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Competition in Artificial Intelligence Infrastructure – Note by Korea

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1. Introduction

1. Since the emergence of ChatGPT in 2022, generative Artificial Intelligence (AI) has advanced at an unprecedented pace, becoming a new driver of global economic growth by improving economic efficiency and enhancing consumer welfare. Amid this rapid expansion, competition to secure early-mover advantages has intensified, with not only global Big Tech companies but also numerous start-ups entering the AI market. In particular, as the scale of recently introduced large models—such as GPT, Gemini, and Llama—continues to grow, vast amounts of high-performance AI infrastructure have become essential for their development and operation.

2. AI infrastructure refers to the physical and technological foundations, as well as related intangible assets, that are necessary for the provision of computing resources and for the development, training, inference, and deployment of AI. Specifically, physical AI infrastructure includes high-performance semiconductors such as AI accelerator chips, the cloud computing environments that enable them to operate at scale, data centers, network infrastructure, and large-scale power-supply facilities. Because the development, maintenance, and commercialization of AI demand substantial AI infrastructure resources and corresponding investment, the AI infrastructure market has a high likelihood of becoming concentrated in a small number of firms—especially global Big Tech companies with significant resources and technological advantages. There is a growing policy concern that such firms could leverage this market power to influence multiple downstream markets and restrict competition.

3. Against this backdrop, this contribution presents the Korea Fair Trade Commission's (KFTC) 2024 policy report “Generative AI and Competition” and shares the KFTC's merger review experience in the AI semiconductor sector as well as its criteria for assessing mergers in innovation markets. By doing so, it aims to identify potential competition concerns in AI infrastructure markets and draw policy implications for addressing them.

2. Publication of the Policy Report “Generative AI and Competition”

2.1. Background to the Publication

4. In December 2024, the Korea Fair Trade Commission (KFTC) published the policy report “Generative AI and Competition” to examine the rapidly evolving competitive landscape of AI markets driven by emerging technologies and to proactively analyze competition and consumer issues so as to enhance predictability for market participants. The report aims to foster an environment in which fair competition can be sustained without hindering innovation, and to serve as a policy reference for establishing and maintaining a fair competitive order going forward. The report covers: (i) the current state of the generative AI value chain, (ii) an analysis of competitive conditions in Korea's generative AI market, and (iii) an analysis of competition and consumer issues along with the corresponding policy challenges.

2.2. Status of the Generative AI Value Chain

5. The policy report defines the major value chain of generative AI as comprising three stages—AI infrastructure, AI development, and AI implementation—and analyzes the corresponding market structure in Korea. Operating in the upstream segment of the value chain, which includes AI infrastructure and AI development, requires substantial capital and technological capabilities. Accordingly, global Big Tech firms and large domestic conglomerates with such resources have been the primary participants in the relevant markets.

6. By contrast, the downstream segment of the value chain—AI implementation—allows businesses to develop AI services using foundation models provided by other firms. As a result, numerous smaller start-ups, in addition to global Big Tech firms and domestic conglomerates, are also actively engaged in these markets.

7. A notable structural feature of the generative AI market is that major Big Tech firms have entered virtually all segments of the industry, building vertically integrated ecosystems. This reflects the fact that large firms—including global Big Tech companies—have already been active in related areas such as cloud services and possess substantial capital and technological capabilities, which makes it relatively easier for them to secure the essential inputs required for the development and implementation of generative AI and to undertake related investments.

8. Accordingly, the firms that are vertically integrated across the generative AI value chain include Google, Microsoft, Amazon, and Meta. Some of these firms simultaneously act as competitors that develop and provide AI services and as suppliers that provide essential inputs—such as AI infrastructure—to other AI firms.

2.3. Structural Factors Affecting Competition in the AI Infrastructure Market

9. Structural characteristics of the AI infrastructure market may raise concerns about increasing market power. The policy report finds that large firms are likely to enjoy competitive advantages due to structural factors such as economies of scale and scope, which shape the competitive dynamics in the AI infrastructure market. As a result, large firms and vertically integrated players may gain competitive advantages over small or new entrants such as start-ups, raising concerns about potential restrictions on competition and barriers to entry.

10. Specifically, providing cloud computing resources requires significant upfront investment in AI semiconductors and data centers. In addition, the development of foundation models demands vast computing resources and large volumes of data. These characteristics give rise to economies of scale, under which average costs decline as production and input volumes increase. Moreover, providers of cloud computing resources can realize economies of scope by developing AI semiconductors in-house for use in their data centers, thereby shortening lead times and lowering procurement costs. Such effects are likely to be more pronounced among large, vertically integrated firms with sufficient capacity to operate across multiple stages of the generative AI value chain.

2.4. Competitive Landscape in the AI Semiconductor Market

11. The policy report analyzes the competitive landscape of Korea's generative AI market across each stage of the value chain. This contribution focuses in particular on the AI semiconductor and cloud computing markets.

