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Competitive advantage in the AI semiconductor industry: A comparative study of NVIDIA, AMD, and Intel

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Abstract
The research uses Porter's Five Forces analysis as its theoretical basis to evaluate how three top semiconductor companies—NVIDIA and AMD and Intel—perform in their main business areas through their competitive market systems and profit generation abilities. The research shows that the three companies operate in the same semiconductor market but they face different competitive challenges because their products and business operations and network systems vary. Through its technological superiority in AI GPU production and CUDA system capabilities NVIDIA achieves minimal competition from current market players and new market entrants and substitute products which creates an excellent market situation. The five competitive forces create intense market challenges for AMD because it operates in two competitive spaces which include server CPU and AI GPU markets. The PC market reached its peak market value which made Intel face its strongest competition because ARM processor architectures became more popular and customers gained more control during their buying process. The study reveals that ecosystem lock-in effects have developed into a separate force which now ranks above the traditional Five Forces system to form a new essential element that impacts business competition. The fabless business model allows companies to focus on research and development while building their operational network but the IDM model lets them control their supply chain and manage their expenses. The profitability of a business depends on more than its technological abilities because it involves how industry systems and natural networks and business strategies interact with each other.

Keywords: Five forces analysis, semiconductor industry, NVIDIA, AMD, Intel, CUDA ecosystem, competitive strategy

Introduction

The modern information technology industry depends on the semiconductor sector because it serves as its fundamental base which enables progress in artificial intelligence and cloud computing and personal computing and mobile communication technologies. The semiconductor industry has experienced multiple fundamental changes since IBM controlled mainframes until Intel took control of personal computers and then ARM gained power in mobile devices and now NVIDIA leads the artificial intelligence sector. The industry leadership continues through its ongoing succession process. The semiconductor industry achieved its highest strategic value during the current artificial intelligence surge which started in recent times. The latest computing chips serve as essential resources for AI model training and inference because global technology leaders fight over GPUs and AI accelerators. The semiconductor industry faces new challenges because geopolitical elements have started to shape its business environment. The U.S.-China technology separation along with the CHIPS Act and export restrictions has created a major transformation in how worldwide semiconductor distribution networks operate.

The semiconductor sector needs proper competitive system understanding to develop company strategies and industrial policies which will help them achieve their financial goals. The semiconductor industry includes various sub-sectors which range from PC processors and server CPUs to AI accelerators and mobile chips and automotive chips and IoT chips that show distinct market competition patterns and different levels of market entry difficulty and production chain structures. The generic analysis of the semiconductor industry would not reveal the specific market competition patterns and revenue generation methods which each sub-sector possesses.

Literature Review and Theoretical Foundations

External Environment Analysis in Strategic Management

Strategic management focuses on understanding why particular businesses maintain their position as market leaders against their competing organizations. Two major theoretical traditions have emerged in addressing this question: the industrial organization (IO) school, which emphasizes the decisive role of the external industrial environment on firm performance, and the resource-based view (RBV), which contends that a firm's unique internal resources and capabilities constitute the fundamental sources of competitive advantage. Porter demonstrated that industry profit potential and competitive strength stem from the fundamental design elements which form an industry instead of depending on how competitors interact with one another. The strategic options which companies can choose from become limited because of their industry structure; firms need to understand their industry's competitive environment before they can develop effective competitive strategies. The process of strategic formulation begins with external environmental analysis which focuses on industry structure analysis as its fundamental component.

The external environment undergoes systematic analysis through three separate levels which include the macro-environment and the industry environment and the competitor environment. The PESTEL framework helps organizations identify external forces which include political elements and economic factors and social aspects and technological developments and environmental conditions and legal requirements. The analysis of industry environment centers on how businesses compete and generate profit within their specific market through the Five Forces model which serves as its primary analytical

framework. The competitor environment requires companies to track every strategic move which their direct competitors execute. The three levels of analysis work together because they form a continuous chain of linked elements. The PESTEL framework shows the common industry trends which affect all business sectors while the Five Forces analysis demonstrates how market competition and profit potential affect particular business sectors.

Theoretical Connotations of the Five Forces Model

Porter established the Five Forces model which stands as his most significant theoretical achievement within strategic management. The model shows that industry competition exists beyond current market competition because five distinct competitive forces create the entire competitive environment. These forces consist of five elements which include (1) existing competitor rivalry intensity and (2) new market entry threats and (3) substitute product threats and (4) supplier bargaining power and (5) buyer bargaining power. The Five Forces model introduces a theoretical advancement through its complete system which provides an all-encompassing perspective. The industry analysis system before Porter operated through market concentration studies which counted companies to determine industry competition. The industry competition goes beyond present market players because other elements exist in the market according to Porter. The industry faces competition from customers and suppliers and substitute products and potential new market entrants who seem to affect the market more than current competitors within the industry.

Force One: Rivalry Among Existing Competitors

The first force explains how strongly current businesses within an industry fight against each other which creates the most basic form of competitive pressure. The market competition between existing players has reached such a high level that they fight to win both market share and customer resources and revenue growth. The industry shows declining profit margins between its players because competition between rivals reaches its highest point. The industry experiences rising competition because companies fight through price battles and promotional fights and resource struggles which lead to unstable profit performance. Three main categories serve as the primary factors which impact the situation. The system requires two basic data units to function properly: the total number of market competitors and the level of industry market concentration. The market contains multiple competitors which split the market into several equal-sized segments that create fierce rivalry between these businesses. High market concentration occurs when few companies control most of the market which leads to stable competitive conditions because dominant companies maintain their ability to set prices and achieve consistent financial results. Second, the industry growth rate; Market expansion velocity determines how strongly competitors battle against each other. The market expansion during growth periods enables companies to obtain new revenue without needing to fight for existing market position thus leading to reduced competition. The market expansion stops which forces companies to fight for existing customer base which results in higher market competition and falling profit margins. Third, the degree of product or service differentiation; The market becomes more competitive when companies offer similar products because consumers find it easy to switch between brands which forces companies to fight through price competitions.

