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*V. Gorbachuk, S. Gavrilenko, G. Golotsukov,
M. Lupei, D. Nikolenko, M. Pustovoit, L. Batih*

ASYMMETRIC INFORMATION, INTERMEDIATION, COORDINATION, RATIONAL SELF-SELECTION AND SOCIAL WELFARE

Vasyl Gorbachuk

V.M. Glushkov Institute of Cybernetics of NAS of Ukraine, Kyiv,
GorbachukVasyl@netscape.net

Serge Gavrilenko

V.M. Glushkov Institute of Cybernetics of NAS of Ukraine, Kyiv,
Gavrilenko@nas.gov.ua

Gennadii Golotsukov

V.M. Glushkov Institute of Cybernetics of NAS of Ukraine, Kyiv,
Golotsukov@nas.gov.ua

Maksym Lupei

V.M. Glushkov Institute of Cybernetics of NAS of Ukraine, Kyiv,
Maxim.Lupei@gmail.com

Dmytro Nikolenko

V.M. Glushkov Institute of Cybernetics of NAS of Ukraine, Kyiv,
Nikolenko@nas.gov.ua

Mykhailo Pustovoit

V.M. Glushkov Institute of Cybernetics of NAS of Ukraine, Kyiv,
Pustovoit@nas.gov.ua

Liudmyla Batih

V.M. Glushkov Institute of Cybernetics of NAS of Ukraine, Kyiv,
l.taran77@gmail.com

To understand the choice of an intermediary, let us focus on the organization of exchange of products (goods and services) between sellers and buyers through the two extreme forms of intermediary exchanges, ignoring the other roles that intermediaries often play. In one of the forms of intermediary exchanges, the intermediary acts as a dealer (retailer) in a sense that it buys products from sellers and resells them to buyers: pricing is centralized by the intermediary. In the second form of intermediary exchange, the intermediary does not take control of the seller's products, but simply offers access to a platform (or marketplace) where buyers and sellers can interact as they see fit: pricing is decentralized to market participants, and the platform- taxes trade. The first form corresponds to a business model in which the dealer sets the wholesale price for sellers and sets the retail price for buyers, and sellers and buyers are price-takers. The second form corresponds to a business model in which the platform operator collects a platform usage charge from each seller and collects a platform usage fee from each

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M. PUSTOVOIT, L. BATIH, 2022

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buyer, and sellers set retail prices for buyers. Market intermediaries coordinate the actions of buyers and sellers. Firms carry out transactions, servicing the payment system, inventory control, and record keeping, which are important for the functioning of markets. In addition, firms provide a central place of exchange, thus reducing the search costs for buyers and sellers. By comparing the costs of intermediation with the costs of non-intermediated exchange in the markets, matching buyers and sellers, or the costs of search, it can be shown that an intermediated exchange happens to be more beneficial. Indirect network effects on both sides of the market lead to the concept of so called two-sided platforms. In such a platform, the primary role of intermediary is to control access to the platform that at least two groups of economic agents use to their interaction. A similar platform should be valued more by users of each group when the platform is used more by another group. Individual decisions to join a particular platform then generate indirect network effects on agents on the other side of platform. Due to the centralized operation of the platform, the intermediary can add value and capture rents by facilitating the internalization of the externalities related with network effects. The characteristics of intermediaries must meet certain expectations of market participants.

Keywords: random matchings, transaction costs, search costs, utility, surplus, bid-ask spread.

Introduction

Obviously, there are many cases when trade takes place or matching (of buyers with sellers) occurs in the absence of intermediaries, say, in cases of visits to department stores or shopping malls [1–3]. Although some producers sell goods to consumers directly, and people often establish personal relationships in the absence of intermediaries, shops and dating clubs exist when there are economic agents who benefit from the use of intermediaries. Let us start with the analysis of a decentralized market where buyers and sellers interact in the absence of an intermediary, and then we shall proceed to the analysis of changes in the distribution of outcomes and rents in a market where an intermediary has entered.

Assume that the market is free, that is, buyers and sellers are not charged for joining it. Let us also assume that buyers and sellers (in general, trading partners from two groups) match randomly. Then the market maker can profitably enter the market to buy and sell the product at the price difference, making a profit, despite the opportunity for consumers to participate in the random matching market for free.

