ASSESSING THE POTENTIAL FOR ANTITRUST MOATS AND TRENCHES IN THE GENERATIVE AI INDUSTRY

BY ALLISON HOLT, SUSHRUT JAIN & ASHLEY ZHOU[1]

1 Allison Holt, PhD (Managing Principal), Sushrut Jain, MA Econ. (Managing Principal), and Ashley Zhou, PhD (Managing Principal) are employees of Edgeworth Economics, 1111 19th St, Suite 1200, NW, Washington D.C. 20036.

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This article explores the economic dynamics and competition issues within the fast-advancing Generative Artificial Intelligence (AI) industry. Generative AI, encompassing hardware, models, and applications, has seen rapid growth across sectors, offering potential for efficiency gains and innovation. However, this growth has drawn attention from antitrust regulators concerned about risks such as the concentration of key inputs, the extension of existing market power, and strategic arrangements between leading players. The article delves into economic concepts of moats and trenches, emphasizing the importance of differentiating competitive advantages from anticompetitive practices. It also highlights the complexity of assessing market power in a rapidly evolving industry, where collaboration and competition often intersect. As regulatory bodies navigate these challenges, the article underscores the need for rigorous economic analysis to balance innovation with competitive fairness. The discussion concludes with an outlook on the future of AI regulation, emphasizing the delicate balance between fostering growth and ensuring a level playing field.

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I. INTRODUCTION

Artificial Intelligence ("AI") refers to computer systems that can simulate human intelligence by performing tasks that include learning, understanding natural language, and recognizing patterns.[2] Advances in AI can serve to enhance efficiency, improve customer experience, predict market trends, bolster cybersecurity, and streamline data analysis. The rapid rise of AI across various sectors — such as healthcare, retail, manufacturing, and banking — has the potential to fundamentally transform how businesses operate. This surge in AI adoption has also drawn attention from antitrust regulators. For example, in March 2023, during their remarks at the Annual Enforcers Summit, leaders at the DOJ and the FTC highlighted the AI industry's reliance on scale and the consequent risk of large incumbents blocking or acquiring new entrants to protect their "moats" and "dominance."[3] In this article, we highlight some key economic dimensions of the generative AI industry including its various components and key players. In addition, we discuss several key economic concepts critical to an assessment of competition issues in this rapidly evolving generative AI space.

II. WHAT IS GENERATIVE AI?

Generative AI is a type of machine learning that uses neural networks to identify patterns within data to generate new content including images, text, audio, and video.[4] At a high level, generative AI encompasses three broad components: (1) hardware; (2) models and platforms; and (3) tools and services (applications).[5]

A. Hardware

Hardware refers to the actual physical computer systems that are used to process data for the AI programs. Hardware includes AI chips, which are microchips that are specifically designed to handle AI tasks such as machine learning and natural language processing.[6] Large language models ("LLMs"), which are pre-trained on immense amounts of data, rely heavily on AI chips.[7] The parallel processing capability of AI chips, such as Graphic Processing Units ("GPUs"), enables them to perform many computations at once. This makes them ideal for training large, generative AI models. AI chips are typically incorporated into servers within data centers. Although Nvidia (credited with creating the first GPU chip) is the key player, it faces rapidly growing competition from established chipmakers AMD and Intel, as well as from startups including d-Matrix, backed by Microsoft.[8] Tech players such as Alphabet, Microsoft, and Amazon are among the largest buyers of Nvidia's GPUs, but are also key competitors as they are developing their own AI chips.[9]

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2   Google, *What is artificial intelligence (AI)?*, https://cloud.google.com/learn/what-is-artificial-intelligence#what-is-artificial-intelligence-ai.

3   *2023 Annual Antitrust Enforcers Summit: Welcome and Interviews of AAG Kanter and FTC Chair Khan*, DEPARTMENT OF JUSTICE YOUTUBE CHANNEL (Mar. 28, 2023), https://youtu.be/bmPLUlEGxeo?si=-wOsXbPqVn1WJfnu.

