



# Layered CHIPS Instruments and Firm Response: Evidence from Micron's High Bandwidth Memory Investment Program

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**Abstract.** This article examines how the United States' layered industrial policies—the Chip Manufacturing and Manufacturing Information System (CHIPS) incentive, Section 48D Advanced Manufacturing Investment Credit, and New York State's performance-based program—influenced Micron's investment in high-bandwidth memory (HBM). The study assesses attachment, conditionality, and governance mechanisms by tracking the flow of key disclosures (2022–2025). Evidence suggests that these policy instruments reinforce each other: CHIPS anchors location and timing; Section 48D enhances after-tax returns; and New York State adds milestone projects and community benefit obligations backed by state capacity. Governance mechanisms—milestone project expenditures, recaptures, and foreign entity guardrails—redistribute bargaining power, curb subsidy leakage, and shift execution risk toward on-time delivery. Policy effects are expected to propagate through system bottlenecks, expand domestic HBM supply, and pave the way for advanced packaging readiness, although capacity remains a limiting factor. Remaining risks relate to execution capacity, workforce, and policy durability.

**Keywords:** CHIPS Act, Advanced Manufacturing Investment Credit, High-Bandwidth Memory, Industrial Policy, Subsidy Conditionality.

## 1 Introduction

High-bandwidth memory (HBM) has become a performance and cost bottleneck for AI accelerators and data center systems. To address this, the United States has developed a layered policy toolkit, including milestone-based direct CHIPS funding, a 25% Advanced Manufacturing Investment Credit (AMIC) under Section 48D of the Internal Revenue Code, and state performance-based programs. Micron provides a timely example: its HBM3E platform is scheduled for mass production and shipment in 2024, alongside NVIDIA's H200 GPU, establishing a clear path from policy design to market success.

The importance of examining this case is threefold. First, HBM capacity and yield now constrain the pace and cost of AI deployment, making supply security a national competitiveness issue. Second, the CHIPS Program Office (CPO) has instituted a rules-based award process—LOI → (recommended) Pre-Application → Formal Application → Due Diligence → Award/Disbursement—with milestone installments, workforce and community-investment commitments, and a requirement to coordinate “covered incentives” from states and localities. Third, most projects are expected to combine direct funding with §48D credits and state packages, raising questions about how instruments interact, how conditions and governance shift risk–return profiles, and how much additional private investment is mobilized.

This study aims to trace how federal and state government mechanisms influence firm location, timing, and scalability decisions in strategic bottleneck technology areas and assess whether additional conditions and governance (e.g., reacquisition, milestones, and workforce/community provisions) can improve supply security and readiness for advanced packaging. Drawing on primary government and firm disclosures, the study employs a process-tracing approach to construct micro-level evidence on mechanisms and outcomes. The study contributes by linking project-level contract details to agency-level policy design and providing the operational metrics needed for evaluation.

#### Research Questions

RQ1. How do federal and state instruments jointly affect Micron’s location, timing, and scale decisions?

RQ2. How do conditionality and governance (recapture, milestone disbursement, workforce/community provisions) reshape risk–return profiles?

RQ3. Do layered incentives materially improve U.S. HBM supply security and readiness for advanced packaging?

## 2 Policy Landscape and Instruments

The CHIPS Act introduces the Section 48D investment tax credit for advanced manufacturing facilities primarily engaged in the production of semiconductors or semiconductor manufacturing equipment. The credit is equal to 25% of the qualifying investment basis for the taxable year. Qualifying property must be depreciable or amortizable, directly related to production and not used for office purposes, and placed in service after December 31, 2022.

Clawback and National Security Guardrails. The final rule establishes a 10-year clawback mechanism triggered by “applicable transactions”: if a taxpayer significantly expands into China or other countries of concern, the credit will be clawed back under Section 50. The definition of “foreign entity of concern (FEOC)” is consistent with the U.S. Department of Commerce’s national security guardrails [1].

