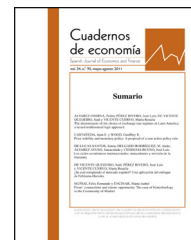




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Evolutionary efficiency in economic systems: A proposal



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Abstract The paper proposes an efficiency criterion for evolving economic systems. Drawing on the idea that these systems develop from the interconnected actions of intentional creative agents (which invent and try to carry out action plans), the suggested criterion at a micro level could be state as follows: a system is efficient (from a micro evolutionary perspective) if agents' intentional and hierarchical (open) goals are actualized through action. Thus, intentionality leads to facts and goals are reached. The evolutionary efficiency criterion proposed in the paper links the intended goals of heterogeneous agents and the performance of the system they are involved.

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Eficiencia evolutiva en los sistemas económicos: una propuesta

Resumen En este trabajo se propone un criterio de eficiencia para los sistemas económicos evolutivos. Basándose en la idea de que estos sistemas se desarrollan a partir de acciones intencionales desplegadas por parte de los agentes creativos (que inventan los planes de acción y tratan de llevarlos a cabo), el criterio sugerido a un micro-nivel podría establecerse como sigue: un sistema es eficiente (desde la perspectiva micro evolutiva) si los objetivos (abiertos) intencionales y jerárquicos de los agentes se materializan a través de la acción. El criterio de eficiencia evolutiva propuesto en el documento vincula los objetivos propuestos por los agentes heterogéneos y el rendimiento del sistema en el que están inmersos.

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1. Introduction

The difficulty of theorizing from the normative perspective on evolving processes is a present issue in evolutionary

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economics. Over thirty years ago, [Richard Nelson and Sydney Winter \(1982\)](#) raised the need to rethink the usual criteria for evaluating the efficiency of resource allocations, analyzing economic systems as subject to processes of self-transformation. As the authors wrote, "If the economic world is in continuing flux, as our positive theory suggests is the case, the normative properties associated with competitive equilibrium become meaningless, just as that equilibrium is meaningless as a description of behavior [...]. An evolutionary approach to positive economics thus calls for a complementary rethinking of normative economics - a difficult task" (Ibid: 356). Additionally, to postulate the invalidity of standard static welfare criteria for evolutionary analysis of economic systems, [Nelson and Winter \(1982: 359-364\)](#) criticized the inappropriate use of the fundamental theorems of welfare economics as a scientific basis for comparing the performance of "market economies" with alternative forms of social organization. According to these authors, comparing the performance and viability of different forms of organization requires economic activities¹ other than those used by standard welfare economics. Nelson and Winter used the Mises-Hayek-Lange² controversy on the possibility of economic calculation in socialist economies to show the need for an essentially dynamic and evolving regulatory analysis when comparing the performance of different economic systems. Nelson and Winter also anticipated the possibility of reinterpreting market failures analyzed by neoclassical economics from the perspective of evolutionary economics, once the static perspective of equilibrium models is modified for the dynamic study of economic processes. Thus, the types of normative issues that arise from the existence of monopolies (in the case of evolutionary models the issue is not one of existence but of endogenous formation of monopolies) in a static framework differ from those in a dynamic framework of endogenous self-transformation.

Externalities can also be observed from an evolutionary perspective,³ where technical change and transformation of the structures of social values (in processes of technological and institutional co-evolution) can generate new benefits and/or individual and social costs. The implications for collective action mechanisms and criteria that agents must establish to direct their actions should be studied in theoretical frameworks in which it is possible to address the generation of novelty in economic processes. Only this type of approach might capture some of the essential points that Nelson and Winter anticipated as major pitfalls for establishing normative judgments (necessary, moreover, for

policy making) as part of the framework of an evolutionary approach to economic change.

Economic change implies structural change in that it involves not only quantitative but also qualitative change ([Saviotti and Pyka, 2004; Saviotti, 2007](#)). The qualitative dimension is closely connected to the process of innovation, the introduction of 'new' and the withdrawal of 'old' economic activities.⁴ Structural change appears when novelties are generated, disseminated, and incorporated in the economic system. These novelties may concern inventions (technical novelties)⁵ ([Arthur, 2009](#)), institutional change ([Hodgson, 1988, 2006; North, 2005](#)), new rules ([Dopfer and Potts, 2008; Nelson and Sampat, 2001](#)), or organizational forms ([Penrose, 1959](#)) and are the result of new combinations ([Loasby, 1999; Potts, 2000](#)). Continuous generation, dissemination, and retention implies continuous change in the economic system: the economy is a complex evolving system ([Foster, 2005; Witt, 2003](#)). In other words, economists need to explain the dynamic processes that lead to the emergence of orders ([Hayek, 1977, 1988](#)) or, more simply, emergence ([Harper and Endres, 2012](#)).⁶

Related to the emergence of novelties a fundamental theoretical problem arises: is change the product of intentional actions or it is the outcome of the unintended consequences of an action? This is a complex issue with many aspects and implications affecting concepts from theoretical economics such as rationality. For an action to be rational it must be intentional, with the intentional action arising from complex interaction processes ([Muñoz et al., 2011; Muñoz and Encinar, 2014](#)).