The model of heterogeneous buyers and sellers

Let each consumer buy at most one unit of the product and each supplier sell at most one unit of the product. Suppose there is a large number of heterogeneous buyers and sellers: buyers have a high valuation type v_H or a low valuation type v_L (regarding to a product unit), and sellers have a low cost type c_L or a high cost type c_H ; there are no other types of buyers and sellers. Let both types of buyers and sellers be equally likely [4–7].

A non-intermediated market can work efficiently [8, 9] (one of the editors of the publication [8] is a 2004 Nobel Laureate). If the seller or buyer does not trade, his (her) surplus is normalized to zero. Let both the total mass of buyers and the total mass of sellers be normalized to 1.

If $v_H > c_H > v_L > c_L$, then there are positive gains from trade for all pairings except the pairing in which a low-value type buyer meets a high-cost type seller: in case $c_H > v_L$ no trade takes place. It is assumed that any gains from the trade are distributed equally (between the buyer and the seller) as a result of Nash bargaining (John Nash was born in Bluefield, West Virginia in 1928, received bachelor's and master's degrees in mathematics from the Carnegie Institute of Technology (founded in 1900 by the in-

dustrialist and philanthropist Andrew Carnegie (1835–1919)) in 1948, a doctor of philosophy in mathematics from Princeton University (founded in 1746) (where one of the authors of this work worked as a Fellow on the Contemporary Issues Program) in 1950, Nobel Laureate in 1994, died near Monroe Township, New Jersey, in 2015), according to which the joint surplus over the joint evaluation of the outside option (opportunity cost) for bargaining is distributed equally, yielding the utility of the bargaining participant after termination of negotiations [10–13]. Better external options lead to more beneficial deals (bargains): the opponent in the bargain must give the other participant a sufficient share of the surplus to assure the latter does not use the external option rejecting the deal.

Marketers, including retailers, wholesalers, used car dealers, energy dealers, buy and resell goods. Brokers, in particular travel agents, real estate agents, insurance agents, stock brokers, provide coordination services without buying and selling goods. Real estate brokers set home prices, fix commissions, and invest in finding home buyers and sellers. The model [14] explains the value of such shared listings as the Multiple Listings Service (MLS) — an organization with a suite of services that real estate brokers use to establish cooperation and compensation offers (among brokers), as well as to accumulate and disseminate information to enable real estate appraisals. The MLS database and software are used by real estate brokers (or aircraft brokers) who represent sellers under a listing contract to share information widely about properties with other brokers who may represent potential buyers or those who wish to work with the seller's broker to find a buyer to the property or asset. The listing data stored in the MLS database is the proprietary information of the broker who obtained the listing agreement with the seller of the property. Such intermediaries improve the welfare of consumers and suppliers by reducing or eliminating the uncertainty associated with establishing a satisfactory match. Intermediaries also increase the number of potential trading partners, thereby increasing the probability of meeting a trading partner and reducing search costs.

Intermediaries have to compete with the variant of decentralized exchange, in which consumers and suppliers search for each other and negotiate prices directly [8, 9, 14]. Sometimes such competition happens at close quarters: for example, an organized used car market served by car dealers coexists with a decentralized market where buyers and sellers meet informally, often using advertisements. In the matching market, consumers have different levels of willingness to pay, and suppliers have different opportunity costs. If consumers and suppliers get connected randomly (in a decentralized manner), the terms of exchange become uncertain, increasing the risks that the parties will not reach an agreement. When consumers and suppliers trade directly, the buyer has an incentive to understate his (her) willingness to pay and the seller has an incentive to overstate his (her) opportunity costs. Asymmetric information about willingness to pay and opportunity costs [10–13, 15, 16] leads to inefficient trading volumes, including zero volume (breakdown of trade). An intermediary can eliminate this uncertainty by posting bid prices and ask prices, thus offering an advantage over a decentralized matching market.

