to draw the entire high-income population, leading to a corner solution and the segregated demand structure (structure (b)).

In the fully segregated outcome portrayed in Figure 3.2b all of the poor shop at the Corner Stores and all of the rich shop at the Superstore. Two of our inequality constraints are binding, $\theta_\ell = 0$ and $\theta_h = \alpha$ (and so by definition the other two constraints are slack). In addition, as long as the condition on the Superstore's price from the inequality in (3.16) is satisfied, we have that $\frac{\partial \theta_i}{\partial p_s} = 0$ for $i = \ell, h$ and $\frac{\partial v_\ell}{\partial p_s} = 0$.

The only part of the model that is changing with marginal changes in the Superstore's price is intensive demand from high-income consumers, $\frac{\partial v_h}{\partial p_s} = \frac{-v_h}{p_s}$, giving us:

$$\frac{\partial \pi_s}{\partial p_s} \;=\; \tfrac{-\alpha v_h}{p_s}(p_s - \hat{c}) + \alpha v_h \;=\; \tfrac{\alpha v_h \hat{c}}{p_s} \;>\; 0 \tag{3.24}$$

Within this city structure profits are increasing with p_s. This is because as long as $\frac{\bar{c}}{1+\alpha\lambda_\ell} < p_s < \frac{\bar{c}}{1+\alpha\lambda_h}$ demand from consumers is unit elastic with respect to Superstore price, $\epsilon_{v_h} = \frac{\partial v_h}{\partial p_s}\frac{p_s}{v_h} = -1$. The Superstore would want to raise its price as long as doing so would not cause it to lose any customers. In other words the Superstore would increase p_s until $z_h^* = 1 - \alpha$ in Figure 3.2b. This gives us a corner solution where equilibrium price and profit are:

$$p_s^{*(b)} = \frac{\bar{c}}{1+\alpha\lambda_h} \qquad\qquad \pi_s^{*(b)} = \frac{\alpha g \hat{c}}{\lambda_h \bar{c}}\left(\frac{\bar{c}-\hat{c}}{\hat{c}} - \alpha\lambda_h\right) \tag{3.25}$$

Substituting the Superstore's price from (3.25) into the range in (3.16) we have the following sufficient condition for (b) to represent an equilibrium:

$$\bar{T}_1 \quad\leq\quad \frac{\bar{c}-\hat{c}}{\hat{c}} \quad\leq\quad \alpha\lambda_\ell\left(1 + \tfrac{\lambda_\ell}{\lambda_h}\right) \quad=\quad \bar{T}_2 \tag{3.26}$$

Beyond transition point $\bar{T}_2$ the Superstore's cost advantage is large enough to induce the Superstore to lower its price below the lower constraint in (3.16), drawing a portion of the low-income consumers. But as we can see in Figure 3.4 when $\frac{\bar{c}-\hat{c}}{\hat{c}} = \bar{T}_2$ the Superstore would be better off charging $p_s^{*(b)}$ in a fully segregated outcome since we still have $\pi_s^{*(b)} > \pi_s^{*(c)}$[37]. Comparing the Superstore's maximum profit from demand structures (b) and (c) we can show that the necessary and sufficient range for (b) to represent and equilibrium is wider than the one in (3.26), and given by the range below:

$$\bar{T}_1 \quad\leq\quad \frac{\bar{c}-\hat{c}}{\hat{c}} \quad\leq\quad \bar{T}_2 \;+\; 2\lambda_\ell\sqrt{\tfrac{\lambda_\ell-\lambda_h}{\lambda_h}} \quad=\quad \bar{T}_3 \tag{3.27}$$

[37]Note that at $\bar{T}_2$ the Superstore's maximum profit from demand structure (c), $\pi_s^{*(c)}$, is weakly greater than its profit in the segregated structure when charging $p_s = \frac{\bar{c}}{1+\alpha\lambda_\ell}$, but less than its its maximum profit, $\pi_s^{*(b)}$, which it obtains by charging $p_s = \frac{\bar{c}}{1+\alpha\lambda_h}$.

As the difference between the transportation parameter of the two types, λ_i, increases it becomes more likely that the Superstore will charge a higher price and only target the higher income consumers. This is as we would expect. A higher λ_ℓ means that transportation costs represent a higher percentage of the income of ℓ-type consumers, making it more costly for them to travel out to the Farmland for shopping. As we noted earlier, λ_i is a increasing function of t and g and is decreasing with income.

