THE MARKET STRUCTURE AND PRICING MODELS OF CLOUD SERVICES

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ABSTRACT

The macroeconomic policies of developing counteries have repeatedly emphasized the creation of a suitable platform for the growth and emergence of knowledge-based businesses and domestic production. Using cloud services, among others, could flourish ecommerce industry for the related countries and skyrocket the revenue for information and communication technology companies. In this regard, governments will consider supportive agenda for private copmponies to enter the lucrative market of cloud services. However, this is not enough and such componies require to have profound understanding over the market structure and therby the performance of the coresponding main players. Specifically, financial issues and the way of absorbing the potential consumers through adopting appropriate business models are of paramount importance. This study works as a guide for the new followers of the market by identifing the Oligopoly structure of the cloud services market and introducing the pricing models of the cloud services.

***KEYWORDS*:** Cloud services, Oligopoly, Business analysis, Pricing models.

1. INTRODUCTION

Cloud computing is one of the most significant paradigm shifts in information technology. The term ''cloud'' refers to the Internet, based on the way people draw on the Internet as a cloud symbol, and is an abstraction of the complex infrastructure it hides (Erdogmus, 2009). The main types of services, though not the only ones, typically available in the cloud are: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS), whose definition and features have been widely discussed in the literature (Buyya et al., 2009). Recently, to optimise the use of exisiting resources, the additional activity of Function as a Service (FaaS) is also taking place. Such service is developing under the so called serverless computing, where specific functions are performed without an explicit reference to infrastructure (Spillner, 2019). The landscape of cloud computing services has also expanded from its original focus on IaaS (infrastructure), PaaS (platform), and SaaS (software) to numerous "X-as-a-service" offerings that include everything from the Internet of Things to machine learning, artificial intelligence (AI) and analytical services on the cloud (Shang et al., 2020).

Cloud services are much more cost-effective than home systems, especially in cases where the processing is highly data-driven, with savings of up to about 95%. In fact, these services allow small IT companies to thrive by providing them with resources through rent (at a lower price than the purchase price). Cloud computing services enable companies to expand their operations without having to worry about resource conservation and

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thus focus only on the core business (Huang et. al, 2015). Global cloud market analysis also shows that equipment is deployed in cloud data centers instead of traditional data centers. Customers also prefer to use the services provided by cloud providers, especially for infrastructure services, instead of equipping dedicated data centers (Zare, 2017).

The macroeconomic policies of developing counteries have repeatedly emphasized the need to create a suitable platform for the growth and emergence of knowledge-based businesses and domestic production. As a result, increasing demand for these services will be on the government's agenda. Therefore, naturally there are increasing number of private companies setting up new businesses aiming at providing these services. The purpose of this article is to identify the perspective of cloud services, their market structure and review the pricing models of this market. This study, as a guide for these businesses, examines the structure of the cloud services market and the pricing models of their services with a systematic review methodology. As shown in Fig.1, first, we will define the market structures and introduce their indicators. Then we will identify the type of cloud services market in the world and we conclude what will be the situation in developing countries. Finally, we will review the models of determining the price and the amount of equilibrium in this market.
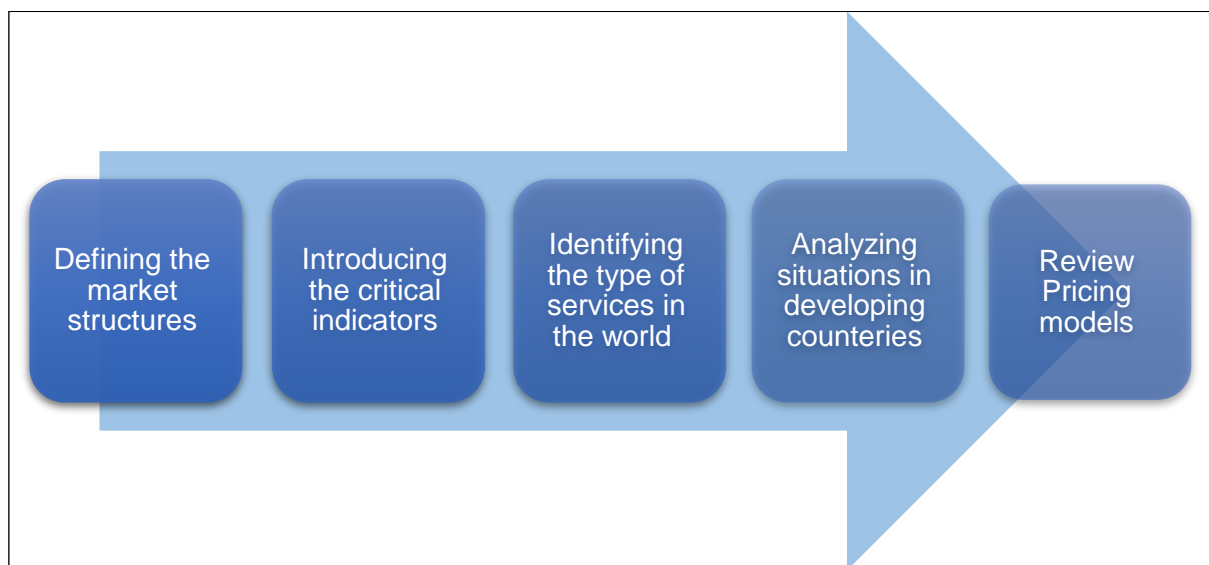