4   Machine learning, a subset of AI, uses algorithms to make predictions about input data, optimizing the algorithms iteratively until the predictions achieve a threshold of accuracy. A neural network is a machine learning program or model that makes decisions in a manner similar to the human brain by using layers of nodes or artificial neurons to process data. Seldon, *Generative AI vs. Machine Learning*, (November 10, 2023), https://www.seldon.io/generative-ai-vs-machine-learning; IBM, *What is a neural network?*, https://www.ibm.com/topics/neural-networks.

5   There are, of course, marketplaces for non-generative AI products and services that support the generative AI industry. For example, cybersecurity companies provide data security products and services to companies that make generative AI models. Consulting companies advise consumers in their use of generative AI.

6   Mesh Flinders and Ian Smalley, *What is an AI chip?*, IBM THINK ARTICLE (June 6, 2024), https://www.ibm.com/think/topics/ai-chip.

7   Deep learning is an AI method that teaches computers to process data in a way inspired by the human brain. Facial recognition, fraud detection, voice-activated TV remotes, are all examples of applications that rely on deep learning technology. Pre-training is the first stage in the development of an LLM, for instance, in which it is fed large amounts of text data so it can learn the patterns and structures of human language. See, Amazon Web Services, *What is deep learning?*, https://aws.amazon.com/what-is/deep-learning/; Neri Van Otten, *Top 20 Most Powerful Large Language Models For NLP Tasks & Transfer Learning In 2024*, SPOT INTELLIGENCE ARTICLE (April 18, 2023), https://spotintelligence.com/2023/04/18/large-language-models-nlp/.

8   Kif Leswing, *Nvidia dominates the AI chip market, but there's more competition than ever*, CNBC TECH COLUMN (June 2, 2024), https://www.cnbc.com/2024/06/02/nvidia-dominates-the-ai-chip-market-but-theres-rising-competition-.html; Max A. Cherney, *Exclusive: AI chip startup d-Matrix raises $110 million with backing from Microsoft*, REUTERS TECHNOLOGY COLUMN (September 6, 2023), https://www.reuters.com/technology/ai-chip-startup-d-matrix-raises-110-mln-with-backing-microsoft-2023-09-06.

9   Jeremy Bowman, *Who are Nvidia's Largest Customers?*, YAHOO! FINANCE COLUMN (March 2, 2024), https://finance.yahoo.com/news/nvidias-largest-customers-201900375.html; Cade Metz, Karen Weise, and Mike Isaac, *Nvidia's Big Tech Rivals Put Their Own A.I. Chips on the Table*, THE NEW YORK TIMES ARTIFICIAL INTELLIGENCE COLUMN (January 29, 2024), https://www.nytimes.com/2024/01/29/technology/ai-chips-nvidia-amazon-google-microsoft-meta.html.

B. Generative AI Models and Platforms

Hardware products are used in the pre-training and deployment of generative AI models and consumer-facing platforms. Leading models in the generative AI marketplace include OpenAI's GPT, Google's Gemini, Meta's Llama, Anthropic's Claude, and Cohere's Command. Industry participants focus on building multimodal models, which can understand and generate images and audio in addition to just text.[10] Generative AI models are trained on both open-source and proprietary data. These models support user-friendly platforms, such as chatbots.[11] An interesting consequence of the fast-paced evolution of the AI landscape is that companies that collaborate on one aspect of the industry may find themselves competing in others. For instance, Microsoft is one of OpenAI's collaborators and its largest investor, but the companies also increasingly view each other as competitors.[12]

C. Applications

The third segment is the most broadly defined and encompasses generative AI applications, tools, and services. These applications are used in fields such as customer service, legal technology, and finance, among others. Globally, businesses spent around $19.4 billion on generative AI "solutions" in 2023.[13] Wayfair, for example, created its own interior decorating application, Decorify, using a generative AI model from Stability AI.[14] Schneider Electric, an electrical manufacturer, used Microsoft's Copilot to build its "Resource Advisor" tool, which visualizes and tracks customers' energy data.[15] To streamline diagnostics and treatments, Mass General Brigham, a healthcare system, uses LLMs to identify patients with similar profiles.[16]

