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Beyond order: contingency, recursion, and meta-stability in economics

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Leonardo Ivarola, Alfredo García and Martin Szybisz

Abstract: This paper explores the ideas of order and equilibrium in economics. Drawing on the philosophical concept of absolute contingency (Meillassoux 2008; Hui 2019), this paper shows that equilibrium-based economic approaches encounter three key conceptual issues. First, ontologically, there is no inherent order that must persist. Second, epistemically, there are no guarantees that current conditions will remain the same in the future. Third, pragmatically, individuals act and revise their plans in a world without certainty. The terms ontology, epistemology, and pragmatics are used here as heuristic tools. These three dimensions are viewed as a triad that, open to contingency, evolves recursively. Instead of viewing economic systems as mechanistic, we suggest seeing them as metastable processes open to transformation. In this perspective, order is not a necessity but merely one possible state. It is also argued that traditional economic models, emphasizing deductive rigor, are limited in external validity and learning potential. Simulation models, such as ABMs, are proposed as valuable complements for examining economic scenarios shaped by absolute contingency.

Keywords: recursive learning, equilibrium, adaptive processes, economic modelling, simulation models.

Introduction

In a broad sense, economics refers to arrangements, dispositions, and actions aimed at achieving a particular order (Cartwright 1999, pp. 49–50, 121–124). What falls outside this order is considered inefficiency, waste, and entropy.

Traditionally, economic models emphasize equilibrium as a state of order in which economic forces—such as supply and demand—are balanced (Arrow and Debreu 1954; Lucas 1981). A system in equilibrium is understood as being in its 'natural state', where external forces exert minimal or no influence over its trajectory (Kydland and Prescott 1982, pp. 1354–1356, 1360–1361; Woodford 2003, pp. 247–252, 405–411).

However, this mode of theorizing has been challenged by phenomena such as market booms and crashes, monopolies, price rigidities, and breaches of contract (Hart and Moore 1988; Minsky 1986), which may prompt an ontological and methodological reorientation. In this sense, an opposing view holds that economic relations cannot be established without regulation, so government authorities must intervene in the economy to ensure a regulated order. To achieve this, they employ tools such as tariffs, taxation, and price controls to steer the economy toward a balanced path (Chang, 2002; Glaeser and Shleifer 2003; Stiglitz 2010).

Both approaches conceptualize economic systems as being in equilibrium, whether natural or regulated. However, they leave aside a view of the economy as a field of interacting forces in continuous transformation. In this sense, equilibrium would represent merely a particular state within a wider range of possible results (Arthur 2015, 2021; Hidalgo 2015; Shackle 1972). The same applies to the rationality of economic agents: models often assume that their utility or production functions are stable, whereas, in reality, agents continuously alter their habits, preferences, and technologies, thereby generating new information regularly (Arthur 2021; Beinhocker 2006; Kahneman 2011; Nelson and Winter 1982).

Although contingency is usually treated as secondary to order and equilibrium, the approach we develop here—following Hui (2019) and Meillassoux (2008, 2011)—takes contingency as its point of departure. From that perspective, order and equilibrium are not treated as primitive elements, but as possible outcomes. In this sense, we encounter problems at the levels of entities, knowledge, and economic agents' practices. For purely heuristic reasons, we call them *ontological, epistemic*, and *pragmatic*, respectively. At the ontological level, economic systems should not be understood as isolated mechanisms

tending toward equilibrium, but as metastable processes open to transformation. Epistemologically, nothing guarantees that what we know today will prevail in the future. Finally, at the pragmatic level, we find economic agents who must make decisions in a world without certainties, reformulating their plans as they acquire new information. It will be argued that these three elements are not isolated dimensions, but interact nonlinearly, forming a triad in which the ontological affects the epistemic (and vice versa), the epistemic affects the pragmatic (and vice versa), and the pragmatic affects the ontological (and vice versa). This triad enables us to understand the economy as an open, historically situated process subject to recursive learning.

Problem and theoretical framework

This paper begins with a specific question: Is the economy best understood in terms of order and equilibrium, with contingency considered secondary? Or is it more appropriate to start with contingency and view order and equilibrium as just possibilities?

In economics, arguments have been made both in favour of the idea of equilibrium (Arrow and Debreu 1954; Kydland and Prescott 1982; Muth 1961; Lucas 1972, 1981; Sargent and Wallace 1976; Woodford 2003) and against it (Arthur 2015, 2021; Davidson 2002, 2009; Dopfer et al. 2004; Hart and Moore 1988; Hidalgo 2015; Kindleberger 1978; Minsky 1986; Nelson and Winter 1982; Roos 2024; Shackle 1972).

Within the first group, contingency is seen as a clearly exogenous element that, randomly and temporarily, disrupts a system whose natural tendency is toward equilibrium. In the second group, contingency takes on greater importance, but its philosophical basis is not developed in depth, since it is not made explicit that economic order need not be necessary. What we find instead are 'manifestations' or expressions of that contingency in the form of *uncertainty* (Knight 1921; Keynes 1936, 1937; Hayek 1945; Shackle 1972; Davidson 2002, 2009), *complexity* (Arthur 2015, 2021; Dopfer et al. 2004; Roos 2024), *openness* (Dow 2002; Lawson 1997, 2003; Fleetwood 2017), or *nonlinearity* (Baumol and Benhabib 1989; Chick 1998; Harcourt 2006; Loasby 1991, 1999; Rosser 1999).

At this point, we argue that an additional philosophical step is still necessary: specifically, asking what status is given to order and contingency in economics, and what implications follow. Given these concerns, the paper suggests examining the concept of absolute contingency as developed by Meillassoux (2008, 2011, 2014) and Hui (2019).

Taking contingency as the starting point does not imply abandoning the idea of order or equilibrium in economics. In this sense, we argue that order and equilibrium are possibilities in a world where contingency is primitive, and where such forms of order are only transitory historical constructions. For this reason, we propose thinking of the economy as a metastable system (Arthur 2015; Galves and Laxa 2024; Kelso and Engstrøm 2006; Scheffer 2009; Simondon 2017).

From that point on, the OEP triad—ontology, epistemology, and pragmatics—serves, in purely heuristic terms, to show that the metastable condition of a system is not played out in merely one-dimensional terms, but across the whole set of its relations, whose elements transform one another within a recursive process open to contingency.

In this recursive movement, changes in one dimension affect the others, and those transformations, in turn, feed back into the system's overall dynamics. This is not a simple form of recursion, as in first-order cybernetics, where feedback affects only the system's behaviour (Wiener 1948; Ashby 1956), or as in intertemporal economic problems modeled through a decision rule repeated in each period (Stokey *et al.* 1989), but a higher-order recursion, in which the system is gradually reconfigured through its own operations. In this context, simulation appears as a complementary tool to traditional deductive models in economics (Axtell and Farmer 2025; Davis 2018; Delli Gatti et al. 2018; Farmer 2025; Hommes et al. 2025; Ören et al. 2023; Poledna et al. 2023) because it allows us to explore possible scenarios without presupposing that either equilibrium or the model's outcomes are defined in advance.

