

Promotion and co-evolutionary dynamics in contemporary capitalism

Isabel Almudi

Francisco Fatas-Villafranca

University of Zaragoza

Faculty of Economics. Gran Via 2. 50005 Zaragoza (Spain).

Abstract

In this work, we characterize the *dynamics of contemporary capitalist societies* as emerging from the *co-evolution between five different subsystems*: the intimate realm of individuals, the market, the State, civil society and nature. We spotlight a specific co-evolution mechanism between some of these subsystems which we call *promotion*. The insights we get from this co-evolution approach are twofold: on the one hand, from the *ontological* and *heuristic* perspectives, we argue that our proposal opens lines of progress towards the construction of a general interpretative framework in evolutionary economics. On the other hand, from a *theoretical-explanatory* perspective, we detect certain co-evolution paths which may engender global pathologies in capitalist societies. We suggest future research lines to explore the *normative* implications of the approach, and alternative *methodological* strategies to develop it.

Keywords: Co-evolution, Promotion, Capitalism, Evolutionary Economics.

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1.-Introduction

Little attention has been paid to “non-market” aspects of socio-economic systems in mainstream Economic Theory (Hicks, 1939; Samuelson, 1947; Arrow and Debreu, 1954; Debreu, 1959; Friedman, 1968; Lucas, 1981; Woodford, 2003).

However, the importance of interactions between the market and the non-commercial aspects of societies has been explicitly recognized by other influential economists (Keynes, 1936; Schumpeter, 1942; Hirschman, 1970; North, 1990; Nelson, 1990; Gowdy, 1994; Hodgson, 1999; Witt, 2003a, 2003b; Sen, 2009, to name just a few). In this work we start out from this “mixed” approaches, and we characterize the dynamics of contemporary capitalist societies as resulting from the co-evolution between five subsystems: the intimate realm of interacting individuals, the market, the State, civil society and nature.

As we state later on, these five subsystems can be conceived as *complex population systems* which co-evolve (Hodgson and Knudsen, 2010a; 2010b and Aldrich et al. 2008). In order to justify this claim, we shall define the types of processes which operate *within* the (evolving) subsystems, and the co-evolution mechanisms operating *between* them. Furthermore, we will pose a specific mechanism of co-evolution, which we shall call *promotion*. To be specific, we shall state that two subsystems (X,Y) co-evolve through deliberate acts of inter-systemic promotion, when some agents of X, upon realizing that by influencing the propagation of elements of Y can improve their own position in X, decide to act on Y. The same occurs for the case of Y-agents and their actions on X. As we will show, by delineating specific actions of promotion underlying co-evolution, both, virtuous and pathological dynamic paths can be detected for contemporary capitalist societies.

This representation of the dynamics of contemporary capitalist societies -as resulting from the co-evolution among *complex population systems*- is inspired by fundamental insights which have emerged from the application of *evolutionary theory to social problems* in recent decades.¹ At least in the case of *evolutionary economics*, it is fair to

¹ Among others, Donald, 1991; Barnett and Burgelman, 1996; Burgelman, 1991; Cyert and March, 1963; Baum and Singh, 1994 in culture, management and organizations; Campbell, 1965; Dawkins, 1976; Brandon, 1998; Hull, 1980, 1988 in philosophy of biology; Alchian, 1950, Nelson and Winter, 1982; Metcalfe, 1998; Foster and Metcalfe, 2001; Dopfer et al 2005; Dosi and Nelson, 2010 in economics.

say that a certain *variety of approaches* co-exist under this common heading, perhaps still looking for a general framework. Thus, if we look at Nelson, 1995, 2006; Winter, 2014; Witt, 2008, 2014; Hodgson and Knudsen, 2010a; or Dollimore and Hodgson, 2014, we can feel the need of a general interpretative frame for evolutionary economics.

In this sense, and following Witt (2008), we argue that our co-evolution approach may open new ways towards this overarching frame, both, from an *ontological* perspective and from a *heuristic* viewpoint. Thus, as we will see, from an *ontological* perspective (Dopfer and Potts, 2008), our proposal takes on board (within a frame which – otherwise- might be perceived as a Generalized Darwinian, or, a Neo-Schumpeterian setting) aspects of the naturalistic streams in evolutionary economics: e.g. we consider the fact that human societies co-evolve with (and are contingent on) nature. Moreover, as it will be shown, we believe in the need of advancing towards a theory of individual behavior which must be consistent with findings in evolutionary psychology and behavioral economics (Donald 1991; Henrich and Gil-White, 2001; Witt, 2001; 2016). Thus, we incorporate some of these insights when we define the realm of individuals and its co-evolution with other subsystems. In fact, we highlight the role of individual action (apart from organizational action, State, etc.) in a way which seems stronger than usual in an (otherwise) Neo-Schumpeterian or Generalized-Darwinian setting (Hodgson and Knudsen, 2010a). Finally, as it is usual in evolutionary approaches, we recognize the importance of historical contingency to analyze economic phenomena (we focus, specifically, on *contemporary capitalist societies*).

On the other side, from an *heuristic* viewpoint, we argue that our co-evolution proposal opens possibilities for cross-fertilization among, on the one hand, the Darwinian approaches of Hodgson and Knudsen (2006) or the Neo-Schumpeterians (Nelson and Winter, 1982; Winter, 1987) and, on the other hand, those evolutionary economists who argue in terms of endogenous qualitative change and the dissemination of novelties - without relying on Darwinian analogies (Vromen, 1995; Witt, 2003a; North, 2005). As we will see, we propose combining complex population thinking and Darwinian analogies, with a naturalistic embedding, and then we try to highlight (in a clearer than usual way) the role of individual agency (intentionality, human creativity) as a source of novelty and promotion in co-evolving systems.

In order to build up our framework, it is crucial to link the intra-subsystem (domain-specific) processes of variety generation, retention, learning, adaptation and selection (at individual and organizational levels), with the inter-subsystem processes of co-evolution. According to Murmann (2013; 2003), when dealing with a co-evolutionary analysis, we should always consider two steps: first, we must spell out how the variation, selection and retention processes (VSR-processes) work in each domain (subsystem); second, the analytical framework must show bidirectional causal links involving, at least, one of the VSR-processes in coupled subsystems.

