

**ABORDARE
ANTREPRENORIALĂ A
MODELELOR ECONOMICE ȘI DE
MEDIU**

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Rezumat

Economia umană depinde atât la nivel local cât și la nivel global de mediul natural, sine qua non. Problemele de mediu și ecologice sunt omniprezente, dar acțiunile antreprenoriale le pot rezolva dacă predomină norme socio-economice și culturale care să le permită să facă acest lucru. Antreprenorii nu răspund, de obicei, în mod direct la informații privind degradarea mediului, dar, în schimb, reacționează la informațiile cu privire la impactul acestora asupra bunăstării umane și nivelului de viață. Semnalele de preț transformă o problemă în termeni economici. De exemplu, atunci când pescuitul excesiv reduce serios stocurile de pește, prețurile la pește cresc, de obicei, la un nivel fără precedent. Antreprenorii care anticipează că peștele va fi în scurt procurat, fie din cauza epuizării stocului sau restricțiilor severe guvernamentale privind pescuitul, vor vedea oportunități certe în a investi durabil în piscicultură. Aceasta menține aprovizionarea ritmică cu pește în timp ce scade presiunea asupra mediului. Cu toate aceste schimbări, acest lucru nu va fi posibil fără fluxuri de informații adecvate, cadre de reglementare adecvate și existența instituțiilor de piață viabile. Pentru că trăim într-o lume

nesigură, sunt perspective de a continua, în același mod, de la o criză de mediu la alta. Fiecare criză actuală ecologică este consecința neintenționată a inovațiilor economice anterioare, care, la rândul lor, pot fi rezolvate prin noi inovații economice.

Această lucrare prezintă un model co-evolutiv al dinamicii sistemelor economice și ecologice care poate fi implementat printr-un comportament antreprenorial.

Un model economico-ecologic se bazează pe rolul central al ideilor experimentale noi. Dimensiunea acestei "noi cunoștințe", este frecvent neglijată în dinamica modelelor economico-ecologice. Antreprenoriatul prevede că experimentul provoacă două cauze pentru menținerea acestei dinamici. Economii sunt doar durabile, cu alte cuvinte, prin capacitatea lor de a facilita, mai degrabă decât de a constrânge, deoarece capacitatea antreprenorială generează soluții noi la problemele de mediu existente.

Cuvinte-cheie: evoluție economică, spiritul antreprenorial, creșterea economică durabilă, mediu.

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**ENTREPRENEURIAL
APPROACH TO ECONOMIC AND
ENVIRONMENTAL MODELS**

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Abstract

The human economy is locally and globally dependent upon the natural environment, sine qua non. Environmental and ecological problems are omnipresent, but entrepreneurial actions can solve them if prevailing socioeconomic and cultural rules permit them to do so. Entrepreneurs do not usually respond directly to information concerning degradation but, instead, react to information about its impacts upon human welfare and wellbeing. Price signals often translate a problem into economic terms. For example, when overfishing seriously reduces fish stocks, fish prices usually rise to unprecedented levels. Entrepreneurs who anticipate that fish will be in short supply, either because of stock exhaustion or severe governmental restrictions on fishing, will see opportunities to invest in sustainable fish farming. This maintains fish supply while removing environmental pressure. However, this will not be possible without adequate flows of information, appropriate regulatory frameworks and the existence of viable market institutions. Because we live in an uncertain world, there tends to be continuous lurching from one environmental crisis to the next. Each current ecological crisis is the unintended consequence of previous economic innovations which, in turn, can be resolved by new economic innovations.

This paper outlines a co-evolutionary model of the dynamics of economic and

ecological systems as connected by entrepreneurial behaviour.

Keywords: *economic evolution, entrepreneurship, sustainable economic growth*

Few elements of a model

First, it is necessary to acknowledge that the environmental degradation that we observe is, ultimately, due to the use of free energy flow to drive economic activities that yield goods and services to growing populations. Such degradation is a manifestation of the entropy process that must accompany increasing order and complexity in economic systems. This perspective was first presented in Georgescu-Roegen (1971) and generalised to an open system (or dissipative system) context in Foster (1996) and Raine et al (2006). Spaceship earth travels according to the laws of physics, whereby large energetic transformations must satisfy the second law of thermodynamics.