Intermediated versus non-intermediated trade

While buyers and sellers can choose between using intermediaries to trade at a known price and using the risky option of a decentralized market, intermediation can be beneficial for the trading parties [9]. Then the market demand function is represented by the distribution of the buyer's willingness to pay levels, and the market supply function is represented by the distribution of the supplier's willingness to sell levels. The intermediary chooses the spread — the difference between the best ask and bid prices at the same moment in time for the product given in order to maximize his (her) profit, taking

into account the value of the matching-market option for buyers and sellers: at the market equilibrium, consumers willing to pay above the critical purchase level (more than the ask price) will buy (the product) from the intermediary, and suppliers with opportunity costs below the critical sale level (less than the bid price) will sell to the intermediary; consumers and suppliers, whose willingness to pay or opportunity cost lies in the gap between these two critical levels, enter the matching market. Under the above conditions, the expected value of the consumer's willingness to pay is $v = 0,5v_H + 0,5v_L$, and the expected value of the supplier's opportunity cost is $c = 0,5c_H + 0,5c_L$.

Before entering the matching market, a consumer and a supplier do not know the type of their trading partner. Assume that after the consumer and the supplier have decided to trade (have agreed to trade), they learn each other's type. At this point, the trade takes place if and only if they have gains from the trade.

A consumer of the type v_H can trade with suppliers of both types c_H and c_L , and a supplier of the type c_L can trade with consumers of both types v_H and v_L . The market outcome will depend on whether a supplier of the type c_H can trade with a consumer of the type v_L : such a trade requires the inequality $v_L > c_H$.

If the inequality $v_L > c_H$ takes place, then all the types of consumers and suppliers will trade in a non-intermediated exchange market. Since they are not informed about the type of their trading partner, the expected trade profit of a consumer of type v_H is $0,5(v_H - c)$, that of a consumer of type v_L is $0,5(v_L - c)$, that of a supplier of type c_H is $0,5(v - c_H)$, that of a supplier of type c_L is $0,5(v - c_L)$.

Let us examine the issue of the profitability of a monopoly intermediary. If the intermediary chooses the highest ask price and the lowest bid price that attract a consumer of the type v_H and a supplier of the type c_L , then he (she) sets the monopoly purchase price (ask price)

$$p_a^m = v_H - 0,5(v_H - c),$$

taking into account the expected profit from trade of a consumer of the type v_H , as well as the monopoly sale price (bid price)

$$p_b^m = c_L + 0,5(v - c_L),$$

taking into account the expected profit from trade of the type c_L supplier. The profitability of such an intermediary needs inequality

$$0 < p_a^m - p_b^m = v_H - 0,5(v_H - c) - c_L - 0,5(v - c_L) = 0,5(v_H - v + c - c_L),$$

which is obviously the case (let transaction costs be 0 for simplicity). If the transaction costs are equal to K , then the intermediary's profitability needs inequality

$$K < p_a^m - p_b^m.$$

If the inequality $v_L < c_H$ holds, then a supplier of the type c_H cannot trade with a consumer of the type v_L , and the expected gains from trade for a consumer of the type v_H and the supplier of the type c_L do not change, being equal to $0,5(v_H - c)$ and $0,5(v - c_L)$, respectively. At the same time, since a consumer of the type v_L will then have the only other potential trading partner, such a consumer expects a profit from trade in the non-intermediated exchange market equal to $0,25(v_L - c_L)$, which together

with $0,25(v_H - c_L)$ will equal $0,5(v - c_L)$. The type c_H supplier expects a trade gain equal to $0,25(v_H - c_H)$, which together with $0,25(v_H - c_L)$ will equal $0,5(v_H - c)$. Prices p_a^m and p_b^m of the intermediary attract the type v_H consumer and the type c_L supplier: the type v_L consumer and the type c_H supplier will not participate in trade, because they will not gain from non-intermediated exchange with each other. Therefore, when there is a probability of trade disruption in non-intermediated exchange (when $v_L < c_H$), the intermediary will enter the market, leading to a separating market equilibrium.

However, in a multi-intermediary world, consumers and suppliers continue to incur search costs due to reacting to multiple intermediaries [17]. Consumers and suppliers discount future net gains due to monetization of search time costs [18, p. 188–193]. Consumers have different levels of willingness to pay, suppliers have different opportunity costs, and intermediary firms have different transaction costs. These firms set both bid prices and ask prices. Consumers look for firms that offer a lower purchase price, and suppliers look for firms that offer a higher sale price. Due to such heterogeneity and search costs, the market equilibrium is a distribution of sale prices and a distribution of purchase prices. This equilibrium depends on the discount rate of consumers and suppliers, for whom a higher discount rate stands for a decrease in activity (the number of active consumers and suppliers), while a higher discount rate means an increase in the activity of intermediary firms (the number of active firms): a higher discount rate increases the costs of time-consuming search for consumers and suppliers. Intermediary firms then raise their purchase prices and lower their sale prices because consumers and suppliers are willing to pay a premium to avoid further search, thus increasing the returns to intermediation for firms and stimulating growth in the number of intermediary firms active at the market equilibrium.

