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From Newtonian Economics to Quantum Uncertainty: The Revolution Reshaping Economic Theory

Ioannis Aznaouridis[1], Chris-Nektarios Aznaouridis [2]

[1] University of Derby, Mediterranean College, Athens, Greece
[2] University of Patras, Greece.
Corresponding Author: Ioannis Aznaouridis, E-mail: aznajohnny@gmail.com

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ABSTRACT

The article explores the transition from "Newtonian Economics," grounded in deterministic and linear models, toward a new condition referred to in the study as "Quantum Uncertainty." Drawing upon the quantum revolution, it highlights how the technological, epistemological, and social dynamics of the 21st century are causing a profound rupture in the foundational assumptions of economic theory. The study argues that the quantum shift is not confined to computational power, but conceptually reconstructs the notions of information, uncertainty, risk, and prediction – rejecting the neutrality of observation and the rationality of Homo Economicus. At the same time, it addresses the uneven geopolitical distribution of computational supremacy and the emerging institutional asymmetry. The comparison between the two paradigms underscores the need for a new epistemological framework, an economic thought that embraces radical uncertainty, participatory information (open data, collective intelligence), and open, nonlinear models of economic reality.

Keywords: *Predictability, Collective intelligence, Quantum uncertainty, Technological supremacy, Rationality, Epistemic modelling*

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INTRODUCTION

The title *'From Newtonian Economics to Quantum Uncertainty'* is not merely a poetic metaphor, but rather signifies a deeper conceptual and methodological shift in economic thought, encapsulating the fundamental concern with the nature of economic knowledge in the 21st century. The issue at stake is not simply whether the new technological era provides more tools, but, more importantly, whether it demands a radical reconfiguration of the theoretical and methodological arsenal of science.

'Newtonian Economics'[1] symbolizes the classical scientific paradigm of stability, predictability, and causality. However, this paradigm appears increasingly inadequate in the face of the complexity and indeterminacy of modern markets. Can economic thought remain predictive in a universe of radical uncertainty? This question is not merely technical; it is conceptual and epistemological. It touches the very core of economic theory, as it challenges the capacity to model and control a dynamically unstable and fundamentally unpredictable world. Within this framework, economic agents are assumed to act rationally, to possess full information, and to be guided – through market mechanisms – towards equilibria that can be mathematically described. This paradigm dominated for decades, forming the basis for most macroeconomic models and for mainstream economic thinking.

On the other hand, *'Quantum Uncertainty'*[2] represents a new ontological and epistemic condition in which uncertainty is endogenous and irreducible. Inspired by quantum physics, this perspective emphasizes indeterminacy, entropy, and the role of observation in the very formation of the phenomenon. Information is neither complete nor objective; it is fragmented, subjective, and at times generates self-fulfilling expectations. Within this new framework, linear relationships and equilibrium points become unstable – or even obsolete (Beinhocker, 2006; Kay & King, 2020).

This study, through a review of the literature, concludes that the quantum revolution of the 21st century – not only as a technology but as a mode of thinking – reconfigures economic theory. Computational superiority, new forms of information, asymmetric flows of power, and the growing entropy of markets[3] render the need for a new paradigm not only timely, but imperative. Economic theory is now called upon to abandon the illusion of control and to embrace uncertainty not as an adversary, but as a foundational element of reality.

Through an interdisciplinary and conceptually reflective methodology, this study undertakes a conceptual reconstruction of the foundations of economic thought, drawing upon the history of science, epistemology, the natural sciences, and especially quantum mechanics (Beinhocker, 2006; Kay & King, 2020).

NEWTONIAN ECONOMICS AS A PARADIGM

Newtonian Determinism: Causality, Prediction, and Mechanistic Regularity

Newtonian physics constitutes the foundation of the classical scientific worldview, introducing an ontological and methodological framework grounded in causal determinism. According to Isaac Newton, the universe is a vast, fully predictable machine – provided that we know its initial conditions and the laws governing it. Causality here is not merely a philosophical principle but also a tool for prediction, since every phenomenon has a clear, traceable cause and leads to a predictable outcome (Newton, 1999).