Economic evolution thus runs up an energetic gradient (Schneider and Sagan, 2005). Increased energetic throughput is associated not only with an increased quantity of energy conversion but also with changes in the quality of the energetic form, as in the highly controlled use of energy for moving electrons or photons in precise ways to perform computation (Huber and Mills 2004). Because entrepreneurs must, necessarily, make decisions in uncertainty, they are the key actors in the process whereby increased energy use has resulted in economic growth. But they have also been key players in the introduction of innovations that have resulted in more efficient energy use. Environmental degradation depends critically upon the energy-entropy nexus and entrepreneurs,

for better or worse, have always been at its core.

Second, our model must recognise that environmental resource depletion and degradation in ecological systems and services present new opportunities for human action.

Economists commonly conceptualise this negatively in terms of increased scarcity, i.e. action in response to a rise in the price of a factor, inducing reduced use of that factor relative to others. But, as we have discussed, this may also lead to longer term thinking about how to achieve the underlying goal in a different way. Invention and innovation can result in new connections and combinations that can generate value or new ways of creating value. There are no hard environmental constraints on economic evolution and there are no hard economic constraints on natural evolution. Economic evolution is a fast process that modifies the natural environment while natural evolution is a slow process that can inflict catastrophic impacts on human society in the longer term. Knowledge of the possibility of the latter provides entrepreneurial opportunities, for example, in developing alternative energy sources and carbon trading.

Third, our model must recognise that the increasing complexity in the institutional rules that are operative in an evolving economic system is an outcome of the co-evolving economic-ecological process. As ecological systems become stressed by the growth of economic systems, the latter can respond by becoming more (not less) complex. The presumption that environmental stresses lead inexorably to economic stress, as in the Malthusian hypothesis, is a false analogy from the ecosystem context

whereby a species in a diminished environment cannot respond ‘entrepreneurially’ by creating and implementing new technologies, organisational structures and institutional rules. Instead, population dynamics over extant variety is the prime ecological mechanism of resolution. This is not true of economic mechanisms. Although we can find historic examples where economic exploitation has wholly depleted a natural environmental niche, we can also find cases where depletion did not occur because of adaptive, forward looking behaviour by entrepreneurial risk-takers. Subject to cultural and legal/political constraints, economic entrepreneurship can create new organisational, institutional and technological rules that can resolve environmental problems. This may seem counter-intuitive if it is increased economic activity that causes environmental problems in the first place. So to suppose that further increases in economic activity might resolve these problems may seem perverse. But ‘economic activity’ is not homogenous over time; it is adaptive and can change qualitatively. This does not deny that new activities will not create new environmental and ecological problems-for they almost certainly will-but the point is that these are mostly unknown or latent and cannot be anticipated in the cost-benefit calculations of contemporary economic activity. Economic and ecological systems are at different ‘orders of complexity’ and the former has a creative and adaptive capacity that the latter lacks (Foster 2005).

Fourth, our model must recognise that the political arena in such a co-evolving world is one of several possible spaces where endogenous action can occur in response to changes in current or

anticipated environmental circumstance. Environmental constraints and ecological problems present emergent opportunities for political entrepreneurs. This is also a legitimate mode of response (Lachmann 1986). There may also be behavioural or socio-cultural change (i.e. changed preferences induced by changed models of behaviour that are then adopted) as well. Furthermore, these political, socio-cultural and economic entrepreneurial responses may interact in complex ways.

A model of economic-environmental co-evolutionary dynamics of this kind must emphasise the core role of experimental new ideas. This ‘new knowledge’ dimension is commonly neglected in models of economic-ecological dynamics. Entrepreneurship provides the experimentation that both causes and maintains these dynamics. Economies are only sustainable, in other words, through their capacity to facilitate, rather than constrain, the ability of entrepreneurship to generate new solutions to extant environmental problems.