The characterization of evolutionary economic processes leads to the essential role of novelty and intentionality. There appears to be broad agreement about what the desirable properties of an evolving system should be in its process of development: generation of novelty and co-ordination. For the system as a whole, [Potts \(2000\)](#) states that a system is a set of constitutive elements (objects such as knowledge, agents, institutions, beliefs, and goals) and that connections among them serve a common purpose. Such a structure and its evolution support the analytical description of dynamic phenomena. In this way, [Metcalf \(1995, 2003\)](#) establishes the need to maintain adaptive processes of policy making, [Hodgson \(1999\)](#) proposes an *evotopian* scheme of thought about policy issues, and [Witt \(1996\)](#) suggests the need to reconcile the role of innovation as a stimulus for economic progress with social cohesion ([Pelikan, 2003](#)).

The crucial questions for identifying the differences across economic systems are how and why each evolves. A traditional answer involving evolutionary processes considers the way dynamic connections are formed. The characteristic evolutionary processes of selection and retention operate on this basis ([Foster and Metcalfe, 2001](#)). In this context is important to judge which connections are activated within an economic system. In this paper, it is

¹ 'Here we simply note that evolutionary normative analysis adheres naturally to a principle espoused by many economists before us: the most useful form of normative analysis is the detailed comparison of relatively specific organizational alternatives. It is not helpful to compare the performance of real markets with that of idealized central planners, or to compare the performance of real planners to that of idealized markets. It may be helpful, however, to consider at a relatively abstract level the kinds of policy problems that seem almost inevitably to arise in a political economy that places heavy reliance on profit-seeking firms and markets' (Ibid: 365).

² [Mises \(1951\)](#), [Lange \(1938\)](#), and [Hayek \(1945\)](#).

³ [Nelson and Winter \(1982: 368\)](#).

⁴ The quantitative dimension is inseparable from ongoing processes of structural change in the economy ([Metcalf et al., 2001](#)).

⁵ For distinguishing between types of innovations, see [Godin \(2008\)](#).

⁶ Some emergent properties are development and innovation ([Antonelli and Ferraris, 2011](#)).

proposed that coevolving processes result from the dynamics of generation and connection and the hierarchical change of agents' goals as they are linked to their intentionality. From this perspective, and by means of the analytical concept of an agent's action plan, it is possible to propose an evolutionary efficiency criterion in economic processes.⁷

The argument is consistent with the role that the categories of intentionality, such as belief, goal, intention, and collective intentionality, are part of cognitive sciences, artificial intelligence and social philosophy, among other fields, and serve as the explanation of individual and collective behavior and the emergence of institutions (see Baldwin and Baird, 2001; Grosz and Hunsberger, 2006; Metzinger and Gallese, 2003). If we are right, this proposal would contribute to the microfoundations of economic systems concerning agent action, which results in individual and organizational evolving capabilities, and the consequences of intentional action for economic change (Felin and Foss, 2006; Loasby, 2008).

The following section presents the core elements of the analytical framework, which lead to the question of evolutionary efficiency in economic systems. In this context, an analytical basis for an evolutionary efficiency criterion is proposed. Finally, the paper addresses other ongoing research and related research questions, especially those that explain the dynamic performance of an economic system based on agents' action plans interacting within that system.

2. An analytical proposal for dealing with evolutionary efficiency in economic systems

As is known, the traditional Pareto optimality criterion proposed in a neo-walrasian framework for analyzing equilibrium states denotes that these states show efficiency, in Pareto's original sense (see Pareto, 1981 [1909]: VI, §33). Departing from a conventional microfoundation (with an important formalization, (Arrow, 1951; Arrow and Debreu, 1954; Debreu, 1959) that was based on the axiomatic ideas of consistent preferences and complete rationality that operates on a set of information that includes all relevant information about the environment and the assumption that agents know all the consequences of each choice (Simon, 1983). This view argued that the agents would allocate their resources as efficiently as possible. For these choices to be unequivocally judged more efficient requires not only that agents know all the means at their disposal and how these are directed to the objectives (ends) that can be achieved, but also the exact consequences of each of the possible alternatives. This is possible only if production functions and utility functions are given, or if they are known a priori. Existence of equilibrium is thus equivalent to the logical possibility of pre-reconcilable choices (Weintraub, 1979). This reduces economic processes to the study of the static properties of equilibrium states resulting from mere

market exchange. The applied Pareto efficiency criterion seems unsuitable for evaluating and judging evolutionary economic processes that include the appearance of novelty. That criterion includes no reference to processes, information requirements, no dynamism (Pareto, 1909) or dynamism that would lead to the search for and realization of surplus under the assumptions of given production functions, utility indexes, and homogeneous agents (Allais, 1981) required for evolutionary economics. Staveren (2012: 110) writes: "(...) it is surprising to see that the major economic evaluative criterion of neoclassical economics -Pareto efficiency- is still the dominant criterion of efficiency in most of economic research."