The Newtonian approach formulates nature through mathematical laws that precisely describe the behavior of bodies in space and time. This *'mechanistic regularity'*[4] is exemplified in Laplace's (1951) famous assertion that, if a mind knew the exact position and velocity of all particles in the universe, it could predict the future with absolute precision.

This deterministic worldview played a decisive role in the development of science as a tool of control and prediction, fostering the belief that the natural world operates with absolute order and that uncertainty is merely the result of ignorance or technical limitations in measurement, rather than an

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inherent feature of reality (Popper, 1957). This scientific paradigm, in turn, was transferred as an epistemological model to other disciplines – including economics – shaping the expectation for fully mathematized and equilibrated models of prediction and regularity.

This is exemplified in neoclassical general equilibrium models, where the market is assumed to reach stable equilibria through the interaction of fully informed and rational agents. Furthermore, rational expectations theories (Lucas, 1972) incorporate the assumption that economic actors correctly anticipate the future based on the same models used by analysts, reinforcing the deterministic belief in informational completeness and linear predictability.

The same worldview is embedded in contemporary tools such as Dynamic Stochastic General Equilibrium (DSGE) models, which – despite their stochastic nature – rely on the assumption of a return to equilibrium and full rationality. It is also reflected in Value at Risk (VaR), where financial risk is represented as a predictable quantity within defined probabilistic bounds.

However, since the early 20th century – and especially with the advent of quantum mechanics-this foundational certainty of classical physics began to be challenged, paving the way for new, non-deterministic interpretations of reality.

Reflections in Economic Theories

The Newtonian deterministic and mechanistic worldview found its theoretical reflection in economic thought through the emergence of Homo Economicus and the development of mathematical equilibrium models. The economic man is depicted as a fully rational agent, with coherent preferences, perfect information, and unlimited computational capacity (Persky, 1995). Within this framework, deviations from equilibrium are considered temporary or exogenous anomalies, rather than endogenous characteristics of the system itself.

The general equilibrium framework (Arrow & Debreu, 1954) and Ramsey-type models (Ramsey, 1928) in macroeconomics embody this particular perspective, aiming to depict the economic system as a closed and predictable whole, wherein prices and quantities move toward equilibrium points according to the rules of the market.

This evolution culminates in the neoclassical synthesis and, later, in the Dynamic Stochastic General Equilibrium (DSGE) models, which are extensively employed by central banks and policy-oriented economic institutes (Woodford, 2003). These models attempt to incorporate shocks and uncertainties within a deterministic framework, assuming that the economy tends toward an equilibrium point, even if through temporary disturbances and fluctuations.

Although they incorporate stochastic elements, DSGE models typically rely on linear approximations and on the fundamental assumption that the economy stabilizes around a unique equilibrium. This approach often overlooks the unpredictability and multiple instability regimes observed in real economic dynamics. Similarly, tools such as Value at Risk reflect the belief that risk can be quantified within strict statistical frameworks, effectively reducing radical uncertainty to technical volatility.

The mathematization of economics, while it introduced significant rigor and formalism, was accompanied by a detachment from the real, complex, and uncertain nature of economic phenomena. As Mirowski (1989) notes, the influence of physics – particularly classical mechanics, proved decisive in shaping the tools and paradigms of modern economic theory.

Despite its internal limitations and the critiques it has received, the Newtonian influence went beyond mere metaphorical borrowing and became a structural foundation for the way economics is

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conceived – as a system that can be analyzed, predicted, and controlled through strict laws. This conception is now being fundamentally challenged in an era defined by uncertainty and complexity.

Economic 'neutrality' as an ideology of stability

The diffusion of formalistic and deterministic models in economic science did not remain confined to theory, but fundamentally shaped the way economic policy is practiced and legitimized. Thus, the dominance of the mathematically expressed neoclassical model extended beyond the scientific domain of economic analysis, exerting a decisive influence on public policy and ideology as well. The notion that the economy is a neutral and technically predictable system reinforced the belief that governance can and should be based on *'objective'* economic models, irrespective of social and political conditions (Rodrik, 2015).

Within this framework, economic *'neutrality'* functions as an ideological construct that conceals the value-laden and political nature of economic choices (Fourcade, 2009). The purported independence of economics from ideological contexts is reinforced through the language of mathematics, technocracy (i.e., governance by 'experts' based on models), and the depoliticization of the public sphere (Amable, 2011). In this context, the market is portrayed as a natural system that spontaneously gravitates toward equilibrium and stability, provided it is not disrupted by exogenous interventions.