The dynamic structure of ecological and economic co-evolution

Economic activity is always embedded in an ecological context. Economic activity is ‘squeezed’ at the margin as increased environmental scarcities will cause price rises that induce substitution toward economic activities with lowered environmental impact. But there is nothing automatic about such substitutions in complex situations since they always involve uncertainty and it is here that neoclassical economics can be highly misleading because too strong assumptions are made about knowledge and risk. The substitution of one technology for another is a difficult matter and history is littered with failures. We can

think of a degrading environment as opening up an entrepreneurial opportunity space as a map of the actual and perceived constraints. Within this space, four complex systems co-evolve:

1. the economic system
2. the ecological system
3. the political system
4. the socio-cultural system

These are connected through multiple interactions and feedbacks. As such, any model of this

co-evolution must have the following three mechanisms:

1. how economic systems evolve
2. how ecological systems respond (i.e. the ecological part of ecological economics)
3. how political/socio-cultural systems respond to ecological change caused by economic evolution

We sketch the structure of our co-evolutionary model. In the beginning, there is an economic innovation derived from a new ‘generic’ idea that changes the structure and level of resource use (we call this a ‘meso trajectory’). Eventually, this creates a set of environmental and ecological impacts. When the environmental conditions that originally prevailed have been seriously damaged, or are perceived to be so in the foreseeable future, new entrepreneurial opportunities emerge. However, inasmuch as new actions emerge to resolve that problem, new problems are, in turn, created (Arthur 2009). So the co-evolutionary process can continue as one of emergent cumulative causation with many possible end states.

In constructing a co-evolutionary model, we employ the ‘micro meso macro’ analytical framework. In this framework, the economic system is viewed as having at its core an inter-connected

system of rules. The application of these rules in a diverse range of microeconomic contexts results in the generation of value which can be aggregated at the macroeconomic level of inquiry.

Economic evolution occurs when new rules to generate value are applied at the microeconomic level by entrepreneurial action. These rules spread as they are taken up by a population of adopters. At the same time, some rules fall out of favour and decline in importance.

Entrepreneurial response

Environmental loss, as caused by prior economic evolution, thus offers four classes of entrepreneurial opportunity: political; socio-cultural; technical; and economic.

First, we may conceive of the lead response emerging in the form of social or cultural entrepreneurship in the form of corporate leadership, celebrity leadership, or fashion leadership, or in general the process by which a local initiative has wider effect. The socio-cultural mechanism works via seeking to change beliefs, preferences and behaviours via an imitation or social learning mechanism. This creation and adoption of meso-rules may be spontaneous, in the form of the emergence of cultural leadership and fashion, or it may be more systematic and programmed via education and media mechanisms. This socio-cultural mechanism does not require a single general solution (i.e. a new law), but will issue from a diversity of behaviours that are then subject to differential copying or replication over social networks. In this way, new models of thought and behaviour, as well as social organizations and institutions, may emerge in response to environmental problems.

The entrepreneurial response here refers to the agents that provide the institutional or cultural seeds, in the form of new models of thought, action or organization that might subsequently be replicated by others.

Second, environmental problems present political opportunities to the entrepreneurial politician or law-maker if a socio-cultural meso-rule concerning action to solve an environmental problem has been widely adopted. Such political solutions are retailed by most political franchises. Such political entrepreneurship creates new conditions for ongoing economic evolution by changing the underlying constraints and opportunity sets for value creation, thus providing entrepreneurial feedback (via constitutional rules) from the environmental problem to new economic rules of the game.

The third entrepreneurial mechanism concerns scientists, technologists and engineers.

All are part of processes that yield physical, chemical (and now micro-biological) discoveries that can be used to devise new techniques and new combinations of components in machines and mechanisms that can do work using energy. Because there is a significant ‘public good’ dimension to technologies, there is governmental support for education, training and research.

Entrepreneurs in this space seek to secure patents or simply be first to develop and profit from a new technology or machine. For example, the increased concern over global warming has stimulated a great deal of entrepreneurship in the development and commercialisation of new, low carbon emitting power generation. Because of the public good

dimension, support for this kind of entrepreneurship and the associated innovation process is both private and public. This is because the uncertainty involved renders these technologies too high risk to be financed adequately only by the private sector yet it is a high social priority to ensure that they are developed once the meso-rule that originated in the socio-cultural domain becomes embedded in the political process and related policies. Because of the ‘creative destruction’ that the development of such technologies can bring, often political entrepreneurs are essential to overcome entrenched vested interests.

