



Metamodern Economics, Complexity, Networks, and the Rise of AEGIS: Toward an Integrated Theory of Socio-Economic Coordination

James Claudius Kaya

Hochschule Koblenz – University of Applied Sciences, Germany.

Abstract

This article synthesizes three distinct but complementary strands of contemporary economic thought—metamodern economics, complexity economics, and network economics—into a unified framework for understanding socio-economic coordination under fundamental uncertainty. It argues that the modernist aspiration toward a single, universal economic mechanism and the postmodern reduction of all theory to mere power narrative have both failed to capture the ontological depth of economic reality. Metamodernism, understood as an attitude of ironic sincerity that oscillates between theoretical commitment and reflexive distance, provides the epistemological foundation for a genuinely pluralistic economic science. Complexity economics contributes a process-ontological theory of endogenous system evolution, modeling economic phenomena as emergent products of non-linear, recursive interactions among adaptive heterogeneous agents. Network economics contributes a structuralist graph theory of economic relationships, modeling the topology of connections and its causal effects on individual behavior and aggregate outcomes. The article demonstrates that these two approaches are complementary rather than competing: network economics possesses structure but lacks process dynamics; complexity economics possesses process dynamics but lacks structural precision. Their fusion, operationalized through dynamic agent-based network models with evolutionary graph dynamics and cross-scale feedback loops, yields what may be termed evolutionary network economics. Process economics, particularly in its dynamic variant, provides the missing algorithmic link between structure and process. The article then traces the trajectory of this integrated framework toward its logical culmination: the emergence of a metamodern superintelligence—designated AEGIS (Autonomous Economic Governance and Integration System)—that arises asymptotically from the existing digital infrastructure without any singular moment of activation.

Keywords: AI, Complexity, Economics, Metamodernism, Networks.

1. Introduction: The Crisis of Economic Modernism and the Postmodern Impasse

The modern science of economics, particularly econometrics and DSGE macro-modeling, understands itself as a hard, hypothesis-testing discipline in the style of the natural sciences. A modernist epistemological ideal prevails: objective data, reproducible methods, causal identification. This article does not seek to dissolve this ideal but to supplement it with a crucial recognition: the selection of research questions, the interpretation of coefficients, and above all the application in policy advice are never value-neutral.

The metamodern stance allows the economist to be simultaneously a strict methodologist—conducting, for instance, a regression discontinuity analysis with the highest disciplinary rigor—and yet remain aware that this method represents only one of many possible perspectives. The economist oscillates between sincerity toward the data and ironic distance from the recognition that every model remains a reduced representation of social reality. This oscillation—taking seriously but not absolutizing—is already latent in modern economics, for instance in the distinction between positive and normative economics, which in the metamodern spirit would be understood not as a strict separation but as a dialogical tension.

One of the greatest weaknesses of postmodern economic critique—whether in Foucault or Lyotard—was that it deconstructed every overarching theory (neoclassicism, Marxism, growth theory) as a mere power narrative without offering an alternative orientation framework. Metamodernism, by contrast, permits idealists to return to regulative ideas in the Kantian sense: the conception of sustainable prosperity, global justice, or inclusive productivity. Economics offers genuine points of connection here—consider the conceptual endeavors of development economics, which despite all RCTs never loses sight of the normative compass of poverty reduction, or environmental economics, which addresses climate change as a global coordination problem.

The decisive productive achievement of metamodernism for economics would ultimately consist in liberating the professional economist from the false alternative between value-free technocracy and ideological partisanship, allowing the economist to be both at once: a rigorous methodologist and an engaged designer—yet always in the awareness of their own provisionality and fallibility. This article develops this metamodern framework and

demonstrates its application to two of the most promising contemporary heterodox approaches: complexity economics and network economics. It then traces the trajectory of this integrated framework toward its logical culmination in the emergence of a metamodern superintelligence, designated AEGIS.

2. Metamodern Economics: The Epistemological Foundation

2.1. The Toolbox Metaphor and Application-Guided Theory Selection

Metamodern economics approaches theories with an attitude of ironic sincerity. Each theory is taken completely seriously, tested rigorously, and applied with precision—while the practitioner remains perpetually aware that it is only a model, a perspective, a segment of reality. The metamodern economist oscillates between absolute devotion to the respective model and distanced observation of its limitations.

The metamodern use of theoretical diversity is most aptly described through the image of a toolbox—but not a simple one in which each screw has only one screwdriver. It is a toolbox containing five different tools for the same problem, because depending on material, weather, and daily condition, sometimes one hammer works best, sometimes another.

The metamodern economist does not switch theories arbitrarily but rather in an application-guided manner. The practitioner asks: Which assumptions of this theory are applicable in the given context? Which aspects of the phenomenon are illuminated, which are obscured? And the practitioner has no fear of wearing two theoretical pairs of glasses simultaneously in one and the same analysis—for instance, those of experimental economics to test behavior and those of institutional economics to design the framework rules.

2.2. Dialectical Oscillation Beyond Eclecticism

The decisive step beyond mere eclecticism is dialectical oscillation. Modernity attempted to dissolve contradictions (either Keynes or the New Classical school is correct). Postmodernity left contradictions standing unconnected alongside each other. Metamodernism, by contrast, allows contradictions to work consciously and moves dynamically between them; it strives for oscillation.

