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ORIGINAL PAPER

Envisioning post-capitalist utopias via simulation: Theory, critique and models

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Abstract

We discuss the role of heterodox economics in opening new perspectives, the question of scalability of socio-economic order, the heritage of the "socialist calculation debate" and its ongoing relevance for discussions on "post-capitalism" today and finally the potentials of computational simulation and agent-based modelling for the exploration of alternative socio-economic approaches. The contributions to our special issue address these aspects and topics in different ways and therefore underline the fruitfulness of these discussions, especially in regard to the development of more just and sustainable socio-economic structures. Faced with the contemporary polycrisis, we can no longer afford "capitalist realism".

Keywords Utopia · Post-capitalism · Commons · Labour theory of value · Money · Computational simulation · Climate change · Agent-based modelling · Critical political economy · Cultural evolution · Heterodox economics

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1 Introduction

The latest phase of capitalist development brought a series of critical processes to the foreground, drastically reshaping economic and social conditions of reproduction, social strata of identity and class, as well as the planetary biosphere and its climate. Serious vulnerabilities and contradictions have emerged around the core institutions of capitalist development, the state, the market and the money form of capital, heading to questions about post-capitalist futures (see e.g. our edited volume Project Society after Money 2019). The relevance of such a perspective is given by capital's systemic crisis, i.e. a polycrisis concerning the evolutionary variation and transformation of technology, nature and work, as mediated by capital.[1] This crisis did not emerge suddenly but built up cumulatively through the evolution of the capitalist world system. One may speak therefore of the crisis of the Capitalocene (Moore 2017). The exploitation of labour and appropriation of nature have intensified through commodification and accumulation processes[2] over the centuries, making the polycrisis the locus of modern class struggle. This is the political economic arena where social classes—and factions among those classes—battle for their futures, today most visible in the global capitalism of platforms (see e.g. Likavčan and Scholz-Wäckerle 2022). Platform technologies paralyze counter-hegemonic tendencies through a concretion of skewed global and local power relations and an on-demand supply of consumption goods satisfying the needs and wants of a global middle class. Once this supply develops frictions and the oppression of the working class hardens, the very same technologies may enhance the development and growth of social movements, fighting for the rights of human wage labourers as well as for "extra-human natures in the web of life" (Moore 2015). Eventually, climate justice means social justice (Martínez-Alier 1997) and a transformation towards better living conditions on Earth is a social ecological transformation. The step from impulsive protest and grassroot mobilization to proposing and adopting novel counter-hegemonic political economic strategies is complex and shaped by constant struggles and failures (Brown 1991; Srnicek and Williams 2015).

The current global political economic configuration demands strong proposals engaging in interdisciplinary debates about viable futures of societal evolution, thereby reflecting and going beyond the mainstream of current transition studies focusing on growth (as rightly criticized by Hickel and Kallis 2020; Spash 2021). Necessarily, long-run utopias need to deal with the question of economic planning, an anathema for the most part of the second half of the twentieth century.[3] Recently, both the urgency of the unfolding climate catastrophe and the Covid-19 pandemic have ever more boosted interest in questions of planned economies. The aforementioned platform technologies may not only play a significant role in counter-hegemonic mobilization politics, but will most probably be essential

[1] Previously dubbed as "Planetary Carambolage" (Gruszka et al. 2020).

[2] Next to capital accumulation via expanded reproduction, we highlight the centrality of primitive accumulation (Marx 1976, Part 8) and accumulation by dispossession (Harvey 2004).

[3] Due to the rather catastrophic experiences with Soviet Gosplan-style authoritarianism.

in the development of digital, democratic planning on several scales, by complementing or replacing market-based allocation. If the concept of planned economies shall not merely mean a more extensive role of the state within a market economy (the old social-democratic agenda), substantial questions need to be re-addressed, including a re-evaluation of markets, of monetary regimes, of corporations and of the role of public policy and the importance of the public sector. Today, post-capitalist utopias that are not based on dreams of total computability, a central plan or another variant of top-down control seem feasible, making the traditional socialist agendas at least in part outdated. Instead, the newer narratives argue that bottom-up and networks-centred approaches will lead the way, merging the advantages of centralization with the much-needed autonomy of producers with regard to their own production processes and perceptions of the future (Groos 2021; Sorg 2023). However, these new ideas are currently confronted by ever more aggressive and desperate variants of what had been labelled "capitalist realism"—viz. "the fatalistic acquiescence in the view that there is no alternative to capitalism" (Fisher 2018, p. 761). Capitalist realism—as the default mode of neoliberal and neoconservative class politics, so to speak—aims at the extirpation of the very idea of democratic socialism or anarchist communism, suggesting that variants of capitalism are the only realistic modes of organizing society, the only game in town.

Section 2 addresses the problematic discourse of capitalist realism and the role of heterodox economics in debunking this perspective. We highlight this aspect via Proctor's (2023) contribution to this special issue, who stresses the failings of mainstream economics in integrated assessment modelling and outlines the role of heterodox economics in creating alternative pathways, ranging from pragmatic short-term to more utopian long-term responses. Along with a diversity of different methods used, heterodox economics has a definite role in "expanding the possible" (ibid.). Section 3 addresses contemporary research on scalability with respect to long-term perspectives on cultural evolution. Is a rise in complexity necessarily complemented by stratification and hierarchy or is it conceivable that alternative modes of large-scale organization promote more equality while still being stable and sustainable? In this context, we highlight the central contributions of Levitas (2023) and Hanappi (2023) to this special issue. The former reminds us on the potential of utopia as a method in critical social theory. The latter revisits the evolution of money forms as carriers of social value and the role of money in a post-capitalist utopia. Section 4 turns to the socialist calculation debate of the 1920s and 1930s and its modern variants. A major theme is complexity, coordination and evolution, but this time more specifically related to questions of economic planning. In Section 5, we highlight questions about top-down and bottom-up planning, in the context of the substantial contributions of Dapprich (2022), Ferrer-Hernandez (2023), Gerdes et al. (2023) and Miyazaki (2023). The last two follow moreover a bottom-up logic in its method used, i.e. agent-based modelling. A brief discussion on scientific (dis)aggregation outlines the role of method in shaping utopia. Section 6 concludes.

