CNMC'S CONTRIBUTION ON COMPETITION IN VIRTUAL WORLDS AND GENERATIVE AI

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1. INTRODUCTION

(1) On 9 January 2024, the European Commission launched two calls for contributions on competition in virtual worlds ("**Virtual Worlds**") and generative artificial intelligence ("**Gen AI**") to gather specific information and views in relation to competition aspects from regulatory experts, academia, industry and consumer organisations in these fields.

(2) As stated by the EC in its call for contributions, while Virtual Worlds and Gen AI systems are still taking shape, it has become clear that the potential impacts of this new phase of digital transformation could be wide-ranging with new technologies, business models and markets.

(3) Gen AI is being at the forefront of public discussion due to its profounds and multidimensional implications for societies. As a breakthrough and disruptive innovation, it has the potential to revolutionise industries, boosting its productivity and efficiency, but also bringing about concerning risks and downsizes for societies[1].

(4) An effective competition among Gen AI firms is crucial to deploy the innovative potential of Gen AI. However, several risks to competition arise along the whole value chain of Gen AI ecosystem. As in other digital industries, many stem from the economic singularities of the inputs and the sector (network effects or scale economies among others), which may be prone to turn out in dominant positions and potential abusive practices.

(5) Similarly, Virtual Words bring new opportunities and business models in many areas (such as health services, education and training, cultural experiences, etc.) but Competition Authorities must be also vigilant to potential risks from the perspective of the enforcement of competition law.

(6) The National Commission on Markets and Competition (CNMC) submits this contribution in order to analyse the potential impacts that this new phase of digital transformation could have on the work of Competition Authorities (CA), by identifying potential competition issues that may arise in these fields. Also, by pointing out potential opportunities of this revolutionary technologies for CA (e.g. enhancing its detection capabilities through Gen AI technologies).

(7) After this first introductory section, the second section of this contribution will deal with the implications of Gen AI for Competition Authorities, the third one with the implications of Virtual Worlds for Competition Authorities and the fourth and final section will include a final conclusion.

[1] This contribution merely analyses the impact of both Gen AI and Virtual Worlds from the point of view of Competition Auhorities, without analysing other potential implications in other fields.

2. POTENTIAL IMPLICATIONS OF GENERATIVE AI FOR COMPETITION AUTHORITIES

2.1. Concept and uses

(8) Artificial intelligence ("**AI**") can be defined as the ability of a machine to display human-like capabilities such as reasoning, learning, planning and creativity. It encompasses a variety of techniques and approaches to enable machines to simulate human-like capabilities such as machine learning, deep learning, expert systems, and fuzzy logic, among others. Depending on the desired outcome, different techniques may be chosen or combined to build an AI solution. For instance, the European Commission (EC) proposal for an AI act[2] defines an AI system as means software that is developed with one or more of the techniques and approaches listed in Annex I and can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with.

(9) Within all these techniques to simulate human-like capabilities, the one that currently has more apparent commercial success to date is machine learning ("**ML**"). ML focuses on the development of algorithms, models and other techniques that enable computers/machines to learn and make predictions or decisions based on data. The core idea behind ML is to design predictive models based on the analysis of data so the machine/computer can learn patterns and make decisions or predictions based on such data.

(10) Gen AI is a specific type of ML where the focus is on creating new content, based on the patterns and knowledge they have acquired during their training, rather than making predictions or decisions based on existing data. The output created is frequently indistinguishable from content crafted directly by humans.

(11) Foundation models ("**FM**") or large foundation models ("**LFM**") are a form of Gen AI. They generate output (synthetic audio, image, video or text content) from one or more inputs (prompts) for a wide range of possible uses, and which can be applied to many different tasks in various fields. FM are, typically, deep learning models, trained with massive amounts of data. FM are at the base of the Gen AI applications and could be distinguished among them by each one specific architecture and parameters.

(12) Large language models ("**LLM**") are a sub-category of FM. They are deep learning algorithms that can recognize, summarize, translate, predict, and generate content using very large datasets[3].

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2 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52021PC0206

3 For example, the well-known ChatGPT is one example of a Gen AI, within it, of a FM, and within it, of a LLM.

(13) In a nutshell, Gen AI is able to produce new content from a data set, but the content produced is new, it is not a copy of the initial data. The new content is produced based on patterns and knowledge based on such data, which may not necessarily be accurate. This is the reason why when confronted with a user prompt, sometimes, the Gen AI could produce a so-called "hallucination" (i.e. when there is not a "true" answer and the AI produces false but often plausible information).