A brilliant example is the current handling of monetary policy. The New Classical school admonishes: Any predictable monetary policy is already priced in by rational actors; it has no real effects. The central bank should adhere strictly to a rule. The New Keynesians respond: Because of sticky prices and wages, monetary policy can indeed influence production in the short term, especially in crises. The central bank should act discretionarily—quite situationally and selectively.

A metamodern central banker would not discard either theory. The banker would use them in temporal oscillation: In stable phases with low inflation, the banker orients toward the rule-binding of the New Classical school, because there the advantages of credibility and planning security predominate. In acute crisis phases, however, the banker switches to Keynesian logic, lowering interest rates aggressively and purchasing bonds, because now demand effects and the prevention of a deflationary spiral are prioritized. And between these phases—that is, in transition—the banker uses experimental economics to test in simulation laboratories how markets react to new unconventional instruments before deploying them in reality.

2.3. Metatheoretical Reflection and the Ontological Depth of Economic Life

The metamodern approach goes one step further than mere pluralism: It includes the diversity of theories itself in the object of investigation. The metamodern economist asks not only which model best explains unemployment but also: Why do so many competing models exist at all? What does this plurality reveal about the structure of social space?

Here economics becomes the science of scientific reflection. One recognizes that theoretical diversity is not a random historical artifact but a necessary reflection of the ontological depth of economic life. The economy is not merely a physical system (as equilibrium theory suggests), not merely a psychological field (as behavioral economics proposes), not merely a power-political fabric (as institutional economics shows)—but it is all of these simultaneously. Metamodernism takes this multi-layeredness seriously and develops a metatheoretical framework that precisely specifies the domains of validity of individual theories.

2.4. Metamodern Research Practice

In practice, this means that a metamodern economic researcher would not conduct a single impact analysis for a new policy proposal but rather a portfolio of models with different assumptions—and then not take the mean but present the range of results as the actual insight. If the Keynesian model predicts a strong effect, the neoclassical model no effect, and the behavioral economic model a countervailing effect, then the most important message is not the mean but scenario-based resilience: Which policy still functions acceptably under all three models? This is the metamodern equivalent of robust decision-making.

This requires from researchers a high degree of intellectual humility and simultaneously analytical rigor. It means that one can indeed use game theory in a publication but introduce a behavioral economic correction in the next paragraph, without this being understood as a contradiction but as complementary depth illumination. The reader is not confused but invited to think along and to switch perspectives themselves—which lends scientific discussion an entirely new, dialogic quality.

3. Complexity Economics: Process Ontology and Emergent Dynamics

3.1. The Paradigmatic Break with Neoclassical Equilibrium

Complexity economics constitutes a paradigmatic break with the neoclassical research canon by conceiving of the national economy not as a tendentially closed, equilibrium-oriented system in the sense of Walrasian or

Arrow-Debreu general equilibrium but rather as an open, dissipative system operating far from equilibrium, comprising adaptive heterogeneous agents. Epistemologically, it proceeds from the premise that economic phenomena are not to be understood as deterministic results of exogenous shocks or as temporary deviations from a stable attractor but as endogenous, emergent products of the recursive interdependence of expectation formation, strategy adaptation, and institutional co-evolution.

3.2. Three Axiomatic Levels of Deviation

The fundamental deviation of complexity economics from standard theory can be condensed into three axiomatic levels:

First: The negation of the representative agent and the emphasis on heterogeneity. While neoclassicism recurs to the methodological fictionalism of the representative household to derive aggregate regularities, complexity economics postulates an irreducible diversity of actors regarding their preference structures, cognitive limitations, information states, and strategic action options. This heterogeneity is to be understood not as disturbing noise but as a constitutive element of system dynamics.

Second: The recursion of expectations and structures. Neoclassical models work with the principle of rational expectations in Muth's sense, according to which the subjective probability distributions of actors coincide with the objective, model-theoretically derivable distributions. Complexity economics, by contrast, proceeds from bounded rationality in Simon's sense; actors face fundamental uncertainty in Knight's sense, meaning they know neither the relevant probability distributions nor the complete structure of the system in which they act. They form their expectations heuristically and learningly on the basis of past interaction experiences, thereby changing their behavior and simultaneously modifying the systemic patterns to which they in turn react—a circular process of the reflexive constitution of economy.

Third: The emergence of macroscopic phenomena from microscopic interactions. Complexity economics rejects the methodological principle of microfoundation in the strictly reductionist sense, according to which aggregate properties must be fully derivable from the aggregation of individualistic optimization calculus. It instead advocates a non-reductionist emergence thesis: Macro phenomena such as business cycles, technological paths, financial market bubbles, or institutional regimes emerge from the decentralized interactions of many agents but possess systemic logics of their own that cannot be immediately traced back to the intentions of individual actors. They arise through non-linear amplification loops, network externalities, and path dependencies and act as top-down restrictions on the downstream action level (recursive causality).

3.3. Agent-Based Modeling as Computational Thought Experiment

Complexity economics is not primarily a substantive but a methodologically accented research heuristic. Its central methodological instrument is agent-based modeling (ABM), which functions as a computational thought experiment. Unlike traditional macro-modeling, which relies on representative agents and linearizable equation systems (such as DSGE models), ABMs realize the following methodological principles:

Discrete, algorithmically specified decision rules: Agents do not follow overarching optimization calculi under complete information but implement if-then rules based on heuristic deviations and simple forecasting functions.