Following this procedure, we will begin, firstly, by explaining why our subsystems can be considered as *complex population systems* (Hodgson and Knudsen, 2010a), and which are the specific VSR-mechanisms operating within each subsystem. Secondly, we will delineate the specific co-evolutionary mechanisms in action, paying special attention to what we call *promotion*. As we will see, once we link the subsystems and make the intra-subsystem VSR-mechanisms endogenous through co-evolution, both, the possibility of virtuous sustainable trajectories in capitalist societies, and the possibility of pathologies with negative effects on individual welfare emerge. These results lead us to reflect on certain normative issues in evolving systems (Witt, 2016; Wilson and Kirman, 2016). Finally, we also introduce some reflections on alternative formal methods that could be used (in future research) to articulate our co-evolution frame (Hofbauer and Sigmund, 1998; Frank, 1998; Okasha, 2005; Nowak, 2006; Vega-Redondo, 2007, and others).

The rest of the paper is structured as follows: in Section 2, we propose our view of contemporary capitalist societies as made up of five co-evolving subsystems (*complex population systems*). In Section 3, we define co-evolution and we specify the *promotion* mechanisms linking different subsystems. Previous studies by Gowdy, (1994); Volberda and Lewin, (2003); Henrich and Boyd, (1998); Henrich, (2004); Breslin, (2011); and Murmann, (2003, 2013) have been of help to define co-evolution, and to come up with the concept of co-evolution through promotion. In Section 4, we draw on apparently unrelated sources (Maruyama, 1968; Hodgson, 2015; Witt, 2016) to reflect on the normative aspects of alternative societal paths. Finally, we present our conclusions.

2.- Contemporary capitalist societies. An evolutionary approach.

2.1.- Fundamental concepts and definitions

Following the definitions of *capitalism* given by Hodgson (2015) and (implicitly) by Phelps (2009) –among others, we define a *contemporary capitalist-democratic society* as that in which:

- 1) The right to private ownership exists and is guaranteed.
- 2) There exists a general institutional framework guaranteeing: free establishment of contracts; freedom for business initiatives; and the possibility of market monetary exchanges (including capital and labor markets).
- 3) There is a public body (the State) – whose legitimacy originates in that it represents the freely-exercised will of citizens – responsible for guaranteeing, among others, the aforementioned rights.
- 4) Most productive activity is carried out via private firms aiming to make monetary profits in markets.

We claim that the dynamics of this kind of society may be analytically represented as resting on the interactions between five realms of action – *subsystems* – which, in themselves, experience transformations; our proposed subsystems are: the personal realm of individuals, the market, the State, civil society and nature. Moreover, we state that these subsystems can be characterized as *complex population systems* in *co-evolution*. By definition (Hodgson and Knudsen 2010a; 2010b and Aldrich et al. 2008), *complex population systems* contain multiple (intentional and/or unintentional) *types of entities* (with *heterogeneity* within the types), which interact with their environment and among them. These entities face *scarce* resources and *struggle* to survive. They *adapt* and can pass on information to others through *replication* or *imitation*. Finally, different sources of *novelty* are observed in these complex systems.

As we have said, departing from this definition, we shall consider in what follows five interlinked complex population sub-systems in contemporary capitalist societies: the personal realm of individuals, the market, the State, civil society and nature. For the sake of clarity, and considering the scope of this specific-single paper, we will focus in more detail in the internal structure and mechanisms of *markets*, the *realm of individuals* and *civil society*. The *State* and *nature* will play key roles but –in this paper– we will look at their structure and internal processes in less detail.

Let us begin by providing a preliminary presentation of the market, the civil society and the realm of individuals as *complex population systems*. According to the definition (above) we can point out to the following subsystem features in these realms:

- 1) The processes generated in these realms are carried out by different kinds of *interacting agents* (which are cohesive wholes, types of entities) *facing scarcity* and *struggling to survive*, and which are, necessarily, *heterogeneous*.
- 2) These *agents interact* with the environment and among themselves generating structural change from the combination of *three mechanisms*: the *generation of new elements* which regenerate diversity; the *retention* of certain traits (so that novelty does not lead to persistent extreme systemic volatility); and certain mechanisms of *selection and replication* which produce changes in the relative frequency of agents (and/or certain agent traits) within subsystems. As (e.g.) Hodgson and Knudsen (2010a) recognize, the agents interacting in social complex population systems *may be* (or at least certain types of them can be) *intentional*. In fact, we will consider intentional agents in the rest of this work.

To clear the stage, we must specify now what we mean by *replication* and *selection* (perhaps the most confusing terms within our framework). We use these terms since they condense effectively a lot of analytical information and allow us to simplify the presentation of our complex framework. Moreover, from a heuristic viewpoint, we believe that Darwinian analogies are one of the legitimate approaches in evolutionary economics (although we will do a prudent use of the terms in our overall approach). Then, from here on, we will refer to the following definitions of *replication* and *selection* (Nelson and Winter, 1982; Price, 1995; Hofbauer and Sigmund, 1998; Knudsen, 2002; 2004; Andersen, 2004; Henrich, 2004; Hodgson and Knudsen, 2010a):

**Selection* (Def.)- (Hodgson and Knudsen, 2010a, pp. 241): “Selection in a *complex population system* involves an anterior set of entities that is somehow being transformed into a posterior set, where all members of the posterior set are sufficiently similar to all members of the anterior set, and where the resulting frequencies of posterior entities are correlated positively and causally with their fitness in the environmental context. The

transformation from the anterior to the posterior set is caused by the entities interaction with the environment”.

**Replication* (Def.)- (Sterenly, Smith and Dickinson, 1996; Godfrey Smith, 2000; Sperber, 2000; Aunger, 2002; Nanay, 2002; Hodgson and Knudsen, 2010a, pp. 241): It is the process whereby replicators diffuse (get transmitted) under the following conditions: causal implication, similarity and information transfer. By *replicators* we mean agent traits, with informative content, and which can be replicated (in the above-mentioned sense; more on this, later). The entity which contains the replicators and which interacts with the environment may be called the *interactor* (interactive agent; see Dawkins, 1976; Hull, 1980; Hull et al. 2001). We may mention another concept which is that of *generative replication* (Hodgson and Knudsen, 2008) consisting of a type of replication which implies a fourth condition: the operation of conditional generative mechanisms.

To finish this subsection devoted to basic concepts we should remark that:

(i) The kinds of traits which can be replicated (replicators) have informative content (skills, ideas, values, habits, policy proposals, techniques). Examples of replication mechanisms in social contexts would be learning, imitation, emulation. The *carriers* of these *traits*, and those who make their replication possible, are interactive *agents* such as individuals, firms, civil organizations, political parties, etc.

