

If you strip economics down to something that doesn't assume markets, money, or even society, you're left with a very bare, almost physical observation: Organisms must allocate limited time and energy among competing uses to sustain themselves.

From this starting point, "economics" is no longer about prices or institutions, but about the physics of survival under scarcity. Every organism is a budgeting system: it must decide; through evolved behavior, neural computation, or simple chemical response; how to spend finite energy across competing demands such as foraging, reproduction, repair, and vigilance. In stable conditions, this allocation merely maintains existence. But once an organism consistently acquires more energy than it immediately needs, something qualitatively new emerges: surplus.

Surplus changes the structure of behavior because it breaks the strict equivalence between intake and immediate expenditure. An organism with surplus can afford delay, storage, and optionality. Energy that is not immediately consumed for survival can be redirected into reserves (fat, caches, stored food) or into future-oriented behaviors such as territorial expansion or reproductive investment. In this sense, surplus introduces the first crude form of "capital": a buffer that decouples survival from immediacy. It also introduces hierarchy within the organism's own priorities, because stored energy must now be managed, protected, and allocated across time.

Once surplus exists, it becomes socially relevant in species capable of interaction. In cooperative or social organisms, surplus sharing can stabilize alliances. An individual that distributes excess resources; food, protection, grooming time, or information; can increase group cohesion and improve its own long-term survival prospects indirectly. This creates the earliest form of reciprocal exchange: not yet money or contract, but conditional generosity shaped by repeated interaction. Sharing surplus is not purely altruistic; it is often a strategy for reducing variance in risk, outsourcing future support, or reinforcing bonds that improve collective efficiency in acquiring resources.

However, surplus is also inherently attractive to other organisms, which introduces conflict. Once resources can be stored or controlled, they become targets for theft, coercion, or parasitism. This pressure forces organisms to develop protective strategies: concealment, aggression, vigilance, and physical or behavioral barriers. Over time, protecting surplus can become as costly as acquiring it, producing an evolutionary arms race between accumulation and exploitation. In social species, this tension also shapes group structures, where dominance hierarchies or collective defense mechanisms emerge to stabilize control over valuable resources.

As surplus becomes both useful and vulnerable, a further layer of complexity arises: strategic restriction of access. An organism may choose not merely to share or hide resources, but to condition access to them. Surplus becomes leverage. It can be exchanged for labor, protection, mating opportunities, or subordination. In this arrangement, control over stored energy translates into control over other organisms' behavior. The holder of surplus effectively converts material advantage into influence over the actions of others, without necessarily expending that surplus directly.

At this stage, the logic of economics begins to resemble something recognizable: proto-institutions form around repeated patterns of exchange, enforcement, and expectation. What began as metabolic allocation has expanded into structured interdependence. Surplus is no longer just stored energy; it is a medium of coordination and control. And once access to surplus can reliably shape the behavior of

others, the foundation is laid for more abstract systems of exchange, where tokens, norms, and eventually money emerge as compressed representations of the same underlying reality: limited energy, strategically allocated under conditions of competition and cooperation.

The transition from biological surplus to human economy does not begin with a sudden conceptual leap, but with a technological compression of the same underlying logic. Agriculture does not invent surplus; it stabilizes it. Where wild organisms experience surplus as intermittent and uncertain; dependent on seasons, chance encounters, and ecological volatility; agriculture converts it into something deliberately produced, harvested, and stored. The domestication of plants and animals is, in this sense, the domestication of surplus itself: energy is no longer merely found in the environment, but systematically extracted from it in predictable cycles.

With this shift, the spatial and temporal scale of surplus expands dramatically. A hunter-gatherer's surplus is fleeting and local; an agricultural surplus can be accumulated in granaries, stored across seasons, and concentrated in specific locations. In early settlements such as those in Mesopotamia, particularly in cities like Uruk, this stored grain becomes something more than food. It becomes a stable reservoir of future survival, and therefore a focal point of social organization. The economy ceases to be only about immediate allocation among individuals and becomes increasingly about managing reservoirs of energy across time.

