Specialization and Exclusion in Two Sided Markets

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Abstract
When will a platform specialize in a sector and when a platform will choose to contain a variety of sectors? In reality, we see that specialized platforms like specialized markets and malls with a variety of sectors coexist. This paper tries to investigate the reasons for specialization in a sector when the platform size is limited and when the platform size is not limited in a two sided market context.
Keywords: two-sided markets, specialization

1. Introduction

Specialized platforms like complexes where only furniture producers meet with the customers coexist with complexes like malls which carry a variety of sectors like food, shoes and apparel. Platforms like Google Play which choose to include mostly free or low priced applications coexist with platforms like Apple Store which choose to include priced applications.

Some shopping malls are specialized to be outlets. For example, in Ankara, 4 out of a total of 22 shopping malls are specialized to be outlets. 1 out of 22 malls in Ankara is specialized in evening dresses with 44 shops out of 198 shops and also specialized in casual wear with 57 shops out of 198 shops. 1 out of 22 malls in Ankara is specialized in home decoration with 9 shops out of 42 shops which also excludes shoes and bags sector.

Specialization of different areas in different products may be an endogenous process.(Krugman, 1991) Specialization in matching markets occur in two sided bee and flower markets. Bees may specialize in particular flowers where the maximum number of specialist bees is bounded.(Peleg, Shmida and Ellner, 1992)

The variety effects the side to be charged and the prices for each side of the market. Accordingly, as the substitutability of the products increase, a monopoly will prefer to charge more to the consumer side than producers side. That is because the consumer surplus is increasing relatively more than the producers surplus.(Hagiu,2009) Shape of the utility function also effects the equilibrium; when the workers are gross substitutes in a two sided matching labor market a stable equilibrium exists.(Kelso and Crawford, 1982)

Size of the platform may change according to competition level and the type of externatities. The market is segmented in equilibrium when the competition within sellers side is harsh. On the other hand when the competition is mild an agglomeration equilibrium exists.(Karle, Peitz and Reisinger, 2016) Different sized platforms may exist at the same time but larger platforms are the efficient platforms in the presence of positive network effects between sides and negative network effects[1] within sides (Anderson, Ellison and Fudenberg, 2008)

The mall may charge different prices for different brands or different floors with the aim of product differentiation. Product differentiation of the intermediaries leads to tipping of the market to only one platform if there is quality competition. But with price competition both platforms will be included. (Brangewitz and Manegold, 2016)

This paper investigates the reasons of specialization in two sided markets; when the platform size is limited and when the platform size is not limited. In the model the two sides of the market consists of consumers and producers side. The model contains a utility function where consumers have a taste for variety in each sector of sectors in the platform they join. There are two sectors of producers, producing different products. Producers may join the platform to meet the consumers. In a mall, the rental rates may be different, a mall can charge different prices to different sectors, thus the model allows product differentiation; platforms can distinguish between different sectors and can charge different rental rates to different sectors. Section 1 searches for the cases where a monopolist may exclude certain sectors thus specialize in other sectors. Section 2 investigates the case of duopoly, if it is possible for one platform to specialize in one sector and the other platform in the other sector.

2. The Model

The two sides of the market are the consumers side and producers side. Producers are said to have shops on the platform they join and meet the consumer through the shops. Consumers meet the shops of the platform they join. There are two sectors where producers of these sectors produce 2 goods, Good A and good B. First, it is assumed that the number of producers in a platform is not limited; the platforms are big enough to carry all

[1] See Kurucu 2008

demand from consumers side and producers side. n_A is the number of shops that offer good A and n_B is the number of shops that offer good B. Number of total consumers are assumed to be equal to a continuum of 1, similarly there is a continuum of 1 total A producers and a continuum of 1 total B producers. Therefore the utility of a consumer from joining platform j can be written as:

$$u = U(n_A^j, n_B^j) - C(P^j)$$

where n_i^j is the number of firms in platform j sector i where $i \in \{A,B\}$. n_i^j depends on the consumer demand for platform j, D^j. Producer $i \in \{A,B\}$ maximizes its profits and choose the platform to join accordingly. The profit of a producer $i \in \{A,B\}$ for joining platform j can be written as follows:

$$\pi = \pi(R(D^j) - C(r_i^j))$$

$R(D^j)$ is the revenue of brand i where D^j is the demand of consumers for platform j and r_i^j the rent that platform j charges to producers of sector $i \in \{A,B\}$. It is assumed that costs are increasing with n_A, n_B and D. The profits of a platform j can be written as:

