DYNAMIC ECOLOGY AND DYNAMIC ECONOMICS: THE FOUNDATION OF AUSTRIAN ENVIRONMENTAL ECONOMICS

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INTRODUCTION

Analyzing nature and economies as static systems tending toward equilibrium distracts our attention from the dynamic forces in both. In the case of nature, ecologists increasingly recognize that there is no "state of nature" which would exist in the absence of humans or to which nature would return if left alone by humans.[1] Whether it is cosmic or geological forces that would alter the Earth's resources—air, water, land, flora, and fauna—or Darwinian evolutionary forces, nature is in a continual state of flux. Similarly, there is no market equilibrium because markets are an amalgamation of human action dependent on subjective valuation of demand and opportunity costs.[2] Both of these are also continually changing along with the particular circumstance of time and place.

Unfortunately, economics, in general, and environmental economics, in particular, are saddled with static models that lead to static legal and policy implications.[3] To be sure, such models provide useful predictions of tendencies toward competitive forces that tend toward equilibrium, even if those models do not tell us much about the harmonization process.

Just as equilibrium market models oversimplify and ignore the important dynamic forces of entrepreneurship, environmental models have oversimplified ecological systems and ignored the importance of dynamic organisms. They build on a balance of nature perspective rather than on ecosystems that are continually confronting and generating new constraints and adjusting to those constraints. As with economic models, ecological models based on carrying capacity may give some idea of tendencies toward a steady state, but because the ecological *ceteris paribus* conditions

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1 *See* DANIEL A. BOTKIN, DISCORDANT HARMONIES: A NEW ECOLOGY FOR THE TWENTY-FIRST CENTURY (1990) [hereinafter BOTKIN, DISCORDANT HARMONIES].

2 For a concise discussion of the fundamentals of Austrian economics, see Peter J. Boettke, *The Concise Encyclopedia of Economics: Austrian School of Economics*, LIBRARY OF ECON. & LIBERTY (2008), http://www.econlib.org/library/Enc/AustrianSchoolofEconomics.html.

3 For an example of how prevalent static equilibrium theory is in natural resource economics, see the popular textbook TOM TIETENBERG & LYNN LEWIS, ENVIRONMENTAL AND NATURAL RESOURCE ECONOMICS (2011).

are continually changing, there is no steady state or no state of nature. In the words of ecologist Daniel Botkin:

> We have tended to view nature as a digital camera's ["Kodachrome" in earlier versions] still life, much like a tourist-guide illustration of La Salute; but nature with and without people is and always has been a moving-picture show, much like the continually changing and complex patterns of the water in the Venetian lagoon.[4]

Botkin asks, "How real is the concept of a balance of Nature? What is the connection between people and nature? What are our roles in and obligations to nature . . . ?"[5]

As with ecologists, economists must ask similar questions. Given that markets are never in equilibrium, economists need to focus on dynamic processes in both nature and markets, and on the links between human action and nature. Those links are determined by property rights—the rules of the game—that determine who has the right to decide how resources are used and who derives value therefrom. If, at a point in time, property rights are clearly defined and enforced, then the roles and obligation of human beings to one another as users of nature will account for the human values and natural conditions at that time.[6]

As values and environmental conditions change, however, dynamic forces come into play, disrupting the status quo property rights and creating incentives to change those rights.[7] Once abundant resources become scarce, individuals with different values will compete for uses, necessitating reallocation among those competing uses.[8] Effective environmental entrepreneurship, therefore, is akin to Darwinian evolution in economies. As Matt

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[4] DANIEL A. BOTKIN, THE MOON IN A NAUTILUS SHELL: DISCORDANT HARMONIES RECONSIDERED 8 (2012); BOTKIN, *supra* note 1, at 6.

[5] BOTKIN, *supra* note 4, at 18.

[6] Throughout this paper, the terms "natural resources" and "the environment" are used interchangeably, but it is important to keep in mind that entrepreneurs take actions regarding specific natural resources, such as trees, water, air, and so on, rather than some general, amorphous concept of the environment. In a sense, for the entrepreneur, there is no such thing as the environment. What we call the environment is an amalgam of individual natural resources to which property rights may or may not be defined. If there are property rights to a resource, the entrepreneur will account for its value. If there are not, he will either capture the value in a scramble for ownership via first possession or engage in establishing property rights.