This change introduces a new kind of problem: memory. When surplus is transient, behavior alone is enough to manage it. But when surplus is durable and accumulable, societies must remember who contributed, who is entitled to what, and how much exists in total. This is where recordkeeping emerges not as an administrative luxury, but as a necessity imposed by scale. Early systems of writing, such as Cuneiform writing in Sumerian cities, are deeply entangled with accounting practices. The earliest written marks are not philosophical or literary; they are numerical traces of grain, livestock, and labor obligations.

Writing transforms surplus from a physical substance into a tracked abstraction. A stored quantity of barley is no longer just a pile in a granary; it is also an entry in a ledger, a claim that persists beyond the immediate presence of the goods themselves. This separation between physical possession and recorded entitlement allows surplus to be redistributed at scale, but it also creates a new layer of reality: the symbolic economy of records. Control over information about surplus becomes nearly as important as control over surplus itself.

Once surplus is tracked through records, it becomes possible to organize it systematically. Centralized storage systems emerge, often tied to religious or administrative institutions that function as both custodians and distributors. In places like ancient Mesopotamia, temple complexes acted as both economic and bureaucratic centers, coordinating the flow of grain, labor, and taxation. The economy thus becomes partially abstracted into institutional form: instead of individuals directly managing their own survival buffer, they participate in a collectively administered system of allocation.

This institutionalization also intensifies the dynamics of protection and access that already existed in pre-agricultural surplus economies. However, the scale and permanence of stored resources change the stakes. Where an animal defends a cache, early states defend entire systems of accumulation. Where social animals negotiate access through dominance or reciprocity, agricultural societies formalize these

relationships into obligations, duties, and enforced contributions. The strategic limitation of access to surplus evolves into taxation, rationing, and controlled distribution networks.

What emerges, then, is not a replacement of biological economics but a scaling transformation. The same fundamental logic; allocation of limited energy under constraints of competition, cooperation, and threat; persists, but it is externalized into durable systems of storage and representation. Agriculture provides the surplus; writing makes it persistent across time and legible across distance. Together, they convert the fluid, immediate economics of organisms into the structured, record-driven economies of human civilization, where survival is no longer managed only in bodies, but also in symbols.

With surplus now stored, recorded, and administratively allocated, a further problem becomes unavoidable: the coordination of exchange beyond direct obligation. Grain ledgers and livestock counts work well within bounded institutions, but they do not easily scale across strangers, regions, or timing mismatches in need. A tax in grain is useful to a temple granary, but less useful in a marketplace where participants require a flexible, universally acceptable claim on value. Out of this tension, commodity money emerges; not as an invention *ex nihilo*, but as a selection process among stored surpluses for those most capable of acting as generalized claims on future energy.

The key transformation is that some stored surpluses begin to detach from their immediate use-value and become primarily instruments of exchange. A commodity becomes “money-like” when its role as a medium of coordination outweighs its role as direct consumption. This requires several rare properties: it must be storable without rapid decay, divisible without loss of identity, recognizable without ambiguity, and sufficiently scarce that its distribution cannot be casually replicated. In other words, it must behave like a stable proxy for deferred energy across time and space.

Grain, for instance, often served this function in early agrarian systems. It was already the dominant form of surplus in societies organized around agriculture, and in places like Uruk and broader Mesopotamia, grain receipts could function as transferable claims on stored food. But grain is imperfect money: it decays, it varies in quality, and it is costly to transport in bulk. Its monetary function therefore remained entangled with its physical limitations, and it tended to operate within relatively local administrative systems rather than fully fluid markets.

Other commodities were selected; through repeated social and economic pressure; for their superior fit to the constraints of exchange. Livestock, for example, embodies surplus in a mobile, self-replicating form, but it is difficult to subdivide and requires ongoing maintenance costs. Still, its visibility and intrinsic value made it a natural unit of account in pastoral economies. Over time, however, societies tended to converge on commodities that minimized friction in exchange while maximizing persistence of value.

