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CRITICAL REALISM AND ECOLOGICAL ECONOMICS: COUNTER-INTUITIVE ADVERSARIES OR OSTENSIBLE SOULMATES?

Abstract: *The paper questions the compatibility of critical realism with ecological economics. In particular, it is argued that there is radical dissonance between ontological presuppositions of ecological economics and critical realist perspective. The dissonance lies in the need of ecological economics to state strict causal regularities in socio-economic realm, given the environmental intuitions about the nature of economy and the role of materiality and non-human agency in persistence of economic systems. Using conceptual apparatus derived from Andrew Brown's critique of critical realism and Bruno Latour's actor-network theory, the paper refuses ontological nature/society dualism employed by critical realism, and stresses the role of non-humans in practical production and reproduction of socio-economic networks on the one hand, and in broadly defined ecological economic research on the other hand.*

Keywords: *ecological economics; actor-network theory; causality; collective events; critical realism; non-human actors; nature/culture dualism*

Kritický realismus a ekologická ekonomie: neintuitivní protivníci nebo zřejmí spojenci?

Abstrakt: *Příspěvek poukazuje na neslučitelnost ontologických předpokladů ekologické ekonomie s teoretickým rámcem kritického realismu. Ekologická ekonomie totiž potřebuje předpokládat existenci kauzálních pravidelností ve společnosti a ekonomice, nakolik musí zůstat věrná svým před-teoretickým intuicím o povaze ekonomiky, rovněž jako o roli materiality i ne-lidských aktérů pro existenci ekonomických systémů. V článku se pracuje s konceptuálním aparátem oponenta kritického realismu Andrewa Browna a s teorií aktérů-sítí Bruna Latoura. Na tomto základě pak článek odmítá ontologický dualismus přírody a kultury. Závěrem pak článek upozorňuje na dvojitou roli ne-lidských aktérů v praktické produkci/reprodukci společensko-ekonomických sítí a v široce pojatém ekologicky ekonomickém výzkumu.*

Klíčová slova: *ekologická ekonomie; teorie aktérů-sítí; kauzalita; kolektivní události; kritický realismus; ne-lidští aktéři; dualismus přírody a kultury*

LUKÁŠ LIKAVČAN

Department of Environmental Studies
Faculty of Social Sciences, Masaryk University
Joštova 10, Brno 602 00
email / 362455@mail.muni.cz

1. Introduction

Tony Lawson is widely acknowledged as one of the major contemporary philosophers of economics. He follows the school of critical realism set up by Roy Bhaskar's theory of *transcendental realism*,¹ and applies Bhaskar's general philosophy of science and social ontology in economic philosophy. In last decade, critical realism in Lawson's interpretation emerged as an attempt to unify various heterodox economic schools. Lawson states that in social world, strict causal regularities of the form "When X then Y" are extremely rare.² That means it provides alternative ontology to mainstream economics, where strict causal regularities are presupposed. However, it remains open how this philosophical school should be adopted by ecological economics. The argument presented here supports the assumption that if ecological economics were really to embrace the critical realism as its own paradigmatic theory, it would be in conflict with central pre-analytic vision of ecological economics, as formulated e.g. by Clive Spash: economy is an inseparable part of the ecosystem in which it is situated.³ Such a vision has certain ontological consequences that conflict with Lawson's account of social reality and social agency. In particular, ecological economics implicitly supports an ontological account in which society and nature are not in hierarchical relation, but are parts of the same ontological region. It implies also that the boundaries between nature and society collapse and such a dualist framework then appears as inadequate ontological model. In essence, the blurring of nature/culture dichotomy is a central idea this paper follows.

At least two general motivations regarding discussion about compatibility of critical realism and ecological economics can be found:

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¹ Roy BHASKAR, *A Realist Theory of Science*. London – New York: Routledge 2008.

² Clemens HIRSCH – C. Tyler DESROSCHEs, "Cambridge Social Ontology: An Interview with Tony Lawson." *Erasmus Journal for Philosophy and Economics*, vol. 2, 2009, no. 1, pp. 113–114 (100–122).

³ Clive L. SPASH, "New Foundations for Ecological Economics." *Ecological Economics*, vol. 77, 2012, pp. 44–45 (36–47).

1. Tony Lawson proposes critical realism as a unifying philosophical paradigm for heterodox economics.⁴ Besides post-Keynesian, feminist or Marxist economics, the contemporary ecological economics can be equally included under this umbrella term. Critical realism is meant to provide solid ontological and methodological groundings for all these various economic studies. That could prove useful, since nowadays schools of ecological economics seem to rest in unstructured methodological pluralism, eclectics and overproduction of puzzling and contradictory presuppositions.⁵
2. Critical realism has already been a trending topic in ecological economics, and in some sciences, such as critical management studies or human geography, it has recently emerged as one of the paradigmatic theories.⁶ Hence the critical discussion should add some limits to what extent the critical realism is applicable for ecological economics.

Given the pre-analytic vision of ecological economics, we need to presume that strict causal regularities are not rare in the socio-economic realm. For example, the following statement proposes strict regularity: "Intensification of industrial production in China leads to rising levels of CO₂ in atmosphere." Another example is: "An economy cannot grow indefinitely in a finite world," i.e. more growth implies more ecological turbulences. In uttering such statements, one posits some regularly occurring causal relation between economic activity and natural processes. These statements are analysed as examples of *collective events* defined by Andrew Brown.⁷ Such statements are standard for practically all branches of environmental science and if it were true that they cannot be proposed, a huge part of ecological research would be cast out as irrelevant. Thus, regarding ecological economics, we need to presuppose the existence of strict causal regularities in socio-economic realm, contrary to what Lawson proposes.

Moreover, the paper goes one step further even from Brown's analysis. An alternative notion of social actor is introduced, because in critical realism, this notion is too narrow to include some key economic actors – notably

⁴ Tony LAWSON, "The Nature of Heterodox Economics." *Cambridge Journal of Economics*, vol. 30, 2006, no. 4, p. 484 (483–505).

⁵ SPASH, "New Foundations for Ecological Economics," p. 40.

⁶ HIRSCH – DESROSCHES, "Cambridge Social Ontology," p. 103.

⁷ Andrew BROWN, "Reorienting Critical Realism: A System-Wide Perspective on the Capitalist Economy." *Journal of Economic Methodology*, vol. 14, 2007, no. 4, pp. 499–519.

the non-human parts of the environment in which the economy is situated. To address this issue, Bruno Latour's *actor-network theory* (ANT) is used.⁸ In terms of ANT, the nature of socio-economic reality is reconsidered and the question of elementary parts of social assemblage is newly answered

Here is an itinerary of the paper. In Section 2, the kernel of ecological economics is briefly sketched. Section 3 describes critical realism's social ontology and Lawson's critique of economic mainstream, connected to an argument against the existence of strict regularities in socio-economic realm. The following Section 4 presents Andrew Brown's notion of collective events, which opens up the possibility to propose strict causal regularities in economics anew. Further discussion of Lawson's as well as Brown's own ontology takes place in Section 5, where the perspective of ANT is introduced. Concluding Section 6 points at the modernist notion of science and the blurring boundaries between nature and culture.

