ABSTRACT

Key Words：Pricing algorithm, machine learning, oligopoly problem, plus factors, unilateral practice, tacit collusion, reward and punishment mechanism

Pricing algorithms are very common, especially for online platform trading. Evidence shows that many sellers in Amazon have already used their own pricing algorithms, while Amazon itself (or other platform operators) provides some simple pricing rules for sellers. In response to this trend, some third-party vendors have also begun to sell more sophisticated pricing algorithms to retailers, and even directly accept commissions to make retail pricing for retailers. Therefore, the application of the competition law must be examined in response to it. How should machine algorithms be viewed in competition law? How should the competitive behavior generated by it be regulated? More importantly, how can the pricing algorithms and human beings be inextricably linked, and how should they be positioned in the competition law? These are all new issues that the competition authorities must face in the digital era.

The machine algorithm receives the input, values the current state, and determines the response action in an instant. Thus, in the market competition, the roles of human beings began to be weakened. On February 5, 2018, US stocks suddenly experienced a sharp drop in profits, which was thought to be caused by most financial companies due to their using machine algorithms to execute complex trading orders. It is estimated that more than 50% of S&P 500 index transactions have been determined by machine learning algorithms.

This project first introduces the basic logic, the classification, the advantages,

and the functions of algorithms, and how they assist manufacturers for efficient operations. It is the basic knowledge and equipment that law enforcement personnel face in the platform economy. The pricing algorithm quickly assists manufacturers in price-and-profit correlation estimation and in price-and-market-condition adjustment. With the help of pricing algorithms, manufacturers are more efficient in dynamic markets,

The third chapter of this study continues to explore the impact of pricing algorithms to the market structure, firms' behaviors, and the possible use as a collusion tool. Because of the pricing algorithm, the number of firms and the fluctuations of market supply and demand become less likely to impact the formation or maintenance of collusion. On the other hand, pricing algorithms make a firm's entry easier but harder to succeed, leading to numerous bubble firms with a very small number of large-scale firms. However, the possibility of heterogeneity has increased, providing a niche for new entrants and making collusion relatively difficult. Moreover, the pricing algorithm-based firms increase their efficiency: better allocation, more accurate estimation (especially demand), more efficient and faster search for optimal prices, more rapid price changes to the market change, and subtle segmented users for personalized pricing. This allows firms to quickly and efficiently estimate the relations between their price and profit, as well as the dynamic relations between their price and the market state.

Of course, the pricing algorithm changed the market environment and thus changed the possible conditions for collusion. According to the OECD classification, there are four types of pricing algorithms that facilitate collusion, namely, monitoring algorithms, parallel algorithms, signal algorithms, and self-learning algorithms. According to Ezrachi and Stucke, it is classified into four types:

the messenger, the hub-and-spoke, the predictive agent, and the digital eye.

Collusions are concerted practices, which still need for human communication as an evidence in current legislation. However, the interdependence of oligopolistic firms will inevitably make the firms behave the same trending of prices in competition market. Therefore, the both price increases are the inevitable result of competition structure, which makes the deliberate concerted practices often difficult to be distinguished. This is the so-called oligopoly problem.

Although the economic analysis may be sufficient to confirm that the current high price is due to a set of reward and punishment mechanism, or it is enough to confirm, unless the competitors adopt a set of reward and punishment mechanism strategy, they will not be able to obtain supercompetitive prices; there is still not enough to convict a case because the reward and punishment mechanism itself is a series of strategic actions, not any other plus factors. It is still necessary to find additional factors that are written, interviewed, communicated or leaked in various forms. At present, the collusion cases involved in the pricing algorithm are all based on the coordination of human communication and supplemented by the pricing algorithm, such as Meyer v. Kalanick (2016), US v. Topkins (2016), CMA v. GB eye (2016), US v. Aston (2015), etc.

The pricing algorithms can, of course, be used to carry out other anti-competitive behaviors, which is discussed in Chapter 5 of this project. For example, four home appliance manufacturers, Asus, Denon & Marantz, Philips, and Pioneer, were judged by the European Commission to maintain the resale price of online retail products, and the rates of the online travel platform operators such as Booking.com were investigated by the European Commission. Uber has been sued in many parts of the United States, including the claims that Uber is looting at a loss, attempting to monopolize, or abusing market positions.

The sixth chapter discusses the application of the competition law to the pricing algorithms. The human agent and the automation agent actually constitute a principal-agent model. With a lower advanced algorithm, human agents in the model play a heavy role in collusion, which can be reviewed by the existing legal standard framework. However, with a higher advanced algorithm, it is difficult to find specific evidence for being colluding between firms. Therefore, the ability to program detection and inspection becomes important for the competition authority. We conclude many possible ways in which the pricing algorithms participates in the type of collusion; for example, a monitoring algorithm that relies on human practices, a pricing algorithm that shares the same data, a manufacturer that uses the same pricing algorithm as others, and a third party with price algorithms to make decision for firms, a predictable pricing algorithm, a signaling pricing algorithm, and a self-learning pricing algorithm.

In fact, before the popularization of self-learning algorithms, the issues involved in the pricing algorithm are sufficiently regulated with the current competition law framework. When analyzing whether a behavior constitutes collusion, we have to take away the fact that the algorithm is involved. However, the widespread use of pricing algorithms makes the identification of collusion behavior more difficult, so law enforcement officials must have updated survey techniques. When the external detection fails, we can also use the Leniency Policy and the crime penalty to create incentive for firms to self-detect and cooperate.

In the final chapter of this project, we made some suggestions for competition law enforcement agencies. First of all, learning from the foreign competition law institutions, educate and train law enforcers to be familiar with the logic of algorithms. Then, recruit sufficient information talents, conduct network detection, search, surveillance, and comparison, develop a scale of test and inspection programs, and prepare well results of the algorithmic detection as evidence. At the same time, conduct the industrial survey and the training of relevant personnel about how the competition laws works on pricing algorithms. Establish a continuous monitoring and detection unit for price fluctuations, and develop a test mode for detecting reward and punishment mechanisms in programming. Further, encourage the manufacturers who adopt pricing algorithms to comply the competition laws at the design stage of the software.