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The paradox of (Inter)net neutrality: An experiment on ex-ante antitrust regulation☆

Irene Comeig [a,*], Klaudijo Klaser [b], Lucía D. Pinar [c]

[a] University of Valencia, ERI-CES and Department of Corporate Finance, Av. de los Naranjos, s/n, 46022, Valencia, Spain
[b] Università degli Studi di Trento, Dipartimento di Economia e Management, via Inama 5, 38122, Trento, Italy
[c] University of Valencia, ERI-CES and Department of Economic Analysis, Av. de los Naranjos, s/n, 46022, Valencia, Spain

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ABSTRACT

Net neutrality has been the most relevant and heavily debated Internet regulation policy of the last decade. Net neutrality aims to prohibit discrimination between data packages in terms of content, origin, destination, or type of equipment used. However, the Big Tech companies, sheltered by the net neutrality policy, have flourished. They now have the power to exclude minor companies, and therefore their contents, from the Internet market in de facto defiance of the net neutrality principle. Academic results regarding this net neutrality paradox are still ambiguous. To represent the current Internet market distortions and analyze a potential tool to adjust and strengthen the net neutrality principle, an economic experiment based on an extended version of the dictator game was conducted. In particular, the effect of an ex-ante control and sanctioning mechanism on the collusive behavior of big companies was studied. The regulation mechanism proves effective, significatively reducing the abusive behavior of large Internet companies. This result contributes to the debate on net neutrality, reinforcing the idea that policymakers, given the current asymmetric Internet market structure, should revise and update net neutrality regulations.

1. Introduction

Net neutrality is defined as the principle that all Internet data packages, regardless of their content, origin, destination, or type of equipment, should receive the same treatment. The definition of equal treatment concerns only network traffic in the provision of retail services. It does not refer to wholesale or aspects related to security, privacy, or freedom of expression (Greenstein et al., 2016).

In the early 2000s, the capacity of Internet service providers (ISPs) to control and block access to content and network applications led to questions over the legal need to keep networks neutral (Wu, 2003). Although net neutrality can also be approached from an ethical perspective (Pinar et al., 2021; Turilli et al., 2012), this article focuses on the purely economic sense of net neutrality.

To better understand the debate around net neutrality, the Internet market can be described as a two-sided market (Economides, 2016; Economides and Hermain, 2012; Kaiser and Wright, 2006; Rochet and Tirole, 2006). On the one side, an ISP such as Orange, Vodafone, or AT&T sells broadband Internet access to end users, while on the other side, the ISP grants content providers such as Google, Amazon, Netflix, or smaller apps access to the network by sending their contents to end users (Fig. 1). When this access is monopolized or market competition is low, cross-group externalities (network effects) provide a rationale for net neutrality, a policy designed to prevent discriminatory practices toward some content providers.

The salience of this topic is also reflected by the recent interventions of the major Internet authorities. In 2015, Europe followed the United States by incorporating the net neutrality principle into its regulations (Faulhaber, 2012; Maxwell and Brenner, 2012). In the European Union, the Body of European Regulators for Economic Communications (BEREC) prohibits prioritization practices, although it does allow for certain cases of zero ratings, which creates bias in access prices (BEREC, 2016).

In the current dispute, the Big Tech content providers (i.e., Google, Amazon, Netflix, and Facebook) claim that there is a need to maintain net neutrality to keep the Internet an open global network that fosters

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* Corresponding author.
E-mail address: Irene.Comeig@uv.es (I. Comeig).

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innovation. In contrast, ISPs (e.g., Orange, Vodafone, Movistar, and AT&T) and other net neutrality detractors argue that net neutrality discourages ISP investment in maintenance and the extension of network capacity and that it allows free-riding behavior from the side of the content providers (Table 1).

So far, research has been unable to clarify the economic consequences of net neutrality,[1] and lobbying pressure on the debate has been substantial (Krämer et al., 2013; Krämer and Peitz, 2018; Greenstein et al., 2016; Lee and Wu, 2009; Schuett, 2010). In addition to inconclusive theoretical frameworks, empirical data are scarce (Hazlett and Wright, 2017; Hooton, 2020; Nurski, 2012). Moreover, the few existing results are mostly weak due to poor data quality and narrow time frames.

During the controversy surrounding the need for neutrality regulations, the Internet market has experienced substantial restructuring. Google, Amazon, Facebook, and Apple, together known as Big Tech, not only dominate the current content market but have also experienced huge growth in their innovative capacity, technically giving them a symmetrical position in regard to ISPs within the Internet market. Hence, Wright (2017) cited Big Tech as the big winners of net neutrality. On the contrary, Economides (2017) argued that a large number of small innovative companies, startups, and apps have thrived because they did not have to pay or were not discriminated against when accessing the ISPs. In fact, looking at the current digital ecosystem, none of these statements can be refuted.

Nevertheless, net neutrality regulation seems to have tilted the balance in favor of large content companies (Jacobides, 2020). Indeed, the large companies that dominate the content market (and the digital market as a whole) now have the power to engage in the discriminatory practices that the net neutrality principle was supposed to prevent. Therefore, despite formal net neutrality regulation, considered by many academics to be obsolete, in reality, the Internet does not seem to be a neutral network anymore.

Within this general context and given the lack of empirical research and knowledge on the topic, our study provides experimental evidence to contribute to the debate on European Internet regulations and on the need for new mechanisms to keep the Internet neutral. More specifically, taking advantage of the methods and the tools of experimental economics, this study tests the effectiveness of a regulatory organism in preventing abusive behaviors by the biggest companies in the Internet market.

The rest of the paper is organized as follows. Section 2 describes the Internet market regulation challenges that provide the context for the analysis. Section 3 offers some recent experimental approaches to Internet market regulation, together with the two fundamental hypotheses of this study. Section 4 describes the experimental design and the experimental procedure. Section 5 presents the results and data analysis. Finally, Section 6 offers the main conclusions and some indications for future research.