The notion of order in economic theory

According to the *Cambridge Dictionary* (Cambridge University Press, n.d.), economics is defined as *the way in which trade, industry, or money is*

organized, or the study of this. Like many other disciplines, economics has its philosophical roots in the Enlightenment or the Age of Reason. In those days, the universe was conceived as a great machine governed by mathematical laws. Economics was no exception. Mill (1848) considered that the economic world was an ordered system governed by laws. The notion of equilibrium was introduced to show how causal forces interact to produce order. As depicted in Quesnay's *Tableau économique* ([1758] 1972), equilibrium was conceived as a natural phenomenon. Walras ([1874] 1954) used the metaphor of *tâtonnement* to illustrate the iterative price-adjustment process that continues until all markets are simultaneously in equilibrium. In this state, agents would have no further incentives to change their behaviour.

Later, in the twentieth century, the existence of a competitive general equilibrium was formalized by Arrow and Debreu (1954, pp. 265–266). Likewise, Muth (1961, p. 316), Lucas (1972, p. 103), and Sargent and Wallace (1976, pp. 170, 178) conceptualized equilibrium in dynamic terms. Economic modelling shifted from static models to intertemporal models. Future outcomes are to be understood through the formation of rational expectations. Contingencies are modelled as stochastic exogenous shocks that may affect the economy's equilibrium path. More than being understood as a fixed point, equilibrium is now represented as a canonical trajectory that evolves over time.

However, we may find in economic history many events that call into question the idea of equilibrium as a natural self-regulating centre – e.g., financial crises, speculative bubbles, market volatility, and so on. Markets often move from periods of relative stability to episodes of speculation and crisis (Kindleberger 1978, pp. 5–8, 17–24; Minsky 1986, pp. 3–6). Economic agents are not always rational but often make decisions based on emotions and cognitive biases (Akerlof and Shiller 2009; Kahneman 2011; Shiller 2000). This leads to an alternative view that criticizes the idea of self-regulation. Even so, they generally agree that equilibrium can be achieved through specific governmental interventions. Institutions become relevant for shaping agents' behaviour and macroeconomic policies (Hodgson 2004, pp. 3–4, 18). In many cases, a regulated order is not a distortion, but a condition for developing countries. The market and the state interact to create a new economic order (Chang 2002, pp. 19–20, 125–126). In this context, the role of the state and

regulatory authorities becomes important. There are market failures that must be corrected through government intervention (Stiglitz 2010, p. 24). The state acts as an informed and strategic agent, using its knowledge to implement public policies that lead to a more desirable economic order (Mazzucato 2013, pp. 13-15, 75). The state has tools at its disposal, such as taxes, subsidies, or regulations, which it can use to guide the economy toward a better equilibrium.

We could say that these two ways of thinking share two important presuppositions. The first presupposition holds that order and equilibrium are constitutive aspects of economic functioning. On the one hand, there is a view that assumes a natural order in which equilibrium emerges from the sole interaction of economic forces. State intervention can alter this natural course. We will call these economists *naturalists*, as they assume that equilibrium is reached naturally. On the other hand, there is an opposed view that assumes a regulated order, that is, an equilibrium attainable through state intervention. Here, intervention takes on a necessary character in the face of the inevitable failures of economic systems. We can call these economists *constructivists*, as they assume that this order is attainable through construction modelled by public agents.

The second presupposition, related to the previous one, holds that future outcomes can be projected along single trajectories. For naturalists, order is taken for granted, so the economist's role is to identify the underlying mechanisms that give rise to this order. Models are thought to include the relevant rules of the game, allowing one to trace a path from the current equilibrium to a new one. Results are not expected to be open-ended but follow canonical trajectories conditioned by the model structure. Conversely, constructivists believe that future states can be shaped through intervention. For this, the intervening agent must understand the rules of the game. For example, if there are information asymmetry problems that the market cannot fix on its own, the state must intervene to correct these failures and guide the economy toward a more efficient future state (Stiglitz 2000, pp. 1445–1446). In cases like these, a particular future outcome can be guided by an analysis of current market imperfections.

As can be seen, these two approaches, seemingly dissimilar at first glance, share a common element: the primacy of order and equilibrium. Contingencies are understood as something that disrupts this state of order only temporarily. In what follows, we propose to challenge this view. And we will do so based on the idea of absolute contingency.

Contingency as an absolute necessity

In the approaches discussed above, contingencies are regarded as exogenous factors that temporarily disturb order. Even when randomness is included, it is viewed as something represented by a probability distribution. However, the concept of contingency is much broader than just random error. Since Aristotle's *De Interpretatione* (1963), contingency has been understood as something possible but not necessary. In this context, economic modelling usually begins with the idea of *necessity*. To make models tractable (Hindriks 2006, p. 411; Kuorikoski, Lehtinen, and Marchionni 2010, p. 547) and internally valid (Cartwright 2005, p. 121), economic models are built based on a fixed set of rules that allow the modeler to deduce results. We use the term 'necessity' because the results of the model, being deduced logically, cannot be otherwise. This is like stating that 2 + 2 = 4 – the result is logically deduced and cannot be different. If it were, it would be false.

Contingency is the flip side of necessity. Broadly speaking, contingency means that things could be otherwise—that what exists does so without necessity (Meillassoux 2011, p. 17). Contingency has been conceptualized in varied ways within philosophy. For our purposes, we analyze the approaches provided by Quentin Meillassoux (2008, 2011, 2014) and Yuk Hui (2019). To begin with, Meillassoux asserts that contingency designates the possibility that something can either persist or perish, without either option contravening the invariants that govern the world (2008, p. 53). Things could be different, and this would not involve any contradiction. However, the author proposes a radical view of contingency. Specifically, he does not maintain that a determinate entity exists, but rather that it is necessary that every entity might not exist (2008, p. 60). From this point, he proposes a *principle of unreason*. There is no reason for

anything to be or to remain the way it is; everything must, without reason, be able not to be and/or be able to be other than it is (2008, p. 60).

Contingency is therefore understood as an *absolute necessity* (Meillassoux 2008, p. 62) as the only ground for entities, since there is no ultimate reason for things to exist. Although this argument may appear self-contradictory, Meillassoux is not merely saying that 'everything is contingent,' but something more fundamental: that it is necessary for every being to be contingent. The claim is not simply that everything may change, but that it is impossible for anything to exist that could not change. Thus, every entity – from a house to the very laws of nature – must be capable of being otherwise. What we find here is a radical conception of ontological, rather than logical, contingency. Meillassoux does not call the principles of logic into question. On the contrary, he draws on the principle of non-contradiction to show that if there were a contradictory being – one that included both what is and what is not – it would be immutable, that is, incapable of change, and would therefore be a necessary being, thereby violating the necessity of contingency (2008, p. 79).

Meillassoux's contingency precedes and subsumes any particular order. Following Hume ([1748] 2000), to the extreme, sciences and disciplines may find invariant rules, but in the end, they are only a matter of past habits, and these rules cannot be given for sure in the future. The future is only a matter of speculation, open to the creation of new forms. There may be order, provided we take causality to be a construction of habits, but that order and the laws derived from it could break down at any moment, without reasonable explanation. This radical conceptualization of contingency leads to a hyper-chaotic understanding of the world. It can also be seen as the ground for the vast and constant efforts humanity must make to establish organized systems, which are themselves historical and contingent. The latter means that instability is not only within a framework but may also affect the framework itself. If so, the causal relationships identified in economics cannot be assumed to remain invariant, because nothing guarantees that the underlying structures on which they rest will continue to hold.

