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The Economics of the Bomb: Costs, Maintenance, and the Political Economy of Nuclear Forces

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Introduction

Nuclear forces are often discussed in the language of strategy, credibility, and national survival. Less frequently are they discussed as balance sheets, contract portfolios, and long-term obligations that compete with every other public priority. The Economics of the Bomb argues that budgets do more than fund strategy—they shape it. By examining the lifecycle costs of nuclear forces, the incentives that guide procurement, and the trade-offs inherent in maintaining arsenals, this book seeks to illuminate the financial architecture behind deterrence and to assess its long-run sustainability.

The costs of nuclear forces are not a single line item; they are an ecosystem. Research and development, test infrastructure, and early design choices set paths that can lock in expenses for decades. Procurement introduces schedule risk, cost growth, and industrial bottlenecks. Operations and sustainment bring recurring obligations for personnel, training, maintenance, and nuclear command, control, and communications. At the end of life, decommissioning, dismantlement, and environmental remediation impose their own bills. Taken together, these phases form a continuum of commitments that any realistic debate about force structure must recognize.

Money and politics are inseparable in this arena. The defense-industrial base consists of prime contractors, dense networks of suppliers, specialized labor, and uniquely stringent regulatory regimes. Production lines are geographically distributed, creating constituencies invested in continuity. Procurement systems, contract types, and oversight mechanisms create incentives that can either reward efficiency and resilience or entrench delay and cost growth. Understanding these dynamics is essential to explaining why some programs flourish while others falter—and why budgets rarely behave like neutral reflections of strategic doctrine.

Every dollar spent on nuclear forces has an opportunity cost. Governments juggle competing needs—conventional defense, public health, education, infrastructure, climate resilience—and face demographic and fiscal pressures that sharpen the trade-offs. This book evaluates those trade-offs explicitly, not to prescribe a single “right” answer, but to render the choices transparent. It assesses how different force postures and modernization pathways affect debt trajectories, intergenerational equity, and the flexibility to respond to non-military shocks.

Methodologically, the chapters combine economic reasoning with institutional analysis. They map cost drivers across the nuclear enterprise, survey procurement systems and their incentive structures, and examine how budget politics and transparency norms influence outcomes. The approach is comparative where useful,

drawing lessons from allied and rival arsenals to provide benchmarks while acknowledging differences in missions, legal frameworks, and industrial capacity. Throughout, the goal is to translate technical debates into clear economic propositions and measurable trade-offs.

The audience for this work includes policymakers who must adjudicate among competing budget claims, economists who scrutinize public investment and risk, and watchdogs focused on accountability and transparency. Their shared need is a coherent framework: one that connects strategic aims to programmatic costs, highlights where uncertainty and bias enter estimates, and identifies levers—contracting choices, governance reforms, and sequencing decisions—that materially alter outcomes. By making those connections explicit, the book aims to elevate debate from slogans to scenarios.

The chapters are organized to move from foundations to decisions. Early chapters define cost concepts and map the nuclear enterprise. Mid-book analyses unpack procurement, industrial base dynamics, sustainment, warhead stewardship, and the economics of command-and-control. Later chapters examine opportunity costs, budget politics, arms control, environmental liabilities, regional economic effects, and reform options. The closing chapters present forward-looking scenarios and decision frameworks to help readers evaluate sustainable postures under uncertainty.

Ultimately, *The Economics of the Bomb* is about stewardship. Deterrence requires credibility, but credibility purchased without regard to cost, risk, and transparency can erode the very political consensus it depends on. By aligning strategic objectives with realistic budgets, resilient industrial capacity, and honest accounting of trade-offs, societies can make choices that are both strategically sound and fiscally responsible. This book offers the tools to do so.

