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Evaluating the potential of marketable permits in a framed field experiment: Forest conservation in Nepal

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ABSTRACT

A marketable permits system (MPS) has been deemed effective in laboratory experiments, however, little is known about how the MPS works in the field. We evaluate the MPS efficiency for forest conservation by framed field experiments in Nepal. Forestland demands are elicited from farmers, with which the experiments are carried out. The novelty lies in instituting a uniform price auction (UPA) under trader settings and in identifying the MPS efficiency for forest conservation in the field of developing nations. The results suggest that farmers with limited education understand UPA rules, reveal their forestland valuations and that the MPS is effective with 80% of efficiency.

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Introduction

Economists have long considered a marketable permits system (MPS) to be potentially effective for preservation of environments and natural resources due to the decentralized nature and the price signals of market exchanges (Shogren, 2005).¹ The most important advantage economists claim for the MPS is that it can achieve environmental objectives with the least cost to the society, i.e., efficiency (Field and Field, 2006). Given this positive view of the MPS, extensive studies have been conducted to test theories and examine the performance (Ledyard and Szakaly-Moore, 1994). However, little is still known about how the MPS achieves the efficiencies in the real-world conditions of the field, especially in the context of managing the natural resources of developing nations. Therefore, this research addresses the efficiency of the MPS and to provide an important test for its proposed institution in a framed field experiment.²

Many studies on MPS experiments have been conducted to verify the performance in controlled laboratory settings with various environments and treatments. There are two important dimensions of the experimental designs: (i) the market institution for permit trading, either a double auction (DA) or a uniform price auction (UPA) and (ii) the trader or non-trader settings. The first dimension is concerned with the organization of the price determination mechanism in the permit market. The DA mechanism is a real-time trading institution where agents can submit bids to buy and offers to sell for permits or can accept the best bid and offer made by other agents at any time during trading periods of several minutes.³ Therefore, the DA gives more flexibility to agents in terms of trading strategy.

In comparison, the UPA is simpler because all of the permit trades are made with a uniform price.⁴ First, each agent is asked to submit his or her “bids to buy,” representing the price she is willing to pay for each unit of additional permits, as well as “offers to sell,” representing the price with which she is willing to sell each unit of permits she has. After all the agents submit bids to buy and offers to sell, a central authority collects and ranks all of the bids to buy

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¹ In this paper, the MPS is interchangeably referred to as “tradable property rights” or “transferable development rights.”

² We categorize our experiment as a “framed field experiment” following Harrison and List (2004) and List (2011).

³ Refer to Davis and Holt (1992) for the details of the DAs.

⁴ A UPA is also known as a call market. See Davis and Holt (1992) for further reference.

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Nomenclature

CFUG	community forest user group
DA	double auction
EV	economic valuation
MPS	marketable permits system
NPR	Nepalese rupee
TDR	transferable development rights
TEP	theoretical equilibrium price
UPA	uniform price auction
WEIRD	western, educated, industrialized, rich and democratic
WTP	willingness to pay

from high to low (the demand curve), all of the offers to sell from low to high (the supply curve) and determines the intersection of the demand and supply curves. Specifically, the intersection occurs at the last unit in which the bid to buy exceeds the offer to sell, and the uniform price is the average between the two. The UPA has also been established to achieve high efficiencies and stable price dynamics (Smith et al., 1982; Cason and Plott, 1996).

The second dimension is concerned with whether each agent in a permit market can be both a seller and a buyer or each agent can be only one of these during trading periods. If he (she) can be both, we call the environment a “trader setting,” and if he (she) cannot, the environment is a “non-trader setting” (Ledyard and Szakaly-Moore, 1994). Regarding application of the MPS, the trader setting is known to be closer to real-world conditions. However, a considerable portion of experimental works employ non-trader settings as it simplifies the experimental procedures and reduces the decision complexity for agents.

A majority of previous works has used the DA for experimental studies of the MPS. In particular, works by Plott (1983), Cason et al. (2003) and Kilkenny (2000) have employed the institution under non-trader settings. They report that the average efficiencies observed in the experiments are approximately 98% and that the DA promises greater flexibility and relief from administrative burdens than other schemes, even though instability in the permit's prices is observed. These MPS results are consistent with the high efficiencies achieved under non-trader settings in other DA studies under general settings such as Williams (1980) and Plott and Gray (1990).

