ECOLOGICAL DYNAMISM, ECONOMIC DYNAMISM, AND CO-EVOLUTION:
Implications for Urban Land Use Planning

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Recent developments in ecological science have emphasized the dynamic character of ecological systems, focusing on the role of disequilibrium responses to both endogenous and exogenous change. This understanding of ecosystems mirrors approaches within economic theory that emphasize the role of competition not as a "stationary state" but as the driving force of adaptive socio-economic change. Combining these insights suggests that the relationships between human action and the natural world should be seen as a co-evolutionary process rather than one of separate development. Unfortunately, much public regulation continues to be dominated both by a static equilibrium perspective and by one that sees human action as a disruptive intervention in the natural world. Nowhere is this approach more evident than in the realm of urban land use planning, where cities are often represented as an external threat to the natural order.

This short chapter sketches the implications of a dynamic, co-evolutionary perspective for the institutional management of the relationship between cities and ecology. It begins by outlining the core concepts of disequilibrium and dynamic adaptation in both ecological and economic theory. It proceeds to highlight the deficiencies of current urban land use policies when seen from a co-evolutionary standpoint. It concludes by outlining some institutional implications for land use and urban policy that is appropriately informed by co-evolutionary principles.

DYNAMISM IN ECOLOGICAL AND ECONOMIC THEORY: TOWARD A CO-EVOLUTIONARY VIEW

Ecological Theory: From Equilibrium to Dynamism

Until relatively recently, the science of ecology was understood in terms of the equilibrium or steady-state properties of environmental systems. The natural balance of ecological processes was taken as a given, and the primary threat to the natural order was thought to arise from the exogenous intervention of human agents. Though these models recognized some role for change within nature itself, such changes were conceived as temporary shocks or destabilizers that would be corrected by equilibrating forces. Concepts such as "climax communities," for example, recognized that climatic changes or events including fire or volcanic eruptions could disrupt the natural order. But the assumption was that the process of ecological succession would over time return toward a natural equilibrium point. In this view, insofar as ecological systems failed to return to their natural state, it was primarily owing to human action *disrupting* the path to a natural balance.

Though these notions of steady state ecology and the balance of nature still hold considerable sway in the popular imagination, contemporary ecological science has now largely abandoned the equilibrium perspective. In place of this view is one that emphasizes a complex process of dynamic, evolutionary adaptation in response to both endogenous and exogenous changes. Some are beneficial to elements of the system, and others are harmful.[1] While this new understanding has the potential to harm some species and habitats, change is also what creates opportunities for new and better-adapted forms to evolve and grow. From the perspective of disequilibrium or dynamic ecological science, there is no baseline or natural state against which the condition of ecological systems can be judged. Neither is there any particular direction or "end point" toward which these systems are or should be headed. In essence, ecological systems are open-ended processes with no fixed start or ending point toward which they can be managed or directed.

Economic Theory: From Equilibrium to Dynamism

The shift toward recognition of disequilibrium and adaptation in ecological science has a parallel in economic theory. For much of the post-war period and still to some extent today, theorists in the neo-classical tradition have been concerned with defining the conditions where the forces of supply and demand can be perfectly equilibrated. Equilibrium models that posit the existence of perfectly informed agents operating in an institutional setting of zero transactions costs depict a world

of full efficiency where all possible gains from trade are exhausted. Models of this kind are often viewed as a rough description of economic reality, but full information equilibrium is also seen as a normative benchmark against which to *indict reality* and call for appropriate corrective measures. Thus, if market participants are thought to have less than perfect information (or a proxy for such information); if competition is "imperfect," with some agents exercising a greater influence on prices than others; and if transactions costs are positive; these are taken to be instances of "market failure" in need of corrective government interventions.