CHAPTER ONE: Counting the Cost: Why Nuclear Budgets Matter

Nuclear arsenals are often discussed in terms of megatonnage, missile ranges, and targeting doctrine. Yet they are first and foremost commitments of money over time. The phrase “counting the cost” is not merely metaphorical; it captures a practical reality. Each leg of a nuclear triad—submarines, land-based missiles, and bombers—embodies decades of engineering choices, production schedules, and sustainment obligations. Every warhead type entails laboratory design work, manufacturing, surveillance, and eventual dismantlement. Command, control, and communications systems demand constant upgrades to remain resilient against cyber and electronic threats. In short, deterrence is not a one-time purchase but a long-term portfolio of investments, each with its own lifecycle and set of uncertainties.

Understanding why nuclear budgets matter begins with recognizing their persistence. Once a program is launched, it typically generates cost streams for thirty, forty, or even fifty years. The decision to build a new class of ballistic missile submarines, for instance, locks in funding for design, construction, and operation well into the 2060s. Such commitments shape the rest of the defense budget, crowding out flexibility to respond to unforeseen challenges. They also affect non-defense spending, since deficits must be financed and taxes set accordingly. In practical terms, a nuclear program is less a line item than a fiscal mortgage taken out against future budgets.

A second reason to focus on budgets is their influence on strategy itself. Doctrine written on paper can be implemented only if appropriations are available to build, train, and maintain forces capable of executing it. If Congress or the executive branch is unwilling to fund a particular leg of the triad, strategic planning may pivot to alternatives—sometimes more credible, sometimes less. Conversely, budgetary inertia can keep legacy systems in service long after their strategic rationale has faded. In other words, dollars have a way of shaping force structure, not just funding it. The map of deterrence is thus drawn as much in spreadsheets as in war plans.

The costs of nuclear forces are often perceived as opaque, shrouded in classification and complexity. There is some truth to this: sensitive details about warhead design and certain operational capabilities are restricted. Yet the broad cost categories—development, procurement, operations, sustainment, and retirement—are public in most democracies. Budget documents, oversight reports, and audit findings provide substantial material for analysis. While secrecy can mask the fine print, the financial contours are visible enough to evaluate trade-offs, compare programs, and identify trends. The challenge is less about access than about synthesis: knitting

together disparate data into a coherent picture of the total cost of ownership.

Budgets matter for accountability. When programs experience cost growth, schedule delays, or performance shortfalls, the implications extend beyond engineering. They affect credibility, both domestic and international. Large overruns can fuel skepticism about the value of nuclear forces and erode political support for modernization. Poor oversight can allow inefficiencies to persist, wasting resources that might otherwise strengthen conventional forces or other public priorities. Transparent accounting and rigorous audits are therefore not bureaucratic niceties but essential elements of deterrence. A credible arsenal requires a credible budgeting process.

Opportunity cost is a core concept in economics and an unavoidable reality in defense planning. Every dollar devoted to nuclear forces is a dollar that cannot be spent on healthcare, education, infrastructure, or climate resilience. Recognizing this trade-off is not a statement about priorities; it is a description of scarcity. Policymakers must balance competing needs, and the balance they strike will influence both national security and social welfare. By making the opportunity costs explicit, budgets illuminate the true price of deterrence and enable more informed decisions about what to fund and what to defer.

The politics of nuclear budgets are complex. In the United States, the Department of Defense, the Department of Energy's National Nuclear Security Administration, and Congress each play significant roles. Committees with jurisdiction over authorization and appropriations shape the size and composition of funding. Constituencies tied to production sites and bases press for continuity. Allies and partners are affected by procurement decisions, particularly when interoperability or technology sharing is involved. The resulting negotiation is as much about incentives and coalitions as it is about strategy. Budgets are thus a lens through which the political economy of nuclear forces becomes visible.

International comparisons provide useful benchmarks but must be approached with caution. The United States, Russia, and China maintain large arsenals with different organizational structures, industrial capacities, and strategic concepts. United Kingdom and French programs emphasize sea-based deterrents with distinct procurement and stewardship models. India, Pakistan, and North Korea confront unique fiscal constraints and security environments. Israel's posture is typically opaque. Each case offers lessons in cost management, program execution, and the interplay between doctrine and dollars, but direct comparisons are complicated by differing accounting practices, classification levels, and strategic assumptions.