[7] This analysis may seem unduly anthropocentric because it presumes that humans hold property rights over nature. Some legal scholars, for example, have argued that flora, fauna, and even inanimate objects have rights, but accepting this, those rights can only be expressed by humans making claims for things in nature. Christopher D. Stone, *Should Trees have Standing—Toward Legal Rights for Natural Objects*, 45 S. CAL. L. REV. 450, 480 (1972). Therefore all rights boil down to human rights, even if those rights are expressing an intrinsic value of nature.

[8] *See generally*, Ronald Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

Ridley puts it, markets are "spontaneously self-ordered through the actions of individuals, rather than ordained by a monarch or a parliament."[9]

In summary, this paper argues that instead of focusing on equilibrium conditions in markets or nature, more emphasis needs to be put on the dynamic processes that provide a link between markets and the environment by emphasizing that 1) environmental problems result from a lack of clear property rights; 2) property rights problems are entrepreneurial opportunities; and 3) entrepreneurs respond to and create market signals in the form of prices, which reflect environmental conditions. The effectiveness of markets in providing a link between humans and their natural environment depends on how well the property rights induce owners to account for changing human values and changing states of nature.

The actor in this dynamic process is the entrepreneur who observes changing human values and changing states of nature and who see opportunities in coordinating between the two. The challenge for the entrepreneur is to discover the values of goods, services and the inputs that go into their production and to capture those values through market exchanges of ownership claims to labor, capital, and natural resources (the environment).

When an entrepreneur successfully responds to disequilibrium conditions created by changing human values or by changing ecosystems, he or she is responding to resolve what Daniel Botkin calls "discordant harmonies."[10] Just as ecological disturbances create discordance in the environment to which species respond by filling niches and evolving, economic disturbances create discordance in markets to which entrepreneurs respond. If they are successful, they tend to create harmony from dissonance.

I. AUSTRIAN ECONOMICS AND ECOLOGY

Economists have traditionally analyzed markets using comparative statics, comparing one equilibrium with another and specifying the conditions for the equilibrium to hold. The assumptions of perfect information, costless market transactions, and perfect competition focus attention on the equilibrium where price balances the quantity supplied and demanded at a price equal to the marginal cost of production. Austrian economists criticize neoclassical economics on the grounds that it ignores basic Austrian propositions as enunciated by Peter Boettke,[11] and those criticisms are condensed as follows:

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9 Matt Ridley, *The Natural Order of Things*, THE SPECTATOR, January 10, 2009, at 12, 12.

10 BOTKIN, DISCORDANT HARMONIES, *supra* note 1.

11 *See* Boettke, *supra* note 2.

A. *Only Individuals Choose.*

Environmental economics acknowledges that individuals choose, but it assumes that private actors ignore some costs of their action and therefore engage in more of that action than is socially optimal. Too much fishing of a stock of fish, too many emissions into the air, and too much diversion of water from rivers are examples. The implication is that private action must be curtailed by collective action to achieve socially optimal resource use.

There are two problems with this conclusion. First, environmental economics often fails to consider how collective action works, i.e., public choice. The work of the late Elinor Ostrom has opened the door for greater recognition of communal property rights, but still there is little recognition of the potential for government failure.[12] Second, static models leading to policy recommendations to correct the divergence between private and social costs do not recognize the evolutionary nature of property rights.[13] They fail to recognize that incomplete property rights are opportunities for entrepreneurs who can better define and enforce property rights and thus capture the previously uncaptured rents.

B. *The Study of the Market Order Is Fundamentally About Exchange Behavior and the Institutions Within Which Exchanges Take Place.*

If markets are about exchange, then markets cannot be created by simply setting a price to correct alleged market failure. For example, economists generally agree that low water prices lead to inefficient uses of water and conclude that prices need to be increased. Doing that does not create a market even if it does reduce water consumption. The problem is that there are not well-specified water rights that can be exchanged. Such rights are the institutions on which exchange behavior could be based.

Philosopher Mark Sagoff confronts economists who view markets and ecosystems as equilibrium systems that can be objectively valued for their contributions to human welfare. "Ecological knowledge, like any kind of empirical knowledge that is relevant to economic activity, is too spread out among people and too sensitive to the moment to be captured by any one individual or by any group—even scientists given sufficient resources."[14] Remarking on recent attempts by economists and scientific experts to as-

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[12] *See generally* ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION (1990).

[13] *See generally* Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347 (1967); Terry L. Anderson & Peter J. Hill, *The Evolution of Property Rights: A Study of the American West*, 18 J.L. & ECON. 163 (1975).