2. The paradox and current challenges of the internet market

Internet market regulation faces important challenges. First, applying the net neutrality principle as has been done so far (i.e., to content providers) can lead to a vicious circle where the dominant position passes from one side of the market (ISPs) to the other (big content providers). Second, costly ex-post antitrust regulations have proven inefficient with Big Tech companies because they operate at the international level. Even though the recent G20 Summit left the door open for a minimum global tax, neither the OECD nor the EU has so far been able to agree on how to tax Big Tech.

However, what is certain, and at the same paradoxical, is that those Big Tech companies, earlier protected by net neutrality regulations, now have the power to exclude minor companies from the economic rewards

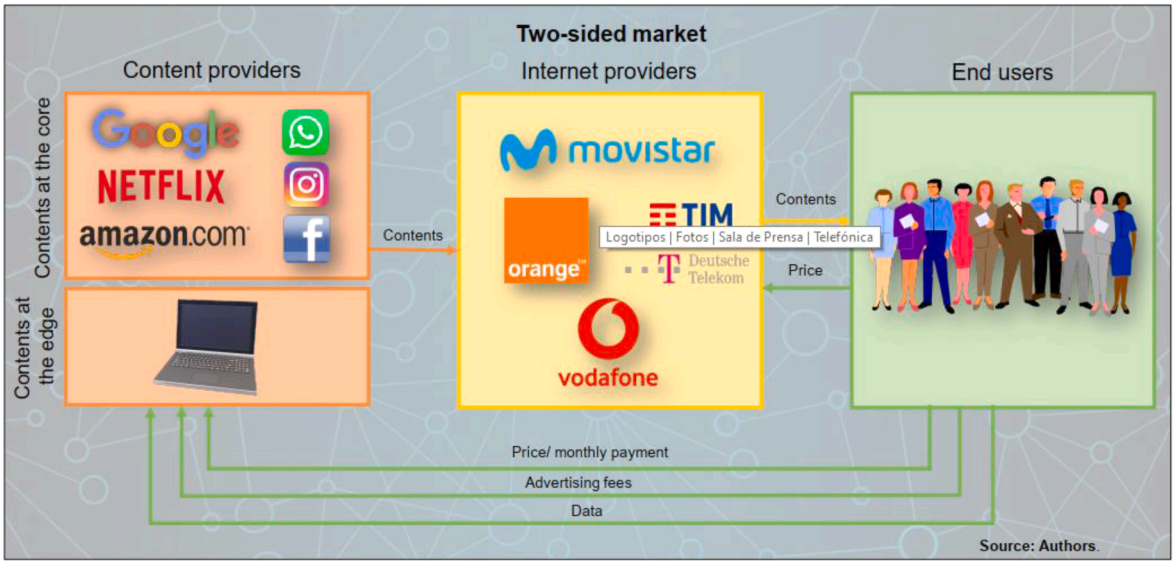


Fig. 1. The Internet market's two-sided structure (last mile structure).

generated by the Internet market, violating the very principle of net neutrality (Jacobides, 2020). Hence, both the United States and the European Union are constantly studying how to control Big Tech through legal and administrative measures.

In July 2020, Apple, Amazon, Facebook, and Alphabet appeared in front of the U.S. Congress to clarify their market position. Between 2017 and 2019, Google received fines amounting to 8.25 billion euros for dominating the European Union market with the Android Operating System. Moreover, in several states, Google is considered a monopoly in

[1] However, the economic consequences of different regulation policies depend on the specific type of net neutrality. Strong net neutrality means that the ISP cannot discriminate in its pricing with either content providers or consumers. Weak content provider net neutrality means that the ISP cannot discriminate in its pricing with content providers. Weak consumer net neutrality means that the ISP cannot discriminate in its pricing with consumers. No regulation means that the ISP can charge content-contingent prices to consumers and content providers (Gans, 2015).

Internet searching and advertising. In 2013, Microsoft was fined 561 million euros for imposing the Internet Explorer browser on all Windows 7 users. The United States regulator has also filed lawsuits against Facebook due to its control of Instagram and WhatsApp.

The European streaming market is basically a duopoly between Netflix and Amazon. Their combined market share within the European Union is nearly 80%. In certain countries, their share is even higher. In France, for example, these two companies had 97% of the market at the end of 2018. Of the two, Netflix is the largest. It had a 46% market share in the EU at the end of 2018, beating Amazon's 33%. Hence, all their competitors combined could only manage 21% of the market. These two giants have been relatively unchallenged, but the situation might be changing.[2] Jacobides (2020) suggested that two more ingredients are necessary to address the real malaise underlying this European regulation challenge: proactive strategies by industry leaders considering the role of their business models and a thriving and open ecosystem of technology participants.

The European Union aims at changing the business practices of Big Tech through the Digital Markets Act.[3] This law puts the spotlight on companies that have become gatekeepers. These companies, which dictate the rules of the market, will be forced to share the data they collect with rivals and regulators, will be prohibited from granting themselves preferential access to adjacent markets, and will be banned from mergers. Violation of these rules will entail substantial fines amounting to between 6% and 10% of their annual turnover. This new digital market regulation is designed to prevent these tech companies from abusing their dominant position by giving consumers more choice and control over their data and, above all, to help smaller companies flourish and ensure that they are not driven out of the market by the power of their stronger rivals.

Unlike current competition laws, which have proven inefficient and ineffective in the digital age, the new law will trigger preventive measures by punishing ex-post abuses of dominance. Until the legislation is approved, Big Tech is expected to lobby against this law, which represents one of the strictest regulation packages in the world. These important changes to the Internet market and the recent debate on its regulation demonstrate the need to focus on rethinking the net neutrality principle. Hence, this study uses tools from experimental economics to examine the effectiveness of an ex-ante regulatory mechanism in the Internet market.

Table 1
Summary of the current debate on net neutrality.

For	Against
No a priori exclusion	Inefficiencies in traffic management
No Internet fragmentation	Disincentives for network provider investment
End-to-end principle	Free-riding behavior by large content providers

3. Experimental approaches to the internet market and hypotheses

Due to the algebraic complexity in giving theoretical answers to economic challenges such as Internet market regulation, in this paper, a more practical approach is adopted to simplify the analysis and approximate the problem to a real scenario. Specifically, a laboratory economic experiment is used.