Cost estimation is itself an exercise fraught with uncertainty. Long development timelines, evolving threats, and technological surprises introduce variables that are difficult to quantify. Learning curves can drive costs down as production scales, but supply chain disruptions can reverse that trend. Inflation, wage pressures, and

changes in regulatory requirements add layers of complexity. Program managers often rely on models that project costs based on historical data, but these models can be sensitive to assumptions. The result is a landscape where estimates are invariably probabilistic and subject to revision, making disciplined oversight essential to avoid systemic optimism.

The defense-industrial base underpins every cost category. Prime contractors assemble platforms and systems, while thousands of suppliers provide specialized components and materials. Workforce skills—engineers, technicians, and tradespeople—are concentrated in firms and national laboratories that require long lead times to develop. Production lines cannot be switched on overnight; they must be sustained through consistent funding or carefully managed phaseouts. When capacity atrophies, costs rise and schedules slip. Understanding these industrial dynamics is crucial to evaluating the affordability of modernization plans and the risks associated with concurrency—building and deploying before development is complete.

Maintenance and sustainment are the quiet engines of deterrence. A weapon system's lifecycle cost is dominated by operations, training, and periodic refurbishment. For submarines, this includes extended maintenance availabilities and refueling; for bombers, depot-level repairs and avionics upgrades; for missiles, reliability assessments and component replacement. Warheads require surveillance, life-extension programs, and occasionally manufacturing of new components. The tempo of these activities is often dictated by technical requirements rather than budget cycles, creating pressure to secure stable funding year after year. Neglecting sustainment can degrade readiness and increase long-term costs.

Procurement systems shape behavior. Fixed-price contracts can incentivize efficiency but may discourage innovation when risks are high. Cost-plus contracts allow flexibility for complex development but can reduce pressure to control costs. Milestone-based payments, incentives for early delivery, and penalties for delays attempt to align interests. The choice of contract type influences schedule performance, risk allocation, and the likelihood of cost growth. Oversight mechanisms—government program offices, independent reviews, and audits—are designed to monitor compliance and performance. Their effectiveness depends on authority, expertise, and access to timely information.

Transparency and the classification regime exist in tension. Some cost data are public, but operational details and certain technical parameters are often classified to protect security. This can frustrate analysis and constrain public debate, especially when budgets rise sharply. Governments address this challenge through redacted reports, unclassified program summaries, and briefings to oversight bodies. The balance between protecting sensitive information and enabling democratic scrutiny is delicate. Where transparency is too limited, assumptions go unchallenged and cost growth may persist; where it is too broad, adversaries might glean strategic insights. Finding the

right equilibrium is a governance problem with fiscal consequences.

Budgetary sustainability is a question of pace and sequencing. Modernization programs across multiple legs of the triad often overlap, creating “bow waves” of demand that strain procurement capacity and workforce availability. If too many programs ramp up simultaneously, competition for resources can increase costs and delay deliveries. Rational sequencing—staggering starts, aligning production rates with capacity, and phasing retirements to avoid gaps—can reduce stress on budgets and industry. Yet sequencing choices also have strategic implications: a delay in one leg affects force posture and allied confidence. Trade-offs between affordability and readiness are therefore inherent and unavoidable.

Deterrence value cannot be measured purely in dollars, but budgets provide indicators. A force that is poorly funded, frequently delayed, or plagued by reliability issues may undermine credibility even if it looks impressive on paper. Conversely, a lean, well-managed program can deliver stable capability at predictable cost. Reliability metrics, inspection outcomes, and production yields are tangible inputs to strategic judgment. They inform decisions about force size, deployment patterns, and alert levels. By linking financial performance to operational readiness, budgets serve as a bridge between strategic intent and practical execution.