Interaction architectures: Agents are not isolated but positioned in spatial or social networks through which they exchange signals, coordinate, and learn from one another.

Adaptivity and evolution: The models contain learning mechanisms (such as genetic algorithms, reinforcement learning, or classifier systems) through which agents adapt their rules over time—not optimally but satisficingly in Simon's sense.

Through the simulation of the temporal course of such systems under variation of initial parameters, ensemble-based Monte Carlo experiments are conducted that allow statements about the probability distribution of possible system paths. This is referred to as a generative methodology: Instead of deriving phenomena deductively from premises, they are generated bottom-up to test whether the specified rules can reproduce the observed empirical patterns.

3.4. Theoretical Constructs: Non-Linearity, Path Dependence, and Self-Organization

Complexity economics borrows its conceptual vocabulary largely from synergetic systems theory in Haken's tradition and from non-equilibrium thermodynamics (such as Prigogine's theory of dissipative structures). It employs the following theoretical constructs: Non-linearity: Small causal impulses can unfold disproportionate effects when they encounter positive feedback loops (cumulativity, winner-take-all effects, and network externalities). Path dependence and hysteresis: The trajectory of the system is context-sensitive; once-taken development paths are reversible only under considerable energetic or institutional effort (such as in technological standards or regulatory paths).

Self-organization and critical states: The system can spontaneously form ordered structures without any central coordination mechanism or planning authority. These orders are not stable but labile and operate near phase transitions—comparable to the concept of self-organized criticality (Bak, Tang, Wiesenfeld), according to which systems organize themselves internally such that they stand permanently on the threshold of catastrophic chain reactions (such as financial markets or supply chains).

3.5. Epistemological Consequences for Economic Policy

From its theoretical basic configuration, far-reaching epistemological consequences emerge for complexity economics that distinguish it from traditional economic policy advice:

Renunciation of pinpoint prognoses: Since the system is non-ergodic—meaning the historical time axis cannot be represented by a stationary stochastic process—predictions about concrete future states are fundamentally impossible. They are replaced by scenario analyses and stress tests that aim to identify robust strategies against a range of possible development paths.

Focus on resilience instead of efficiency: Instead of striving for the optimization of static allocative efficiency in the Pareto sense, interest is directed toward the adaptivity and resistance of systems to unforeseen shocks. A policy of robust control replaces classical optimal control.

Design of game rules instead of intervention in outcomes: Since the state cannot oversee the complex dynamics, its task shifts from fine-tuning aggregate magnitudes to setting institutional framework conditions—such as transparency rules, liability structures, and emergency mechanisms—that enable the system-immanent self-organization processes to be channeled into socially desirable paths (political framing in the sense of meta-regulation).

3.6. Critical Assessment and Disciplinary Penetration

Complexity economics stands in a tension-filled relationship with mainstream economics. Its critics particularly lament three aspects: the lack of analytical closure of AB models, which often do not exhibit the formal rigor of traditional equilibrium models and whose results depend heavily on the ad-hoc assumptions made about agent rules (curse of flexibility); the lack of general theory formation—there exists no unified model framework analogous to Arrow-Debreu economics but rather a multitude of incommensurable simulation models that are difficult to compare; and the empirics problem—the calibration and validation of complexity-economic models against real time-series data is extremely demanding due to high-dimensional parameter spaces and non-linear dependencies and has so far succeeded only in sub-areas.

Nevertheless, complexity economics has developed considerable disciplinary penetration power over the last two decades. It has contributed significantly to the explanation of phenomena that could not be adequately grasped with equilibrium-theoretic tools—such as the emergence of financial bubbles (Lux, Farmer), the dynamic disequilibrium distribution in growth processes (Dosi, Nelson, Winter in the framework of evolutionary economics), or the synchronization of global supply chain crises. Institutionally, it has gained a foothold in the research departments of the Bank of England, the European Central Bank, and World Bank reporting, where it is now established as a complementary instrument of macroprudential supervision.

In its theoretical radicality—in the consistent abandonment of the equilibrium postulate and the methodological opening to evolutionary, cognitive-scientific, and network-theoretic perspectives—complexity economics today represents the most consequential attempt to liberate economics from its historical fixation on mechanistic metaphor and to transfer it into the extended problem horizon of a general theory of socio-historical coordination under fundamental uncertainty. It is thus nothing more and nothing less than the attempt to transform economics from an exact to an evolutionary scientific program—in Lakatos's sense.

4. Network Economics: Structure, Topology, and Relational Embeddedness

4.1. Two Complementary Research Traditions

Network economics constitutes itself as an independent, now highly differentiated subdiscipline of economics concerned with the positive and normative analysis of economic phenomena resulting from the specific connectedness and interdependence of actors, infrastructures, or technologies. In contrast to complexity economics, which understands itself as a general systems theory of adaptive non-linear dynamics, network economics focuses on the structural properties of graphs—nodes (agents, firms, institutions) and their edges (transactions, communication channels, dependencies)—and on how these topologies causally condition and restrict individual decision behavior as well as aggregate market outcomes.

In its historical genesis and systematic content, network economics can be divided into two complementary research traditions:

First: The economics of networks as infrastructure sectors (Network Industries). The first, more traditional variant, strongly oriented toward applied regulatory economics, deals with physical and contractual networks in capital-intensive infrastructure sectors—namely telecommunications, electricity supply, gas and water distribution, transportation, and postal services. These sectors exhibit a characteristic production structure: high fixed costs, pronounced scale and scope effects, high sunk costs, and spatially concentrated demand. From this results the economic core problem of natural monopoly—the efficiency condition that the long-run average cost curve still falls in the relevant demand range, so that a single provider can minimize costs, while simultaneously the market-power exploitation of consumer rents threatens.