Fig. 1. Steps of review methodology

2. MARKET STRUCTURE

In economics, different structures are defined for the market in which the subject of competition is different (GHahremanian & GHahremanian,2014). The structure of each market can be divided into two abstract forms of monopoly and complete competition with features such as the number of firms, the degree of freedom of entry and exit, the existence of complete information, the degree of homogeneity of goods and the amount of economic profit. The most prominent aspects and organizational characteristics of the market, the concentration of sellers and buyers, entry conditions and how to distribute their size are determined (Darvish et al., 2017). Market structure reflects the organizational characteristics of the market and is usually defined in terms of the level of focus, product differences and the severity of barriers to entry. Market structure based on the number of companies selling a particular product or providing a specific service to the market Perfect competition (multiple sellers and buyers), complete monopoly market (one seller and many buyers), oligopoly market (limited number of sellers and Multiple buyer) and multipolar market (multiple sellers but limited number of buyers). If there are two sellers in the oligopoly market, it is called a bilateral monopoly market (Milan, 1996).

In recent decades, the entry of various suppliers into the market for specialized products and services, such as aircraft manufacturers or electronic products, has led to the complete monopoly markets being replaced by oligopoly markets. Oligopoly market has a more realistic structure than other types of markets because most goods around the world are introduced in the relevant markets by several major sellers or manufacturers. In the

oligopoly structure, companies are usually faced with a kind of dilemma. Companies can pursue industry profitability strategies without considering competitors' strategies and accept the risk of competitors' retaliatory reactions and increased competition and struggle within the industry, or they can plan their strategies based on competitors' movements to succeed in the market (Mahmoudinia et al., 2016).

Deciding on the production and pricing policies of each supplier in the oligopoly market and taking into account how competitors will react to each policy, are issues that manufacturers face in these markets because any change in the price or amount of production of an enterprise affects the sales and profits of competitors (SHahiki Tash & Mohamadzade, 2014). As a result, the issue of analyzing oligopoly markets and formulating appropriate strategies for sellers, taking into account the reaction of competitors (decision dynamics), while having a certain complexity compared to the analysis of other market structures, is of particular importance (Dizji, 2010). To determine the type of market structure, there are several indicators in applied economics such as price discrimination, Lerner index, profit rates, Herfindal index and concentration ratios (Milan, 1996).

However, the strongest and most suitable one is the Herfindahl-Hirschman index in terms of theoretical foundations (Rezaei & Haghighat, 2012; Grace & Scordis, 2005; Volosinova & Bosakova, 2005). The simplicity and limitation of the information required in calculating the firm K's Concentration Ratio has made it one of the most widely used indicators in the concentration calculation (Abasi & Nazari, 2017). In this study, the Concentration Ratio and Herfindal index are used to examine the global cloud services market.

