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Methodological and Ideological Options

Inferences from sparse data: An integrated, meta-utility approach to conservation research

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ABSTRACT

Current behavioral research in conservation adoption has been unable to clearly identify the key characteristics of successful adoption. Most conservation studies employ a theory which focuses on one feature (e.g., profits, attitudes, information, norms, or technology). We propose an integrated, three-component framework to model conservation comprising: 1) motives (including stewardship) and meta-utility, 2) firm practices and technology choice, and 3) impacts. We justify this model and compare its use with others in an empirical setting. We build two empirical conservation measures and apply them to a sparse primary data set. Our results show links between the measures and underlying motives—financial and non-financial. We conclude that research and data interpretation using a multiple-motive, integrated framework can improve future research efforts and conservation policy.

1. Introduction

Despite decades of research and billions of dollars of policy efforts, conservation policies have met with mixed success. Losses of soil due to wind and water erosion have declined modestly in recent years but still exceed 1.7 billion tons per year in the US (USDA, 2013). Over 30% of river miles, lake acres and estuary square miles cannot fully support their Clean Water Act designated uses (Heimlich, 2003). While agricultural practices are a major contributor to soil erosion and poor water quality, the environmental impacts of agricultural production practices can differ significantly. Farm operators select practices, and their motives determine the effectiveness of policy and, ultimately, the environmental impacts.

As Reimer et al. (2014) observe current behavioral research in conservation adoption has been unable to clearly identify the key characteristics of successful adoption. Thus, in their meta-analysis, Knowler and Bradshaw (2007) classify a long list of conservation related factors (170) into four major categories and find inconsistent and weak results. They infer that conservation adoption is an idiosyncratic process. Similarly, in their extensive review, Pannell et al. (2006) conclude that adoption "depends on a range of personal, social, cultural and economic factors, as well as on characteristics of the innovation itself." In a meta-analysis of recent empirical work, Baumgart-Getz et al. (2012) examine the effects of 31 social factors and find many potential variables to be insignificant, and where significant, small. They conclude that understanding how effects "fit together" is essential since few stand out.

In response, several recent papers have called for increased effort to create new research directions (e.g., Reimer et al., 2014). Indeed, some scholars have done so. For instance, an emerging literature focuses on the heretofore neglected spatial dimensions of conservation adoption; but spatial models tend to ignore established theories and results and consign non-spatial factors to ad hoc control variables (e.g., Broch et al., 2013). Kabii and Horwitz (2006) offer another approach; they attempt to incorporate the diverse findings of many studies into a single model. However, they introduce a new systems model. In the first case (Broch et al) new components are added, but the old knowledge is set aside; in the second case (Kabii and Horwitz) an integrative model is proposed, but it comes with a completely new paradigm. We believe that success in sorting through the complex and multi-dimensional conservation practice decision problem depends on increasing interdisciplinary conversations through construction of an integrative framework.

In this paper we hope to help remedy two problems: the lack of a framework that facilitates cross discipline communication and research integration, and the constraints on what the data reveals because the use of ad hoc "control" variables reduces the scope for inference. To be transparent we will rely heavily on economic traditions, but we freely incorporate elements of sociological and diffusionist models. There are many precedents for our proposal, and we start with existing models and theories. One economic foundation is standard production economics which very nicely models production technologies. We link the physical and production dimensions to behavior by using a multiple-motive, meta-utility approach. The meta-utility approach facilitates

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the introduction of concepts that do not fit in a traditional economic utility function.

Using this framework, we examine a specific empirical case with limited data. We construct two somewhat innovative empirical conservation measures using primary data. We use these indicators to examine the motives behind adoption of conservation practices and compare the resulting inferences using four different socio-economic paradigms. We argue that researchers employing three standard disciplinary frameworks would find little in this limited data set. However, using the proposed approach we can extract a story, which helps illustrate the power of the proposed integrating framework.

In the remainder of this paper we begin with a short review of the literature on conservation adoption motives. We develop the proposed integrated model of the conservation process. Then, we present two empirical measures of conservation and apply each of the idealized models to interpretation of the data.

2. Related Literature—Motives, Interests and Behavior

We begin with a brief overview of theories of motives for conservation practice adoption including profit, utility, attitudes, and multiple motive or meta-utility models. The profit motive has appeared prominently in economic adoption work since Griliches' (1957, 1958) seminal and influential studies of hybrid corn adoption. Many economic studies suggest conservation practices are adopted when they increase (or do not reduce) profits (e.g., Cary and Wilkinson, 1997; Honlonkou, 2004; and Lichtenberg 2004). In most profit-based empirical studies non-financial factors including demographic characteristics of farmers are included as ad hoc "controls."