[14] Mark Sagoff, *The Quantification and Valuation of Ecosystem Services*, 70 ECOLOGICAL ECON. 497, 501 (2011).

sign values to ecosystem services from the top down, Sagoff concludes that "[t]he 'ecosystem services' project is bound to fail in its attempt to substitute an *in natura* calculus of value for the artifice of market price."[15] Instead of seeking to valuate ecosystems, markets aggregate disparate knowledge through entrepreneurial action.

C. *Utility and Costs Are Subjective.*

This point is particularly relevant in environmental economics where benefit–cost analysis is put forward as a substitute for markets and as a basis for making governmental actions mimic markets. Given that demand and supply—utility and costs—are subjective, doing benefit–cost analysis is meaningless when done in the absence of market transactions. If such transactions existed, benefit–cost analysis would be unnecessary; if market transactions are absent, there is no way that benefit–cost analysis can discern what the subjective values are.

D. *The Price System Economizes on the Information That People Need to Process in Making Their Decisions.*

This point made by Hayek is crucial for understanding the nexus between dynamic ecology and dynamic economics.[16] Prices arrived at through market transactions are a reflection of people's perceptions of scarcity and value. In a world where resource and environmental constraints are continually changing along with the value that people put on the environment, prices provide the necessary information to allow people to respond to dynamic natural and human conditions.

E. *Private Property in the Means of Production is a Necessary Condition for Rational Economic Calculation.*

This gets to the heart of my contention that all environmental problems are property rights problems. Without property rights, people cannot engage in exchange, and without exchange, there is no way of knowing what the subjective values are or knowing how people perceive dynamic changes in their environment. This shifts the focus from what Ronald Coase called "the problem of social cost"[17] to the problem of property rights, which is the essence of what Coase was saying. In other words, property rights force

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15 *Id.*

16 *See* F. A. Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV. 519 (1945).

17 Ronald Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

owners to consider the opportunity costs of their decisions. In the environmental context, the owner of oil-bearing lands who says no to drilling faces the cost of saying no. Without transferable property rights, however, it costs nothing to "just say no."

F. *The Competitive Market Is a Process of Entrepreneurial Discovery.*

Much like the interaction of organisms in nature, the market process emphasizes the interaction of individuals based on factors that are time- and place-specific. Just as individual species fill niches in ecosystems, entrepreneurs find market niches and specialize in production and marketing to fill those niches. Successful entrepreneurship depends on the entrepreneur utilizing local knowledge and resources more efficiently than other individuals. As a result, inefficient resource use in markets and in ecosystems is crowded out in an evolutionary process where sustainability requires profitability for survivability.

In this sense, human action is ordered spontaneously through market processes just as animal and plant speciation is ordered spontaneously through evolutionary processes. Information on which niches are opened and how they should be filled cannot be acquired or ordained from the top down; it requires responses to, what Nobel laureate Friedrich Hayek described as, "rapid adaptation to changes in the particular circumstances of time and place."[18]

The ability of market institutions to resolve conflicting human demands on natural resources relies on entrepreneurs who reallocate inputs and outputs guided by market prices and property rights. With clear and transferable property rights to all resources, owners will compare the value they place on resources to values of others willing to make offers to buy them. These competing values are imbedded in prices, which provide a condensed form of information about individual preference, resource scarcity, and technology.

The spontaneous orders that emerge in markets require market prices to consolidate and condense diffuse information. As Nobel laureate Friedrich Hayek pointed out many years ago, knowledge in society is dispersed and "not given to anyone in its totality."[19] Prices communicate decentralized knowledge of the relative scarcity of resources that cannot be comprehended entirely by any individual or group of central planners. Individuals in markets make decisions based on local knowledge and personal preferences, which contribute to the formation of prices. These market prices then transmit knowledge to the rest of society and encourage people to adjust their economic behavior in accordance to changing market circum-

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[18] Hayek, *supra* note 16, at 524.

[19] *Id.* at 520.

stances of which they are not fully aware. In this way, the market process collects decentralized local and time-specific knowledge through the constant fluctuation of market prices to bring about an emergent, but dynamic, order to society. Hayek provides a simple example to illustrate the way in which prices convey dispersed knowledge to coordinate the separate actions of many individuals. Consider a raw material such as tin, which has suddenly become either more limited in supply or more in demand due to changing market circumstances. As Hayek explains, it does not matter which force—decreased supply or increased demand—has made tin more scarce:

> All that the users of tin need to know is that some of the tin they used to consume is now more profitably employed elsewhere, and that in consequence they must economize tin. There is no need for the great majority of them even to know where the more urgent need has arisen, or in favor of what other needs they ought to husband the supply. If only some of them know directly of the new demand, and switch resources over to it, and if the people who are aware of the new gap thus created in turn fill it from still other sources, the effect will rapidly spread throughout the whole economic system and influence not only all the uses of tin but also those of its substitutes and the substitutes of these substitutes, the supply of all the things made of tin, and their substitutes, and so on . . . .[20]

According to Hayek, the process of market coordination would occur "without the great majority of those instrumental in bringing about these substitutions knowing anything at all about the original cause of these changes."[21] The implication is that the problem facing all human societies is not how any one authority or group of experts can direct economic activity as it relates to the use or conservation of resources. Instead, the challenge is for the knowledge that is dispersed throughout society to be conveyed in a way so that individual market actors can adjust their behavior in response to changes of which they could not be fully aware. Hayek referred to this challenge as one of "rapid adaptation to changes in the particular circumstances of time and place," and viewed the price system as the mechanism for humans to adapt to changing market circumstances.[22]

At their core, markets depend on a dynamic process of entrepreneurial discovery guided by prices. Hayek's critique of standard economics was that its preoccupation with equilibrium led economists to assume that conditions leading to changes in the supply or demand for resources such as tin were already known by market actors who respond like computers to reestablish equilibrium. Neoclassical economists largely ignored the process by which decentralized knowledge of the relevant changes is conveyed through the price system. Moreover, they overlooked the role of entrepreneurs who respond to changing conditions.

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20 *Id.* at 526.

21 *Id.*

22 *Id.* at 524.

Entrepreneurs act on the disequilibrium inherent in the market process by discovering knowledge not currently represented in market prices and by discovering alternative approaches to adapt to dynamic market conditions. In the process they generate information on the subjective values of individuals as they engage in voluntary trades. According to Hayek, the decentralized decisions made in markets are crucial because "practically every individual has some advantage over all others in that he possesses unique information of which beneficial use might be made, but of which use can be made only if the decisions depending on it are left to him or are made with his active cooperation."[23] Once we recognize that most knowledge is fragmented and dispersed, then we can understand that, in the words of Thomas Sowell, "systemic coordination among the many supersedes the special wisdom of the few."[24]

Owners of assets have an incentive to consider their long-term resource values, of course, discounted for time preferences reflected in interest rates. With clearly defined and enforced property rights, the asset owner is a residual claimant[25] with an incentive to collect information about any tradeoffs there are in alternative uses of the asset and value those tradeoffs. He will consider how much it costs to produce a flow of benefits vis-à-vis how much he can gain by selling the flow of benefits. In the context of wolf habitat versus cattle grazing, assuming the two uses are incompatible, the comparison would be between the potential net revenues from wolf habitat and the net revenues from grazing. To the extent that it is difficult to obtain payments from people who derive value from having more wolves, i.e., there is a free rider problem, wolf revenues are likely to be low compared to cattle grazing where revenues are more easily collected. Hence the asset value will be determined by grazing returns over time rather than wolf habitat. If property rights can be redefined to include returns from value of wolf habitat, the owner of potential habitat will have an asset whose value will depend on the higher of the two, wolves or cattle. If he can combine the two, he may find some balance between them, or better yet, find a way to make them complementary. In short, the price of assets for which there are secure property rights provides a subjective measure of dynamic ecological factors. If the property rights are not secure, making them so provides an entrepreneurial opportunity.

Emma Marris summarizes the modern challenges facing environmentalists in the following way: "In a nutshell: Give up romantic notions of a stable Eden, be honest about goals and costs, keep land from mindless de-

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23 Hayek, *supra* note 16, at 521-22.

24 THOMAS SOWELL, A CONFLICT OF VISIONS: IDEOLOGICAL ORIGINS OF POLITICAL STRUGGLES 46 (Basic Books 2007) (1987).

25 For a discussion of the importance of residual claimancy, see Armen A. Alchian & Harold Demsetz, *Production, Information Costs, and Economic Organization*, 62 AM. ECON. REV. 777 (1972).

velopment, and try just about everything,"[26] This is what entrepreneurs do—try just about everything. In some cases, their decisions will be wrong, but just as poor adaptations in nature are eliminated, albeit slowly, via evolutionary processes, bad decisions in markets are purged by economic losses.