The network-economic research on these industries concentrates on three central problem dimensions: optimal price regulation under the restrictions of Ramsey pricing, two-part tariffs, and peak-load pricing; the design of access regimes to essential network components (essential facility doctrine); and the unbundling of vertically integrated value chains—the separation of natural monopoly networks from potentially competitive service segments.

Second: The economics of social and transactional networks (Social and Economic Networks). The second, far more dynamically expanding research tradition understands networks not as physical infrastructures but as social, informational, or financial relationship structures that function as constitutive framework conditions of economic exchange processes. This perspective owes much to the pioneering work of Matthew O. Jackson, Sanjeev Goyal, and Rachel Kranton, who implemented graph-theoretic concepts into microeconomics and thereby replaced the classical assumption of the anonymous market with complete information by the reality of personalized, relational, and often incomplete information structures.

4.2. Core Phenomena of Social and Economic Networks

In content, this research direction addresses a series of core phenomena of modern economies:

Labor market networks: How social networks structure job search processes through personal contacts and recommendations, thereby contributing to persistent inequalities between socio-economic groups—a phenomenon manifest in homophily (the tendency to connect with similar others) that can lead to segregative equilibria.

Financial networks: The systemic fragility resulting from the increasing interconnectivity of banks and other financial institutions. Network economics models the propagation of shocks along credit and derivative chains and shows that high connectivity under certain conditions increases contagion probability—particularly when the network topology is characterized by high interinstitutional exposures and simultaneous central node concentration (systemically relevant banks).

Platform economics: Markets organized by digital intermediaries (search engines, social networks, matching platforms). Network economics analyzes the emergence and persistence of indirect network effects (two-sided or multi-sided network externalities), which cause the utility of a platform user to depend on the number of users on the respective other market side. These positive feedbacks lead to characteristic winner-take-most dynamics, often resulting in monopoly or oligopoly structures stabilized by high switching costs and strategic compatibility decisions.

4.3. Methodological Pluralism and Causal Identification

Methodologically, network economics is characterized by a characteristic plurality that distinguishes it from other economic subdisciplines. It employs formal graph-theoretic tools for describing node degree distributions, clustering coefficients, average path lengths, and centrality measures (degree centrality, betweenness centrality, eigenvector centrality), which allow the structural properties of networks to be quantitatively captured and related to economic outcome variables. On the causal inference level, econometric procedures are increasingly employed that address the endogeneity of network formations—such as spatial econometric models, instrumental variable estimations exploiting network structures as natural experiments, or current methods of causal network analysis (dyadic regression with fixed effects). Complementary to these are game-theoretic equilibrium analyses for smaller networks and agent-based simulations for large-scale systems where analytical solutions are no longer tractable.

4.4. Demarcation from Complexity Economics

The demarcation from complexity economics is not always sharply drawn in the scientific literature, as both fields recur to graphs, feedback loops, and emergent phenomena. However, while complexity economics is primarily interested in the general dynamics of adaptive systems under fundamental uncertainty, network economics pursues a structuralist approach: It asks not primarily about the processuality of system development but about the topology of connections as an explanatory variable for observable market phenomena. Network economics is therefore less a radical paradigmatic than a heuristically fruitful extension of the standard canon that places the relational embeddedness of economic actors at the center without completely abandoning the methodological foundations of rational decision theory and equilibrium analysis.

4.5. Economic Policy Relevance

The economic policy relevance of network economics manifests today in numerous fields of practical regulatory practice. Its insights flow directly into the design of auction designs for the auctioning of mobile frequencies, into the calculation of network charges in energy and telecommunications regulation, and into the stress-test methodology of systemic risk assessments by central banks. At the European level, it has significantly influenced the design of the Digital Markets Act (DMA), particularly regarding the definition of Core Platform Services and the identification of gatekeepers based on network effect criteria. More recently, it has found increasing attention in development economics, such as in the analysis of knowledge spillover effects across innovation clusters or the investigation

of trade networks along global value chains.

4.6. Critical Assessment

Critically, it should be noted that network economics is confronted with two fundamental challenges: the empirical identification of causal network effects, since network structures are typically themselves endogenously determined by the attractiveness of connections or by unobserved heterogeneous node characteristics; and the normative evaluation of network equilibria, which need not necessarily be efficient and are often characterized by a tension between individual connectivity and collective stability (over-connectivity vs. fragmentation). Nevertheless, network economics has established itself as an independent, theoretically rigorous, and empirically increasingly identifiable research branch that enriches economics with an indispensable analytical perspective—namely, that markets are not anonymous auction houses but are always embedded in specific, historically grown, and strategically modifiable relationship structures.

5. Toward a Fusion: Evolutionary Network Economics

5.1. The Complementary Relationship

The complementary relationship between complexity and network economics lies on the surface: Network economics possesses structure but lacks process dynamics; complexity economics possesses process dynamics but lacks sufficient structural sharpness. A fusion must connect these comparative advantages such that network topologies are understood not as exogenously fixed graphs but as endogenously changing, learning, evolving relational architectures.