In the third case of demand all of the high-types and some of the low-types shop at the Superstore. Therefore we have that $\theta_h = \alpha$ (so that $\frac{\partial \theta_h}{\partial p_s} = 0$) and $\theta_\ell = 1 - \alpha - z_\ell^*$. Similar to case (a) we have that $\frac{\partial v_i}{\partial p_s} = \frac{-v_i}{p_s}$ for $i = \ell, h$ and $\frac{\partial \theta_\ell}{\partial p_s} = \frac{\partial(1-\alpha-z_\ell^*)}{\partial p_s} = \frac{-\bar{c} v_\ell}{g p_s}$. Substituting into the Superstore's FOC we get the following for the Superstore's price and profit in (c).

$$p_s^{*(c)} = \frac{2\bar{c}}{\frac{\bar{c}+\hat{c}}{\hat{c}} - \alpha\lambda_\ell\left(\frac{\lambda_\ell - \lambda_h}{\lambda_h}\right)} \qquad \pi_s^{*(c)} = \frac{g\hat{c}}{4\bar{c}\lambda_\ell^2}\left[\frac{\bar{c}-\hat{c}}{\hat{c}} + \alpha\lambda_\ell\left(\frac{\lambda_\ell - \lambda_h}{\lambda_h}\right)\right]^2 \tag{3.28}$$

Substituting $p_s^{*(c)}$ into the range on the Superstore's price from (3.19) as well as comparing the Superstore's maximum profit in (b) and (c) we get the following necessary and sufficient range for (c) to represent an equilibrium:

$$\bar{T}_3 \quad \leq \quad \frac{\bar{c}-\hat{c}}{\hat{c}} \quad \leq \quad 2\lambda_\ell + \alpha\lambda_\ell\left(\frac{\lambda_\ell - \lambda_h}{\lambda_h}\right) \quad = \quad \bar{T}_4 \tag{3.29}$$

This result is depicted in Figure 3.4 above. When $\frac{\bar{c}-\hat{c}}{\hat{c}}$ falls between the transition points $\bar{T}_3$ and $\bar{T}_4$ the Superstore would choose a low price and target both types of consumers. This scenario becomes more likely as the aggregate purchasing power of the poor increases. If the poor represent a large portion of the city market (low α) or have a high purchasing power relative to their cost of traveling (low λ_ℓ), they would be a more attractive consumer for the Superstore. Note that if the Superstore's cost advantage falls beyond $\bar{T}_4$ the Superstore would charge $p_s = \frac{\bar{c}}{1+\lambda_\ell}$ and capture the entire market.

The above constraints follow the path we would expect. When income inequality in the city, measured in our model by α and $(\lambda_\ell - \lambda_h)$, is high relative to the Superstore's cost advantage, the Superstore would be expected to charge a higher price and only target the wealthy consumers. As the cost advantage of the Superstore increases relative to the inequality within the city, we move through the different demand structures depicted in Figure 3.2 above. We can use our results above to draw figures depicting the ranges in which the three cases of demand obtain. The diagram below compares the cost advantage of the Superstore over the Corner Stores, $\frac{\bar{c}-\hat{c}}{\hat{c}}$, relative to the proportion of high-income consumers in our city, α.