Following this idea of absolute contingency, Hui (2019) conceptualizes contingency as a relational concept (p. 227), in which connections can occur or

not, and links it to innovation and evolution (p. 163), among other things. His idea is to enlarge the concept of contingency beyond modal logic, where contingency is opposed to necessity (2019, p. 13).

For Hui, contingency is not only the mere probable, but rather that which exists in different causal movements, linear and nonlinear (2019, pp. 13–14). In the linear mechanical movement, contingency means error, that is, something unexpected that breaks the productive relationship between cause and effect. Nonetheless, the finality remains the same. In nonlinear movements, he distinguishes between those with predefined finality and those with auto-finality. In the first case, contingency is demanded to improve system performance (for example, introducing noise into the operation, as in machine learning). In the second case, contingency becomes a constitutive part of its finality, in the sense that the process or movement itself generates its direction as it goes through contingent events (as in the evolution of an organism).

Unlike Meillassoux, who focuses on the ontological aspects of contingency, Hui is particularly interested in the historical relationship among technology, symbolism, and cosmology. Hui calls it 'cosmotechnics': the idea that each civilization and each historical era use different techniques, and that these techniques shape how we understand the world and how we act within it (2019, p. 270). When technology transforms economic and social life in an unpredictable, contingent way (as it did with the agricultural revolution, the steam engine, or artificial intelligence), such events generate historical fractures within the system, opening new ways of organizing (2019, p. 25).

Including absolute contingency in economic theorizing entails recognizing that the unexpected and the uncertain lie at the heart of the economy's functioning. Economic order can be seen as arising from historical relationships that may endure for a time but can also fracture without warning. In this sense, equilibrium and order are possible, but only temporarily.

We should also stress that contingency is not a defence of pure chance (Hui, 2019, p. 37). Meillassoux uses the term *hyper-chaos* to make this point (2008, p. 64; 2011, p. 21). In classical chaos, for instance, systems are highly sensitive to initial conditions. Even so, they still operate according to fixed rules. Meillassoux's hyper-chaos, by contrast, is a kind of chaos in which even those

rules are not fixed. This does not, however, mean that such rules cannot exist. In this sense, order remains a possibility. At no point is it denied that a system may reach a regular behaviour. However, such stability may be fractured. In the Meillassouxian approach, the emphasis is on the non-reason behind that fracture. In Hui's approach, the emphasis is on the ongoing period of reconfiguration toward new orderings, which is never definitive.

Contingency in economics

In economics, contingency can be understood in two ways. The first, discussed above, treats it as a shock that temporarily disrupts an equilibrium system. This matches what Hui (2019) calls 'linear mechanical movement' and the economic approach of calculable risk. Based on the work of von Neumann and Morgenstern (1953), Savage (1954, Ch. 3) proposes reducing uncertainty to subjective probabilities to make rational decisions under risk. The idea of calculable risk was further extended in macroeconomic modelling with the emergence of rational expectations theory, which assumes that agents form expectations consistent with the model describing the economy. This approach became more important with the work of Muth (1961, p. 315), Lucas (1972, p. 103), and Sargent and Wallace (1976, p. 169), which later became the standard foundation for Dynamic Stochastic General Equilibrium (DSGE) models (Kydland and Prescott 1982, p. 1352).

The second way treats contingency as an inherent property of the economic world. In this case, the economy is understood as an open, complex system, prone to non-linearities and unexpected changes. Let us start with the notion of *uncertainty*. Uncertainty means that the future cannot be known in advance, so agents must make decisions under scenarios that have not yet taken shape. In this regard, Knight (1921, p. 197) distinguishes between risk (calculable, insurable probabilities) and uncertainty (unmeasurable, non-insurable real uncertainty). Uncertainty is distinct from risk in that it concerns situations where probabilities are unknown or unknowable, leading to different economic behaviours and outcomes. Keynes (1936, Ch. 12) furthers this distinction, arguing that because the future is inherently unpredictable, investors and agents act on 'animal spirits' rather than precise calculations. From another

angle, Hayek (1945, p. 519) argued that uncertainty is not merely a lack of data but an inescapable feature of complex social systems. Likewise, Shackle (1972) argues that economic agents cannot even know all possible futures: they do not choose among pre-given alternatives, but they imagine scenarios in a creative context, with no guarantee that these scenarios exhaust all that may occur. Along post-Keynesian lines, Davidson (2002, 2009) asserts that economic systems operate in a non-ergodic environment, in which no stable regularities allow us to infer the future from the past. Uncertainty is not just a problem of information; it is linked to the fact that the future cannot be reliably inferred from past data. Past data is not a reliable guide to future events because the economic environment is constantly being transformed by human agency and new decisions (Davidson 2009, p. 4).

Another approach to contingency is from the perspective of *open systems* (Dow 2002; Lawson 1997, 2003; Fleetwood 2017). In a closed system, a set of internal mechanisms governs its functioning, and the researcher's task is to discover these mechanisms. Methods such as isolation are usually used to get the pure contribution of a causal relationship (Mäki 2009). However, when the system is open, these causal relationships become dynamic, changing as they interact with their environment. Any form of isolation omits key elements that explain the evolving dynamics of the causal relationship, which is not static but develops through interaction. Fleetwood adopts a dialectical view, arguing that the social world is in constant flux (2017, p. 54). Whether describing the interaction of multiple mechanisms or institutional and technological change, many factors make it difficult to find stable patterns in the social world. Still, this does not imply total chaos or an absolute inability to observe any regular behaviour. At this point, Lawson (2003, pp. 105–107) and Fleetwood (2017, p. 47) introduce the concept of *demi-regs*, which are statements like 'whenever event x, then sometimes, but not always, event y', e.g., 'wage rates rise and sometimes, but not always, the quantity of labour supplied increases'.

Contingency in economics can also be understood through the notion of *complexity*. According to Arthur (2015, p. 3), the economy is a vast and complex set of arrangements and actions where agents—consumers, firms, banks, investors, government agencies—buy and sell, speculate, trade, offer services, invest in companies, strategize, explore, compete, learn, innovate, and adapt.

Complexity studies how these interacting elements create patterns that, in turn, affect those elements. In a complex system, interdependencies among its constituent elements cannot be explained solely at the micro or macro level but rather at an intermediate or *meso* level (Dopfer *et al.*, 2004). Outcomes emerge unintentionally from interactions at this level. Unlike a linear chain of the form A→B→C→D, a complex system consists of a network of interconnections among elements; for instance, B may affect not only C but also A and D, and the same holds for the other elements. Another distinctive feature of complex systems is their adaptive character. This is the case of *Complex Adaptive Systems* (CAS). For Holland (2006, p. 1), CAS are those systems with many components—often called agents—that interact, adapt, and learn. Through these interactions, agents may change not only their behaviour, but also some of their properties in response to both their environment and other agents. This kind of change is potentially infinite and leads to a permanent evolution of the system (Roos 2024, p. 54).