(14) There is a wide range of content that can be created:

- **Text**: (i) answering questions; (ii) translations; (iii) writing stories, poems, etc.; (iv) editing text and correcting errors.
- **Images**: (i) generating images from text; (ii) removing objects from an image; (iii) replacing people; (iv) changing the style of an image.
- **Video**: (i) generate video from text; (ii) introduce effects in a video; (iii) change people in a video.
- **Audio**: (i) generate speech from text; (ii) voice cloning; (iii) real time translation; and/or (iv) generate music.

(15) There are several examples of Gen AI for each of this type of content that have been created to date:

	Examples
Text	ChatGPT (OpenAI - Microsoft)
	Bard (Google)
	LLaMA (Meta)
	Olympus (Amazon)
Image	Dall-E 3 (OpenAI)
	Stable Diffusion (Stability AI21)
	Midjourney
Video	GEN-2 (Runaway)
Audio	Google's MusicLM
	Eleven Labs

2.2. Main elements

(17) In a simple way, the main components (i.e., inputs) necessary to build, train, deploy and distribute Gen AI systems are the following (the "**Gen AI Stack**"):

Gen AI Stack	**Elements**
AI Infrastructure	Computer power (hardware and/or cloud computing services)
	Data

	Expertise and experimentation
AI Manufacturers	AI models
AI Developers	Developers of IA apps
Consumers	End-users

(18) **AI infrastructure** refers to infrastructure needed to deploy Gen AI systems. Their deployment needs, basically, computer power, data and specialized know-how running and experimenting the models.

(19) **Computer power** is a core element for the development and deployment of Gen AI models. It influences the size and complexity of models, training and inference speed, scalability, etc. As Gen AI continues to advance, the demand for powerful computational resources is likely to persist. In this sense, GenAI models, particularly FM, require specialised and costly hardware such as supercomputers, chips and processors. Companies already present in the computer power stack at the hardware level include Nvidia, Intel, AMD, Google, Amazon and Meta.

A key chip for running the models (IA accelerator chip) depends mainly on a leading provider (NVIDIA), whose supply has been punctually disrupted as being surpassed by a growing demand. A similar pattern occurs with GPUs, also made by the same manufacturer[4].

(20) Instead of in-house computing hardware, **cloud computing hardware services can also be used to train and** develop **GenAI models.** (some experts refer to Google Cloud, Amazon AWS and Microsoft Azure with the term *hyperscalers)*. A healthy competition in the market of cloud computing services is particularly desirable in order to provide smooth access to one of the key components of GenAI systems. Multi-cloud, effective switching and avoidance of lock-in specific cloud infrastructure will be key.

(21) After computer power, **data** will be the second element that will play a crucial role in the development and deployment of Gen AI models. The success of these models depends on the initial training data set and on access to real-time relevant data. Data can be public, proprietary or come from a data repository (such as GitHub).

(22) Massive amounts of data are needed, especially in FM. On one side, training datasets have been so far mainly publicly available and free, but they may be scarce in the future and imply additional acquisition costs. On the other, to

[4] Shortages of GPUs and other IA chips were being documented widely by the press last summer. See for example, Brian Fung (2023, August 6) The big bottleneck for AI : a shortage of powerful chips. https://edition.cnn.com/2023/08/06/tech/ai-chips-supply-chain/index.html; or Griffit, E. (2023, August 16). The Desperate Hunt for the A.I. Boom's Most Indispensable Prize. *The New York Times. https ://www.nytimes.com/2023/08/16/technology/ai-gpu-chips-shortage.html.*

optimise the model, monitoring data (e.g. feedback from the user behaviour) is also very relevant.

(23) Specialized profiles are needed to train and adapt any Gen AI models. Significant amount of experimentation is required, and the professional know how is key. **Expertise and experimentation** is, therefore, another seminal input.

(24) Regarding **AI manufacturers** of Gen AI models, these are the ones behind the examples quoted above: OpenAI – Microsoft (ChatGPT); Google (Bard); Meta (LLaMA); and Amazon (Olympus). Since 2017, 86% of the models have been developed by the business sector, and 13% by the academic sector; and 73% are from the U.S. and 15% are from China[5].

(25) **AI developers** (AI manufacturers or third parties), as it happens with applications in electronic products, are the ones who will develop applications or plugins with different uses for the Gen AI models. For example, for ChatGPT, KAYAK's plugin is a tool that allows end-users to search for travel options using natural language; PlaylistAI generates Spotify music playlists based on the end-users' descriptions, and PhotoRoom removes backgrounds accurately and generate AI backgrounds instantly.