The analysis of evolutionary processes with specific microfoundations involving heterogeneous agents in a world of bounded rationality and imperfect understanding of the environment, in which the continuous appearance of novelty is a cause and a consequence of interactive learning processes generating emergent properties, is *not* analytically compatible with that criterion and its related framework.

Contributions to normative analysis from the evolutionary perspective broadly agree about the desirable properties of an evolving system: generation of novelty and coordination. The criteria that aim to guide policy making should consider appropriating the production of novelty that is perceived as beneficial because it expands the possibilities of action for agents and not threatening the viability of the system, understood as the possibility of economic order (Nelson and Winter, 1982), of social cohesion (Witt, 1996, 2003; Lundvall, 1998; Hodgson, 1999), or of generation of sufficient variety to perpetuate progress (Metcalf, 1995; Pelikan, 2003).

Evolutionary economics searches for a criterion that brings together the capacity to generate novelty without risk of coordination and continuity of the ongoing processes of economic development. In this sense, one could argue that a social or economic system evolves following a progressive process of development if it is able to generate a sufficient flow of novelties to expand the space of action⁸ of agents without compromising coordination of agents' actions and, therefore, the viability of the system and its capacity to continue producing novelties.

Our proposal could comprise some of those elements departing from microfoundations. Let us pose the concept of an action plan. An action plan is the agent's projective linkage of actions (means) to goals. It is a system in which actions and goals are ordered at a given instant in time in a projective manner. Actions and goals need to be imagined before they are deployed by agents. The set of actions and goals can vary: be material or not; be located at any point in time; able to be expressed in monetary terms or not; etc. An action plan is therefore a general open structure (Encinar and Muñoz, 2006). We acknowledge that an individual's real action consists of planned action as well as unplanned action. Unplanned action is not something unimportant, residual, or trivial; neither is it fully inaccessible to rational knowledge. Our focus here, however, is on the

⁷ The concept of 'dynamic efficiency' proposed in Huerta de Soto (2012) is conceptually different to the present proposal because of that criterion is focused on creativity and entrepreneurs' coordination.

⁸ For example in terms of: income, consumption, opportunities of innovation, competitiveness, production capacity, ongoing processes of learning, evolving capabilities, profitability, wealth, etc.

planned components of action because they allow us to address analytically the activating role of intentionality.

In this approach it is relevant to focus on the types of connections that are established between: the means (actions) and the goals (objectives) of a plan, which determine the ordering of connections between means and goals. At any given time, all individuals form the set of means and goals as each are perceived by those individuals. Thus, if it were possible to define at least two alternative plans (combinations of actions and objectives), an allocative process would be specified from which the allocative operation itself would take place. This operation allows a particular personal action plan to be selected, which the agent will then attempt to enact on their physical and social environment. In this context, economic dynamics may be understood as the process of generation, adoption, and attempted inter-active deployment of the agents' action plans and creation of the resulting 'products' (Rubio de Urquía, 2005).

At each instant of time, an action plan prospectively connects elements of a different nature: something the agent wants to achieve (goals) with the actions and means the agent 'knows' will afford him/her success. The efficiency criterion agents employ in practice is the extent to which what has been planned is being executed and is thus producing the desired goals. Otherwise, the degree of unfeasibility of plans is a proxy measure of their inefficiency. As a consequence, agents will revise parts of or entire plans (or even discard and replace them completely) if they judge the plans are not effective enough.⁹

Agents can establish new connections between the previous elements (actions/means) or with entirely new ones, which triggers learning processes that consist of reconfiguring mental connections and exploration of adjacent states of the system (individual frameworks).¹⁰ In our approach, the process of the dynamic sequence of connections between means/actions and goals that are established by the agents that interact within an economic system may be judged in terms of the adequacy of connections. Connections between actions/means and goals are adequate if they allow the projected actions and the deployment of actions/means to produce the pursued goals. In other words, connections between means/actions and goals are adequate when intentions (which activate and change as new goals are formulated) give rise to actual facts as expected.