2. Ecological Economics

As probably in all recently emerged disciplines, the standard definition of what is ecological economics is not yet established. However, we can trace several core features that distinguish this field of study as a separate scientific discipline. Following some key authors – such as Herman Daly, Robert Constanza, Kenneth Boulding, Clive Spash, Inge Røpke or Silvio Funtowicz – the mostly agreed characteristics of ecological economics are:

1. *Insistence on ethical dimension* of economic practices.⁹
2. *Intertwining natural and social sciences* in order to describe the interconnections between human actions and ecosystem mechanisms.¹⁰

⁸ See Bruno LATOUR, *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press 2005; Bruno LATOUR, *We Have Never Been Modern*. Cambridge, Mass. Harvard University Press 1993.

⁹ Clemens L. SPASH, "The Development of Environmental Thinking in Economics." *Environmental Values*, vol. 8, 1999, no. 4, p. 413 (413–435); SPASH, "New Foundations for Ecological Economics," p. 45; Silvio O. FUNTOWICZ, S. – Jerome R. RAVETZ, "The Worth of a Songbird: Ecological Economics as a Post-Normal Science." *Ecological Economics*, vol. 10, 1993, no. 3, p. 205 (197–207).

¹⁰ SPASH, "The Development of Environmental Thinking in Economics," p. 424; Inge ROPKE, "The Early History of Modern Ecological Economics." *Ecological Economics*, vol. 50, 2004, no. 3–4, p. 294 (293–314).

3. *Inspiration as well as critical distance from other heterodox traditions in economics, such as institutional, Marxist or feminist economics.*¹¹
4. *Strong orientation on policy-making*, which is a consequence of conscious normative groundings of ecological economics.¹²
5. *Irreducible value pluralism*, that is essential in grasping the problems of democratic negotiation of environmental policies.¹³

These characteristics draw from the general intuition of ecological economics, as formulated by Inge Røpke:

The basic observation in ecological economics is banal and difficult to disagree with: *the human economy is embedded in nature*, and economic processes are also always natural processes in the sense that they can be seen as biological, physical and chemical processes and transformations [...] The basic idea of what becomes ecological economics is that the economy ought to be studied also, but not only, as a natural object, and that economic processes should consequently also be conceptualized in terms usually used to describe processes in nature.¹⁴

Spash and Johanisová coined this proposition (italics in quotation above) as a *pre-analytic vision* of ecological economics.¹⁵ It can be also articulated as follows: economy is an inseparable part of the ecosystem in which it is situated.¹⁶

At this point, one shall argue that the same can be attributed to environmental economics, understood as an attempt to extend the narrow-minded interpretation of what enters into mainstream economic analysis with environmental factors (both in terms of preconditions and consequences of economic activity), usually counted as mere externalities. The difference between ecological and environmental economics is however methodologically as well as ontologically insurmountable, for environmental economics does not take economic activity as genuinely biophysical. Moreover, it only “internalizes externalities”, i.e. evaluates ecosystems and their services in

¹¹ SPASH, “The Development of Environmental Thinking in Economics,” p. 413.

¹² *Ibid.*, p. 425; SPASH, “New Foundations for Ecological Economics,” p. 45; FUNTOWICZ – RAVETZ, “The Worth of a Songbird,” p. 206.

¹³ SPASH, “The Development of Environmental Thinking in Economics,” p. 425; ROPKE, “The Early History of Modern Ecological Economics,” p. 294.

¹⁴ ROPKE, “The Early History of Modern Ecological Economics,” p. 294.

¹⁵ SPASH, “New Foundations for Ecological Economics,” pp. 36–47; Naďa JOHANISOVÁ, *Ekologická ekonomie: vybrané kapitoly*. Brno: Masarykova univerzita 2014.

¹⁶ SPASH, “New Foundations for Ecological Economics,” p. 44–45.

terms of mainstream economic methodology. For this reason, environmental economics is completely out of scope of this paper.

Let me explain now a case of typical analytic apparatus of ecological economics. We can start from the Georgescu-Roegen distinction between three elements of economy: *stocks*, *funds* and *flows*. Imagine the economy as a giant organism that has certain inputs and certain outputs.¹⁷ In such a system, materials and energy flow through it. The inputs can be sorted into two categories. An input of the first type is a *fund*. The most common fund is solar energy, which is always used only at the particular rate (i.e. it is not a subject of depletion) and as such it cannot be stockpiled without being captured in some specific energy carrier. The second type is a *stock*, which means (besides other characteristics) that it can be stockpiled and once entering the system, it is a subject of various transformations and can be depleted (the *rate* of extraction is not limited by the nature of the resource). Stocks are basically the sources of energy carriers, such as oil, gas or coal. Given these definitions, a *flow* can be understood as a stream of energy carriers through the system.¹⁸

How is the economy conceived in this approach? In case of global terrestrial ecosystem, the primary fund is solar energy.¹⁹ This energy is consumed by various strategies, e.g. photosynthesis. In limiting cases, it can be trapped for some time. That is the case of fossil fuels, which are virtually the rays of sun caught in the organic material that was accumulated under the surface

¹⁷ It is important to note that the metaphor of organism is widely used across various social scientific disciplines. In general, the use of metaphor in scientific explanation is usually ignored or belittled, but its omnipresence is nevertheless self-evident, from sociology or economics to political science and philosophy. See Zuzana KOBÍKOVÁ – Jakub MÁCHA, “From Metaphor to Hypertext: An Interplay of Organic and Mechanical Metaphorics in the Context of New Media Discovering,” *8th AISB Symposium on Computing and Philosophy*: 20–22.4.2015; Thomas S. KUHN, “Metaphor in Science.” In: ORTONY, A. (ed.), *Metaphor and Thought*. Cambridge: Cambridge University Press 1979, pp. 409–419.

¹⁸ According to Herman E. DALY – Joshua FARLEY, *Ecological Economics. Principles and Applications*. Washington: Island Press 2011, pp. 70–72. See also Arnim SCHEIDEL – Alevgul H. SORMAN, “Energy Transitions and the Global Land Rush: Ultimate Drivers and Persistent Consequences,” *Global Environmental Change*, vol. 22, 2012, no. 3, pp. 589–590 (588–595).