Finally, without attempting to cover all approaches to the problem of contingency in economics, contingency can also be seen in concepts such as the *nonlinearity of temporal trajectories* (Baumol and Benhabib 1989; Loasby 1991, 1999; Rosser 1999). In equilibrium models, the economy moves along a convergent path toward equilibrium. However, in actual economic systems, trajectories can be nonlinear. Changes in technology or decision-making might redirect the economy onto different paths. Similarly, small decisions or variations in earlier states can cause significant shifts (Chick 1998, p. 1866). History does not necessarily develop in a linear way but through path-dependent processes in historical time (Harcourt 2006, pp. 42–43, 179).

Table 1 Order and contingency in economics

Approach/authors	How order is conceived	How contingency appears
Natural equilibrium (Arrow & Debreu 1954; Muth 1961; Lucas 1981; Sargent & Wallace 1976; Kydland & Prescott 1982; Woodford 2003)	Natural state or canonical trajectory of the system.	Exogenous, random, and temporary shock.

Approach/authors	How order is conceived	How contingency appears
Regulated equilibrium (Chang 2002; Stiglitz 2010; Mazzucato 2013)	Does not emerge spontaneously but can be reached through interventions.	Failure, misalignment, or problems requiring correction.
Uncertainty-based approaches (Knight 1921; Keynes 1936; Hayek 1945; Shackle 1972; Davidson 2002)	Cannot be known in advance.	Radical uncertainty, imagined futures, or non-ergodicity.
Open systems (Dow 2002; Lawson 2003; Fleetwood 2017)	Regularities may exist, but neither strict closure nor constant laws can be assumed.	Openness, interacting mechanisms, and demi-regularities.
Complex systems (Arthur 2015; Dopfer et al. 2004; Holland 2006; Roos 2024; Hidalgo 2015)	Emergent, local, and revisable.	Nonlinear interaction, emergence, adaptation, and learning.
Nonlinearity and historicity (Baumol & Benhabib 1989; Loasby 1999; Rosser 1999; Chick 1998; Harcourt 2006)	May exist, but not as a unique path or guaranteed convergence.	Path dependence, historical divergence, and nonlinear change.
Financial instability approaches (Minsky 1986; Kindleberger 1978)	May persist for a time, but it generates its own internal fragilities.	Crisis, endogenous fragility, and abrupt shifts.
Evolutionary approaches (Nelson & Winter 1982)	Historical and changing.	Innovation, changing routines, and technological transformation.

In all these cases, we can see that contingency is not just external 'noise' but an intrinsic feature of economic systems, in which the interaction of countless factors produces a multiplicity of possible outcomes that cannot be anticipated from the initial framework. Notions of order and equilibrium are called into question. However, contingency is not explicitly examined as something primitive. What we find instead are expressions of absolute contingency – in the form of nonlinearity, complexity, openness, or uncertainty. We call them 'expressions' of absolute contingency because each, in its own way, challenges the idea that economic order or equilibrium is attainable, and in some cases, even that such an equilibrium exists.

Three problems: ontological, epistemological, and pragmatic

Once contingency is seen as a starting point of economic systems and modelling, we not only question the concepts of order and equilibrium but also, more importantly, the very possibility of ensuring that any stability will last. Economic regularities, causal structures, and institutional forms may hold temporarily, but none can be assumed to remain immutable.

Philosophically, this raises three issues. The first concerns the entities on which our understanding of the economy is based. The second refers to the limits of what can be known and anticipated. The third one concerns the agents' decision-making in economic life. For heuristic purposes only, we refer to these as the *ontological, epistemological,* and *pragmatic* dimensions, respectively. In this sense, it is important to note that our mention of ontology, epistemology, and pragmatics should not be taken as 'grand' philosophical concepts. Rather, they are merely employed as guiding labels to distinguish different but interrelated aspects of economic modelling: the kinds of entities and processes presupposed (*ontology*), the forms of knowledge that can be obtained (*epistemology*), and how such knowledge is used in economic practice (*pragmatics*). Specifically, by ontology we do not refer to a metaphysical account of an economic reality 'in itself', but to the ontological commitments embedded in economic theorizing. In a sense commonly adopted in contemporary philosophy of science (e.g., Alston 1958; Brogaard 2008; Jackson 1989) and philosophical economics (e.g., Cartwright 1999; Mäki 2009; Morrison and Morgan 1999; Morgan 2012), these commitments help to single out certain structures and processes that are assumed to exist within the economic sphere. Likewise, by epistemology we do not refer to a general theory of knowledge, but to the specific forms of intelligibility and inference enabled by economic models under assumptions. Finally, by pragmatics we do not refer to a linguistic theory of meaning, but to the concrete ways in which agents use such knowledge to form expectations and make decisions.

Firstly, from an ontological standpoint, the issue is not whether some form of order exists in the economy, but what status is assigned to it. As we have seen above, both *naturalists* and *constructivists* often treat order and equilibrium as given. Contingency is reduced to fluctuations that temporarily disrupt them. In

some interpretations (e.g., Kydland and Prescott 1982; Long and Plosser 1983), equilibrium does not represent a state of rest so much as the way an economy operates under a set of optimal internal rules. These rules, together with agents' rational decision-making, make up the ordering of the system, and any fluctuations that arise within it do not break with equilibrium. On the contrary, they are movements consistent with equilibrium trajectories (Kydland and Prescott 1982, pp. 1354–55; Long and Plosser 1983, pp. 45–46).

The idea of absolute contingency reverses that point of departure. More specifically, contingency becomes the starting point, while order becomes an eventuality or an emergent outcome of particular configurations. Accordingly, absolute contingency does not call into question the possibility of forms of order or equilibrium states. What it calls into question, rather, is which of the two is primitive and which one is secondary. As an absolute principle, contingency means that there is no guarantee that the set of rules sustaining an equilibrium situation will persist over time. Order and equilibrium cease to be the cornerstone from which the economy is conceived, and instead become contingent outcomes open to possible transformation. We believe this distinction is not trivial, since if order is taken as primitive, that is, as the point of departure, the theoretical commitment lies in explaining how a system returns to order after experiencing shocks or contingencies. If, by contrast, contingency is taken as the starting point, the commitment lies in explaining the conditions under which that order comes to emerge, how it is sustained, and, eventually, whether it dissolves and gives rise to new forms of order (or fails to do so).

Secondly, there is an epistemological problem. Given the ontological contingency mentioned above, even stable knowledge about the past offers no guarantee of continued stability in the future. Several economists have defended the importance of knowledge of the past and the predictive power of economic models. Friedman (1953), for instance, argues that economic models should be judged by their predictive power. For Friedman, positive economics aims to find 'a system of generalizations that can be used to make correct predictions about the consequences of any change in circumstances' (Friedman 1953, p. 4). In this sense, a model that has worked so far—*i.e.*, one in which the observed and predicted patterns are consistent—is a good guide for the future,

regardless of whether or not its assumptions are realistic. Likewise, on the premise that observed behaviour can serve as a reliable guide for projecting future trends, econometricians have developed methods such as cointegration (Engle and Granger 1987; Granger 1981) and ARCH/GARCH models (Engle 1982, 2001) to analyse relationships between variables over time.