One weakness of a purely profit-based theory of technology choice is the implication that producer preferences are homogeneous (Nowak, 1987). Hence, if all producers manage under the same profit motive, we should observe identical producer actions across technically equivalent farms. In fact, we observe that conservation and other farm practices vary substantially over time and across people. Variation may occur because operations differ on technical factors such as weather, soil properties, crop rotations, and agronomic and machinery choice sets. However, even when econometric models incorporate technical factors, results leave considerable unexplained variation in producer practices.[1]

Some researchers explicitly incorporate more heterogeneous agents and non-financial goals. Klonsky et al. (2004) show that farmers can maximize profit and still be land "stewards." Many others incorporate a significant role for stewardship and social motives (e.g., Neill and Lee, 2001, van Kooten et al., 1990). Agricultural producers may be motivated to follow a "way of life," rather than to operate entirely as a profit-maximizing business (Wallace and Clearfield, 1997). Some part of these factors can be formally incorporated into economic models by using a utility framework (e.g., Upadhyay et al., 2003), but they are often ad hoc additions.

Heterogeneity in the rate of technology adoption has been widely recognized in many disciplines, especially since Rogers' seminal book was first published in 1960 (Rogers 2003). In the diffusionist literature people are heterogeneous across information and personality: some individuals adopt new technology early and enthusiastically, while others adopt new technologies reluctantly, after a period of observation and reflection. Adoption of new technology will be spread out over time—as described by the classic innovation adoption S-curve. It has been incorporated in many sociological studies as well as some economic studies of conservation adoption (Bishop et al., 2010; Sheeder and Lynne, 2011).

Historically, economists have shared investigation of agricultural conservation practices with sociologists (Reimer et al., 2014; Pannell et al., 2006). We highlight some social-psychological models of stewardship motives. These studies often employ attitude models (e.g., Maybery et al., 2005; Greiner and Gregg, 2011). The family of theories (Theory of Planned Behavior; Theory of Reasoned Action) founded by Fishbein and Ajzen (1975, 2010) and Ajzen (1988, 1991) underlie most models. Here, intentions are formed when agents have positive attitudes toward an action and believe that others approve or expect them to act in particular ways. While economic models treat the brain as a "black box," attitude theories conceive of mental features as real brain processes. However, attitude theories leave the leap from mental state to action largely unexplained: the theories predict tendencies rather than distinct choices. Recently, economists have begun to explore the "black box;" behavioral, experimental and neuro-economics increasingly reveal the neural and behavioral roots of choice (Glimcher et al., 2008).

Over the last few decades, a number of economists and social psychologists have attempted to explicitly incorporate multiple motives, thereby connecting the profit and utility world of economists with the mental world of other social sciences. Some early examples of use of multiple motives in studies of conservation adoption include the work of Van Kooten et al. (1990), Maybery et al. (2005); Dobbs and Pretty (2004), Upadhyay et al. (2003), and Sinden and King (1990). In this genre, producer motives can be multidimensional and include non-selfish and/or non-consequentialist motives. For example, stewardship may be grounded in a belief in the "rightness" of conservation actions based on social norms. Such a norm-based motive is deontological and non-selfish; hence, not formally compatible with the standard utility model on both counts (Sen, 1977).

Several recent economic studies have developed a multidimensional motive approach and applied it to the conservation adoption decision. One emerging strand of research employs some version of a dual utility, meta-utility or multiple-interests model. A sample of studies includes: Lynne, 1995, 1999, and Lynne, 2002; Lynne et al. 1995; Lynne and Casey 1998; Hayes and Lynne, 2004; Kalinowski et al. 2006; Chouinard et al. 2008; Bishop et al. 2010; and Sheeder and Lynne, 2011. While these models are recent, multi-dimensional utility models can be traced to the foundations of economics. For discussion, see, inter alia, Brennan, 1989, Etzioni, 1986, Lutz, 1993, Sen, 1977.

3. An Integrated Conservation Framework

In this section we describe our integrated model of the conservation process. It has three components: motives (meta-utility), behavior (farm practices) and impacts (farm profits and environmental impacts). The discussion presented here is similar to the model developed in Hayes and Lynne (2004, 2013) and Sheeder and Lynne (2011). However, the Hayes-Lynne-Sheeder model is intended to be a broader reconstruction of economics and contains elements beyond our scope. Our model follows more closely that found in Chouinard et al. (2008). We describe a simple algebraic model for clarity.

We start with behavior—the choice of technology or farm practices, FP, described by a production function. The production technology comprises three vectors of inputs (v, w, z) and two of outputs (Y, E). The three inputs enter production in different ways. Some inputs are used only in conventional practices (v), some are used only in conservation practices (w), and some are used in both types of practices (z). Farm practices generate agricultural outputs, which we summarize as crop yields which generate profits (Y) and environmental effects (E). Some practices may generate negative environmental effects (E_{neg}) (dust, soil erosion, water contamination), while other practices may generate zero or positive environmental amenities (E_A)—such as increased soil quality or open space. Eq. 1

[1] A conventional, but problematic, economic explanation for farmer heterogeneity involves differences in risk attitudes (Marra, Pannell, Ghadim, 2003). See also discussion of farmer heterogeneity in Sheeder and Lynne (2011)