¹⁹ Nicholas GEORGESCU-ROEGEN, “Energy and Economic Myths,” *Southern Economic Journal*, vol. 41, 1975, no. 3, p. 369 (347–381); see also Kenneth E. BOULDING, “The Economics of the Coming Spaceship Earth.” In: JARRETT, H. (ed.), *Environmental Quality in a Growing Economy: Essays from the Sixth RFF Forum*. Baltimore: John Hopkins University Press 1966, p. 5 (3–14).

for hundreds of millions of years.²⁰ The procreation of fossil fuel stands as an example of the situation when a stock is created. It carries initial solar energy that can be unleashed by series of activities, such extraction, refining and combustion in our case of oil. Moreover, it can be materially transformed (e.g. oil can be converted into numerous types of plastics).

From this point of view, economy does not resemble a closed cycle of money and commodities between supply and demand. Instead, a picture of organic *metabolism* arises. It is particularly important to stress that ecological economics introduces biophysical processes as central to the existence of economy. We end up with a picture of economics as analysis of material and energy flows through the system, because as the matter of fact, economy is a system of material processes and it ought to be studied in this respect.²¹

Henceforward, ecological economics balances between natural and social scientific approach. It frequently crosses the borders between realms of physical reality and social constructions, in order to include all objects that count in real-world economy for the purpose of adequate explanation its structuration and dynamics. It follows that sometimes, ecological economics states propositions claiming strict causal regularities of the form “If A, then B always follows,” as in the case of the platitude that *we cannot grow indefinitely in a finite world*.²² Such a general assertion is a hidden declaration of causal relation between growth of economy and the stability/resilience of global ecosystem – the more growth you have, so worse for the ecosystem. Taking ecosystem stability and resilience as central abilities for its defence against disrupting exogenous factors, growth of economy increases stability but lowers the resilience of the system, i.e. it leaves the system vulnerable to exogenous factors and also uncovers structural problems that are in many cases just accidents waiting to happen.²³ Growth of economy as an imperative of capitalism is intrinsically connected with existence of cheap and accessible energy resources.²⁴ That brings us back to fossil fuels. Evidence from energy studies, namely in research on Peak-Oil, suggests another causal

²⁰ Christian KERSCHNER, “Economic De-Growth vs. Steady-State Economy.” *Journal of Cleaner Production*, vol. 18, 2010, no. 6, p. 546 (544–551).

²¹ GEORGESCU-ROEGEN, “Energy and Economic Myths,” p. 350.

²² See e. g. BOULDING, “The Economics of the Coming Spaceship Earth,” pp. 3–14.

²³ Crawford S. HOLLING, “The Resilience of Terrestrial Ecosystems: Local Surprise and Global Change.” In: CLARK, W. C. – MUNN, R. E. (eds.), *Sustainable Development of the Biosphere*. Cambridge: Cambridge University Press 1986, pp. 296–297, 308, 311 (292–317).

²⁴ Charles A. S. HALL – David J. MURPHY, “Energy Return on Investment, Peak Oil, and the End of Economic Growth.” *Annals of the New York Academy of Sciences*, no. 1219, 2011, p. 52 (52–72).

regularity within current economic system – the predominant depletion of fossil fuels that is a necessary precondition to maintain capitalism.²⁵ These examples will be further investigated in Section 4.

3. Critical Realism

Generally speaking, critical realism can be introduced as a version of social ontology. By social ontology, it is meant here philosophical endeavour challenging the questions of basic existences that are units of social analysis. For example, when economist formulates theory of economic behaviour, she presupposes certain agents (e.g. firm) with certain properties (e.g. organisational structure, sets of preferences) and other entities that interfere with these agents (e.g. commodities, money). Moreover, critical realism is a realist ontology, i.e. it poses an existence of external reality behind the perceiving subject – there is simply some “world out there”, independent on the perception.²⁶ Crucially, critical realism states that social reality is fundamentally different from natural reality, thus we can distinguish between two ontological “layers” that enjoy certain level of mutual autonomy.²⁷ The exact relation between those layers is the one of *emergence*: properties of entities situated in “higher” level are dependant but not reducible to properties in “lower” layer.²⁸ For example, economic actors exist only insofar there are atoms and molecules in the universe, but it is nonsensical to reduce those actors to sole atoms and molecules and explain their economic behaviour in terms of particle physics. Similarly, according to critical realism, social institutions exist insofar as there are conscious human beings, but these institutions are more than simple conglomerates or concatenations of individuals – they are emergent structures irreducible to individuals. Thus social and natural layers are *ontologically dissociated*. Nature is the realm

²⁵ KERSCHNER, C. et al., “Economic Vulnerability to Peak Oil.” *Global Environmental Change*, vol. 23, 2013, no. 6, pp. 1424–1425 (1424–1433); KERSCHNER, C., “Peak-Oil.” In: D’ALISA, G. – DEMARIA, F. – KALLIS, G. (eds.), *Degrowth: A Vocabulary for a New Paradigm*. London: Routledge 2015, p. 131 (129–132); Andreas MALM, *Fossil Capital*. London: Verso 2016.

²⁶ Margaret ARCHER, “Introduction: Realism in the Social Sciences.” In: ARCHER M. et al. (eds.), *Critical Realism: Essential Readings*. London – New York: Routledge 1998, pp. 194–195 (189–205).

²⁷ ARCHER, “Introduction: Realism in the Social Sciences,” p. 189. For *stratification*, see also Roy BHASKAR – Tony LAWSON, “Introduction: Basic Texts and Developments.” In: ARCHER et al. (eds.), *Critical Realism*, p. 6 (3–15).

²⁸ BHASKAR, *A Realist Theory of Science*, pp. 102–103.

of iron causal rules; society functions in terms of ever-changing dialectical dynamics.²⁹

Critical realism further employs these assumptions to tackle methodology of mainstream economics.³⁰ Notably, critical realism insists that despite mathematic analysis proved to be fruitful methodology in physics (situated in layer 1), it is not decisive reason for its application in sociology or economics (situated in layer 2).³¹ Social reality has to be treated as dynamic, processual, continually reproduced and transformed by social practice, structured, meaningful, valuable, relational and morphogenetic.³² It follows that “[...] social reality is found not to comprise parts that are isolated, for more or less *everything seems to be constituted in relation* to other things. And components cannot be treated as atomistic or stable, for *each is being continually transformed*.”³³ This conclusion is supported by our *a posteriori* observation of recurring failures to predict economic events by mainstream economics, or by dissonances between electoral polls and real results. Consequently, social reality is in critical realism evidently open and unpredictable. Hence one shall pay good attention to the methods that one uses in approaching social reality. Let me closely explain these statements.