However, past knowledge does not guarantee what the future will be like. Cartwright (1999, p. 50) argues that regularities in science result from stable underlying structures – nomological machines – that enable the emergence of invariant regularities through the continuous operation of the machine. But these regularities depend on the machine's stability. The problem is that we cannot know whether this machine's configuration will remain stable over time. If we consider the principle of absolute contingency, nothing guarantees that its configuration will remain stable; it could change at any moment and for entirely unexpected reasons. Thus, even if invariant regularities are found, nothing guarantees that they will prevail in the future. Similarly, Taleb (2007) argues that knowledge of the past is not only of little use but can also lead to highly improbable events—the well-known 'black swans'. Taleb uses Russell's (1912) inductivist turkey metaphor to illustrate the risk of using models that worked in the past to make future projections. Including contingency in our conceptualization of the world implies recognizing that knowledge of invariant regularities, even if it has helped solve different types of problems – predicting, explaining, intervening, etc. – may cease to be helpful in the future. It is not about the idea that these regularities will necessarily be different from the past, but rather that there is no necessary reason to expect them to remain the same.

Finally, there is a pragmatic problem. This problem concerns how agents act and make decisions under contingent conditions. In the vision of order, the pragmatic problem is largely bracketed. With no issues of access to information or temporal constraints in decision-making, modelled agents can wait for an 'auctioneer' to collect all relevant information and establish a set of prices that will clear the market. Agents make lifelong plans from the beginning. If there is any shock, it will be random and temporary and will not change the dynamics toward equilibrium.

However, once contingency is recognized as a starting point of the economy, agents no longer have complete control over the outcomes of their actions. Unintended and unanticipated consequences emerge from people's interactions. This issue is a classic insight in social theory: as Adam Smith (1776) famously argued, individuals pursuing their self-interest—such as the butcher, the brewer, or the baker – often promote societal welfare without intending to do so. Arthur (2015) argues that in complex systems, outcomes emerge from agents' interactions under conditions of uncertainty, feedback, and self-organization. Patterns emerge from the interactions of heterogeneous agents, without any central control. This makes prediction inherently limited, since agents act under information constraints and the system's behaviour is shaped by emergent processes rather than fixed causal chains. Likewise, obtaining information is costly. Bernanke (1983) builds a model in which the agent can either wait to obtain information or decide to invest immediately; waiting incurs an opportunity cost. Agents must make a decision. They cannot wait for everything to be perfect or certain, because waiting is costly and, in some way, detrimental to their survival as economic agents. As the remainder of this paper argues, decision-making under these conditions becomes recursive, emphasizing adaptability and the simulation of possible scenarios.

Meta-stable systems and the triad OEP

In our approach, contingency is not treated as something secondary – that is, as a disturbance or exogenous shock – but as a basic point of departure for thinking about the economy. This view is consistent with Meillassoux's (2008) proposal of contingency as a central foundation. Order is a result of that very contingency. Therefore, it can only be temporary and eventual. Contingency is constitutive of what makes things possible. Either A or B could occur. The fact that A occurs, with A being a stable and orderly system, is nothing more than an eventuality; B could have occurred as well. Contrary to naturalists and constructivists, contingency is not the residue or the inexplicable aspect of an ordered system, but a starting point for thinking about the economy. The fact that things are as they are today is an accident that can be sustained over time, but it could also have been otherwise and could change at any moment.

To illustrate this point, let us imagine an ant colony. Ants go out randomly in search of food. When they find food, they leave behind pheromones. The other ants follow those pheromones. The more ants follow that path, the more pheromones get laid down on the ground, reinforcing one path over the rest. Since pheromones decay quickly, the shortest path is the one ants choose: if the food source is good, more ants follow, reinforcing the scent; if the food runs out, ants stop reinforcing the path, allowing the volatile chemicals to evaporate. Eventually, a pattern (or order) emerges randomly: the shortest path between the anthill and the food. One might even appeal to the Friedmanian idea that the ants move along that path *as if* they were rational agents, since they behave as if they were minimizing transport costs and maximizing coordination by converging on the same behavioural rule. However, that order was not necessary. That path could have been different: the ant might have set out 10 degrees farther to the left or right, or, along the way, it might have ended up as food for an anteater. The selection of the shortest path is based on the paths initially taken at random, not on previous calculations; it is an eventual or contingent path and could have been otherwise.

This example helps illustrate not only the primacy of contingency but also the idea of a *system*. Following the tradition of von Bertalanffy (1968), Ashby (1956), Bunge (1979), Luhmann (1995), and especially Arthur (2015, 2021) and Roos (2024), a system can be understood as a set of interrelated elements whose behaviour depends on how those relationships evolve. From this perspective, stability and change are not mutually exclusive properties, but possible outcomes of the same network of interactions. In this sense, contingency should not be understood as a synonym for chaos (the initial random walk of ants evolves into organized paths and, finally, into an efficient one). Here we can see another point of convergence with Meillassoux's seemingly 'extreme' view of hyper-chaos. For this author, hyper-chaos is not absolute disorder, but rather the absence of guarantees of stability. In our approach, the possibility that things could be otherwise does not imply a link to disorder, chaos, disequilibrium, or even the unknowability of the processes under study, but to a broader dynamic: that of a *meta-stable* system (Galves and Laxa 2024; Kelso and Engstrøm 2006; Scheffer 2009; Simondon 2017; Arthur 2015).

Broadly speaking, a system is meta-stable when it can keep a stable form of organization over time. However, this stability emerges from a very particular configuration of elements—what Cartwright (1999, p. 50) called 'nomological machines'. Any internal or external tension can disrupt that stable configuration. Likewise, in metastable systems, multiple regimes may occur. In nonlinear dynamics, for instance, the same system can shift from regular patterns to episodes of instability without implying the system's total breakdown. Examples include multiple equilibria, basins of attraction, bifurcations, and so on. In economics, this fits with the idea that stable periods can be followed by moments of instability and eventual reconfiguration such as financial crises or institutional change. Order is possible. However, it is an order that emerges from a contingent state and is therefore not guaranteed. These are not exogenous shocks that disrupt a 'natural' equilibrium, but emergent reordering within a system that, because it is open to contingency, remains in ongoing feedback with other interacting parts.

In this sense, it is difficult to think in terms of stable economic systems for several reasons. First, because such a system emerged from an initially contingent situation that, in terms of possibility, could have unfolded differently. Likewise, because the elements of that system are constantly interacting with one another and with their environment, any given ordering can give rise to new configurations that, depending on their form, lead to either stable or unstable behaviour. This is the typical case of complex adaptive systems, where phenomena are understood as interdependent parts whose mutual connections give rise to configurations that were not previously foreseen or planned by any of those parts. Even if an emergent structure reaches a certain degree of order, its stability is not guaranteed, since it exists within an environment that may eventually drive it toward greater complexity or even cause it to disappear—whether because the amount of elements shifts, because the system adapts to new forms of interaction among those elements, or because its interdependence with the environment increases, and so on (García et al. 2018; Roos 2024).