The effectiveness of market processes and entrepreneurship in adapting to changes in nature depends on well-defined, enforced, and transferable property rights to environmental resources. If those rights exist, costs and benefits will be internalized by owners. If they do not, entrepreneurs have an incentive to establish property rights in order to capture the benefits of ownership. The evolution of property rights may come from the bottom up or from a political process that distributes rights.[27] In either case, there is no guarantee that property rights will be complete because the costs of defining and enforcing property rights must always be compared to the benefits. For this reason, incomplete property rights do not necessarily imply market failure.[28]

II. ENVIROPRENEURSHIP"

With clearly defined and enforced property rights, environmental entrepreneurs, "enviropreneurs," have an incentive to consider all the costs of alternative resource uses and to seek gains from trade through mutually beneficial trades to resolve competing demands for natural resources. When and where this environmental entrepreneurship occurs depends on the value of the environmental assets in question. Until wildlife habitat becomes scarce enough to reduce wildlife populations, there is no need to be concerned about who owns the habitat or how it is used. However, if populations fall in response to habitat loss or people place a higher value on wildlife, new demands emerge for conserving habitat. Entrepreneurial conservation groups have met those demands by writing contracts with habitat owners—Ducks Unlimited has paid farmers to conserve wetlands—and by acquiring property rights in key habitats—the Nature Conservancy has established conservation easements that save habitat.[29]

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[26] EMMA MARRIS, RAMBUNCTIOUS GARDEN: SAVING NATURE IN A POST-WILD WORLD 170 (2011).

[27] *See* TERRY L. ANDERSON & PETER J. HILL, THE NOT SO WILD, WILD WEST: PROPERTY RIGHTS ON THE FRONTIER (2004).

[28] *See* HAROLD DEMSETZ, *Ownership and The Externality Problem*, *in* PROPERTY RIGHTS COOPERATION, CONFLICT, AND LAW (Terry L. Anderson & Fred S. McChesney, eds., Princeton Univ. Press 2003).

[29] One of the best examples of contracting for conservation is the Nature Conservancy's Pine Butte Preserve in Montana. *See* TERRY L. ANDERSON & DONALD R. LEAL, FREE MARKET ENVIRONMENTALISM FOR THE NEXT GENERATION 40-41 (2015).

Hence, the enviropreneur is, above all, a person or organization who develops innovative contractual arrangements.[30] To do so, enviropreneurs must:

- discover new resources, rebundle rights to resources into new production processes, discover new outputs which can be produced from those resources, or some combination of all;
- measure and monitor the production process, especially regarding the contribution of inputs combined for team production; and
- establish the value created by the new combinations of inputs, by new outputs, or by some combination of both.

Each task focuses on property rights and contracting costs. Where property rights do not exist, the entrepreneur must create them, meaning she must define the boundaries of the property and exclude others from using it. In cases where property rights are already defined and enforced, the challenge for the entrepreneur is to measure and monitor contracts with input owners and buyers of goods and services, which were purchased as a result of entrepreneurial production.

Contracting issues are particularly important for environmental entrepreneurs because many environmental goods and services are subject to the free-rider problem. That is to say, goods such as clean water or air, endangered species preservation, or greenhouse gas reduction can be enjoyed by people who cannot easily be restricted from enjoying the good if they do not pay for it. Once clean air and water are produced, anyone in the vicinity can enjoy it; once endangered species are preserved, people can enjoy a sense of satisfaction out of knowing those species continue to exist; and greenhouse gases reduced in one location can potentially stave off global warming around the world. Environmental entrepreneurs trying to capture rents in producing such goods will be undercompensated for their efforts if they cannot find ways of contracting—privately or collectively through government—with potential free-riding consumers. By bundling a private good, such as housing, with a public good, such as open space in the form of a golf course, environmental entrepreneurs can overcome at least some of the free-rider problem.

III. POLITICAL ENVIRONMENTALISM

Public choice, which has its roots in Austrian economics, provides at least two reasons to be skeptical about the potential for politics to respond

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[30] *See* Yoram Barzel, *The Entrepreneur's Reward for Self-Policing*, 25 ECON. INQUIRY 103 (1987).

to dynamic environmental conditions. They are self-interest and information costs.[31]

Consider how self-interest interfaces with dynamic ecology. Political approaches to environmental problems begin with a presumption that politicians act in the public interest, utilizing sound science as the basis for decisions and considering both the short- and long-term consequences of decisions. Consider management of public lands.[32] Managers are expected to manage lands for multiple uses by and for people, but they are also accountable for meeting broad environmental standards set by laws such as the Endangered Species Act, the Multiple Use and Sustained Yield Act, and the National Environmental Policy Act.[33] Because neither the tradeoffs between competing uses nor the environmental standards are objective or definitive, managers must make judgment calls. Such judgments are conditioned by politics, budgets, and constituency pressure, to mention a few, all of which may or may not lead to efficiency or environmental quality.