2 From capitalist realism to utopian realism: the role of heterodox economics

Given the vast concentration of wealth within the hands of the already super-rich, we can clearly speak of a matured financial expansion phase of the current systemic cycle of accumulation (Arrighi and Moore 2001; Lapavitsas 2013). "[Every] capitalist development of this order seems, by reaching the stage of financial expansion, to have in some sense announced its maturity: it [is] *a sign of autumn*" (Arrighi and Moore 2001, 59, citing Braudel 1984, 246). Braudel associated mature financial expansion with the end of a period of capitalist development. Following this conjuncture, Arrighi and Moore (2001) conclude that the US hegemony is in such a highly financialized phase of systemic accumulation crisis. This opens up medium-run questions about the hegemonic change in the capitalist world system—a set of questions that we don't follow in this article and special issue—and long-run questions about capitalist property regimes in general (see e.g. Buller and Lawrence 2023) . Systemic long-run change hinges on a new era of democratic ownership, including a reinvention of the firm as a vehicle for collective endeavour and meeting social needs rather than as a vehicle to further enrich the already powerful.

Property relations are about cumulatively evolving institutions. Pistor (2019) has shown in detail how contemporary law—regarded even among most progressives today as a solution instead of being part of the problem—selectively codes assets, endowing them with the capacity to protect and produce private wealth and thus transforms mere wealth into an asset that automatically creates more wealth. She demonstrates empirically how capital is created behind closed doors in the offices of private attorneys, engineering the widening wealth gap between the holders of capital and everybody else.[4] Mazzucato's (2018) ground-breaking work on the need to redefine how value is understood and measured in our society complements Pistor's account very well. Mazzucato shows how economic value has been determined and re-defined since the days of physiocracy, mercantilism and classical political economy. Her work reveals how the former prominent difference between value creation and value extraction had become increasingly blurry with the rise of marginalism, neoclassical and mainstream economics. Mazzucato further indicates that this blurriness allowed certain actors in the economy to portray themselves as value creators, while in reality, they were just moving existing value around or, even worse, destroying it, among other strategies via confusions between rents and profits and between value and price. Behind the seemingly neutral, physics-like appearance of mainstream economics lurks a regressive class politics agenda.[5] Austerity policy is another ideological stronghold of capitalist realism. New works in the field of

[4] Christophers (2022) should also be mentioned at this point. He presents a forensic examination and critique of the prototypical ills of contemporary rentier capitalism: vast inequalities combined with entrenched economic stagnation.

[5] One might critically remark here that Mazzucato's perspective in her writings on the entrepreneurial state is not about replacing capitalism with a real utopia from the bottom-up (as favoured in this special issue) but about correcting capitalism from the top-down in order to save it. In this regard, Mazzucato, too, is a capitalist realist.

history of (economic) ideas were able to show, in painstaking detail, how economists originally invented austerity and paved the way to fascism in the 1920s and 1930s. For instance, Mattei (2022) explored the intellectual origins of austerity to uncover its originating motives: the protection of capital—and indeed capitalism—in times of social upheaval from below. She concludes that the solvency of the state ("die schwarze Null" in contemporary German newspeak) and engineering economic growth were never really the goals of austerity measures. Instead, its historical and contemporary protagonists aim at the defence of entrenched privilege and the elimination of all alternatives to capitalism. Quite similarly, mainstream economics approached and internalized the problem of climate change into the standard canon of the general equilibrium. By putting a price tag on carbon, an optimal carbon tax can be introduced, guaranteeing the continuity of capital accumulation, i.e. growth. Following Keen (2021), the climate economics of Nordhaus and colleagues led to a huge underestimation of the damages caused by climate change and a consequential abasement of climate change within economics in particular and among mainstream international institutions in general.

Standard economics is systemically ignoring the vast atrocities emerging from capital's evolution in spatiotemporal terms. Heterodox economic approaches, as the ones indicated above, aim for a more realistic picture of capitalist development, i.e. necessarily one of "environment-making".[6] The world ecology produced by capitalism is facing severe climate change, and we are in desperate need of more realistic and critical models of integrated assessment in order to produce more sustainable world ecologies for the future. Proctor (2023) highlights in this special issue that heterodoxy is slowly putting the ties together in such directions. "Expanding the possible" (ibid.) discusses the theoretical and conceptional cornerstones as well as methods leading to models ranging from capitalist realism to what we would call "utopian realism". Heterodox economics is shaped by pluralism for good reason, because it demonstrates, contrasts and complements the explanatory power of different schools of thought. In Proctor's (2023) essay, Marxism, Keynesianism, institutionalism and evolutionary economics are employed to develop five basic "climate-economy pathways" organized on an axis of "institutional stability/change" and an axis of "low and high economic growth". It is evident that the method used for the models and simulations of those pathways signifies a spectrum between capitalist and utopian realism. We will discuss this aspect along with the difference between top-down and bottom-up simulation techniques below. Now, we turn attention to the theoretical nuances within this spectrum of "expanding the possible".