Though equilibrium theories continue to be influential in policy circles, critics such as Friedrich Hayek and, more recently, Vernon Smith have pointed out that these models ignore the dynamic processes through which knowledge of resource scarcities is acquired and communicated.[2] In this view, the relative strength of market-based systems compared to central planning and control is their greater capacity to generate dynamic adaptation in response to exogenous and endogenous change. Entrepreneurial action in markets is often of the "price-making" variety, where firms duel with one another, launch price-cutting campaigns, and fashion new products and forms of business organization. In conditions of uncertainty and highly imperfect knowledge, it is precisely the inequalities in bargaining power arising from entrepreneurial competition that help to spread dispersed knowledge about which business models to copy and which to avoid. As knowledge spreads throughout the market via price signals, the plans of producers and consumers are gradually adapted to each other. But the resultant "order" has no tendency towards a fixed equilibrium point, because there will be a constant stream of perturbations generated by new innovations and entrepreneurial discoveries that demand further adjustments. Neither can the results of this process be judged against an overall "social standard" of efficiency. A market economy does not maximize any one set of values. It is a process of exchange where the often-conflicting plans of agents with diverse standards are subject to mutual adjustment through the push and pull of contractual bargaining.

The Dynamics of Social Ecology

Both ecological and socio-economic processes can best be understood as examples of complex, adaptive systems that adjust dynamically to exogenous and endogenous changes. Exogenous changes in weather patterns may, for example, create opportunities for some species to thrive, where those less well adapted to the new circumstances may migrate or see a decline in their population. In markets, meanwhile, exogenous shocks such as meteorological events prompt adjustments through shifts in the relative prices of different goods. Endogenous changes within ecosystems may occur by way

of genetic mutations that result in some species becoming more or less adapted to their environment and hence creating opportunities and constraints for competitors. The equivalents of these genetic mutations in markets are entrepreneurial innovations in consumption, production, and organizational ideas, the least successful of which are weeded out though competition and profit-and-loss accounting.

The processes of evolution in the natural and human worlds do not occur separately but should be conceived as a process of *co-evolution.* Changes in ecological conditions affect resource scarcity in the human world, and human action can change environmental conditions, creating ecological niches and constraints for different species and habitats. Within this context, ecological theorists have increasingly questioned the wisdom of seeing human agency as separate from, or an "intervention" in, an otherwise "natural" order. There is no baseline equilibrium state against which to judge the effects of human activity. Even some of the oldest "natural" habitats and environments bear the imprint of human action in some form or another. It follows from a co-evolutionary standpoint that no one set of socio-ecological conditions can be considered more or less "natural" than another.[3] This is not to imply that no state of the world, whether in terms of aesthetic appeal or contribution to health and well-being, can be considered better, but that whatever criteria of "better" we use will not relate to how "natural" that state happens to be. Trade-offs between potentially conflicting values will always arise, but these cannot be judged in terms of their compatibility or incompatibility with an underlying "natural order."

A disequilibrium or dynamic perspective recognizes that adaptability and change are critical to the robustness of co-evolving socio-ecological systems. Change and variation, both natural and human-induced, create the space within which new and potentially better adapted forms of life emerge and grow. A system that does not generate variety will be prone to evolutionary "dead ends." Thus, protecting ecosystems from change by trying to zone them off from other natural or human influences is unlikely to improve the robustness of such systems any more than protectionism in markets helps the robustness of firms. A framework allowing for competing responses to ecological and human-induced change cannot guarantee beneficial outcomes, but it may increase the possibility for people to learn about the trade-offs associated with different socio-ecological inter-actions and to adapt to the new possibilities that arise as people make these very trade-offs. It is important, therefore, to avoid the creation of one-size-fits-all regimes that thwart competition and experimentation. The institutional environment should allow a variety of solutions rather than impose a single conception of "what is right for nature" or what the "right trade-offs" are for humans to make.

Though direct planning at the *micro-scale* has an important role to play, such planning at the macro-scale is to be avoided because planners have no way of knowing in what direction to move the system as a whole. Priority should be given to indirect forms of coordination that communicate information from the many dispersed nodes that constitute the socio-ecological order. Signaling mechanisms, such as prices that communicate shifting trade-offs via movements in supply and demand conditions, or changes in tax revenues that communicate movements of people and resources across jurisdictions, may enable people to adapt to both the intended and unintended opportunities and constraints emergent from the decisions of countless agents.

LAND USE AND URBAN POLICY IN CO-EVOLUTIONARY PERSPECTIVE

Seen from the standpoint sketched above, far too much environmental policy fails to take into account the dynamic nature of human-ecological relations and the conflicting trade-offs generated by these interactions. One area where this tendency is especially pronounced is urban land use planning. Many land use policies have been predicated on the notion that nature is fundamentally separate from the city—with cities seen as threats or intrusions into an otherwise settled equilibrium state. Consider in this context the "urban containment" policies that have been pursued in many nations. In the United Kingdom, for example, throughout the entire post-war period land use policy has been dedicated to limiting urban expansion with the intention of keeping tight boundaries between urban areas and the surrounding countryside. In the recent past, these policies have received support from a "deep green" standpoint that views urban development as a threat to the stock of critical "natural capital." According to this view, transfers of land into residential and other urban uses represent a net loss of irreplaceable natural assets that should be avoided at all costs.

