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THE MARKET STRUCTURE OF THE MOBILE OPERATING SYSTEM INDUSTRY

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Abstract: Miller (2021) refers to smartphones as the "Transportal Home", describing smartphones as a place where we live, rather than as a device that we use. Today, smartphone users tend to concentrate on tasks rather than individual apps. To accomplish their goal, frequently they simply combine bits of various apps. The application programs are managed by operating systems (OS), so each mobile phone has OS.

This literature review is going to discuss the main aspect of the market structure such as market share, consumer preferences, and the behavior of the operating system producers. Additionally, this paper examines the Stackelberg model of oligopoly to determine why competition among these mass-market operating system companies creates an oligopolistic market.

Key words: smartphones, application programs, market share, IOS, Android.

INTRODUCTION

Miller (2021) refers to smartphones as the "Transportal Home", describing smartphones as a place where we live, rather than as a device that we use. Today, smartphone users tend to concentrate on tasks rather than individual apps. To accomplish their goal, frequently they simply combine bits of various apps. The application programs are managed by operating systems (OS), so each mobile phone has OS. There are two major operating systems iOS and Android, which control a huge share of the market. Consumers consider perceived quality (Hellofs, Jacobson, 1999) to be a variable of choice when selecting between these operating systems. Even though their core functions and performance are very similar, these two major mass-market operating system manufacturers signal their products as distinct in the real world. In a market of smartphone software where to exist not many competitors, these rivals are perfect examples of an oligopoly market. Any change in the strategies of one player in an oligopoly market forces the second player to act accordingly to keep the higher market share possible (EconomicsOnline, 2020).

This literature review is going to discuss the main aspect of the market structure such as market share, consumer preferences, and the behavior of the operating system producers. Additionally, this paper examines the Stackelberg model of oligopoly to determine why competition among these mass-market operating system companies creates an oligopolistic market.

Main Body part

The market share of the mobile operating system industry

Maintaining the position of leading OS, Android's share in the mobile OS market made up 87.7%. Yielding to Android, IOS is taking second place with 12.1%, whilst other operating systems, such as

KaIOS, Windows, Symbian, and others, represent only 0.2% (European Parliamentary Research Service, 2018). In this case, Android OS and IOS represent a duopoly, neither than oligopoly, because the share of other OS has almost no opportunity to compete (D.Maradin, A.Malnar, and E.Dipalo, 2020). In 2012, the shipments of Android and IOS made up 159.8 million and 47.8 million devices (A.A.Sheikh, N.Malik, T.Ganai and K.Ahmad, 2013). The spread of market shares of operating systems is dependent on the cost of devices, on which the operating system was installed. Since android devices are more affordable than IOS, Android's share is noticeably higher (A.Sahani, 2017). Another factor, which plays a role in compiling market share, is company politics concerning companies, which manufacture devices. Apple maintains a closed policy to devise producers and installs the IOS only on Apple devices, meanwhile, Android supports the open policy. Android is a ready package, which can be converted and installed on different devices. (A. Sahani, 2017). "The low cost and open-source nature are major factors contributing to helping Android lead the market share. Whereas iOS is not open source and is expensive." - A.Sahani writes in 2017. According to IDC, 2022, the ASP (Average selling price) of Android and IOS devices made up 265$ and 950$, respectively. However, despite the competition between Google's Android and Apple's IOS and huge losses on both sides, due to the spread of the coronavirus pandemic in 2020, the companies agreed and made collaboration to create a solution to help against the spread of infection, starting work on application programming interfaces (APIs) and operating system-level technology to assist in enabling contact tracing (Apple, 2020).

Consumer preferences for the mobile operating system

According to the articles that researched consumer preferences for mobile operating systems, it was found that there are several factors influencing consumers' choices such as the convenience of the users in using the operating system, the functionality and perceived quality of the system, and affordability of the price.