Another group of studies, such as Ledyard and Szakaly-Moore (1994), Godby (1997), Muller et al. (2002) and Cason and Gangadharan (2006), also have used the DA but under trader settings. The results of these experiments indicate that the observed efficiencies exhibit higher variations and can be lower on average than the DA experiments under non-trader settings, ranging between 60% and 98%. Furthermore, these works report that the observed prices of permits could be unstable. In summary, the DA under trader settings is more likely to generate lower efficiencies and less stable price dynamics than those under non-trader settings. Some economists argue that agents have more opportunities for speculative trades under trader settings and that this may be the reason for the results (Ledyard and Szakaly-Moore, 1994).

Cason and Plott (1996) have conducted an experiment with the UPA under non-trader settings. The work confirms that the UPA is very efficient in the MPS and induces true revelation of abatement costs for pollution through the bids to buy and offers to sell in the experiments. It is also found that the price dynamics are stable because the UPA is relatively simple and does not offer agents the opportunities of speculative trades in the permit market. In summary, most of the research that has examined the performance of MPS mechanisms has been conducted in controlled laboratory

conditions with induced value frameworks, irrespective of market institutions and of trader or non-trader settings (Muller and Mestelman, 1998; Cason, 2010).

Some MPS markets are operated in the real world, especially in developed countries such as the European union emissions trading scheme, and several empirical studies were conducted to estimate their effectiveness (Ellerman and Montero, 1998, 2007; Montero, 1999; OECD, 2000; Newell et al., 2005; Ellerman et al., 2010; Hahn and Stavins, 2011). However, these empirical studies have not addressed or cannot identify how the market has achieved overall efficiency, i.e., market surplus achieved under the MPS through permit trading. This is due to the fact that each agent or firm in the market never reveals his private information of abatement costs to others, otherwise there is no way for authorities to know the abatement costs. Therefore, there has been no MPS research to explicitly report and compare the efficiency and applicability in the field with those in laboratories.⁵ Furthermore, no previous works evaluate the applicability of the MPS in the field of developing countries where depletion of natural resources such as forests is a more serious concern (FAO Forest Department, 2010, 2015).

Given this paucity, our research question becomes “how does the MPS perform and achieve the overall efficiency in the field of developing nations?” To answer this question, we conduct a framed field experiment of the MPS based on local farmers' valuation for forests and evaluate the overall efficiency and performance of the MPS as applied to forest conservation in the field of Nepal. The setup of our field experiment is in contrast to the laboratory setting with induced value frameworks. More specifically, we have designed a novel setup of framed field experiments that is feasible in developing nations and can be understood by the “real” subjects. We chose Shaktikhor in Nepal as a site because the livelihoods of farmers highly depend on the forest and the farmers can naturally report their valuations of forestry. First, we conducted a survey through which we elicited valuations of local farmers for each unit of forestland, i.e., deriving the demand and supply for forestland as well as for permits.⁶ Second, MPS experiments were carried out with the UPA under trader settings based on the aggregate demand and supply derived in the first stage. These experiments allow for observations of efficiencies, price dynamics and revelation of valuations through bids to buy and offers to sell and enable us to analyze the overall performance of the UPA in the real field.

Subjects in this field experiment were local forest users and farmers who have elementary education. Many of them cannot make some arithmetic calculations, such as a series of summations and subtractions, but they can understand which number is larger when given two different numbers. Thus, they can compare and trade their forest products in their daily life. With these facts in mind, we chose the UPA as a market institution because it is simpler and more intuitive for local farmers regarding how they incur the loss or to reap the benefit from the permit trades, compared to the real-time trading of the DA. We chose a trader setting for our experimental design to reflect the real-life condition of the MPS when applied to natural resource management. Due to the aforementioned arguments, an additional novelty in this research lies in designing a field experiment with real subjects of a developing country in comparison with a standard laboratory experiment of WEIRD subjects as claimed in Henrich et al. (2010).⁷

⁵ Levitt and List (2007) claim that the comparison between fields and laboratory experiments is important for bridging the gap.

⁶ The permits are entitlements for the owners to utilize a single unit of forestland for commercial purposes in a legal way. More detailed explanation for the definition of permits will be given in later sections.

⁷ Henrich et al. (2010) claim that although behavioral scientists publish many research papers of human behavior with samples of population from western, educated, industrialized, rich and democratic (WEIRD) societies as a “standard”

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