III. DEFINING MOATS AND TRENCHES

Colloquially, the term "economic moat" is credited to Warren Buffett, who suggests that investors should seek opportunities in firms with "a wide and long-lasting moat around a terrific economic castle."[17] Moats can stem from being the low-cost producer, having a strong brand presence, enjoying network effects, or possessing unique technological advantages.[18] Antitrust enforcers, however, have more forcefully emphasized moats as derived from monopoly positions. For example, in a recent speech on monopoly power in digital markets, AAG Jonathan Kanter described the anti-competitive threats of moat-building:

> Anticompetitive moats protect the monopolists' core product or service. Given the value of a dominant position, monopoly maintenance has become a strategy for dominant firms to maintain their position. The strategy does not merely involve leveraging a dominant position — moat-building means erecting barriers to entry that protect the core monopoly itself.[19]

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10   Strictly speaking, LLMs are limited to text, while multimodal models can handle multiple additional types of information, including images, audio, and video only language-based inputs. See, Amazon Web Services, *What is LLM (Large Language Model)?*, https://aws.amazon.com/what-is/large-language-model/.

11   Phillip Wegner, *The leading generative AI companies*, IOT ANALYTICS ARTICLE (December 14, 2023), https://iot-analytics.com/leading-generative-ai-companies/; Imad Khan, *Microsoft's Copilot Embraces the Power of OpenAI's New GPT-4o*, CNET TECH SERVICES AND SOFTWARE COLUMN (May 20, 2024), https://www.cnet.com/tech/services-and-software/microsoft-copilot-embraces-the-power-of-openais-new-gpt-4-o/.

12   Sol Rashidi, *Microsoft Says OpenAI Is Now A Competitor*, FORBES INNOVATION COLUMN (August 4, 2024), https://www.forbes.com/sites/solrashidi/2024/08/04/microsoft-says-openai-is-now-competitors/.

13   Belle Lin, *How Did Companies Use Generative AI in 2023? Here's a Look at Five Early Adopters*, THE WALL STREET JOURNAL (December 29, 2023), https://www.wsj.com/articles/how-did-companies-use-generative-ai-in-2023-heres-a-look-at-five-early-adopters-6e09c6b3.

14   *Ibid.*

15   *Ibid.*

16   *Ibid.*

17   Amy C. Arnott, *What Makes an Attractive Warren Buffett Stock? Companies that make it into Berkshire Hathaway's portfolio have some common threads in their genetic code*, MORNINGSTAR EQUITY RESEARCH AND INSIGHTS COLUMN (March 14, 2024), https://www.morningstar.co.uk/uk/news/247248/what-makes-an-attractive-warren-buffett-stock.aspx; *Warren Buffett & Charlie Munger: Moats, Castles and Lords*, THE FINANCIAL REVIEW YOUTUBE CHANNEL (February 24, 2019), https://www.youtube.com/watch?v=10y0kekBO7E.

18   Nomadic Samuel, *Warren Buffett's Views On Economic Moats: A Comprehensive Analysis*, PICTURE PERFECT PORTFOLIOS (September 1, 2024), https://pictureperfectportfolios.com/warren-buffetts-views-on-economic-moats-analysis/.

19   Jonathan Kanter, Assistant Attorney General, U.S. Department of Justice, Assistant Attorney General Jonathan Kanter Delivers Keynote at CRA Conference (March 31, 2022).

An essential element of this conduct is steps to protect, or entrench, an existing "monopoly position."[20] Entrenchment or "trenches" in this context refers to conduct employed by some firms to maintain their monopoly position and potentially discourage new entrants.[21]

While both concepts — moats and trenches — relate to an assessment of market power, they function in complementary ways. Firms with a natural moat could seek to broaden or deepen that moat through entrenchment.[22] From a competition perspective, however, the behavior that might be essential to fostering consumer welfare and innovation can be hard to distinguish from behavior that potentially harms competition by making it harder for other firms to compete. This is where careful, rigorous economic analysis is critical. For example, firms may enhance their natural advantage over competitors by offering superior products or services and making their networks more attractive for customers and providers. A consequence of this behavior may be to discourage customers from seeking alternatives, but this outcome in theory is not one that is anti-competitive. Additionally, investing in technological innovation can maintain a firm's appeal relative to competitors. Protecting proprietary technology, such as patents and software, is another strategy that can fortify market position and encourage additional innovation.