Thus, the discount rate determines the search costs. When this rate falls to zero, the search costs are eliminated and the relationships between the size of the bid-ask spread and transaction costs are revealed. Then the Walras equilibrium (Leon Walras was born in Evreux, Normandy (France), in 1834, studied at the School of Mines in Paris (founded in 1783), explored political economy at the University of Lausanne (founded in 1537) in Switzerland, died in Montreux, Switzerland, in 1910) will be the limiting case of the intermediated market when transaction costs fall, and the supply and demand model can be considered an ideal case compatible with the market under consideration at the presence of search costs and price-setting firms.

Thus, when $c_H > v_L$ different agents have the following expected net surpluses (ENSs):

- a buyer of the type v_H has $ENS(v_H) = 0,5(v_H - c)$;
- a buyer of the type v_L has $ENS(v_L) = 0,25(v_L - c_L)$;
- the type c_L seller has $ENS(c_L) = 0,5(v - c_L)$;
- the type c_H seller has $ENS(c_H) = 0,25(v_H - c_H)$.

Hence, the matching market has (expected) social welfare (the sum of the expected net surpluses of all economic agents)

$$\begin{aligned}
 &0,5(v_H - c) + 0,25(v_L - c_L) + 0,5(v - c_L) + 0,25(v_H - c_H) = \\
 &= 0,5(v_H - 0,5(c_H + c_L)) + 0,25(v_L - c_L) + \\
 &+ 0,5(0,5(v_H + v_L) - c_L) + 0,25(v_H - c_H) =
 \end{aligned}$$

$$\begin{aligned}
&= 0,5v_H - 0,25c_H - 0,25c_L + 0,25(v_L - c_L) + \\
&+ 0,25v_H + 0,25v_L - 0,5c_L + 0,25(v_H - c_H) = \\
&= v_H + 0,5v_L - 0,5c_H - c_L,
\end{aligned}$$

which does not provide a socially efficient solution: the social welfare function is maximized when all buyers of the type v_H interact exclusively with sellers of the type v_H , and the first best solution provides public welfare

$$v_H - c_L > v_H + 0,5v_L - 0,5c_H - c_L \text{ at } v_L < c_H.$$

In other words, economically redundant matches reduce the social welfare [19, 20].

Rational self-selection

In this situation, introducing an intermediary can improve the allocation of matches and achieve the first best solution. The intermediary sets bid-and-ask prices p_b^m and p_a^m , called retail and wholesale prices, in order to maximize his (her) profit. Such prices should stimulate the type v_H buyers and the type c_L sellers to intermediate exchange, and the remaining buyers and sellers should be stimulated to direct exchange. Therefore, suppose that all buyers of the type v_H and sellers of the type c_L go to the intermediary, and all buyers of the type v_L and all sellers of the type c_H remain in the matching market. Since buyers of the type v_H know that they face only sellers of the type c_H , they are willing to pay a higher price to the intermediary, avoiding an unfavorable matching in this market, which would give the buyer of type a comparatively smaller net surplus

$$0,5(v_H - c_H) < 0,5(v_H - c) = ENS(v_H).$$

For such buyers, it does not matter whether they go to an intermediary or enter the non-intermediated market of random matchings, when

$$0,5(v_H - c_H) = v_H - p_a^m, \quad p_a^m = 0,5(v_H + c_H).$$

Similarly, sellers of the type c_L know that, in the matching market, they face buyers of the type v_L only, and such sellers are therefore willing to pay a higher price to the intermediary, avoiding unfavorable matching in this market, which would give a seller of the type c_L a comparatively smaller net surplus

$$0,5(v_L - c_L) < 0,5(v - c_L) = ENS(c_L).$$

Such sellers do not care whether to go to an intermediary or to enter the non-intermediated market of random matchings when

$$0,5(v_L - c_L) = p_b^m - c_L, \quad p_b^m = 0,5(v_L + c_L).$$

The prices found $p_a^m = 0,5(v_H + c_H)$, $p_b^m = 0,5(v_L + c_L)$ maximize the intermediary's profit, which is equal to the product of the spread ($p_b^m - p_a^m$) and the share of the intermediary market matchings in the overall market. At the same time, the type v_L buyers and the type sellers c_H have no incentives to follow the behavior of other types of buyers and sellers, because

$$v_L - p_a^m = v_L - 0,5(v_H + c_H) = 0,5(v_L - v_H) + 0,5(v_L - c_H) < 0 \text{ at } v_L < c_H,$$

$$p_b^m - c_H = 0,5(v_L + c_L) - c_H = 0,5(v_L - c_H) + 0,5(c_L - c_H) < 0 \text{ at } v_L < c_H.$$