(ii) In human *complex population systems* some degree of *intentionality* is generally recognized (Vromen, 1995; Wilson and Kirman, 2016). This intentionality (inherent to the afore-mentioned social agents) can affect the replication and selection processes. These agents (individuals, firms, etc) have hierarchical objectives – the content and sorting of which defines the *intentionality* of each agent. The agents obtain and allocate resources in their domain-specific realms, seek to achieve their aims, and can project *action*, emit and receive *information*, and revise said action in consequence. These processes appear in humans in a highly developed version.

(iii) Replication is carried out because specific traits (or replicators) are perceived by certain agents as *performance-enhancers*². That is, the *replicative intensity* – capacity

² Achieving objectives, increasing presence and relative importance.

for propagation – of certain traits in a realm is greater, the greater the importance they are presumed to have as engines of successful performance.

2.2.- Composition and endogenous change in evolving subsystems.

Once we have defined certain basic concepts, we can focus in detail on the subsystems: *the market*, the personal *realm of individuals* and *civil society*. These three subsystems can be considered as *complex population systems*. To develop our frame, we will specify for each subsystem: i) which are the heterogeneous entities (i.e. domain-specific interactors/interactive intentional agents) that operate as cohesive wholes; ii) how they can pass on/receive information to deploy action, grow and/or to survive (i.e. we will explain in detail domain-specific replication/selection processes); iii) how these agents can improve their adaptation to the environment through the generation of novelty.

2.2.1.- The market

We believe that all the streams of thought within evolutionary economics coincide in characterizing markets as evolving systems (Alchian, 1950; Nelson and Winter, 1982; Knudsen, 2002, 2004; Witt, 2003a; Aldrich, 2008; Dosi and Nelson, 2010). Here, more precisely, we shall consider that markets are *complex population systems* in which exchanges take place and change with time based on the following elements:

- (1) Firms are the fundamental *agents* in this field (Aldrich, 1999; Aldrich and Ruef, 2006). They may be considered as boundedly-rational agents (Simon, 1986) whose *generic objective* is to obtain profits (in this sense firms can be considered as purposive interactors)³. To this aim, and based on technologies consisting of capital goods, techniques and routines, firms manage their resources and produce – with a certain efficiency – goods and services which they supply in the market in exchange for money. A significant proportion of the firm relevant knowledge to adapt and survive is embodied in *routines* (Hodgson, 2003). Routines can be transmitted and can be considered as replicators. Replication processes may take place through imitation, and/or by scaling-up, spin-offs involving generative replication, etc.
- (2) Since firms have to adapt and try to survive in a specific environment, they try to *innovate* and/or (imperfectly) *imitate* other firms' routines, strategies. These

³Hodgson and Knudsen (2004; 2010a).

sources of variety entail the persistence of diversity and the appearance of new products, processes, new firms and even new sectors (*novelty*).

- (3) Different levels of success result from the development of firm-specific plans, strategies and sales, generating profit distributions and different rates of growth (Metcalfe, 1998). The multiple interactions between rival firms striving for profits, providers and demanding agents, together with that previously mentioned in (1) and (2), can be characterized as a market *selection mechanism*. Those firms which are endowed with well-fitted traits (routines/replicators) will increase their relative importance (increasing sales, profits, market share). Consequently, these firms and/or some of their corresponding routines will become more frequent/visible in the market realm.

These evolutionary market processes underlie structural change and, also, emergent trajectories of income growth, employment, relative prices, etc. These processes generate a huge amount of information and action which exceeds the commercial realm and allows us to link *the market* to other subsystems.

2.2.2.- *The personal realm of individuals.*

The *personal realm* includes the realm of heterogeneous interacting individuals, with private lives, including family and friendship relationships, social interactions, etc. This realm can be also considered as a *complex population system*.

- (1) The interacting agents in this realm are the *individuals* (interactors). They may be characterized as boundedly-rational (intentional) agents whose generic objective is to obtain *personal well-being* through the satisfaction of different types of wants (Witt, 2001; 2016). Individual well-being requires meeting basic needs (e.g. maintaining physical health), but it also demands satisfying more complex needs –such as achieving personal autonomy, increasing social status, maintaining self-esteem, etc. Personal well-being can be achieved through (monetary and non-monetary) individual action interacting with the social and natural environment. We assume that human individual action involves, partly, the consumption of (catallactic) monetary goods/services⁴ and, in part, the

⁴ Mises (1949). Examples: food, shelter, medicine, tourism, entertainment, transport, etc.

obtaining and enjoyment of non-marketable goods⁵ (that is, goods which not always can be obtained through monetary exchange in the market). Both types of goods are needed to satisfy different types of human wants.

To obtain goods/services of one kind or another, individuals deploy human action (von Mises, 1949) relying on certain personal features such as knowledge (often tacit knowledge) and skills (Polanyi, 1967), ideas and values (Campbell, 1965; Wilson and Kirman, 2016), and habits (Hodgson, 2003; Hodgson and Knudsen, 2008; see also Veblen, 1899). Replication of these traits can take place through different kinds of processes:

- i) *Social conformity* (Henrich and Boyd, 1998): individuals show a certain propensity to imitate some of their peers as long as their traits are considered to be “good” (i.e. fitness-enhancers) within a reference community (not free-riding, respecting the elderly, regard for others; Burnham et al. 2016);
- ii) *Prestige-based transmission* (Henrich and Gil-White, 2001): individuals tend to imitate the behavior of the most successful individuals in society (adoption of celebrities life-styles; emulation of consumption patterns trying to signal social status, etc);
- iii) *Learning skills -to get money/resources, or to carry out other activities:* individuals often try to learn those skills (traits) which provide them with high possibilities to find a job, get funding, to create and run a firm, or to deploy action oriented to satisfy individual wants.

These *replicative mechanisms* will tend to propagate those existing traits (replicators) which are perceived to be beneficial by individuals.

- (2) As long as individuals have to adapt to the environment and/or they perceive uncertainty regarding their future fitness, they will explore new behavioral patterns, conceive new values or beliefs, attempt to improve and sharpen their skills (i.e. individuals innovate, they can generate *novelties* (e.g.) through imperfect replication, personal creativity, entrepreneurship at different levels, etc). Thus, individuals may innovate with the aim of improving their well-being, or avoiding, in certain situations, social exclusion, financial impoverishment, etc. Most of the chapters in Wilson and Kirman (2016) are extremely

⁵ Self-fulfillment, affection, cultural learning, transcendent experiences, social integration, etc.

informative on the naturalistic-evolutionary grounds of some of these perceptions and adaptive reactions (see e.g. Burnham et al. 2016).