This approach contributed to the consolidation of the ideology of stability: the notion that the primary task of political and institutional actors is to ensure the conditions that allow for the 'spontaneous' operation of markets. This ideology found its political expression in the neoliberal turn of the 1980s and 1990s, through the rise of independent central banks, strict fiscal rules, and the deregulation of markets (Harvey, 2005). The function of economic 'neutrality' became particularly evident during periods such as the Eurozone debt crisis, when austerity policies were presented as *'technically inevitable'*.

However, this purported economic neutrality has proven to be deeply politically charged. As Dani Rodrik (2015) argues, 'technical' economic solutions are always embedded in social conflicts and policy choices, even when presented as scientifically necessary. The invocation of stability as a supreme value often serves to preserve existing power structures and to prevent radical changes to the economic or social status quo.

The questioning of the 'neutrality' of economic science thus opens the way for a more critical and pluralistic approach, in which economic knowledge is not detached from its historical and political context, but is instead situated within it.

QUANTUM UNCERTAINTY AS AN ONTOLOGICAL RUPTURE

The Philosophy of Indeterminacy

The quantum revolution in the natural sciences – particularly the contributions of Heisenberg, Bohr, and more recent thinkers such as Karen Barad – brought about a radical rupture with the Newtonian worldview (Barad, 2007; Rovelli, 2016; Zohar, 2022). At the heart of this rupture lies the principle of indeterminacy (Heisenberg, 1927), according to which certain physical quantities, such as a particle's position and momentum, cannot be simultaneously determined with absolute precision, regardless of the instruments of observation.

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This uncertainty is not a technical limitation or an indication of incomplete knowledge; it arises from the very structure of reality itself and thus constitutes a fundamental ontological principle. This position stands in stark opposition to the epistemology of Newtonian physics, where prediction is regarded merely as a matter of information (Smolin, 2019; Rovelli, 2021).

If uncertainty is indeed intrinsic, how is the relationship between observer and observed transformed? Bohr introduces the notion of complementarity, according to which phenomena such as light may exhibit contradictory properties - particle or wave - depending on the conditions of observation. Within this framework, the observer is neither external nor neutral; they participate in the very constitution of the phenomenon itself (Bohr, 1934). The notion of prediction, central to the Newtonian worldview, is here transformed into a dialectical process of interaction rather than a passive extraction of rules.

Barad radically extends this position, arguing that knowledge does not merely observe the world but is co-constituted with it through active and material practices of observation. Through the concept of agential realism, she rejects any separation between observer and reality, proposing instead that every act of measurement is simultaneously an act of meaning-making (Barad, 2007).

Within this philosophical framework, uncertainty ceases to be an obstacle to be overcome and becomes a foundation for understanding. Participation in the world is not grounded in predictability but in participatory uncertainty as a condition of existence. If such radical uncertainty characterizes physical reality, then it cannot be disregarded in the understanding of social and economic phenomena, where the observer actively participates in shaping the very field of inquiry.

From Precision to Probability

The shift from the Newtonian demand for precision to the stochastic representation of reality concerns not only the natural sciences but also bears significant implications for economic theory. Traditional macroeconomic thought, particularly in DSGE models, relies on linear causality and the expectation of fully informed rational agents. However, stochastic variables are merely introduced as 'shocks' to an otherwise stable system, rather than as structural features of that system (Kay & King, 2020).

Quantum theory, by contrast, suggests that probability is not a deviation from precision but a fundamental framework for understanding. Just as the collapse of the wave function is non-deterministic, so too economic collapse, the destabilization of trust or of prices, cannot always be explained through a clear causal chain (Peters, 2016; Busemeyer & Bruza, 2016).

At the same time, the concept of entropy finds application in economic systems, particularly in markets characterized by high uncertainty and in algorithmic financial practices. In such environments, the accumulation of information does not reduce uncertainty, on the contrary, it structures and displaces it. Informational entropy is directly linked to financial instability, the multiplicity of narratives, and the failure to predict systemic events (Beinhocker, 2006), such as the 2008 financial crisis or the collapse of Silicon Valley Bank, which eluded explanation through linear models.