$$\pi^j = PD + r_A n_A + r_B n_B - C(D, n_A, n_B)$$

Optimal prices and quantities are determined in a two stage game. In the first stage platform(s) set r_A, r_B and P. The model allows for product differentiation, the platform can set r_A and r_B different from each other. In the second stage consumers and producers decide to join the platform or not. In the second stage, given that r_A, r_B and P are set in the first stage, the derived demands of n_A, n_B and D are as follows:

$$n_A = n_A(P, r_A)$$
$$n_B = n_B(P, r_B)$$
$$D = D(P, r_A, r_B)$$

3. The Case of Monopoly

First, assume that the monopoly platform is big enough to be able to include all consumers and producers in the market. The monopolist incurs costs of C where C depends on $D(P, r_A, r_B)$, $n_B(P, r_B)$ and $n_A(P, r_A)$. First order conditions for profit maximization are derived from $\frac{d\pi}{dP} = 0$, $\frac{d\pi}{dr_A} = 0$ and $\frac{d\pi}{dr_B} = 0$ where $\frac{dn_A}{dP} < 0$ and $\frac{dn_B}{dP} < 0$, $\frac{dc}{dP} = \frac{\partial c}{\partial D}\frac{\partial D}{\partial P} + \frac{\partial c}{\partial n_A}\frac{\partial n_A}{\partial P} + \frac{\partial c}{\partial n_B}\frac{\partial n_B}{\partial P} < 0$, $\frac{dD}{dr_A} < 0$, $\frac{dc}{dr_A} < 0$ and $\frac{dD}{dr_B} < 0$, $\frac{dc}{dr_B} < 0$. Marginal cost of D, increasing consumer demand by 1 unit can be written as $MC_D = \frac{\partial c}{\partial D}$. Marginal cost of n_B, increasing B producers by 1 unit can be written as $MC_B = \frac{\partial c}{\partial n_B}$. Marginal cost of n_A, increasing A producers by 1 unit can be written as $MC_A = \frac{\partial c}{\partial n_A}$. Arranging the above equations, profit maximizing P, r_A and r_B can be written as:

$$r_A n_A = \frac{|\varepsilon_{n_A,r_A}| C_A}{(|\varepsilon_{n_A,r_A}| - 1)} - \frac{|\varepsilon_{D,r_A}| \pi_D}{(|\varepsilon_{n_A,r_A}| - 1)}$$

$$r_B n_B = \frac{|\varepsilon_{n_B,r_B}| C_B}{(|\varepsilon_{n_B,r_B}| - 1)} - \frac{|\varepsilon_{D,r_B}| \pi_D}{(|\varepsilon_{n_B,r_B}| - 1)}$$

$$PD = \frac{C_D |\varepsilon_{D,P}|}{(|\varepsilon_{D,P}| - 1)} - \frac{\pi_B |\varepsilon_{n_B,P}|}{(|\varepsilon_{D,P}| - 1)} - \frac{\pi_A |\varepsilon_{n_A,P}|}{(|\varepsilon_{D,P}| - 1)}$$

where $R_D = PD$ is the revenue from including D and $C_D = MC_D D$ is the total cost of including D. From there it can be written as profits of a monopoly platform π_D from consumer side is equal to $R_D - C_D$. $R_i = r_i n_i$ is the revenue from including n_i, $i \in \{A,B\}$ and $C_i = MC_i n_i$ is the total cost of including n_i, $i \in \{A,B\}$. ε_{D,r_A} and ε_{D,r_B} are cross price elasticities of D with respect to r_A and r_B. ε_{n_A,r_A} is the price elasticity of n_A and ε_{n_B,r_B} is the price elasticity of n_B. $\varepsilon_{D,P}$ is the price elasticity of D. $\varepsilon_{n_A,P}$ and $\varepsilon_{n_B,P}$ are the cross price elasticities of n_A and n_B, with respect to P.

$r_A n_A$ depends on profits from consumer side and cost of including A side, weighted by the elasticities. Cost of A effects $r_A n_A$ positively when $|\varepsilon_{n_A,r_A}| < 1$, n_A is inelastic with respect to r_A. But when $|\varepsilon_{n_A,r_A}| > 1$, n_A is elastic with respect to r_A, cost of A effects r_A negatively. In that case, it can be concluded that $r_A n_A$ and markups are decreasing with elasticity in general. When $|\varepsilon_{n_A,r_A}| < 1$, $r_A n_A$ is negatively effected by $|\varepsilon_{D,r_A}| \pi_D$ per A producer and when $|\varepsilon_{n_A,r_A}| > 1$, price is positively effected by $|\varepsilon_{D,r_A}| \pi_D$ per A producer, elasticity $|\varepsilon_{n_A,r_A}|$ is important in determining which side to make profits from. To increase its revenues from the consumer side, platform chooses to put a negative markup over costs. When it is elastic platform charges a positive markup over costs and the revenues will fall due to network effects of the consumer side.