12. In the AI semiconductor market, both domestic and international firms develop AI semiconductors—such as GPUs and NPUs—and supply devices such as AI accelerators. Major global players include NVIDIA, Intel, and AMD, while key domestic firms include SAPEON Korea, Rebellions, and FuriosaAI. In recent years, several users of AI semiconductors—such as Google, Microsoft, and Amazon Web Services (AWS)—have begun developing their own AI semiconductors for use in their cloud infrastructure to reduce their reliance on third-party manufacturers.

13. Currently, many firms are developing and launching AI semiconductors in Korea’s domestic market. However, given NVIDIA’s strong technological capabilities, production capacity, and the high demand for and preference toward its products, the market can be characterized as one led by NVIDIA, which continues to hold a leading position, while other global and domestic firms are striving to strengthen their competitiveness. Considering that some cloud service providers (CSPs)—including AWS and Microsoft—have developed and are using in-house AI semiconductors in their cloud infrastructure, and that AI semiconductor technologies continue to evolve, it will be important to closely monitor potential changes in market dynamics, including any possible reduction in the current concentration around NVIDIA.

2.5. Competitive Landscape in the Cloud Computing Market

14. There are numerous domestic and international cloud service providers (CSPs), including Amazon Web Services (AWS), Microsoft, and Google among the global players, and Naver Cloud, KT Cloud, and NHN Cloud among the domestic providers. Given that global CSPs currently hold a large market share in Korea’s cloud computing market and enjoy a comparative advantage over domestic CSPs in building infrastructure (including AI semiconductors) and expanding AI capabilities necessary for competition, domestic CSPs nonetheless compete within a market that remains centered on global CSPs.

15. Looking ahead, it will be important to closely monitor whether competitive conditions for domestic CSPs improve—for example, through expanding infrastructure, including AI semiconductors, and greater adoption of multi-cloud strategies by customers—and whether these developments help reduce market concentration around global CSPs. AI developers and other customers may also choose to use multiple cloud services in parallel to enhance service stability, which could, in turn, intensify competition among CSPs.

2.6. Potential Competition Concerns in the AI Infrastructure Market

16. The policy report identifies potential competition concerns that could arise from firms’ conduct in the AI infrastructure market, taking into account theoretical and hypothetical scenarios as well as concerns raised by industry participants. It notes that, in particular, restrictions on access to essential inputs or merger activity could pose risks to competition, and emphasizes the need to strengthen monitoring of markets where such concerns are likely to emerge.

17. Regarding restricted access to essential inputs, the report observes that AI infrastructure—such as high-performance semiconductor chips and computing resources—serves as de facto essential inputs for the development and implementation of generative AI. In theory, competition could be harmed if a firm with significant market power in those input markets were to abuse that power—for example, by controlling prices, quantities, or other terms of trade. As discussed in the previous section on the competitive landscape, NVIDIA’s GPUs have been in consistently high demand in the AI semiconductor market.

In light of this concentration around NVIDIA, the report underscores the importance of closely monitoring GPU sales and allocation.

18. As for mergers and acquisitions (M&A), there are instances where vertically integrated firms, including Big Tech companies with ample financial resources and strong technological capabilities, make substantial investments in, or enter into partnerships with, start-ups that lack sufficient capital. There are concerns that such investments and acquisitions by large firms could further strengthen their market power in relevant markets, highlighting the need to closely examine their effects on competition in the AI infrastructure market. In addition, although certain strategic partnerships may not fall within the traditional scope of mergers under competition law, they can nonetheless produce outcomes similar to conventional mergers. Given the strong economies of scale in the market—which have contributed to increasing concentration among a few large firms—these developments highlight the need to consider appropriate policy responses to address such new forms of business combinations.

3. Changes in the Ecosystem of the AI Semiconductor Industry and Korea's Competition Law Enforcement Experience

3.1. Changes in the Ecosystem of the AI Semiconductor Industry: Portfolio Expansion through M&A

19. AI semiconductors generally refer to AI processors or AI accelerators used for training and inference in AI operations. The emergence of AI semiconductors has reshaped the competitive landscape of the semiconductor industry, creating new opportunities for late entrants. As AI models are increasingly adopted across industries, demand for low-power, high-performance AI semiconductors has surged, encouraging new entrants into the broader semiconductor market.

20. The rise of AI semiconductors has blurred traditional boundaries within the semiconductor value chain—design, manufacturing, and assembly/testing—and driven innovation across the broader ecosystem and value creation process. Firms are increasingly expanding their portfolios through M&A and strategic collaborations, crossing boundaries both across and within different stages of the semiconductor value chain.

