



The role of communication on an experimental market for tradable development rights



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ABSTRACT

Tradable development rights (TDR) are discussed as a means of containing urban sprawl in numerous countries. Introducing a novel experimental setting, we simulate a cap & trade TDR scheme and investigate the effects of communication, specifically among competing market participants and within teams of decision-makers. Communication reduces auction prices, leading to substantially less income redistribution from participants to the auctioneer. Nevertheless, no collusion is sustained. Team decision-making reduces overshooting prices and improves the system's efficiency. We interpret these results as emphasizing the efficiency and political feasibility of TDR schemes for economic contexts in which communication among its participants can be assumed.

1. Introduction

Urban sprawl and its adverse ecological consequences have long been addressed by researchers and policy-makers. Among the regulatory options to foster a sustainable land use discussed in recent years, tradable development rights (TDR) are increasingly considered in different countries as a viable instrument achieving reductions in land consumption while allowing for the realization of the most profitable projects (Van der Veen et al., 2010).¹

The application of cap & trade market mechanisms to land use control has primarily been motivated by the scientific discussion and the political implementation of CO₂ emission trading systems in recent decades. Apart from land-take control and urban sprawl reduction, the general cap & trade market mechanism can be applied to a broad range of environmental and other political objectives. Examples include other domains of environmental protection suffering from emission issues (e.g. SO₂ trading schemes) or overconsumption of resources as in the case of tradable water rights (see e.g. Joskow et al., 1998; Ellerman and Buchner, 2007; Convery, 2009a,b; Wrake et al., 2012; Rinaudo et al., 2015; De Vries and Hanley, 2016; Zaeske and Krishnamurthy, 2017).

As with similar market-based instruments, TDR are expected to be

the superior regulatory instrument for implementing constraints on land consumption. Assuming floating prices and an effective system of trading and issuing TDR, planners can reduce land consumption with near-perfect precision while reallocating development rights to the most valuable projects (c.p. Thorsnes and Simons, 1999; for more recent theoretical contributions, see e.g. Nuissl and Schroeter-Schlaack, 2009; Ward, 2013; Vejchodská, 2015).

While this basic theoretical framework underlies all concepts of TDR, the respective national implementations vary. For instance, various different regional and local solutions have been implemented in the US, which encompass single regions with quite heterogeneous land use issues. In those cases, the markets for TDR are clearly defined, regional or local in scope and integrate public and private market participants. By contrast, the German system, as it is currently discussed, would aim at establishing a nation-wide system of TDR with federal authorities defining the cap on land use and municipalities organizing the trading and use of development rights. While several studies have provided surveys on the success and problems of TDR schemes, particularly for the United States (e.g. Kaplowitz et al., 2008; Pruetz and Standridge, 2009; Tan and Beckmann, 2010; Chan and Hou, 2015; Linkous, 2016; Colavitti and Serra, 2017; Linkous, 2017), their ability

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¹ TDR are predominantly discussed by environmental economists and planners in economically developed nations such as Australia (Harman and Choy, 2011), China (Wang et al., 2009), Germany (Henger and Bizer, 2010), Italy (Micelli, 2002; Colavitti and Serra, 2017), the Netherlands (Janssen-Jansen, 2008), Switzerland (Mengini et al., 2015). In Germany, the discussion on TDR has increased following the federal government's commitment to drastically reduce land consumption within the next years; consequently, several large-scale trials for a nation-wide system of TDR have been conducted. The United States, in turn, have been using TDR on a broad scale since the 1970s in more than thirty states (see e.g. Pruetz, 1997 for an overview).

to provide generalizable policy implications for different national and institutional contexts remains limited (Bengston et al., 2004; Kopits et al., 2008).

As a promising complement to these case-study based surveys, it has been suggested to run laboratory experiments investigating more general behavioral patterns and testing specific policy instruments (Greenstone and Gayer, 2009), e.g. for the design of CO₂ cap & trade schemes (c.p. Convery, 2009a,b and Grimm and Ilieva, 2013).² Despite the potential value for improving the design of TDR schemes, few studies capture TDR experimentally; for instance, Henger (2013) compares student and professional TDR trading, while Meub et al. (2016) investigate the resilience of a TDR system against exogenous shocks.

Building on these studies, we argue that the current experimental approaches have an inherent limitation similar to that of theoretical studies, namely the assumption that agents decide autonomously without communicating and potentially coordinating with other agents in the TDR system. This assumption might be unrealistic; indeed, we would suggest that it is unlikely for individuals charged with making land use decisions within a system of TDR to do so in complete isolation from other officials. Rather, it can be expected that they are members of networks at regional, state or national levels, communicate extensively about the decisions taken in the TDR system and build up long-term relationships, thus potentially making arrangements that could distort or improve market outcomes. It is therefore an open question whether communication among participants of a TDR scheme could lead to a failure in the market's capability to efficiently reallocate certificates or even increase the system's efficiency. Both outcomes would have substantial implications for the political feasibility of TDR schemes and the viability of its theoretical assumptions.