Public choice, however teaches that these incentives must be taken into account in evaluating the actions of politicians and bureaucrats. These incentives result in outcomes that diverge from the public interest as a result of lobbying, log rolling, agency delegation and discretion, executive authority, and litigation. In this political process, benefits are concentrated on special interests while costs are diffused to the general population, and voters remain rationally ignorant, meaning they typically are well informed about narrow issues of concern to them, and ill-informed about broader issues outside their coalition.[34]

A.C. Pigou presaged public choice, noting that "It is not sufficient to contrast the imperfect adjustments of unfettered private enterprise with the best adjustment that economists in their studies can imagine. For we cannot expect that any public authority will attain, or will even whole-heartedly seek, that ideal."[35] He recognized self-interest in politics, saying that the political solutions depends on

> the intellectual competence of the persons who constitute it, the efficacy of the organisation through which their decisions are executed, their personal integrity in the face of bribery and

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31 *See* RANDY T. SIMMONS, BEYOND POLITICS: THE ROOTS OF GOVERNMENT FAILURE 49-54 (2nd ed., 2011).

32 See HOLLY L. FRETWELL, WHO'S MINDING THE FEDERAL ESTATE? (2009), for an excellent discussion of public land management.

33 *C.f.* MICHAEL D. BOWES & JOHN V. KRUTILLA, MULTIPLE-USE MANAGEMENT: THE ECONOMICS OF PUBLIC FORESTLANDS, 21-22, 34 (1989).

34 SIMMONS, *supra* note 31, at 52-54.

35 A.C. PIGOU, THE ECONOMICS OF WELFARE, 247-48 (1920); *see also* STEVEN G. MEDEMA, THE HESITANT HAND: TAMING SELF-INTEREST IN THE HISTORY OF ECONOMIC IDEAS 54-76 (2009) (thoroughly discussing Pigou's understanding of political action).

> blackmail, their freedom from domination by the privileged class, [and] their ability to resist the pressure of powerful interests or of uninstructed opinion.[36]

Optimal regulation and taxation will always be conditioned by political pressures because "[e]very public official is a potential opportunity for some form of self-interest arrayed against the common interest."[37]

On the constituent side of politics, voters and taxpayers are rationally ignorant, meaning that they are not well informed on most issues because the costs of being well informed are high relative to the benefits. Only when the costs of political action are concentrated will they be rationally informed.

In the context of dynamic ecology, there is little reason to expect that politicians, bureaucrats, or constituents will take account of dynamic changes, especially if they require considering consequences beyond the political cycle. Biologists Daniel Botkin and David Challinor capture this problem regarding invasive species.

> Because humans are relatively short-lived and the time scale of their interest is short. In the short run, . . . an invasion's results can be negative, causing the extinction of some native species and the increase of others. However, a period of adjustment follows the initial invasion. . . . Over an even longer time, biological evolution will occur to create new species, thus continuing to increase biological diversity. Because of the long time it generally takes for a new species to evolve, humans cannot witness their genesis, but can only record species extinctions.[38]

As noted above, asset prices in markets will take account of benefits and costs, to be sure discounted for people's time preferences, but politics has no such asset pricing mechanism. To the extent that future values are included in political decisions, the time horizon is likely truncated by the political terms. Given that one legislature cannot bind a future one, the costs and benefits to constituents are also truncated.

Of course, information costs exist for private resource owners, but short political time horizons reduce the incentive to gather information that will account for dynamic changes in the future. Part of the information cost results from having the scientific knowledge for what can be accomplished. Just as an aircraft company must hire aeronautic engineers to determine flight characteristics of an airplane, enviropreneurs or environmental regulators must have scientific knowledge about what can be produced from the natural resource base and about how that base is changing. Making good decisions requires having knowledge about what resources are available, what they can and cannot produce, and what the tradeoffs are among the

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[36] A.C. PIGOU, ECONOMICS IN PRACTICE: SIX LECTURES ON CURRENT ISSUES 125 (1935).

[37] PIGOU, *supra* note 35, at 248.

[38] Daniel B. Botkin & David Challinor, *Biological Invasions*, 80 LE TEMPS STRATEGIQUE 9 (1998).

various production possibilities. For example, enviropreneurs or environmental regulators need to know how much land is available for wolf habitat; how much land is necessary for viable wolf populations; and what the tradeoffs are between wolf habitat and other land uses.