From a co-evolutionary standpoint, cities should not necessarily be seen as "bad" for "the environment." Human beings and their activities have always been bound up with ecological systems irrespective of whether these activities have been rural or urban. What is clear, however, is that the productivity gains and technological developments that arise when large numbers of people are clustered in cities—while they may have some negative consequences—can help reduce the impact of human activity outside of urban areas. Improvements in agricultural machinery, for example, have been stimulated by the size of urban markets and facilitated by technological expertise that congregates in cities. These improvements have enabled much higher levels of food production from a smaller amount of land. Were it not for the policies of agricultural subsidization that often lock land into farming, these improvements

might enable a significant amount of "rural" land to be withdrawn from production altogether, creating space for alternative land uses. Policies that block the development of cities on the grounds that they are in some sense "less natural" or "bad" for the environment therefore should be questioned.

In the British case, for example, the countryside that is "protected" from urban development is not remotely a "natural" phenomenon, and its qualities vary enormously. On the one hand, some of the most prized rural landscapes in the designated national parks are in fact farmed landscapes where practices such as sheep farming and grouse hunting have created a more diverse set of habitats than might have prevailed had they been devoid of human interference. On the other hand, a large proportion of the land that is directly protected from urban development is devoted to highly subsidized farming practices that have created agricultural monocultures far less supportive of bio-diversity than the suburban residential gardens that might replace them if a less hostile attitude to new urban development were to emerge. Indeed, one of the unintended consequences of urban containment policies in the United Kingdom has been an increasing loss of gardens and wooded areas within urban areas as developers scramble to build on the few plots of land that have been deemed by planners to be of lesser ecological significance.[4]

None of the above implies that urban growth can be considered objectively good from an environmental point of view either. Many people may consider a rural form of living superior from an aesthetic standpoint and would willingly accept lower material living standards as a price worth paying to avoid the costs of urbanization. There is a strong case for any balanced land use policy to ensure that open spaces and scenic vistas should be maintained because of their contribution to quality of life—though it must be recognized that such landscapes are not the result of "pristine" natural processes. What matters in this context is that *neither* a rural nor an urban pattern of human settlement has any claim to be one that is more in tune with nature. Deciding in favor of more or less urbanization should be recognized as a conflict between various human values. The realization of that fact will create a different set of opportunities and constraints, both for human beings and for elements of the environmental systems with which they interact—but none of these has any unique claim to ecological virtue. These conflicts point toward a case for allowing the trade-offs and value-judgments at their heart to be made in different ways by different people. Increasing the variety of decisions rather than ruling in favor of any one trade-off will increase the scope for learning. It will also facilitate more rapid adaptation to the unintended or unexpected benefits and costs that follow from the decisions people take, and it will reduce the probability of becoming locked in to any single path.

A similar set of issues arises in debates over the question of what has come to be known as "sustainable urban form." Even among those who recognize that cities are not necessarily "bad" for the environment, urban land use policy has nonetheless been formulated on the assumption that *particular* settlement patterns should be promoted because they have a less pronounced "ecological footprint" than others. In discussions over climate change, for example, it has been suggested that land use planning policies should promote higher-density urban settlements because they reduce energy use, commuting lengths, and the need for car-based travel, relative to the low-density style "sprawl" that is typical of many American cities. According to this perspective, higher-density cities can contribute to a reduction in CO_2 emissions by reducing the need for automobile use as people can access a wider range of services within a smaller surface area. Others claim a whole host of additional benefits from higher density living, such as higher energy efficiency and lower heating bills.