2.1. Concentration ratios CR_x

This ratio shows the sales size of "x" of the largest firms to the total production (sales) size of the market; to be more specific, the single firm focus ratio CR_1 shows what share of the largest firm in the market accounts for the total output (sales) of the market or the concentration ratio of "n" firms CR_n indicates the ratio of the total size of "n" of the largest firms in the market to the total size of the market because in a competitive market the market size is distributed among many firms and as a result the concentration ratio of single firm CR_1, quadruple firm CR_4, eight firms CR_8 and even sixteen firms CR_{16} is very low and in a full monopoly market where one firm occupies the total market size, the ratio of single firm focus will be close to one. By using the CR Index, the type of market structure (competition and monopoly) is somewhat determined, but does not provide comprehensive information on the status of other firms in the market. Although this index is highly used, it also has weaknesses. These weaknesses are partially covered by the Herfindal index (Curry & George, 1983).

$$CR_x = \sum_{i=1}^{x} S_i \qquad (1)$$

x = the number of firms to measure concentration ratio
S_i = Percentage of firm i
If the resulting number is close to zero, it indicates that "x" number of the largest firms are with a small market share and the number 100 for S_i indicates the existence of only one firm in the market (Bakhshi, 2003).

2.2. Herfindal index

This index was actually suggested by Herfindal to overcome some of the shortcomings of the concentration ratio. The Herfindal index shows how the market size is distributed among existing firms and the type of structure is far better than the concentration ratio. This index is indicated by HHI.

Herfindal index is calculated as follows;

$$HHI = \sum_{i=1}^{n} (x_i/X)^2 \qquad (2)$$

n = Number of firms in the market
X = the value of productions of total market production
xi = the value of productions of firm "i"

If there are countless firms of the same relative size in the market, the Herfindahl index will be very small and close to zero, and if there are a small number of firms of unequal relative size in the market, the index will be close to one (Herfindal, 1959).

Market focus is a good indicator that can be used to examine how the market is managed (Kwon, 2010). Real markets can be divided from monopoly to competition according to the value of the focus index. The types of market structures and their characteristics are presented in Table 1:

Table 1. Market structure and their characteristics in terms of number and size of firms

Description	CR	HHI	The main feature of the market
Perfect Competition	$HHI \rightarrow 0$	$CR_1 \rightarrow 0$	They have more than 50 competitors in the market without having a significant share
Monopolistic competition	$(1/HHI) \rightarrow 0$	$CR_1 < 10$	None of the competing firms has more than 10% of the market.
Loose oligopoly	$6 < (1/HHI) \leq 10$	$CR_4 < 40$	4 firms have a maximum of 40% of the market
Tight oligopoly	$4 < (1/HHI) \leq 6$	$CR_4 > 60$	4 firms hold at least 60% of the market
Dominant firm market	$1 < (1/HHI) \leq 4$	$CR_1 \geq 0$	A single company owns more than 50% of the market
Monopoly	$HHI \rightarrow 1$	$CR_1 \rightarrow 0$	One firm monopolizes the entire market.

3. CLOUD SERVICE PROVIDERS MARKET

The STATISTA report (Statista, 2021) on the share of cloud service vendors in the global market from 2017 to 2020 is shown in Fig. 2:
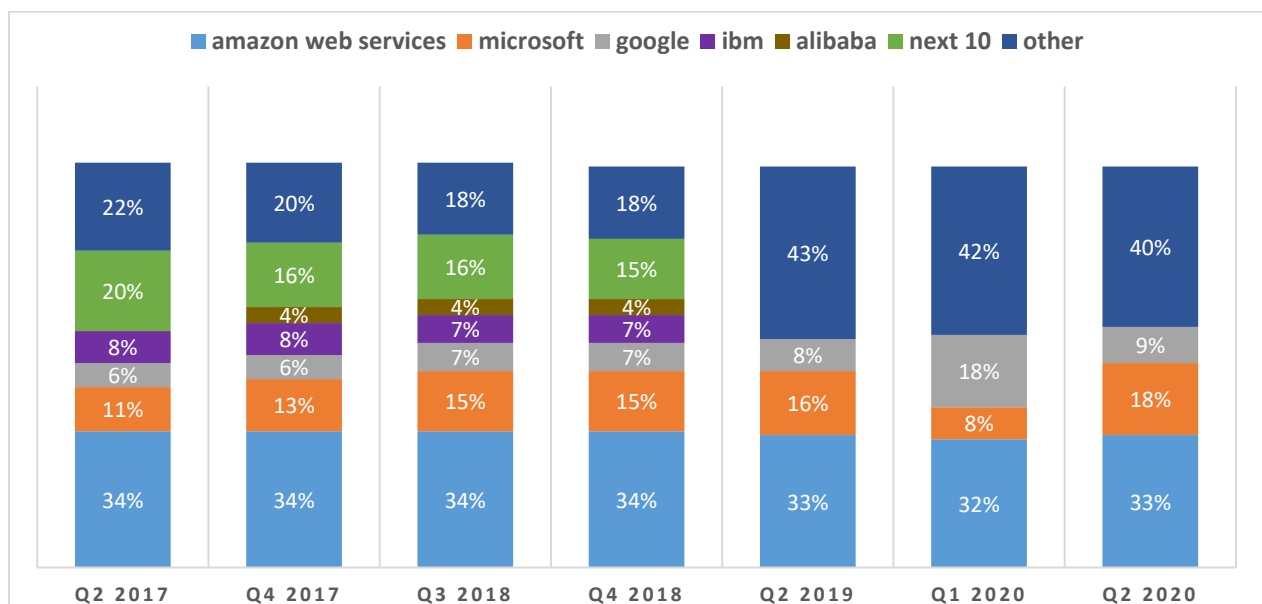