An assessment of the complex competition issues in rapidly advancing technological industries such as Generative AI requires the careful application of foundational economic tools — including market definition and assessment of direct and indirect competitive effects. Although some incumbents in the generative AI marketplace possess competitive advantages that may appear to be economic moats, in the rapidly innovating AI landscape, emerging disruptive technologies present a continuous threat to those advantages.

IV. ANTITRUST ENFORCERS' STATED CONCERNS ABOUT AI

In a Joint Statement on Competition in Generative AI Foundation Models and AI Products by the competition authorities for the European Union, the United Kingdom and the U.S., there is explicit recognition of the "transformational potential of artificial intelligence, including foundation models," noting that "[a]t their best, these technologies could materially benefit our citizens, boost innovation and drive economic growth." In the same statement, however, the commissioners highlighted three key areas of risk to competition in the AI industry: (1) concentrated control of key inputs; (2) firms with existing market power extending such power to AI-related marketplaces; and (3) arrangements between key players.[23]

A. Concentrated Control of Key Inputs

Controlling essential inputs may constitute an important competitive advantage. Two key inputs to generative AI are data and computational resources, either of which could theoretically be subject to concentrated control. Generative AI models require vast amounts of data for pre-training.[24] Access to these large data troves may allow for the existence of moats and result in natural barriers to entry. New entrants may find it more difficult to gather large and diverse datasets than more established companies, which have been collecting data from their users over a longer period. In specialized industries, where access to data is more regulated, an established company may possess an even greater advantage. Access to these large data troves may result in natural barriers to entry.

Computational resources are a second key input for AI models. These present another possible advantage for both the makers of generative AI models as well as for the makers of the hardware used to perform the computations because of the high costs associated with developing them.[25]

B. Extension of Existing Market Power

Prior to the emergence of AI, the digital landscape already had several large firms competing in numerous arenas. Enforcement agencies have argued that these firms may be able to use their established power in related markets to control channels of distribution for AI-enabled services,

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20   *Ibid.*

21   Giorgio Castaldo et. al., *Monopolisation, Moat Building and Entrenchment Strategies**, OECD WORKING PAPER (June 11, 2024), https://one.oecd.org/document/DAF/COMP/WP3(2024)1/en/pdf.

22   Jonathan Kanter, Assistant Attorney General, U.S. Department of Justice Assistant Attorney General Jonathan Kanter of the Antitrust Division Delivers Remarks at the Keystone Conference on Antitrust, Regulation & the Political Economy (March 2, 2023).

23   Press Release, U.S. Department of Justice et. al., Joint Statement on Competition in Generative AI Foundation Models and AI Products (July 23, 2024).

24   For instance, OpenAI's GPT 3.5 model was pre-trained using about 300 billion words obtained from books and websites. See, Alex Hughes, *ChatGPT: Everything you need to know about OpenAI's GPT-4 tool*, BBC SCIENCE FOCUS COLUMN (September 25, 2023), https://www.sciencefocus.com/future-technology/gpt-3.

25   The cost of computational resources ("compute") required for the training of OpenAI's GPT-4 is estimated at $78 million and the compute cost for training Google's Gemini Ultra, a multimodal model is estimated to be $191 million. See, Human-Centered Artificial Intelligence Stanford University, Artificial Intelligence Index Report 2024.

thereby extending their power to AI-related spaces.[26] For example, a large cloud computing company may be able to "lock" AI service providers into its cloud computing solutions.[27]

Another concern the agencies have discussed is that a firm that has success in one segment of the generative AI marketplace may be able to extend its potential market power to another segment, by bundling or tying its products and services.[28] By linking together new generative AI applications or software with existing core products, incumbent firms may reduce the value of competitors' standalone generative AI offerings.