When $|\varepsilon_{n_A,r_A}|$ is elastic, the effect of r_A on n_A and therefore D will be high. A high π_D will have a decreasing effect on $r_A n_A$ when $|\varepsilon_{n_A, r_A}|$ is elastic, π_D will have a subsidization effect on $r_A n_A$; $r_A n_A$ will be lower to subsidize consumer side as $\%\Delta r_A > \%\Delta n_A$ an increase in r_A will decrease $r_A n_A$, thus $r_A n_A$ will be lower. Note that in this case, if $|\varepsilon_{D, r_A}|$ is higher, then the subsidization effect on the A side will be more due to π_D. When $|\varepsilon_{n_A, r_A}|$ is inelastic the effect of r_A on D will be negligible, thus platform will prefer to raise the revenues from A side due to positive network effects of A side on consumer demand Profits from consumers will have a positive effect on revenues from A side due to network effects. An increase in π_D will increase $r_A n_A$, revenues from A side, as $\%\Delta r_A < \%\Delta n_A$, an increase in r_A will increase $r_A n_A$. Markups on costs will be negative when $|\varepsilon_{n_A r_A}|$ is inelastic and positive when $|\varepsilon_{n_A, r_A}|$ is elastic

For specialization in A, conditions for exclusion of B side, $n_B = 0$ is searched. The necessary condition for the platform to exclude B producers is

$$C_B|\varepsilon_{n_B, r_B}| = \pi_D|\varepsilon_{D, r_B}|$$

In this case neither covering the costs of producers of B side nor profits from consumer side is more important than the other. Platform is in between charging positive prices to cover costs from producers of B and subsidizing producer of B to increase profits from the demand side. Thus it can be concluded that, a platform earns from the difference between $C_B|\varepsilon_{n_B, r_B}|$ and $\pi_D|\varepsilon_{D, r_B}|$, if costs are higher, profits from consumer demand side is relatively negligible and $r_B n_B > 0$ to cover up high costs of including producers But if profits from demand side due to n_B is high and costs are relatively negligible, in that case, platform will subsidize B side by $r_B < 0$

Assume that the size of the monopoly platform is small so that N_A, the sum of the total number of A producers and N_B the total number of B producers is bigger than the total slots $\bar{N}$ available for producers in the monopoly platform $N_A + N_B > \bar{N}$ and monopoly incurs no costs. When the number of firms in sectors is not fixed, $N \to \infty$, the monopoly will not be specialized in one sector but will include all sectors and include the varieties within sectors, the tipping equilibrium will occur. That is because there is no loss of including more sectors but an increase in consumer and producers surplus. Platform can earn more by including N_A, N_B and D by setting r_A, r_B and P low enough. Subsidizing of a sector or consumers side is also possible.

Consumers have a preference either for specialization or for variety. Consumers preference is reflected on the their utility function. A utility function which is convex in n_A and n_B, is said to reflect a preference for variety and a utility function which is concave in n_A and n_B, is said to reflect a preference for specialized platforms.

Suppose that available places of the monopolist for shops is fixed and the platform is small enough, as in the case of a mall, platform may choose to specialize or include variety of sectors. Assume that the platform is small such that the maximum number of shops is $\bar{N}$. In that case the optimal choice of n_A and n_B, will be such that $N_A + N_B = \bar{N}$. Of the total number of shops, n_A is the number of shops that offer good A, the total number of shops offering good A is N_A and n_B, is the number of shops that offer good B, the total number of shops offering good B is N_B where $N_A + N_B > \bar{N}$. Below, the cases are shown where a monopoly can choose variety or specialization when the number of available places for producer shops is fixed a in either case where consumer preferences may be in favor of variety or specialization.