Fig. 2. The share of cloud service vendors from 2017 to 2020 in the global market (Statista, 2021)

The CR and HHI indicators and market structure in the interval between the first quarter of 2017 to the second quarter of 2020 are described in Table 2:

Table 2. CR and HHI and market structure in the first quarter of 2017 to the second quarter of 2020

Period	1/HHI	CR3	Market structure
Q2 2017	0.51	2.7	oligopoly
Q4 2017	053	2.8	oligopoly
Q3 2018	0.56	3.0	oligopoly
Q4 2018	0.56	3.0	oligopoly
Q2 2019	0.57	3.1	oligopoly
Q1 2020	0.58	3.1	oligopoly
Q2 2020	0.6	3.2	oligopoly

The dominant firm in this period is AMAZON WEB SERVICES (AWS), which has the largest share in this market, but it should be noted that the inverse price index (1 / HHI) increases over time and approaches to 4 according to Table 1. and that means the market structure is changing towards a closed oligopoly.

Recognition of these markets is a new issue and the governments are seriously concerned about the occurrence of monopolies, as the German Ministry of Economic Affairs and Energy of Germany in modernizing the law of abuse of market power in the digital age in 2018 and announced that there are still many questions which remain unanswered about the economic power of digital communities (Schweitzer et al., 2018).

The need for self-sufficiency in various economic sectors, the reasons given in the introduction, as well as the need for initial investment and high knowledge in the field of cloud service businesses, create a oligopoly market in developing counteries (by domestic companies). Therefore, in the following section, we will introduce price determination patterns and equilibrium amounts in these markets.

4. OLIGOPOLY MARKET

In the analysis of the oligopoly market, due to the uncertainty of the demand curve in front of each firm, it is necessary to pay attention to the following points:

a) The small number of effective businesses

b) Reaction of effective businesses to each other's behavior (reciprocal reaction):

Not every firm can fully predict the reaction of its competitors when there is a change in price or quantity. The first firm may do something to dissuade the second firm from entering the market, for example, Amazon threatening Google that if it increases its products, it will reduce its price. Now anything can happen between Amazon and Google. For example, suppose that in response to Amazon's 5% reduction, Google lowers its price by 10%, or increases its price and production, or does nothing. In any case, there will be a complex game similar to chess between them. For more information about price competition in oligopoly market, one could refer to (Feng et al, 2013). In a Perfect Competition market, due to the large number of firms, it is not possible for each firm to be seen by others, and for this reason, in this market, there is no reaction from firms to the change in the price of each firm. There is also technical competition in the market of Perfect Competition between firms and non-price competition has no place in this market. For example, advertising alone has no role for each firm. In the monopoly, given that there is only one firm operating in the market, there is no competitor who wants to worry about or seek out reactions. In other words, in principle, there is no competition in the monopoly market. Regardless of the differences in the products of other firms in the oligopoly market, the main difference between this market and the monopoly competition market is that in the monopoly competition market, one firm does not consider the reaction of other firms while in the oligopoly market, firms are aware of each other's behavior.