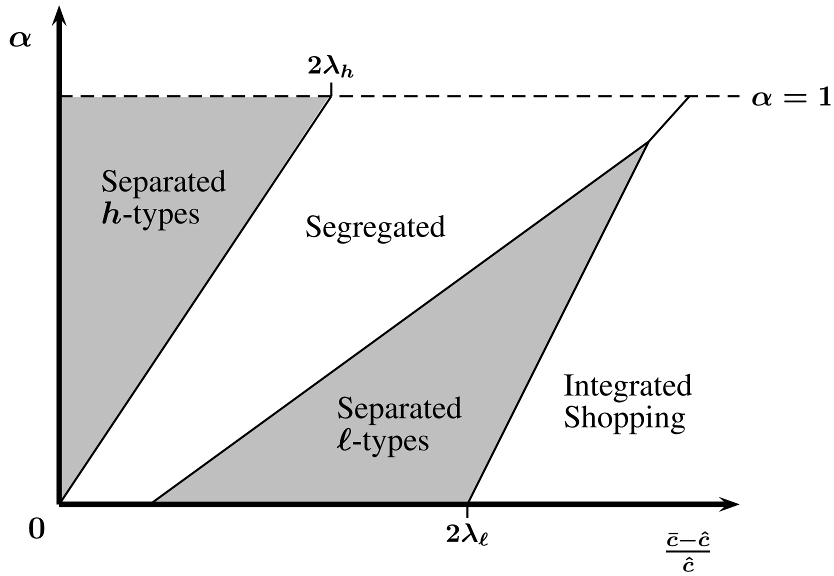

Figure 3.5: Regions of Equilibria: α

For low levels of α and a high cost advantage for the Superstore it becomes more likely that both types of consumers shop at the Superstore. This outcome is associated with the lowest price charged by the Superstore, and the lowest rental prices across the city. Interestingly, for low values of the Superstore's cost advantage, holding α constant, income differential does not impact the equilibrium outcome. Even for very small differences in income, when the Superstore does not have a significant advantage over the Corner Stores the demand structure $D_s^{(a)}$ would be an equilibrium. We can interpret this result as a capacity requirement for stores to impact consumer shopping decisions. For consumers to consider shopping at the Superstore, there must be a significant difference between the price (and capacity) of the Superstore relative to the Corner Stores that are more readily available.

3.4.2 Equilibrium Utility

To see the impact of the Superstore on consumer welfare we plug in the Superstore's equilibrium choice of price into the utility of the two types of consumers from the three different demand structures. Substituting $p_s^{*(a)}$, $p_s^{*(b)}$ and $p_s^{*(c)}$ into the utility functions we derived in Section 3.2 we have two surprising results. One is that both types of consumers benefit from the lower price offered by the Superstore, even in the first case of demand where the low-income consumers only shop at the Corner Stores. The second is that the utility of the ℓ-types increases at a faster rate with Superstore price in the Separated h-type equilibrium (a), when the ℓ-types do not shop at the Superstore. Figure 3.6 below depicts how consumer utility changes with the marginal cost of the Superstore holding all other parameters constant.

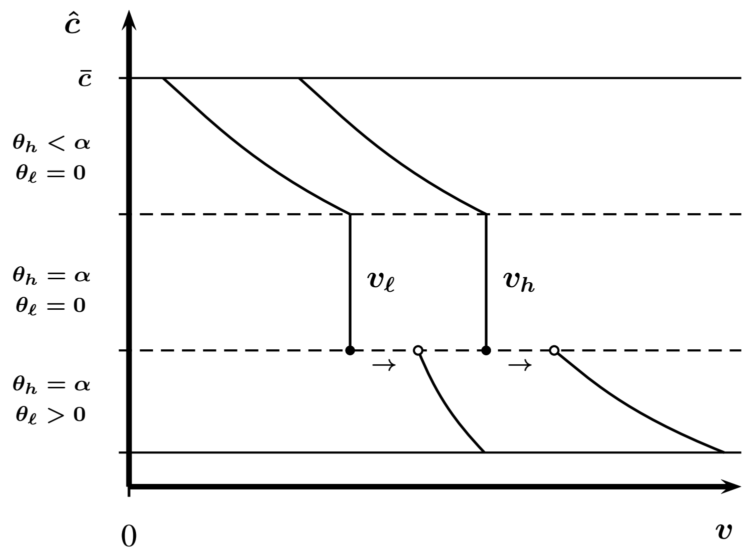

Figure 3.6: Equilibrium Utility

In the Separated h-type equilibrium in the top part of the graph both types of consumers benefit equally from the cost advantage of the Superstore. That is because in that section of the graph the equilibrium rent across the city changes with Superstore's price in order to keep high-income consumers indifferent between shopping at the Superstore and the Corner Stores, conditional on their location. Low-income consumers benefit from the low price offered by the Superstore through lower residential rent. These rents must decrease at the same rate as v_h increases with p_s in order to maintain equilibrium.

In the middle of Figure 3.6, the Superstore chooses the maximum possible price such that it does not lose any high-income consumers. In this structure p_s^* does not depend on the Superstore's marginal cost. Therefore we have that consumer utility does not depend on the cost advantage of the Superstore, and only changes with our consumer parameters.

In the lower portion of Figure 3.6 the low-income consumers begin to benefit directly from the low price offered by the Superstore. Now the utility of both types of consumers is determined by the representative consumer living at $z = 1$ and shopping at the Superstore. Yet, the utilities of the two types of consumers begin to diverge. The greater buying power of high-income consumers allows them to benefit more from the decrease in the Superstore's price, their utility increases at a faster pace relative to that of the low-income consumers.