Within this framework, the evolution of technology is not merely a matter of application, but operates as an embodied expression of a new epistemological condition. The development of quantum information science is not solely about computational power. It introduces a new paradigm in which complexity and ambiguity are not obstacles but resources for understanding and reconstructing economic reasoning (Orrell, 2020).

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The New Epistemology of Information

In digital and post-algorithmic capitalism[5], information is no longer a static and complete entity to be collected and computed, but a fragmented and fluid assemblage of signals, correlations, and narratives. Contemporary economic knowledge is formed through continuous data flows, partially opaque algorithms, and predictive models that function more as generators of expectations than as mirrors of reality (Mackenzie, 2017). This is evident in financial markets, where risk or valuation models shape investor behavior rather than merely describing the *'real'* state of affairs.

Within this framework, quantum information science is not merely a technological leap but a model of understanding: information is non-clonable, relational, and dependent on the context of measurement (Aaronson, 2013). The principle of indeterminacy intersects with market complexity, nonlinear effects, and the volatility of human expectation.

This new epistemology acknowledges that economic knowledge is contingent, mediated, and politically charged (Rodrik, 2015). Prediction is not a neutral process but a form of performative intervention in the future. The model itself participates in producing the very reality it purports to describe.

As quantum computing accelerates the processing of complex possible states, the need emerges for an interpretive economic theory, one capable of integrating uncertainty as a foundation rather than a flaw. Knowledge is no longer a tool of prediction, but a strategy of adaptation and embodied judgment.

DISCUSSION

The following discussion examines how the quantum rupture in physical thought, centered on indeterminacy, relationality, and non-deterministic dynamics, redefines foundational concepts in economic theory. The notion of radical uncertainty (Knight, 1921; Kay & King, 2020) is no longer treated as a deviant exception, but as a central element of understanding. At the same time, the emergence of quantum computing introduces not only new tools, but also a new mode of thinking about information, modeling, and prediction (Orrell, 2020; Aaronson, 2013).

Quantum thought -as an epistemological and technological shift- opens the way for an economic theory that embraces uncertainty, dynamic complexity, and reflexivity as structural features of reality.

From Newtonian Certainty to Quantum Uncertainty

Classical science, as it was primarily shaped within the framework of Newtonian physics, established a deterministic and predictable model for understanding reality, wherein every phenomenon could be reduced to definitive cause–effect relationships. Nature was conceived as a mechanical system which, under appropriate initial conditions, could be fully described through mathematical equations (Ladyman & Ross, 2007).

This conception profoundly influenced classical economic theory as well, in which economic agents -the Homo Economicus archetype- are assumed to be fully rational, equipped with perfect information and stable preferences, and are led in a predictable manner to equilibria through market mechanisms (Mirowski, 2013). Equilibrium, as the mathematical point of gravity in the models, was established as the analytical ideal.

The quantum revolution of the 20th century radically challenged this worldview. Heisenberg's uncertainty principle introduces the notion that certain physical quantities – such as the position and

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momentum of a particle – cannot be simultaneously determined with precision, not due to limitations in measurement, but as an intrinsic feature of nature itself (Heisenberg, 1927). Bohr deepened this rupture through the concept of complementarity, arguing that observation plays a constitutive role in the very formation of the phenomenon (Bohr, 1934).

In contemporary philosophy of science, Karen Barad transforms these ideas into an ontological framework she terms *agential realism*. According to Barad (2007), knowledge is not a neutral representation but a *material-discursive* practice[6], in which both the observer and the phenomenon are co-constituted through the process of measurement. Uncertainty is no longer treated as an instrumental limitation but as a fundamental condition of reality.

In the realm of economic theory, the adoption of a probabilistic framework as a substitute for determinism is not new. However, even the most advanced stochastic models often retain a deterministic underpinning, where uncertainty is incorporated as an external shock or a technical deviation (Kay & King, 2020). The quantum perspective counters this by proposing that uncertainty is not a deviation from precision, but rather a framework for understanding, a conception that directly challenges the logic of absolute control and predictability in economic thought (Rovelli, 2021).