Table 1. Semiconductor Value Chain

Stage	Category	Description	Major Players
Design	EDA (Electronic Design Automation)	Software tools that automate the electronic design, simulation, and analysis of complex, highly miniaturized semiconductor circuits.	Synopsys, Cadence, Siemens
	IP (Chipless)	Design standardized semiconductor intellectual property (IP) blocks that can be applied and reused in circuit design.	ARM, Synopsys
	Fabless	Design application-specific semiconductors	NVIDIA, AMD, Qualcomm, Samsung,

		optimized for various uses by utilizing standardized IP and EDA tools.	Intel
Manufacturing	Foundry	Build semiconductor fabrication facilities and perform contract manufacturing of semiconductors based on circuit designs supplied by fabless companies.	TSMC, Samsung, Intel
Assembly / Testing	OSAT	Conduct semiconductor assembly, packaging, and testing processes. (Outsourced Semiconductor Assembly and Test)	ASE, PTI, JCET, SPIL

21. More specifically, within the Electronic Design Automation (EDA) stage, the accuracy and efficiency of design verification using EDA have become core capabilities for AI semiconductor development. As demand for AI semiconductors continues to rise, the importance of EDA has likewise increased, and EDA firms are broadening their portfolios—by providing IP together with EDA tools or by offering integrated tool suites for the different stages of the semiconductor design process. Representative cases include the 2024 Synopsys–Ansys merger and Siemens’ 2021 acquisition of Insight EDA.

22. At the fabless stage, design-specialist firms likewise continue to compete in the AI semiconductor market. Fabless firms are expanding their portfolios by offering IP alongside their design services, and they are pursuing M&A to advance AI semiconductor design for a range of demand sectors—such as data centers, mobile devices, and automotive applications—while seeking to increase their market share.

23. A similar effort to broaden portfolios can be seen in foundries and other segments. Foundries not only provide the core manufacturing processes but also offer a flexible environment that enables diverse customers to manufacture custom AI semiconductors. Anchored in their physical semiconductor manufacturing capabilities, they seek to meet diverse customer needs by facilitating collaboration among IP, EDA, and ancillary service providers. Meanwhile, end-users such as Google, Amazon, Meta, and Apple have themselves emerged as developers of AI semiconductors, giving rise to new collaborative frameworks among these firms and EDA, IP, and foundry providers.

3.2. The KFTC’s Merger Review Case in the AI Semiconductor Sector: Synopsys–Ansys Transaction

24. Since 2021, the Korea Fair Trade Commission (KFTC) has reviewed and cleared four major merger cases related to the AI semiconductor sector. It approved without conditions SK hynix’s acquisition of Intel’s SSD business unit, AMD’s merger with Xilinx, and AMD’s acquisition of shares in ZT Systems. In March 2025, the KFTC conditionally approved Synopsys’s acquisition of all shares of Ansys, subject to the divestiture of specific assets by both Synopsys and Ansys.

25. In reviewing the Synopsys–Ansys transaction, the KFTC conducted an in-depth assessment of potential competition concerns in the relevant markets. To that end, the KFTC gathered views from a broad range of domestic and international stakeholders, obtained technical advice from subject-matter experts, and—recognizing the cross-border

nature of the case—worked closely with foreign competition authorities, including those in the European Union, the United Kingdom, and the United States.

26. More specifically, both Synopsys and Ansys operate at the chip design stage and supply the inputs required by fabless companies to design chips. As noted above, the rise of AI semiconductors has increased the importance of chip design IP and tools supplied by the two firms, and the KFTC therefore considered that the transaction could have a significant impact on competition in semiconductor design markets.

27. The KFTC found that, following the transaction, there was a significant risk that Synopsys and Ansys could restrict competition in the markets for Register Transfer Level (RTL) power consumption analysis software, optical software, and photonics software by leveraging their market power to unilaterally raise prices or otherwise worsen terms of trade.

28. First, with respect to market concentration, the KFTC found that the parties' combined share was estimated to exceed 50 percent in all three markets, suggesting that the merged entity could hold a strong market position. In each of the three markets, the transaction combined the first- and second-largest suppliers—Ansys and Synopsys—effectively eliminating direct competition between them. Combined with customers' limited willingness to switch to alternative suppliers, these factors led the KFTC to conclude that there was a high likelihood of unilateral effects. In all three markets, the two firms devote a substantial proportion of their revenues to R&D, which translates into significant barriers to entry; given these high barriers, the transaction was assessed as likely to further entrench market power.

29. The KFTC also examined whether the conglomerate merger could give rise to foreclosure strategies against rival firms in the relevant markets. It concluded that Synopsys and Ansys would have neither the ability nor the incentive to pursue such strategies and that, even if attempted, the likelihood of actual foreclosure effects would be low. Taking these factors together, the KFTC found that the transaction does not raise competition concerns.