- (3) The multiple interactions between different individuals striving for well-being, together with (1) and (2), allow us to consider the existence of certain *selection* mechanisms in the realm of individuals. The compatibility (or conformity) of an individual's habits with those of the majority – or with those of a reference group – will favor the social integration of said individual in the group. On the other hand, the opposite case can generate social exclusion. Likewise, the degree of adaptation of an individual's knowledge and skills to the needs of the market can increase their relative participation in the distribution of income. Therefore, those individuals endowed with fitted traits at any time (habits, customs, opinions, skills) will experience an increase in (or, at least, will maintain) their relative importance in society (distribution of income, fame, prestige, social acceptance) and, consequently, the traits (replicators) of those successful individuals will propagate in this realm.

The mechanisms detailed in (1), (2) and (3) allow us to explain the change in the habits, values and ideas of a society, the mechanisms of social exclusion, and -in interaction with other subsystems, such as the market and civil society- the production and distribution of income, the change in social knowledge (Hayek, 1945; Nelson, 1990), or the dynamics of public opinion.

2.2.3.-*Civil society*

In capitalist-democratic societies, individuals can freely express their opinions and join together to exercise (to some extent) their influence on political questions. These individuals also choose (via democratic elections) those groups which will rule the State (Witt, 2003b). From now on, we shall define *civil society* as the subsystem in which political-social-civil debate takes place through *civil organizations*. We argue now that this realm can also be considered as a *complex population system*. Thus:

- (1) There are groups of individuals who share values, ideas, beliefs, visions of society, etc. They organize themselves so as to collectively allocate means to ends, with the aim of orientating civil action in a certain direction – a direction which reflects the

intentions of each specific civil organization. That is to say, the *civil organizations*⁶ are the civil society *agents* (interactors) which interact with the environment. We shall assume that they are *influence seekers*. To this end they must obtain money, and other non-monetary resources (active participation of individuals, sympathizers, and access to strategic resources within the State). These organizations have values and proposals, as well as certain operative routines (replicators) -communication policy, organization schemes, and strategies- which make the functioning of the organization possible. In this realm, *replication* processes take place through imitation and scaling up (generative replication), persuasion, and even by exerting social pressure.

- (2) On the other side, reformulating values, ideas, routines and proposals for collective action and, even, creating new traits and organizations, together with imperfect replication are sources of variation (*novelty*).
- (3) These civil organizations maintain diverse interactions among themselves, and with other subsystems, trying to influence society's direction through the propagation and application of their ideas and proposals. It is clear that competitive processes between organizations emerge in the non-commercial realm. As a result of these *processes of competitive selection*, those organizations which carry traits which are more efficient, or have more in common with the interests of the agents of other subsystems, will capture greater shares of participation, will gain support and will experience growth in their resources, and their capacity for social influence. That is, those civil organizations endowed with well-fitted traits (routines/ideas/proposals) will experience an increase in their relative importance (increasing resources, influence, etc.); consequently, the traits of those successful organizations would be more frequent within the civil society realm.

Note that the evolutions of the personal realm and market subsystems affect the evolution of civil society, as they may shape the competitive setting in which civil organizations develop. Likewise, the evolution of civil society shapes the other

⁶ Our concept of *civil organizations* is compatible with Aldrich (1999), who defines organizations as goal-directed, boundary maintaining, and socially built human systems; and with Hodgson and Knudsen (2010a) where organizations are seen as a special type of institution involving: (a) criteria to establish its boundaries; (b) principles of power and direction regarding who is in charge; and (c) a chain of command defining roles within the organization.

subsystems (individual values, demand structure, public policies). In general, this happens among the subsystems, considered as coupled in a global perspective.

We summarize in Table 1 (in a simplified way) the main VSR-mechanisms that we have stated (above) for the three subsystems.

Realm	Agent/ Cohesive whole/ Interactor	Replicative Traits/ Replicators	Replication Processes	Selection Processes	Variation Sources
Market	Firm	Routines Strategies	Generative Rep. Imitation/Diffusion	Market Selection	Imperfect rep. Innovation
Personal	Individual	Habits/Values Skills/Ideas	Social Conformity Prestige-based Learning skills	Individual Selection	Imperfect rep. Innovation
C. Society	Civil Organization	Routines/Ideas Soc. proposals	Generative Rep. Diffusion Persuasion	C. Society Selection	Imperfect rep. Innovation

Table 1: VSR mechanisms for the three subsystems

To sum up, we have described three subsystems (market, personal realm and civil society) as *complex population systems* in which some of the key drivers of change move around the concepts of *replication-cum-variation* and *selection*. We have not entered into the parallel dynamics within the State and nature for the sake of clarity, and because we try to focus on the specific scope of this paper. In any case, the role of these two subsystems will be clear in what follows.

In the next section, we shall show that the replication/selection drivers examined above may be considered as endogenous, and their dynamics can be explained through specific co-evolutionary forces linking the subsystems in our framework.

In fact, we pose a specific co-evolutionary mechanism which we call *promotion*. This mechanism reflects the agents' intentionality in attempting to shape the *replication/selection* processes in other subsystems, to reach competitive advantage in their own realm. As we will see, the *promotion* mechanism incorporates interesting aspects of human intentionality and inter-subsystem deliberate shaping, which may connect Darwinian ideas and Neo-Schumpeterian approaches, with the naturalistic-evolutionary ones. Likewise, the incorporation of co-evolution through promotion to our previously stated proposal will lead us to obtain new properties of contemporary capitalist societies.

3.- Co-evolution between structurally different subsystems.

In this section, we analyze in what sense we can state that the market, civil society, the personal realm of individuals, and, in a less detailed way, the State and nature, co-evolve. As we will see, although we depart from a general definition of *co-evolution*, we will focus on a specific co-evolution mechanism which we call *promotion*. Let us begin, first, by elaborating on Murmann (2003; 2013) definition of co-evolution⁷ and, then, we will move to define our specific mechanism. Thus:

**Co-evolution* (Def.)- We shall say that two realms – subsystems – co-evolve, if both influence each other causally in such a way that this bi-directional influence affects, at least, one of the three VSR-processes. That is to say, mutually-influencing subsystems must causally affect their respective internal processes. We shall consider that this causal influence takes place in either, or both, of these ways: i) by altering the criteria which drives the *intra-subsystem selection processes*; or, ii) by influencing the *replication* of the intra-subsystem replicable traits. We should also mention co-evolution through *novelty-generation* shaping processes but, considering that novelty still remains (relatively) not-well understood in economics, we leave a detailed exploration of these effects for future research (see interesting points in Witt, 2009).