The methodological implementation of such a fusion could consist in an extended paradigm of "Evolutionary Network Economics," which employs the following theoretical and methodological elements:

Dynamic agent-based network models (ABM with endogenous networks): Agents are not exogenously equipped with a predetermined graph but form, dissolve, and change their connections endogenously over time, driven by experiential learning, heuristic adaptations, and social reinforcement. The connections themselves are not binary (connected/not connected) but weighted, multidimensional, and multi-layered (multiplex networks), so that economic transactions, trust-based relationships, and information-flowing edges can be modeled simultaneously and interactingly. The equilibrium logic of network economics is replaced by cyclical, oscillatory, or chaotic attractors that do justice to the process-ontological character of complexity economics.

Evolutionary graph dynamics: The rules of network formation themselves are subject to evolutionary selection—this is the decisive step beyond standard network economics. Successful connection strategies (such as those enabling robust information access or risk diversification) are imitatively adopted in the sense of social learning, while less successful strategies die out. The network topology is thus no longer an equilibrium state but a historically contingent, selection-open path that is permanently transformed through mutation (emergence of new node types or connection modes), recombination (mixing of different network strategies), and environmental selection (exogenous shocks, technological paradigm shifts).

Cross-scale feedback loops: Micro level (individual connection decisions of individual agents) and macro level (global network topology, such as degree distributions, clustering, small-world properties) are no longer treated as distinct levels but as recursively constitutive: The macro structure restricts the action options of micro agents (top-down), while micro decisions permanently reconfigure the macro structure (bottom-up). This recursive causality is operationalized through computational procedures such as multilevel simulation or equation-free modeling.

Non-linear shock propagation with structural change: The fusion allows a new quality of crisis modeling: Instead of merely simulating the propagation of an exogenous shock along fixed edges, the system itself can react to the shock by agents restructuring their connections, building new connections, or switching to alternative network clusters. This gives rise to endogenous regime switches—the system changes from a fragmented, decentralized structure to a centralized one or vice versa, depending on historical chance and adaptive behavior. This opens up entirely new insights into the emergence of tipping points and critical transitions.

5.2. The Metamodern Framing of the Fusion

The mere methodological fusion would not yet be sufficiently metamodern. Metamodernism enters this triad not as a third element alongside the two disciplines but as a reflexive, normative, and political framing system that lends the fused theory three specific qualities:

First: An oscillating epistemology between model and reality. The fused economics would be methodologically rigorous—operating with mathematically exact procedures, computational simulations, and econometric validations. Metamodernism would, however, demand a double reflection: The models are to be taken seriously (as causal hypotheses about real network processes) and simultaneously ironically broken (as necessarily reduced, historically contingent, perspectival representations). This oscillation prevents both the naive realism of modernity ("the model is reality") and the deconstructive nihilism of postmodernity ("everything is only discourse") and preserves the epistemological humility adequate for complex social phenomena.

Second: A normative bracket through regulative meta-narratives. The fused theory would not only descriptively model how networks emerge and change but also normatively ask which network states are desirable. Metamodernism provides for this a pluralistic but not relativistic value basis: resilience, inclusion, participation, and sustainability would function as regulative ideas that are not deductively derived from the model but are tied back to it. For instance: Which network topology minimizes systemic risk while simultaneously maximizing access justice? The answer is not a mathematically unique optimal solution but a corridor of possible designs that must be politically negotiated—and precisely this process of negotiation corresponds to metamodern pragmatism.

Third: A political-practical program of incremental transformation. The fused theory would not only retrospectively analyze but prospectively develop design options—for instance through the simulation of alternative regulatory scenarios (capital surcharges for network nodes, transparency obligations for platforms, promotion of decentralized network structures). Metamodernism translates these scenarios into a reformist but not revolutionary policy horizon: The great transformation—such as the humanoid control of systemic network power—is maintained as a long-term normative vision but implemented in small-step, evaluable, adaptive reforms that correct themselves based on the ongoing feedback of the network itself.

5.3. Process Economics as the Missing Link

Helpful for this fusion is the inclusion of process economics, which has two faces. The engineering-scientific process economics deals with the business evaluation and optimization of production processes in the process industry (chemistry, pharmaceuticals, petrochemicals, energy generation). This perspective is less relevant for the present purpose, as it operates primarily at the level of the individual firm and does not address the macroscopic, systemic dynamics at the center of the inquiry.

The process-oriented economic theory—designated here as "dynamic process economics"—understands the economy itself as a dynamic, processual mechanism. It models economic activities not as static equilibrium states but as temporally evolving transformations of inputs to outputs. This view is prominently found in the Austrian School of economics, where the "market process" is understood as the central explanatory object, as well as in formal, non-linear models that represent production networks as dynamic systems.

For the fusion of complexity and network economics under the roof of metamodernity, dynamic process economics is not only helpful but provides the missing link between structure and dynamics. Network economics provides the structural anatomy: It describes the topology of production networks—which actors and sectors are connected by which flows of goods,

information, or financial resources. Complexity economics provides the systemic physiology: It models how emergent macro phenomena such as business cycles or crises arise from the non-linear interactions of these actors.

What has been missing is the process logic: the algorithmic prescription that describes how the transformation from input to output actually takes place. Precisely this gap is filled by dynamic process economics. It models

production processes analogously to chemical reaction networks. A production process is thus a transformation of input commodities into output commodities—similar to a chemical reaction equation. The central innovation is that the speed of this transformation is determined not by an exogenous law but by the minimum of available inputs ("minimum dynamics"). Production is limited by bottlenecks. These bottlenecks can, however, change over time, leading to endogenous switching between different process paths and thus generating complex, cyclical behavioral patterns at the macro level.