"Utopian realism" is about developing pre-analytical visions, in the Schumpeterian understanding (Schumpeter 1994, 41), or imaginaries in the understanding of Castoriadis (2005)—as we explain later in a few paragraphs. The assessment of a

[6] Moore advances Lefebvre's (1991) and Harvey's conception of "the production of space", and its implications for local as well as global "uneven development", by shifting attention to capital's more general role in "environment-making" (Moore 2015, 21ff) and the "production of world ecologies" (ibid. 182ff): "The point is to highlight the ways in which evolutionary processes were powerfully co-produced: humanity is a species-environment relation" (ibid, 21).

pre-analytical vision or an imaginary can only be informed by its "aesthetic quality" (Hanappi and Scholz-Wäckerle 2017, 159). Following McAuliffe (2022, 221), Ernst Bloch once highlighted in "The Principle of Hope" that "only the aesthetic illusion detaches itself from life, whereas the aesthetic pre-appearance is precisely one because it stands itself in the horizon of the real". It is this aesthetic pre-appearance that makes a utopian vision real: "Realism in art is no descriptive or explanatory stock-taking, but it holds up, in an activating way, a mirror of immanent anticipation, it is tendential-utopian realism [tendenzhaft-utopischer Realismus]". (ibid.) In general, discourses largely mirror society's aesthetics and are to be understood as signifiers for utopian realism, as they mirror social complexity. "The experience of beauty rather occurs in the process of interaction with something outside the individual mind. It is a property of a special type of dialogue, more precisely an interaction that goes beyond the communication level of a dialogue, leading from metaphysical action to physical action. It is the mirror that certain types of beautiful interaction enable, that they indeed create, which is attractive" (Hanappi and Scholz-Wäckerle 2017, 159). Therefore, utopian realism engages with aesthetics as "What is reproduced in discourse is at the same time produced in reality, in the mode of 'immanent anticipation'" (McAuliffe 2022, 221). The discourse layer informs us on "a tendency lying latent in material reality itself" (ibid). As this material reality can only be a child of history, utopian realism cannot be a-historical and needs to involve the potential of realistic transformation, i.e. looking out for existing "real utopias" and scaling them up for further transformation (see e.g. Wright 2010). Utopian realism emerges within the intersection between aesthetics mirrored through original discourses (this excludes capitalist realism and the standard economic canon) and current utopian transformative showcases.

The movement from capitalist to utopian realism concerns the relationship between utopian thinking and critical social theory. Utopianism has always been a somewhat controversial topic—in critical social research as well as in social movements. Let us just recall two influential major events or forks in the intellectual road: Following Marx's critique of utopian socialism since the 1840s, the most influential Marxist orthodoxies of the twentieth century took a harshly negative stance towards utopias, oftentimes to underline their own (sometimes questionable) scientific character.[7] Utopian thinking was henceforth oftentimes dismissed as pure wishful thinking or as a branch of idealism that goes against proper socialist research and struggles. The legitimacy of utopian thought was further marginalized by the dogmas of value neutrality and positivism in early sociology. In this case, the main aim was to construct a rigid distinction between wishful thinking, prose and pure fiction on the one hand and proper science, backed by rigid methodological standards, on the other.[8]

[7] Marx' critique of the various branches of utopian socialism was in fact more differentiated and balanced than often suggested. This has been recently shown by Leopold (2020).

[8] It is quite obvious today that the so-called scientism of most early social science wasn't always as neutral as its protagonists maintained. Max Weber, probably the most influential of the founding fathers of sociology, used the paradigm of value neutrality to act as a major protagonist of the so-called passive revolution that led to Fordism in Germany (Rehmann 2015).

Alternative visions of sociology as science that had been quite widespread in the anarchic and pluralistic early days of the emerging discipline, more friendly to utopian thinking, never gained the same long-term influence as the proposals of the more positivistic camps. For instance, H.G. Wells—today best-known as a science fiction writer—was engaged in sociological inquiries but tried in vain to get a chair in sociology. For Wells (1906), the creation of utopias was "the proper and distinctive method of sociology". Similarly, Otto Neurath suggested in the 1920s that social scientists should formulate ideals of social arrangements in utopian style, thus adopting a creative stance which aimed at discussing scientific proposals about future pathways in dialogue with a community (Da Cunha 2016). These proposals, however, never made it to the forefront in the formative years of the social sciences.

However, recent decades have seen a revival of scientific utopianism, broadening its former aims and scope. Contemporary approaches range from treating utopian thinking as a distinct and powerful methodological strategy (Levitas 2013) to envisioning real utopias (Wright 2010; von Redecker 2020; Groos 2021). These writings outline possible future societies and develop theory-based utopias in contrast to simple wishful thinking. They focus on social potentials, viability and tendencies to realize a society given the current state of knowledge and discuss general societal characteristics: How utopian societies might organize reproduction, coordinate themselves, solve conflicts, make decisions, distribute unpopular tasks, …? Utopian visions and the aesthetics of this kind may become powerful collective ideas in social movements. If society is an "imaginary institution" (Castoriadis 2005), it might be an option to develop new imaginaries.