In this paper, we shall pay special attention to certain *inter-subsystem flows of (monetary and/or non-monetary) intentional action* which make up *co-evolution through promotion* mechanisms affecting, mostly, replication and selection in different subsystems. Thus, we define the *promotion* mechanism as follows:

**Promotion* (Def.)-It is a specific mechanism of co-evolution among subsystems that implies: (i) agents (interactors) in subsystem X realize that, by shaping the VSR-processes in Y, they can increase their possibilities of being selected in their own domain X; (ii) because of (i), agents in subsystem X decide to act *intentionally* in Y by *shaping* (or trying to shape) any of the Y-VSR mechanisms. And the same applies for Y-agents and their actions on X.

⁷ Gowdy (1994), Volberda and Lewin (2003) or Henrich (2004) led us to Murmann's stylized and accurate definition. On the other side, we find (somehow complementary) uses of co-evolution in Colander (2016; State-market co-evolution) and Gintis (2016; co-evolution among nature-genetic endowment of individuals and culture). We draw upon these sources to pose our proposal.

More specifically, we can state that two subsystems (X,Y) *co-evolve through promotion*, if agents of X try to foster the propagation (in the case of replicators/traits), or support the selection (in the case of agents), of certain Y-entities (replicators and/or interactive agents) in an attempt to increase their own chances of success in X; and the same applies to Y-agents and their promotional shaping actions on X.

In the following sub-section, we shall show how co-evolution mechanisms work in our frame, with a special focus on those intentional actions which fit into our definition of *promotion*. To this aim, and without being exhaustive in the analysis –given the scope of a single paper- we shall analyze the subsystems: market, civil society and the personal realm of individuals, together with the State and nature, by taking some of them at a time.

3.1.- Co-evolution between the market and the personal realm of individuals (with certain considerations regarding the nature-subsystem).

Bearing the definitions (above) in mind, we begin by considering some significant causal relations between the market and the personal realm of individuals. As we explained in section 2, competitive market processes operate on the basis of the demand structure, the relative capacity of firms to adapt to demand, and the firms' relative technological conditions and input costs. These factors drive the market selection process (engendering paths for market shares and profit rates), as well as the direction and intensity of the replication of techniques, routines and strategies (Table 1). Thus, they underlie *selection* and *replication* processes in the *market*.

Now, we put forward the idea that the dynamics within the *personal realm of individuals* (section 2; Table 1) affect, in a crucial way, the afore-mentioned market processes of selection and replication. Thus, changes in the values, habits and the distribution of income and wealth among individuals – all being evolving elements of the personal realm tackled in section 2– underlie the changes in market demand; likewise, evolving scientific and technological knowledge, skill distributions, and habits of wealth management, influence the possibilities for production, innovation, funding and the firm labor costs.

Furthermore, we explained in section 2 how values, habits, and skills, as well as wealth and income distribution, and the relative-status and visibility of individuals in the social scene, change via processes of replication and selection *within the personal realm* (see Table 1). Since we have just said that these processes and traits are crucial for market competition, it seems sensible to state that they may be targeted, and shaped, by firms as part of their struggle to survive and grow in the market. On the other hand, the same motivations can be detected within the realm of individuals to target and try to shape aspects of the market realm.

Consequently, from the afore-mentioned we can conclude that:

1. *There are strong incentives for firms to try to shape, from the market realm, the processes of replication and selection in the personal realm of individuals, orientating these processes and, in consequence, the determinants of replication and selection in the market, in their favor.* Likewise, it follows that:
2. *The individuals also have incentives to intentionally influence replication and selection mechanisms in the market, benefiting certain firms and, consequently, shaping – at least in part – the dynamics within the personal realm of individuals in their favor.*

Notice that co-evolution between these subsystems not only takes place via market-monetary-exchange (as it is clearly stated by modern Economic Theory), but also via *intentional monetary and/or non-monetary promoting actions*. There is clearly *co-evolution through promotion between these subsystems*.

Additionally, we would like to note that it is easy to connect these co-evolving subsystems with the dynamics of the *natural realm (Nature)*. Thus:

3. Depending on the specific trajectory of co-evolution among (firm and individual) values, habits, skills / strategies, technologies, routines, and also, depending on the emergent path of (changing) relative shares of diverse firms/individuals in their corresponding (interlinked) sub-domains, we may obtain, both: *sustainable trajectories of resource extraction and sustainable co-evolution patterns between the market and nature*; or, on the contrary, we can

see the emergence of trajectories characterized by the *market-driven depletion of environmental resources and the erosion of nature* (use of rare metals, deteriorated biodiversity, pollution, etc).

For example, a long history of investment in fossil-fueled energy generation technologies has led to increasing returns to scale and supply/demand lock-in situations, finally engendering pollution and non-renewable resource depletion that generate tensions in our societies. Another more general example: the exponential GDP growth that has emerged from the co-evolution mechanisms (above) in capitalist societies during the last two centuries -with highly beneficial increases in material well-being almost all over the world-, has also generated a huge dangerous expansion of the human imprint on Earth (Carbon emissions, population, biomass, etc; see Wilson and Kirman, 2016). This expansion is currently jeopardizing the environmental sustainability of contemporary societies and even long-run economic growth.

If we now move a modest step forward, we would like to check whether the previously stated co-evolution theoretical framework (specifically the links through co-evolution among the market, the realm of individuals and nature) may shed new light on how to curb these and other pathological trajectories in our societies. To this aim, we are going to extend (in what follows) our previous arguments on *co-evolution through promotion between the market and the realm of individuals, having an eye on the implications for the environmental sustainability in contemporary capitalist societies*.

Thus, as we have shown (sections 2 and 3), it seems clear that firms have an interest in promoting certain *values, habits, skills*, and even certain *referential individuals* (e.g. celebrities) within the personal realm of individuals; in this way, firms may shape demand; transform the structure of human capital and the cost structure in society; etc. Basically, firms can try to orientate, in their favor, the market process. There are multiple promotion mechanisms that they can use. For instance, they can try to shape demand through *marketing activities* spotlighting specific lifestyles of their convenience; or firms can design and promote *celebrities*, who gain favor with the public, and become models of that which is “presumably” desirable and successful within the realm of individuals (inducing influence-biased consumer decisions in firms’

favor; see Jackson, 2008). These are all examples of *promotion* activities led by firms which try to shape the evolution of the personal realm of individuals.

In turn, from the realm of individuals, both the artificially created celebrities, and the individuals who receive income, funding, accumulate wealth and gain presence and power by virtue of the previously (firm-driven) mentioned actions, *will promote*, in very different ways “their” firms in the market. Firm’s loyalty, daily presence in social life, individual lobby actions, prominent individuals holding specific life-styles to promote firms – these are all examples of the *promotion* of firms by individuals who have an interest in doing so.