In addition to scientific knowledge, decision makers must have information about the values people place on alternative natural resource uses and about how those values are changing. Accepting that human values are subjective, obtaining the values requires a process wherein people reveal their subjective preferences. In the marketplace, trade requires that people give up something—the opportunity cost—in order to obtain something else. This tradeoff provides an objective way of measuring subjective values, usually in the form of prices measured by the medium of exchange, e.g., dollars.

Hayek recognized that "[t]he economic problem of society is . . . not merely a problem of how to allocate 'given resources' if 'given' is taken to mean given to a single mind which deliberately solves the problem set by these 'data.'"[39] The "use of knowledge in society" requires obtaining information on benefits and costs—information that often is not well known. Prices, generated in markets where people trade well-defined and enforced property rights, produce an objective, even if incomplete, summary of this knowledge.

Political environmentalism is typically agnostic—if not outright hostile—towards economic incentives, profits, and growth. The Endangered Species Act illustrates this perspective: "The Congress finds and declares that various species of fish, wildlife, and plants in the United States have been rendered extinct *as a consequence of economic growth* and development untempered by adequate concern and conservation . . . ."[40] Indeed, to political environmentalists, there is an inescapable tension between economic costs and benefits and environmental quality.

Without prices generated by exchange, politics is the art of providing benefits to one individual or group at the expense of another, wherein those benefiting do not have to compensate those bearing the cost. Little information is gained by asking people what they would be willing to sacrifice to obtain a good, unless they actually have to make the sacrifice. There are the costs of forming coalitions to engage in rent-seeking activities which reflect how much parties are willing to spend for a chance at getting what they want, but, given that costs are diffused, there is no guarantee that the benefits exceed the rent-seeking costs.[41]

Political environmentalism is at the heart of the global warming debate. For the most part, policies begin with the assumption that Earth's

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[39] Hayek, *supra* note 16, at 519-20.

[40] 16 U.S.C. § 1531 (emphasis added).

[41] *See* TERRY L. ANDERSON & GARY D. LIBECAP, ENVIRONMENTAL MARKETS: A PROPERTY RIGHTS APPROACH, ch. 5 (2014).

climate is out of balance due to human action and that there is some ideal temperature to which we must return if we are to reestablish that balance. However, Daniel Botkin asked in his testimony to the House Subcommittee on Science, Space, and Technology, "Has it been warming?"[42] His answer:

> Yes, we have been living through a warming trend, no doubt about that. The rate of change we are experiencing is also not unprecedented, and the "mystery" of the warming "plateau" simply indicates the inherent complexity of our global biosphere. Change is normal, life on Earth is inherently risky; it always has been. The two [IPCC] reports, however, makes it seem that environmental change is apocalyptic and irreversible. It is not.[43]

Such dynamic thinking is missing in virtually all discussions of climate variation. Instead the "balance of climate" mentality persists, promoting mitigation rather than adaptation.

IV. FREE MARKET ENVIRONMENTALISM VERSUS POLITICAL ENVIRONMENTALISM

Political environmentalism tends toward the ideological and the extreme. "We must eliminate water pollution!" manifests itself as the Clean Water Act's National Pollution Discharge Elimination System.[44] Julia "Butterfly" Hill lived in a California Redwood for 738 days in an effort to prevent Pacific Logging Company from cutting it down.[45] Compromise is not part of the mainstream environmental lexicon.

Enviropreneurs may be equally passionate about conservation, but they depart from the political environmentalists in their willingness and ability to negotiate and their creativity in negotiating to achieve conservation results. Wolf reintroduction was not popular among ranchers when it was first proposed, but Hank Fischer and the Defenders of Wildlife addressed the ranchers' opposition by assuming financial responsibility for the wolves and agreeing to compensate the ranchers for livestock losses.[46] This approach was unpopular among the political environmentalists who wanted reintroduction without paying any of the costs, simply because reintroduction was the environmentally "right thing to do." Granted, the wolf reintroduction may well have proceeded without the compensation program, but it likely would have taken longer and been more contentious.

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[42] *Intergovernmental Panel on Climate Change, Hearing Before the Subcomm. on Science, Space, and Technology*, 113th Cong. 2 (2014) (statement of Daniel B. Botkin).

[43] *Id.*

[44] 33 U.S.C. § 1342.

[45] *See Julia Butterfly Hill*, WIKIPEDIA, http://en.wikipedia.org/wiki/Julia_Butterfly_Hill (last visited April 12, 2015).

[46] For a discussion of the wolf reintroduction issue, see ANDERSON & LEAL, *supra* note 29, at 5-6.