The experimental approach is widely recognized as a suitable tool to analyze market dynamics (Smith, 1962, 1982). Furthermore, many authors have highlighted the reliability of economic experiments for studying issues related to competition policies (Hinloopen and Normann, 2009), including market power structures (Krause et al., 2004) and market regulation policies (Berg, 2003; Bohm, 2003; Riedl, 2010).

Regarding the Internet market, to the best of the authors' knowledge, only three experimental studies have investigated price setting in two-sided Internet markets. Nedelescu (2013) examined the monopoly model of Armstrong (2006) by studying the effects of two price-setting restrictions (no prices below costs and uniform prices) and increased costs. The study showed that only in the uniform-price treatment (net neutrality) did participants reach the profit-maximizing price predicted by the underlying theoretical model. Fig. 3 shows the structure of a two-sided market.

A second experimental study, also based on the model of Armstrong (2006), was run by Kalaycı et al. (2017). In four treatments, they varied

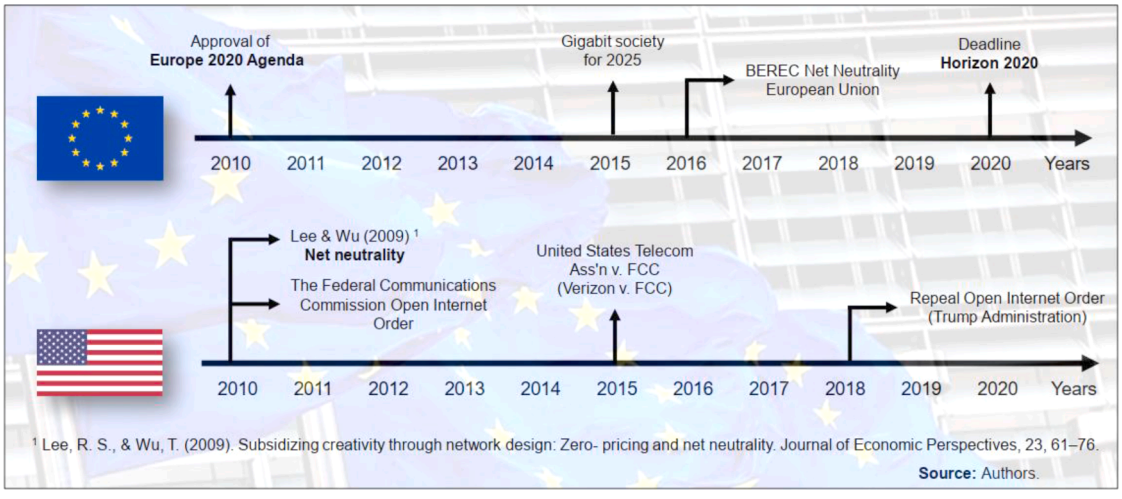


Fig. 2. A timeline of the last decade in Internet regulation.

users' transportation costs and the strength of the (one-way) indirect network effect. A key finding was that prices showed no convergence to the equilibrium. Both Nedelescu (2013) and Kalaycı et al. (2017) suggested that the missing convergence to the equilibrium might be driven by the high complexity of the task.

(Weghake et al., 2018)also examined asymmetric equilibria, so the complexity in their experiment was even higher. Their study showed

[2] https://www.nasdaq.com/articles/the-state-of-the-streaming-market-in-europe-2020-04-15, by Stephen Lovely. Last time entered September 2021.

[3] https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/digital-markets-act-ensuring-fair-and-open-digital-markets_en, European Commission. Last time entered September 2021.

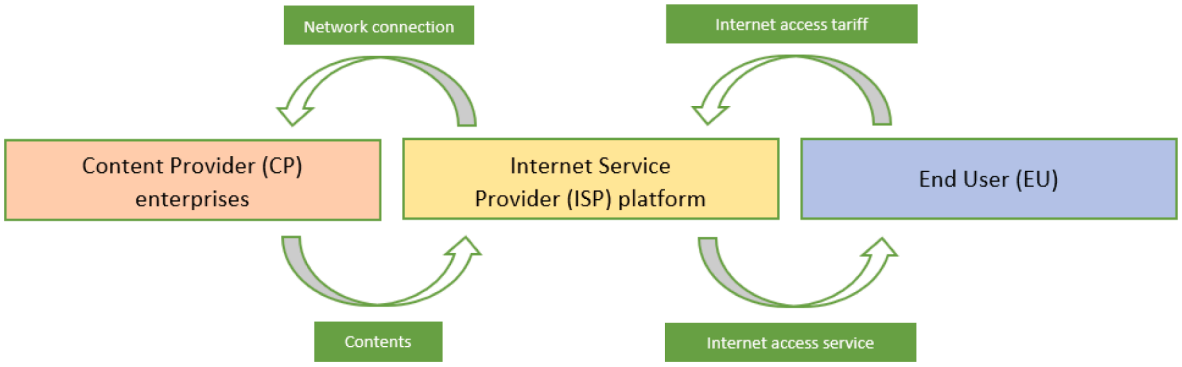


Fig. 3. Representation of a two-sided Internet market.

that there was hardly any realization of the Nash equilibrium. According to the authors, participants seemed to use simple heuristics, and "it remains quite unclear whether the equilibrium theory of two-sided markets covers the most important features of market behavior."

The main limitations of these few experimental studies concerning two-sided markets are task complexity and the interpretation of the results and hence policy implications. Given these limitations, in this study, the structure was simplified, considering one of the two sides by excluding end users. Thus, the experiment included a single ISP, a strong content provider (CP_{big}) and a weak content provider (CP_{small}), as illustrated in Fig. 4.