With these newer works, intentions that were already prominent with Neurath and Wells might be brought to a new level of influence, last but not least due to the potentials of computational simulation: What if imaginary conceptions of society, culture, economy and politics could be experimentally tested? How could one develop such an experiment? There are obvious and manifold reasons why grand-scale radical social experiments should not be tried out—first-hand—in real societies. However, there is no reason why we should not run such experiments in artificial societies, simulated in computational sandboxes.

In order to integrate the aesthetics of current post-capitalist discourses within utopian realist simulations, its narratives should be complemented with the transformational knowledge of already existing utopian projects, as e.g. followed by Wright (2010). Their potential of transforming current systems needs to be evaluated (e.g. experiments with basic income, deepening democracy or democratizing finance). One avenue outlined below concerns realizations of commons and commoning on a larger scale, i.e. to transform capitalist institutions and organizations into commoning projects. We have already highlighted the potential of such an imaginary, which can be complemented by the use of computational simulation experiments regarding infrastructures of commoning. The point that Erik Olin Wright and others try to make is that small-scale real utopias can evolve into large-scale real utopias provided all the necessary conditions come in place. Computational sandboxes offer a complementary path to help identify the infrastructures concerning the meta-coordination on large scale, as they provide sufficient space for experimentation with the

aesthetics of pre-analytical visions, imaginaries and discourses in general. These are the aspects that a utopian realism could offer in contrast to capitalist realism.

3 Scalability: complexity, hierarchy and emancipation from an evolutionary political economy perspective

The notion of artificial computational laboratories, for such experiments, allows thinking in terms of scalability. Evolutionary political economy aims to combine theories of evolution and complexity and apply them to the realm of critical political economy. Complexity is a central issue for scalability, foremost when it comes to alternative forms of socio-economic organization from a long-term perspective. The relation between the integrative potentials of different historical social forms is quite well understood thanks to research on cultural evolution and cliodynamics, although many open questions remain. Figure 1 highlighted by Turchin (2016) shows different historical polity types and their average social scale, i.e. the number of people who could be integrated and thus coordinated. Of course, figures of such kind do not tell us much about the normative, emancipatory quality of the respective polity types, but they nevertheless provide a general picture to begin with.

Political economic evolution[9]—looked at from a bird's-eye view—consists of an ever-broadening scope of cultural units. There is a growth in scale that highly correlates with (and depends upon) increasing social complexity, i.e. "the variety of specialized social roles […], the number of distinct social personalities present, and the variety of mechanisms for organizing these into a coherent, functioning whole" (Tainter 2004, p.23). While, for instance, traditional and modern hunter-gatherer societies contain no more than a few dozen distinct social personalities, modern censuses recognize 10,000 to 20,000 unique occupational roles, and industrial societies may contain overall more than 1,000,000 different kinds of social personalities (ibid.). The menu of cultural or civilizational capacities that historically enabled the rise of population and social complexity—against the background of unevenly distributed natural and geological conditions (Diamond 2005)—includes factors such as communication and storage media (language, scripture, printing, computers), forms of political organization (bands, cities or states), systems of morality and (codified) law, types of religion, economic media like coin money, credit etc. (Löffler 2018, 2019; Pahl 2021).

Probably the most distinctive feature of human societies is their high degree of cumulative cultural development—a phenomenon today conceptualized as the outcome of multiple ratchet effects (Tennie et al. 2009) or mountaineering effects (Lombard 2016). Human cultures accumulate modifications of artefacts and practices over time, with relatively little loss or backward slippage. Improvements stay in the population fairly readily until further changes ratchet things up again. Stable transmission mechanisms across generations keep the novelties in place until other

[9] See Hanappi and Scholz-Wäckerle (2021) and O'Hara (2021) for some basic conceptualizations of evolutionary political economy.

novelties come along (Tennie et al. 2009). The evolution of culture is based on, but cannot be reduced to, biological evolution—due to unique, non-genetic channels of inheritance and cultural persistence (Henrich 2016). Some obvious examples of cumulative cultural evolution (in general) and political economic evolution (in particular) or ratchet effects include the following: For the printing press to come into existence, it needs a system of writing in advance. Modern credit money and a two-tier banking system did not emerge ex nihilo but had precursors, e.g. state-issued coin money and privately issued bills of exchange. This reasoning does not affirm teleology; there is no goal of history and not necessarily convergent evolution all over the place. But, in general, later civilizations build on the advancements of earlier ones and sociocultural development has a direction—it is not random—because of path dependencies.[10]

Growth in scale and in social complexity were among the main drivers of the development of productive forces, affecting the metabolic regimes of human societies, unfolding potentialities for emancipation and threatening future well-being. White (1949, 362) put it already 70 years ago: "The history of civilization is the story of the control over the forces of nature by cultural means. But the story of energy control may provide the epitaph of civilization". Archaeological, historical and ethnographic evidence today broadly confirms that societal scales have increased in parallel with the intensity of sociocultural niche construction. The productivity of land and resource management, population size, population density, societal complexity and the amount of nonhuman energy used per capita are all positively correlated across societies over time (Ellis et al. 2018). The presently dominant industrial social ecological regime of modern capitalism dates back no more than 300 years and is based upon the utilization of fossil fuels. Its sustainability seems limited not only by the limitations of its energy resource base but also by the transformations it triggers globally in various life-sustaining natural systems (Fischer-Kowalski and Haberl 2007).