C. Arrangements Between Key Players

Another area of potential risk to competition, as identified by the regulatory agencies, involves arrangements between key players in the AI marketplace, including partnerships, financial investments, and other connections.[29]

V. ECONOMIC CONSIDERATIONS IN ASSESSING POTENTIAL ANTITRUST ISSUES IN THE AI INDUSTRY

Given the unique and complex nature of the rapidly advancing AI technologies, there are several key economic considerations that are particularly salient in an assessment of any antitrust concerns.

A. Regulators Have Presumed Moats Require Monopoly Power

First, at least in their public statements, antitrust regulators have equated the existence of a "moat" as requiring monopoly power, which differs from the more common definition of "moat" being a simple comparative advantage. To determine the existence of monopoly power regulators will need to properly define the relevant antitrust market, using practical indicia and quantitative tests such as the SSNIP test. Within a properly identified antitrust market, market share is not a static measure of market power. Barriers to entry, sunk costs, substitute products, customer base, and customer price sensitivity must all be considered. The task of determining the existence of monopoly power requires rigorous economic analyses that fit the constantly evolving realm of the AI industry.

B. Collaborators Can Be Competitors At the Same Time

Second, it is important to remember that competitors are frequently collaborators in the AI space. There are many procompetitive reasons for key players to form partnerships.[30] Partnerships can create competition, such as when Google's acquisition of Android led to increased competition for Apple's iPhone.[31] Co-development or other financial arrangements can serve to provide necessary funding to innovate, decrease development costs, and lower prices to consumers. Partnerships can also allow for the integration of new technology into existing products, enhancing their performance without forcing consumers to change platforms. Regulatory agencies need to evaluate these benefits to consumers before weighing whether a particular business arrangement is actually stifling competition from smaller entrants.

For example, Nvidia's Blackwell chip, set to launch in the last quarter of 2024, is expected to be priced at $22,000 apiece and generate nearly $10 billion in sales in a single quarter.[32] Large customers such as Meta, Google, and Amazon are reported to be developing their own AI

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26   Paulo Abecasis et. al., *GENERATIVE ARTIFICIAL INTELLIGENCE: THE COMPETITIVE LANDSCAPE*, COPANHAGEN ECONOMICS WHITE PAPER (February 2024), https://www.justice.gov/atr/media/1361151/dl?inline.

27   Belle Lin, *Companies Weigh Growing Power of Cloud Providers Amid AI Bloom*, THE WALL STREET JOURNAL (August 1, 2023), https://www.wsj.com/articles/companies-weigh-growing-power-of-cloud-providers-amid-ai-boom-478c454a.

28   *Generative AI Raises Competition Concerns*, FTC TECHNOLOGY BLOG COLUMN (June 29, 2023), https://www.ftc.gov/policy/advocacy-research/tech-at-ftc/2023/06/generative-ai-raises-competition-concerns.

29   *Supra* note 23.

30   John M. Newman, *Procompetitive Justifications in Antitrust Law*, 94 INDIANA LAW JOURNAL 501, 502-44 (2019).

31   Sam Bowman & Sam Dumitriu, *Better Together: The Procompetitive Effects of Mergers in Tech*, THE ENTREPRENEURS NETWORK AND INTERNATIONAL CENTER FOR LAW & ECONOMICS BRIEFING PAPER (September 2021), https://laweconcenter.org/wp-content/uploads/2021/10/BetterTogether.pdf.

32   Adam Spatacco, *Morgan Stanley Thinks Blackwell Chips Could Generate $10 Billion in Sales for Nvidia by Q4. Here's 1 Other Figure I'm More Interested to See*, THE MOTLEY FOOL COLUMN (October 11, 2024), https://www.fool.com/investing/2024/10/11/morgan-stanley-thinks-blackwell-chips-could-genera/.

hardware.[33] Within the AI model space, firms have found that collaborating with other models can increase the reliability of their output.[34] OpenAI, for example, has found that creating synthetic data works best when two different models work together, with one model producing the data and the competing model checking it.[35] In the rapidly evolving AI landscape, the interplay between collaboration and competition fosters innovation and drives progress. Competing firms must navigate this duality carefully to get the benefits of the existing technology while simultaneously seeking to maintain a competitive edge.