From a co-evolutionary standpoint, the problems with the above line of thinking are two-fold. First, there is the assumption that there is a natural climatic state that would prevail absent human intervention, when in fact climate is subject to considerable natural variation. This is not to deny that anthropogenic impacts associated with the emission of CO_2 and other greenhouse gases may contribute to, or exacerbate these changes. What it does suggest, however, is that it is pointless to speak of a natural climatic state as if this is somehow "optimal" from an ecological standpoint. Different climatic conditions create different sets of opportunities and constraints for both humans and non-humans, none of which should necessarily be considered "optimal" from some global point of view. Of course, different parts of the world may be affected for better or worse by climate changes, and this possibility creates conflicts between people which are a legitimate cause for concern, both in terms of their economic dimension and with regard to distributive fairness. Ultimately, however, any resolution of these conflicts cannot be judged against an assumption that absent human intervention climate would not be changing and that such natural changes *would not cause a different set of conflicts.*

Second, recognizing that CO_2 emissions are a legitimate policy concern, it does not follow that any one form of urban settlement should be targeted as a way of reducing emissions. Urban areas are themselves examples of dynamic, evolving systems where the range of inter-connected variables that reflect the shifting choices of residents and businesses in response to changing socio-economic conditions may be far too complex for policy-makers and planners to comprehend. Within this context, it is not at all obvious that higher densities, whether now or in the future, would help to lower emissions. While lower densities may contribute to increased travel to work

distances, in other circumstances there is evidence that the growing decentralization of employment centers toward suburban areas may actually lower journey times and emissions.[5] Moreover, even if it is the case that with *current* technology higher density development produces fewer emissions, this may cease to be so in the wake of future technological evolution. Widespread adoption of the electric car and new forms of employment relationship arising from the further growth of online technologies may, for example, make a much less emissions-intensive form of suburbanization feasible. Yet the opportunities that this might afford will be foreclosed by policy measures that deliberately seek to favor higher densities. There may, of course, be aesthetic reasons why people prefer higher- to lower-density living, and vice versa, but the trade-offs people make in this regard should not be judged from a static perspective that views one form of development as *inherently* unfavorable from an emissions-related standpoint.

POLICY IMPLICATIONS FOR URBAN LAND USE PLANNING

In view of the preceding remarks, adopting a co-evolutionary perspective implies the need for an open-ended and experimental approach to urban land use planning of a sort that is hard to find in a context where one-size fits all thinking tends to dominate.

The first principle of a land use policy informed by co-evolutionary thinking should be to strive for *neutrality* between different land use patterns. If no particular configuration of land uses, whether rural or urban, has any unique claim to be more or less natural or "good" for the environment, and if variation and competition are important in promoting adaptation to shifting conditions, then land use policies should not seek to promote any particular path. In the British context, for example, this would imply abandoning the commitment to urban containment and "green belts" in favor of a framework that is neither hostile to urban growth *per se* nor favors a high-density form of growth. Opportunities that might arise for low-density development that combine residences with woodland and open space have been largely shut down by a regime that aims for a rigid separation between town and country and that shoehorns new buildings into smaller and smaller plots. Within this context, the "green belts" enforced around many of the major cities may actually have contributed to increases in travel-to-work times, congestion, and subsequent pollution as development that might have occurred on the urban fringe has been pushed outward, miles beyond the green belts over which people must then commute.[6] It is ironic that a country where one of the founders of the town planning movement, Ebenezer Howard, argued for a form of development that brought the "town into the country" and "the country into the town" should have institutionalized a framework that has made experiments with such ideas next to impossible.

In the U.S. context, by contrast, a more neutral land use policy would imply moving away from a regime that has historically promoted low-density sprawl. The combination of large lot zoning ordinances and federal subsidies to road construction such as the interstate highway system has promoted a highly dispersed and energy-intensive form of growth, which has had many negative environmental consequences. Recognizing the existence of such negative consequences, however, does not imply that policy should seek to deliberately favor high-density settlements instead. As noted earlier, that a particular pattern of development may have been associated with negative external effects in the past does not imply that this will be the case in the future given ongoing shifts in technology, employment, and lifestyle patterns.