30. In a further assessment, the KFTC examined whether Synopsys's semiconductor chip design IP could be bundled with Ansys's semiconductor chip design tools to exclude competitors. It found that these products are supplied under different business models, so the parties lack the ability to bundle them.

31. The KFTC also considered the possibility of bundling semiconductor chip design software more generally. Post-merger, the parties would have the ability and incentive to bundle their products. However, because competitors would also have the ability to offer similar bundles and customers tend to mix and match best-performing products from different suppliers, it would be difficult for the merged entity to induce customers to switch to its bundled products. Accordingly, the KFTC found no evidence of foreclosure effects.

32. For customers to mix and match products from different suppliers, interoperability—the ability to read and write data across different vendors' tools—is essential. Against this backdrop, the KFTC examined whether, post-merger, the combined firm could undermine interoperability between its products and those of rivals. Because interoperability is based on standards established by international bodies, the parties lack the ability to undermine them; moreover, rivals could retaliate. On that basis, the KFTC concluded that the parties would have no incentive to degrade interoperability.

33. Accordingly, to address the competition concerns in the markets for Register Transfer Level (RTL) power consumption analysis software, optical software, and photonics software, the KFTC required divestitures—on a market-by-market basis—of all

relevant assets held by either Synopsys or Ansys. Specifically, in the RTL power consumption analysis software market, Ansys and its affiliates were required to divest all relevant assets, while in the optical and photonics software markets, Synopsys and its affiliates were required to divest all relevant assets.

34. In developing these divestiture remedies, the KFTC used the Correction Scheme Submission System for the first time since its introduction in August of the previous year. To address the competition concerns, the KFTC first took into account the remedy proposals that set out asset divestitures directly submitted by Synopsys and Ansys, then solicited views from competitors and customers, made revisions where warranted, and ultimately finalized the specific divestiture measures.

35. This approach is noteworthy because it enabled the KFTC to design remedies that effectively addressed the competition concerns while remaining workable and acceptable to the market, drawing on extensive market information from Synopsys, Ansys, competitors, and customers.

36. Beyond the remedy design, the KFTC examined whether the horizontal and conglomerate merger could give rise to anticompetitive effects in the relevant markets. Drawing on this assessment, it will be necessary to carefully consider in future merger reviews in the AI-infrastructure market whether horizontal mergers could lead to monopolization by a few firms, or whether conglomerate mergers pose the potential to foreclose competitors. Furthermore, as previously examined, an important question will be whether a small number of firms could leverage market power gained in AI infrastructure markets to strengthen their positions in downstream markets and thereby restrict competition.

3.3. Merger Review Criteria for Innovation Markets

37. The Korea Fair Trade Commission (KFTC) has established market-definition methods and competition-assessment criteria for merger review to appropriately analyze competitive dynamics in innovation-driven sectors—such as the AI infrastructure market—where innovation competition is active.

38. When the industries in which the merging parties operate depend heavily on R&D or when ongoing innovation rivalry exists and at least one party plays a key role in that process, the KFTC may define a field of closely related innovation activities as a distinct “innovation market,” or treat it as part of a broader manufacturing or sales market. For example, if firms with strong capabilities in developing semiconductor manufacturing equipment—having long competed in technology development to meet customer demand—decide to merge, the KFTC may define a separate market for the development of next-generation semiconductor manufacturing equipment.

39. With respect to market concentration, the KFTC has established criteria allowing market shares in innovation markets to be measured using alternative indicators, since sales data for relevant products are often unavailable. In such cases, market shares may be assessed by reference to factors such as R&D spending, the scale of assets and capabilities dedicated to innovation, the number of patent applications or citations in the relevant field, and the number of firms that substantially participate in innovation competition.

40. In assessing whether a merger would substantially lessen competition, the KFTC may also consider potential harm to innovation. If, after the merger, the parties would have both the incentive and the ability to reduce R&D and other innovation efforts, rivalry in innovation could be significantly weakened. Such potential harm is assessed holistically, taking into account (i) whether the parties are important innovators in the relevant field;

(ii) the closeness of the parties' past and current innovation activities; (iii) whether a sufficient number of firms would remain to participate meaningfully in innovation competition after the merger; and (iv) disparities in innovation capabilities between the parties and their rivals.

4. Conclusion

41. The transformation of the AI infrastructure ecosystem represents not merely technological progress but a structural reconfiguration of the broader industrial landscape. As portfolio expansion and ecosystem integration emerge as core competitive strategies, firms are increasingly pursuing technological complementarities and greater market power through mergers.

42. This transformation presents new challenges for competition authorities in balancing the promotion of innovation with the enforcement of competition law. As the AI infrastructure industry continues to grow and evolve, merger reviews are expected to place greater emphasis on ecosystem-based, dynamic-competition analysis, moving beyond traditional market-definition frameworks to better capture the complexity and technological characteristics of AI ecosystems.