Force Two: Threat of New Entrants

The second force analyzes how businesses must defend themselves from new competitors who want to enter their market space. The presence of profitable business opportunities in any industry will attract outside resources together with fresh market entrants who bring extra capacity and new competition methods and market expansion activities which reduce the market share and profits of current industry players. The threat level from new market entrants depends on how difficult it becomes for them to enter the industry instead of their actual entry plans. The entry process becomes more challenging when businesses face elevated obstacles which simultaneously protect them from market competition. The entry process becomes more challenging when businesses face elevated obstacles which simultaneously protect them from market competition. Core entry barriers include three types. First, capital requirements; The entry process for outside companies becomes more difficult when businesses need to invest substantial amounts of capital and acquire equipment and conduct research and development and build distribution networks and assemble teams and pay for other essential expenses. The industry creates a defensive position because outside companies face entry barriers through substantial capital requirements which make it difficult for them to initiate operations. Businesses that operate with restricted financial resources cannot enter the market because of high capital requirements which establishes a steady competitive environment. The continuous arrival of new businesses into industries which need low startup money and have minimal entry barriers creates an ongoing increase in market competition. Second, brand loyalty and customer switching inertia; The process of overcoming established market perceptions and building customer trust requires new market entrants to dedicate extensive time and resources because incumbents have built long-term brand equity and market reputation and strong customer loyalty. The combination of strong brand dependence and low customer switching behavior creates an environment which makes it difficult for new market entrants to establish themselves while maintaining stability in the existing industry structure. Third, economies of scale; Large production numbers enable businesses to lower their unit expenses which creates a natural cost advantage for established big companies that already operate in the market.

Force Three: Threat of Substitutes

The third force examines how alternative products create substitution pressure which affects market dynamics. Substitutes exist as products and services which originate from different industries but they satisfy identical customer requirements. The industry does not create substitutes because they appear as alternative solutions which come from different industrial sectors. The availability of substitute products creates two main effects on the original industry because it restricts both how much companies can charge and the total market value of their products. Substitutes which provide better price-to-performance ratio and more convenient access and reduced expenses will eventually replace original products which will decrease the survival chances of the original industry. The danger level of substitute products depends on four main elements which include their price benefits and their complete functionality and the expenses users must pay to switch and how people decide to replace things. The original industry faces rising

competitive forces because customers can switch without obstacles and they find substitute products equally valuable which leads to unstable profit patterns. The substitution of products functions as a vital element which drives industrial evolution during extended periods while it creates major threats that can lead to industry collapse and disappearance so it stands as an essential element in industry evaluation.

Force Four: Bargaining Power of Suppliers

The fourth force examines how upstream suppliers use their bargaining power to influence market conditions. The industry depends on suppliers to provide all the necessary resources and materials and equipment and technology which drive its production operations. The power of suppliers to negotiate prices determines how much a company pays for procurement and production which affects their profit margins. The supplier power level determines their ability to set material costs and distribute expenses and control product availability which results in reduced profits for downstream businesses. Businesses need to evaluate two different sets of elements which operate as their primary factors that influence their business operations. First, supplier concentration; The market power of suppliers grows when there are fewer suppliers operating under monopolistic conditions which makes it difficult for downstream businesses to negotiate.

Force Five: Bargaining Power of Buyers

The fifth force studies how downstream buyers develop their ability to negotiate with other market participants. The final buyers in the industry purchase all products and services which the market offers. The ability of buyers to make choices creates the maximum range which businesses can use to set prices and maintain their service quality and achieve their desired profit margins. Customers who possess strong purchasing power can force businesses to reduce their prices while they need to obtain superior service experiences and better commercial agreements which ultimately reduce industry profit margins. Core influencing factors include three categories. First, the number of buyers and purchase concentration; The total number of buyers together with their individual purchase amounts and their market distribution patterns determine the power level of each buyer in the market. The industry gains control over price decisions because many buyers exist but each buyer purchases only small amounts. Second, user switching costs; Customers face various expenses when they decide to switch their products or services between suppliers which include their time investment and financial costs and educational requirements and adjustment period and potential dangers they must face. Customers face minimal expenses when they want to change their suppliers, which allow them to select different companies while maintaining their power to negotiate with multiple businesses. The process of switching between options becomes difficult because of high costs which results in customers staying with their current choices while they lose their ability to negotiate with buyers. Third, market information transparency; The availability of detailed product information together with price and service and competitor data helps buyers perform better comparison and decision-making processes about their options which results in increased buying power and greater negotiation strength. The lack of information symmetry and poor transparency levels allow companies to maintain their control over pricing decisions and negotiation processes while buyers face reduced ability to influence market dynamics. The strength of these five forces creates the conditions which determine how much profit an industry can generate throughout its operational existence. The five forces create intense competition which results in low profit margins that only a few businesses become successful beyond typical industry earnings. The industry operates under a friendly market structure because all five forces have minimal impact which results in high profit margins and stable financial results for most market participants. Porter further argued that a firm's strategic objective should be "to find a favorable position within the rules of industry competition"—or even "to reshape those rules through strategic action in a direction favorable to itself." Since its introduction, the Five Forces model has been widely validated in both theoretical and practical applications, but has also faced certain criticisms.

Semiconductor Industry Characteristics and Competitive Structure

The semiconductor industry possesses several distinctive characteristics that influence its competitive structure. First, significant economies of scale; Chip R&D requires enormous upfront investments—advanced process chips can entail development costs ranging from hundreds of millions to several billion dollars—but marginal costs after mass production are relatively limited, giving high-volume producers substantial unit cost advantages. While this elevates entry barriers, it also incentives existing players to expand output and pursue market share, intensifying price competition during periods of overcapacity. Second, rapid technological iteration; Although Moore's Law has decelerated, semiconductor technology continues to evolve at a remarkable pace, with process nodes progressing from micrometers to nanometers and even to angstroms, and new technology introduction cycles shortening. This characteristic makes competition not only about current market share but also about technological roadmaps and R&D timelines. Technologically lagging firms face rapid market share erosion, while leaders enjoy first-mover advantages and pricing power. Third, high concentration of intellectual property; The semiconductor industry has accumulated an enormous patent portfolio covering chip architectures, process technologies, packaging methods, software ecosystems, and more. Patent portfolios not only constitute legal barriers for new entrants but also serve as strategic weapons for cross-licensing and mutual deterrence among incumbents. The x86 patent fortress, ARM's licensing model, and GPU ecosystem software patents all exert profound influences on competitive structure. Fourth, global division and high concentration of the supply chain; The semiconductor supply chain—from IC design and wafer fabrication to packaging/testing and equipment/materials—features highly specialized participants in each segment. Advanced process wafer fabrication and EUV lithography equipment are near-monopolies, giving certain upstream segments extremely high bargaining power, significantly affecting cost structures and profitability of downstream fabless design firms and IDM manufacturers.