To determine the impact of communication, we build on an experimental design simulating a comprehensive TDR scheme, which allows us to measure subjects' reactions to variations of its core parameters. In this experiment, experimental subjects simulate political or private entities buying, trading and using TDR for building projects, which yields individual payoff. There are different types of players, which simulate entities with stronger or weaker market power as well as more or fewer potential building projects. Note that these player specifics are applicable to different possible TDR schemes involving private developers or, as e.g. in the German case, municipalities acquiring and using TDR or mixed institutional settings. Within this experimental setting, we investigate two prominent mechanisms of communication that potentially have a strong impact on the functioning of a TDR mechanism. Firstly, communication among all agents within a TDR market is introduced to determine whether agents establish cooperation – e.g. by collusive behavior in the auction of certificates – during their repeated interaction. Since collusion has been identified as a potential source of inefficiency in CO₂ cap & trade systems (Whitford, 2007; Ehrhart et al., 2008), its prevalence in TDR markets might similarly reduce the system's feasibility. Secondly, we investigate the effects of communication within small groups of participants representing a single agent to determine whether small group decision-making increases the overall efficiency in the TDR market. Numerous experimental studies have shown that intra-group communication leads to more rational decision-making overall (Kugler et al., 2012; Charness and Sutter, 2012). If this finding transfers to TDR Schemes – where extensive communication within organizations responsible for obtaining, trading and using TDR can be assumed – specific problems of TDR systems emphasized in previous experimental studies might be mitigated, such as overshooting prices (e.g. Meub et al., 2016).

² The discussion regarding the application of experimental evidence to the institutional design in different domains of policy-making has been an ongoing debate for several years, with numerous authors arguing for a pragmatic approach of using behavioral evidence as a complement to other forms of empirical and theoretical evidence. For an introduction to the discussion, see e.g. Falk and Fehr (2003), Falk and Heckman (2009), Madrian (2014) and Chetty (2015).

The remainder of this paper is structured as follows. The subsequent section reviews the related literature, before section three explains the experimental design and the underlying theoretical model. Section four presents our findings and section five concludes.

2. Literature review

To date, TDR systems have primarily been considered from a case-study perspective, yielding broad evidence regarding the factors that determine the success of TDR at a regional or local political levels, such as strong demand for additional areas of development or regionally customized receiving areas (Pruetz and Standridge, 2009). The results are quite broad in terms of different political layers of implementation, which range from local to regional. These policy-oriented considerations are based upon a large body of review studies covering fairly heterogeneous implementations of TDR systems, particularly in the United States. Therefore, studies using qualitative indicators (e.g. Santos et al., 2015; Harman et al., 2015; Kaplowitz et al., 2008; Pruetz and Standridge, 2009; Macheimer and Kaplowitz, 2002; Danner, 1997) as well as reviews using quantitative measures (Menghini et al., 2015; Kopits et al., 2008; Lynch and Musser, 2001; Lynch and Lovell, 2003) have been presented. While these studies have led to the identification of several determinants for the successful regional or local implementation of TDR, we argue that these conclusions are necessarily tied to the respective national and institutional contexts.

Complementary to the reviews on local implementations of TDR schemes, laboratory experiments can be used to test specific institutional parameters relevant in the context of land use decisions. Analyzing counterfactual situations with or without a specific regulation (Charness and Fehr, 2015 and Santos, 2011), a limited number of studies have provided initial laboratory evidence. Testing the general applicability of results obtained by observing student participants to land use decisions, Henger (2013) compared the performance of students and regional planners in a TDR scheme, yielding the result that both groups achieve efficient reallocations of development rights overall. Meub et al. (2017a) extend this basic setting and investigate the influence of political business cycles on the efficiency of TDR schemes, pointing to potential distortions in TDR schemes due to politicians' self-serving incentives. Meub et al. (2017b) compare different mechanisms of issuing development rights, finding that auctioning introduces several sources of inefficiency, making grandfathering the superior institutional choice from a welfare perspective. Proeger et al. (2017) have considered the effects of sustained high investment risk, finding that TDR schemes lose efficiency when confronted with higher levels of risk. Finally, Meub et al. (2016) investigate the resilience of a TDR scheme to exogenous economic shocks, finding that the system compensates shocks fairly well.

While several core factors regarding TDR schemes have been investigated in laboratory settings, it is important to emphasize that the experimental designs uniformly assume individual decision-making, excluding interaction among agents. Since this should be considered an overly strict assumption for the study of behavioral patterns in TDR systems, previous results might only insufficiently represent the actual decision situation. Rather, the broad results of economic group research should be taken into account, pointing out that decisions taken by groups are regularly closer to game-theoretically optimal behavior across a wide range of economic contexts (Kugler et al., 2012; Charness and Sutter, 2012). Overall, three distinct reasons are given concerning why groups show superior rationality when compared to subjects in settings of individual decision-making. First, teams have higher cumulated cognitive abilities than individuals, which increases the likelihood of reaching better decisions. Examples of this include the Beauty-Contest game (Kocher and Sutter, 2005), urn experiments on first-order stochastic dominance (Charness et al., 2007) or the Linda Paradox game, involving the correct interpretation of probabilities (Charness et al., 2010). Second, teams anticipate the behavior of other persons

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