Monetization. Section 48D allows for optional/direct payment and transfer: an eligible entity can treat the credit as tax at the time of filing and receive a refund, or transfer the credit to a third party in exchange for cash [1].

**Reconciliation with CHIPS Direct Grants.** The Treasury Department has clarified that capital expenditures incurred under a CHIPS incentive agreement with Commerce do not lose their status as “qualified investments” under Section 48D as a result of the agreement, and such agreements do not constitute long-term contracts under Section 460. Finally, Section 48D rules are reconciled with Commerce’s national security guardrails to avoid conflicts between incentive and security objectives.

The Green Chip Community Investment Fund (CIF) has been established around Micron's Superfab in Syracuse, New York (CNY). The fund, totaling \$500 million and to be invested over 20 years, will be funded by Micron \$250 million and the State of New York \$100 million, with the remainder coming from a variety of public and private sources. These funds will primarily be used for workforce development, education, community programs, and housing. The State has also established a Community Engagement Committee to ensure transparent, community-driven governance and prudent resource allocation [2, 3].

Most importantly, state-level “covered incentives” are a statutory prerequisite for federal CHIPS funding, thereby establishing a sequential and structural link whereby state/local commitments first anchor the program, and the federal government then evaluates and prices it accordingly.

**National security guardrails.** In September 2023, the U.S. Department of Commerce issued a final rule prohibiting funded entities from substantially expanding in “countries of concern” for ten years. Violations of capacity/technology guardrails will result in full forfeiture of funding. A December 2023 revision further clarified that greenfield construction also falls within this scope.

**Payment rules and performance tracking.** The CPO ties funding to milestones such as construction, process qualification, production output, and commercialization, and monitors performance through financial and project reports. Micron's official award announcement also emphasizes milestone-based installment payments.

**Workforce Plans and Wrap-Round Services.** The NOFO requires separate workforce plans for the construction and operations phases, and includes “wrap-around services” (including education, transportation, housing, and emergency cash assistance) as a scoring criterion. This reflects the policy expectation that work-life factors will support increased production. It also reflects the public's high level of concern about education requirements: multiple organizations stated that applicants for direct funding exceeding \$150 million must submit an affordable, high-quality education plan.

**Capital structure and cash flow.** Based on the CPO's projected 5-15% direct funding and 25% §48D credit mix, Micron's large DRAM/HBM projects can utilize milestone-based installments. Combined with the direct disbursement and transferability of the credit, this creates a cycle of “upfront capital expenditure → cash flow replenishment → subsequent reinvestment.” This will significantly alleviate the liquidity and capital cost pressures associated with large-scale, multi-year capital expenditures.

**Improved workforce and production capacity.** NOFO's workforce and education requirements closely integrate recruitment, training, and retention with community and housing infrastructure, thereby increasing the availability and stability of the workforce during construction and ramp-up. With investments in communities and housing under

the New York State Green CHIPS program, regional workforce and housing constraints will be further alleviated.

Compliance boundaries and spillover effects. The Commerce Department's guardrail measures, along with Section 48D of the Equal Employment Opportunity Act and its clawback clause, together constitute a comprehensive constraint between industrial policy and national security. For Micron, any capacity expansion or greenfield project in a "country of concern" must assess the risk of clawback of federal grants and tax credits, thereby strengthening the position of domestic US factories (Idaho/New York) as the leading node in its investment path.

### 3 Case Context: Micron's U.S. HBM Build-out

Micron Technology will begin mass production of its 24GB, 8-bit high-density HBM3E in early 2024 and has confirmed that the device will begin shipping with NVIDIA H200 Tensor Core GPUs in the second quarter of 2024. Micron's announcement highlights a 30% reduction in power consumption compared to competing HBM3E products, positioning the device as a tool to reduce data center operating costs amid an industry-wide HBM shortage. Public product materials released at the same time indicate that sampling of 36GB, 12-bit high-density HBM3E is on the roadmap, highlighting the path to capacity expansion per stack associated with future accelerator SKUs [4].