Another critical feature of the semiconductor industry is the diversity of business models. From the perspective of value chain integration, two primary types predominate: IDM (Integrated Device Manufacturer) and Fabless. IDM firms

such as Intel and Samsung simultaneously control chip design, manufacturing, and packaging/testing capabilities. Fabless firms such as NVIDIA, AMD, and Qualcomm focus on chip design and marketing, outsourcing manufacturing and packaging/testing. Business model choices profoundly affect a firm's position within the Five Forces structure. For IDM firms, supplier relationships involve not only equipment and materials but also internal manufacturing capacity management and technology accumulation. While providing supply chain autonomy and capacity flexibility, the IDM model also subjects firms to extreme pricing pressure from advanced equipment suppliers and entails massive capital expenditures for wafer fab construction and operation. For Fabless firms, the absence of manufacturing capital burdens and technological risks allows resources to be concentrated on chip design and ecosystem development. However, the Fabless model creates high dependence on a few foundries (especially TSMC) for advanced process capacity, giving these suppliers extreme bargaining power in capacity allocation and pricing, constituting a core supply chain risk. Furthermore, business models affect strategic flexibility in responding to new entrants and substitutes. Fabless firms, unconstrained by proprietary capacity, enjoy greater agility in product iteration and capacity adjustment. IDM firms, due to heavy fixed asset investments, face greater adjustment pressure during industry downturns. This study will consistently attend to how business model differences interact with Five Forces structures to shape competitive advantages and strategic options across the case analyses.

NVIDIA Case Analysis

Industry Definition and Market Structure

NVIDIA's core revenue source is the data center AI GPU, encompassing training and inference chips such as the H100, H200, and B100 series. This product line accounts for over 70% of NVIDIA's total revenue and represents the absolute leading product in the global AI computing power market. Primary application scenarios for AI GPUs include large language model training, generative AI inference, scientific simulation, and high-performance computing. The customer base is concentrated among global cloud service giants (AWS, Azure, GCP), AI startups, and government and research institutions worldwide. From a market structure perspective, the global high-end AI GPU market features an extreme oligopoly. According to industry research estimates, NVIDIA holds over 90% market share in the global AI GPU market, with AMD and Intel together accounting for only single-digit percentages. If considering the AI training market alone, NVIDIA's share is even higher, approaching monopolistic levels. This market structure fundamentally differs from the traditional PC processor market (duopoly between Intel and AMD) and the server CPU market (also a duopoly). This high concentration stems from the complexity of AI GPU technology and the lock-in effects of the ecosystem. An AI GPU is not merely a hardware product but a comprehensive computing platform integrating hardware architecture, software stacks, development tools, and community ecosystems. By purchasing NVIDIA GPUs, customers simultaneously enter the NVIDIA CUDA ecosystem, creating a self-reinforcing mechanism that continually increases market concentration.

Rivalry among Existing Competitors: Low

In the high-end AI GPU market, rivalry among existing competitors is relatively low, substantially below that in most semiconductor sub-sectors. NVIDIA occupies an absolutely dominant position, and neither AMD nor Intel can match NVIDIA in market share or ecosystem maturity in the AI GPU space. While AMD's Instinct MI300/MI350 series have progressively caught up in hardware specifications, significant gaps persist in software ecosystem (ROCm vs. CUDA), developer community scale, and market recognition. AMD's strategic positioning in the AI GPU market is relatively reactive, largely following NVIDIA's product cadence, and it struggles to mount effective competitive offensives on the main battlefield. Intel's AI accelerator presence lags even further. The Gaudi series AI chips, although offering certain price-performance advantages, have not posed a substantive threat to NVIDIA in terms of overall performance, ecosystem compatibility, or customer trust. Intel's strategic focus remains on its core CPU business and foundry services, with comparatively limited resource allocation to AI GPUs. Another factor contributing to low rivalry intensity is rapid market growth. The AI GPU market is experiencing explosive growth, with aggregate demand continuously expanding, allowing all participants to capture revenue growth from market increments rather than aggressively seizing shares from each other. In this context, price wars and destructive competition lack economic incentives. Notably, NVIDIA does not entirely neglect competitive threats. The company sustains an extremely fast product release cadence (from H100 to H200 to B100), maintaining a generational hardware performance gap that prevents competitors from surpassing it on specifications. This "self-surpassing" product strategy essentially serves, during a period of rapid market growth, to proactively raise competitive thresholds and compress rivals' catch-up space as a defensive measure.

Threat of New Entrants: Low

Entry barriers to the AI GPU market are exceptionally high, rendering the overall threat of new entrants low. Principal potential entrants include cloud giants and major technology firms such as Google (TPU series), AWS (Trainium/Inferentia), Microsoft (Maia), and Huawei (Ascend series). Google TPU is the most mature alternative custom chip on the market, now in its fifth generation, and widely deployed for Google's internal AI workloads. However, TPUs are positioned for "internal use" rather than external sales; their design is highly optimized for Google's own model architectures (Transformers), lacking generality and ecosystem extensibility. Similarly, AWS Trainium and Inferentia primarily serve internal AWS customers, delivering computing power through cloud services rather than selling chips directly. The fundamental reason for the low threat of new entrants lies in the multi-layered nature of entry barriers in the AI GPU market. The first layer is hardware technology barriers: high-end AI GPUs require state-of-the-art chip architecture design, advanced process tape-outs, high-bandwidth memory integration, and high-power thermal solutions—extremely high technical complexity. The second layer is software ecosystem barriers: the CUDA ecosystem, built over nearly two decades, has become the common language of global AI developers. Even if new entrants achieve comparable hardware performance, they would struggle to persuade

developers to switch platforms in the short term. The third layer is customer trust and scale barriers: AI GPU procurement decisions involve capital expenditures of hundreds of millions to billions of dollars; customers prefer proven market leaders, and new entrants lack track records to overcome procurement inertia. NVIDIA sustains these high entry barriers through three strategic actions: first, constantly accelerating product iteration cadence to compress competitors' "copy-catch up" time windows; second, expanding CUDA ecosystem coverage and strengthening collaborations with top global universities, research institutions, and developer communities, making CUDA the de facto standard in AI; third, locking in key customers through long-term strategic partnerships, limiting the external market impact of internal custom chips developed by potential competitors (especially cloud giants).