c) Existence of non-price competitions:

In a oligopoly market, due to non-price competition such as advertising competition, additional services, competition for product diversification and countless other methods, any firm can react to competitors' decisions.

d) Lack of a single model for determining the price and equilibrium amount of the market:

In Perfect Competition markets and monopoly, the basis for obtaining price and equilibrium is based on achieving maximum profit, but in oligopoly, obtaining price and equilibrium is not easy because the sales and profits of each firm depend on the sales and profits of the competitor. Therefore, it is not possible to reach a universally accepted theory for the oligopoly market in such a way that all different cases can be analyzed with it. Based on the way each firm chooses to act and the way the other firms react, the demand curve for each firm

is affected and it can be concluded that extracting the demand curve in the oligopoly market is not easily possible.

5. PRICING PATTERNS IN OLIGOPOLY MARKETS

Success for cloud providers can be achieved by developing adequate pricing models that provide an efficient way to allocate and valuate a variety of services (Weinhardt et al., 2009). Cloud customers often pay more than required since cloud providers' pricing strategies are designed to the interest of the providers (Mireslami et al., 2017). While pricing is one of the core marketing activities of cloud providers, there is a paucity of studies on revenue and pricing management and therefore it is challenging for cloud providers to make informed decisions in regard to the pricing of services (Lee, 2019). In the following, pricing models such as the cournot model, Bertland, Edgeworth, Chamberlain, SWEEZY, S Kinked Demand Curve Model, price leadership, and cartel models are discussed.

5.1. Cournot model

The cournot model is the first model proposed in the field of bilateral monopoly market by a French economist named Cournot. This model is about two manufacturers (firms) in the bilateral monopoly market, which of course can be generalized to oligopoly, and the following patterns are based in part on this moddel (Ruffin, 1971).
This behavioral model assumes:
- There are two firms (two suppliers) in the market and they are looking to get their maximum profit and consider the competitor's behavior as an unchangeable data, without any attempt to drive the competitor out of the market.
- Two firms produce two completely homogeneous and similar goods.
- The total cost of production is assumed to be constant or the final cost of production is very low and close to zero. Consider, for example, the exploitation of a mineral water spring, where the cost of drilling a well is only a fixed cost, and assuming that buyers come to buy with their own container, the variable cost of production is also zero.
- The decisions of each firm to determine its level of production are made independently of the decisions of the other firm. In this case, it is assumed that the economic decisions of each firm have no effect on the behavior of another, and each firm only determines the amount of its production. In other words, when one seller changes its sales volume, another firm will produce the same amount as before, and a change in the size of the first firm does not change the output of the second firm, and vice versa.
- The size of firm production can be from zero to infinity

In this model, each firm produces a quantity of product in which the final income from the sale of their goods is equal to the final cost of production. It is as if each one, regardless of the existence of the other, seeks to maximize his profit.

5.2. Bertrand model

In 1883, Bertrand introduced another version of the Cornet model, considering price as a decision variable. In Bertrand's model, it is assumed that firms react to each other's decisions by changing prices (Kreps & Scheinkman, 1983). They seek to produce at any price enough to have a buyer for their products. They produce homogeneous and inhomogeneous goods at the same cost of production, so it is necessary to examine homogeneous and inhomogeneous goods separately here.

Homogeneous goods: In this model it is assumed that:
- There are two manufacturers.
- The goods produced are homogeneous.
- Both producers operate independently of each other.

Manufacturers recognize the interdependence between themselves and act in a way that maximizes both prices and profits.

Heterogeneous goods: If the goods are heterogeneous, it means that prices can be different, and in this case, in addition to price, quality, design and durability of the product is important, and firms can change their market share by method, change in efficiency, difference in design and other factors.

5.3.   Edgeworth model

The Edgeworth model is based on the following assumptions with a slight difference similar to the Bertrand and cournot models, which are: The market consists of two firms. Two companies offer the same amount of goods (Maskin & Tirole, 1988). The demand curve for the goods of the two firms is linear. The final cost is zero. The production capacity of each firm is limited and constant and can not meet the total market demand. Other firms also know that competitors' production capacity is limited. To maximize its profits, each firm assumes that the firm no longer changes prices. But in the event of a price war, the price changes. Price changes are made to the point that the price reaches a point and each firm produces to its maximum capacity. If the price remains at equilibrium and wants to change; Price fluctuations and price wars will occur so that the final price fluctuates between the monopoly price and the maximum selling price. But in the long run, the price of the firm's product will be constant and their profits will be maximized.