The pragmatic, results-oriented nature of environmental entrepreneurship draws its practitioners out of the legislative halls and courtrooms where battles of political environmentalism are fought. For enviropreneurs, the goal is to diffuse or circumvent the environmental "fight" altogether by negotiating voluntary, mutually beneficial conservation agreements that are resilient to legislative repeal and judicial appeal. Rarely do such agreements garner the support of the most vocal and vitriolic extremists on either side of the environmental debate, and rarely do successful enviropreneurs trouble themselves with achieving unanimity.

Enviropreneurs recognize the positive relationship between economic incentives and environmental quality. Whether an enviropreneur is running a for-profit company or a not-for-profit organization, the financial component cannot be ignored. Successful enviropreneurs devise ways to combine sustainability with profitability.

The potential link between dynamic ecology and dynamic economics is illustrated in the debates over climate policy. The 2014 Intergovernmental Panel on Climate Change (IPCC) report, for example, offers some hope for dynamic adaptive thinking. The press release issued before the actual report mentions mitigation only once and adaptation twelve times.

In fact, markets seem to be responding to the prospect of higher temperatures. For example, vintner Matthieu Elzinga moved his vineyard in the Loire Valley of France to an emerging wine region in southern England, a move consistent with scientific predictions that current wine producing areas will decline by 25 to 73 percent by 2050. This prediction prompted the headline *Wine from Wyoming? How Yellowstone and Yukon Will Steal Napa's crown.*[47] John Dickerson, founder of Summit Water Development Group, is putting his money where his mouth is by purchasing and brokering water rights in the American West and Australia in response to his prediction that climate change is causing "the percentage [of water] that is freshwater is getting smaller, [while] the percentage that is salt water is getting larger, and the maldistribution of freshwater is getting much more severe."[48] In his book, *Windfall: The Booming Business of Global Warming*,[49] McKenzie Funk documents dozens of other business ventures including the development of giant water bags to float fresh water across oceans, the construction of sea walls pioneered by the Dutch to keep the sea at bay, and the planting of a Great Green Wall of trees to stop the advance of the Sahara. Mr. Dickson is an entrepreneur who is digesting climate science and acting on it based on his perception of prices. He believes that water is underpriced compared to what he thinks it will be when others recognize

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[47] Steven E.F. Brown, *Wine from Wyoming? How Yellowstone and Yukon Will Steal Napa's Crown*, S.F. BUS. TIMES (Apr. 9, 2013), http://www.bizjournals.com/sanfrancisco/blog/2013/04/wine-from-wyoming-how-yellowstone-and.html?page=all.

[48] MCKENZIE FUNK, WINDFALL: THE BOOMING BUSINESS OF GLOBAL WARMING 119 (2014).

[49] *See generally id.*

the maldistribution of the resource.[50] His actions illustrate the interface between dynamic ecology, in this case the earth's climate, and dynamic economics, in this case water markets.

The task for environmental economists is to deemphasize static equilibrium models and better incorporate dynamic market forces reflected in natural resource asset prices into their thinking. The challenge is to test how well entrepreneurial actions reflect dynamic ecological forces, and where they do not, to carefully examine why property rights institutions fail to accurately reflect changing resource scarcity.

CONCLUSION

Typically, economists think of markets and prices as a way of connecting demanders and suppliers of material goods and services, but they are equally important as a mechanism for connecting human values with the dynamic forces of nature. Prices provide condensed information about human demands, and, if property rights to inputs are clear and transferable, prices provide similar information about the human value of resources in competing uses. When human values for nature's bounty change, entrepreneurs recognize the change and reallocate resources to higher valued uses, profiting in the process. In the context of dynamic ecology, prices speak for Mother Nature.

Entrepreneurship is rewarded for recognizing changes when human demands and nature's supply are in disharmony and for reallocating resources in ways that tend to harmonize the two. Producing more with fewer resources, discovering new sources, and developing technologies that better utilize resources are all tools in the entrepreneur's kit.

In order for dynamic markets to respond to dynamic environments, the right institutions—well-defined, enforced, and transferable property rights—must be in place. If these institutions are lacking, the link between dynamic markets and dynamic ecology is broken. Although such broken links are most often referred to as market failures, in the context of dynamic—Austrian—economics, they are better thought of as entrepreneurial opportunities. If institutional entrepreneurs can overcome the technological, legal, and political transaction costs to facilitate market responses changing human demands and changing natural conditions, they will link dynamic economics and dynamic ecology.

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[50] *See* Brown, *supra* note 47.