Metals, particularly silver and gold, became especially effective in this role. Their usefulness does not come from consumption utility but from physical properties that align unusually well with the requirements of abstract exchange. They do not corrode easily, they can be melted and reformed without loss of substance, and they can be divided into smaller units while retaining homogeneous identity. Most importantly, they are difficult to produce, meaning their supply cannot be easily inflated by ordinary productive activity. This scarcity anchors their function as reliable stores of accumulated surplus.

Once metals begin to circulate as standardized units; eventually marked, weighed, and certified; they become detached from their original identity as mere material surplus. They are no longer just valuable substances; they are generalized claims on social labor. To hold a unit of metal is to hold a condensed right to the future energy expenditure of others. This is a profound abstraction: surplus is no longer tied to a specific good or institution but becomes liquid across the entire social field.

This liquidity transforms the structure of exchange itself. Instead of barter between specific goods, individuals exchange goods for a universally accepted intermediary, which can then be converted into any other good. This reduces the cognitive and logistical burden of matching needs and enables exchange between strangers who share no direct relationship. In effect, commodity money expands the radius of coordination far beyond what direct reciprocity or institutional accounting could achieve.

But this expansion also deepens the earlier dynamics of surplus control. If stored grain created centralized power within early administrative systems, metallic money decentralizes surplus management while simultaneously making it more transferable and accumulable. Surplus can now be moved across great distances, concentrated in new forms, and deployed strategically in ways that are less visible and more flexible than before. Protection of surplus shifts from guarding physical stores to controlling flows, securing trade routes, and regulating the conditions under which money changes hands.

In this way, commodity money does not replace earlier forms of surplus management so much as generalize them. It extends the logic of stored energy into a portable, abstract medium that can represent virtually any form of labor or resource. What began as an organism allocating energy in a local environment has become a civilization coordinating vast networks of deferred energy claims across time, geography, and social structure; all still grounded, at the deepest level, in the same biological constraint: finite energy, strategically distributed under conditions of scarcity and competition.

As commodity money stabilizes exchange and makes surplus portable, it also sharpens a structural asymmetry that has been present since surplus first appeared: the separation between those who control stored energy and those whose bodies are the primary mechanism for generating new energy through labor. Once this separation becomes durable and institutionalized, it no longer manifests only as episodic dominance or localized hierarchy, but as systematic arrangements for extracting sustained labor in exchange for subsistence.

At its core, the logic is simple and physically grounded. An organism must consume a minimum amount of energy to remain alive and capable of further exertion. If access to that energy is controlled by another agent, then labor can be induced by conditioning survival on work. The worker produces more energy, in transformed form, than they receive back as sustenance; the difference is surplus. That surplus can then be captured, stored, and redeployed by the controller of resources. What changes across history is not the underlying mechanism, but the institutional form through which this extraction is stabilized and justified.

In extreme forms, this arrangement appears as slavery, where control over an individual's labor capacity is direct and coercive. The enslaved person's bodily autonomy is removed from economic consideration entirely; their energy output is treated as an owned resource, similar in principle to

livestock or machinery, though biologically more complex. The surplus generated is entirely externalized to the owner, who bears only the cost of maintenance sufficient to preserve continued productivity. In this configuration, the human body becomes a direct extension of the owner's surplus-generating system.

In other arrangements, such as serfdom, the relationship is less absolute but still structurally similar. The worker is tied to land rather than owned directly, but their access to subsistence is conditional on providing labor, goods, or dues to a controlling authority. The land itself becomes a medium through which surplus extraction is organized. The serf retains partial autonomy over time and production, but a fixed portion of their output is systematically redirected upward into a hierarchical structure of obligation. Surplus is thus extracted not through total ownership of persons, but through control of access to the means of survival.

With the expansion of monetary economies and labor mobility, these arrangements evolve into wage labor systems. Here, the coercion is less visibly physical, but the underlying structure persists in a more abstract form. The worker does not receive subsistence directly from a patron or landholder, but instead sells their labor time for wages, which must be sufficient to purchase subsistence in a market system. Because access to resources is mediated by money, and money is itself concentrated through ownership of capital and productive assets, the worker remains dependent on those who control surplus-generating infrastructure.