When the utility of consumer is convex in n_A and n_B, meaning that consumers have a preference for variety and if the size of the monopoly is fixed meaning the number of available places for new shops is fixed, monopoly may choose specialization over variety depending on $\frac{\partial D}{\partial n_A}$. It is assumed that $\frac{\partial D}{\partial P}$<0. If a monopoly can increase its profits with a change in n_A and n_B, at points $(D, n_A, n_B) = (D, n_A, 0)$ and $(D, n_A, n_B) = (D, 0, n_B)$ which are the corner solutions where platform specializes in one sector, then, monopoly is said to choose variety over specialization. n_B, can be written as $n_B = \bar{N} - n_A$. At point $(D, n_A, 0)$ if monopoly increases the number of firms in sector A, where $n_A \to 0$ it will increase profits if $\frac{d\pi}{dn_A} > 0$.

$$P\left(\frac{\partial D}{\partial r_A} - \frac{\partial D}{\partial n_B}\right) > r_B - r_A$$

which can be written as

$$2P\frac{\partial D}{\partial n_A} > r_B - r_A$$

$\frac{\partial D}{\partial n_A} > 0$ because for a convex utility function at point $(D, n_A, 0)$, as n_B is substituted for n_A the utility of the consumer rises. Remember that $\frac{\partial n_B}{\partial n_A} = -1$ as $n_A + n_B = \bar{N}$.

For an interior solution above equation should hold. This is when $P\frac{\partial D}{\partial n_A}$ is large enough and $r_B - r_A$ is low enough. As P and $\frac{\partial D}{\partial n_A}$ are large enough the shape of the utility function becomes more important and forces an interior solution as the consumers surplus rises with an increase in utility of the consumer. $r_B > r_A$ points to a revenue higher from the side of product B compared to side A, in that case it is profitable to substitute B for A. To rule out corner solution at point $(D, n_A, n_B) = (D, 0, n_B)$, the condition is similar.

$$2P\frac{\partial D}{\partial n_B} > r_A - r_B$$

For an interior solution $\frac{\partial D}{\partial n_A}$ and $\frac{\partial D}{\partial n_B}$ should be high enough, meaning, the shape of the utility function be more important. It is required that $|r_A - r_B|$ is low enough; the optimal rents for brands A and B should not be different from each other. The rent difference leads to a revenue difference and thus can lead to an interior solution. Corner solutions happen if $P\frac{\partial D}{\partial n_B}$ is low enough and $|r_A - r_B|$ is big enough. If the shape of the utility function is less convex, it can allow an interior solution. Remember that when the utility function is concave $\frac{\partial D}{\partial n_A} < 0$ negative network externalities dominate. For a utility function that is concave in n_A and n_B, similar equations apply; if either of the following conditions hold, it points to a corner solution.

$$-2P\left|\frac{\partial D}{\partial n_A}\right| > r_B - r_A$$

$$-2P\left|\frac{\partial D}{\partial n_B}\right| > r_A - r_B$$

Again, when $\frac{\partial D}{\partial n_A}$ or $\frac{\partial D}{\partial n_B}$ are high enough the importance of the shape of the utility function increases and forces a corner solution as the consumers surplus rises with an increase in utility of the consumer.

4. The Case of Duopoly

Assume that there are two platforms competing with each other. It is possible for platform 1 to specialize in A producers (and the other platform to specialize in B producers) if profits of platform 1 are decreasing with n_B^1, the number of B producers that platform 1 includes, but increasing in n_A^1, the number of A producers that platform 1 includes, and D^1, the number of consumers that platform 1 includes. Thus platform 1 to specialize in A producers profits of platform 1 should be decreasing with the number of B producers at $n_B^1 = 0$; $\frac{\partial \pi^1}{n_B^1} < 0$

$$P^1\frac{dD^1}{dn_B^1} + r_B^1 + r_A^1\frac{dn_A^1}{dn_B^1} < \frac{dC^1}{dn_B^1}$$

Note that $\frac{dC^1}{dn_B^1} > 0$. The left side of the equation should be low enough, for this either $P^1\frac{dD^1}{dn_B^1}$ or r_B^1 or $r_A^1\frac{dn_A^1}{dn_B^1}$ or a combination of them should be low enough. $P^1\frac{dD^1}{dn_B^1} < 0$ means either negative network externalities are present or price for the consumer side is negative or low enough such that the loss from consumer side is large. A negative r_B^1 may also decrease profits from B side, platform may not be able to cover the costs. Similarly $r_A^1\frac{dn_A^1}{dn_B^1} < 0$ means either negative network externalities are present or price for A side is negative such that the loss from A side is large. When $P^1\frac{dD^1}{dn_B^1} + r_B^1 + r_A^1\frac{dn_A^1}{dn_B^1}$ is low enough, meaning low positive or negative externalities exist and the revenues from B side is low due to a low r_B^1, with a high marginal cost of B increases the probability of exclusion of B side.

