Tropentag 2021, hybrid conference
September 15-17, 2021
Conference on International Research on Food Security, Natural Resource Management and Rural Development
organised by the University of Hohenheim, Germany

The role of the Reference point and Time inconsistencies in Farmers' Adoption of Sustainable Soil Practices.

María Eugenia Silva Carrazzone[a*]; Francisco Rosas[b]; Jorge Sellare[a]

[a] Center for Development Research (ZEF), Universität Bonn, Germany.
[b] Universidad ORT, Uruguay.

[*] *Corresponding author email: maria.silvacarrazzone@uni-bonn.de*

Abstract

Agri-environmental policies can make apparent the trade-offs between agricultural production and environmental goals at the farmer level. In particular, soil conservation policies might imply restrictions to soil use, with a negative impact in farmers' incomes in the short term. Thus, the efficiency of soil conservation policies can be affected by farmers' perceptions of gains and losses and their time preferences. Behavioral economics provide meaningful hints on how the agri-environmental policies can be framed to mitigate the trade-offs and improve their efficiency. In this context, this paper aims to assess how the reference point of the Prospect Theory -against which individuals define losses and gains- and their time inconsistencies can contribute to farmers' compliance to soil conservation policies that imply trade-offs. The empirical strategy consists in modelling farmers' behaviors using Positive Mathematical Programming models, as they allow to replicate observed behaviors by calibrating key parameters. This is a novel approach, as most of the papers on decision making consider Expected Utility assumptions and do not incorporate behavioral hints. Models will be built using a unique dataset from the soil use plans submitted by farmers under the soil conservation policy implemented in Uruguay. We expect that this paper contributes to the growing but not extensive literature on behavioral aspects in the agri-environmental realm. If the findings confirm that the reference point and/ or time inconsistencies affected compliance to the policy; this would suggest that behavioral features should be factored in in agri-environmental policies in at least, two ways. First, behavioral characteristics of the regulated should be used to frame agri-environmental policies. Second, the efficiency of alternative policy designs, e.g. based on monetary compensations estimated considering behavioral factors of the regulated, should be evaluated.

Keywords: agri-environmental policies – behavioral factors – reference point – time inconsistencies.

Introduction

Agri-environmental policies can make apparent the trade-offs between agricultural production and environmental goals at the farmer level, as the environmental objectives might become a constrain to agricultural production. Trade-offs between the agricultural outcome and environmental goals can lead to a low uptake -under voluntary schemes- or a low level of

compliance to the regulation -under command-and-control designs. Thus, the trade-offs can undermine the effectiveness of the policy.

In particular, soil conservation policies usually foster less intensive soil uses, in detriment of cash crops, what can lead to a reduction of agricultural income in the short term. However, in the longer term, agricultural productivity should be higher, provided that soils are healthier and better adapted to climate shocks. Therefore, soil conservation policies can mean modifications in land use that are correlated with changes in the magnitude, sign and temporal distribution of economic outcomes. Thus, the efficiency of soil conservation policies can be affected by farmers' perceptions of gains and losses and time preferences.

Behavioral economics provide meaningful hints on how the agri-environmental policies can be framed to mitigate the trade-offs and facilitate their adoption or compliance. However, there is a recognized need to further assess findings from behavioral economics in the agri-environmental field (Palm-Forster et al., 2019). Moreover, the efficiency of public policies can be further improved by incorporating behavioral aspects (Dessart et al., 2019; Palm-Forster et al., 2019).

This paper addresses how farmers' perceptions of gains and losses and their time preferences can be used to harness the implementation of soil conservation policies. These behavioral factors are conceptually framed in the Prospect Theory of decisions under risk (Kahneman & Tversky', 1979; Tversky & Kahneman, 1992) and in the studies of the time inconsistencies in decision making (Frederick & Loewenstein, 2002; Loewenstein & Prelec, 1991, 1992, 1993).