As a consequence of these co-evolution processes, different results in terms welfare and/or sustainability can emerge. For example: it has been recently shown that influence-biased effects produced by celebrities upon consumer behavior may induce new wants (acquired wants) through conditioning learning (Witt, 2016). More precisely, by associating recursively the consumption of specific discretionary (non-basic) goods/services with a specific “celebrity-image” who, in itself appeals to certain individuals’ innate (eventually deprived) needs (social recognition, status, beauty, or self-esteem), newly induced needs for said discretionary! (non-basic) goods/services may be created by association. And these new wants may propagate among consumers in the realm of individuals. As Witt (2001, 2016) states, *the welfare effects of this induced consumption activities are not clear* –they depend (among other factors) on the ex-ante/ex-post point of reference when assessing welfare, etc. Despite of not being clear to what extent these consumption activities generate individual welfare, these type of activities underlie an increasing share of ongoing consumption growth in contemporary capitalist societies. Furthermore, if the co-evolution between the market and the realm of individuals we have just described drives us through a *profitable, but not welfare-enhancing path*, which, additionally, demands an *excessive rhythm of extraction/use of certain natural resources* (rare metals, biodiversity, pure air, clean oceans), or contributes to a *global-warming in Earth climate* (jeopardizing global systemic intertemporal viability), *we face a pathological path which urges precise understanding and action*.

In this sense, (and these are the good news!) let us notice that sustainability-enhancing effects could also be *promoted* in a bi-directional manner between the realm of individuals and the market, in such a way that they could contribute to curb the above-mentioned environmental and personal unsustainable path. Thus, e.g. the same conditioning (induced/associative) learning of wants through *promotional activities* explained above, or the same type of promotional initiatives from the realm of individuals that we have mentioned, could be used to spur the diffusion of environmental-friendly values, habits, or technologies. On other domains of human activity, this kind of *positive promotion* could foster the taste for individual self-development and capabilities-enhancing lifestyles, socially-responsible firm-strategies, etc. Eventually, these bi-directional action flows may *change the pathological trajectory* (above), with positive effects on the nature-realm and on individual welfare.

Another (totally different) example of *bi-directional promotion* would be the following: we know that skills and individual knowledge, as well as behavioral habits and values, are traits (see Table 1) which can replicate with greater or lesser intensity in the personal realm, depending on their perceived fitness-enhancing effects within this realm. For example, firms may need a specific type of profile or skill; therefore, a certain kind of training can facilitate individual success in the labor market. Furthermore, specific patterns of personal behavior can adapt better than others to that which firms desire. Thus, firms may try to *promote* training in certain areas – thus propagating certain skills by funding, lobbying, etc – and they will try to give *prestige* to a certain profile of individual⁸. This can affect the share of individuals in society with these specific aspirations, behavior, training, because of monetary, prestige and/or social acceptance reasons. Likewise, the firms will benefit from this situation.

Again: *it is not clear to what extent the result of this process always favors, both individual well-being, or the sustainability and development of the global system (apart from the specific incumbents)*. As before we can find examples in both directions.

⁸ E.g.: risk-taking experts in finance capable of obtaining money for the firm very quickly, without realizing the co-lateral accumulation of systemic financial risks. On the other hand, we could see the promotion of specific skills suitable for scientific understanding and the deployment of technical action to avoid the erosion of Nature.

Notice that individuals can favor certain firms not only by buying, but also by expressing their opinions and evaluations in suitable forums (e.g. internet forums, user forums, etc.); thus, individuals try to increase trust in (and the reputation of) some firms which fit with their values, skills or interests. Therefore, these forums (e.g. in internet, the mass-media) can be used by individuals (even specific individuals -“influencers”) to shape the market. And they may do it by intentionally doing promotion.

All these cases illustrate how not only *monetary market exchanges*, but also *bi-directional promotion* activities between firms and individuals condition the replication, selection and variation of certain traits and agents, making up co-evolution mechanisms between the market and the personal realm of individuals. In Table 2, we summarize *promotion* actions and we highlight which of the VSR mechanisms (in brackets) are specifically affected by the corresponding *promotion* activities.

Promotion Actions		VSR processes affected	
Market	Marketing Campaigns	Individuals	(new) Habits (V,R)
	Lifestyles (celebrities)		(new) Habits/Values (V,R)
	Funding activities		(new) Skills (V,S,R)
Individuals	Celebrities	Market	Firms to buy (S)
	Opinions/Evaluations		Firms to buy (S)

Table 2: Promotion activities and VSR affected

All the mechanisms shown in this section –and many others- may influence the evolution of the nature-subsystem, and they are (to a certain extent) always connected with the policies and regulations the State establishes. In this sense, both directly, and indirectly (via civil society and social action), many of the previously-explained actions are strongly linked not only with nature, but also (in a bi-directional way) with the State. The processes delineated above may influence (or be influenced) in crucial ways by public regulations and policies. The exhaustive analysis of this theme is far from being addressable within a single paper (see Wilson and Kirman, 2016 for suggestive directions of search in this regard).

Nevertheless, we want to say something regarding socio-political mechanisms and their interaction with what we have seen before. Therefore, we shall look (in the next subsection) at the co-evolution between the personal realm, civil society, and the State.

3.2.- Co-evolution between the State, the personal realm and civil society.

In this subsection we delineate intentional action flows underlying the co-evolution between the State, civil society and the personal realm.

The different expansion rates of the different civil organizations in the realm of civil society (in terms of *citizen participation*, members, followers, funding) show us that some of these organizations may gain *influence and social presence*, while others may lose it (Table 1). These effects affect to their survival and growth. The competitive environment within civil society is composed of: potential followers, potential members or supporters, individuals-as-citizens seeking to transform society in one way or another, funding personalities (apart from rival organizations, firms, the State, etc.).

Focusing on the scope of this subsection, notice that changes in the *social influence of different organizations* often involve changes in the visibility and replicability of certain values, proposals for action, habits, ideologies, (replicators) in the personal realm. Note also that civil organizations not only influence *replication* within the personal realm; they also have incentives to spotlight -and even directly *select* and *project* - the image and social position of specific individuals, depending on whether they share certain values, habits, beliefs, in their favor.

In turn, many processes within the *realm of individuals* (or even indirectly connected with the market, the State or nature) crucially affect *the prevailing civil organizations in society* at any time. Thus, consider individuals as workers who join a trade union to increase their power. Or, consider the hypothetical case of well-known financial speculators who fund prestigious academic centers (often civil organizations -not being public), with the aim of spreading ideologies favorable to their position and roles in society. Or, even think of individuals who decide to support and promote environmentalist associations, because they are afraid of nature erosion becoming so intense, that it may not be a way back in a medium span of time. By taking stock of all the afore-mentioned, it is clear that we are detecting *co-evolution through promotion mechanisms between civil society and the personal realm of individuals*.