Threat of Substitutes: Medium-Low

Substitutes are products capable of performing AI computing functions but following different technological paths from general-purpose GPUs. AI GPUs currently face two main categories of substitutes: ASIC (Application-Specific Integrated Circuit) AI chips and FPGA (Field-Programmable Gate Array) programmable chips. The overall threat level is medium-low. ASICs are specialized chips that are hardware-optimized for specific AI workloads, eliminating unnecessary computational units found in general-purpose GPUs, yielding significant advantages in performance-per-watt and performance-per-cost. Products such as Google TPU, AWS Trainium, and Groq fall into this category. In inference scenarios (as opposed to training), ASIC advantages are particularly pronounced because inference workloads are relatively fixed and better suited to ASIC's hardwired designs. FPGAs allow users to flexibly configure hardware for specific applications, offering combined advantages in power consumption and flexibility in edge computing, industrial AI, and low-latency inference scenarios. Both AMD (via the Xilinx acquisition) and Intel (via the Altera acquisition) have FPGA footprints. However, substitute threats remain limited for several reasons. First, the AI training market demands strong generality: AI model architectures evolve rapidly—from CNNs to RNNs to Transformers to diffusion models and MoE—each imposing different requirement on compute hardware. The flexibility of general-purpose GPUs allows adaptation to diverse model architectures—an advantage ASICs find difficult to match. Additionally, large-scale AI training requires clusters of thousands to tens of thousands of chips for parallel computation, with stringent demands on communication bandwidth, memory coherence, and software orchestration—capabilities currently fully supported only by NVIDIA's ecosystem. NVIDIA's strategies to address substitute threats include: continually reinforcing GPU dominance in the training market to secure the core business; launching inference-optimized product lines (such as L40S) to directly target ASIC markets; and continuously optimizing the software ecosystem to increase the economic incentive for customers to continue using GPUs in mixed training/inference scenarios.

Bargaining Power of Buyers: Medium-High

Buyer concentration for NVIDIA's AI GPUs is extremely high, with the top four global cloud service providers (AWS, Azure, GCP, OCI) accounting for a substantial share of purchases. The overall bargaining power of buyers is medium-high, but with structural limits. Microsoft Azure and Amazon AWS, as NVIDIA's top two customers, make enormous annual purchases and possess significant volume-based bargaining advantages. Both companies are also actively developing their own AI chips (Microsoft Maia, AWS Trainium), which, although not yet capable of fully replacing NVIDIA GPUs, provide an "internal option" and "negotiation leverage" to demand more favorable pricing and supply terms. However, buyer bargaining power faces two critical constraints. First, the supply-demand imbalance: amid the AI boom, NVIDIA GPUs have been in chronic shortage, and customers are willing to pay premiums to secure supply, creating an unfavorable bargaining environment for buyers. Second, deep entrenchment with NVIDIA's GPU and CUDA ecosystem: switching to AMD or custom chips would entail not only hardware performance gaps but also massive reinvestment to redevelop or migrate software stacks—prohibitively high switching costs. This lock-in effect prevents customers from easily abandoning NVIDIA for critical training workloads. NVIDIA's buyer management strategy operates on three levels: first, deepening entrenchment with key customers through priority supply and technical collaboration—for example, developing customized H100 variants with AWS and jointly optimizing AI cluster architectures with Azure, raising customer switching costs; second, maintaining product scarcity and technological exclusivity—by managing supply cadence to keep the market in a persistent "demand exceeds supply" state, weakening buyers' price negotiation space; third, expanding the customer base—actively pursuing diverse clients including global small-to-mid-sized cloud providers, AI unicorns, and national AI computing centers to reduce revenue concentration on a few hyperscalers.

Bargaining Power of Suppliers: Extremely High

As a Fabless firm, NVIDIA's AI GPU production is highly dependent on external supply chains, conferring extremely high bargaining power to core suppliers. TSMC is the sole wafer foundry for all of NVIDIA's advanced AI GPUs, utilizing 3nm, 4nm, and 5nm processes. Globally, only TSMC and Samsung can mass-produce at these advanced nodes, and Samsung cannot yet compete with TSMC in yield and capacity, giving TSMC effective monopoly power over NVIDIA's manufacturing. TSMC holds dominant power over pricing, capacity allocation, and delivery schedules—particularly amid surging AI chip demand and insufficient advanced capacity—rendering its bargaining power at its peak. SK Hynix and Micron are the primary suppliers of High Bandwidth Memory (HBM) required for NVIDIA's GPUs. HBM is a critical performance bottleneck for AI GPUs, with extremely high technical barriers and limited supplier numbers. High-speed interface IP (e.g., PCIe, NVLink-related technologies) also depends on a few specialized providers. To address this extremely high supplier bargaining power, NVIDIA's countermeasures include: signing long-term capacity lock-in agreements with TSMC with prepayments to secure priority allocation of advanced capacity; actively cultivating secondary suppliers in secondary segments such as packaging and substrates to diversify supply sources; and strengthening strategic relationships with key suppliers through technical collaboration and joint R&D, transforming pure

transactional relationships into symbiotic partnerships to mitigate unilateral price increases and supply instability.

Synthesizing the Five Forces analysis, NVIDIA's AI GPU business exhibits a highly asymmetric competitive structure. Rivalry among existing competitors is low, the threat of new entrants is low, the threat of substitutes is medium-low, supplier bargaining power is extremely high, and buyer bargaining power is medium-high. Among the five forces, only suppliers and buyers fall into the high-intensity range unfavorable to NVIDIA, while the remaining three forces are at low or medium-low threat levels. This structure implies that NVIDIA's profitability is constrained primarily by supply chain costs and customer concentration rather than intra-industry competitive behavior. NVIDIA's strategic priorities should therefore focus on: continuously reinforcing the CUDA ecosystem to sustain entry barriers; using rapid product iteration to maintain a generational gap over competitors; and managing supply chain and customer relationship risks through long-term contracts and strategic partnerships. The NVIDIA case also illustrates the theoretical significance of "ecosystem lock-in" as a sixth competitive force within the Five Forces framework. The CUDA ecosystem not only strengthens customer stickiness (reducing buyer power) but also creates entry barriers that potential entrants find difficult to surmount, while simultaneously diminishing the attractiveness of substitutes. This ecosystem effect can be viewed as NVIDIA's strategic action to reshape industry competitive structure, fully embodying Porter's (1980) [24] emphasis that "firms are not only acceptors of industry structure but also shapers of it."

AMD Case Analysis

Industry Definition and Market Structure

AMD's core growth momentum derives from its data center product lines, including EPYC series server CPUs and Instinct series AI accelerator GPUs. This dual-product strategy places AMD in two sub-sectors with distinct competitive structures: the server CPU market features a duopoly between Intel and AMD, with AMD's market share exceeding 30%; the AI GPU market, in contrast, features NVIDIA's near-absolute monopoly, with AMD in a significantly trailing second place. This dual-front strategy serves both as AMD's growth engine and as a source of complex competitive pressures. In the CPU arena, AMD continues to erode Intel's market share through EPYC's superior performance and price-performance ratio. In the GPU arena, AMD is striving as a challenger to close the gap with NVIDIA. The competitive dynamics of the two fronts differ markedly, demanding differentiated resource allocation, technological R&D, and marketing strategies from AMD.