We can now pose a criterion in the micro-level: *there is evolutionary efficiency within an economic system when an agent's intentionality is being actualized through the agent's actions*. Because of the efficiency of the connections between means/actions and goals, intentions turn out to be

facts that demonstrate that goals are being produced.¹¹ The fulfillment of different agents' goals and the compatibility (coordination) of their plans and expectations (Hayek, 1937: 37) strengthen the (new) connections within the system.

This criterion could be applied for measuring the performance of a system because it is relative to the goals, intentions, and expectations of the agents involved in that particular economic system. The basis of the criterion is micro and the effects are observable at the meso-macro levels (Dopfer, 2008, 2011, 2013).

In terms of the criterion, the performance of an economic system is: (a) high, if the connections within that system are adequate insofar as they cause the achievement of pursued goals; if this is the case, we say that the system is evolutionarily efficient, or (b) low, if the performance results from inadequate connections that do not lead to the achievement of the pursued goals; this is the case of an inefficient evolutionary system.

The agent's action plan is efficient/inefficient a priori if the orderings of means/actions achieve the desired goals. At the same time, efficiency depends on the absence/presence of logical contradictions or impossibilities among the actions/means to goals and on the absence/presence of conflicting goals.

If this formulation means that the agent/organization is capable of reaching a sufficient aspirational level of satisfaction regarding its main goal, we can say that the connections between means/actions to goals are efficient (from the point of view of the agent) ex-ante. When the agents involved in the economic system formulate internally inconsistent plans, they actually give rise to inefficient action in the meso level of interaction.

3. Ongoing research questions

From the moment in which we assume an economic agent carries out his/her action in an environment that is itself changing and evolving, it is also necessary to assume that an economic theory that explains this action has to contemplate the intrinsic dynamics and the unfolding of the new elements that are generated by the agent. Does this argument require all agents in the economic system to perform well? What if the system supports the fulfillment of the goals of some agents, but blocks those of others? What if one agent's goal is to block the development of the system? What if an agent's goals are unrealistic?

An internal inconsistency of action plans in an economic system produces a rationing of goal satisfaction, generating a worsening of the efficiency of the agents' actions. Thus, a system (individuals, organizations, etc.) as a whole may produce lower performance in terms of pursued goals (Geels, 2004).

There are different options for removing the source of rationing¹² within such a system: agents may lower their expectations (reviewing and eventually removing some of

⁹ 'Intentional' changes in plans may be brought about not only by failure but also by success. The case in which an agent wants to make new plans after achieving success should also be considered. Extra profits may allow for extended search and hence favor changes in plans. In other words, success leads to extra profits that reduce the opportunity costs for new changes.

¹⁰ From any starting position there are many adjacent states, and they may differ between individuals because their categories differ; but any organization can tolerate only a limited amount of variety, because its coherence and stability relies on its members predominantly conforming to accustomed practices.

¹¹ Agents' actions are both 'effective' and 'efficient' (Barnard, 1938).

¹² A proposal for dealing with agents do not change their plans but rather ration them is (Benassy, 1986).

their goals); adjust their actions/means to the rationing; review the content and/or the hierarchy of their goals; abandon some of their goals; change the institutional setting; and perhaps introduce creative responses to the rationed environment, which implies shaping the whole course of subsequent events (Schumpeter, 1947). At time $t+1$ the structure of the landscape differs from time t . Thus, an improvement in the efficiency of an economic system would require the revision of the individual (or collective) intentionality of the agents involved in the system. Agents pursuing their goals may or may not reach them.

The underlying evolutionary processes in which an adaptive policy maker could monitor and guide economic progress are (a) creative processes that determine the range of available innovations and new options in any moment of time and (b) processes that link the unpredictable emergence of novelty with coherent patterns of economic and social change. The simultaneous performance of such processes in evolving systems implies the need to ensure an adequate institutional design and a network of connections between agents, which would make the generation of variety possible through organizing knowledge and generating novelties. Policy makers, when they try to improve the performance of an evolutionary economic system, should take into account how and why actors within a system have specific goals and how they articulate and deploy their actions to reach them.

Moreover, since agents' goals are hierarchicalized, and it is (somehow) illusory thinking that all goals from all agents may be reached maybe it will be possible to re-define the criterion by considering just the actualization of high level goals from the individual perspective. This analytical way (actualized high level intentions from each agent perspective) may open issues that the proposed criterion leaves unresolved (mostly at a meso-macro level).

Summarizing the main argument, the dynamic action of agents that interact within an economic system should be explained in relation to agents' intentionality. Otherwise, it is not possible to explain the products (commodities, technologies, structures, systems, etc.) and categories (value, prices, causality, etc.) of action other than using self-referencing explanations, which are not explanations by means of microfoundations. This work has proposed a foundation for explaining the performance of an economic system based on agents' action plans interacting within that system. The evolutionary efficiency criterion proposed in this paper links the intended goals of heterogeneous agents and the performance of the system they are involved.

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