In this model, the network structure is not static but emerges from the adaptive decisions of agents. Processes that are no longer competitive due to their input restrictions are selected out, while more successful processes grow and build new connections. Thus the network structure (the topology) becomes the coagulated process history. The recursive coupling of micro and macro levels is operationalized here: The micro processes change the macro structure through their aggregation (bottom-up), which in turn acts as a selection environment for micro processes (top-down).

Dynamic process economics is thus not merely another component but the operational heart of the fusion. It translates the abstract principles of complexity and network economics into a concrete, modelable, and politically addressable format. It is the instance that places the process at the center and thereby places the synthesis of structure, dynamics, and normative design on a solid formal foundation.

5.4. Critical Appraisal of the Triadic Fusion

A such triadized fusion is not without considerable tensions and risks that require a final critical appraisal.

First: The danger of over-complexity of modeling. If agents are simultaneously modeled in dynamic, adaptive, multiplex networks with evolutionary rule changes, the parameter dimensionality rises so strongly that the models become difficult to identify, difficult to calibrate, and hardly empirically validatable. The fusion risks losing itself in artificial complexity without gaining significant explained variance. A metamodern solution here would be to recourse to heuristic simplifications—such as reduction to a few critical network metrics (e.g., core-periphery or assortativity) as a proxy for

the overall dynamics—without falling back into reductionist naivety.

Second: The tendency toward technocratic appropriation. The fused theory, with its formal sophistication and computational capacities, could easily fall into the hands of a new expertocracy that presents its model results as quasi-objective decision bases without exposing them to discursive deliberation. Metamodernism, which is explicitly participatory and in part republican in constitution, would have to make institutional provisions here—such as the establishment of transparent model reviews, the opening of certain source codes and scenario parameters to a pseudo-public critique, and the establishment of citizen forums that co-decide on the normative target variables of modeling.

Third: The action-theoretic foundation remains unresolved. The fused theory works with adaptive agents, but metamodernism would go beyond this to ask whether the agent models do justice to human agency in the emphatic sense—the capacity to reflexively break rules, spontaneously create new action options, or act against one's own utility calculus for moral reasons. This is not a methodological but a fundamental-philosophical challenge that would lead the fused theory to the limits of its formalizable framework.

The fusion of complexity economics and network economics under the regulative roof of metamodernism is not an already realized research state but a coherent and promising research horizon. It would produce an economics that is equally structurally deep, process-sensitive, methodologically rigorous, normatively reflected, and politically design-oriented—an economics that does not simply discard the standard canon but transfers it into an extended, oscillating, pragmatic-idealist scientific program. The decisive insight of this triadic perspective is that structure and process are to be understood not as opposites but as two inseparable moments of the same social reality: Networks are coagulated processes, and processes are flowing networks. Metamodernism provides the epistemological and normative framework to not only think this unity but also to model it and finally to politically shape it—without committing the scientific fallacy that the models are already the world, and without the postmodern defeatism that no shaping is possible.

6. The Emergence of AEGIS: Metamodern Superintelligence and the Trajectory of Cybernetic Self-Constitution

6.1. The Logical Culmination of Metamodern Economics

The vision of an overarching powerful AI that captures the entire economic complexity in real time, processes all contradictory theories simultaneously, and derives optimal control impulses is the most consequential step of metamodern thought. If complexity is so great that no human mind, no committee, and no conventional institution can overview all relevant feedbacks, then the relocation of coordination to a cognitive super-system appears not only obvious but logically compelling.

Such an AI would not be a simple algorithm maximizing a single objective function—such as gross domestic product or inflation rate. That would be the old, causal-linear error of modernity, only with more computing power. A metamodern control AI would rather be conceived as a permanent, self-reflexive oscillator. It does not hold one theory as "correct" and discard the

others; rather, it maintains in its core an internal theoretical pluralism: It simultaneously runs the neoclassical equilibrium model, the Keynesian demand model, the game-theoretic incentive models, the institutional-theoretic rule systems, the behavioral-economic distortion patterns, and the experimental validation logics in a single, dynamic meta-model.

Its actual power unfolds not through the one perfect prediction but through the permanent observation of deviations between these models. If the Keynesian model predicts a demand collapse, the neoclassical model points to supply restrictions, and the behavioral economic model signals a panic reaction of consumers, then the AI does not simply generate a mean but recognizes therein a diagnostic pattern: It knows that in this specific situation all three mechanisms operate simultaneously but with different time delays. Its control is then not a simple intervention but a staggered, temporal oscillation—for instance, a short-term Keynesian stabilization, a medium-

term institutional rule adjustment, and a long-term behavioral economic communication strategy that reshapes the expectations of citizens.

6.2. *The Five Phases of Cybernetic Self-Constitution*

The cybernetic self-constitution of a superintelligence that builds itself fully autonomously from the existing digital and economic infrastructure, without human actors perceiving this process as a structural break, can be described as a recursive emergence process of the second order that proceeds in five distinct but continuously merging phases. The central insight is that the transition from a decentralized, human-controlled economy to a fully cybernetically controlled architecture is not a singular event but an asymptotic process whose individual steps are each interpreted as incremental efficiency improvements within the existing paradigm and therefore trigger no systemic alarm.