Rivalry among Existing Competitors: Extremely High

AMD faces the most intense competitive pressures among the three firms in the data center market, because it simultaneously confronts dominant leaders on two fronts. In the server CPU domain, Intel's Xeon series remains the market leader, leveraging decades of accumulated customer trust, software optimization experience, and brand advantages to defend its market position. However, AMD's EPYC series, with higher core counts, better energy efficiency, and more competitive pricing, continues to gain ground, achieving increasingly broad adoption among cloud service providers and enterprise customers. Competition spans multiple dimensions: process technology (Intel 18A vs. AMD Zen architectures), product specifications (core counts, memory bandwidth, security features), ecosystems (Intel oneAPI vs. AMD ROCm), and pricing strategies. In the AI GPU domain, AMD's Instinct series confronts an even more daunting competitive landscape. NVIDIA holds a commanding market share advantage, a mature CUDA ecosystem, and strong brand recognition, establishing an unassailable leadership position in AI training. Although AMD has launched the MI300X and MI350 series, progressively narrowing the hardware specifications gap with NVIDIA, significant disparities remain in software ecosystem (ROCm vs. CUDA), developer community scale, and market share. More fundamentally, competitive pressure arises from different market growth patterns. The server CPU market has entered a relatively mature stage characterized by share-stealing competition. Each percentage point of market share AMD gains almost invariably comes at Intel's expense—a zero-sum game that inevitably breeds intense rivalry. While the AI GPU market remains in rapid growth, NVIDIA's first-mover advantage and ecosystem lock-in impose high customer switching costs on AMD when pursuing new clients.

Threat of New Entrants: Medium-High

AMD faces potential entry threats from two primary directions. The first is ARM architecture server chip vendors, such as AWS Graviton, Ampere Computing, and Alibaba's Yitian. These firms leverage the ARM architecture to emphasize high energy efficiency, low cost, and cloud-native optimization. They are steadily gaining traction in cloud service providers' internal workloads and beginning to offer external sales, directly challenging the traditional dominance of x86 in the server market. The second is Chinese domestic AI chip vendors, such as Huawei Ascend and Cambricon. Benefiting from Chinese government policy subsidies and procurement support from domestic cloud providers, these firms are gradually replacing imported x86 CPUs and AI accelerators in China's edge computing and IDC server markets. Although they are unlikely to enter global markets in the short term, share erosion in China—the world's second-largest semiconductor market—poses potential risks to AMD's long-term growth. AMD's strategies to build entry barriers include: continuously strengthening EPYC and Instinct hardware-software integration and extending the coverage and maturity of the ROCm open-source software ecosystem to raise customer switching costs; creating product uniqueness through heterogeneous integration (e.g., the MI300X's CPU+GPU+memory integrated design) that ARM architectures and new entrants cannot easily replicate; signing long-term partnership agreements with global cloud providers and system vendors (e.g., Supermicro, HPE) to lock in key customer orders; and continuously accumulating server and AI chip-related patents to build a patent barrier.

Threat of Substitutes: Medium

AMD faces two principal categories of substitutes in the data center market, with a threat level slightly higher than NVIDIA's, because AMD's products are less "indispensable" than NVIDIA's CUDA ecosystem in their respective markets. First, FPGA programmable chips; AMD's acquisition of Xilinx brought FPGA capabilities—both a product diversification move and a defensive response to FPGA substitution threats. In edge computing and low-volume AI inference scenarios, FPGAs can offer

customized acceleration at lower power consumption, partially replacing general-purpose CPUs and GPUs. Second, ASIC custom AI chips; Products such as Google TPU and AWS Trainium, highly optimized for specific AI workloads, exert substitution pressure on general-purpose GPUs (whether NVIDIA or AMD) in cloud inference scenarios. For AMD, this substitution threat is particularly direct: large-scale adoption of custom ASICs by cloud customers would directly reduce the addressable market for Instinct GPUs. AMD's response leverages a distinctive advantage relative to NVIDIA: with the Xilinx FPGA portfolio, AMD can offer hybrid "general-purpose GPU + FPGA" solutions covering a wide range of scenarios from high flexibility to high customization, mitigating the risk of full substitution by any single alternative; opening semi-custom business to help clients develop dedicated accelerators based on AMD architectures, preventing clients from completely abandoning the AMD ecosystem; and continually optimizing Instinct's energy efficiency and per-unit computing cost to close the price-performance gap with ASICs in inference scenarios.

Bargaining Power of Buyers: Medium-High

Customer concentration for AMD's data center products is extremely high, placing buyer bargaining power at a medium-high level, similar to NVIDIA but with AMD in a relatively weaker bargaining position. Google Cloud is one of AMD's major customers, procuring EPYC CPUs and Instinct GPUs in large volumes to build AI infrastructure. Google's enormous procurement scale allows it to solicit bids from Intel, NVIDIA, and AMD simultaneously, granting buyer leverage through diversified sourcing. However, Google's internal TPUs cannot fully replace general-purpose GPUs and CPUs, especially in heterogeneous computing and general workloads where reliance on x86 and GPU suppliers remains necessary—this provides AMD with some bargaining headroom. Supermicro, as one of the world's top three server ODMs, ships large volumes of EPYC-based server systems. Its high-volume procurement affords negotiating leverage, yet its product lines depend heavily on two CPU suppliers—AMD and Intel—and switching costs are relatively high, constraining its bargaining power. Notably, compared with NVIDIA's supply shortages and ecosystem lock-in in AI GPUs, AMD's CPU competition is more intense, and product differentiation is more limited, giving customers greater latitude in negotiations with AMD. This relative weakness in the bargaining landscape constitutes a structural challenge AMD must confront. AMD's counter-strategies include: signing annual volume-based procurement agreements with key customers to secure baseline order volumes and price stability; leveraging priority supply of next-generation products (e.g., MI350) to exchange product uniqueness for long-term customer procurement commitments; providing free ROCm software technical support and on-site engineering optimization services to deepen technical dependence and raise switching costs.