Economic entities and variables, along with the knowledge and practices associated with them, evolve in relation to this meta-stability. In this regard, our goal is to rethink the problems addressed in the previous section from a dynamic

perspective, in which being, knowing, and doing constantly interact, giving rise to metastable behaviours. It is precisely within this framework that we propose, in purely heuristic terms, a schematic way of understanding how these elements, open to contingency, may be interrelated. We call it the *ontological-epistemic-pragmatic* (OEP) triad. It is through this dynamic interaction that novel forms of adaptation and learning emerge. The triad we propose is simply a framework in which entities, agents' practices, and their ways of interpreting the social and economic world interact continuously, generating dynamics that cannot be explained solely through isolated causal mechanisms, but instead require a systemic approach, since what happens at the aggregate level ultimately depends on how different internal processes interact and feed back into one another at the same time. In what follows, we will examine how each vertex of the triad is in constant dialogue with the other two.

Ontology → Epistemology: If the economic world is contingent, any stable structure might change to different arrangements. As a result, agents' knowledge is also subject to change. An economic system might involve the use of specific game rules that, *prima facie,* appear stable. However, since they are emergent from a contingent base, their stability cannot be taken for granted. This lack of guarantees implies that the knowledge of these rules and behaviours must also be revisable. Contingent entities presuppose a flexible way of knowing, which does not claim to represent an immutable essence but is open to change.

Epistemology → Ontology: Our understanding and conceptualization of the economic world influence its arrangement. There is no ontology given in itself—or *noumenal*, to use a Kantian expression—but rather one co-constructed from our ways of knowing. The fact that contingency is primitive means that knowledge of entities is speculative. In this sense, an economic model is not only a way of representing the economy, but also of defining economic variables and entities, prescribing policies, shaping expectations and decisions, and so on. What we consider 'real' is always mediated by an interpretive theory (e.g., Hanson 1958).

Ontology → Pragmatics: If the ontology is contingent, our conditions for action are also susceptible to contingency. A contingent world forces economic agents

to live in a world without routines or standard solutions. The ontology of contingency presupposes a pragmatics of adaptation. People do not follow the same rules because what worked before may no longer work. In contrast, they will adapt as the entity changes. In this framework, it is questionable to think in terms of intertemporal optimizing behaviour—typically modelled as utility maximization over time under rational expectations—as a stable description of agency, since the world can change at any moment and agents lack this information. The best thing agents can do is review and adapt their behaviour.

Pragmatics → Ontology: People's practices are not only receptive to the world as it is understood but also transform it. Creating new technology reconfigures the social, cultural, and economic world. A currency exists and functions because agents trust and agree to use it, but if that confidence is lost, its value will vanish. Unlike physical systems, where human agencies seek to discover their laws and mechanisms, in economic systems, this agency is co-creative of their self-existence. Therefore, in a contingent world, ontology is in a state of permanent construction and transformation, with human agency serving as a constitutive factor.

Epistemology → Pragmatics: Agents act based on a theoretical construct that enables them to perceive the world in a specific way. Agents' knowledge of the world acts as a filter, shaping expectations, assessing possible courses of action, and guiding decision-making. If the epistemological framework asserts that the environment is stable, agents will rest on decisions based only on repetition and routine. However, if they think the world is contingent, they will recognize the possibility of surprises and unexpected events, not as mistakes or system failures, but as creative opportunities. In that case, they will be willing to adapt their decision rules through trial and error.

Pragmatics → Epistemology: Finally, agents' activities influence their epistemic possibilities. Sometimes, an innovative practice, like a new technology, uncovers aspects of the world that we previously couldn't conceptualize. For example, the invention of a new microscope or statistical software allows us to observe once unobservable phenomena. People's practices create new opportunities, meaning epistemology is always subject to revision. Agents need to be willing to relearn and update their knowledge as their practices change.

The movement of the OEP triad allows us to account for the idea of meta-stability as we use it in this paper. Traditionally, meta-stability is often understood as a stage of temporary stability. We might picture a rock that is initially motionless (stable) on a mountainside, then begins, possibly because of a strong wind, to roll down the slope (instability), until it reaches a surface robust enough to absorb the force of its fall (a new stability). However, that surface, a hole, for example, is not a deep valley: if a new disturbance hits it, the rock will move again. That hole is a meta-stable state. In economics, meta-stability is often understood as a situation of 'false' calm, in which periods of apparent stability paradoxically generate future crises. This is Minsky's (1986) famous *Financial Instability Hypothesis*: during periods of economic prosperity (e.g., economic and financial growth, low unemployment rate, etc.), the sense of uncertainty is kept to a minimum. A sort of stability emerges, leading people to make riskier decisions. The problem is that, at some point, the system becomes so saturated with debt and risk that any event, however small, can shatter that false calm, thereby triggering a financial crisis. Eventually, the system reaches a new state, a new stability, so to speak, in which conditions are very different from the initial ones (bankruptcies, tight credit, new regulations, etc.).

We argue that, in economics, this meta-stability is, at its core, an emergent result of the ongoing interaction among agents' practices, their beliefs and expectations, and the economic world they inhabit, generating order in some moments and disorder in others. Stability, equilibrium, and order, in general, are the products of complex, multidimensional interactions among economic facts, their knowledge, and the practices built around them. Rather than being treated as a foundational axiom of economic theorizing or as an endpoint reached after successive iterations, we hold that order and equilibrium are merely provisional outcomes that emerge from the coordination among the three vertices of the triad. What must be examined is the interaction and compatibility among particular entities and institutions, forms of knowledge, and agents' practices, because that compatibility, being open to contingency, may cease to hold at any moment. That is why we speak of meta-stability: because the system's stability depends on a contingent articulation among what exists, what is known, and what is done with what exists and with what is known. In what follows, we will explore in greater depth the idea that these

interactions cannot only affect behaviour but also transform the system itself. We will argue this through the concept of *recursion*.

Recursion and the openness to contingency

Recursion, or recursivity, can be understood in different ways. In its most general sense, it refers to feedback within a system's input-output relation. In mechanistic approaches, the system produces an output, and although this productive relation may be regular, the result does not return to the system as a new input. Recursion is precisely this cycle: an output that feeds back into the system as a new input. This simple form of recursion can be found in what is known as first-order cybernetics (Wiener 1948; Ashby 1956). A common example is a home thermostat: given a target, for example, maintaining a temperature of 24°C, the thermostat will turn on the heating if the temperature is below the target and turn it off if it is above the target.

However, while adaptive, this type of recursion is limited by the unchanging rules of the game —in the previous example, the rule of turning the heating on or off according to the given objective remains the same. Based on the historical development of technology—although not limited to it—Hui (2019) proposes a more sophisticated notion of recursion. For Hui, recursivity is associated with a system's capacity to modify not only its behaviour, but also—and more importantly—the underlying rules and conditions within which it operates. In this sense, it is helpful to think of this movement as cycles or loops to better understand recursion. Given specific goals and rules, a system can produce a particular result. This result is used as information for the system; this is how it learns. However, this type of learning is aimed at much more than just correcting deviations—as in first-order cybernetics. Corrections can also be made to those conditions and rules on which the system operates. The latter means that the system can transform itself. Contingency, far from being noise to be eliminated, is an essential part of this recursive cycle. In Hui's words, 'Recursivity is not mere mechanical repetition; it is characterized by the looping movement of returning to itself in order to determine itself, while every movement is open to contingency, which in turn determines its singularity' (2019, p. 4).