In the research by Ruqiya et al, there were conducted a questionnaire survey with 60 participants, who compared the mobile operating systems in several aspects. One of the main factors highlighted in the research was the price of the gadget together with its operating system. Moreover, the availability and functionality of the operating system affect the preference of consumers similarly. On the other hand, Santhanakrishnan. R and Ashok. S, in their article, state that price is no longer a factor in consumers' choices. Furthermore, according to the research of Nair in 2013, the functionality of IOS and Android has a larger effect on preference. At the same time, Setting and Chandel (2009) stated that consumers choose the operating system considering the brand of mobile phone. The android operating system is mostly used for middle- and lower-class mobile phones, however, IOS is only available for iPhones. Moreover, consumer happiness, according to a study by Santhanakrishnan. R and Ashok. S, are influenced by a slew of aspects, including meeting needs, enhancing performance, protecting privacy, harnessing peer influence, and being simple to use. Furthermore, N. Khan stated, that client satisfaction relies heavily on innovation. Whenever consumers are satisfied, brand loyalty increases. The preference of customers for the emotional value of mobile phone services was the most significant determinant of their pleasure.

Overall, both research states that more than half of consumers prefer the Android operating system due to its functionality, availability, and affordability.

Stackelberg's model and behavior of IOS and Android

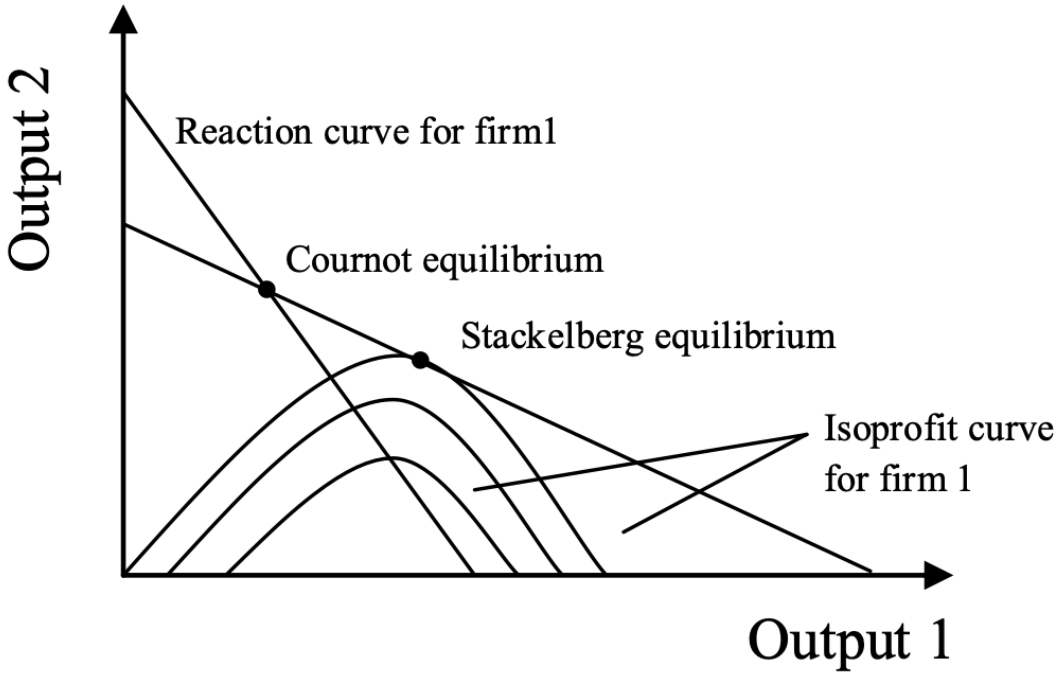

Figure 1: Comparison of the Cournot and Stackelberg equilibrium. Source: (Shapiro and R. Varian, 1998)

Output 1 = y1, Output 2 = y2.