High-bandwidth memory (HBM) is a 3D stacked DRAM layered on a silicon interposer, adjacent to the GPU/accelerator and connected via through-silicon vias (TSVs). This topology offers orders of magnitude higher total bandwidth and lower power per bit than on-board memory, which is why modern AI systems pair accelerators with multiple HBM stacks. HBM3E represents the latest performance tier, increasing per-stack bandwidth and available capacity while constraining power budgets. In practice, HBM3E has become a system-level bottleneck: (i) limited DRAM chip production and TSV stacking capacity, (ii) constrained interposer/ABF substrate supply, and (iii) scarce advanced packaging production lines (e.g., CoWoS-level), which extend lead times and constrain capacity. These frictions mean that accelerator shipments are often "HBM-limited," shifting bargaining power to memory and OSAT suppliers and driving public policy focus on packaging pilots, labor, and localized supply chains.

On December 10, 2024, the U.S. Department of Commerce (CHIPS for America/NIST) finalized \$6.165 billion in direct federal funding for Micron projects in Idaho and New York [5]. The agency's materials describe a new memory fab in Idaho and two new fabs in New York, projected to create approximately 20,000 jobs by 2030. Micron plans to invest approximately \$50 billion in initial construction (Phase 1), which involves installing the first batch of precisely replicated modules, site infrastructure, and tools by approximately 2030. The New York campus, located in Clay (Onondaga County), will adopt a "Gigafactory" model: a multi-module, scalable campus with standardized factory modules that can be replicated over time. Micron and New York previously outlined a 20-year, \$100 billion investment plan, with approximately \$20 billion in Phase 1 spending through 2030. State documents and the Governor's com-

munications on the draft Environmental Impact Statement (DEIS) indicate the Administration's momentum on utilities, housing, and workforce planning is aligned with federal milestones and the Section 48D deployment window [6].

In addition to the Idaho/New York package, the U.S. Department of Commerce also tentatively finalized approximately \$275 million in CHIPS funding in December 2024 for the expansion/modernization of Micron's facility in Manassas, Virginia. In June 2025, Micron and federal agencies reported that the \$275 million in funding had been finalized as part of its broader expansion plans in the United States; local government communications clarified that the Virginia grant would support Micron's domestic production of 1-alpha DRAM chips and related capacity upgrades starting in 2025. Independent news reports the same day confirmed the finalization of the Virginia grant and its connection to Micron's plans to expand in the United States [7, 8].

On June 12, 2025, Micron and the U.S. government announced an expanded U.S. investment plan totaling approximately \$200 billion, encompassing Idaho, New York, and Virginia—a plan designed to restore "full coverage" of domestic memory manufacturing and R&D. That same day, a federal communication reiterated the \$6.165 billion in funding through December 2024, highlighting a \$275 million allocation to Virginia[8]. Micron's investor relations press release outlined the geographic footprint and strategic intent (HBM leadership, DRAM scale-up, and R&D center co-location). Trade and policy media outlets summarized the latest developments and noted Micron's cadence of disclosures (including a securities filing the same week regarding the Virginia contract).

Viewed through our framework, the June 2025 package operationalizes the paper's three questions. First (RQ1), the pairing of federal grants with state allocations and site-prep actions pins down New York/Idaho/Virginia as priority nodes and advances the Phase-1 schedule and scale. Second (RQ2), the use of milestones, recapture language, and co-location for R&D and workforce investments shifts execution risk away from the public balance sheet while preserving upside for timely delivery. Third (RQ3), this layered design, tied to 48D deployment windows, explicitly targets the HBM supply chain and advanced-packaging throughput, aiming to ease the system-level bottleneck that gates accelerator output.

