Ecological Economics 117 (2015) 244–252

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Extending market allocation to ecosystem services: Moral and practical implications on a full and unequal planet

Joshua Farley [a,b,*], Abdon Schmitt Filho [c], Matthew Burke [a,b], Marigo Farr [a]

[a] Department of Community Development and Applied Economics, University of Vermont, Morrill Hall, Burlington, VT, USA
[b] Gund Institute for Ecological Economics, University of Vermont, 617 Main Street, Burlington, VT 05405, USA
[c] Departamento de Zootecnia e Desenvolvimento Rural, Centro de Ciências Agrárias, Universidade Federal de Santa Catarina, Florianópolis, SC, Brazil

ARTICLE INFO

Article history:
Received 12 March 2013
Received in revised form 16 May 2014
Accepted 27 June 2014
Available online 23 July 2014

Keywords:
Market based instruments
Ecosystem services
Essential resources
Inelastic demand
Income inequality

ABSTRACT

Both economists and conservationists are calling for expanded use of market-based instruments (MBIs) to address worsening environmental problems, but the lack of MBIs at the scale required to solve major global problems makes it difficult to empirically evaluate their effectiveness. This article indirectly evaluates MBIs for essential ecosystem services by examining market allocation of another essential resource that is allocated by markets and which has experienced dramatic price increases: food. In an unequal world, markets respond to price increases by reducing food allocations to the destitute and malnourished, but not for the affluent. MBIs would increase the prices of ecosystem services and the commodities whose production degrades them, forcing the impoverished to reduce consumption by more than the wealthy. Furthermore, most MBIs would be prone to speculation and price instability, be incompatible with the satisfaction of individual preferences, or would not maximize economic surplus. Most environmental problems can be characterized as prisoner's dilemmas, which are best solved through cooperation, not competition. Society must create economic institutions that promote cooperation and ensure that the burdens of reducing throughput are not borne disproportionately by the poor.

1. Introduction

A growing number of studies suggest that the continually expanding human economy threatens potentially catastrophic destabilization of planetary life support functions, with specific threats ranging from climate chaos to the irreversible domination of oceanic ecosystems by jellyfish (Gershwin, 2013; IPCC, 2013; Millennium Ecosystem Assessment, 2005; Rockstrom et al., 2009). If the field of economics is to remain relevant to human society it must acknowledge and address these emerging challenges.

Conventional microeconomics[1] (also known as price theory) has long defined environmental problems as externalities, with the implication that solving these problems requires the internalization of these externalities into the market system via monetary penalties for activities that harm the ecosystem and monetary rewards for activities that benefit it (Baumol and Oates, 1989; Pearce and Turner, 1990; Pigou, 1932). For the purposes of this article, we define a market as an institution in which private sector parties offer goods and services to other private sector parties in voluntary exchange for money. Prices adjust to and balance supply and demand. Market-based instruments (MBIs) are incomplete markets in which the government or some other institution determines supply, demand or price, while the other two are determined through voluntary exchange. With environmental taxes, the government determines a major component of the price, and supply and demand adjust; with cap and trade or cap and auction systems, governments typically determine the supply, and demand and price adjust. In most examples of payments for ecosystem services, governments or other forms of collective action determine the demand and/or the price, and allow supply to adjust.[2] These mechanisms allow individual agents to balance the costs and benefits of a given activity at many different margins (e.g. shifting consumption to substitutes, improving efficiency, and developing new technologies), which in theory can minimize the cost of achieving particular environmental goals.

In recent years both conservationists and economists have been calling for even greater use of MBIs to achieve environmental goals

* Corresponding author at: 205 B. Morrill Hall, University of Vermont, Burlington, VT 05408, USA. Tel.: +1 802 656 2989.

[1] By 'conventional microeconomics', this article refers to neoclassical economic theory as taught in the vast majority of economics programs in the US, Europe, and many other nations. Its core features include the assumptions (i) that economic behavior is driven by individual preferences with the goal of maximizing preference satisfaction, and (ii) that analysis should start from the axiomatic imposition of equilibrium (Arnsperger and Varoufakis, 2006).

[2] In some cases, such as Costa Rica's payment for environmental service program, landowners are essentially compensated for complying with existing law, so there is an element of government-determined supply as well (Daniels et al., 2010).

http://dx.doi.org/10.1016/j.ecolecon.2014.06.021
0921-8009/

(McCauley, 2006; Spash, 2008). One result has been a dramatic surge in payment for ecosystem service schemes (See for example three special issues in Ecological Economics on PES: Engel et al., 2008; Farley and Costanza, 2010; Muradian et al., 2010). Leading academic proponents of these schemes explicitly seek to model them after conventional markets, and argue that private sector initiatives show the greatest success (Engel et al., 2008; Wunder et al., 2008).

However, market-like approaches have also drawn serious criticism. One standard criticism is that many ecosystem services are both non-excludable and non-rival: markets do not function for non-excludable resources, and are inefficient for non-rival ones (Farley and Costanza, 2010; Randall, 1993; Samuelson, 1954). Another major criticism is that MBIs are grossly unfair: the planet's richest inhabitants have done the most harm to the global environment, but MBIs might force the poorest people to reduce their consumption the most. A partial list of other criticisms include the high level of irreducible uncertainty involving natural systems (Faber et al., 1998; Limburg et al., 2002; Vatn, 2005), the argument that nature's values are incommensurable with market values (Martinez-Alier et al., 1998), and the lack of confirmation that MBIs actually work (Pattanayak et al., 2010).