Both the Prospect Theory and studies of time inconsistencies depart from traditional neoclassical assumptions. The Prospect Theory states that individuals make decisions in two stages: first, in the framing stage, they build the prospects of the alternatives by identifying the outcomes and risks; second, in the evaluation stage, the prospects of the alternatives are evaluated based on their framing. In consequence, the framing of the alternatives matters in decision making. The choices are done based on a value function. The outcomes of the alternatives are defined as gains or losses in relation to a reference point. Different framing of the alternatives leads to redefinitions of the reference point and, therefore, to different perception of the gains and losses (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992).

Time preferences are another relevant determinant in decision making. Individuals are not time-consistent in their preferences, as they might vary when measured in different points in time or realms (DellaVigna, 2009; Frederick & Loewenstein, 2002; Hardisty & Weber, 2009). The departures of time preferences from neoclassic assumptions follow different patterns (Frederick & Loewenstein, 2002; Loewenstein & Prelec, 1992; Loewenstein & Prelec, 1993; O'Donoghue & Rabin, 2015). For the purposes of this paper, the Hyperbolic discounting, the Sign effect and the Preference for improving sequences are the more relevant, given how the soil conservation policy affects temporal distribution of agricultural outcomes. Hyperbolic discounting takes place when immediate rewards are preferred over larger gains in the future. The Sign effect occurs when losses are discounted at a lower rate than gains. This means that subjects prefer to suffer a loss in the present instead of postponing it. Finally, Preference for improving sequences operates when the outcomes are framed as a sequence of interrelated events along a defined time horizon. In this case, sequences of outcomes that improve along time are preferred over those that decline.

This paper builds on the case of the soil conservation policy implemented in Uruguay under a command-and-control scheme since 2013. In order to prevent soil erosion, crop farmers must submit a soil use and management plan that results in soil erosion levels below the tolerable

threshold. These plans are the key instrument of the policy, as they contain the crops sequences that farmers aim to implement under the restrictions imposed by the policy.

Against this background, the research questions of this papers are the following:

(i) How did the time in which the policy entered into force operate as a favorable reference point for different types of farmers?

(ii) How did the times inconsistencies of different types of farmers (specifically Hyperbolic discounting, the Sign effect and the Preference for improving sequences) contribute to align soil use decisions with the restrictions imposed by the policy?

Methodology

The empirical strategy consists of modelling farmers' land-use decisions in different scenarios, based on data on soil use at the farmer level for the case of Uruguay.

The modelling will be done using the General Algebraic Modeling System (GAMS). This widely used tool allows building Positive Mathematical Programming (PMP) models, which allow to reproduce an observed situation. The purpose of the model is to understand why agents behave in a certain manner, instead of determining their optimal behavior under the assumption of rational decision making. In consequence, the calibration of the model is a very relevant step in the method. The models will assume a representative agent. To better capture the characteristics of the farmers, the models will be developed for different types of farmers.

The methodology integrates Prospect Theory and time inconsistencies to model decision making, which is a novelty, as most of the papers that model behavior assume the Expected Utility and constant discount rate theoretical frameworks. In addition, models based on PMP have been sparsely used for decision making under risk and uncertainty.

The main source of data for this paper is the soil use and management plans database. This unique dataset reports the soil use decisions submitted in each plan at the farmer level, by harvest season from 2013 to 2021. It will be used in combination with microdata from other Surveys that allow to classify farmers based on their observable characteristics and business model.

For the research question (i), the value function of the Prospect Theory will be calibrated to replicate the soil use decisions made by farmers according to the submitted soil plans. In the alternative scenario, different trajectories for the gross margin- that operates as a reference point- will be simulated. The purpose of this scenario is to compare the resulting soil use decisions between scenarios and assess if deviations from compliance to the policy take place.