In this configuration, the extraction of surplus becomes more flexible and scalable. The worker produces value greater than the cost of their wage; this difference, surplus value in economic terms, is captured by owners of capital. Unlike earlier systems where surplus was often tied to land or direct coercion, wage labor allows surplus extraction to be reorganized dynamically across industries, geographies, and populations. Labor becomes a modular input into larger systems of production, and surplus becomes something that can be recombined, reinvested, and expanded.

Crucially, this reinvestment creates a feedback loop. Surplus captured from labor is not merely consumed; it is frequently reinvested into expanding productive capacity, which in turn increases the scale and efficiency of labor extraction. This can take the form of improved tools, expanded infrastructure, technological development, or organizational systems that coordinate larger numbers of workers. The result is a compounding dynamic: surplus generates more capacity to extract surplus, which generates still more surplus over time.

Across all of these systems; slavery, serfdom, wage labor; the same structural pattern persists: one group must secure access to surplus-generating resources and distribute subsistence in a way that sustains the labor of another group, while retaining the difference between output and compensation. The historical variation lies in the mechanisms of enforcement, the degree of autonomy permitted to workers, and the complexity of the systems through which surplus is tracked and redistributed.

What changes most profoundly over time is not the existence of exploitation in this technical sense, but its abstraction and decentralization. As economies grow more complex, the direct visibility of surplus extraction diminishes, even as the scale of the underlying energy flow increases dramatically. Control shifts from physical domination to institutional arrangement, from explicit ownership of bodies to

ownership of assets, contracts, and productive systems that shape the conditions under which labor must be offered.

Yet beneath these evolving forms remains the same foundational constraint that began the entire chain of development: finite organisms must allocate limited energy to survive, and wherever surplus can be reliably produced, it becomes the object of organization, protection, coordination, and ultimately, structured extraction.

Once surplus has been extracted from labor, the next evolutionary step in the management of energy and resources is the internal consolidation of that surplus among the owners themselves. In early systems, owners might simply consume or reinvest individually, but as production scales and the number of participants grows, collective coordination of surplus among the controlling class becomes advantageous. This is the origin of financial mechanisms: tools and institutions that allow owners to pool, allocate, and strategically deploy surplus at scales far beyond what any single individual could manage.

Pooling surplus provides several strategic benefits. First, it allows risk to be diversified: a crop failure, a downturn in a market, or a localized labor disruption can be offset by the shared resources of a collective. Second, it enables coordinated investment in new productive capacity, from infrastructure to technology, multiplying the ability to generate further surplus. Third, it strengthens the negotiating position of owners relative to non-owners. When surplus is concentrated collectively rather than dispersed among individuals, the controlling class can set terms, manipulate access, and enforce structures that maximize future accumulation while maintaining the separation of surplus from those who generate it.

Financial mechanisms; ledgers, credit instruments, joint ventures, and eventually banks and stock markets; formalize this collectivization. Surplus is no longer a simple physical stockpile of grain, metal, or manufactured goods, but a claim recorded, transferrable, and combinable. Ownership shares, bonds, and accounts become instruments that represent portions of pooled surplus, enabling collective decision-making about allocation, investment, and protection. The crucial effect is that surplus becomes socially concentrated among owners while remaining largely inaccessible to those outside the class, even if they contributed labor to produce it.

This separation is not merely physical but also informational and procedural. Non-owners do not have legal, social, or practical access to these financial instruments; their ability to influence the deployment of surplus is restricted to labor or contractual obligations. Meanwhile, the owners' class can reorganize, subdivide, and multiply their claims across diverse economic domains. Surplus becomes an instrument not just of sustenance, but of strategic leverage over markets, political systems, and labor itself. Financial mechanisms effectively abstract and codify power, allowing owners to extend control beyond immediate production sites and laborers.