In a Stackelberg model, Firm 1 sets the first output level, y1. And then firm 2 follows in response and sets its output level based on y1 with its optimal level of y2. (Maradin, Malnar, Ena, 2020) claims that Android is the leader in this situation, stating that "Apple has been putting a lot of effort to follow trends and remain competitive" as the follower. The accompanying operating system (OS) iOS has given Apple the boost of being more competitive in the market: "The company has put a lot of effort in following up with latest trends". By iOS seeking the leadership position while android is in this position of 'Firm 1' then the Stackelberg model becomes a Cournot model as both firms wish to hold the follower title at the same time. (Henderson and Quandt, 1976) stated that Stackelberg himself thought that his model did not hold up to its name as it resulted in the economic war between firms leading to the collapse of one firm or resulting in a collusion agreement. As there is no collapse of any one of the firms, we will look at the possibility of collusion.

A collusion agreement is when firms conspire together to output y1 and y2 to maximize the total industry profit (Boff, 2013), in most cases this is illegal. In 2021 Epic Games Inc. claimed of Apple and Android of colluding (mspoweruser, 2021), however, this is not a reliable source as it contains much bias since they're involved in a lawsuit against them plus there are no academic articles that back up their case. Not only that but (Shapiro and R. Varian, 1998) published that a collusion situation is not stable as there is an enticement to cheat. Meaning that if so does happen, then a prisoner's Dilemma arises in that if one firm stays to its assigned quota but another one defects and produces more output means that it will benefit from higher profit (Shapiro and R. Varian, 1998). So, achieving a one-time agreement that wouldn't be broken by the very attractive prospect of cheating, especially in a software industry which is easy to do is very difficult (Boff, 2013) so we can assume that colluding is not the factor playing out here.

Regarding the competition between iOS and Android, it was found two different schools of thought. One (Sahani, 2017) claims that "Android is a better operating system than iOS" as Android has an 88.0% growth while iOS only has 29.2%. An unfortunate rollout of events is that iOS's year-over-year growth has slowed compared to the overall market, while Android continues to attract customers with its lower prices and a wider range of smartphone players like Samsung, Motorola, and Nexus One. The second critic (Sheikh et al., 2013) states that "it is very hard to predict that which is ahead" as both look towards the future. What we notice between these two critics is the date published. In 2013 iOS and Android were seen as equal and 4 years later Android is deemed the better option. This relates to the Stackelberg model and (Maradin, Malnar, and Ena, 2020) above as (Sheikh et al., 2013) also state that

Android is the leader in this competition.

Operating System	4Q12 Shipments	4Q12 Market Share	4Q11Unit Shipments	4Q11 Market Share	Year Over Year Change
Android	159.8	70.1%	85.0	52.9%	88.0%
IOS	47.8	21.00%	37.0	23.0%	29.2%
BlackBerry	7.4	3.2%	13.0	8.1%	-43.1%
Windows Phone	6.0	2.6%	2.4	1.5%	150.0%
Linux	3.8	1.7%	3.9	2.4%	-2.6%
Others	3.0	1.3%	19.5	12.1%	-84.6%
Total	227.8	100.0%	160.8	100.0%	41.7%

Figure 2: Top 5 smartphone operating systems, shipments, and market share, 4Q12 (Units in millions). Source: (Sheikh et al., 2013)

Conclusion

To sum up, the analysis of articles was made to find the main information about the competition between two big operating systems in the world. According to the market share, the Android is leading mobile operating system due to its affordability and comfort of usage. On the other hand, by the surveys conducted about consumer choice in this market, it can be seen that IOS operating system is mostly preferred because of its functionality and safety. Moreover, it has been reviewed the Stackelberg model to see if one of the operating systems follows the other. However, due to several facts stated above, we cannot assume the use of this model in the market of the mobile operating system. Furthermore, there are some periods when they collude with each other, but mainly they compete. Overall, in our opinion, the market of the mobile operating system will stay an oligopoly, however, the market share between the two main players may change in the long run.

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