Domestic economic effects are significant. Nuclear production is concentrated in specific regions, creating clusters of skilled employment and specialized supply chains. These clusters can benefit local economies, but they also create dependencies. When funding is stable, communities thrive; when budgets shift, ripple effects follow. Policy debates often invoke these impacts as reasons to sustain programs, but the economic arguments should be weighed alongside strategic needs and cost-effectiveness. Understanding the regional footprint helps clarify who bears the costs and who receives the benefits, adding nuance to discussions about value for money.

Alliances add another layer of complexity. Allied procurement of compatible systems, joint exercises, and shared basing arrangements spread costs and enhance interoperability. Technology transfer and industrial participation can boost efficiency but also introduce regulatory and political hurdles. For nuclear-capable allies like the United Kingdom and France, collaboration is selective; for non-nuclear allies under extended deterrence, cost-sharing often occurs through conventional force contributions or infrastructure support. Budgeting within an alliance framework requires reconciling different national priorities, industrial policies, and procurement rules, making coordinated modernization both a technical and diplomatic exercise.

Arms control and risk reduction can have direct budget implications. Treaty limits on numbers, ranges, or types of systems may reduce procurement needs and allow reallocation of funds. Verification mechanisms and data exchanges add costs but can increase stability and lower the risk of expensive missteps. When treaties lapse or new

constraints are introduced, budget plans must adjust—sometimes rapidly. Economic analysis helps quantify the savings from limits and the costs of maintaining redundancy, informing negotiations and posture reviews. In this way, the ledger becomes an instrument of diplomacy.

Environmental and decommissioning obligations are often underestimated. Legacy facilities, test sites, and storage areas require cleanup and stewardship. Dismantling retired weapons and platforms involves specialized labor and regulated processes. These tasks may be deferred during periods of budget pressure, but liabilities tend to compound over time. Including these future costs in present-day planning is essential to avoid shifting burdens to future generations. Transparent accrual accounting and dedicated funding mechanisms can improve intergenerational equity and ensure that deterrence’s full lifecycle cost is recognized.

Innovation and risk are inseparable. Advanced technologies—hypersonics, artificial intelligence, cyber capabilities—are being integrated into the nuclear enterprise, promising new efficiencies or capabilities but also introducing uncertainty. AI may improve logistics and predictive maintenance, but it can also create new vulnerabilities. Cyber defenses for command and control systems add costs and require constant updates. Evaluating these investments means weighing potential strategic advantages against development risks, cost volatility, and the likelihood of obsolescence. Budgeting for innovation is about managing uncertainty while preserving reliability.

Forecasting the future is an art and a necessity. Demographic trends, energy transitions, inflation, and geopolitical shifts will affect defense spending over the next decades. Scenario analysis—asking what happens if costs grow faster than GDP, or if certain technologies mature earlier than expected—helps identify pressure points. A useful approach is to model several plausible futures, each with different assumptions about growth, inflation, and industrial capacity. By stressing budgets against these scenarios, planners can assess the resilience of modernization plans and identify levers—sequencing, contract design, production scaling—that can mitigate risks.

A useful starting point for comparing cost categories is a simple framework that captures the major phases of nuclear forces. While numbers vary by country and program, the relative shares offer insight into where money flows over the life of a deterrent:

Illustrative Lifecycle Cost Distribution for a Typical Nuclear Platform		Phase	Share of Total Lifecycle Cost	Key Activities
		Research & Development	1	

Phase	Share of Total Lifecycle Cost	Key Activities
		Procurement 2
		Operations & Sustainment 4
		Decommissioning & Cleanup 1

The table suggests a practical lesson: procurement, while large and visible, is often overshadowed by the recurring costs of operations and sustainment. A new submarine or bomber fleet is not a one-time capital purchase; it is the beginning of decades of expenditures to keep it effective and ready. Recognizing this helps temper expectations about near-term savings from production efficiencies alone. It also underscores the importance of designing sustainment strategies early, including spare parts, depot capacity, and workforce planning, so that costs remain manageable over the long haul.