5.4.   Chamberlin model

The Chamberlain model is designed with the same basic assumptions as the cournot model, but the Chamberlain model assumes that the two firms in the bilateral monopoly market are aware of each other's relationship and seek to work not compete with each other (Eichner, 1973). In this way, the two firms try to maximize their profits by dividing the monopoly power, and in this model, it is assumed that the firms have the same production process and production cost, and the final production cost for both firms is zero.

5.5.   SWEEZY, S Kinked Demand Curve Model

Another theory of oligopoly is the "SWEEZY theory" proposed by the American economist Paul SWEEZY, known as the Kinked Demand Curve Model. In this model, prices remain constant and under constant conditions, the equilibrium in the oligopoly is examined (Currarini & Marini, 2009). In the SWEEZY model, the following assumptions are made. Manufacturers think rationally for their economic decisions and are aware of the disadvantages of price warfare. As one firm lowers its price, so do other firms in the industry. If a firm raises prices, other firms in that market will not raise prices. In this model, too, it is possible to achieve stable prices even without any agreement.

5.6.   Price leadership

The one firm may have more power in determining the market price (Kim et al., 2021). This firm is called the dominant firm (leader) and in this market, other firms follow the price set by the dominant firm. In this case, it is as if there is an implicit agreement between the firms in the oligopoly market.

5.7.   Cartel model

In this model, it is assumed that the firms in the oligopoly market all unite in such a way that a complete agreement is reached between them (Böckem, 2004). In this case, they act as a monopolist, who controls all market sales. Although there is less complete agreement between firms, such an assumption is closer to the reality of their behavior than the assumption of competitive performance. However, in this model, the total profit is tried to be maximized. Therefore, firms in a particular industry delegate the power to determine the price and amount of production to a central union. This central union determines the share of each firm in the total production as well as how the industry profits are distributed among them. Maximizing cartel profits is necessarily a monopoly issue because in fact the decision-making power for the industry in question is in the hands of a single representative.

5.8.   Non-price competition

Firms operating in oligopoly markets do not compete solely on price. By using different solutions, they seek to differentiate between their product and the product of their competitors so that they can attract more applicants and retain them. It is sometimes said that in this type of market, the benefits of non-price strategies for firms outweigh the price reduction. Non-price strategies include: advertising, quality improvement, differences in design and even appropriate treatment of customers can be non-price activities that businesses try to inform and make their product attractive to applicants. If these factors are effective, the firm's demand curve

will be shifted to the right and the firm's sales will increase. The simulation results show that in the feedback structures, with the increase of the sticky price, the optimal values of supply and advertising have an upward trend. However, with increasing the degree of product or service replacement in the market, the optimal amount of supply and advertising has a decreasing trend. Also, decreasing advertising efficiency brings with it the financial burden of advertising activities (Raufinia et al., 2019).

6. CONCLUSION

In today's business world, the tendency to use cloud services is growing rapidly due to its cost-effectiveness. The vision of cloud computing services has also expanded from its original focus on IaaS (infrastructure), PaaS (platform), and SaaS (software) to "X-as-a-service" offerings that include everything from the Internet of Things to machine learning, artificial intelligence (AI) and analytical services on the cloud. In this study, we analyzed the structure of the market realated to cloud services and the results show that structure follows an oligopoly. Perceisly, the dominant firm in the period of this study is AMAZON WEB SERVICES (AWS), which has the largest share in this market, but it should be noted that according to the concentration ratio the company would lose its position in the market. The results also indicate that the market structure is changing towards a closed oligopoly. In this regard, it has been suggested that in spite of facing such an oligopoly structure, private sectors of developing countries sould invest on cloud market to reach self-sufficiency and support e-governmental policies. Moreover, to increase competitiveness, the newcomers of the market could follow the guidelines of this research to find a suitable pricing model. As a future research, one could focus on finding a balance that could maximize the utilities of the members of the oligopoly via the stachelberg game theory.

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