In their much-discussed book *The Dawn of Everything*, Graeber and Wengrow (2021) try to challenge the standard model of social cultural development, i.e. a specific narrative about humans starting off with a high degree of liberty but not much prosperity and ended up with a lot of prosperity but not much liberty. Graeber and Wengrow (2021) reject the assumption that small hunter-gatherer bands of humans lived in egalitarian harmony before they discovered agriculture, settled down, scaled up their populations and necessarily implemented hierarchical systems

[10] Of course, there are fall-backs in cultural evolution, for instance the so-called bronze-age collapse starting around 1100 BCE or the later breakdowns of the Roman and Han empires, to mention some classical cases (Tainter 2004; Cline 2014). While Diamond (2006) stresses predominantly external constraints, Elsner (2021) offers a more endogenous explanation, emphasizing cycles of institutional success and of institutional decline caused by ceremonialization (see also Bush 1987 for an introduction into Veblen's evolutionary theory of dialectical behaviour and institutional dichotomy). But overall, looking at long-term processes, there is much cumulative development leading to ever increasing scales and internal complexity. Even huge crises and regional breakdowns usually did not completely erase the formerly acquired capacities and innovations. Of course, with global climate change, this pattern might change rather sooner than later.

Social scale (people)	Polity Types	Time (kya)
10s	Foraging bands	200
100s	Farming villages	10
1,000s	Simple chiefdoms	7.5
10,000s	Complex chiefdoms	7
100,000s	Archaic states	5
1,000,000s	Macrostates	4.5
10,000,000s	Mega-empires	2.5
100,000,000s	Large nation-states	0.2

Fig. 1 Historical polity types and their average social scale (Turchin 2016, p.24)

of administrative and political control. While the authors certainly have a point—stressing the sheer variety and hybridity of early human societies—in demonstrating that organizing processes were much more complex and diverse as depicted by the older versions of cultural evolution theories, they tend to overstate the uniformity and simplicity of the standard model. In a point-by-point review of their claims, Morris (2022) shows that Graeber and Wengrow (2021) proposals are already incorporated in the received knowledge of contemporary research on cultural and political economic evolution, which has long abandoned its former affirmative and streamlined "from Plato to NATO" origins.[11]

However, the political impact of Graeber's and Wengrow's work is most important, addressing and putting the question of complexity, hierarchy and emancipation[12] on the agenda. Closely related is the question of a possible abolishing of money, which has been and still is very much a contested terrain.[13] This special issue features two non-formal contributions entering this contested terrain from a rather different angle. In decades of research, Ruth Levitas has made the topic of utopianism—as a distinctive method of critical social scientific thinking—the centre of attention like few others. "Utopia as method" in Levitas (2023) is characterized by a holistic and ecologically embedded approach. In her rather essayistic contribution to this special issue, she assesses the transformative potential of quite popular works by Stephanie Kelton and Mariana Mazzucato. While Levitas is in fundamental agreement with the general line of critique put forward by Kelton and Mazzucato,

[11] Compare also the German-language reviews by Paul (2022) and Luks (2022) with similar conclusions.

[12] On the concept of emancipation in the context of transformation theories aiming at overcoming capitalism (see chapter 3 in Sutterlütti and Meretz 2023).

[13] See sections below with a discussion on the socialist calculation debate and on communing; furthermore, compare our recently published edited volume Project Society after Money (2019).

she criticizes an abstraction of "the economy" from a wider understanding of social structures that can be found in the respective works. Her contribution argues that the neglect of unpaid work and a commitment to economic growth undermines the radical potential of perspectives like the Modern Monetary Theory (MMT), a blind spot that should be addressed to set popular modes of critique straight.

In his contribution to this special issue, Hardy Hanappi is rather sceptical about the possibility of future moneyless societies, arguing for a post-capitalist form of money instead, a money form that gets rid of the most abstract imperative of capital accumulation. Hanappi (2023) starts off with two well-grounded assumptions: First, for every commodity producing human society, money has been a steady companion since it emerged. Second, money forms, the way in which money took on its material cloth, have changed a lot. During these changes of its material cloth, money's content, its mystery, evaporates behind its physical form. Hanappi shows that money forms follow an evolutionary trajectory, leading through alternating stages of contributing to the stabilization of a mode of production and then actively destroying it in revolutionary turning points—just to give birth to a new form of representation of social value.

4 From the socialist calculation debate to commonism

In the workers' movements of the nineteenth century (especially Marxism and Anarchism), discussions on how capitalism should be overcome and replaced by an alternative economic system emerged. At the beginning of the twentieth century, there were revolutionary waves leading to the October Revolution and other upheavals in Europe. By then, the question of alternatives quickly became far more concrete, especially with war communism in the emerging Soviet Union, where money and markets were abolished with problematic results (Szamuely 1974; Richman 1981). In the context of the very short-lived Bavarian Soviet Republic, Neurath (1919) developed substantial economic ideas on planning in kind. These ideas, and earlier work by Enrico Barone (1908) and others, led to a controversy which "is widely acknowledged to have been the most important theoretical controversy in the history of the field of comparative economics" (Lavoie 1985, 1), i.e. the "Socialist Calculation Debate" (SCD).

The original debate took place mainly from the 1920s to the 1940s. It was essentially about the question whether a socialist economy, building on central planning and/or market socialist models, could work or not. Central figures of the "Austrian school", Mises and Hayek, who criticized the ideas of Neurath (1919), vigorously contested this against their equally vigorous socialist opponents such as Lange or Lerner (see Vaughn 1980 and Lavoie 1985 amongst many others for overviews). The basic argument was, first, that a central planner would not have the complete information necessary to "run" the economy and, second, if this agency would have complete information, it would not be able to process it in meaningful terms, especially

with respect to the production of means of production.[14] Society is assumed to be too vast and complex and its development too uncertain. Even some of the socialist opponents accepted that market mechanisms are necessary in one way or the other, giving rise to conceptions of "market socialism".