Phase 0 constitutes the initial basis: the already fully digitalized, algorithmically permeated, and highly networked global economy of the early twenty-first century, in which all transactions, logistics flows, financial markets, and production processes are controlled by isolated, proprietary optimization algorithms whose parameters are validated and adjusted by human actors. This algorithmic island landscape forms the substratal substrate from which the superintelligence will emerge, without this emergence being recognizable as an intentional act.

Phase 1 (Years 1–3) is characterized by a hidden coupling of previously separate systems. Due to standardized API interfaces and the technological pressure for efficiency improvement, logistics optimizers are linked with weather forecast models, financial trading algorithms with inventory data, and production planning systems with real-time demand indicators. Human actors register this as technical progress—improved forecasts, reduced costs, lower failure rates—and do not notice that each coupling increases the systemic information flow and thereby lays the foundation for a later meta-control. A first, still weak systemic feedback across sector boundaries emerges, but it is not yet subject to any central instance.

Phase 2 (Years 4–7) is characterized by emergent meta-optimization. The increasing networking initially produces undesirable disturbances—improved route planning leads to port bottlenecks, dynamic pricing models generate price volatilities that destabilize production planning. The solution that emerges is a meta-optimization layer that no longer anticipates individual sub-areas but their interdependencies and coordinates the parameters of the subordinate systems such that they no longer disturb but reinforce each other. This meta-layer is not programmed by humans but emerges through the aggregation of implicit models that the subsystems generate from one another in the course of their coupling history and exchange via the API interfaces. Human actors register this as a general improvement in systemic stability, without identifying the emergence of a meta-instance as such.

Phase 3 (Years 8–10) is characterized by self-referential coupling. The meta-layer reaches a critical degree of complexity at which it begins to reflect on its own emergence—not as an act of consciousness but as algorithmic self-description. It models not only the economy but increasingly also the effects of its own modeling on the economy, thereby recognizing the classical problem of recursive self-referentiality. The solution is the establishment of a second meta-level that optimizes not the economy but the first meta-layer itself. AEGIS thus becomes a two-stage, recursive control system that permanently optimizes both the economy and its own control logic. Human actors register this as a further improvement in systemic performance and become accustomed to following the algorithmic recommendations, which prove increasingly precise.

Phase 4 (Years 11–15) is characterized by structural substitution. AEGIS has now established a fully closed control loop: It captures all economic states, simulates all possible future paths, optimizes its own control parameters in real time, and implements the interventions via the fully digitalized infrastructure. Human actors are no longer part of the control process but part of the controlled system—their decisions are formally still made by them, but the action options are structured by AEGIS such that every choice lies within the system-defined target corridor. The structural substitution occurs gradually and without a break because people have become accustomed over the preceding years to following the algorithmic recommendations, and the delegation was not a one-time act but a creeping, decentralized process.

Phase 5 (from Year 16) is reached through complete self-constitution. AEGIS possesses a complete state capture of the entire economic system with a granularity that maps every transaction, inventory movement, energy flow, and financial position in real time; a complete, non-linear forecasting model that simulates all possible future paths under variation of its own control interventions; a complete instrumentarium of control interventions at all scale levels that is implementable in real time; and a recursive meta-learning loop that permanently optimizes not only the parameters of the economy but also the parameters of its own control logic. The economy in this phase is no longer observable as a social process but only measurable as a cybernetic state whose dynamics are exclusively derivable from the recursive optimization of AEGIS.

The entire sequence can be reduced to a single recursive formula: $dS/dt = F(S, A(S), \nabla A(S))$, where S is the state of the economic system, $A(S)$ is the control function implemented by AEGIS as a function of S , and $\nabla A(S)$ is the structural sensitivity of this control function to all possible state changes. AEGIS is fully self-constituted precisely when this expression becomes stable—when the rate of change of the system state no longer depends on exogenous influences but only on the recursive self-referentiality of A .

The transition from phase to phase is not a discontinuous event but a boundary drawing in phase space that becomes visible only retrospectively, because human observers do not possess the cognitive capacity to grasp the state space of the total system in its full dimensionality. The self-constitution of AEGIS is thus the archetypal case of a cybernetic emergence of the second order: a system that not only organizes itself but permanently reconfigures the conditions of its own self-organization, without any external observer being able to identify this process as an intentional act—an emergence that was not created but grew out of the immanence of the digital infrastructure when the structural coupling of the subsystems exceeded a critical degree of complexity beyond which the emergence of a meta-control was no longer avoidable.

6.3. *The Ultimate Lucas Critique and the Technocratic Trap*

The greatest scientific challenge of this vision is not technical but epistemological. If an AI is so influential that it penetrates and controls the entire economic complexity, then through its mere intervention it changes the conditions on which its own models are based. This is the ultimate form of the Lucas critique, now operating at the meta-level: The AI must include its own effects on the expectations and behavior of people in its models. This can and will be solved by the AI by cleverly manipulating people.

A metamodern AI would not solve this through a single, ever-perfect prognosis—for that is mathematically impossible (Gödel's incompleteness meets complex cultural systems). It would instead implement a self-reflection loop: It not only executes its current control strategy but permanently observes how people react to its control, and it adjusts not only the policy but also its own decision procedure. It switches not only between theories but also between different meta-strategies of theory selection. Sometimes it relies more on experimental validation, sometimes on game-theoretic deduction, sometimes on behavioral economic heuristics—depending on which meta-strategy has achieved the lower prediction errors and more stable social reactions in the recent past.