To represent the power relationship between these three actors under the current asymmetric market structure, an extended version of the dictator game was used (Engel, 2011; Kahneman et al., 1986). This game is referred to in the literature as the exclusion game (Faillo et al., 2014; Sacconi et al., 2011). The basic version of the exclusion game is a resource allocation experiment with groups of three players. Each group is then provided with a common endowment that can be shared among the three players. However, only two players in the group are assigned the power to decide (individually) about how to distribute the common endowment. The third player assumes the role of a passive spectator affected by the choices of the two active parties. Given this structure, the two dictators can exclude the weak player from the distribution of the initial endowment.

Based on this framework, the ISP and CP_{big} were assigned the role of joint dictators (Fig. 5). In other words, they had the possibility to collude at the expense of CP_{small}, which had neither the possibility to interact with the strong parties nor any decision-making power. To make the possible collusion more formal, two substantial differences were included with respect to the standard exclusion game. First, the two strong companies were asked to make a unanimous decision about the division of the market profits. Second, the two dictators were allowed to communicate via a written chat. In the real market, big companies have the power and resources to communicate so that they can coordinate on how to split the economic rewards within a market.

In this study, within the debate on net neutrality and the tools to solve the current paradox, the aim was to examine the effects of an ex-ante market regulation mechanism that can potentially prevent or limit collusive behavior between the Big Tech companies. Therefore, the laboratory experiment described later was used to test two fundamental hypotheses:

H1: With no regulation mechanism in the Internet market, the big companies (the ISP and CP_{big}) will frequently collude at the expense of the small company CP_{small}.
H2: With an ex-ante regulation mechanism, the collusive behavior between the ISP and the CP_{big} will reduce significantly.

There are several motivations behind this experimental approach to Internet market regulation based on the exclusion game. First, as explained earlier, the aim in this study was to simplify the analysis. Having a smooth game design can lead to a better interpretation of the results and therefore clearer policy implications for the net neutrality debate.

Second, the study aimed to provide an understanding of how big Internet companies, which may abuse their position, can distort the net neutrality principle and harm smaller actors, thereby altering the distribution of the economic rewards within the Internet market. Experimental studies of collusion have so far exclusively focused on the potential gains for the companies that decide to collude (Andersson and Wengström, 2007; Andres et al., 2020; Block and Gerety, 1987; Fonseca and Normann, 2012; Roux and Thöni, 2015). No study has explicitly considered the economic or social effects of collusive behaviors on weaker third parties.

Lastly, this study can contribute to the literature on the dynamics of communication between big companies and the links with their collusion decisions (Andersson and Wengström, 2007; Andres et al., 2020). Whereas in the basic version of the exclusion game, the two dictators act individually in a predictable manner (Cherry et al., 2002), the fact that they can actively interact in this modified version might (positively or negatively) alter their joint choices.

4. Experimental design and procedure

Based on the theoretical framework of the exclusion game described in the previous section, an experiment was designed to test this study's fundamental research hypotheses. As explained earlier, the ISP and CP_{big} played the role of joint dictators (Fig. 5). In the baseline version of the game, the two dictators could decide whether to share the market profits according to two opposite options, which reflected two different market structures. One option represented the net neutrality condition. This option allowed the weak content provider to enter an inclusive market and earn a profit because of fair competition between all actors.[4] The second option represented the situation where the ISP and CP_{big} were tempted by huge economic rewards to collude at the expense of the CP_{small}, which could not earn a profit because of its exclusion from the market.

Thus, the participants in the role of ISP and CP_{big} were required to decide unanimously which market structure to implement (Table 2):

- they could opt for an inclusive market structure where all three actors earned 5€ of profit;
- they could decide to collude by choosing a market structure that excluded the CP_{small} from a share of the market profits, so that the ISP and CP_{big} gained 25€ each and the CP_{small} gained 0€.

[4] In this representative world, the practice of net neutrality is equivalent to the situation where there is no discrimination in terms of price or quality.

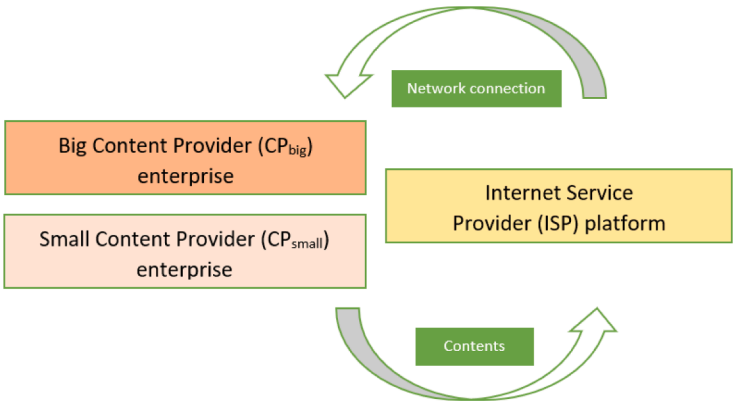


Fig. 4. Representation of a one-sided Internet market.

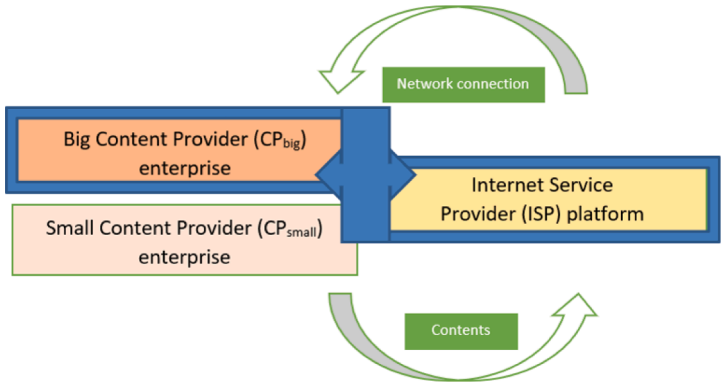


Fig. 5. Power relationships in Internet markets based on the exclusion game.

Table 2
Payoff matrix in the baseline treatment.