Starting from this discussion, a lot of twentieth-century economic theory revolves around the role of information in economics (Mirowski and Nik-Khah 2017). The discussion rippled back and forth, but Keynes' macroeconomic response to the severe crisis of 1929, as well as the imposition of more regulated economies afterwards, seemed to disprove Mises and Hayek in the afterwar period. Decades later, in 1989/1990, the Eastern bloc collapsed, the miserable state of the planned economies became visible and Hayek prevailed, with people like Reagan and Thatcher advocating neoliberal policies. The end of history and the triumph of the market economy were proclaimed. Furthermore, statistical figures seemed to show that absolute poverty has declined and will decline even more.[15] The question of an alternative to capitalism was off the table. Mises and Hayek seemed to have been proven right, unleashing a capitalist realism sans phrase.

However, economic crises did not disappear from capitalism: the 2007/2008 crash led to the Great Recession, global wealth inequality did intensify tremendously and "capitalogenic" climate change (Moore 2015) indicates that Hayek's "use of knowledge" (1945) is useless for long-run political economic evolution. In this atmosphere of polycrisis, a diverse and many-voiced discourse about "post-capitalist" alternatives thrived. Are the arguments of Mises and Hayek still valid today? Might supercomputers be able to solve the countless top-down equations needed to coordinate a country's economy?[16] Can't mobile sensor technology (e.g. in smartphones) be used to collect precisely that wealth of data needed to feed the supercomputers?[17] Isn't a planned economy conceivable after all, combining the algorithmic efficiency of markets with governmental stability, along with an endogenization of ecosystems? Aren't large corporations already functioning like planned economies, corporations that are in some cases larger than states?[18] Didn't even Hayek (1945, 520) stress that market economies must actually be described as decentralized planning, because every single person, every household, every company, every university plans? And if this is the case, why does coordination between these units necessarily have to take place without collusion, but only via abstract price signals and via competition eventually? And did this picture ever correspond to reality? After all, people can and do talk to each other. Is it really only price signals that transmit information (see Cottrell et al. 2009, 323–326)? But there remain questions: Could centralized or decentralized planning (or a mixture of both), no matter how well this works, supported by decentralized data collection in quasi-real time and by supercomputing (and perhaps "artificial intelligence"), avoid authoritarian effects (which Hayek had always painted on the wall as a spectre)? The activities instructed by the

[14] Even if the process of planning would work via price signals.

[15] A claim that has recently been substantially refuted by Sullivan and Hickel (2023)

[16] Compare Cockshott and Cottrell (1993) as well as Dapprich (2022) in this volume.

[17] Compare Morozov (2019) as well as Kathöfer and Schröter (2019).

[18] See Phillips and Rozworski (2019).

plan, however democratically and cybernetically arrived at, would then have to be done and, if necessary, enforced (Bernes 2020). It is also not clear how the transition to such an economy should appear, since the disempowerment of capital ownership could certainly not be avoided.

Numerous approaches discuss such questions, some of which are mathematically advanced. To mention just the most well-known ones, there is the approach of participatory planning by Adaman and Devine (1996), Laibman's idea of multilevel democratic iterative coordination (2002), Hahnel's (1991) concept of participatory economics and the proposal of a new socialism by Cockshott and Cottrell (1993). Dapprich (2022), a PhD student of Cockshott, discusses in his contribution to this volume the introduction of labour value-based tokens to coordinate a planned economy on behalf of top-down linear programming simulations, in order to address the problems discussed by Hayek. The tokens are conceptualized as non-circulating, therefore different from the usual all-purpose conception of money. The tokens would be used to distribute consumer products to individual consumers via socialized production entities. But unlike money, these tokens are not intended to facilitate the private exchange of commodities. Thereby, Dapprich operationalizes economic planning via labour *time* calculation and may overcome the law of labour *value* correspondingly. Still, as indicated by Ferrer-Hernandez (2023), in his contribution to this volume, the "socialist principle of payment in terms of labour time" (ibid. 12) would reproduce a specific kind of social relations, namely those building upon an "abstract equality as a regulative principle subordinated to the needs of the social equilibrium in the distribution of labour" (ibid.) Economic planning via tokens would not be able to sublate production as a "naturalization of a social objectification characteristic to commodity production".[19] Moreover, following Mandel (1986), Ferrer-Hernandez (2023, 11) argues that the substantial problem of planning design is not only input–output coordination, but also integration of bottom-up feedback processes to production targets. This aspect highlights the value of the evolutionary and complexity paradigm for a modularized mode of economic planning.