Budget transparency can be enhanced through structured reporting and independent review. Many governments publish budget justifications and program acquisition strategies. Oversight bodies issue cost assessments and highlight areas where estimates have shifted. Audits can reveal weaknesses in cost controls or areas where incentives are misaligned. While classification limits public visibility into certain details, a culture of rigorous internal review and periodic external evaluation strengthens accountability. When oversight is effective, it reduces the risk of cost surprises and improves the credibility of the entire nuclear enterprise.

The link between budgets and strategy deserves ongoing attention. Strategic reviews often start with threat assessments and desired capabilities, then translate those into program requirements. Budget constraints can force choices—favoring one leg of the triad over another, extending the life of legacy systems, or pacing modernization. Conversely, generous budgets can lead to expansive programs that create their own strategic logic. The key is ensuring that budget-driven choices are explicitly acknowledged and evaluated, rather than embedded invisibly in procurement schedules. Making the link explicit allows decision makers to align means and ends more clearly.

Cost growth is a recurring theme in defense procurement, and nuclear programs are no exception. Several factors contribute: evolving requirements, supply chain shocks, regulatory changes, and technological complexity. The temptation is to blame contractors, but responsibility is shared with government oversight and funding stability. When budgets are unpredictable, production lines hesitate to invest, and

costs rise. When requirements shift mid-stream, rework and delays follow. Effective cost control requires stable requirements, realistic schedules, disciplined oversight, and incentives that reward performance, not just activity. Managing growth is less a mystery than a discipline.

Risk management is central to affordability. Programs often assume optimistic learning curves, stable supply chains, and benign regulatory environments. Reality frequently intrudes. A prudent approach builds in contingencies, reserves, and alternative pathways. Risk-sharing contract structures can align incentives, but only if both parties have skin in the game. Independent cost estimates and “red teams” can challenge assumptions. Importantly, risk management is not about eliminating uncertainty—impossible in complex systems—but about recognizing, pricing, and hedging it. That is how budgets become more reliable and strategies more credible.

Maintaining workforce expertise is a subtle but critical cost driver. Nuclear design, production, and maintenance require specialized skills that take years to develop. An aging workforce and limited pipelines of new talent can lead to knowledge gaps, slowing production and increasing costs. Training, apprenticeships, and knowledge transfer programs are essential investments. They may not show up as headline items in procurement budgets, but their absence is felt in schedule delays and quality issues. Sustaining human capital is as important as sustaining equipment; both are part of the total cost of deterrence.

Industrial policy choices also influence affordability. Government decisions about where to locate facilities, how to manage production rates, and whether to maintain multiple suppliers shape the cost structure. Duplicating production lines can provide resilience and competition but adds expense. Consolidating production may achieve economies of scale but introduces single points of failure. The choice is not purely economic; it involves strategic risk tolerance and political considerations. Evaluating these trade-offs requires a clear understanding of capacity, lead times, and the cost of redundancy versus the cost of fragility.

Modernization schedules are often the most visible drivers of near-term budgets. Replacing legacy systems—ballistic missile submarines, land-based intercontinental ballistic missiles, and heavy bombers—creates multi-year funding commitments that coincide with other priorities. The timing affects industrial capacity, workforce availability, and the ability to absorb shocks. Staggering modernization across legs can smooth costs but may create temporary capability gaps. Synchronizing them enhances deterrence but strains budgets. The decision about pacing is inherently economic as much as strategic, and it shapes fiscal sustainability for decades.

Allied and partner contributions can alleviate some costs but introduce complexity. Co-development projects, such as shared research on missile defenses or joint production of components, can spread risk and leverage expertise. However, they also require

coordination, diplomatic agreements, and sometimes compromises on design choices. For countries hosting dual-use infrastructure—bases, test ranges, logistics hubs—the economic benefits can be significant, but the dependencies add strategic risk. Budgeting within these frameworks means accounting for both financial and geopolitical variables, with implications for resilience and autonomy.