## 4 Findings

Micron's HBM construction in the United States is supported by a complementary, multi-tool financing system. First, direct federal funding of up to \$6.165 billion (finalized on December 10, 2024) for projects in Idaho and New York reduces upfront capital intensity and aligns cash flow with proven progress through payments based on construction/production milestones. Simultaneously, the Section 48D Advanced Manufacturing Investment Credit (AMIC) provides a credit equal to 25% of the qualifying investment in advanced semiconductor manufacturing facilities. Guidance from the U.S. Treasury and IRS further supports optional payments ("direct payments") and transferability, thereby increasing the monetization of large, equipment-intensive sites during

early capacity ramp-up [4,5]. On the state side, New York's performance-based program is complemented by the \$500 million Green CHIPS Community Investment Fund (CIF), a 20-year fund with explicit allocations from Micron, New York State, and other partners designed to internalize local benefits and enhance political and economic sustainability (focused on workforce, education, community investment, and housing) [1, 5, 9, 10].

Overall, this tiered structure—milestone-based grants, a monetizable 25% investment credit, and state/community instruments conditional on performance—reduces financing risk and supports parallelization of sites and phases across Idaho and New York, increasing the likelihood of on-time delivery and enhancing the credibility of the multi-decade scale-up plan.

The governance framework embeds enforceable conditions at both the federal and state levels. At the federal level, the Section 48D final rule established a special 10-year credit recovery regime, coordinated with the Foreign Entities of Concern (FEOC) guardrail regime, with tangible consequences for prohibited expansion, thereby aligning incentives with national security objectives; technical amendments issued in November 2024 refined these provisions [11]. CHIPS direct funding is disbursed in milestone installments, and performance is tracked through project and financial reporting according to the terms of the award, mitigating the risks of overpayments and non-performance common in large industrial subsidies. At the state level, New York State's Community Investment Fund (CIF) formalizes measurable commitments to workforce development, education, housing, and community assets, and is co-funded and managed by communities over a two-decade period, thereby strengthening lasting local co-benefits and community engagement (through regional engagement committees).

Taken together, these conditions and oversight mechanisms—federal recapture/FEOC limits, milestone-based payments, and CIF-anchored community obligations—directly address classic subsidy traps (overpayment, non-performance, weak public returns) and strengthen the credibility of the policy stack as a tool for attracting private capital at scale.

## 5 Discussion

Tiered federal and state incentives appear poised to compress capacity realization timelines, thereby boosting the domestic supply of high-density memory (HBM) in the United States during a period of global supply constraints. Beyond front-end fabs, US policy has begun addressing advanced packaging, a common system bottleneck, through the Chip Manufacturing System (CHIPS) National Advanced Packaging Manufacturing Program (NAPMP) and its associated awards. The NAPMP is not a single-company subsidy, but rather a combined R&D and pilot program. Competitive awards cover equipment/tool and process integration, power/thermal, interconnect (including photonics/RF), chipsets, and co-design/EDA. Successful processes are then transitioned to production through subsequent prototyping. Simultaneously, a co-located advanced packaging pilot facility provides shared production lines for validating new processes and training employees. By January 2025, the US Department of Commerce had

finalized \$1.4 billion to promote the establishment of a self-sufficient domestic packaging ecosystem, complementing previous program guidance projecting approximately \$3 billion in investment in this area. Meanwhile, state and local processes surrounding Micron's New York facility are also progressing. The draft Environmental Impact Statement (DEIS) for the facility, under the National Environmental Policy Act (NEPA)/Sequential Effects and Reproduction Act (SEQRA), was released in mid-2025, demonstrating the government's commitment to aligning utility, housing, and workforce development with phased construction.

Despite these measures, advanced packaging capacity remains a strategic dependency. Industry tracking shows that TSMC's CoWoS-level capacity roughly doubled in 2024 and is expected to reach approximately 75,000 wafers per month by 2025, but demand continues to outstrip supply—highlighting the need for pilot lines and supplier localization in the United States to convert new HBM wafer output into delivered accelerator modules. On the governance front, New York State combined the National Environmental Policy Act (NEPA)/Sequencing Authorization and Authorization Act (SEQRA) with synchronized planning (coordinated scoping, parallel multi-agency review, and a milestone calendar clearly tied to the federal CHIPS program), reducing timeline uncertainty and integrating utility, housing, and workforce actions with phased construction. In terms of industrial footprint, domestic initiatives—notably Amkor's U.S. Advanced Packaging fab in Arizona, which launched with federal incentives and is set to scale up in 2025—have policy implications beyond a single fab: They localize OSAT capabilities, increase interposer/substrate throughput, spread geopolitical risk, and provide a domestic ramp-up path for NAPMP output, thereby enhancing multi-year back-end resiliency.