For platform 1 to specialize in producers of A, the profits should be increasing at the point where $n_A^1 = 0$. An option is that the positive externalities of the consumer demand side should be positive with a high price for the consumers. A higher price for the consumers increase the revenue from the consumer side with an increase in the number of A producers. A positive r_A^1 means positive revenues from the producers of A. Externalities on the B side should be positive with a high price for B producers. A higher price for producers of good B increase the revenue from the B side with an increase in the number of A producers. Also for specialization in A side it is required that $\frac{d\pi^1}{dP^1} > 0$.

When the number of producers in the market is fixed, platforms will engage in price competition. Platforms strategy will be to decrease all of r_A^i, r_B^i and P^i to capture the market. Assume that when $r_A^i < r_A^j$ and $r_B^i < r_B^j$ firm i can set the quantities n_A^i and n_B^i and that $n_A^j = N_A - n_A^i$ and $n_B^j = N_B - n_B^i$, firm j will accept the remaining quantity of firms. If $r_A^i = r_A^j$ and $r_B^i = r_B^j$, the market will be divided into two, $n_A^i = n_A^j = \frac{N_A}{2}$ and $n_B^i = n_B^j = \frac{N_B}{2}$

Strategies for Firm i will be:

If there is an $(\hat{r}_A^i, \hat{r}_B^i, \hat{P}^i)$ such that $\pi(r_A^i, r_B^i, P^i) < \hat{\pi}^i(\hat{r}_A^i, \hat{r}_B^i, \hat{P}^i)$ for all (r_A^i, r_B^i, P^i) set $(r_A^i, r_B^i, P^i) = (\hat{r}_A^i, \hat{r}_B^i, \hat{P}^i)$

It can be observed that there is no Nash Equilibrium in pure strategies. Let $(\hat{r}_A^i, \hat{r}_B^i, \hat{P}^i)$ be the profit maximizing price schedule for a monopoly platform. It cannot be an equilibrium price schedule for firm i in a duopoly as firm j can increase its profits by setting (r_A^j, r_B^j, P^j) lower than $(\hat{r}_A^i, \hat{r}_B^i, \hat{P}^i)$. This will derive profits to 0. When $r_A^i < r_A^j$ and $r_B^i < r_B^j$ and $P^i < P^j$, firm i sets the quantities $n_A^i = n_A^*$ and $n_B^i = n_B^*$ that maximizes profits of a monopoly. The price competition will continue until $n_A^i = n_A^j = \frac{N_A}{2}$ and $n_B^i = n_B^j = \frac{N_B}{2}$. This cannot be an equilibrium because a firm i can increase its profits by decreasing r_A^i and r_B^i a little bit and capture the quantities $n_A^i = n_A^*$ and $n_B^i = n_B^*$, unless $n_A^* = \frac{N}{2}$ and $n_B^* = \frac{N}{2}$. Allow r_A^i and r_B^i which corresponds to n_A^* and n_B^* maximize the profits when $\pi^i(r_A^{i*}, r_B^{i*}, P^{i*}) = 0$ At this time dividing the market into two $n_A^* = \frac{N}{2}$ and $n_B^* = \frac{N}{2}$ will result in $\pi^i(r_A^{i*}, r_B^{i*}, P^{i*}) < 0$ will result in a loss. Therefore, firm j will not operate. If firm j does not operate than firm i will set monopoly prices and earn monopoly profits.

5. Conclusion

In this paper, it is shown that when the benefits of inclusion of a side is equal to cost of inclusion, a monopolist will maximize its profits by excluding that side from the market. That is, when the benefit of charging positive prices to cover costs from producers of a sector is equal to the cost of subsidizing producers of that sector to increase profits from the demand side, then the platform will exclude that side. When the number of slots in a platform is fixed, specialization occurs depending on the importance of shape of the utility function Specialization depends also on the optimal prices for each side If the optimal prices are close to each other, then, platform will have more incentives to prefer the interior solution. In the case of duopoly, for a platform to exclude a sector, it is required either that negative network externalities between sides play a role or the positive externalities are low. Another option is that the price charged for to be excluded side be negative enough for costs to exceed revenues from that side, or the price to be low enough. In the case of duopoly, if the number of slots in the platform is fixed, then there will be no Nash Equilibrium when producers and consumers act simultaneously.

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