It is clear that both types of consumers benefit from the entrance of the Superstore into the market. In addition, the welfare of both types of consumers is increasing monotonically with decreases in the price of the Superstore, even when the ℓ-types are shopping at the Corner stores. This is a variation of what is called in agglomeration literature as "Neighborhood Effects". When the city center is integrated, the rental lines across the city are interconnected, allowing low-income consumers to benefit from the Superstore's price through lower rent costs.

An interesting result is that in the third case of demand the two types of consumers do not benefit equally from the Superstore's discount. In the first case of demand, when only the high-income group are shopping at the Superstore, the welfare of the two types of consumers increases at the same rate. This is because the rent in the inner part of the city decreases to keep the h-types indifferent. The low-income consumers benefit from living close to wealthy consumers that shop locally. In the third case of demand, when some low-income consumers begin shopping at the Superstore, v_ℓ increases relatively slower than v_h. When all of the h-types shop at the Superstore the rent in the city is only changing to keep low-income consumers indifferent. This divergence severes the ties between the welfare of the two types of consumers, limiting the benefit of the Superstore' to the ℓ-types due to their lower purchasing power.

4 Conclusion

In this paper we analyze the impact of introducing a low-priced Superstore into a city segregated by income. In our base case model with a homogeneous consumer population we show that the Superstore's entry into the city leads to changes in relative rental prices, allowing all consumers to benefit equally from the entry of the Superstore into the market.

Next we introduce heterogeneous consumers into our model, with consumers earning two exogenously determined levels of income. We construct our model in such a way as to assure a segregated city with the poor living near the city center. Our general equilibrium results demonstrate the impact of the entry of the Superstore into the higher income area of the city. We argue that the low-income consumers that are segregated away from the Superstore might benefit from its entry into the city through lower relative rents. In some ways this is a natural result, one that can be seen as the flip side of gentrification. The main idea is that the monetary benefit of low-priced shopping may be transmitted to the segregated population through lower relative rents. Our results show that if the rental markets fully adjust then we could have the benefit of an amenity to be shared (unevenly) across the entire population, even when the city is segregated. At the same time we show that the poor benefit at a greater rate from changes in the Superstore's price when rental prices are adjusting to keep h-types indifferent. The utility of the two types begins to diverge in the third case of demand, when the rental lines change in response to the welfare of low-income consumers. It is very important to make clear that we are not arguing against the negative impacts of segregation. The rental markets in most cities face various forms of frictions and are impacted by a variety of factors. We would need to test the results of our model empirically to truly understand the welfare transmission of the benefits of the Superstore through retail rent.

A second important result of our paper is the impact of the distribution of income on the price of the Superstore. Our model suggests that the Superstore is more likely to offer a lower price when the difference in income between the two types is not too large (smaller differential between λ_ℓ and λ_h) or when the proportion of the rich is not too large (small α). This is a similar result to Somekh (2014b), which argues that the size of the middle class is inversely proportional to market prices.

The agglomeration factors that we consider in this paper are similar to those considered in previous literature in that they are associated with the amenities available in a city. We go beyond previous literature on regional economics by focusing on the interplay of the rental market with firms' strategy, thereby looking to connect the existing work in regional economics with the industrial organization literature. We also introduce distributional considerations into the city model, demonstrating how the makeup of the consumer population can impact firm strategy and city structure.

One natural question to ask is what are the policy implications of our results. Clearly the transportation costs present in our model are key factors in the outcomes we have described. But lowering transportation costs across the city line would not necessarily help remove these frictions. Our results depend mainly on λ, transportation costs relative to consumers' disposable income. Lowering the cost of transportation would not necessarily lower the relative λ between the two types of consumers. An alternative would be to tax the high-income consumers, and/or the Superstore, and use the tax proceeds to subsidize the transportation costs of the lower income group. But these taxes might have a distortionary impact on Superstore pricing as well as our rental market.

An alternative policy approach might be focused on the retail rental market. Our model demonstrates how the benefits of an amenity might be transmitted across the city through changes in relative rents. The benefits of this transmission to low-income consumers is unclear. If equilibrium is achieved through higher rents in the area close to the amenity then the poor might not benefit, and in fact might be hurt through spillover gentrification as higher-income consumers move away from the more expensive neighborhood. Alternatively if the market responds through lower rents in the area segregated away from the amenities the poor might benefit through a lower cost of living. We look forward to addressing these new questions in future work.

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