Consequently:

1. *Civil organizations have incentives to act on the replication and selection processes in the personal realm of individuals because, in this way, they can strengthen their own competitive position in civil society.* This is so because the propagation of certain traits or entities in the realm of individuals (including specific individuals), will affect the non-commercial competitive processes at work in civil society.
2. Likewise, looking at the inverse causal flow: *certain individuals have incentives to participate in, and promote, certain organizations because, in this way, they will improve their position in the personal realm.*

Let us elaborate a bit these ideas. The capacity for *persuasion* by certain civil organizations, and the degree of matching of their values, proposals, ideas to the perceived needs of a growing number of people, are all factors which influence the expansion of civil organizations. Of course, the needs which lead individuals to connect to certain civil organizations are often (indirectly) linked to the market⁹. However, it is increasingly evident from the literature on psychology, experimental and behavioral economics that an important part of individual well-being depends on *non-commercial motivations*. For instance, individuals aim to integrate themselves into social (non-market) groups for very different reasons: learning non-market skills, regard of others, beliefs, traditions, and, importantly, sometimes just looking for placing themselves within the social reality (Burnham et al., 2016)¹⁰.

Supply of these non-marketable goods/services that meet important types of wants is often the responsibility of specific non-commercial, non-public organizations which play an unavoidable role in society (NGOs; trade-unions; professional associations; cultural, scientific or religious associations; all types of foundations; a variety of protecting civil organizations, etc). Once again, these organizations will gain or lose social presence depending on whether they are in tune with a greater or smaller number of people. On the other side, of course, we find individuals promoting (from and within

⁹ Hence, individuals as consumers, workers, credit applicants, investors, resort to specific civil organizations to guarantee the reliability of goods, services, legality. The responsibility for safe-guarding these rights falls on the State, but civil society cannot renounce its role.

¹⁰ An important role is played here by beliefs and ideologies. Individuals need explanations regarding existence, their place in society, etc.

the personal realm) the proposals, ideas, membership, or social influence of specific civil organizations of their interest. From these co-evolution flows different paths may emerge. They may turn out to be beneficial for social sustainability and individual welfare; but we can also find detrimental and unsustainable paths: (we may think –as an extreme case- about the emergence of populist social organizations –or political parties- which condense and take advantage of needs and frustrations within the realm of individuals, and do their best to propagate anti-systemic values, habits and destructive proposals in the political arena. Some cases in Europe come to our mind).

Apart from these bi-directional relations between civil society and the personal realm, civil organizations also bear an influence on the State, and they do it via *direct action and social pressure*. Let us mention strikes, lobby networks, certain political mass-media, or direct/indirect cooperation with firms and political parties (Witt, 2003b). These mechanisms play an important, informative and leading role in contemporary society. The aim of these actions is often to promote regulations and policy in a certain sense or another, or, on the other hand, to avoid their application. Of course, we could also find positive and/or negative paths emerging from this. Whatever the case, these organizations always aim to influence, partially or globally, social evolution.

Finally, in contemporary societies we must give a special mention to *political parties* and *democratic elections*. These special organizations play an important role in the transformation of values, ideas, ideologies and public opinion, and sometimes lead the evolution of political preferences in society. These processes of change in opinions (and their effects on parties) are seen in electoral results as a consequence of the competition between parties. These elections are competitive processes to decide who (and to what extent, in which direction, etc) will rule the State.

We should stop here, since the scope of these topics extends far into the realm of future research. For the time being, we summarize in Table 3 the main *promotion* actions we have stated between individuals and civil society (we also show in Table 3 some of the VSR mechanisms -in brackets- which we have specifically mentioned).

Additionally, we suggest in Table 4 (below) for future research, some co-evolutionary promotion activities which may link the market with civil society. They might be explored in future works.

Promotion Actions		VSR processes affected	
Civil Society	Persuasion Campaigns	Individuals	(new) Habits (V,R)
	Collective Action		(new) Habits/Values (V,R)
Individuals	Opinions/Evaluations	Civil Society	Civil Organizations (S)
	Direct support		
	Membership		

Table 3: Promotion activities and VSR affected

Promotion Actions		VSR processes affected	
Civil Society	Collective actions	Market	Firms to buy (S)
	Lobbying		
Market	Funding Institutions	Civil Society	Civil organizations (S)
	Funding Activities		

Table 4: Promotion activities and VSR affected

As we have already seen, *the welfare effects of these bi-directional co-evolution through promotion processes among subsystems are not always clear, and, both, sustainable but also unsustainable dynamics of social transformation may emerge.*

In the next section, we will highlight certain reinforcing feedback mechanisms among subsystems which can lock-in contemporary capitalist societies in pathological paths. On the other hand, once we detect these feedbacks, we can take advantage of them – together with what we know regarding promotion- to suggest ways to curb the problematic trajectories in our societies. In any case, the processes we are detecting from our frame, regarding contemporary capitalist societies, lead us to (briefly) tackle normative issues for complex systems in the last section of this work (in the spirit of Gowdy et al. (2016) which appears as Ch.18 in Wilson and Kirman, 2016).

4.- Promotion and co-evolutionary dynamics in contemporary capitalist societies: normative and methodological reflections.

4.1.- Final normative reflections and suggestions for future research.

From the previous sections, we want to propose that when examining the evolution of a society from a normative point of view, we must look: firstly, at the results that this society produces regarding individual well-being -in the widest sense; and, secondly, at the sustainability of society and the natural environment.

As we have seen, human action aiming to meet certain wants and obtain well-being involves, in our societies, the consumption of market goods via monetary exchanges, but it also requires the access to goods/services which cannot be acquired through the market (self-improvement, social affection and integration, cultural formation, transcendent life experiences, a feeling of fulfillment and efficiency in action; von Mises, 1949; Phelps, 2009; Hodgson, 2015; Witt, 2016). It seems that human individual welfare requires a suitable (person-specific) combination between different types of “goods/activities” – market ones or others – that we as humans need.

Regarding this paper, this idea leads us to claim that sustainable and welfare-enhancing societal paths should allow the co-existence, viability and congruent transformation of all the subsystems mentioned, as they all contribute directly or indirectly to the supply of market and non-market “goods” necessary for a happy life. Nature, the personal realm of individuals, the market, the State and civil society – all these fields seem to play a role in the provision of favorable conditions for people’s welfare. In a sense, a creative, efficient, democratic, inclusive and environmentally-sustainable society seems to require a harmonious “co-evolutionary beat” of all the subsystems.