Critical realism obviously stands in sharp contrast with underlying ontological and consequently methodological presuppositions of mainstream economics. In particular, critical realism proposes social ontology that leaves the methodology of mainstream economics inadequate. The latter studies socio-economic layer by means of formal-deductive method that according to critical realism does not meet the essential ontological features of this layer. Thus Lawson criticizes mainstream economics for being ultimately exclusive in relation to any other method than quantitative, formal-deductive method of econometrics. He traces this insistence back to the three interconnected propositions mainstream economics rests upon:

²⁹ ARCHER, “Introduction: Realism in the Social Sciences,” p. 195.

³⁰ According to Lawson, the definition of mainstream economics can be stated in following terms: “the mainstream project of modern economics just is an insistence, as a discipline-wide principle, that economic phenomena be investigated using only certain mathematical–deductive forms of reasoning.” LAWSON “The Nature of Heterodox Economics,” p. 492. See also Tony LAWSON, “Economic Science Without Experimentation / Abstraction.” In: ARCHER et al. (eds.), *Critical Realism: Essential Readings*, pp. 144–186.

³¹ LAWSON “Economic Science Without Experimentation / Abstraction,” p. 163, 169.

³² LAWSON, “The Nature of Heterodox Economics,” pp. 495–496; see also Tony LAWSON, *Reorienting Economics*. London – New York: Routledge 2003, pp. 16–17.

³³ HIRSCH – DESROSCHES, “Cambridge Social Ontology,” p. 114.

1. *Event regularities*:³⁴ Formal-deductive models presuppose the existence of strict causal regularities in social world of the form “If A, then B always follows,”³⁵ e.g. “Increase in oil prices (A) causes inflation (B).” The presence of event regularities in a system means that given system is *intrinsically closed*.³⁶
2. *Isolated atoms*: The causal explanations of economic phenomena can be formulated in terms of “isolated atoms”.³⁷ These isolated events or objects can be represented as *factors* that are elements of the causal nexus.³⁸ In oil price-inflation nexus, increase in oil prices is such an isolated, atomic factor.
3. *System isolation (separability)*: The system which displays causal regularities is separated from external influences, i.e. it is *extrinsically closed*.³⁹ Lawson states this condition in following terms: “[...] if the factor is triggered—this triggering is the first event—the *same outcome, the second event, always follows*, so long as nothing interferes. It is the assumption of *system isolation* that guarantees that nothing does interfere.”⁴⁰ In case of oil price caused inflation, it means that if no third distinct element occurs (e.g. sudden shift in demand), the causal relation always holds.

Any system that displays causal regularities must fulfil these three premises and is labelled as *closed system* in terminology of critical realism. While closed system is defined in terms of extrinsic and intrinsic closure [premises 1) and 3)], critical realism also distinguishes *open systems*, where multiple causal mechanisms operate simultaneously and thus it is impossible to determine single causal factor that repeatedly triggers the same outcome.⁴¹ Neither intrinsic, nor extrinsic closure takes place in a system of this kind. According to critical realism, socio-economic realm is precisely the paradigmatic case of an open system (because of its relational and dynamic features)

³⁴ “Event regularities” and “(strict) causal regularities” are used interchangeably.

³⁵ HIRSCH – DESROSCHEs, “Cambridge Social Ontology,” p. 113. See also BHASKAR, R. – LAWSON, T., “Introduction: Basic Texts and Developments,” pp. 14–15.

³⁶ ARCHER, “Introduction: Realism in the Social Sciences,” p. 190.

³⁷ LAWSON, *Reorienting Economics*, p. 225.

³⁸ HIRSCH – DESROSCHEs, “Cambridge Social Ontology,” p. 113.

³⁹ LAWSON, *Reorienting Economics*, p. 224; ARCHER, “Introduction: Realism in the Social Sciences,” p. 190.

⁴⁰ HIRSCH – DESROSCHEs, “Cambridge Social Ontology,” p. 113.

⁴¹ Ted BENTON, “Realism and Social Science. Some Comments on Roy Bhaskar’s ‘The Possibility of Naturalism.’” In: ARCHER et al. (eds.), *Critical Realism: Essential Readings*, p. 300, 308 (297–312).

and it follows that genuine strict regularities – similar to the iron causal rules of nature – do not occur here.⁴²

Econometrics is thus ontologically inadequate method for economic science, since socio-economic systems are not closed, granted the features of social reality enlisted above, such as relationality.⁴³ Against premise 2), relationality alone contradicts any possibility of atomization of social system.⁴⁴ Furthermore, meaningfulness of social realm implies discrepancy with premise 3), since social systems are always open to new articulation and re-interpretation, which leads to impossibility of any systematic isolation.⁴⁵ Imposing formal-deductive quantitative methods on society or economy violates their structuration and dynamics, and the models these methods yield are inherently biased in this respect.

4. Collective events

Let us problematize assumptions of critical realism. What's the drawback of exorcizing strict regularities from social reality, as critical realism attempts for? In general, the problem is that social realm sticks together by practices of social actors. It is not an abstract structure imposed on material world – social structure is continuously produced, shaped and re-shaped in practices situated in the material world. Indeed, it is trivial to assert that social norms are parts of social system. However, these norms exist only in practice and so the system as such persists as long as certain rules are being recurrently obeyed. A recurrence of certain practice in predominant population of social actors is thus a necessary condition for persistence of given socio-economic system, or – as Andrew Brown would say – an *organic necessity* of the system.⁴⁶ To grasp the socio-economic network adequately, we have to give an account of *key causal regularities* that are reproduced in the system.

What are the features of these key regularities? Brown labels them as *collective events*. By using this notion, he tries to show that “the contemporary economic system displays many strict event regularities, and is in this

⁴² ARCHER, “Introduction: Realism in the Social Sciences,” p. 190.

⁴³ Roy BHASKAR, “Societies.” In: ARCHER et al. (eds.), *Critical Realism: Essential Readings*, p. 225 (206–257).

⁴⁴ HIRSCH – DESROSCHES, “Cambridge Social Ontology,” p. 114.

⁴⁵ ARCHER, “Introduction: Realism in the Social Sciences,” p. 189.