The power of this collective surplus manifests in multiple ways. Owners can fund projects that generate more surplus, lending it to other owners or investing it in production that employs non-owners under terms favorable to the capital-holding class. They can absorb temporary losses without compromising the structural relationship between labor and surplus. They can influence policy, negotiate monopolies, and secure property rights that further entrench their access. In short, the collectivization of surplus

through financial mechanisms transforms individual advantage into a systemic advantage: the owners operate as a coordinated network controlling not only resources but also the rules by which new surplus can be captured.

At the same time, this system amplifies the structural inaccessibility of surplus to non-owners. Laborers may produce the material basis of wealth, but the fruits of that labor are codified into instruments that require pre-existing ownership to wield. Access to surplus becomes conditional on participation in the ownership network, rather than merely on contribution to production. This entrenches a dual economy: one for the owners, capable of strategic accumulation, redistribution among themselves, and leveraging surplus for further expansion; and one for the non-owners, whose access is limited to subsistence or wages and whose surplus creation is systematically captured externally.

Thus, financial collectivization represents a higher-order abstraction of the original biological principle. Whereas early surplus was a direct buffer for survival, and later social arrangements concentrated surplus among individual owners, financial mechanisms allow surplus to circulate, multiply, and coordinate among the owners themselves while remaining largely opaque and inaccessible to those who generated it. In doing so, these mechanisms create a recursive system of accumulation: the more surplus the owners capture, the greater their capacity to structure future surplus capture, perpetuating and amplifying the asymmetry between owners and non-owners across generations.

Financial collectivization sets the stage for an even more abstract evolution: the decoupling of claims on surplus from the actual existence of surplus itself. Once financial mechanisms exist to pool, allocate, and leverage accumulated resources, it becomes possible to create instruments that represent not current, but **future** surplus. This is the origin of what economists call **fictitious capital**; claims that promise a share of resources or profits that have not yet been produced, sometimes in projects that may never materialize. The abstraction here is striking: the economy becomes capable of operating on anticipations and expectations as much as on actual energy and material flows.

Fictitious capital leverages the productive capacity of society in advance. A bond issued for a new mine or factory is essentially a claim on the labor and energy that will be mobilized in the future to generate surplus. Stock certificates represent ownership claims on profits that will only exist if the enterprise succeeds. Derivatives, options, and complex financial instruments further generalize this logic: they are claims on contingencies, on interactions between various potential sources of surplus, rather than on any tangible stockpile. Through these instruments, the owners of capital gain the ability to control future surplus long before it is realized in material form.

The practical power of this abstraction is twofold. First, it allows for the **multiplication of leverage**: the same base of actual surplus can underwrite multiple financial claims, each structured to extract value once production occurs. Second, it permits the owners of capital to coordinate and speculate on social labor and energy at scales that are difficult to perceive directly. Whereas early surplus required direct physical management, fictitious capital allows for strategic claims on processes and outcomes distributed across entire societies, regions, or even global networks. Control over these claims amplifies the owners' capacity to extract surplus without immediate physical intervention.

At the same time, fictitious capital intensifies the separation between those who control claims and those who generate the underlying surplus. Laborers and producers may contribute energy, goods, or

services to society, but their output is increasingly mediated through layers of abstraction that favor pre-existing owners of financial instruments. A wage earner's labor may generate real value, yet much of that value is captured upstream by holders of claims on future profits. The tangible connection between production and reward becomes obscured, allowing owners to multiply their effective access to surplus through mechanisms that operate largely independently of immediate material conditions.

This abstraction also introduces systemic risk. When claims outpace actual surplus; when fictitious capital is issued faster than the economy can produce; there is the potential for collapse, corrections, or crises. Yet from the perspective of capital owners, the incentive remains strong: the ability to temporarily mobilize societal energy, to extract and redeploy labor and resources, and to concentrate gains disproportionately outweighs the occasional instability. The very structure of financialized surplus is designed to amplify control over future flows of energy and production, even at the cost of creating volatility for the wider population.