A careful evaluation of the empirical evidence regarding MBIs for ecosystem services would help inform efforts to expand their use. Such an evaluation should include not only conventional economic criteria such as impacts on cost-effectiveness, efficiency and utility, but also fairness: will those who caused the problem pay the costs? The evaluation should also carefully define the criteria so that decision makers can better assess their suitability. However, using MBIs to address major problems like climate change, excessive nitrogen emissions or biodiversity loss will require changes to market signals beyond the scale of past or current experience, which makes empirical evaluation very difficult, especially if responses to price or quantity restrictions are non-linear.

The objective of this paper is to evaluate the potential desirability and effectiveness of MBIs in allocating the most important ecosystem services, defined as those for which there is a high likelihood that beyond some threshold, the marginal loss of the service or of the ecosystem that generates it would have unacceptable impacts on human welfare. Such ecosystem services are essential and non-substitutable, and if an economic instrument is going to allocate any resources correctly, it should be those that are essential. Given the lack of empirical data on MBIs that that have major impacts on essential ecosystem services, we will use as a proxy an essential market resource that has undergone dramatic price increases, and for which there is abundant data on the outcomes: staple foods. We will evaluate these outcomes in terms of market efficiency, utility maximization, and justice, but also assess the desirability of market efficiency as a criterion for allocating essential resources in the presence of extreme income inequality. This approach ignores whether or not it is possible to apply MBIs to ecosystems to focus instead on whether it is desirable. We will therefore also assess the extent to which the physical characteristics of essential ecosystem services affect the ability of MBIs to achieve efficient outcomes, then suggest alternatives to market instruments allocating ecosystem services and other essential resources.

Section two of this paper discusses the economics of essential, non-substitutable resources and describes how they are allocated by markets in an unequal world. Section three explains how the resulting allocations are defined by conventional economists as efficient or optimal, and discusses the desirability of this criterion for essential resources. Section four examines how markets might allocate ecosystem services if market allocation were possible. Analysis in the first sections focuses on the economics of essential resources. Section five in contrast explains how the physical characteristics of ecosystem services pose serious challenges to their market allocation, with the result that MBIs in ecosystem services will not even satisfy the criteria for efficient outcomes discussed in section three. Most environmental problems have the characteristics of prisoner's dilemmas, and solving them requires institutions that promote cooperative and other-interested behaviors (Henrich et al., 2001; Nowak and Highfield, 2011; Sober and Wilson, 1998; Wilson, 2007), not competition and self interest. Section six suggests that rather than trying to force environmental problems into market institutions, we must instead develop economic institutions tailored to the physical characteristics of the environmental problems, the goals society wishes to achieve, and our best understanding of human behavior. Section seven offers some brief conclusions.

2. The Economics of Essential, Non-Substitutable Resources

A resource is essential if humans require it to survive, such as food, water, energy, and life sustaining ecosystem services. Ecosystem services have been defined in numerous ways (Fisher et al., 2008), but we use a definition derived from Georgescu-Roegen's (1971) seminal work, in which he distinguishes between stock-flow and fund-service resources. Stock-flow resources, such as timber, seafood, oil, and water for irrigation, are materially transformed and used up in the act of production. A tree for example is transformed into a house, and oil into work, dissipated heat, greenhouse gasses and particulate matter. We can decide how fast to harvest stock flow resources, and we can stockpile them if we choose to do so. We define stock-flow resources provided by nature as *ecosystem goods*.

A fund-service or fund-flux resource, in contrast, results from a particular configuration of stock-flow resources that interact to generate a flux of services over time. Both labor and built capital are fund-service resources. In the case of natural systems, a particular configuration of plants, animals, water, minerals, atmospheric gasses and so on creates an ecosystem fund that generates a flux of *ecosystem services*. Funds are not materially transformed into the services they generate, but rather are worn out over time. Human made funds can be maintained with a constant flow of stock-flow inputs, while ecosystems continually renew themselves by capturing solar energy. A fund generates services at a rate over time that is determined by the size and health of the fund, and services cannot be stockpiled for later use. For example, a forest is not physically transformed into something else when it regulates water flows, it can regulate a certain maximum flow per hour, and the regulation capacity cannot be stockpiled. By this definition, provisioning services are the reproductive capacity of ecosystems, not the stock of raw materials they contain (Daly and Farley, 2010; Farley and Costanza, 2010; Malghan, 2006).

All economic activity involves the use of energy to transform raw materials into economic products. Many of those raw materials alternatively serve as the structural building blocks of ecosystems funds, and their removal or reconfiguration coupled with waste emissions affects the fund's ability to generate services, including its ability to reproduce. Economic production inevitably affects ecosystem function, and so-called externalities are completely internal to the economic process. This is basic ecological economics.

For a resource to be truly essential, it must be extremely difficult or impossible to obtain a substitute. Many economists argue that ecosystem goods and services are neither essential nor non-substitutable. Several classic publications on essential resources assume that resource scarcity is reflected in rising prices, creating incentives to use the resources more efficiently or develop substitutes (Barnett and Morse, 1963; Dasgupta and Heal, 1974; Solow, 1974)—in which case the resources are not truly essential.[3] A recent review on the economics of scarcity and growth acknowledges that markets often do not exist for the ecosystem services and thus may fail to signal scarcity, but nonetheless the "majority opinion is that even in relatively short periods—years, even months—substitution possibilities obviate resource scarcity" (Simpson et al., 2005, p. 6). At the extreme, some economists have

[3] It is worth noting that both Dasgupta and Heal explicitly acknowledge that human life depends on ecosystem services, and these services are seriously threatened (Dasgupta, 2008; Heal, 2014).