Thus, the shift from Newtonian certainty to quantum indeterminacy constitutes not only an epistemological rupture but also a critique of the model of economic rationality. Economic phenomena – such as crises of confidence, price collapses, or self-fulfilling expectations, cannot be adequately interpreted through linear causality; rather, they require a new conceptual infrastructure capable of incorporating multiplicity[7], indeterminacy[8], and the dynamic feedback loops of reality[9]. Just as the observer in quantum physics actively influences the observed field, so too does the economic analyst or policy-maker shape the domain through their very assumptions.

Quantum Thought in Economic Theory

Uncertainty occupies an increasingly central position in contemporary economic thought – not merely as a statistical deviation or technical vagueness, but as a structural feature of the phenomena themselves. Already in the work of Frank Knight (1921), a clear distinction is drawn between risk, which can be probabilistically calculated, and uncertainty, which pertains to situations lacking known or quantifiable probabilities. Kay and King (2020) introduce the term radical uncertainty to describe a framework in which the unknown is indeterminate – not merely unknown – and thus not amenable to calculation or optimization through traditional models (Farmer & Foley, 2011; Spiegler, 2015).

This idea is closely linked to the dynamics of complexity and nonlinearity, which characterize economic reality to a far greater extent than neoclassical models typically assume. Agent-based models and chaos theory have demonstrated how even simple systems can give rise to unpredictable and unstable equilibria, where small changes in initial conditions lead to dramatically different outcomes (Arthur, 2021). Within this framework, prediction ceases to function as a form of control and is instead reframed as the management of complex interactions under conditions of uncertainty.

A critical element is also the concept of reflexivity, as introduced by George Soros (2013), according to which economic agents do not operate as neutral observers but, through their actions and expectations, actively influence the very evolution of the phenomena they seek to analyze. This relationship – where the model shapes the reality it is purported to describe – is analogous to the quantum principle of participatory observation, and it undermines the possibility of an external, objective interpretation.

Overall, the integration of quantum thought into economic theory does not consist in the mere transfer of concepts, but in a conceptual reconstruction of foundational assumptions: economic reality

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is no longer regarded as fully representable or computable. In place of static equilibria and deterministic models, what is required is a framework that acknowledges the dynamic, reflexive, and at times unpredictable nature of economic systems (Maas, 2014; Lawson, 2015; Orrell & Chlupatý, 2016).

Quantum Information and Economic Practice

Quantum computing represents one of the most radical technological developments of recent decades. Its rapid advancement is not merely a technological innovation but an accelerator of a deeper epistemological and economic rupture. Quantum computers, based on the principles of superposition and entanglement, offer computational power exponentially superior to that of classical processors, enabling the processing of problems that are intractable by conventional means (Preskill, 2018). In the field of economics, this translates into radical optimization capabilities in problems such as portfolio selection, real-time arbitrage detection, as well as the excessive processing of data in high-liquidity environments (Egger et al., 2020).

At the same time, the concept of information in quantum theory acquires new characteristics. Information is no longer a copyable or stable entity, but a dynamic and indeterminate one. Measurement itself alters it, while the creation of perfect copies is prohibited (no-cloning theorem) (Wootters & Zurek, 1982). A characteristic example is the use of quantum cryptography in high-sensitivity banking systems, where the very act of reading alters the message and limits the predictability of the exchange.

At the economic level, all this implies a new interpretation of information as fluid, temporary, and dynamically dependent on context and observer. Consequently, economic action – such as forecasting, valuation, or risk management – ceases to rely on a fixed data framework and evolves into a participatory process of informational transformation.

Moreover, the technological transition toward quantum supremacy raises critical issues of unequal access and power. The possession or control of quantum computing infrastructures – currently held by a small number of governments and technological monopolies – already constitutes an emerging geoeconomic allocator of power (Krenn et al., 2023). This may directly affect how governments shape monetary or fiscal policy, or how banks detect asymmetries in capital markets. As contemporary analysis suggests, quantum technology is not a neutral tool but an embodied institutional implementation of strategies of influence, with consequences for security, transparency, and democracy in economic governance (Arute et al., 2019; Mohseni et al., 2022).

It thus becomes evident that quantum information and computation cannot be integrated into the economic framework as merely technical instruments. On the contrary, they constitute a new paradigm of power and epistemic condition, in which the manner by which information is produced, transmitted, and acquired reconfigures the very nature of economic action.