In this sense, Maruyama (1968) pointed out that there are certain feedback process in evolving systems that may alter the harmonious dynamic co-existence we are talking about. Thus, Maruyama detects two types of mutual causal mechanisms (*deviation-amplifying and deviation-counteracting forces or loops*) which evolutionary complex systems may have built into them. In our frame, when these reciprocal causal processes among subsystems end up engendering strong deviation-amplifying loops, which move the global system towards extremely subsystem-biased structures (e.g. a co-evolution path leading to the supremacy of a totalitarian State, with almost no market, a very constraint realm of individuals, most active civil organizations supporting totalitarianism, and environmental degradation out of control) then we face the possibility of emergent pathological paths that may “lock” the global system within a destructive area of the space of states at very high speed. We find in the literature examples of pathological trajectories in terms of individual well-being (Burnham et al. 2016; Witt, 2016), and/or regarding the un-sustainability of financially fragile, legally unstable or non-inclusive versions of capitalism in Hodgson (2015).

What seems interesting in normative terms, -if we combine the Maruyama-loops with what we have said regarding co-evolution through promotion in the paper-, is that *context-specific deviation-counteracting loops could be promoted to neutralize deviation-amplifying loops*. Of course the detailed exploration of this idea and its application to real cases exceeds the scope of this single paper. But, at least, we wanted to suggest it as a novel contribution to the normative debate around complex-evolving-systems (Wilson and Kirman, 2016).

Here, we suggest the possibility to analyze certain current problems within our positive and normative framework: (i) analyze the origin and fast accumulation of inefficiencies in action and the emergence of rationing in different interlinked realms (financial markets inefficiencies – leading to productive system collapse - public debt exponential growth - citizens as final debtors – and, finally, economic secular stagnation); (ii) explore “infection” routes through and across the subsystems that may engender surprisingly fast institutional pathologies (corruption), social conflict (migration policies and problems of assimilation) which lead to the deterioration of cohabitation; (iii) explore the motivational sources underlying the (partly) consumption-driven contemporary exponential growth, with non-clear welfare effects and the co-lateral environmental problems that we have already explained (Witt, 2016), etc. All these are current challenges that could be tackled from our approach. Obviously, an analysis of these problems goes beyond the scope of this present work, but they suggest interesting future lines of research which connect with our analysis.

4.2.- Final methodological comments for future research.

Finally, in this subsection, we suggest some alternative ways to model our co-evolution proposal in future works. In this way, we could advance towards operationalizing our proposal and making it understandable for multidisciplinary audiences (Okasha, 2005). Thus, we would like to suggest three viable formal strategies:

- a) Firstly, it is possible to model intra-subsystem dynamics in our frame by using *relative fitness models* typical from the *formal theory of language acquisition* (e.g. Nowak and Krakauer, 1999; Hofbauer and Sigmund, 1998). Then, once we have the intra-subsystem dynamics modelled in this way, we can use our co-evolution concept to link the subsystems by building-up models of *coupled*

replicator-dynamics (Sato and Crutchfield, 2003; see the indications in Nowak and May, 1992).

- b) Secondly, another viable possibility consists of incorporating our approach in *multilayer network models* (Kivela et al. 2014). These models offer the possibility of modelling “horizontally” evolving systems at different layers, while incorporating inter-layer links which would be inspired by our co-evolution concept. In the same spirit, the combination of *Spatial Games* (Nowak, 2006) with *replicator systems* in multiple co-evolving layers could be a fruitful line of advance.
- c) Finally, the construction of models which combine (stylized) agent-based types of interactions in certain subsystems, linked with domain-specific replicator dynamics in other subsystems, could also open up new lines of investigation regarding co-evolution in *complex social networks* (Vega-Redondo, 2007). This idea of trying to “activate” the replicator dynamics -by linking the replicator model with low scale ABMs, or with low-scale stochastic dynamic networks- would lead to new formal bridges between *evolutionary theory* and the *complex systems approach* (Wilson and Kirman, 2016).

5. – Conclusions

In this work we have proposed a possible characterization of contemporary capitalist societies as systems made up of five evolving and structurally different subsystems: the realm of individuals, the market, civil society, the State, and nature. After explaining what the subsystems are and defining in what sense they evolve, we have proposed a definition of co-evolution through promotion which allows us to link precisely the dynamics of certain subsystems with those of the others. The resulting theoretical framework has revealed that possible co-evolution trajectories in contemporary capitalist societies may turn out to be unsustainable paths. Moreover, our analysis suggests the need to develop normative criteria and welfare-evaluation methods for co-evolutionary systems, taking into consideration welfare and viability effects at the individual and systemic levels to “monitor” and try to detect (and curb) societal pathologies.

From a meta-theoretical perspective, we believe that the proposed co-evolution framework may open lines of progress towards a general frame for *evolutionary economics*. Future versions of this frame could further combine valuable elements and insights from the naturalistic (Darwinian and non-Darwinian) streams of evolutionary economics, with the powerful heuristics of Neo-Schumpeterian economics and other more “individual-oriented” traditions (such as Austrian economics). From these different evolutionary approaches, and taking into account our proposed framework, we could develop the Generalized Darwinian *heuristic* (both in the naturalistic and Neo-Schumpeterian variants) to the extent of becoming compatible with an *ontology* which would firmly recognize the crucial role of evolutionary-conditioned individual behavior, and nature, as unavoidable subsystems co-evolving with organizations, institutions and culture. Likewise, from a *methodological* perspective, different –but complementary– types of models (such as coupled-replicator dynamic systems; multilayer evolving networks; or low-scale ABMs taking the form of replicator systems reinvigorated by upstream networks of innovative agents) can be developed and adjusted to the framework presented in this work, while still remaining formally tractable. These three types of models are suitable to deal with the concept of co-evolution, and can do it avoiding unnecessary abuses of stochasticity and high-dimensionality, which often lead to extremely complex models that hide as much as they can show.

We would like to finish by emphasizing two ideas: firstly, our proposal of analysis does not aim to copy biological concepts and use them in the socio-economic field literally; we have used certain concepts because, in our opinion, they facilitate the analysis of extremely complex dynamics and systems. Secondly, and to end with, we have pointed out some imperfections of contemporary capitalist societies with the aim of contributing to prevent and avoid future problems. However, we have not claimed that alternative ways of social organization are superior to contemporary capitalism. In fact, an analysis of this question goes far beyond the scope of this work.

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