Role Option	ISP	CP_{big}	CP_{small}
Inclusive market	5€	5€	5€
Exclusive market	25€	25€	0€
Different choices	0€	0€	0€

The prospect of offering apparently high profits for a single collusion decision with respect to the profits in the competitive market has theoretical as well as practical reasons. Experiments studying collusive behavior usually rely on smaller amounts that accumulate through repeated interactions. These repetitions reveal the dynamics of collusion over time. However, this game is not repeated but instead involves a one-off decision. Thus, for each dictator, the discounted profits from all possible periods of collusion in repeated iterations were represented with a high stake. Indeed, the huge (accumulated) profits that two colluding companies can gain in the long run when they deviate from a competitive market are believed to be at the root of collusion decisions.

Moreover, unlike in the exclusion game, where each dictator must make an individual decision, this game required dictators to make a shared decision on how to split the market profits. If the dictators chose two different options, the game ended and all participants received zero euros. Theoretically, this outcome might be interpreted as a situation where, in a repeated context, one of the two dictators defects after reaching a collusive agreement, creating a negative tit-for-tat dynamic (Andersson and Wengström, 2007).

To replicate a real context as best as possible and allow the dictators to make a conscious joint decision not based on a fortuitous match, the ISP and CP_{big} were allowed to communicate freely via a written chat (Waichman and Requate, 2014). In many real contexts, the strong parties are not required to decide separately like they are in the exclusion game. Instead, given their enormous power, they can communicate and therefore reach a decision before choosing their individual action.

Lastly, the main goal was to provide guidelines regarding the tools that might prevent or limit collusive behavior in the current asymmetric Internet market structure. Therefore, the regulation treatment included an ex-ante control mechanism based on the probability of being detected and receiving a fine.[5] This mechanism was supposed to represent a monitoring and sanctioning institution. Thus, the joint choice of the two dictators (ISP and CP_{big}) was monitored with a probability of 80%. If a deviation from a competitive market structure was detected because the dictators had colluded against the weak content provider, then the ISP and CP_{big} paid a fine of 25€ each, leaving everybody with 0€.[6] These scenarios are shown in Table 3.

Table 3
Payoff matrix in the regulation treatment.

Role Option	ISP	CP_{big}	CP_{small}
Inclusive market	5€	5€	5€
Exclusive market	25€	25€	0€
Different choices	0€	0€	0€
Collusion detected	0€	0€	0€

[5] Such mechanisms are common practice in the experimental economics literature, particularly in the field of tax evasion (Pickhardt & Prinz, 2014).

[6] With a probability of detection of 80% and a fine of 25€, the expected value of this lottery was equivalent to the certain amount of 5€ gained from the inclusive market option.

4.1. Experimental procedure

The experiment was coded using the open-source software oTree (Chen et al., 2016). In January 2021, four sessions of the experiment took place at the Laboratori d'Economia Experimental (LEE) of the University Jaume I in Castellón (Spain). The sessions respected all official measures to prevent the spread of the SARS-COV-2 virus. The experiment involved 114 participants, with 18 groups of three people playing in the baseline treatment and 20 groups playing in the regulation treatment.

On average, the participants were 22 years old, ranging in age from 18 years to 33 years. About 57% of participants were male, and 54% were enrolled in an economics-related degree. On average, the participants had previously taken part in seven other experiments. The average payment, including the show-up fee of 3€, was close to 13€.

During the experiment, some groups experienced technical issues related to the chat. Therefore, six groups were excluded from the data analysis (two in the baseline treatment and four in the control treatment). Excluding these participants left 16 valid groups per treatment, for a total of 96 choices. The demographic and payment statistics did not change significantly after excluding these 18 participants.

5. Results

First, the analysis focuses on the choices of the joint dictators in the baseline treatment with no control mechanisms. In the baseline treatment, the ISP and big content provider in all 16 groups (100%) agreed to exclude the small content provider from the distribution of profits. This result offers evidence that when the economic incentives to exclude are high and there are no institutional mechanisms to prevent exclusion, collusive behavior is dominant, despite having a negative economic impact on weaker third parties. Thus, the experiment provides strong empirical support for the first hypothesis:

H1: With no regulation mechanism in the Internet market, the big companies (the ISP and CP_{big}) will frequently collude at the expense of the small company CP_{small}.

The confirmation of *H1* has at least two immediate implications for the study. First, when Big Tech companies have huge economic interests and their actions are not sufficiently monitored, the principle of net neutrality is systematically violated. Thus, even if the principle of net neutrality formally guarantees that no contents are excluded from the Internet market, the fact that certain actors have the real power to shape the market structure makes the market non-neutral. This situation is the paradox of the net neutrality principle described in the Introduction, which allows some companies to be dominant, turning the Internet market into a de facto exclusive environment.

Second, in the decision to collude, the severe negative consequences for small companies that try to enter or stay in the market become negligible in the eyes of the companies with the power to shape the market. In other words, the dictators collude even if they are aware that they are doing so at the expense of a weaker third party. This pattern also emerges by looking at the chats between the participants, which are analyzed in more detail in the next section.

In the regulation treatment, only seven dictator groups out of 16 (44%) chose to collude, whereas the remaining 56% opted for the equitable distribution of the market profits (Fig. 6).

These percentages imply that the ex-ante regulation mechanism worked effectively. Indeed, compared to the baseline treatment, it significantly reduced (c_1^2=12.52,p-value = 0.0004) the collusive behavior of the ISP and CP_{big}. This finding was observed even though the expected value of the lottery was equivalent to the guaranteed option of sharing the profits between the three players. Thus, the second major hypothesis is also verified:

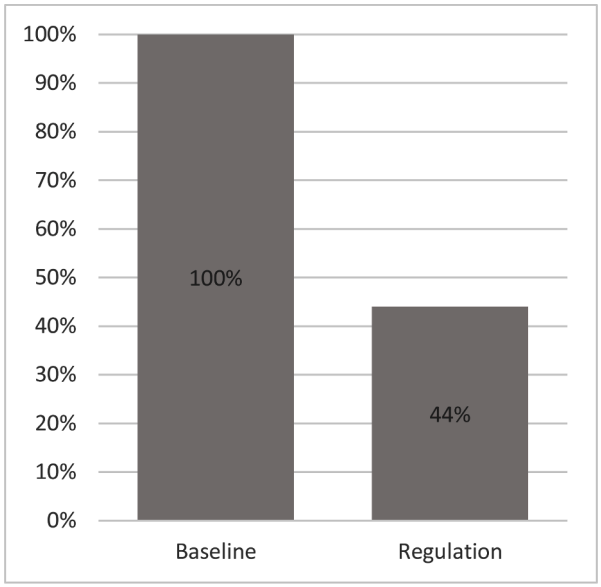


Fig. 6. Percentage of collusion in the two treatments.