The rise of quantum computing must also be examined in the context of widening inequalities in access, expertise, and computational sovereignty. Just as with 'digital colonialism' (data colonialism), where the concentration of data and computational power by a few global actors produces new forms of dependency and invisibility (Couldry & Mejias, 2019), so too in the quantum era a 'quantum divide' is emerging. This divide is not only technological, but also performative and geopolitical: it concerns who has the capacity to control the infrastructure, to develop algorithms, and to construct economic conditions based on computational supremacy.

Quantum supremacy, both as a term and as a reality, risks becoming a mechanism of technological colonization (Morozov, 2020), with the states or corporations that possess it reframing

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even the fundamental frameworks of concepts such as price, value, or market, based on opaque and unaccountable infrastructures. Therefore, the integration of quantum technology into the economy cannot be understood as a neutral advancement, but must be analyzed as a new paradigm of power, asymmetry, and dominance over the very notion of information and decision-making.

The above perspective belongs to a broader theoretical current that understands information and technology not as neutral entities, but as performative and embodied forms of knowledge and power. As Haraway (1988) has argued, all knowledge is locally embodied *('situated')* and produced within specific relational frameworks. Similarly, Mirowski (2002, 2011) has shown how the very concept of the market has been constructed through computational metaphors and technical rationality, while Stengers (2005) has emphasized the importance of 'ecologies of practices' that constitute scientific and technological becoming. From this standpoint, quantum computing and informatics do not merely impact economic activity; they reconstitute it, participating in the performative reconstruction of the very condition of the economic.

Towards a New Epistemological Paradigm

The crisis of the neoclassical paradigm in economic thought is not merely empirical – that is, a failure to predict crises or to model collective behavior – but profoundly epistemological. The model of Homo Economicus, of full information and predictability through equilibrium equations, fails to account for the complexity and entropy of modern markets (Colander et al., 2009). As became evident during the 2008 crisis and is continually reaffirmed by increasing instability, economic reality does not obey static, deterministic laws, but evolves dynamically and unpredictably (Aikman, Haldane, Nelson, 2015). A telling example is the collapse of mathematically framed certainty, offered by models such as Value at Risk (VaR), which contributed to the underestimation of systemic instability prior to the crisis.

In this context, a new epistemological perspective is required: knowledge in economics is neither universal nor neutral, but fragmented, situated, and interpretive (Flyvbjerg, 2001; Bronk, 2009). Observation and decision-making actively participate in shaping reality. Information is not a given to be utilized, but a participatory event under continuous negotiation. A characteristic example is price behavior on trading platforms, where the very act of forecasting market trends tends to either fulfill or negate itself, thereby altering the very field it seeks to influence. Rather than clinging to the illusion of control through fixed models, what is needed is the recognition of radical uncertainty as a condition not to be overcome, but to be integrated (Taleb, 2007; Callon, Lascoumes, Barthe, 2009).

The proposed methodological shift is from equilibrium and optimization models toward computational and evolutionary algorithms that incorporate dynamic information, behavioral asymmetries, and the multiple perspectives of agents (Farmer & Geanakoplos, 2009; Arthur, 2021). The integration of principles from complexity theory further supports this transition, suggesting that economic behavior should be analyzed as the emergent outcome of interacting agents within dynamic systems. Instead of closed models, the new economic thinking advocates for open, nonlinear frameworks that combine technological tools with socio-cognitive awareness. This represents a paradigm without an absolute observer – one that abandons the illusion of rational control and turns toward the participatory and uncertain construction of reality (Kahneman, 2011).

This epistemological opening does not negate the need for economic theory. Rather, it reimagines it, not as a tool for prediction, but as a framework for interpretation, situated action, and the management of uncertainty. Instead of the illusion of absolute predictability, it emphasizes the need to comprehend the dynamic and multi-perspective nature of reality, in line with the distinction between *'prediction'* and *'understanding'* highlighted in interpretive and human-centered approaches.