A second implication arising from the co-evolutionary perspective is to recognize that trade-offs and value conflicts are inevitable to land use planning decisions and that these conflicts cannot be decided by an appeal to what is "better for nature." The notion that there is "one best way" allows policymakers, regulators, and activists to depict some land use patterns as inherently damaging when it would be more appropriate to recognize that where there are conflicting value judgments, the issue is really one of "who is allowed to damage whom."[7] It is not necessarily the case that those proposing new residential or commercial development are imposing costs on those wanting to preserve nature, any more than those who wish to preserve nature are imposing costs on those who wish to see urban development. Who is deemed to be imposing costs is really a question of who has the right not to be damaged and whether they wish to cede such a right in exchange for compensation. The key, therefore, is not to look for a framework that decides what the best decision is, but to specify who has the right to take the relevant decision within a particular domain and to whom any compensation is owed. If rights are specified in this way then the parties concerned will have incentive to take into account the values that other agents place on the rights at issue.

Seen in this light, there is a strong case in favor of property rights and contractual approaches to land use planning issues rather than reliance on direct government regulation to allow the holders of different values the greatest scope to bargain toward their own solutions and communicate opportunities for gains from trade. Where possible, such property rights should reside with individuals and voluntary associations. Attempts to impose regulatory solutions from the center are unlikely to match the dispersed knowledge of the trade-offs associated with particular land uses accessible to those closest to them. In addition, a process that allows different property owners to arrive at different decisions may generate more knowledge about the potential costs and benefits associated with alternative models of land use "regulation." Many environmental goods are not completely indivisible, and their supply can vary across

different territorial zones, thus enabling them to be packaged as "club goods" by proprietary residential communities. Competition between different packages of land use controls would facilitate a process of adaptive learning. Competitive decentralization is appropriate not only because it offers more scope for people with varying aesthetic tastes to realize their values but also because it allows for greater responsiveness to change as the effects of past decisions emerge. Though these benefits can be generated to some extent by more localized forms of government regulation, such as those found in federal political systems like the United States, in many cases even local government regulation works to stifle decision-making by potentially smaller geographical units.

Finally, insofar as decentralized contractual approaches to environmental conflicts are impractical, it is better to encourage behavioral changes via signaling mechanisms such as pollution taxes or congestion charging schemes, rather than attempt to directly control land use patterns. From an informational viewpoint, decentralized signaling generated through a bottom-up process of bargaining in markets is preferable. But where this cannot be organized, centrally imposed signals may be required as a second-best option. One of the advantages of pollution taxes is that they provide signals to individuals and organizations that they should change their behavior in response to environmental costs and provide a financial incentive for them to do so. They do not, however, attempt to specify the nature of the changes concerned, leaving ample room for actors to experiment with different ways of reducing costs or finding substitutes. In a land use context, this is crucial because the discovery procedure that might arise from allowing different groupings of people, whether property owners or municipalities, to experiment with alternative packages would be squashed by any attempt to achieve reductions in pollution or other environmental costs by forcing people into a single pattern of living.

CONCLUSION

I have sought in this paper to outline an approach to the regulation of urban land use that is informed by co-evolutionary principles. With its focus on dynamic processes and the complex interaction between humanity and the natural world, this perspective is unlikely to inspire those who believe they can identify which particular land use decisions are "good" both from a human and from an ecological standpoint. For those who appreciate that we do not know how best to mix humanity and nature, however, it may be inspiring to embrace change in the recognition that learning and adaptation in the face of uncertainty are the keys to survival.

ENDNOTES

1 Botkin, Daniel B. 2012. *The Moon in the Nautilus Shell: Discordant Harmonies Reconsidered*, New York: Oxford University Press.
2 Smith, Vernon. 2009. *Rationality and Economics*, Cambridge: Cambridge University Press; Hayek, F.A. 1978. Competition as a Discovery Procedure, in Hayek, F.A. (1978) *New Studies in Politics, Economics and the History of Ideas*, London: Routledge.
3 Botkin, Daniel B. 2012. *The Moon in the Nautilus Shell: Discordant Harmonies Reconsidered*, New York: Oxford University Press.
4 See, e.g., Evans, A., and O. Hartwich. 2006. *Better Homes, Greener Cities*, London: Policy Exchange.
5 See, e.g., Gordon, P., and H.W. Richardson. 1997. Are Compact Cities a Desirable Planning Goal? *Journal of the American Planning Association*. 63 (1): 95-107; Bogart, W. 2006. *Don't Call it Sprawl*, Cambridge: Cambridge University Press.
6 Pennington, Mark. 2002. *Liberating the Land*. London: Institute of Economic Affairs.
7 See Coase, Ronald H. 1960. The Problem of Social Cost. *Journal of Law & Economics*. 3: 1-44.