⁴⁶ BROWN, “Reorienting Critical Realism,” p. 510.

sense ‘closed’ *contra* critical realism.⁴⁷ The definition of collective event is the following one:

When taking a system-wide, historical perspective on capitalism, an [collective] “event” is defined over a collection of individuals across the capitalist system [...] as follows: “many individuals go to work for a wage”, “many capitalist firms produce in order to make profit”, “there is ubiquitous buying and selling of commodities” [...] Collectively defined events characteristic of capitalism (henceforth termed “collective events”), so formulated, could also be termed “states of affairs”.⁴⁸

It is important to stress that collective events are detectable only at system-wide perspective. Brown acknowledges that from an individual perspective, critical realism appears to be correct, because an individual cannot grasp the system at large – in his or her immediate context, reality can seem to be pretty irregular.⁴⁹ But once we abandon an individual perspective, collective events are traceable in given social system. What are the characteristic features of such events? Here we can list these four:

1. Collective events are *empirically unobservable*, i.e. we never see *many* individuals going to work, but always only some small subset of individuals at given spatiotemporal coordinates.
2. They typically appear during a longer period of time.
3. An utterance of collective event is indicated by operators as “many”, “large”, “predominant”, etc.
4. The persistence of given socio-economic system presupposes an occurrence of collective events.⁵⁰

For example, to make the capitalist system viable, the permanent transaction of money for commodities and back to more money at certain level has to occur.⁵¹ Another case is the depletion of cheap and accessible energy resources mentioned in Section 2. Certain practices need to be conducted in sufficiently large amount in order to preserve the system. Thus to state that

⁴⁷ *Ibid.*, p. 501.

⁴⁸ *Ibid.*, p. 508.

⁴⁹ *Ibid.*

⁵⁰ According to BROWN, “Reorienting Critical Realism,” pp. 508–509.

⁵¹ M-C-M’ formula, see Karl MARX, *Capital. Volume 1*. London: Penguin Books 1976, pp. 250–251.

we live in capitalism means to bind oneself to some ontological assumptions – namely that there are regularly occurring events. It means that we propose a *self-reproducing mechanism*, verbalized as an assertion of strict causal regularity of the form “When X then Y”, or to be more concrete, of the form “When $C(t)$ then $C(t+1)$ ”, where C is a collective event and t is a period when C occurs.⁵² That is exactly the case of fossil fuel extraction in capitalism⁵³ – to maintain the growth-based extractive capitalism, and thus also to maintain an extraction of fossil fuels at $t+1$, the predominant extraction of fossil fuels at t must be the case. To extract an energy resource, you need some energy – and that energy can be gained only by extraction of a resource in a preceding period of time.⁵⁴

Collective events are precisely what is grasped in analysis of ecological economics. Claiming for example that an economic growth is associated with the relative growth in extraction of main energy resources⁵⁵ is not to assert mere correlation, but a *concatenation of collective events explicable as causal regularity*. Blurring the boundaries between natural and social sciences in study of socio-economic system, manifested also in pre-analytic vision of ecological economics, enables to formulate strict event regularities, because an ontological realm of social reality is inseparable from nature.⁵⁶ This inseparability of social and natural can be clearly seen in ecological economic analysis, where socio-economic system is driven by forces of thermodynamics and is bounded by principal mechanisms of global ecosystem.

To sum up this section, in ecological economics, economy is not only embedded in, interfering with or connected to ecosystem, it is an intrinsic part of the ecosystem itself. As far as the ecosystem is assembled from natural, biophysical objects, it follows that economic relations and activities are also biophysical. And by biophysical it is meant displaying certain strict event regularities understood as collective events. Thus, to conduct ecological economic research means to formulate strict causal regularities, if one wishes to stay faithful to the pre-analytic vision of this discipline. Ecological economics thus conflicts with the ontology of critical realism.

⁵² BROWN, “Reorienting Critical Realism,” p. 510.

⁵³ MALM, *Fossil Capital*.

⁵⁴ KERSCHNER, “Peak-Oil,” p. 131.

⁵⁵ HALL – MURPHY, “Energy Return on Investment,” p. 54; MALM, *Fossil Capital*.

⁵⁶ Jason W. MOORE, *Capitalism in the Web of Life*. London: Verso 2015, p. 7.

5. Materiality/Who acts?

Brown's notion of collective events and his critique of critical realism is connected with the argument that we can't abstract from reproductive social practice when we think about the persistence of given socio-economic system.⁵⁷ As far as the notion of practice is essentially connected with our conception of social agency, this statement opens up two interdependent sets of questions:

1. Who are social actors? Is the scope of social agency restricted solely on human beings? Is there any room for *non-human* actors?
2. What is the role of *materiality* in persistence of social systems? Are material objects mobilised in social relations to actively engage in persistence of given system?

By using Bruno Latour's *actor-network theory* (ANT), my contention is that from the perspective of ecological economics, a) social (or economic) agency cannot be restricted on human beings, and b) material objects are actively engaged in persistence of given socio-economic system. Latour in general follows the line of Deleuzian *assemblage theory*.⁵⁸ Assemblages emerge as networked systems across various segments of heterogeneous actors. Such systems can be analysed simultaneously in their separate parts as well as in their irreducible properties emerging through complex interaction, because the Deleuzian of *relations of exteriority*⁵⁹ hold here: "[...] the exteriority of relations implies a certain autonomy for the terms they relate, or as Deleuze puts it, it implies that 'a relation may change without the terms changing'."⁶⁰ As a consequence, the properties of the component parts "[...] can never explain the relations which constitute a whole."⁶¹ Links between the parts are analytically and ontologically prior to the parts themselves.

Bruno Latour operationalizes assemblage theory in terms of actor-networks and provides sound argumentation against predominant notion of social agency, which employs dualist framework of social structures emerging from interactions between human agents. Such an anthropocentric definition of social actor can be contested by the idea of *materiality* – "[...]

⁵⁷ BROWN, "Reorienting Critical Realism," pp. 512–513.

⁵⁸ Gilles DELEUZE – Félix GUATTARI, *A Thousand Plateaus*. Minnesota: University of Minnesota Press 1987.

⁵⁹ *Ibid.*, p. 9.

⁶⁰ Manuel DELANDA, *A New Philosophy of Society*. London: Continuum 2006, pp. 10–11.

⁶¹ *Ibid.*, p. 11.

the notion that social existence involves not only actors and social relations but also objects.”⁶² The very definition of actor in ANT springs out from the acceptance of materiality as inherent part of social. Actor (or *actant*)⁶³ is “[...] *any thing that does modify a state of affairs* by making a difference.”⁶⁴ Why?