(26) **Consumers** (be them individuals or firms) are the end-users of these new technologies.

2.3. Analysis from the perspective of the enforcement of competition policy

2.3.1. Analysis from the standpoint of potential anticompetitive agreements

(27) According to the e-commerce sector inquiry of the EC[6], about half of the retailers track online prices of competitors. In addition, both retailers and manufacturers report the use of specific price monitoring software, often referred to as "spiders" that crawl the internet and gather large amounts of price related information. Lastly, 67 % of those retailers that track online prices also use automatic software programmes for that purpose.

(28) In this context, Competition Authorities must pay heed to the risk that AI could **facilitate collusion** among companies. For example, AI could be used to reduce uncertainty regarding competitors' price strategies. In addition, AI could be used to monitor competitors' prices and to identify patterns. It could also be used to fix prices among competitors in dynamic markets in which the alternative would imply several meetings and negotiate the terms of the agreement every time

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[5] German AI Association, "Large AI Models for Germany Study", 2023, p. 56: https://leam.ai/feasibility-study-leam-2023/

[6] COMMISSION STAFF WORKING DOCUMENT accompanying the document "Report from the Commission to the Council and the European Parliament, Final report on the E-commerce Sector Inquiry", para. 603.

(saving costs and time). Lastly, several AIs could reach the conclusion that the most profitable scenario is to fix prices and coordinate themselves to do so.

(29) Competition Authorities must give regard to the potential risks that AI could also facilitate forms of anticompetitive **price discrimination**. For example, an agreement between competitors to charge different prices according to consumers' characteristics (location, income, address, gender, etc.).

(30) The question of who is liable, whether the company or the algorithm is relevant in the use of algorithms and Gen AI. The answer to this question in most cases is that companies using this technology are be liable, either through the so-called compliance by design or by monitoring the functioning of the technology.

(31) Finally, given the importance of expertise in this sector, limits to labour mobility such as non-compete clauses can undermine the ability of new firms to hire trained workers and therefore constrain their ability to challenge incumbents.

2.3.2. Analysis from the standpoint of potential abuses of dominant position

(32) Gen AI creates markets and business dynamics (as happens with AI in general) that may be prone to the existence of a considerable degree of concentration for several reasons:

- **Strong scale effects**: there are important initial costs, both regarding computer power and access to and processing of data (once a scale is achieved, the average costs will tend to decrease).
- **Strong scope effects**: the more data and the more developed the Gen AI is, the more tasks and services it could offer (and of more quality).
- **Network effects**: a better infrastructure (access to computer power and data) allows better Gen AI models; better Gen AI models attract more developers that develop more and better apps/plugins; more and better apps/plugins attract more consumers. Networks effects may operate in both types of data if the GenAI developers benefits from the users´ data, files, and feedback. The more users feeding the training and monitoring datasets[7], the higher quality and performance of the model. In this sense, Gen AI developer with larger user base enjoy a competitive advantage, and it will be reinforced over time as the user base grows. Conversely, independent developers without access to that growing user base (and data) will have to face the cost of purchasing it and face eventual restrictions to its availability.
- **Switching costs and lock-in effects**: monitoring the end-users, plus their feedback and the so-called learning effects (i.e. the more a product or service

[7] I.e. If the users agree to feeding the model with their own data or files (for training purposes) or the Gen developer has access to the users´ behaviour (how he uses the data or the feedback that provides).

is used, the more the company can learn about it and improve it) could lead to a personalised experience, adapted to the end-user profile and characteristics, difficult to replicate.

(33) These four characteristics, which are common in digital markets, generate barriers to entry and expansion that favour the incumbents or the first companies that consolidate their position in the market (the so-called "*the winner takes it all*" theory).