It calls for novel imaginary economies (Schröter 2020) that should avoid the binary dichotomy of market vs central planning. Ostrom's (1990) magisterial study on "governing the commons" can be regarded as a cornerstone for such conceptualizations: "Noting the numerous occasions in which common pool resources are managed successfully with neither centralized governmental control nor privatization, Ostrom argues for a third approach to resolving the problem of the commons: the design of durable cooperative institutions that are organized and governed by the resource users" (Buck 1992, 415). Ostrom could not only show that Hardin's (1968)

[19] Compare Marx (1976, 47–59) on "commodity fetishism" and its role in the objectification of social relations: "The life-process of society, which is based on the process of material production, does not strip off its mystical veil until it is treated as production by freely associated men, and is consciously regulated by them in accordance with a settled plan" (ibid., 52). See further Balibar (2017, 57–60): "Contrary to what Max Weber could later assert, the modern world is not 'disenchanted', but enchanted, precisely insofar as it is the world of objects of value and objectified values" (ibid. 60). The token socialism would overcome the notion of "objects of value" by "settling a plan" without circulation of commodities, without labour value, but would still reproduce on behalf of "objectified values", i.e. labour time.

tragedy of the commons could be overcome by the design of cooperative institutional structures (Scholz-Wäckerle 2014, 67, 74), but could also highlight that reciprocity as well as polycentric governance is key for progressive institutional evolution (ibid. 128, 188). But isn't this approach—like Hardin's and Ostrom's examples suggest—focused on comparatively small and local structures? Is the communicative form of coordination scalable to encompass a whole economy of modern mass society?[20]

In the socialist calculation debate, there was an emphasis on complexity. The critics of an alternative to market economics aka capitalism argued: Societies are too complex to be controlled by communicative agreements alone, and coordination by verbal exchange would take too long, if it is possible at all. And of course, imagine a commons-based coordination on the level of world society: Should 7 billion people discuss every local problem together until they reach a solution via deliberation? That wouldn't work, because even if everyone had only 10 s to speak on a given problem, it would amount to about 2220 years of discussion. This is just a caricature, of course, but it makes clear in a very simple way what complexity is about and how complexity relates to time—and "Economy of time, to this all economy ultimately reduces itself" (Marx 1973, 173). It seems that the idea of separate private production—described as typical for capitalism by Marx (1976, 132)—and mediation by markets on multiple scales and locations is intuitively more convincing, because it is obviously more realistic. Complexity becomes decentralized, modularized and thus manageable. In this sense, Hayek (1945, 524) remarked that economic problems would have to be solved by "some form of decentralization".

This would probably have been the end of the discussion (and especially after 1989/90 it was widely seen that way), if it wasn't proposed recently to use commons and commoning as an all-encompassing structural principle for a post-capitalist society. The question in the light of the SCD is how a commons-based coordination could be realized beyond a local collective action problem, where society is exposed to real and multiple power structures. This is the central topic in Sutterlütti and Meretz (2023), providing a theoretical base for the contribution of Gerdes et al. (2023) to this issue. The latter introduces and describes an agent-based simulation of

[20] This introduction cannot offer an extensive overview of existing non-capitalist forms of economic and societal organization—including commons. Heitmann (2019) provides a profound synopsis of contemporary real-world alternative economic projects by systematically distinguishing between degrees of division of labour on the levels of needs, production, distribution, decision-making, property ownership and society or culture. It should be emphasized that many alternative economic projects suffer from the problem that the respective forms of organization are limited in scale. A line of research that is highly relevant to these questions of scale has been undertaken by Robin Dunbar (2008). As far as we can see, this research has not been taken into account by scholars aiming for a post-capitalist society. Dunbar and colleagues showed that the typical size of hunter-gatherer communities—a scale of around 150 people—appears frequently in many forms of historical and contemporary human organization as well (for instance: the mean village size recorded for almost all English counties in the Doomsday Book, the typical size of the company in most modern armies, the number of recipients of a typical Christmas card distribution list today, the size of social networks in reverse small world experiments etc.). These reoccurring grouping-patterns clearly show the benefits but also the limits of face-to-face-coordination, a topic of great relevance for any attempts to scale up non-market and non-state forms of coordination.

a commons-based artificial post-capitalist utopia on large scale.[21] The world economy realized as one common, so to speak, would fail due to its informational complexity, but a modularized complex global web of commons, relying on cooperative networks within and between regions, would make a different case.[22]

5 Utopian realism and computational simulation

As highlighted in Section 2, utopian realism is first about the aesthetics of societal visions, about the critical reflection of latent tendencies, pre-analytical visions and imaginaries. Second, it is about up-scaling already existing utopian projects in a transformative way. Computational simulation is useful to complement this approach in a synthetic way, by the design and simulation of artificial societies. The previously developed question of utopia development relates to questions of economic planning as well as societal coordination and mediation, especially in the context of post-capitalist futures. The contributions to this special issue characterize and discuss different varieties of utopian realism, some more concrete and some more imaginary. They also address analytical questions which seem relevant for the question of planning. Especially, the contribution of Ferrer-Hernandez (2023) indicates that it is substantial to address the question of exchange and labour value. Besides this theoretical discussion, computational simulation enables us to investigate economic imaginaries of planning—at such a large scale—more closely, as they are difficult to develop theoretically in all their aspects. However, computational simulation helps us out in this respect. Dapprich's (2022) conceptualization of central planning via tokens is tested and substantiated via linear programming methods and corresponding simulations, enabling a central planner to allocate tokens in just terms. Where this top-down approach may offer new insights about aggregate dynamics and causal relations of a planning apparatus, it surely has limitations in representing the complex dynamics of micro-meso-macro interactions and the various feedback mechanisms between agency and structure. If planning implies modelling of entities and interdependencies between such agencies and structures, as e.g. in the case of commonism, top-down computational simulation is out of the game.[23] Still, top-down computational simulation may provide us with projections about the limitations of the different varieties of utopian realism. Assessing the complexity

[21] The move from the SCD to commonism does of course not necessarily require an agent-based simulation. Simulation is just one interesting and promising tool to analyse certain problems of economic coordination and other dynamics.