In essence, financialization and fictitious capital represent the ultimate distillation of the surplus principle. What began as energy allocation within an organism has evolved into systems of abstract claims that operate across space and time, controlling not just realized resources but potential resources, not just current labor but anticipated labor, not just immediate consumption but the entire trajectory of human and material productivity. Owners of capital are no longer merely custodians of accumulated surplus; they are architects of a system in which surplus itself is a social and temporal construct, governed as much by contracts, expectations, and financial instruments as by any tangible material stock.

As the abstraction of surplus and the proliferation of fictitious capital have grown, a curious inversion has taken place in the management of necessities themselves. For most of human history, scarcity of food, shelter, and energy was a physical condition: survival depended on securing enough calories, warmth, and shelter to sustain life. Today, in much of the world, basic material scarcity is largely artificial. Technological productivity, global logistics, and mechanized agriculture have created a society in which sufficient energy and material resources exist to meet fundamental human needs many times over. Yet subsistence; once a strict biological constraint; remains socially constrained in ways that reproduce patterns of scarcity artificially.

This artificial scarcity is maintained through the very mechanisms that evolved to manage surplus. Ownership, control over financial instruments, market pricing, and legal enforcement all mediate access to necessities. While the physical resources exist in abundance, social and institutional structures dictate who may claim them. The labor and energy of society are still extracted through wages, rent, or debt, ensuring that access to subsistence is contingent rather than automatic. In effect, scarcity has been relocated from the physical domain to the social and institutional domain: it is scarcity of access, not scarcity of matter.

Surplus retains its fundamental role in this environment, but its meaning shifts. Historically, surplus was energy stored beyond immediate biological necessity; today, surplus often consists of control over the distribution of resources that are themselves abundant. The ability to command access to what could be universally provided; through pricing, market leverage, or financial instruments; becomes the

central mechanism by which accumulation occurs. Ownership of capital allows the custodians of surplus to convert a society capable of abundance into one structured by selective access and inequality.

The tension between actual abundance and socially enforced scarcity has profound implications for labor and production. Even when the material basis of subsistence could, in principle, be secured for everyone, non-owners must still produce energy in forms acceptable to the owners of capital in order to secure their survival. Work continues to generate real surplus, but the link between societal productivity and universal subsistence is severed. In this sense, modern financialized surplus magnifies the historical pattern: it abstracts both the accumulation and the allocation of energy, concentrating power over access in the hands of those who control financial claims rather than production itself.

Furthermore, the artificiality of scarcity enables the owners of capital to expand the domain of surplus itself. If necessities are no longer strictly limited by physical constraints, the excess beyond subsistence can be captured, priced, or monetized in new ways. Education, healthcare, housing, and energy; once functions of collective survival; become arenas for surplus extraction. What was once an immediately physical and localized problem; managing energy to survive; has become an abstract game of allocation, where abundance exists materially but is rationed socially. Surplus extraction becomes less about survival and more about strategic control over potential consumption.

In this context, fictitious capital gains new significance. Claims on future surplus can now be generated not just to mobilize labor, but to allocate access to resources that could, in principle, be freely provided. The abstraction of scarcity allows capital owners to engineer scarcity through pricing, speculation, and financial instruments, ensuring that accumulation continues even in the absence of physical limitation. The result is a paradoxical economy: the world possesses sufficient energy and material to sustain its population many times over, yet subsistence remains contingent, and surplus; both real and abstract; remains concentrated and contested.

Thus, modern economics retains the DNA of its prebiotic origin: it is still about energy allocation under constraints; but the constraints are no longer strictly biological or physical. They are social, institutional, and abstract. Scarcity is manufactured; subsistence is mediated; surplus is leveraged through abstraction, collectively pooled, and financialized. The trajectory from organisms managing energy to a global system of claims on potential future surplus demonstrates a remarkable continuity: human economics remains a science of managing finite allocation, but the “limits” have shifted from nature itself to the structures of society that govern access to what could otherwise be abundant.