(34) In this regard, in this scenario (i.e. market tipping in favour of one or of a small number of companies, so they are more likely to acquire a dominant position in the market) Competition Authority must pay attention to the potential risks of several conducts that could eventually amount to an eventual abuse of dominant position:

- **Leveraging/expansion of market power from the Gen AI market to other markets through**:
  - Self-preferencing: the integration of a Gen AI in other products or services by default (e.g. chatbots, search engines, operative systems, or programs) or the favouring its own products and/or services in the results offered by the Gen AI (in both cases foreclosing competing companies) with no objective justification.
  - Tying/Bundling: driving consumers and/or business users to acquire certain products and/or services to gain access the AI.
- **Refusal or restrictions to access computer power and/or data**: tech companies that already have access to these inputs are in a better position than any AI start-up and could give preferential access to their own Gen AI model (if they are vertical integrated companies) or to certain Gen AI models (in case of partnerships between the owner of the inputs and a manufacturer/s), refusing or restricting access to the mentioned inputs to competing Gen AI models.
- **Exclusive dealings**: exclusive access to computer power and/or data (foreclosing competing Gen AI models) or exclusive access to certain Gen AI models (foreclosing competing developers).
- **Privileged access to certain apps/plugins**: giving access to the best version of the Gen AI (the one with more data, access to real-time data and more up to date) only to its own apps/plugins or restricting access to the same to competing apps/plugins. This could also include outright refusals to supply to the Gen AI model to third-party developers.
- **Unfair trading conditions:**
  - Granting intellectual property rights over the content generated by the Gen AI (even when the content is uploaded by the end-user).
  - Granting access to all the data uploaded (with the aim of developing and training the model).

- ➢ Conditioning access to the Gen AI to give access to certain data.

- **Discrimination:** application of dissimilar conditions (e.g. costs of access to the Gen AI) to equivalent transactions (e.g. request of access) placing some trading parties (e.g. some developers) at a competitive disadvantage against others (e.g. to favour certain commercial partners or strategies against competitors).
- **Predatory pricing or margin squeeze:** the Gen AI could be used to analyse pricing, costs and margins data of competitors in order to apply predatory pricing or margin squeeze strategies in the market of the Gen AI or in others (related or unrelated to the aforementioned).

2.3.3. Mergers

(35) Gen AI companies may pursue mergers and acquisitions as a way of achieving and exploiting efficiencies related to digital markets (e.g. economies of scale, scope, network effects) from "external" growth. Mergers in this sector may be of concern insofar as they may affect current and potential competition. In particular, in the context of Gen AI markets, Competition Authorities must pay more attention to the potential risk that companies engage in mergers and acquisitions that reduce competition (e.g. by merging with other manufacturers); to increase barriers to entry (e.g. by increasing switching costs or scale/scope/network economies, for instance through consumers' data accumulation or through data accumulation or computer power); to control relevant inputs (e.g. a new technology or IPR); and/or to vertically integrate themselves (e.g. to acquire presence in certain levels of the production and distribution chain) to leverage market power into other markets (e.g. due to the potential incentives for discriminatory behaviour). Vertical integration and partnerships among firms from the cloud computing sector and Gen AI market may weaken competition dynamics in both markets.

(36) In addition, going beyond traditional leveraging theories of harm, attention should be paid to ecosystem theories of harm too. In this regard, mergers and acquisitions could be used to make certain company's ecosystem so attractive to customers that they would get locked into their platform, making it harder for competitors to challenge the company's strong position on its core market.

(37) In fact, two typical theories of harm in digital mergers could also be applicable to Gen AI markets:

- **Killer acquisitions**: incumbents could acquire a smaller emerging competitor with the primary intention of eliminating a potential competitive threat (e.g. acquiring an emerging AI that adds value over the incumbent).
- **Reverse killer acquisitions**: the incumbents could acquire a smaller emerging competitor not with the intention of eliminating a competitive threat but to develop its product as their own and to discontinue the one they were developing or to incorporate it to its ecosystem.

2.4. Opportunities of Gen AI for competition and CA. The experience of CNMC

(38) Despite these potential risks, Gen AI technology might also offer opportunities for competition and, specifically, for CA capabilities.

(39) First, open-source models could be a driver of competition, and therefore innovation, in the market. Open-sources models allow third parties developers to use and adapt the model to offer products and services with great flexibility and avoiding any licence payment. Entry costs are decreased substantially, competition is promoted (between closed source models, open source and among providers downstream) and innovation, overall, spurred.

However, the degree of openness of the models varies and may contain restrictions (e.g. for commercial application). Besides, open-source models require high levels of expertise, its size is generally smaller than others closed FM models so as its quality and imply safety concerns.

(40) Second, Gen AI may also act as a powerful tool to increase CA´s overall efficiency and efficacy, such could be the example of CNMC.

(41) The BACO project at the CNMC arises with that idea of harnessing these technologies to build a powerful processor of written language, serving as an assistant to humans, to expedite many tasks related to the exercise of the competencies assigned to the CNMC.