If action is limited a priori to what “intentional”, “meaningful” humans do, it is hard to see how a hammer, a basket, a door closer, a cat, a rug, a mug, a list, or a tag could act. They might exist in the domain of “material” “causal” relations, but not in the “reflexive” “symbolic” domain of social relations.⁶⁵

Material objects are thus genuine sources of persistence of social. No abstract, underlying social force is needed, because social is made up and sticks together by means of *a*-social: “[...] ‘social’ is not some glue that could fix everything including what the other glues cannot fix; *it is what is glued together* by many other types of connectors.”⁶⁶ It follows that the elements which are glued together in socio-economic assemblages are predominantly material – from energy resources and power plants, through cars and houses to computers and plastic bottles. Thus socio-natural *hybrids* emerge.⁶⁷ Moreover, society is repeatedly elaborated, assembled and re-assembled.⁶⁸ In other words, non-human agencies have to be massively mobilised in order to maintain such a large network, as in the case of global economy. Material and natural objects render their literally “steely qualities” to any social network.⁶⁹

By means of illustration, consider a flight of an airplane. Who exactly drives the plane? A pilot – that would be a typical answer. But let me examine this case in detail. To make a flight happen, we surely need to invoke a large body of another actors – navigators, communication systems, airports, fossil fuels, engineers etc. All these entities are in action while a plane flies

⁶² Trevor PINCH – Richard SWEDBERG, “Introduction.” In: PINCH, T. – SWEDBERG, R. (eds.), *Living in a Material World*. Cambridge (MA): MIT Press 2008, p. 1 (1–26).

⁶³ ANT has borrowed the term “actant” from literal science, where agency is distributed to various exotic entities, e.g. dwarfs. See LATOUR, *Reassembling the Social*, pp. 54–55.

⁶⁴ *Ibid.*, p. 71.

⁶⁵ *Ibid.*

⁶⁶ *Ibid.*, p. 5.

⁶⁷ LATOUR, *We Have Never Been Modern*, pp. 10–11, 30–105.

⁶⁸ LATOUR, *Reassembling the Social*, p. 47.

⁶⁹ *Ibid.*, p. 68.

above our heads, they are simultaneously engaged in action – an agency is distributed between all of them.⁷⁰ An action is *overtaken*:

[...] the very word actor directs our attention to a complete dislocation of the action, warning us that it is not a coherent, controlled, well-rounded, and clean-edged affair. By definition, action is dislocated. Action is borrowed, distributed, suggested, influenced, dominated, betrayed, translated.⁷¹

Social sciences – including economics – then come to be studies of associations; practices of tracing the connections. Here Brown's observation of centrality of reproductive practices is acknowledged, however the scope of actors conducting these operations is largely extended due to insistence on centrality of materiality. Perhaps the materiality of social can be in fact best acknowledged in economic science – as theories from Aristotle and Xenophon through Physiocrats to political economy of 19th century indeed show us.⁷² For example, Smith gives a very detailed account of wealth in *Wealth of Nations* (1776) in terms of physical objects that constitute the wealth.⁷³ He also emphasises that a real source of wealth is in labour, i.e. in physical practice conducted in a material world.⁷⁴ Ecological economics just extended the realm of relevant material objects and processes that are genuine parts of economy to other natural objects and their assemblages, by introducing ecosystem as a framework in which economic metabolism is situated. Such an approach contrasts with environmental economics, which ignores the heterogeneity and materiality of actor-networks and extends the scope of economic analysis only in terms of compiling various types of agencies into homogeneous mainstream-economic ontological register.

This picture contrasts the social ontology of critical realism, where the agency is granted only to humans and social world is on an ontological level radically distinguished from nature.⁷⁵ Exclusion of non-human agency is

⁷⁰ Michel CALLON, "Economic Markets and the Rise of Interactive Agencements: From Prosthetic Agencies to Habilitated Agencies." In: PINCH – SWEDBERG (eds.), *Living in a Material World*, pp. 34–36 (29–56).

⁷¹ LATOUR, *Reassembling the Social*, p. 46.

⁷² Richard SWEDBERG, "The Centrality of Materiality: Economic Theorizing from Xenophon to Home Economics and Beyond." In: PINCH – SWEDBERG (eds.), *Living in a Material World*, pp. 60, 68–69 (57–87).

⁷³ *Ibid.*, p. 69.

⁷⁴ *Ibid.*, p. 70.

⁷⁵ LAWSON, "The Nature of Heterodox Economics," p. 495; Frederic LEE, "Critical Realism, Grounded Theory, and Theory Construction in Heterodox Economics." *MPRA*, 2012, no. 40341, p. 10. Available at: <<http://mpa.ub.uni-muenchen.de/40341/>> [cit. 27. 10. 2016].

however present also in Brown's systematic dialectics.⁷⁶ A socio-economic actor in critical realist's social ontology is simply understood as human actor who possesses intentional attitudes.⁷⁷ Social reality is thus at least partly dependant on human beings⁷⁸ and they are the ultimate creators of social sphere, because human beings are possessed with capacity to always act otherwise than what is prescribed in established social order, which explains why social reality is an unpredictable open system.⁷⁹ The agency of other entities is not discussed in critical realism – non-humans are just mere parts of surrounding context, in terminology of critical realism called *structure*.⁸⁰ It is indeed quite an old-fashioned sociological account in which social is understood as a distinct dimension, structure or order. *Social* is some special feature that makes an object an inhabitant of "social" world, it is a *differentia specifica* of an independent ontological level, that distinguishes it from another levels, such as geological, biological, chemical etc. It is a kind of a substance, a special stuff⁸¹ – similar to Aristotelian *ether*, which guaranteed the revolution of celestial bodies around the Earth, granted its inherent ability of circular motion.

Such a perspective is glossed by Latour as insufficient: "Like humble servants, they [non-humans] live on the margins of the social doing most of the work but never allowed to be represented as such."⁸² Let me pose a question: Where exactly social practice (including science) happens? Surely in a material world and by means of material objects.⁸³ Moreover, these objects are not passive, they actively take part in social practice as actors. Why? Our life in a material world is negotiated not only between humans and collec-

⁷⁶ BROWN, "Reorienting Critical Realism," p. 504.

⁷⁷ That does not necessarily mean social reality is made up of intentional states, as Archer points out. Nevertheless, consciousness (intentionality) still determines social agency in critical realism. See ARCHER, "Introduction: Realism in the Social Sciences," pp. 189–205. Further see LAWSON, *Reorienting Economics*, p. 46.

⁷⁸ LAWSON, *Reorienting Economics*, p. 16.

⁷⁹ ARCHER, "Introduction: Realism in the Social Sciences," pp. 189–190, 193.

⁸⁰ *Ibid.*, p. 191.

⁸¹ LATOUR, *Reassembling the Social*, p. 1.

⁸² *Ibid.*, p. 73.