For the research question (ii), two different theoretical models will be used, depending on whether the farmers perceive the decisions as a set of independent choices or as a sequence of outcomes. If soil use decisions are treated as independent choices, the behavioral model of intertemporal choice (Loewenstein & Prelec, 1992) is of reference. Based on the Prospect Theory, this model incorporates a time discounting factor on the value function. The time discounting factor will be calibrated to represent the observed situation. Thus, the resulting trajectories of the time discounting factor, by type of farmer, will allow to assess if the relevant time inconsistencies -Hyperbolic discounting and Sign effects- are present. Finally, to test if the choice on soil use is perceived as a decision on sequences, the theoretical model of decumulated utility by Loewenstein & Prelec (1993) will be used, conditional on finding an adequate model specification to be modelled.

Expected outcomes and contributions

We expect this paper to contribute to a growing but not yet extensive literature on the application of the behavioral economics findings in the agri-environmental field. Particularly, the outcomes might shed light on how the behavioral factors behind decision making can enable the acceptance of the trade-offs between the agricultural outcomes and environmental objectives at the farmer level. This could have meaningful impacts in the design of public policies and their efficiency. If we confirm that the reference point and/ or time inconsistencies affected compliance to the policy this would suggest that behavioral characteristics of the regulated should be used to frame agri-environmental policies -in the sense of Kahneman and Tversky. Moreover, based on the research questions assessed in this paper, it could be possible to identify a price threshold at which some farmers become non-compliers. In this case, a policy based in monetary compensations to incentivize compliance could be more efficient from the policymakers' perspective. In addition, the assessment by type of farmer would allow to identify different thresholds for the introduction of monetary incentives. In further studies, more complex systems of compensation to the farmers could be explored. Finally, the paper also makes contributions from the methodological perspective, by modeling famers choices considering the behavioral factors, under the Prospect Theory and time inconsistencies.

References

DellaVigna, Stefano. (2009). "Psychology and Economics: Evidence from the Field." Journal of Economic Literature, 47 (2): 315-72. DOI: 10.1257/jel.47.2.315

Dessart, F. J., Barreiro-Hurlé, J., & van Bavel, R. (2019). Behavioural factors affecting the adoption of sustainable farming practices: A policy-oriented review. *European Review of Agricultural Economics*, *46*(3), 417–471. https://doi.org/10.1093/erae/jbz019

Frederick, S., & Loewenstein, G. (2002). Time Discounting and Time Preference: A Critical Review. *Journal of Economic Literature*, 144.

Hardisty, D. J., & Weber, E. U. (2009). Discounting future green: Money versus the environment. *Journal of Experimental Psychology: General*, *138*(3), 329–340. https://doi.org/10.1037/a0016433

Kahneman, D., & Tversky', A. (1979). *Prospect Theory: An Analysis of Decision under Risk*. 30.

Loewenstein, G. F., & Prelec, D. (1993). Preferences for sequences of outcomes. *Psychological Review, 100*(1), 91–108. https://doi.org/10.1037/0033-295X.100.1.91

Loewenstein, G., & Prelec, D. (1991). *Negative Time Preference*. 7.

Loewenstein, G., & Prelec, D. (1992). ANOMALIES IN INTERTEMPORAL CHOICE: EVIDENCE AND AN INTERPRETATION. *QUARTERLY JOURNAL OF ECONOMICS*, 26.

O'Donoghue, T., & Rabin, M. (2015). Present Bias: Lessons Learned and To Be Learned. *American Economic Review*, *105*(5), 273–279. https://doi.org/10.1257/aer.p20151085

Palm-Forster, L. H., Ferraro, P. J., Janusch, N., Vossler, C. A., & Messer, K. D. (2019). Behavioral and Experimental Agri-Environmental Research: Methodological Challenges, Literature Gaps, and Recommendations. *Environmental and Resource Economics*, *73*(3), 719–742. https://doi.org/10.1007/s10640-019-00342-x

Tversky, A., & Kahneman, D. (1992). *Advances in prospect theory: Cumulative representation of uncertainty*. 27.