(42) This assistant, tailored for the CNMC, fulfils the following tasks: i) Assists in the search for general and specific information about the CNMC and guides the user through a conversation to obtain the required information; ii) Summarizes documents and answers questions about them; iii) Semantically analyses texts, assisting in their classification, detecting sensitive content, inappropriate language, or hate speech.

(43) Technically, this processor is constituted as an independent expert system. Other systems connect to it via API, making necessary service requests to delegate the task of text processing as required.

(44) BACO utilizes the latest Gen AI technologies for text and is built agnostic to the specific LLM used in order to always incorporate the best LLM for the needs, facilitate model changes if necessary, and always maintain confidence and independence from manufacturers and suppliers.

2.5. Main conclusions. The role of CA in promoting competition

(45) There are structural features in the Gen AI sector that lead to concentration. Market concentration in a few firms may be worrisome insofar as barriers to entry and switching costs may reduce actual and potential competition.

(46) A broad array of potential risks to competition in Gen AI ecosystem have been identified. Interaction of this sector with others such as cloud or the labor market

are key: competition conditions in the latter will have an effect on competition conditions in Gen AI.

(47) Given the transformative impact of Gen AI, competition issues in this sector may end up reducing consumer welfare. Firms have expressed that a much stronger transformative impact can be expected from Gen AI as compared to other innovations such as the metaverse or blockchain. As a result, it will be important to preserve entry, entrepreneurial dynamism and innovation. Efficiency gains in this sector would be felt throughout the economy due to potential key role Gen AI in boosting competition in all sectors.

(48) Competition authorities must continue to enforce competition policy as the first line of defence in the Gen AI market.

(49) At the current stage of Gen AI's development, competition advocacy can make useful contributions. Market studies can be a very helpful tool to understand of the functioning and competition dynamics in this still emerging sector.

(50) The transformative impact expected from Gen AI will require a dynamic approach to regulation so that it can be adapted to the evolution and competition challenges of this sector. Regulation should follow the efficient regulation principles of necessity and proportionality.

(51) Means and resources of competition authorities should be strengthened. In effect, additional means and resources will be necessary for competition authorities to be able to adapt to changes brought about by Gen AI and be able to adequately respond to them.

3. POTENTIAL IMPLICATIONS OF VIRTUAL WORLDS FOR COMPETITION AUTHORITIES

(52) This section will analyse potential implications of Virtual Worlds for Competition Authorities. Its first subsection will introduce the concept and uses of Virtual Worlds; its second subsection the main elements/levels in its production and distribution chain; and its third and final subsection the analysis from the perspective of the enforcement of competition policy.

3.1. Concept and uses

(53) Virtual Worlds are persistent, immersive environments, based on technologies including 3D and extended reality (XR), which make it possible to blend physical and digital worlds in real-time, for a variety of purposes such as designing, making simulations, collaborating, learning, socialising, carrying out transactions or providing entertainment[8].

(54) Related to this, the metaverse is built upon a foundation of interconnected virtual worlds, which are created using various technologies such as 3D modelling

[8] European Commission's Calls for contributions on Competition in Virtual Worlds and Gen AI.

software, Web 3.0, augmented/virtual/extended reality, artificial intelligence/machine learning, and distributed computing[9].

(55) In a nutshell, the metaverse is a highly interconnected digital universe (virtual space) that uses the internet, avatars and software agents and binds them together to create a new physical and virtual world.

(56) The metaverse is built upon a foundation of interconnected Virtual Worlds, which are created using various technologies such as 3D modelling software, Web 3.0, augmented/virtual/extended reality, artificial intelligence/machine learning, and distributed computing.

(57) Currently, there are several uses for the metaverse and Virtual Worlds:

- **Immersive entertainment**: they offer a new level of engagement and immersion compared to traditional media formats, such as virtual concerts and/or interactive gaming[10].
- **Social Interaction**: they facilitate social interaction on a global scale, allowing users to connect, socialize, and collaborate with others in virtual environments. There are several examples, from virtual nightclubs to gaming arenas and to art galleries[11].
- **Economic opportunities**: users can buy, sell, and trade virtual goods and services, monetize their creative works, and participate in virtual economies within the metaverse (through virtual commerce or digital asset ownership)[12].
- **Education and Learning**: they serve as a platform for immersive education and learning experiences, offering interactive simulations, virtual classrooms, and skill-building activities[13].

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9 European Economic and Social Committee opinion Initiative on virtual worlds, such as the metaverse, April 2023.