⁸³ Zdeněk KONOPÁSEK, "Making Thinking Visible with Atlas.ti: Computer Assisted Qualitative Analysis as Textual Practices." *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, vol. 9, 2008, no. 2. Available at: <<http://www.qualitative-research.net/index.php/fqs/article/view/420/910>> [cit. 14. 7. 2016]; LATOUR, *We Have Never Been Modern*, p. 24; Bruno LATOUR, "How to be Iconophilic in Art, Science and Religion?" In: JONES, C. – GALISON, P. (eds.), *Picturing Science, Producing Art*. London: Routledge 1998, pp. 436–437 (418–440).

tives of humans, but also between us and objects in nature. That is precisely the case of recent ecological catastrophes, such as Typhoon Haiyan or fires in Canadian Alberta and Indonesia.⁸⁴ The global ecosystem states through events like these the conditions of existence of human society within large-scale planetary structures. The question of our relation towards objects is thus not just a question for natural sciences – it is at the same time the social and political question. Non-humans are actively engaged in social and political processes.

To sum up, non-human actors are in critical realism a priori excluded, which violates Latourian social ontology. Such an exclusion is unjustified, once we see how important non-human objects are in social order. It resembles the cartographer that is trying to sketch a continent by means of easily grasped geometrical figures (rectangles, hexagons, lines...), ignoring all the nuances of the seashores.⁸⁵ In her effort, she tries to push reality to fit into preordained forms, and thus she violates the shape of an object he describes. To stay faithful to the reality, one needs – as our cartographer – to give up the well-defined concepts and ground them in the inconsistencies of the world, populated by actors of many kinds. The final justification of our shift towards broader notion of actor is then the following one:

[...] we are going to accept as full-blown actors entities that were explicitly excluded from collective existence by more than one hundred years of social explanation. The reasons are twofold: first, because the basic social skills provide only one tiny subset of the associations making up societies; second, because the supplement of force which seems to reside in the invocation of a social tie is, at best, a convenient shorthand and, at worst, nothing more than a tautology.⁸⁶

Recall now the pre-analytic vision of ecological economics: “[...] *the human economy is embedded in nature*, and economic processes are also always na-

⁸⁴ For the case of Typhoon Haiyan, see Damian CARRINGTON – Rowena MASON, *Cameron Links Typhoon Haiyan to Climate Change* [online]. Available at: <<http://www.theguardian.com/environment/2013/nov/16/david-cameron-climate-change-typhoon-haiyan>> [cit. 14. 7. 2016]; Dana NUCCITELLI, *Will Extreme Weather Like Super Typhoon Haiyan Become the New Norm?* [online]. Available at: <<http://www.theguardian.com/environment/climate-consensus-97-per-cent/2013/nov/20/climate-change-haiyan-hurricanes>> [cit. 14. 7. 2016]; Jennifer A. FRANCIS – Stephen J. VAVRUS, “Evidence Linking Arctic Amplification to Extreme Weather in Mid-Latitudes.” *Geophysical Research Letters*, vol. 39, 2012, no. 6; James B. ELSNER et al., “Sensitivity of Limiting Hurricane Intensity to Ocean Warmth.” *Geophysical Research Letters*, vol. 39, 2012, no. 17.

⁸⁵ LATOUR, *Reassembling the Social*, p. 23.

⁸⁶ *Ibid.*, p. 69.

tural processes in the sense that they can be seen as biological, physical and chemical processes and transformations [...]”⁸⁷ The abasement of economy to the level of natural processes is a complementary motion to upheaving material objects on the social level. These two motions meet each other in a final picture of one shared reality of heterogeneous entities – a sort of *flat ontology*. Ecological economics thus contradicts hierarchical ontology of critical realism.

6. Conclusion: A non-modernist rationale

Once we know that social is not something only loosely connected to the nature, a new meaning is rendered to this word. By social (in an old-fashion modernistic sense), we should mean from now only a small portion of entities and relations that are genuinely intertwined in actor-network, in a collective. The old term of *social* only “offers convenient shorthand to designate all the ingredients already accepted in the collective realm.”⁸⁸ But the totality of assemblage of social is significantly larger, as the last chapter intended to show. Nature and society are in this sense inadequate modernist categories that collapse into each other. Latour shows how the modern constitution – the ontological model of modernist project – was settled up by the practice of *purification*, an intellectual work of separating human activity from non-human world.⁸⁹ Work of purification (as manifested for example in Cartesian dualism) sorts out objects and subjects and allocates them to the reigns where they “naturally” belong; it makes reality well-defined and comprehensible. On the other hand, the precondition of existence of modern society is a simultaneous work of *translation* (or *mediation*), that blends natural and human bodies and creates hybrid networks, in which things are mobilized in order to petrify and extend social network.

Here one can find the *asymmetry* of modernism. Nature inevitably invades into pure social structure, but the clear cut between natural and cultural pertains. To regain a symmetrical position, we need to do an anthropological turn – to direct the instruments of ethnography at our own modern world, to decolonize the West from its own prejudice of modernism; the prejudice of a Great Divide between Us and Them.⁹⁰ Indeed, last decades of

⁸⁷ ROPKE, “The Early History of Modern Ecological Economics,” p. 294.

⁸⁸ LATOUR, *Reassembling the Social*, p. 11.

⁸⁹ LATOUR, *We Have Never Been Modern*, pp. 10–11, 30–31.

⁹⁰ *Ibid.*, p. 97.

ethnographic research have turned its attention towards the modern world and helped to clarify that in fact, we are the same as *pre-moderns*, showing that no Great Division has ever been sufficiently established in terms of real historical actor-networks.⁹¹ The only difference between moderns and pre-moderns is in the scope of mobilization of non-humans and in a level of proliferation of hybrid socio-natural networks.⁹² The boundaries between modern and pre-modern constitution, and consequently between nature and culture, are not a matter of ontological difference, but just a question of scale; needless to say that these dual categories serve as the cornerstone of modernist epistemological outlook, with all the colonial implications.

If we have never been modern, our science has also never been modern. An idea of modern science is closely tied to Kuhn's conception of *normal science*.⁹³ It depicts science as a rigorous activity conducted in a well-established, consistent framework. In a period of normal science (in contrast to the situation of scientific revolution), fundamental propositions of given paradigmatic theory are not contested and innovations are strictly controlled. Disciplinary boundaries are also narrowly defined and research problems/areas overlap only exceptionally.⁹⁴ Normal science resembles an activity of puzzle-solving, as if every piece of scientific knowledge were on a table, as if the task of science were merely to rearrange the pieces in an adequate manner.⁹⁵

Critical realism accepts the framework of modern, normal science, for its ontology accepts nature/culture dichotomy, where problems and objects are clearly sorted out. From this point of view, it is incompatible with ecological economics, which has intuitively closer to flat ontology of actor-networks. But here the conundrums of critical realism do not end. The argument against strict causal regularities is in fact within the modernist mainstream economic paradigm, for it adheres to the methodological obsession with regularities. The resistance against and insistence on existence of strict causal regularities in social reality are complementary. One should not only get rid of an obsession with formal-deductive method, but of the very

⁹¹ Just to mention the brilliant volume APPADURAI, A. (ed.), *The Social Life of Things: Commodities in Cultural Perspective*. Cambridge: Cambridge University Press 1986.