For Hui, each recursive movement—that is, each return—introduces something new. Within this framework, contingency is not an accident, but what gives shape to the recursive movement itself. In the mechanistic view, contingency appears as a failure or noise, and correction operates on the mechanism to prevent the failure from recurring. In Hui's view, however, contingency contributes not only to correction but above all to the transformation of the system itself. An example of this is the development of AI systems that employ retraining, online learning, or reinforcement learning. These systems operate through a continuous training and learning loop: they are provided with data, learn patterns, and eventually adjust their internal parameters (e.g., synaptic weights and biases in a neural network). With these adjusted parameters, these AI models generate new outputs (predictions, text, images, etc.). These outputs are new input data for future training cycles. The system is open to contingency. On the one hand, these AI systems constantly interact with new data, much of which cannot be anticipated. Likewise, it may be affected by biases, make errors in its predictions, or encounter scenarios not contemplated in its initial training. However, this contingency is not 'random noise' but a constitutive part of its identity and development. In other words, the system learns recursively by integrating this contingency—e.g., data, errors, biases, etc. Its reinforcement learning adjusts the model's internal weights and biases. The system is not static, but it transforms with each recursive loop. In this regard, it is possible that even two AI models trained on the same initial dataset can exhibit different behaviours when exposed to different sequences of contingencies. No less important is the emergence of new capabilities. Some AI models, with a particular ability to perform complex tasks or generate creative responses, are not fixed but evolve through recursive learning. Thus, it is possible that new capabilities for performing these tasks – not initially programmed – could emerge. The system 'learns' to do things that were not directly taught.

It is important to note that recursion is not limited to a single dimension of the triad. On the one hand, entities and relations can be reconfigured, just as the neural network of an AI model can be reconfigured. However, informational structure is also transformed—the model no longer retains the same informational structure it had at the beginning after passing through loops of

contingency and recursion. Likewise, people's practices can also change or acquire new meanings. Recursion shows how these vertices are interconnected. The movement may begin to take shape at one vertex, but because they are interrelated, its strongest effects may emerge elsewhere. It may also happen that, since the relation among the vertices is not linear, the movement starts at one vertex, develops at another, and then returns with greater force to the original vertex. In some cases, certain movements may tend to fade away; others, however, may transform an entire system. For example, the emergence of a new financial technology (O) may initially seem insignificant. It may even disappear if it fails to attract enough users. But if more and more people adopt it, it may eventually call into question the prevailing state of knowledge (E), and new regulations may even be needed to prevent fraudulent practices (P). At the same time, the cycle can gain momentum from any vertex. New theoretical developments (E), for instance, may give rise to new practices (P). And those practices, in turn, may reshape economic structures, allowing new forms to emerge (O).

Recursivity is generally conceived as a circular movement: a system takes certain inputs, produces outputs, and those outputs feed back into the system as new inputs. But the form of recursivity Hui proposes is not circular but spiral (2019, p. 238): with each turn, the system is transformed, so it never returns to its beginning. This difference is crucial when compared with recursive approaches used in economics. For example, Stokey et al. (1989) conceive of recursivity as invariant rules that guide decisions in the present. While this approach works at the level of modelling, Hui's proposal is philosophically deeper. For Hui, recursivity means that with each loop, the system itself is transformed. In this sense, his approach calls into question the scope of approaches based on optimal invariant rules, since rules that worked at one moment may cease to be effective the next. This is why, in Hui's approach, it is better to speak of adaptability and uniqueness rather than invariance. Adaptability, because what the system learns becomes a means of transforming itself, and uniqueness, because the spiral movement means that the system never returns to its original point, but remains in a state of ongoing transformation.

Beyond rigor: simulation in the face of recursion and contingency

Economic modelling is so deeply rooted in theoretical practice that it has been said that 'to do economics is to do models' (Mäki 2002, p. 10). This practice mainly consists of arranging a set of premises that allow us to infer results deductively. These models are usually described as *analogue economies* (Lucas 1981, p. 272). Basically, analogue economies are artificial systems with only a small number of features, agents, and options for what can happen under specific circumstances (Cartwright 2005, p. 119). The model must be necessarily internally valid, even if it comes at the expense of its external validity (Cartwright 2005, p. 121). This modelling strategy, grounded in analytical rigor, is effective when the modeler's purpose is to isolate a specific mechanism or analyse what would happen under very particular conditions. Nonetheless, due to its external validity problems, it may face some limitations when contingency is considered an absolute necessity.

At this juncture, simulations are considered a valuable complement to this kind of modelling (Axtell and Farmer 2025; Davis 2018; Delli Gatti et al. 2018; Farmer 2025; Hommes et al. 2025; Ören et al. 2023; Poledna et al. 2023). Simulations are a hybrid practice that combines theory and experimentation and can be used to explore what might happen under varying conditions, thereby generating knowledge about alternative scenarios and dynamics that have not yet been observed. Simulations are epistemologically novel, as they generate insights that go beyond the limits of theory (Frigg and Reiss 2009; Winsberg 2001, 2003). In our view of contingency, simulations are useful because they allow us to create and run models whose rules need not remain fixed throughout the process. This does not mean that simulations work without methodological constraints. They still need initial specifications, interaction rules, and parameter settings to make the process intelligible. The difference is that, in models of analogue economies, the rules and assumptions are fixed in advance, and the results are derived deductively from them. If key assumptions are modified, this amounts to constructing a different model. In simulation models, by contrast, the system evolves through iterative processes in which these assumptions can be updated or adapted over time.

In the field of simulation, tools such as agent-based modelling (ABM) enable researchers to explore how economic systems evolve under a variety of circumstances (Axtell and Farmer 2025; Farmer 2025; Lux 2021; Steinbacher et al. 2021; Tesfatsion 2003). Broadly speaking, ABM uses agents that, following straightforward rules and interacting at the *meso*-level, give rise to often unplanned emergent results. This emergence can be convergent—as in Schelling's (1969) racial segregation model, where the process stops when agents have no incentive to relocate—although it is also possible that the results will be divergent—as in several financial market models, where simple trading rules may generate bubbles and crashes.

While the deductive rigor of analogue-economy models is useful for understanding the path an economic process may follow under specific conditions, it also limits our ability to grasp the scenarios that could arise if some of those conditions were not met. Consider the case of DSGE models. In many countries, central banks rely on sophisticated DSGE models to understand the canonical trajectory, or saddle path, of an economy, so that, given certain exogenous and random shocks, the economy can return to its steady state along the predicted canonical trajectory. For example, Corrigan et al. (2021) developed a third-generation DSGE model, known as ToTEM III, to produce forecasts and conduct monetary policy analysis for the Canadian economy. Broadly speaking, this strategy is highly useful for guiding central banks' decision-making. However, it cannot account for all those alternative scenarios that might arise if some of the model's background conditions or rules were not met.

Simulation models such as ABMs can, in this sense, serve as a valuable complement to DSGE models. Continuing with the example of the Bank of Canada, Hommes et al. (2025) present an ABM-based simulation model, CANVAS, that captures a range of scenarios not considered in ToTEM III. This strategy is not intended to dispense with DSGE models. On the contrary, CANVAS seeks to complement the knowledge derived from ToTEM III predictions. For example, in some situations, CANVAS may yield conclusions similar to those of ToTEM III. In cases like this, we may be referring to a robustness analysis (Kuorikoski et al. 2010). However, in other runs, CANVAS may show that a small bank failure, through contagion and feedback between

agents at the *meso*-level, ultimately generates a global financial crisis—something that no one regarded as likely within the logic of ToTEM III, in particular, or DSGE models in general.