10 For example, Ariana Grande's concert in Fortnite gathered around 78 million people

https://www.mirrorworld.media/lil-nas-x-to-travis-scott-the-biggest-metaverse-concerts/, accessed 07.02.2024.

11 https://www.linkedin.com/pulse/building-nightclub-metaverse-futuristic-way-socialize-ivanova/, accessed 07.02.2024.

12 Early estimates indicate that the economic contribution of the global metaverse could be valued at more than $3 trillion by 2031

https://about.fb.com/news/2022/12/economic-opportunities-in-the-metaverse/, accessed 07.02.2024.

13 For example, the University of Seville offers teachers the possibility of designing worlds and avatars in the metaverse for teaching and research purposes

https://www.us.es/actualidad-de-la-us/la-us-abre-la-puerta-al-metaverso-con-fines-didacticos, accessed 07.02.2024.

- **Health and Wellness**: they can support health and wellness initiatives by offering immersive fitness experiences, mindfulness practices, and therapeutic interventions[14].

(58) To date, there are several companies providing services in these fields:

- **Fortnite** is a popular multiplayer online game that, as explained above, features virtual events, concerts, and social spaces within its virtual world.
- **Microsoft Mesh** enables work-colleagues to connect in a 3D immersive space, helping virtual meetings and events[15]. In fact, Microsoft bought AltspaceVR in 2017, a space in the metaverse that hosted virtual events, meetups, and gatherings, and decided to close it on January 2023 and its team joined Mesh.
- **Decentraland** is a decentralized virtual reality platform that allows users to buy, sell, and build virtual real estate, participate in virtual events, and interact with others in a shared virtual universe[16].

3.2. Main elements

(59) The metaverse and Virtual Worlds' technology stack has four core building blocks (the "**Virtual Worlds Stack**")[17]:

Virtual Worlds Stack	Elements
Infrastructure and Hardware	Software and Hardware necessary for the deploy and development of Virtual Worlds
Platforms	The providers of the virtual spaces where experiences take place
Content and experiences	The providers of concerts, universities, health services, etc.
Consumers	End-users

(60) Infrastructure and hardware provide the necessary computing power, network connectivity, and devices to support immersive experiences. This includes cloud computing resources, high-speed networks, VR/AR headsets, and other hardware components. It also refers to providers of WiFi, 5G, cloud systems,

14 In this regard, leading GCC healthcare professionals are already exploring metaverse use cases, using tools such as 3D models of a patient's body to help surgeons plan and conduct operations and how VR environments can be used for psychiatric therapy https://www.pwc.com/m1/en/industries/healthcare/the-future-of-healthcare-in-the-metaverse.html, accessed 07.02.2024.

15 https://adoption.microsoft.com/es-es/microsoft-mesh/, accessed 07.02.2024.

16 https://decentraland.org/, accessed 07.02.2024.

17 This is a general classification. The chain can be disaggregated in more blocks and layers.

and physical elements like GPU cores which process metaverse data, such as Nvidia, Microsoft, Telecoms companies, etc. Additionally, it also includes manufacturers of VR/AR headsets used by consumers to access the platforms (i.e. a specific metaverse or Virtual World). Companies already active in this market include Meta (with Oculus VR), Bytedance (Pico), Sony (PlayStation VR), Microsoft (HoloLens), Apple (Apple Vision Pro).

(61) Platforms, such as game engines and virtual world frameworks, provide the infrastructure for hosting and rendering virtual experiences. They enable developers to build, deploy, and manage immersive content efficiently (i.e. this is where developers develop content and experiences to consumers). To date, some of the most relevant platforms include Microsoft (Mesh); Epic Games – Sony (Fortnite); Roblox; Niantic (Pokemon Go); Binance (Binance NFT Marketplace); Meta (there offerings: Horizon Marketplace, Horizon Home and Horizon Worlds) and Decentraland.

(62) Content and experiences are at the core of the metaverse and Virtual Worlds. This includes concerts, nightclubs, games, the activity of buying and selling (through a marketplace platform), etc. Some examples have already been described above.

(63) Consumers (be them individuals or firms) are the end-users of these new technologies.