Hence, the mentioned share is equal to a half, and the intermediary's profit is

$$0,5(p_b^m - p_a^m) = 0,25(v_H - v_L + c_H - c_L) > 0.$$

Thus, an equilibrium has been found in which the type v_H buyers and the type c_L sellers self-select into the intermediary market. In other words, the presence of a profit-maximizing dealer leads to endogenous sorting according to the type of economic agent. In this special model with two types of buyers and sellers, this sorting gives an exact solution. The intermediary gets a positive profit because it offers buyers of the type v_H and sellers of the type c_L a better deal compared to their gains in the market of random matchings. Here, intermediated trade improves the allocation of resources in the decentralized matching market and embodies the first best solution, while socially inefficient trade takes place at decentralized matchings.

In the case, where each pairing generates trade gains (when $v_L > c_H$), it is not obvious that an intermediated trade can survive. In random pairings, there are positive gains from trade for all matchings (buyer-seller pairs), and the pairing market, isolated from intermediaries or other external factors, operates efficiently. However, there is a role for the market maker in such an environment. When $v_L > c_H$, different agents have the following expected net surpluses:

the type v_H buyer has $ENS(v_H) = 0,5(v_H - c)$ (as with $c_H > v_L$);

the type v_L buyer has $ENS(v_L) = 0,5(v_L - c)$;

the type c_L seller has $ENS(c_L) = 0,5(v - c_L)$ (as with $c_H > v_L$);

the type c_H seller has $ENS(c_H) = 0,5(v - c_H)$.

Suppose that at prices $p_a^m = 0,5(v_H + c_H)$, $p_b^m = 0,5(v_L + c_L)$, all buyers of the type v_H and all sellers of the type c_L go to the intermediary. Then the expected profit for a buyer of the type v_H in the matching market is $0,5(v_H - c_H)$, and that for the seller of the type c_L $- 0,5(v_L - c_L)$, which can be compared with the following expected net surpluses:

$$0,5(v_H - c_H) - 0,5(v_H - c) = 0,5(c - c_H) < 0,$$

$$0,5(v_L - c_L) - 0,5(v - c_L) = 0,5(v_L - v) < 0.$$

Therefore, in the situation $v_L > c_H$ for buyers of the type v_H and sellers of the type c_L there is no incentive to deviate from the opposite situation $c_H > v_L$. However, buyers of the type v_L are described by the inequality

$$0,5(v_L - c) - 0,25(v_L - c_L) =$$

$$= 0,25(v_L + c_L) - 0,5c = 0,25(v_L + c_L) - 0,25(c_H + c_L) > 0 \text{ at } v_L > c_H,$$

and sellers of the type c_H are described by the inequality

$$0,5(v - c_H) - 0,25(v_H - c_H) = 0,5v - 0,25(v_H + c_H) =$$

$$= 0,25(v_H + v_L) - 0,25(v_H + c_H) > 0 \text{ at } v_L > c_H.$$

Therefore, in the situation $v_L > c_H$, buyers of the type v_L and sellers of the type c_H have incentives to enter the market of random matchings. Then the intermediary's profit is

$$0,5(p_b^m - p_a^m) = 0,25(v_H - v_L + c_H - c_L) > 0,$$

as with $c_H > v_L$: although intermediation does not change the share of intermediated market pairings in the overall market, it leads to endogenous sorting — pairing of buyers of the type v_L with sellers of the type c_H , as well as pairing of buyers of the type v_H with sellers of the type c_L .

Conclusions

Thus, in the presence of a market of random matchings, intermediaries can profitably conduct centralized exchanges despite of efficient operation of such a market, isolated from intermediaries or other external factors. Intermediation then leads to market segmentation.