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CONCLUSION

The following conclusions summarize the need for a radical epistemological and methodological reconsideration of economic thought in light of quantum uncertainty, quantum computing, informational transformation, and technological power:

Uncertainty is a fundamental feature of reality. The shift from a Newtonian to a quantum mode of thought overturns the deterministic and predictable conception of the world. In economic theory, this implies that uncertainty is not a matter of technical insufficiency, but an inherent condition that renders complete prediction and control impossible. This condition is not limited to philosophical reflection, but has immediate implications for policymaking, as it challenges the feasibility of centralized control and static regulation in highly volatile environments.

Knowledge and observation are participatory processes. The observer is not external and neutral. On the contrary, they actively partake in the constitution of economic phenomena. Economic theory must abandon the claim to objectivity and incorporate the situated, interpretive, and interactive nature of knowledge.

Economic practice is dynamic, non-linear, and reflexive. Phenomena such as crises, bubbles, and expectations cannot be explained through static models. A new conceptual infrastructure is needed, one grounded in complexity, feedback, and interdependence. Reflexivity implies that economic agents do not merely respond to data, but actively transform the very context within which they operate, generating circular and unstable dynamics.

Quantum information redefines the notion of information and decision-making. Information is not a fixed, neutral datum, but mutable, non-copyable, and context-dependent – that is, shaped by the environment in which it is produced and interpreted. Decision-making under such conditions becomes participatory and non-computable in terms of traditional optimization logic.

Quantum technology constitutes a new form of power and asymmetry. Unequal access to computational capacity and infrastructure produces new geoeconomic and institutional inequalities. Technology is not neutral; it acts as a political and epistemic vector of domination.

A new epistemological paradigm is required in economics. Emerging economic thought abandons the illusion of predictability and promotes open, non-linear frameworks that integrate technological tools, socio-cognitive awareness, and radical uncertainty.

This new epistemological paradigm does not negate economic theory, but reorients it toward a regime that acknowledges the role of technology, uncertainty, and information as constitutive elements of economic reality. Within this framework, theory becomes not a mechanism of prediction, but a field of continuous interpretation and engagement.

DIRECTIONS FOR FUTURE RESEARCH

The conceptual discussion presented in this study opens several avenues for further research.

a) Empirical analysis of the performativity of information in highly liquid and volatile markets.

b) Mapping the unequal distribution of quantum computing power and its geoeconomic implications.

c) Development of multi-agent simulation models with limited, contextual, and non-replicable information.

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d) Study of the role of infrastructures and protocols as performative agents in economic practice.

e) Comparative evaluation of classical and participatory methodologies in theoretical and applied economic research.

f) Philosophical inquiry into uncertainty as the foundation of decision-making, with applications in monetary, technological, and environmental policy.

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[1] The term is used here metaphorically, referring to the deterministic, mechanistic, and predictable model of the universe as formulated by Newton, and is applied by analogy to economic thought.

[2] Quantum uncertainty refers to the impossibility of simultaneously and precisely determining key properties of a system, highlighting the fact that the very act of observation affects the phenomenon being observed. In economics, it describes the inherent and irreducible uncertainty that governs markets, where the act of prediction or observation itself influences the behavior of economic agents and shapes the very evolution of the phenomenon.

[3] It refers to the gradual increase of disorder, complexity, and unpredictable behavior within economic systems as they evolve and interact.

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[4] The view that phenomena unfold in a predictable, linear, and deterministic manner, in accordance with universal laws governing a regulated system.

[5] In a form of capitalism where information becomes raw material and algorithms shape, rather than merely analyze, economic reality, knowledge ceases to be an objective representation and becomes participatory, interpretive, and continuously in flux. Essentially, it is a system in which algorithms preemptively configure social and economic behavior.

[6] The relevant formulation—"Practices of knowing are specific material engagements that participate in (re)configuring the world. Knowing is a matter of part of the world making itself intelligible to another part." (Barad, 2007, p.336)—suggests that we do not come to know the world from a distance, but rather that we are entangled within it, actively participating in its configuration every time we observe, measure, or come to know.

[7] A system may possess more than one stable state or outcome, which means that it does not necessarily converge to a single point of equilibrium.

[8] Indeterminacy is not an indication of a lack of knowledge, but a fundamental feature of reality, one that necessitates a rethinking of the very notion of objective prediction.

[9] A mechanism through which reality itself is shaped and evolves via continuous, active interactions with the perceptions, actions, and consequences of the agents within it.

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