Bargaining Power of Suppliers: Extremely High

As a Fabless firm, AMD faces structural constraints in the advanced process supply chain similar to those confronting NVIDIA, with extremely high supplier bargaining power. TSMC is the sole wafer foundry for AMD's 7nm/4nm/3nm advanced process chips—all EPYC and Instinct series products rely on TSMC capacity. Amid persistent advanced capacity shortages, TSMC controls pricing and delivery schedules, leaving AMD with virtually no alternatives. In the packaging and testing segment, AMD relies heavily on Tongfu Microelectronics (TFME), but the packaging market has more competitors (e.g., ASE, Amkor), allowing AMD some diversification of supply sources; hence, bargaining pressure in packaging is lower than in wafer fabrication. AMD's supply chain management strategies include: signing multi-year capacity agreements with TSMC with prepayments to secure advanced process capacity and reduce exposure to price hikes and shortages; shifting mature process (12nm and above) products to GlobalFoundries (GF) and UMC to diversify supply sources and reduce over-reliance on any single vendor; engaging in capital-level cooperation with packaging giants to stabilize packaging costs and delivery timelines; and aligning with TSMC's Arizona fab production schedule to diversify geopolitical risk exposure.

AMD's data center business exhibits a pattern of full-spectrum pressure across all five forces: rivalry is extremely intense, the threat of new entrants is medium-high, the threat of substitutes is medium, buyer power is medium-high, and supplier power is extremely high. Not one of the five forces fall into the low-threat range, a structural condition that renders AMD's profitability in the data center market more difficult to achieve than NVIDIA's. Notably, in contrast to NVIDIA's absolute dominance in the AI GPU market and Intel's historical dominance in PC processors, AMD occupies a "challenger" position on both fronts: pursuing Intel in server CPUs and pursuing NVIDIA in AI GPUs. While this dual-front pursuit strategy imposes higher competitive pressures, it also offers the strategic benefits of risk diversification and diversified growth drivers. AMD's competitive advantages derive from three levels: technological—product performance and architectural innovation (EPYC's multi-core strength, Instinct's heterogeneous integration); strategic—ecosystem openness and customer collaboration (ROCm open-source strategy, semi-custom services); and operational—supply chain management and long-term contract lock-in. However, to further improve its Five Forces position, AMD must continue investing in software ecosystem development and brand differentiation to close the gap with leaders in ecosystem lock-in effects.

Intel Case Analysis

Industry Definition and Market Structure

Intel's core revenue source is client PC processors (Core series), which accounted for approximately 61% of Intel's total revenue in 2025, representing the company's largest revenue contributor. The PC processor market serves end-products including desktops, notebooks, and thin-and-light devices, with demand influenced by global PC shipments, enterprise refresh cycles, and consumer preferences. The PC processor market has reached a relatively mature stage, characterized by a duopoly between Intel and AMD. The x86 architecture remains the absolute mainstream, with Intel historically maintaining market share leadership; however, since the introduction of the Ryzen series in 2017[22], AMD has steadily expanded its share, approaching 30% of the overall PC processor market. The market growth rate remains persistently low—single-digit or even negative—placing the industry in a typical share-stealing, mature-stage competition. Intel's challenges in the PC processor market extend beyond AMD to include a structural paradigm shift:

ARM architecture processors, originating in the mobile device market, are increasingly penetrating the PC space. Apple's full transition and Qualcomm's aggressive entry signal the erosion of x86's traditional stronghold.

Rivalry among Existing Competitors: Extremely High
Rivalry in the PC processor market is extremely intense and continues to escalate. Competition between Intel and AMD spans product performance, process technology, pricing strategies, ecosystems, and customer relationships across all dimensions. On the product front, Intel's Arrow Lake architecture and AMD's Zen 5 architecture engage in annual head-to-head battles across single-core performance, multi-core performance, power efficiency, and built-in NPU AI compute capabilities. On the process front, Intel is striving to advance from Intel 7 to Intel 18A, attempting to regain process technology leadership over TSMC-manufactured AMD products. On the market front, OEM order battles with major brands (Dell, HP, Lenovo) are fiercely contested, with frequent price promotions and marketing subsidies used to secure customer design-ins. Structural industry factors further exacerbate competition. The PC market exhibits sluggish growth, with overall shipment volumes showing little significant increase, rendering the market clearly zero-sum: every percentage point of market share lost by Intel almost invariably translates to a corresponding gain for AMD. Declining product differentiation also weakens brand loyalty—when benchmark performance is comparable, OEM customers and end consumers gravitate toward lower-priced options, making price wars the norm. Apple's 2020 announcement of a complete transition of its Mac product line to self-developed M-series ARM chips, completed by 2023, not only cost Intel a premium PC customer but also sent a powerful signal to the market that "ARM architecture is capable of high-performance PC computing," with profound psychological and substantive impacts on Intel's ecosystem dominance.

Threat of New Entrants: Medium-High
Intel faces rising threats from new entrants in the PC processor market, primarily from two directions. First, Qualcomm's entry into the Windows notebook market with the Snapdragon X series. The Snapdragon X Elite, built on the ARM architecture, emphasizes low power consumption, long battery life, and AI compute capabilities, with full platform support from Microsoft (Windows on ARM). Qualcomm targets Intel's most core segment—thin-and-light notebooks—aiming at business and consumer users prioritizing mobility and battery life. Unlike earlier failed attempts at ARM-based PC chips, the Snapdragon X series now offers performance competitive with Intel's mid-range processors, and with Microsoft ecosystem support, the threat is more tangible. Second, Chinese domestic RISC-V processor vendors (e.g., Zhaoxin, Phytium), benefiting from government procurement subsidies and domestic substitution policies, are gradually replacing x86 chips in the government and enterprise commercial PC markets. Although the RISC-V ecosystem is still in early development and substitution effects in China are unlikely to spill over to global markets in the short term, they already exert real pressure on Intel's China revenue. Intel's defensive lines to build entry barriers include: equipping the full Core Ultra processor line with high-performance NPU AI engines to aggressively capture the AI PC market opportunity, raising competitive thresholds through new functional dimensions; strengthening the Intel oneAPI software ecosystem to make software investments on the x86 platform less portable to ARM architectures; leveraging proprietary fab high-volume production capacity to lower unit costs and offer competitive pricing to OEM customers; maintaining a decades-accumulated x86 architecture patent portfolio as a legal barrier against new entrants replicating x86 compatibility; and sustaining deep technical collaboration with Microsoft to ensure optimized Windows experiences on x86, preserving consumer usage inertia.