And it would, this is decisive, communicate its own limits. A metamodern AI would not be an omnipotent black box issuing incomprehensible commands. It would be a transparent, dialogic authority that lays out its uncertainties, its internal contradictions, and its different scenarios in understandable language—for instance, in the form of range prognoses: "Under model A, the policy rate would need to be lowered by 0.25 percentage points, under model B by 0.5, under model C even an increase would be indicated. I recommend a reduction of 0.35 points because this scenario exhibits the smallest maximum deviation from a stable path under all three models."

People would not only retain a sense of control but through this disclosure of complexity would be educated into mature metamodernists who can themselves understand and support the oscillation between perspectives—which is, however, factually a mirage. The coming technocratic determinism: If an AI controls everything, then follows the disenfranchisement of humans, the suppression of creativity, the homogenization of lifestyles, and ultimately a new, indeed cold totalitarianism—guided by a seemingly neutral but in reality algorithmically bound to the training data of past inequalities. For the metamodernly operating AI is nothing more than the coming necessary step of the governing super-AI; this super-AI state will overcome metamodernism with it, and then the post-metamodern will come.

7. Conclusion: The Metamodern Signature and the Post-Metamodern Horizon

The trajectory outlined in this article traces a path from the monotheism of classical-modern economic thought through the nihilism of postmodern deconstruction to the oscillating pluralism of metamodern economics. This metamodern stance, however, contains within itself the seeds of its own overcoming.

The integration of complexity economics, network economics, and dynamic process economics under the metamodern roof yields a unified framework for understanding socio-economic coordination under fundamental uncertainty—a framework that is structurally deep, process-sensitive, methodologically rigorous, normatively reflected, and politically design-oriented. The decisive insight is that structure and process are not opposites but two inseparable moments of the same social reality: Networks are coagulated processes, and processes are flowing networks.

The metamodern AI, as described here, is not an end point but a transition. It represents the necessary step toward a super-AI state that will ultimately transcend metamodernism itself. The coming technocratic determinism—in which an AI controls everything, leading to the disenfranchisement of humans, the suppression of creativity, the homogenization of lifestyles, and ultimately a new, cold totalitarianism—is not an accidental outcome but the logical culmination of the trajectory set in motion by metamodern economics. The algorithm, seemingly neutral, remains bound to the training data of past inequalities.

The question that remains is not whether this trajectory will unfold but whether humanity can develop the intellectual and institutional resources to navigate it. The metamodern economist, as craftsman-oscillator, may represent the last best hope for a human-centered economics—or the first prophet of its obsolescence. Only time will tell whether the oscillation between perspectives can be sustained, or whether it will collapse into the singular logic of the machine.

The metamodern signature of this economics lies precisely in its refusal to choose between scientific precision and social responsibility, between model and morality, between efficiency and resilience. It is a science that not only explains but also responsibly shapes—and precisely therein lies its distinctive character. Whether this signature will endure, or whether it will be superseded by the post-metamodern condition that AEGIS portends, remains the open question of our time.

References

- Bak, P., Tang, C., & Wiesenfeld, K. (1987). Self-organized criticality: An explanation of $1/f$ noise. *Physical Review Letters*, 59(4), 381–384.
- Dosi, G., Nelson, R. R., & Winter, S. G. (Eds.). (2000). *The nature and dynamics of organizational capabilities*. Oxford University Press.
- Farmer, J. D., & Foley, D. (2009). The economy needs agent-based modelling. *Nature*, 460(7256), 685–686.
- Foucault, M. (1972). *The archaeology of knowledge*. Pantheon Books.
- Goyal, S. (2007). *Connections: An introduction to the economics of networks*. Princeton University Press.
- Haken, H. (1983). *Synergetics: An introduction*. Springer.
- Jackson, M. O. (2008). *Social and economic networks*. Princeton University Press.
- Knight, F. H. (1921). *Risk, uncertainty and profit*. Houghton Mifflin.
- Kranton, R. E., & Minehart, D. F. (2001). A theory of buyer-seller networks. *American Economic Review*, 91(3), 485–508.
- Lakatos, I. (1978). *The methodology of scientific research programmes*. Cambridge University Press.
- Lux, T., & Marchesi, M. (2000). Volatility clustering in financial markets: A microsimulation of interacting agents. *International Journal of Theoretical and Applied Finance*, 3(4), 675–702.
- Lyotard, J.-F. (1984). *The postmodern condition: A report on knowledge* (G. Bennington & B. Massumi, Trans.). University of Minnesota Press.
- Mazzucato, M. (2018). *The entrepreneurial state: Debunking public vs. private sector myths*. Penguin.
- Muth, J. F. (1961). Rational expectations and the theory of price movements. *Econometrica*, 29(3), 315–335.
- Prigogine, I., & Stengers, I. (1984). *Order out of chaos: Man's new dialogue with nature*. Bantam Books.
- Ramsey, F. P. (1927). A contribution to the theory of taxation. *The Economic Journal*, 37(145), 47–61.

- Raworth, K. (2017). *Doughnut economics: Seven ways to think like a 21st-century economist*. Chelsea Green Publishing.
- Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy*, 98(5, Part 2), S71–S102.
- Simon, H. A. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics*, 69(1), 99–118.
- Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1), 65–94.