With intermediation, the type v_L buyers and the type c_H sellers lose out due to the narrowing of group of their possible trading partners. At the same time, buyers v_H and sellers c_L of this model also lose, because due to the market segmentation their expected utility from entering the market of random matchings is less than their utility in a world with exclusively decentralized trade.

*В.М. Горбачук, С.О. Гавриленко, Г.В. Голоцуков,
М.І. Лупей, Д.І. Ніколенко, М.М. Пустовойт, Л.О. Батіг*

АСИМЕТРИЧНА ІНФОРМАЦІЯ, ПОСЕРЕДНИЦТВО, КООРДИНАЦІЯ, РАЦІОНАЛЬНИЙ САМОВІДБІР ТА СУСПІЛЬНИЙ ДОБРОБУТ

Горбачук Василь Михайлович

Інститут кібернетики ім. В.М. Глушкова НАН України, м. Київ,
GorbachukVasyl@netscape.net

Гавриленко Сергій Олександрович

Інститут кібернетики ім. В.М. Глушкова НАН України, м. Київ,
S.A.Gavrilenko@nas.gov.ua

Голоцуков Геннадій Володимирович

Інститут кібернетики ім. В.М. Глушкова НАН України, м. Київ,
Golotsukov@nas.gov.ua

Лупей Максим Іванович

Інститут кібернетики ім. В.М. Глушкова НАН України, м. Київ,
Maxim.Lupey@gmail.com

Ніколенко Дмитро Іванович

Інститут кібернетики ім. В.М. Глушкова НАН України, м. Київ,
Nikolenko@nas.gov.ua

Пустовойт Михайло Михайлович

Інститут кібернетики ім. В.М. Глушкова НАН України, м. Київ,
Pustovoit@nas.gov.ua

Батіг Людмила Омелянівна

Інститут кібернетики ім. В.М. Глушкова НАН України, м. Київ,
l.taran77@gmail.com

Для того, щоб розуміти вибір посередника, зосередимося на організації обміну продуктами між продавцями і покупцями через дві крайні форми посередницьких обмінів, не беручи до уваги інші ролі, які часто виконують посередники. В одній формі посередницького обміну посередник діє як дилер (роздрібний торговець) у тому сенсі, що купує продукти у продавців і перепродає їх покупцям: ціноутворення централізується посередником. У другій формі посередницького обміну посередник не бере під контроль продукти продавця, а просто пропонує покупцям і продавцям доступ до платформи (чи ринкового майданчика), на якому вони можуть взаємодіяти на свій розсуд: ціноутворення децентралізується до учасників ринку, а платформа оподатковує торгівлю. Першій формі відповідає бізнес-модель, в якій дилер встановлює оптову ціну для продавців і встановлює роздрібну ціну для покупців, а продавці та покупці є ціноотримувачами. Другій формі відповідає бізнес-модель, в якій оператор платформи стягує плату за користування платформою з кожного продавця і стягує плату за користування платформою з кожного покупця, а продавці встановлюють роздрібні ціни для покупців. Ринкові посередники координують дії покупців і продавців. Фірми здійснюють трансакції, обслуговуючи систему платежів, управління запасами, ведення записів, що важливо для функціонування ринків. Крім того, фірми забезпечують центральне місце обміну, таким чином знижуючи витрати покупців і продавців на пошук. Порівнюючи витрати посередництва з витратами прямого обміну на ринках при сполученні покупців і продавців або витратами пошуку, можна показати, що посередницький обмін буває вигіднішим. Непрямі мережеві ефекти з обох сторін ринку ведуть до поняття так званих двосторонніх платформ. На такій платформі основна роль посередника полягає у тому, щоб контролювати доступ до платформи, яку принаймні дві групи агентів використовують для своєї взаємодії. Подібна платформа має цінуватися користувачами кожної групи більше, коли платформа більше використовується іншою групою. Тоді індивідуальні рішення про приєднання до конкретної платформи генерують непрямі мережеві ефекти на агентів з іншої сторони платформи. Завдяки централізованій роботі платформи посередник може додавати вартість і захоплювати ренти шляхом сприяння інтерналізації цих зовнішніх ефектів. Характеристики посередників мають відповідати певним очікуванням учасників ринку.

Ключові слова: випадкові сполучення, трансакційні витрати, витрати пошуку, корисність.

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