The measurement of deterrence value remains elusive. Analysts use proxies—survivability, readiness, response times—to gauge effectiveness, but there is no single metric that converts dollars into deterrence units. Budgets provide a practical way to compare alternatives: if two force structures offer comparable strategic value, the less expensive option is often preferred. Yet strategic value is not always comparable, and differences in credibility, signaling, and resilience matter. Budget analysis should therefore inform, not replace, strategic judgment. The goal is to make costs visible and comparable, not to declare that money alone determines security.

Budget politics also affect international perceptions. Allies and adversaries observe not just the size of arsenals but the trajectory of spending. Rapid increases can signal resolve or provoke arms races; sharp cuts may be read as retrenchment or vulnerability. The tone and timing of budget announcements, the use of multi-year procurement authorities, and the treatment of classified programs all send messages. While governments cannot tailor budgets solely for signaling, awareness of the interpretive layer helps avoid unintended consequences. Financial credibility and strategic credibility are intertwined.

Cost transparency can foster public trust. When governments provide clear program descriptions, realistic cost ranges, and candid explanations of uncertainty, they build confidence in the stewardship of deterrence. Opaque budgets invite suspicion and fuel conspiracy thinking. Honest accounting of risks—schedule delays, cost growth, potential operational impacts—strengthens democratic debate. It also equips oversight bodies to enforce discipline. Transparency is not a panacea for budgetary challenges, but it is a prerequisite for accountability and a safeguard against complacency.

Opportunity costs are felt locally and nationally. The choice to fund a new generation of nuclear platforms affects the ability to invest in naval shipbuilding, air combat capability, or ground forces. Beyond defense, it competes with social programs, infrastructure renewal, and climate adaptation. These are difficult trade-offs, and reasonable people disagree on priorities. Making them explicit helps society understand what deterrence costs in concrete terms: fewer hospitals or schools in a given fiscal year, higher deficits, or deferred investments. Honest accounting does not resolve debates, but it ensures they are grounded in reality.

The interplay between budgets and innovation deserves attention. New technologies

promise efficiency, but early adoption can be expensive. Learning curves can reduce costs over time, but only if demand is stable and production scales. Conversely, sticking with legacy systems may save near-term dollars but increase long-term risks if adversaries advance. Budgeting for innovation involves balancing the cost of experimentation with the cost of obsolescence. It also requires careful planning for integration, training, and sustainment. The most affordable path is rarely the cheapest in the short run.

Regional economic effects can be both a blessing and a constraint. Bases and laboratories anchor employment and local supply chains, generating political support for sustained funding. However, this support can discourage necessary restructuring or rationalization when capabilities become redundant. Understanding the distribution of benefits and costs across regions helps policymakers anticipate resistance to change and design transition strategies. It also clarifies the true economic footprint of deterrence beyond direct procurement and operations. A nuanced view avoids simplistic narratives about either boondoggles or silver bullets.

The sustainability of nuclear budgets depends on a credible rationale. Deterrence is valued for its role in preventing catastrophic conflict, but the public expects its cost to be justified and managed. That requires linking strategic aims to measurable outcomes, explaining why particular systems are necessary, and demonstrating prudent stewardship of resources. It also means acknowledging uncertainties and presenting plans that can adapt to changing conditions. A sustainable posture is one that can be funded consistently, maintained reliably, and justified politically over the long term.

Finally, counting the cost is an exercise in candor. It asks decision makers to be explicit about trade-offs, to recognize that deterrence has a price, and to accept that budgets shape strategy as much as strategy shapes budgets. The economics of the bomb is not a dry accounting exercise; it is a way of making the demands of security legible and the choices before societies clearer. By focusing on costs, maintenance, and the political economy of nuclear forces, this book aims to provide a practical toolkit for evaluating deterrence in realistic, transparent terms. The chapters that follow dive into the details: the structure of the nuclear enterprise, the lifecycle of programs, and the many levers that determine whether arsenals are affordable, effective, and sustainable.

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