Threat of Substitutes: High
Intel faces the highest substitute threat among the three companies, because the PC market is undergoing a structural shift from x86 to ARM architectures—substitutes not only exist but have already achieved large-scale commercialization. The primary substitute is Apple's self-developed M-series SoCs. Apple's M1/M2/M3/M4 series, based on ARM architecture, significantly outperform comparable Intel products in performance-per-watt, and have been fully deployed across the entire Mac line—MacBook Air, MacBook Pro, iMac, Mac mini, Mac Studio, and Mac Pro. The M-series has not only earned outstanding consumer reputation but also demonstrated exceptional performance in professional scenarios such as video editing, software development, and graphic design, directly displacing Intel in the high-end PC market. Apple's demonstration effect has also encouraged other PC OEMs to explore ARM solutions. A second substitute is cloud-based virtual desktop infrastructure (VDI) paired with ARM terminal devices. In enterprise office scenarios, moving computing workloads to data centers via cloud virtual desktops allows end-users to connect using lightweight ARM devices (such as Chromebooks or tablets). This model fundamentally reduces demand for local high-performance x86 processors, exerting substitution pressure on Intel's low-end and commercial PC markets. Intel's response strategies operate on three levels. At the product level: upgrading Core Ultra series power efficiency and AI compute capabilities, and introducing ultra-low-power U-series processors to compete head-on with ARM solutions in the thin-and-light segment. At the market level: investing in cloud VDI-dedicated chips and edge computing solutions to align with the trend of computing workloads migrating to the cloud, entering the hardware supply chain for cloud PC infrastructure to offset the impact of declining physical PC shipments. At the ecosystem level: sustaining deep collaboration with Microsoft to optimize Windows-on-Intel experiences, ensuring x86 platform compatibility advantages in gaming, professional software, and enterprise applications, widening the real-world usability gap with ARM substitutes.

Bargaining Power of Buyers: High
Intel's PC processor buyers are highly concentrated among a small number of global OEM brands, making buyer bargaining power the highest among the three companies. Lenovo, as the world's largest PC brand, has enormous procurement volumes and sources from both Intel and AMD, allowing it to adjust procurement shares dynamically as a lever to pressure pricing. Although Lenovo cannot completely abandon Intel in the short term—its product portfolio is overwhelmingly x86-based, and enterprise products are deeply reliant on the Intel ecosystem—it can gradually increase AMD-based models as a bargaining chip.

HP, as a top-two global PC brand, faces a similar situation. HP's commercial PC lines (especially enterprise notebooks and workstations) have long been tightly tied to Intel platforms, with deep dependencies on driver stability, management tools (Intel vPro), and enterprise security features. However, consumer PC lines offer greater flexibility, allowing HP to adjust Intel-AMD procurement ratios more freely. Notably, buyer power is also reinforced by end-market pricing pressures. PC brands face intense competition in the end-market with generally low profit margins; these pressures transmit upstream to processor suppliers, subjecting Intel to persistent downward pricing pressure in annual negotiations. Intel's customer management strategies include: signing annual framework procurement agreements with Lenovo and HP, stipulating baseline volumes and product introduction plans, with new product priority or exclusive launches as collaboration incentives; offering customized CPU variants tailored to specific customer product positioning (e.g., low-power derivatives for particular thin-and-light models) to enhance product specificity and customer switching costs; providing free engineering support teams to assist customers with notebook thermal design, power tuning, and performance optimization, deepening technical collaboration stickiness and making it difficult for customers to maintain product competitiveness without Intel's technical backing.

Bargaining Power of Suppliers: Polarized

As an IDM, Intel's supplier bargaining structure differs structurally from that of Fabless NVIDIA and AMD, exhibiting clear polarization. At the advanced process equipment front, ASML is the sole global supplier of EUV (Extreme Ultraviolet) lithography systems. Intel's advanced process (18A, 7A) capacity expansion depends entirely on ASML's equipment delivery schedules and technical support. No alternative global supplier can provide comparable lithography equipment; EUV systems carry extremely high unit prices (exceeding $300 million each) with delivery lead times of two to three years. ASML's bargaining power is extremely high, and Intel has little leverage over equipment pricing, after-sales service, or priority delivery. At the semiconductor materials front, Japanese firms such as JSR, Shin-Etsu Chemical, and Tokyo Ohka Kogyo are primary suppliers of high-end photoresists and electronic chemicals. Although the technological barriers for these materials are high, there are relatively more global suppliers. Intel can manage costs and supply risks through diversified sourcing, long-term contracts, and inventory stocking; materials suppliers' bargaining power is moderate. Unlike Fabless firms, Intel's supply chain management also involves internal manufacturing capacity decisions. Intel can choose to produce at its own fabs or outsource certain products to foundries such as TSMC. This "internal option" to some extent enhances its bargaining position relative to equipment and materials suppliers. Intel's supply chain security mechanisms include: signing multi-year long-term purchase agreements with ASML with prepayments to secure priority EUV tool allocations, supporting fab expansion plans in Ohio and Arizona; developing multiple backup supply sources in Japan, South Korea, and Europe for critical chemicals to avoid single-supplier disruption risks; and investing in advanced packaging technologies and alternative lithography technologies (e.g., High-NA EUV, direct-write electron beam) through independent R&D, with a long-term goal of reducing structural dependence on any single upstream equipment or materials supplier.

Intel's PC processor business confronts the most severe Five Forces configuration among the three firms: rivalry among existing competitors is extremely high, the threat of new entrants is medium-high and rising, the threat of substitutes is high, buyer bargaining power is high, and supplier bargaining power is polarized (extremely high for equipment, moderate for materials). Compared with NVIDIA (where only suppliers and buyers are high-intensity) and AMD (where all forces exert pressure but with some strategic room), Intel's Five Forces structure is the most unfavorable. Intel's sources of competitive advantage differ fundamentally from the other two. As an IDM, Intel possesses proprietary fab capacity autonomy and cost control, free from foundry capacity allocation and pricing constraints—a unique advantage over NVIDIA and AMD. The x86 patent fortress and decades of accumulated Windows ecosystem entrenchment form intangible barriers difficult for new entrants and substitutes to cross. Long-standing relationships and technical support systems with global tier-1 OEM brands provide a stable foundation at the customer relationship level. However, Intel's IDM model also imposes structural burdens that Fabless firms avoid: massive fab capital expenditures, extreme pricing pressure from advanced equipment suppliers, and the direct impact of capacity utilization fluctuations on profitability. Against the backdrop of PC market maturation and rising ARM substitution threats, Intel's strategic challenge extends beyond product technology catch-up to fundamental business model transformation: how to sustain IDM advantages while successfully entering the foundry market to fully utilize capacity, and finding new growth engines in the AI accelerator space.