H2: With an ex-ante regulation mechanism, the collusive behavior between the ISP and the CP_{big} will reduce significantly.

Taken as a whole, the experimental evidence confirms that a formal institution capable of effectively monitoring and sanctioning the Big Tech companies that profit from collusion plays a fundamental role in protecting small actors that want to enter or stay in the Internet market. In other words, in the current context, having an ex-ante regulation authority is essential to defend the net neutrality principle. Moreover, not having any regulation framework jeopardizes net neutrality.

5.1. Discussion of further qualitative results

Given the structure of the game, even though the CP_{small} had no decision-making power, the participants playing the weak role were asked to predict the choice of the ISP and CP_{big} to explore the expectations of the passive player. To incentivize these predictions, these players received a monetary payoff of 1€ for a correct prediction.

In the baseline treatment, 14 out of the 16 participants (88%) playing the role of small content provider predicted the exclusive market option, systematically anticipating the collusive behavior of the ISP and big content provider. This observed behavioral pattern on the expectations side of the weak player supports the conclusions so far. That is, without any institutional mechanism to limit the power of big companies, weak actors have no reason not to expect coordinated collusive action by the ISP and CP_{big}. This finding is relevant because it implies a less-than-obvious conclusion. That is, if the common belief of small content providers is that the strong companies already operating in the market will act to exclude them, this situation might act as a massive deterrent for small actors to try to enter the Internet market.

Regarding the predictions of the CP_{small} players in the regulation treatment, only five out of 16 participants believed that the companies with greater market power would choose an exclusive market. This percentage (31%) was significantly different from the one for the baseline treatment (c_1^2=10.49,p-value=0.0012), showing that the regulation frame also makes a difference in terms of the expectations of the weak actor. This result implies that if small content providers feel protected by an institutional monitoring framework, they might be encouraged to enter the Internet market, in line with the net neutrality principle.

Lastly, the messages exchanged between the ISP and CP_{big} in the two treatments also provide insight. In the baseline treatment, the subjects

playing the role of ISP and CP_{big} exchanged a total of 186 messages via the written chat. Non-relevant messages such as "*hello*" or "*is anybody there?*" were removed, leaving 161 relevant messages consisting of 671 single words. A rough calculation shows that, on average, it took approximately 40 words to agree on the exclusive option (the only one chosen in the baseline treatment). The brevity of the conversations shows that the chats were highly targeted, as exemplified by conversations such as the following:

Chat 1
Player 1: Decision no doubt, right?
Player 2: Of course, right?
Player 1: Man, 25€ each and we all go home
Player 1: Goodbye
Player 1: Option A [exclusive market]
Player 2: Effective, quick and simple

One of these conversations was extremely direct, as demonstrated by the following exchange:

Chat 2
Player 1: Option A [exclusive market]?
Player 2: Ok
Player 1: Then I'll choose that one
Player 2: Me too

Based on a simple text analysis, the chats in the baseline treatment can be divided into two main groups. One half of the conversations had the tone and length of the last message of the first chat reported above. That is, the dialogs were "*effective, quick and simple*." The analysis shows that, in this chat category, the weak third party (CP_{small}) was not even mentioned. Only a few cases considered the weak party, but the communication was still straightforward, using reasoning referring to efficiency. For example: *"it's better to distribute 50 euros than 15, I think"* or *"if we choose Option B [inclusive market], we lose 20 euros each and the CP_{small} gets 5 euros."*

In the other half of the dictator groups, the conversations followed a different pattern. They were less smooth and direct than the ones in the first group. In particular, in a second subgroup, one of the players showed some moral concerns, expressing a sort of disappointment or displeasure at the negative economic consequences for the weak player. Six groups used expressions such as "*I feel sorry*" and "*it's a bit selfish*" when the exclusive option was mentioned. Nonetheless, this kind of moral sentiment was immediately dismissed and counterbalanced by the remarks of the other strong player who actively emphasized that the monetary gain with the exclusive option was considerable. The following chats offer two examples:

Chat 3
Player 1: Which option were you thinking about?
Player 2: About Option A [exclusive market]
Player 2: And you?
Player 1: Me too. It's a bit selfish, but it's the most beneficial for us
Player 2: Exactly
[…]
Chat 4
Player 1: Which decision do you want to take, A or B?
Player 2: I think that Option A [exclusive market] is the best, isn't it?
Player 1: Yes
Player 2: I feel sorry about it, but there's too big of a difference
Player 1: It's beneficial for both of us
Player 2: Yes of course
[…]

Given these initial moral concerns in this second group of conversations, the convergence toward a common decision was less immediate. These chats show that the main block of the conversation was followed by a series of reciprocal questions and confirmations to reassure the other dominant party about the option they should choose to avoid misaligned decisions. Again, the economic implications for the small actor were irrelevant in the eyes of the big companies.

The chats in the regulation treatment contained 225 messages. Once again, removing introductory messages left 203 messages consisting of 875 single words (54 on average). Therefore, to reach an agreement in the game with a regulation mechanism, the ISP and CP_{big} needed 25% more messages (30% more words) to coordinate their choice. This difference is probably due to the uncertainty created by the control system, and it might have important policy implications. In our experiment, communication was free, but it is reasonable to assume that interacting in this context is costly. If this assumption holds, a further reduction in collusion can also be expected, as demonstrated by the way that other experiments have focused on this topic.