If implemented as planned, onshore HBM capacity will reduce logistical risks, improve forecast visibility for long-lead tools and materials, and enhance the bargaining power of US AI system manufacturers, who currently face allocation friction. Micron's CHIPS project awards to Idaho and New York on December 10, 2024, using a milestone grant structure, signal federal commitment, and mitigate the risk of cross-regional parallelization. Combined with state government tools such as New York's Green CHIPS and CIF, the program can maintain local co-benefits, thereby strengthening community support and enhancing the project's durability throughout political cycles.

Execution risks persist and manifest themselves in three key areas. Financial risks include cost inflation and multi-site construction lead times, which could erode budgets and delay equipment migration. Labor risks stem from tight labor markets in construction and fab operations; New York State's CIF participation framework (workforce, education, housing) partially mitigates talent pipeline and retention gaps. Institutional/governance risks are managed through policy design: the 10-year recapture regime, FEOC guardrails, and milestone-based spending in the Section 48D final rule shift bargaining power and execution risk toward on-time delivery—public funds are disbursed in phases, and missed commitments trigger clawbacks (RQ2). Finally, advanced packaging remains a potential rate limiter: even as front-end HBM scales, CoWoS-class capacity must be scaled domestically (through the National Accelerator Program Management (NAPMP) and incentive-supported US OSAT capacity) to transform wafers into shipped accelerator modules and enhance system security (RQ3).

## 6 Conclusion

Micron's HBM project demonstrates that a layered system of industrial policies—milestone-based CHIPS grants, monetizable §48D investment credits, and performance-based government tools and long-term community co-financing—can significantly reduce financing risks, accelerate site selection and construction, and improve the security of supply of technologies core to AI system performance. Evidence shows that these policies have significant additive capacity (new and accelerated capacity in the United States), strong conditionalities (labor, education, housing, and emissions commitments tied to funding), reliable governance (milestone spending, recapture, and FEOC guardrails), and are already showing initial spillover effects to packaging, suppliers, and regional talent pipelines.

Meanwhile, the conversion of wafer capacity into delivered accelerator modules remains dependent on advanced packaging capacity and the depth of domestic OSAT (foundry assembly and test) capabilities. Execution risks—multi-site concurrency, rising costs, and labor shortages—as well as the risk of policy persistence across election cycles, continue to be rate-limiting factors. Federal rebates and milestone gating mechanisms mitigate these risks to some extent, but require ongoing compliance management and closer coordination among federal, state, and local agencies.

From a policy perspective, the case supports promoting a "bottleneck-oriented" model: combining grants with Section 48D monetization to stabilize project cash flows; embedding CIF-like community funds to ensure social license and talent; and establishing guardrails to align public support with onshore project outcomes. To lock in system-level benefits, priorities should include maintaining advanced packaging projects, synchronizing environmental review/utility/housing timelines with federal milestones, and publishing transparent progress indicators.

Overall, tiered instruments with enforceable conditions appear more credible and effective than single-instrument subsidies in attracting ultra-long-term private investment. If this approach can be sustained and replicated in adjacent bottleneck areas, the United States will be closer to achieving lasting leadership in critical AI memory and its complementary ecosystem. Nonetheless, this single-case, document-based study relies on public disclosures and short-run implementation records; as such, it cannot directly observe firm counterfactuals or establish causal effects beyond process-tracing inference. Future research could combine microdata on milestone expenditures, workforce and housing outcomes, and advanced-packaging throughput with matched nonrecipient sites to estimate system-level impacts and quantify the HBM-packaging bottleneck more precisely.

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