The fourth entrepreneurial mechanism concerns the economic agent engaged in seeking to create value by the discovery, origination and realization of new market opportunities created by new environmental problems. Such entrepreneurial ventures will seek to provide new solutions, in the form of new goods or services, either as new choices or product niches within existing market categories or as new business models and technologies. For example, there is seemingly high and growing demand for ‘green consumption’ (which in part of course derives from the effects of socio-cultural and political entrepreneurial actions.. Thus, there are profit incentives to develop new ‘green’ goods and services, a process presently working its way through much of the economy.

It should be apparent that these four entrepreneurial mechanisms have to interact in order for there to be effective action. There are examples in history where this has occurred but there are others where there was failure. The volume by Landes et al contains a number of examples where there was a disconnect

between these four mechanisms of entrepreneurial action by political interest groups or defenders of cultural norms led to the negation of entrepreneurial attempts to enact, and profit from, changes that could have averted crises and catastrophes.

Implications

This entrepreneur-centred co-evolutionary model has several implications for the analytic focus of ecological economics. First, it implies that the value of a resource, and indeed the very notion of what even ‘counts’ as a resource, along with how it is distributed and owned are less fixed from the entrepreneurial-evolutionary economic perspective. This is due to the entrepreneurial possibility of changing the ‘rules of the game’, or effecting change in the knowledge-base of the economy. As such, the co-evolutionary perspective is sceptical of standard notions of exogenously imposed resource constraints (i.e. a known non-renewable stock of x , or of a maximum flow of environmental services of y), or of concepts of sustainability that leave no role for new knowledge that is the result of entrepreneurial experiment and innovation.

Secondly, expectations play a larger role in this model than in conventional models of economic-environmental dynamics because of the central role of entrepreneurial action in formulating responses by creating new rules, solutions, business models, etc, in the face of uncertainty. Here the perspective is starkly different to standard, neoclassical economics since all four of the entrepreneurial responses discussed occur in states of uncertainty where meso-rule ‘understandings’ have to emerge to enable innovative experiments to occur and best practices to spread through imitation,

collaboration and selection. The neoclassical perspective lays most stress upon economic responses to price incentives where, for example, the increasing scarcity of resources or costs imposed as negative externalities due to depletion of environmental services raise prices.

Now, there is little doubt that prices are important in signalling entrepreneurial opportunity, but, because of the uncertainty involved in innovative experimentation, considerable entrepreneurial failure always occurs. So there is much more involved than simply the neoclassical response, which presumes either certainty or quantifiable risk. Only through the adoption of meso-rules in the formation of beliefs, aspirations and common understandings, will entrepreneurs respond to price incentives. The entrepreneur does not just react to prices set by a market, s/he seeks to bring a new market into existence and to lead in such a market by forecasting how particular patterns of change play out with conjectures of future relative prices or what expected patterns of relative demands and scarcities might be.

A third observation is that entrepreneurial action is properly understood as making conjectures about the value a new idea might create, and then putting that into action in pursuit of profit. As we have noted, this is not necessarily a pecuniary profit, but may include identity, social attention, power or favours, many of which can be converted to material forms through subsequent exchanges. Profit-seeking is not the only class of strategic action in the face of opportunities; the other of course is rent-seeking. Rent-seeking in economic-environmental co-evolutionary contexts is likely to be as prevalent as in any domain

of economic life. Its main effect operates via the formation of coalitions, both within and across economic, cultural and political domains that act to lock-in particular institutional rights or advantages or to exclude or make difficult the adoption of new solutions to emergent problems. In other words, they operate by seeking to shut-down ‘positive’ entrepreneurial responses (whether political, cultural or economic). Thus, the meso-rules embodied in existing institutions that determine the nature and extent of connections between economic and environmental systems need to be evaluated not only in terms of static properties such as allocative efficiency, fairness and so on, but also in terms of their adaptive flexibility and openness to change.