C. Rapid Technological Advances Can Undermine The Existence Of Moats

Economics of scale and network effects can create significant advantages for first movers in digital platform marketplaces, including AI. For example, some argue that OpenAI's first-mover advantage has allowed it to collect data at a scale that few new entrants can match as of now.[36] In addition, Nvidia, which initially made GPUs for the gaming sector became an early entrant when it turned its focus to the AI applications for its chips.[37] Given that the generative AI marketplace is still in its nascency, however, current market leaders face imminent threats from new technologies.

In the hardware segment, for instance, competitors have an opportunity to replace Nvidia's GPUs if their product is less expensive to buy and run. One of the new technologies with the potential to disrupt the hardware segment involves moving the location of AI processing from the large data centers with racks of servers based on Nvidia's GPUs to edge devices such as PCs, tablets and smartphones reliant on smaller chips.[38] This development indicates that taking a static view of the marketplace to assess moats and trenches possessed by large incumbents may fail to account for the constant disruptive innovation expected in the AI marketplace.

Competitive advantages in the modeling space may be less durable than those in hardware. An example of a threat to OpenAI's recent success comes from open-source models, one of which is Meta's Llama, which is freely available to developers. Open-source AI models allow developers to freely access the model's source code and improve it or adapt it for new tasks and use cases. A famous leaked Google memo discusses how neither Google nor OpenAI may have a moat in AI, in part, due to faster, more customizable, more private open-source models.[39]

VI. THE FUTURE

AI technology continues to rapidly advance and reshape markets, and regulatory efforts must continue to adapt to these complexities to ensure that emerging players can thrive alongside established ones. As experiences in digital markets indicate, there can be a variety of moats and trenches that emerge in the generative AI landscape, some of which are competitive practices that are beneficial in boosting innovation and driving economic growth, while others may dampen or distort competition. Striking a balance between promoting innovation and preserving competition remains a central challenge to both policy makers and regulators.

Looking ahead, the way antitrust issues are managed will significantly influence the future trajectory of AI. Stakeholders should prepare by staying informed and engaging in dialogue, ensuring that they are ready to adapt to an evolving regulatory landscape that balances both opportunity and oversight.

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33   Metz, *supra* note 9.

34   Cade Metz and Stuart Thompson, *What to Know About Tech Companies Using A.I. to Teach Their Own A.I.*, THE NEW YORK TIMES ARTIFICIAL INTELLIGENCE COLUMN (April 6, 2024), https://www.nytimes.com/2024/04/06/technology/ai-data-tech-companies.html.

35   *Ibid.*

36   Christopher Bravo, *OpenAI's first-mover advantage*, MEDIUM ARTICLE (April 23, 2023), https://medium.com/byte-sized-insights/the-benefits-of-being-first-85656ea19dee.

37   Katie Tarasov, *Tech Nvidia CEO Jensen Huang's big bet on A.I. is paying off as his core technology powers ChatGPT*, CNBC TECH COLUMN (March 7, 2023), https://www.cnbc.com/2023/03/07/nvidia-grew-from-gaming-to-ai-giant-and-now-powering-chatgpt.html.

38   Lucas Mearian, *GenAI is moving to your smartphone, PC and car — here's why*, COMPUTERWORLD ARTIFICIAL INTELLIGENE COLUMN (January 30, 2024), https://www.computerworld.com/article/1611727/genai-is-moving-to-your-smartphone-pc-and-car-heres-why.html; Leswing, *supra* note 8.

39   Dylan Patel and Afzal Ahmad, *Google "We Have No Moat, And Neither Does OpenAI,"* SEMIANALYSIS ARTICLE (May 4, 2023), https://www.semianalysis.com/p/google-we-have-no-moat-and-neither.

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