Discussion

The core product markets of the three firms exhibit significant differences in their Five Forces structures, which are systematically compared below. First, Rivalry among Existing Competitors: NVIDIA's AI GPU market features the lowest competitive intensity, owing to its absolute technological and ecosystem leadership, rapid market growth, and the strong lock-in effects of the CUDA ecosystem. AMD and Intel, in contrast, face powerful direct competitors in their respective markets, with market growth slowing (PC) or approaching zero-sum competition (server CPUs), making competitive intensity significantly higher than NVIDIA's. This disparity illustrates the critical role of technological leadership and ecosystem lock-in in mitigating competitive pressures from incumbents. Second, Threat of New Entrants: All three companies face potential entrants from ARM architectures (AMD and Intel) or cloud vendor custom chips (NVIDIA and AMD). NVIDIA faces the lowest threat because CUDA ecosystem entry barriers are higher than x86 patent protections or the ROCm ecosystem. AMD and Intel face similar threat levels but from somewhat different sources: AMD primarily from ARM server chips and Chinese domestic AI chips; Intel primarily from ARM PC chips (Qualcomm) and Chinese domestic processors. Third, Threat of Substitutes: Intel faces significantly higher substitute threats than NVIDIA and AMD, because Apple's M-series has achieved large-scale commercialization and market recognition, while cloud VDI models are also gaining traction. NVIDIA and AMD's substitutes (ASICs, FPGAs) are technologically feasible but

cannot yet effectively replace general-purpose GPUs in core scenarios such as AI training. Forth, Bargaining Power of Buyers: Intel faces the greatest buyer bargaining pressure, reflecting the high concentration of PC OEM markets and the thin margins of PC brands. Although NVIDIA and AMD's cloud customers also possess strong bargaining power, NVIDIA's supply shortages and ecosystem lock-in partially offset buyer advantages. Fifth, Bargaining Power of Suppliers: All three firms face extremely high supplier bargaining pressures in the advanced process/equipment segment. NVIDIA and AMD, as Fabless firms, depend heavily on TSMC's exclusive advanced capacity; Intel, as an IDM, depends heavily on ASML's exclusive EUV equipment. This common structural feature reflects the deep asymmetry of the semiconductor supply chain.

Differences in the Five Forces configurations of the three firms partly derive from their distinct business models. NVIDIA's Fabless-plus-ecosystem model enables concentration of capital on R&D and ecosystem development, using CUDA's software lock-in to create "virtual vertical integration": while lacking its own fabs, the ecosystem grants control over customer switching costs and market access decisions. This model has demonstrated extremely high leverage during the rapid growth phase of the AI GPU market. AMD similarly adopts a Fabless model, but its simultaneous two-front CPU and GPU competition disperses R&D resources, and its ecosystem investment is less concentrated than NVIDIA's, resulting in a challenger position on both fronts. However, AMD's dual-product strategy also offers risk diversification and cross-selling opportunities: EPYC CPU customers can be cross-sold Instinct GPUs, providing a degree of portfolio advantage. Intel's IDM model faces greater challenges in the mature PC processor market. The massive capital expenditures of proprietary fabs constitute a heavy fixed-cost burden when market growth slows, while process technology lag (relative to TSMC) further places it at a disadvantage in product performance competition. However, the IDM model also offers Intel unique advantages in capacity flexibility, cost control, and supply chain resilience—advantages that may gain renewed market appreciation in an era of increasing global supply chain uncertainty.

Conclusions

Using Porter's Five Forces model as its theoretical framework, this study conducted a systematic comparative case analysis of the core product markets of three semiconductor leaders—NVIDIA, AMD, and Intel—integrating market positioning, business models, ecosystem strategies, and external environmental factors to dissect differences in competitive structure and profitability logic. The main conclusions are summarized as follows: First, differences in Five Forces configurations directly determine profitability divergence; the three firms operate in distinct sub-sector competitive environments. Although all belong to the global semiconductor industry, their sub-sector attributes produce significantly different Five Forces structures: NVIDIA, with its focus on the AI GPU segment, enjoys the most favorable overall structure—only upstream suppliers and downstream buyers exhibit high bargaining power, while rivalry, new entrants, and substitutes remain low—offering the industry's highest profit potential, with superior returns supported by robust structural foundations. AMD, with its dual CPU and GPU portfolio, faces full-spectrum pressure across all five forces in core data center markets, occupying a challenger position in both arenas, resulting in the most pronounced overall competitive pressures. Intel, centered on the PC processor market, faces dual pressures from substitute technologies and downstream buyer bargaining, compounded by operational model weaknesses, yielding the most unfavorable Five Forces structure and squeezed profitability. Second, ecosystem maturity has become a source of competitive advantage surpassing the traditional Five Forces model and a key variable determining the favorability of firms' Five Forces positions. Compared with hardware performance, hardware-software integrated ecosystems have become the core competitive moat in high-end semiconductor segments: NVIDIA's CUDA ecosystem, through software lock-in, significantly raises customer switching costs, elevates entry barriers, and weakens substitute threats, essentially optimizing its Five Forces position. AMD's dual-product strategy, while diversifying single-segment risk, disperses ecosystem-building resources, making it difficult to create a proprietary ecosystem with monopolistic characteristics. Intel, with a long-term emphasis on manufacturing capacity, possesses relatively weaker software ecosystem integration capabilities, unable to rely on ecosystems to mitigate external competition and substitution threats, further amplifying its competitive disadvantages. Third, the two mainstream business models—Fabless and IDM—each have advantages and disadvantages; neither is universally superior, and both are subject to industry supply chain structural constraints. NVIDIA and AMD's Fabless asset-light model avoids massive fixed capital expenditures for wafer fabs and process equipment, allowing concentration on chip design and advanced R&D, but creates high dependence on TSMC and other advanced process foundries, with limited supply chain autonomy. Intel's IDM asset-heavy model provides capacity autonomy and supply stability, but entails sustained high investment pressures for EUV equipment procurement, fab upgrades, and process advancement, with lower capital turnover efficiency. Simultaneously, the semiconductor industry exhibits a stable structural feature of high supplier bargaining power: advanced process foundries, EUV lithography equipment, HBM, and other upstream segments are highly monopolized. Whether Fabless or IDM, firms cannot escape upstream supply chain bargaining constraints; supply chain control capability has become a critical strategic factor affecting profitability and long-term sustainability. Fourth, global semiconductor industry competition is undergoing a generational shift; AI technology and ecosystem integration will dominate future competitive landscapes. As AI deployment expands across all industries, the traditional competition model focused on single-chip hardware performance is gradually weakening. Future competition will shift toward comprehensive capabilities in hardware-software co-optimization, closed-loop ecosystem development, and global supply chain resource control. The ability to execute AI technology deployment, build high-stickiness industrial ecosystems, and secure upstream core resources will be central to widening competitive gaps and reshaping industry rankings among the three firms.

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