Fourth, because economic activity is often mobile and responsive to both relative prices and institutional regimes this model opens new perspectives on globalization. The main implication that follows from the entrepreneur-driven evolutionary model is that environmental degradation must spread over the entire planet, a process we might think of as ‘globalized ecological degradation’. This also implies that our four entrepreneurial feedbacks in the face of such degradation also have to be global in reach. In this regard it should be apparent that both economic systems and socio-cultural systems by far lead the way in the global context, and thus have a powerful competitive advantage over political entrepreneurship at the global level, which is the opposite of the situation at more local levels where political forces tend to have a greater impact. This points to the likelihood that global environmental treaties may be necessarily parasitic on, or symbiotic with, economic treaties, or

global cultural movements (religious or secular). For example, these interconnections are very evident in the global debate concerning global warming and what to do about it. What we observe is not a logical discussion but a struggle between existing adopters of both socio-cultural, e.g., religious, and economic (e.g., a belief in maximal economic growth) meso-rules versus adopters of an emergent meso-rule that we must act to mitigate climate change. This is not a scientific discussion but one involving the struggle between existing and emerging meso rules, driven by entrepreneurial behaviours.

Fifth, the co-evolutionary model points toward conceptualising policy responses in terms of entrepreneur-led adaptation rather than expert-led optimization. In a co-evolutionary context there is no ideal or optimal policy setting for the simple reason that the set of ‘old’ meso-rules, embodied in existing institutions, will be subject to ongoing change and the nature of this is uncertain in a radical sense. This change comes from continuous experimentation and learning, consolidated by entrepreneurial value creation as circumstances change. Just as there is no ultimately final most-winning competitive business strategy but rather a race without end, so too is there no ultimate optimal environmental policy but rather a continual process of ongoing experimentation, learning and policy adaptation (Potts 2009). The key role of government is not ‘picking winners’ intervention but the careful nurturing and formalization of facilitating meso-rules and the provision of an incentive structure in markets that signals to entrepreneurs the direction that their ventures should take. Generally, entrepreneurs will do a better

job more quickly than government planners. For example, in countries such as Spain and Germany, the provision of feed-in tariffs has led to entrepreneurially driven innovations and reductions in unit costs in solar power generation that government could not have achieved through direct action. Market-based emissions trading schemes, coupled with appropriately reinforcing political and socio-cultural meso-rules, promotes a diversity of entrepreneurial experiments and beneficial outcomes that would not be otherwise possible. This meso rule reinforcement is also important because such policies are expensive and taxpayers will only tolerate a rising cost burden if there is a well-established meso-rule that mitigation of climate change is a very high priority.

Sixth, it is entirely reasonable to question the efficacy of entrepreneurial responses in the market domain in relation to their specialization and experience. Entrepreneurs in a market economy may be well-honed to take advantage of opportunities presented in solving problems in the domains of consumer and producer goods and services, but they may be less well-versed in dealing with environmental opportunities. Raising awareness of environmental problems and proposals for their solution begin with socio-cultural entrepreneurship and, if an associated meso-rule set is adopted widely, political entrepreneurs will begin to devise appropriate policy proposals. An immediate effect is likely to be increased public support for appropriate technological entrepreneurship but lack of experience is likely to mean that economic entrepreneurs will experience high failure rates. It is for this reason that venture capitalists are often reluctant to finance

entrepreneurial, high risk projects and it is, therefore, essential that government is heavily involved in providing appropriate support and facilitation to solve what is principally a public good problem. In instances where environmental problems have a high degree of visibility (e.g. urban smog), emotional salience (e.g. genetic modification), or low discount rates (e.g. climate change) political entrepreneurship may well be highly effective in this regard. But when problems are less visible or charismatic, such as with krill stocks, or involving environmental problems that do not respect political boundaries, then global socio-cultural entrepreneurship, Greenpeace style, may have a comparative advantage.

In this model ‘economic-only’ entrepreneurship and innovation tend to have negative environmental and ecological effects that, in turn, create new entrepreneurial opportunities over several domains: political, cultural, technological and economic. These different entrepreneurial pathways can lead to new meso-rule sets, embodied in new institutions. However, in an interconnected economy-environment system we can expect new environmental problems to arise that then present new entrepreneurial opportunities, so beginning the cycle again. Thus, we believe that it is necessary to adopt a co-evolutionary, non-equilibrium modelling approach in which the core processes are the application of both free energy and new knowledge.

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