3.3. Analysis from the perspective of the enforcement of competition policy

3.3.1. Analysis from the standpoint of potential anticompetitive agreements

(64) Companies can engage in anticompetitive concerted practices in both the physical (offline) and the digital (online) world. And Competition Law applies to both the physical (offline) and the digital (online) world. In this regard, Competition Authorities must pay attention to potential risks that collusive practices may take place in the metaverse and Virtual Worlds like it happens in the physical world:

- **Price fixing**: platform providers might agree the access price to their respective platforms (if any), thus limiting price competition among them. They could also agree on other commercial conditions such as discounts, margins, prices of products or services within the platform, etc. In addition, companies providing content and experiences could also collude to fix prices within the platform (for example, several concert organisers fixing the ticket prices for a concert, or several sellers fixing the price of their offerings in a virtual marketplace).
- **Market sharing**: platform providers might agree to share the markets among them, for example, segmenting the market by consumers' characteristics such as age, gender, location, income, etc., and, thus, limiting competition among them. In addition, companies providing content and experiences could also enter into market sharing agreements within the platform (for example, virtual

land developers in a Virtual World may agree to divide up territories or customer segments to avoid competing directly with each other).

- **Bid rigging**: platforms providers might agree to collude in public procurement contracts (for example, a public contracting authority, such as a public administration or a university, organising a call for tenders to use the metaverse for a specific reason, such as testing a new surgery procedure in a public hospital or creating a virtual learning environment). In addition, companies providing content and experiences could also enter into bid rigging practices in response to call for tenders taking place within the platform.
- **Exchange of commercial sensitive information**: platforms and companies operating within the platform might exchange information on prices or output (or other sensitive information) in order to reduce uncertainty about future behaviour. For example, interoperability among metaverses and Virtual Worlds will probably require manufacturers to exchange information. These exchanges should be confined to the minimum technical information to create the technical standards to ensure interoperability, but companies should avoid using these exchanges as a means to reduce competition.
- **Others**: platforms and companies operating within the platform might engage in other sort of anticompetitive agreements such as: **(i)** limiting output (e.g. limiting the number of accesses to a platform or content or experiences); **(ii)** limiting sales (e.g. of VR devices or of content or experiences); **(iii)** entering into collective exclusive dealings or boycotts (e.g. a group of competitors agree to exclude or hinder an actual or potential competitor); **(iv)** paying competitors to delay the launch of competing products (e.g. other more advanced platforms or new products or experiences within the platform); **(v)** agreeing on limits to labour mobility and/or **(vi)** manipulating financial benchmarks (e.g. benchmarks used by virtual land developers in a Virtual World to grant mortgages).

(65) The aforementioned anticompetitive agreements are all at a horizontal level, however, as the Virtual Worlds Stack encompasses different levels of the production and distribution chain, there are also a number of anticompetitive agreements that could take place at a vertical level, such as: **(i)** imposing fixed or minimum resale prices (e.g. a platform to its distributors of VR devices or a virtual seller to its distributors); **(ii)** some forbidden restrictions of active and/or passive sales (i.e. depending of the distribution system used); **(iii)** non-compete obligations not covered by the VBER (i.e. if after an individual analysis the conclusion is that they are anticompetitive); **(iv)** some sort of online restrictions that directly or indirectly prevent the effective use of the internet (such as non-brand bidding agreements within the metaverse, when advertising is very likely one of the ways of monetization); and/or **(v)** the use of certain sort of most favoured nation clauses not covered by the VBER (i.e. if after an individual analysis the conclusion is that they are anticompetitive).

3.3.2. Analysis from the standpoint of potential abuses of dominant position

(66) Metaverse and Virtual Worlds markets may be prone to the existence of a considerable degree of concentration for several reasons:

- **Strong scale effects**: there are important initial costs, both regarding infrastructure, platform development and the provision of content and experiences (once a scale is achieved, average costs will tend to decrease).
- **Strong scope effects**: the more data and the more developed a Virtual World is, the better position it will have to compete in other markets.
- **Network effects**: the value of a Virtual World increases as the number of other people using the Virtual World also increases. This allows to attract more providers of content and experiences which, in its turn, attract more consumers.
- **Switching costs and lock-in effects**: once you have a personalised experience in a Virtual World, through an avatar, properties, etc., it will be difficult for that user to switch to another Virtual World (even if interoperability and portability can mitigate these effects).

(67) Likewise, these four characteristics generate barriers for entry and expansion that favour the incumbents or the first companies that consolidate their position in the market (the so-called "*the winner takes it all*" theory).