⁹² LATOUR, *We Have Never Been Modern*, p. 105.

⁹³ THOMAS S. KUHN, *The Structure of Scientific Revolution*. 3rd Edition. Chicago – London: University of Chicago Press 1996.

⁹⁴ KUHN, *The Structure of Scientific Revolution*, pp. 6–7, 23–24.

⁹⁵ ROGER, STRAND, “Postnormal Science.” In: GUSTON, D. (ed.), *Encyclopedia of Nanoscience and Society*. Thousand Oaks (CA): SAGE Publications 2010, p. 623 (622–624).

notion of scientific fact based exclusively on identifying recurrent casual events in reality. There are numerous mechanisms generating scientific facts (granted there are many types of associations) and our task is not to exclude any of these mechanisms from any field of research. It means – besides other things – that strict causal regularities can be found also in social reality, as well as other procedures generating scientific facts.

Historically speaking, society was understood as a realm of contingency, while nature as a domain of iron causal rules. Now, we ended up with only one level of reality, which is a realm of contingency and regularity at the same time. There is nothing inherently contradictory in asserting that in contingent world, regularities can occur, because the stability of rules governing reality can very well be the case in contingent universe if we assume that the set of possible worlds is *transfinite*.⁹⁶ So yes, it is true that surprises happen and some events are spontaneous. But it is important to point out that surprises occur in both what could be coined as social and as natural reality in the old modernist constitution of the world. Blurring the boundaries between nature and culture does not rule out the existence of strict regularities. One and the same assemblage of heterogeneous actors can display causal regularities in one respect and unpredictable events in other. This idea is in fact close to recent elaborations in speculative realism/object-oriented ontology,⁹⁷ and it points out that the notion of causality should be generally much more nuanced than is the case in critical discussion between critical realism and mainstream economics. However, precisely for the sake of the argumentation clarity, I have deliberately restricted my considerations to strict causal regularities, i.e. monocausal relations.

From aforementioned remarks on causality it seems necessary to look up for another vision of science, one that resembles more an unending fluid practice than a solid framework. Such is the concept of *post-normal science*, where scientific work is a process of continual arrangement and re-arrangement of entities, as any other social (hence material) practice. In this process, we cope with problems involving *irreducible complexities and uncertainties*, such as the case of global climate change or biosafety issues.⁹⁸

⁹⁶ Quentin MEILLASSOUX, *After Finitude*. London: Continuum 2008, pp. 101–104.

⁹⁷ See Graham HARMAN, *Quadruple Object*. Winchester – Washington: Zero Books 2011, p. 118; Timothy MORTON, *Hyperobjects*. London – Minneapolis: University of Minnesota Press 2013, pp. 39–41.

⁹⁸ Silvio O. FUNTOWICZ – Roger STRAND, “Models of Science and Policy.” In: TRAAVIK, T. – LIM, L. C. (eds.), *Biosafety First: Holistic Approaches to Risk and Uncertainty in Genetic Engineering and Genetically Modified Organisms*. Trondheim: Tapir 2007, p. 265 (263–278).

These problems can be labelled as *post-normal problems*. At the same time, they are *non-modern problems* in the sense that they can't be grasped in the modernist scientific framework. The reason is that these problems are *complex*, i.e. they can be described using multiple and mutually irreducible narrative registers.⁹⁹

But when one talks about uncertainty in complex issues, one does not assert a *global* uncertainty, a total arbitrariness and unpredictability of behaviour of the system under scrutiny. Uncertainties arise also in systems whose general mechanisms can be described in terms of strict regularities, as in the case of climate change. We know pretty well how the climate behaves and what are some key factors influencing this behaviour. But still, we are at odds once we are trying to fully describe dynamics of climate and predict its future state of affairs. That resembles the idea presented by Brown: from the individual perspective, a system may seem to behave largely unpredictably, but once we take a system-wide perspective, we can spot certain regularities.¹⁰⁰

An insistence on complexity of social can be found also in critical realism.¹⁰¹ However, it comes to this conclusion by using an old-fashioned ontology that sticks to the hierarchical image of universe and radically different ontological layers. It cannot bring together fossil fuel resources, typhoons, politics and economic behaviour of consumers. Perhaps, it seems to be a marginal problem, but when we come to the question to what extent some events are strictly regular, we cannot accept critical realism, for it exorcise a cornerstone of our understanding of global ecosystem, in which economic activity occurs and which is thus necessary for our comprehension of the nature of economy as such.

Now, to sum up the main theses of the paper, I argued that:

1. In ecological economics, one needs to presuppose the existence of strict causal regularities, which are otherwise rejected in the realm of socio-economic relationships by critical realism.
2. The notion of social actor is in critical realism too narrow to include some key economic actors – notably the material, non-human parts of the environment in which the economy is localised.

⁹⁹ François DIAZ MAURIN – Zora KOVACIC, "The Unresolved Controversy over Nuclear Power: A New Approach from Complexity Theory." *Global Environmental Change*, vol. 31, 2015, p. 211 (207–216).

¹⁰⁰ BROWN, "Reorienting Critical Realism," p. 508.

¹⁰¹ LAWSON, *Reorienting Economics*, p. 19.

3. Ecological economics – contrary to critical realism – incorporates non-humans into very core of its pre-analytic intuition. Critical realism thus ontologically speaking resembles rather presuppositions of environmental economics as understood in Chapter 2, despite being methodologically dissonant.

Let me conclude with one final remark. The insistence on materiality of economic processes is tremendously important once we see how it influences our notion of social norms and policies. Ecological economics inform us about the nature, and thus about limits of real-world economies as aggregates of specific social practices. Consequently, it imposes boundaries upon real-world economies in terms of which economic activities can be sustainably realized, and hence they provide a general framework for production and reproduction of social and political norms that guide our economic activities. Ecological economics is in this sense engaged into the process of generating certain *politics (or regimes) of value*¹⁰² and its purpose is to propose and criticise particular norms and normative systems from its distinct standpoint. Critical realism pleads for similar engagement of social sciences.¹⁰³ But it does not purport sufficient groundings for its justification.

¹⁰² Arjun APPADURAI, "Introduction: Commodities and the Politics of Value." In: APPADURAI, A. (ed.), *The Social Life of Things: Commodities in Cultural Perspective*, pp. 3–63.

¹⁰³ See e.g. Andrew COLLIER, "Explanation and Emancipation." In: ARCHER et al., *Critical Realism: Essential Readings*, pp. 444–472.