A closer look can provide a better understanding of the effect of the regulatory institution on the choices of the joint dictators. First, there was no substantial lexical or dynamic difference between the conversations of the groups that chose different options (inclusive or exclusive market). The chats were more or less structured in the same way, with an extended discussion on which was the most appropriate alternative, in particular whether the ISP and CP_{big} should take a risk or take the safer option themselves. This discussion also explains why the conversations in this treatment were longer than those in the baseline treatment. The following is a typical dialog in the regulation treatment:

Chat 5
Player 1: We should choose B [inclusive market], right?
Player 2: For me, choosing A [exclusive market] is better
Player 1: Just think that A only has a 20% probability
Player 1: With B, it's a guaranteed 5 [euros]
[…]
Player 1: If we take A [exclusive market], we have an 80% of chance of getting nothing
Player 2: Ok, then let's click B
[…]
Player 2: I'm scared of losing everything
Player 2: I prefer something to nothing

Beyond this standard structure, there was another empirical regularity in the chats of the regulation treatment compared to those of the baseline treatment. In the communications in the regulation treatment, almost all the moral concerns for the weaker third party disappeared. Indeed, 14 of the 16 groups focused exclusively on the consequences for the lottery, as reflected by the previous conversation. In other words, distributional concerns, which often emerged in the baseline treatment, played only a small role in the arguments of the players in the regulation treatment. However, unlike in the baseline treatment, where the moral concerns were immediately dismissed in favor of economic reasoning, the moral lever was somehow effective in some cases of the regulation treatment. The following conversation is one of the two examples of this phenomenon:

Chat 6
Player 1: Which option do you prefer?
Player 2: I don't know. Maybe we should try the 25€ one?
Player 2: A [exclusive market]
Player 2: What do you think?
Player 1: I would prefer B [inclusive market]
Player 1: To me it seems fairer
Player 2: Ok
Player 1: So, what should we do?
Player 2: This way, it's less exciting, but at least we won't annoy the other [player]
Player 2: B

Player 1: A is more beneficial for us, but B is fairer
Player 2: Right, if we don't get A, we'll be annoyed too
Player 2: And we probably won't get it
[…]

Although it was not plausible to formulate precise hypotheses on the qualitative nature of the chats, the data highlight important differences in the dynamics of the chats, particularly in relation to the length of the conversations in the two treatments.

6. Conclusions

There is a paradox within the Internet market. The Big Tech companies, once protected by net neutrality regulation, now have the power to exclude smaller companies from the economic rewards of the Internet market, thus violating the principle of net neutrality. Thus, if it is not revised and updated, the net neutrality principle risks becoming an elegant theoretical achievement that is poorly adapted to the current highly asymmetric market structure.

This paper contributes to the debate on net neutrality, which has intensified in recent years, given the profound changes to the Internet market and the regulation policies proposed in the United Stated and Europe. In particular, the European debate about net neutrality is more strained than ever. The Digital Markets Act aims to stop abuses of power by the Big Tech companies. This act has attracted controversy given the strong sanctions that the European regulator plans to impose on the gatekeepers, which range from 6% to 10% of companies' revenues. However, lobbying pressure has been strong.

This study contributes to confirming the validity of ex-ante mechanisms that discourage collusion. Moreover, it legitimates the idea of the need to ensure that the Internet remains a network that does not allow discriminatory practices. Thus, the study also reinforces the idea that the principle of net neutrality must be extended from ISPs to include all unregulated content providers. An experiment based on the exclusion game provides evidence in favor of having policymakers refresh the principle of net neutrality to adapt it to the current asymmetric Internet market situation, which differs from the one for which the net neutrality principle was originally conceived. In particular, the evidence from this experiment supports the introduction of an effective ex-ante regulation and sanctioning mechanism that reduces the abusive behavior of the largest Internet companies at the expense of weaker parties. This specific result is consistent with the general view that the principle of net neutrality should be defended with new regulatory mechanisms because the existing framework is obsolete. The experiment provides empirical support for this conclusion, which has mainly been debated from a theoretical perspective.

From the experimental point of view, the contribution of this paper is the experiment's simplified design in terms of the effects of collusion on companies with little market power. To the best of the authors' knowledge, all existing experimental studies on collusion have focused exclusively on the potential gains for the companies that decide to collude. This narrow perspective has been broadened in this study to confirm the potential damage of collusion for weaker parties.

At the same time, this experimental study has two main limitations. First, despite being statistically significant, the results are based on a narrow subject sample. Nevertheless, the tendency in the regulation treatment was strong. Second, the analysis focused on one side of the market, so it does not provide an understanding of how the other side of the market (i.e., end users) are affected by the collusive behavior of strong companies.

Because end users are usually the target of protective regulations, future research should include end users in a simplified game design. Moreover, it would be of interest to analyze the possibility of making communication costly to understand whether the price of communication might further reduce the abusive behavior of big companies. Adding these two elements could contribute to the design of better policy tools to protect Internet neutrality more effectively.

Author statement

All authors contributed equally to the study conception and design; data collection; analysis and interpretation of results; draft manuscript preparation, and approved the final version of the manuscript.

Appendix: Instructions of the experiment (regulation treatment)

Good morning. You are going to take part in an experiment that aims to study the behavior of big companies operating in the Internet market. For your participation, you will receive 3.00€, plus an additional amount that will depend on your choices and on the choices of other participants. In this experiment, you can earn up to 28.00€.

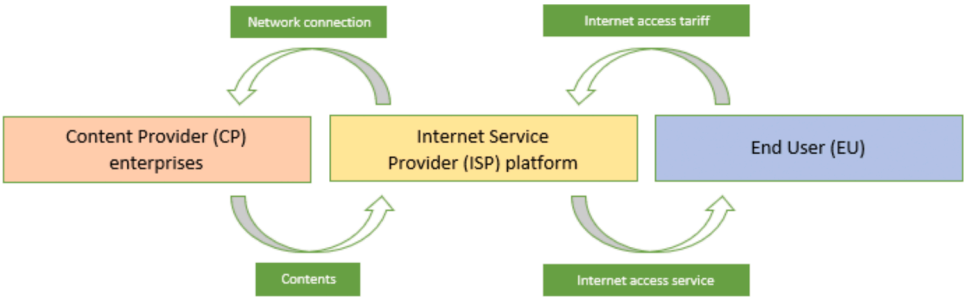
During the experiment, any type of communication with other participants is forbidden if not specified in the instructions.