(68) In this regard, in this scenario (i.e. market tipping in favour of one or of a small number of companies, so they are more likely to acquire a dominant position in the market) Competition Authorities will have to pay the due heed to potential conducts which could eventually amount to an abuse of dominant position such as:

- **Exclusive dealing**: companies might enter into exclusive agreements that prevent competitors from accessing certain resources, platforms, or distribution channels. For example, a Virtual World with market power might enter into an exclusive agreement with certain content or experience creators, limiting the offer that other competing Virtual Worlds could provide to its users. The Virtual World with market power might have the aim of foreclosing rivals from the market by making its own offer more attractive based on exclusive content that can only be accessible through its already prevalent Virtual World. Another possibility is that a content creator with market power would enter into an exclusive agreement with a Virtual World, foreclosing access to other content creators to such Virtual World.
- **Interoperability or data portability restrictions**: in a scenario in which there are several decentralized Virtual Worlds or interoperable metaverse platforms, Virtual Worlds with market power might limit interoperability with other platforms or denying portability of consumers' data, contributing to increase switching costs and lock-in effects, strengthening its position in the market and

trying to foreclose rivals by limiting their capacity to attract consumers. Denying portability of consumers' data might also be a form of exploitative abuse.

- **Refusal to supply**: vertically integrated Virtual Worlds with market power might refuse to supply access to their platform to competing content and experience creators, again strengthening their position in the market and restricting competition. This would eventually entail an outright refusal to supply. There could also be other types of refusals, such as constructive refusals, where the Virtual World with market power makes access subject to unfair conditions (this could include again interoperability restrictions, unfair prices for certain competitors, etc.).
- **Predatory pricing**: a Virtual World with market power might engage in predatory pricing strategies, foreclose competitors or deter new entrants, at both the platform and content and experience levels. For example, such Virtual World could temporarily reduce its prices (of access to the platform or of product or services offered within the metaverse) below sustainable levels (usually the variable cost), undercutting competitors, and then raising prices once competitors have been eliminated or deterred from entering the market.
- **Margin squeeze**: a Virtual World with market power might grant wholesale access to its metaverse at a price that when compared with its own downstream product or service does not allow an efficient downstream rival to effectively compete. For example, such Virtual World might grant access to its platform to a content creator at a price that is so high in comparison to its own retail content and experience prices that such competing content creator is unable to effectively compete against the dominant platform.
- **Leveraging/expansion of market power from one market to another through**:
  - Self-preferencing: the integration of a Virtual World with a device by default (having market power in any of those markets and trying to leverage it to the other); or the favouring of its own products and/or services over competing ones with no objective justification.
  - Tying/Bundling: driving consumers to acquire certain (ancillary) products and/or services to gain access the Virtual World (the core service). The clearest example would be the need to buy certain Virtual World's device to access its own metaverse, but there could be others (for example, requiring its users to pay through its own payment system or through its own virtual currency or requiring commercial transactions to only take place through the Virtual World's own marketplace).
- **Discrimination:** application of dissimilar conditions (e.g. costs of access to the Metaverse) to equivalent transactions (e.g. request of access) placing some trading parties (e.g. some content and experiences creators) at a competitive disadvantage against others (e.g. to favour certain commercial partners or strategies against competitors).

- **Others**: unfair trading conditions (in relation to prices or other commercial conditions, to other platforms, content creators or end-users); foreclosing access to IP or core functionalities; and/or preventing multihoming between different Virtual Worlds.

3.3.3. Mergers

(69) In the context of Virtual Worlds, Competition Authorities must give the due regard to the risks that companies engage in mergers and acquisitions that reduce competition (e.g. by merging with other platforms); that increase barriers to entry (e.g. by increasing switching costs or scale/scope/network economies, for instance through consumers' data accumulation or through data accumulation or computer power); to control relevant inputs (e.g. a new technology or IPR); and/or to vertically integrate themselves (e.g. to acquire presence in certain levels of the production and distribution chain) to leverage market power into other markets.

(70) Likewise, in this scenario, it is also possible to discuss killer and reverse killer acquisitions (the same concerns as describe above for Gen AI apply) and ecosystem theories of harm (i.e. merges with the aim of making certain company's ecosystem so attractive to customers that they would get locked into its platform).

4. CONCLUSION

(71) The development of Gen AI and Virtual Worlds may have some implications from the standpoint of Competition Authorities. In this regard and it is important to recall that Competition Law applies to both the physical (offline) and the digital (online) world. The issues mentioned above are not exhaustive, they are only examples of potential situations that may arise. Competition Authorities must give the due heed of these and other contexts that could be driven by Gen AI or Virtual Words or other digital and non-digital trends.