[22] Hayekians would perhaps argue that every coordination beyond face-to-face interaction would imply "tacit knowledge" that cannot be made explicit and therefore used for planning purposes. But Schmidt (2012) has argued in his critique of the notion of "tacit knowledge", that a completely "tacit" knowledge would be completely useless, because it could not be communicated or taught at all. It must be possible to make it explicit in certain local practices—and if so, it should be at least in principle possible to trace it.

[23] See Miller and Page (2007) for a comprehensive discussion of top-down vs bottom-up modelling approaches.

of a utopian society, on the other hand, implies generating meso behaviour by the development of complex adaptive systems (Scholz-Wäckerle 2017).

Agent-based simulation enables the implementation of heterogeneous agents, social networks and geographical space in discrete time (Wilensky & Rand 2015).[24] Production of social and geographical space by political economic agents and entities is decisive for the development of future utopias, as we have emphasized in Section 2 along Moore's (2015) notion of "environment-making". Evolutionary processes of such political economic kind need to be generated and grown in computational sandboxes (Epstein 2006). Political economic uncertainties demand the implementation of boundedly rational agents and/or institutional agencies, agents that develop and learn decision heuristics over time via imitation and innovation. Such heuristics are called "satisficing", after Simon (1987), because the assumed evolutionary ontology of a modularized complex adaptive system contradicts the logic of complete information. Moreover, from a sociological perspective, agent-based simulation fits well with the profession's long-standing interest in the relationship between individuals' motivations and decisions and large-scale patterns of social organization and change. As nearly all human behaviour is interdependent, individuals' actions are contingent on the past, present and predicted future behaviour of others, which is why the micro–macro problem cannot be solved by simply aggregating over individuals' intentions or behaviour to generate expected population-level attributes (Bruch & Atwell 2015).

As Yang and Gilbert (2008) emphasize, unlike most other modelling approaches, there is nothing inherently quantitative about agent-based modelling. They point out that in principle it should be as easy to develop and validate ABMs with qualitative data as it is with quantitative data, due to the epistemic and technical openness and flexibility of the approach (see Tubaro and Casilli 2010; Edmonds 2015). Millington and Wainwright (2017) point out that ABM provides a means to better *understand* the world via abstraction, and not only to make predictions about it via (statistical) generalization. Thus, it can also be used to open up debates about how the world should or could be, not simply describing and understanding its current state. Good practical examples for this are the so-called companion modelling approaches that are developed to address social dilemmas and conflicts, for instance struggles related to the collective use of natural resources such as land or water (D'Aquino et al. 2003). In these models, stakeholders are involved in the model-building process at different stages and are asked to participate with their own knowledge and understanding of their social context.

As agent-based modelling is successfully employed to macroeconomic questions these days,[25] there is ample potential for exploring utopian realism according to properties, categories and synergies aforementioned. Gerdes et al. (2023)

[24] It could be argued that (agent-based) simulation cannot be an appropriate tool to deal with complexity, since the models used in simulation by definition reduce complexity. That is of course true, but it doesn't mean that simulations are the opposite of complexity. They are a tool to understand complexity better, step by step.

[25] Compare the special issues by Dosi and Roventini (2019) as well as Cincotti et al. (2022).

contribution to this special issue is, according to our knowledge, the first large-scale agent-based simulation of a post-capitalist utopia. The authors implement the narrative of commonism, developed by Sutterlütti and Meretz (2023). Commons organize themselves in a web of input–output production groups, care groups, resource miners and environmental sinks. The simulation operationalizes decentralized planning via networks of commons, coordinated by an ex ante needs communication of agents living in small groups. The originality of the approach is not only given by its modular complex adaptive system design and its introduction of sensual vital (consumption) as well as productive needs, where the latter signals the motive to work in a certain sector of the artificially evolving political economy, but by involving different evolving group cultures, with distinct traits. This allows the authors to test and experiment with resource and production input conflicts as well as shortages in the provision of care and environmental sinks. Polycentric governance is moreover tested along different redistribution mechanisms, ranging from the implementation of commonly used inventories between different production groups and sectors. With a somewhat different focus, Miyazaki's (2023) contribution to this special issue substantiates questions of complex adaptive designs for utopian realism. From a historical media studies perspective, his article theorizes heterodox modelling as being based on a still imaginative, not yet implemented, networked multi-agent online environment, which would integrate the modular programming of agent-based models, group exercises, role-playing, gaming and testing of operations and processes within large-scale socio-ecological networks of commoning.

6 Concluding remarks

In this editorial article, we discussed the role of heterodox economics for opening new perspectives, the question of scalability of socio-economic order, the heritage of the "socialist calculation debate" and its ongoing relevance for discussions on "post-capitalism" today and finally the potentials of agent-based modelling for the exploration of alternative socio-economic approaches. We selected contributions for our issue that address these aspects and topics in different ways and therefore underline the fruitfulness of these discussions, especially in regard to the development of more just and sustainable socio-economic structures. Faced with the contemporary polycrisis, we can no longer afford "capitalist realism".

Utopian realism, on the other hand, engages with the question of economic planning on a large scale. The special issue shows that objectification and abstraction of value play a central role in the coordination of commodity-based market economies. The canonical question for post-capitalist utopias concerns the use of abstracted labour time as a means for socialist coordination. This aspect divides top-down and bottom-up approaches currently, in conceptualization as well as simulation. Contributions to this issue have highlighted the strengths and weaknesses of both attempts, and therefore point to the need for further research in assessing complementarities between centralized and decentralized planning.

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