When a simulation model reveals this type of dynamics, it produces a set of possible scenarios that help us understand risks that would otherwise go unnoticed. In a DSGE model, contingency is treated as strictly exogenous and random, as with technological or financial shocks. ABMs not only take this possibility into account but also, by incorporating an intermediate or meso-level, open the door to a multiplicity of interactions that may, among other things, lead to endogenous crises. In this sense, depending on how the network and its respective nodes are configured, different outcomes may emerge. This strategy helps address contingency more effectively by enabling a broader range of responses to questions about what would happen if things were otherwise.

Simulations, by virtue of their iterative nature, also give rise to recursive dynamics (Axtell and Farmer 2025; Jackson and Cottingham 2000; Railsback and Grimm 2019; Roos 2024). We should note, however, that recursion is not exclusive to simulations. As discussed above, recursion is also present in both economic models with representative agents (e.g., Stokey et al. 1989) and simple homeostatic mechanisms such as thermostats. The kind of recursion that is of particular interest to us, however, is the one proposed by Hui (2019), in which feedback alters not only the system's behaviour but also its very rules. Recursion is not, in itself, a mathematical impossibility. The real difficulty lies in formalizing a type of recursion that operates at the level of the system's rules. This is where simulations become especially relevant, not because they lack formal structure, but because they allow rules to change over time and different trajectories to emerge unintentionally.

Once again, this should not be interpreted as a categorical rejection of the models of analogue economies. These models possess a degree of tractability that allows highly specific mechanisms to be analysed with both simplicity and formal precision. What we do maintain, instead, is their complementarity with simulation models, whose computational capacity enables exploration of complex recursive scenarios in which pre-established rules may evolve into different behavioural patterns, many of which are unthinkable ex ante.

Returning to the example of DSGE models used by central banks, recursion refers to changes in the values of certain variables that feed back into the model, such as capital, inflation, or productivity. The representative agent observes the current state of the economy and, based on this information, decides on consumption and savings. These decisions will affect the values of capital and productivity, which then feed back into the decision-making process in the following period. Even when random shocks are introduced, the rules remain unchanged, as does the model's structure. The problem arises when we seek to describe situations in which the rules themselves change in response to what has happened before. We may imagine a financial system in which a firm defaults. If the firm is small, it is unlikely to provoke significant consequences for such a system. But if it is a major firm, its default may generate uncertainty, push other firms into default, and eventually lead banks to tighten credit and revise their risk assessments. It should be noted that, rather than a fluctuation in relevant model variables, a change in the rules of the game occurs. It can, however, be captured by ABMs, in which agents can modify their own rules. The form of recursion involved here is not simply a matter of repeating the same problem within the same system of equations, but of allowing the process itself to generate, endogenously and unintentionally, new rules whenever necessary.

In this sense, central banks, like firms or governments, should not give up every attempt at orientation. Instead, what is being questioned is the idea that such orientation must be organized solely around an equilibrium or some order assumed in advance. If one starts from contingency, agents' actions are understood not merely as the search for an optimal solution but also as involving learning and adaptability. This is the case of the Bank of Canada, which, although it uses DSGE models to follow a canonical trajectory, does not limit itself to it, but also considers, through ABM models, a range of alternative scenarios that a DSGE model like ToTEM III, by their very logic, cannot capture. In this way, alongside a general target, it is also important to consider what might happen if the initially stipulated conditions are not met, thereby allowing greater adaptability and course correction when needed.

Naturally, simulation models also face major limitations, and this is one of the main reasons for speaking of complementarity between them and traditional

economic models. First, simulation models suffer from epistemic opacity: multiple inferential chains are intertwined, making it difficult to understand how the model's assumptions connect to its results (Beisbart 2021; Grüne-Yanoff and Weirich 2010; Humphreys 2004). There are also problems with validation: the fact that a simulation model can reproduce a given empirical pattern does not constitute proof that it has captured the real underlying mechanism (Oreskes, Shrader-Frechette, and Belitz 1994). The patches or fixes introduced into simulation models to ensure that computation can proceed smoothly ultimately make the results highly sensitive to implementation decisions, complicating their epistemic interpretation (Winsberg 2010).

In sum, while the economic models, insofar as they are grounded in internal validity, can be useful for showing with great clarity how highly specific mechanisms operate, they also suffer, for the very same reasons, from problems of external validity. These models may provide information about what would happen under highly specific circumstances, but very little about what would happen if any of those conditions were not met. This is problematic for the study of absolute contingency, which, as a primitive element, raises the possibility that even the most basic assumptions might differ. In this sense, we see simulation as a tool that, despite its own limitations, can complement traditional economic modelling. Far from being a tool that provides us with rigor and accuracy, simulations allow us to explore, among other things, what would happen if things were different – from changes in the background conditions to changes in the rules of the game itself. And what is even better, these changes are not considered 'random noise', but rather feedback that opens the door to recursive learning.

Concluding remarks

The ideas of order and equilibrium occupy a central place in economic thought. In some cases, it has been argued that they emerge simply from the interaction of economic forces. In others, it has been claimed that the economy does not reach an optimal equilibrium and that state intervention is therefore required. In still others, the dynamics of interaction between agents and with their environment are seen as tending toward instability. And so on.

In this paper, we present an analysis of the idea of order and equilibrium, examining it in relation to the notion of contingency. In general, contingency is modelled as a secondary factor that disrupts an ordered system. Drawing on Meillassoux's (2008) and Hui's (2019) accounts of absolute contingency, we propose a shift in the status of order and contingency. Order and equilibrium, which usually appear as starting points in economic analysis, are instead treated here as secondary elements, that is, as possibilities in a world whose starting point is contingency. From this perspective, we argue for the metastable condition of economic systems: systems that do not naturally tend toward order yet, in principle, can maintain a certain stability for a time. However, the structures that give rise to such stable behaviours should be understood as configurations that are always open to further reconfiguration.

The openness of these systems to contingency has allowed us to see those economic entities and variables, their forms of knowledge, and the practices of economic agents are dimensions that interact within a dynamic open to contingency and recursivity. Nevertheless, when we speak of recursivity, we do not mean a simple form of recursion in which feedback affects the system's behaviour, but a more sophisticated one in which the system's own underlying structure is itself liable to change. Within this framework, contingency is no longer seen as random noise to be eliminated; it becomes a constitutive part of how a system behaves, learns, and transforms.

The paper also suggests a methodological consequence. It has been shown that traditional economic models—what Lucas (1981) called *analogue economies*—focus on deductive rigor and on deriving results about what might happen under very particular circumstances. Cartwright (2005) has shown that this is both a virtue and a problem, in the sense that the internal validity of this kind of model comes at the expense of its external validity. In this respect, we have proposed that simulation models, such as ABMs, can serve as a valuable complement for exploring what would happen under different circumstances.

Conflict of Interest Statement

The authors declare that they have no conflicts of interest to disclose.

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