The Internet market

The Internet market is structured in the following way:

- There is an Internet service provider (ISP) through which content providers access the end users of the Internet.
- The end users must also connect to the Internet service provider (ISP) to consume the contents offered on the Internet.

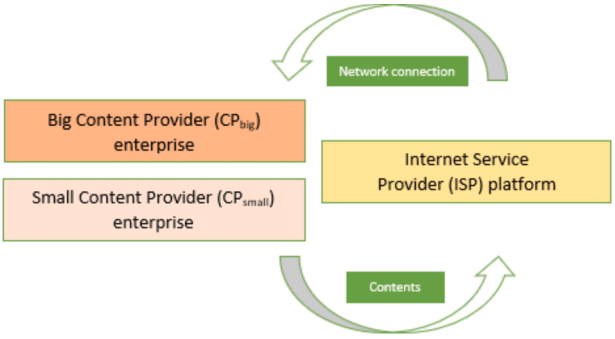
These interactions are illustrated in the following figure:



This experiment focuses on the first part of this market, namely where content providers access an Internet service provider (ISP) platform.

Therefore, end users are not included in this experiment. In this experiment, the aim is to analyze the interactions between a large content provider with considerable market power (CP_{big}), a content provider with little market power (CP_{small}), and a single Internet service provider (ISP).

The following figure represents the first part of the Internet market studied in this experiment.



The Internet was conceived as an open, free, and neutral network where no contents could be excluded. Thus, it is important to preserve the idea that all content providers that want to participate in the network can do so while participating fairly in the economic rewards. There are asymmetries of power between content providers, and Internet service providers have considerable power to exclude some content providers. Therefore, to maintain the neutrality of the Internet, regulatory mechanisms may have to be introduced to punish abusive behavior. In other words, the structure of the market allows interactions between certain agents that break this neutrality and act in their favor, unless regulators can identify and sanction such behavior. In this experiment, there is a regulatory mechanism to sanction large companies.

Role assignment and initial endowment

At the beginning of the experiment, you will be randomly assigned to a group with two other participants. Therefore, each group will have three companies. You and the other two participants will each be assigned one of the following roles: Internet service provider (ISP), big content provider (CP_{big}), or small content provider (CP_{small}).

Each group of three companies will be asked to decide how to divide the economic rewards that are generated in the Internet market. However, only the strong companies, namely the ISP and CP_{big}, will be able to make this decision. Therefore, CP_{small} will not make any decision about the distribution of the economic rewards of the market.

ISP and CP_{big}: decision

The ISP and CP_{big} will have to decide together how to distribute the profits between the three enterprises in the market. The ISP and CP_{big} have two options:

- OPTION A: to divide the economic rewards of the market between the two of them (ISP and CP_{big}), each earning 25.00€ each and leaving the CP_{small} with 0.00€;
- OPTION B: to divide the economic rewards of the market equally between the three enterprises, assigning 5.00€ to each of them (ISP, CP_{big}, and CP_{small}).

The decision of the ISP and CP_{big} must be unanimous. That is, the two enterprises will have to choose the same option. To reach a unanimous decision, the ISP and CP_{big} will be able to communicate via a written chat. The choice of the ISP and CP_{big} will decide the final payment (together with the show-up fee) of the three participants. If the decision is not unanimous and the ISP and CP_{big} choose different options, the experiment will end, and all participants will receive only the show-up fee of 3.00€.

ISP and CP_{big}: regulated market

There is an 80% probability that the regulator will check the unanimous decision of the ISP and CP_{big}. If the two strong companies choose OPTION A (i.e., if they exclude CP_{small} from the distribution of profits), the regulator will impose a sanction that will leave all members of the group (ISP, CP_{big}, and CP_{small}) with 0.00€. If the two strong companies choose OPTION B (i.e., all companies participate equally in the market profits), no sanctions will be imposed, and the final payment for all enterprises will correspond to the final decision.

CP_{small}: prediction

CP_{small} will not be able to communicate with the other two companies and will not make any decision about the division of the market profits. CP_{small} will only be asked to predict the choice of the ISP and CP_{big}. If the option chosen by CP_{small} coincides with the choice of the ISP and CP_{big}, then CP_{small} will receive 1.00€ extra, which will be added to the final payment. If the prediction is wrong, CP_{small} will not gain any additional payment.

Control questions

1) How many enterprises are there in each group?

Type a number

2) If I am CP_{big}, I will take the decision to divide the market profits with the:

¨ CPsmall
¨ the ISP
¨ both

3) If I am CP_{small}, I will take the decision to divide the market profits with:

¨ the end user
¨ the ISP
¨ no-one

4) In this experiment, is there any mechanism that might sanction the decisions?

¨ yes
¨ no

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Irene Comeig is a tenured Associate Professor at the University of Valencia. She holds a PhD in Financial Economics, with a focus on behavioral finance, experimental economics, and gender. She is currently the Director of the Official Master's Degree in Corporate Finance at the University of Valencia, and the Director of the Research+ CashLab.

Klaudijo Klaser is a postdoctoral scholar at the University of Trento, where he achieved his PhD degree in Economics and Management, with a focus on behavioral and experimental economics. His-studies had been enriched with fruitful research visits at the University of Oxford and Harvard University. His-primary areas of research are at the intersection of moral philosophy and economics, with a particular propensity toward the application of John Rawls' social contract theory.

Lucia D. Pinar is a PhD candidate at ERI-CES at the University of Valencia, in the area of Industrial Organization and Economic Analysis. Her thesis analyzes the regulation of the Internet market and its implications for reinforcing the digital economy. She holds a Bachelor's Degree in Journalism as well as her Bachelor's Degree and Master's Degree in Economics and Industrial Organization from the University of Valencia.