AGRICULTURAL UNIVERSITY OF ATHENS
SCHOOL OF APPLIED ECONOMICS & SOCIAL SCIENCES
DEPARTMENT OF AGRICULTURAL ECONOMICS & RURAL DEVELOPMENT

PhD Dissertation

Understanding producers' choices: integrate social psychology and economic rationality into environmentally friendly options

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ABSTRACT

It is commonly accepted among scholars and policymakers that one of the major factors that cause environmental degradation is anthropocentric activity, both in terms of production and consumption. To get a better understanding of human – environment links, advancements from the environmental psychology emphasize the significance of socio-psychological variables on the adoption of various pro-environmental behaviors. However, the majority of current literature on the impact of socio-psychological factors on such behaviors focuses on individuals' (and/or group) choices, whereas producers' pro-environmental choices are usually examined from a profit-maximizing point of view.

Thus, the purpose of this doctoral dissertation is to further contribute to the study of producers' pro-environmental behavior by incorporating elements from the socio-psychological domain. Specifically, by assuming that producers -like any other individual- may exhibit socio-psychological characteristics, and by using the Goal-Framing Theory as a framework, this doctoral dissertation develops two theoretical models that explore producers' responses to external interventions that take the form of economic incentives. Particularly, the first theoretical model explores farmers' choices on organic input use, when vertical integration (i.e., farmers can produce organic fertilizer by themselves) is an option as well. In this model, two payment vehicles are examined, namely price premiums paid by consumers, and a land subsidy offered by the social planner. The second theoretical model studies firms' abatement choices, under the assumptions (a) the market is competitive, (b) firms may exhibit altruistic considerations and a propensity to act accordingly, (c) a social planner imposes an emission tax.

The most important findings highlighted by these two theoretical models can be summarized as follows. The first model stresses that farmers may respond differently to price premiums compared to land subsidies. Specifically, the analysis presented here indicates that land subsidies trigger a trade-off between input use and vertical integration. On the contrary, such a situation does not necessarily emerge under price premiums. Thus, the policy implication is that when the social planner wants to increase both organic input use and vertical integration, then no intervention is necessary. The market through its price system can achieve the desirable outcome. Secondly, the second theoretical model points that emission taxes do not necessarily induce abatement. Given that firms may exhibit both altruistic values and a propensity to behave altruistically, the impact of an emission tax on firms’ abatement choices depends on the “sensitivity” of firms’ propensity to act altruistically as an emission tax is imposed. The policy implication is twofold. First, optimal emission taxes may be lower than the traditional Pigouvian one. Second, it might be of policy maker’s interest to implement a differentiated emission tax scheme instead of a uniform one, as firms are heterogenous both on their altruistic concerns and -most importantly- on the formation of their propensity for altruistic actions.

Finally, the present doctoral dissertation concludes by also stressing the policy relevance of the empirical support of the theoretical results obtained by the two theoretical models. This will lead policymakers to a better integration of producers’ socio-psychological characteristics into the design of financial (and non-financial) policy measures towards environmental targets, eliminating the likelihood of such policy measures to backfire.

Scientific areas: Microeconomic theory

Keywords: producers’ behavior, intrinsic and extrinsic motivation, economic incentives, goal-framing theory, pro-environmental behavior

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Τμήμα Αγροτικής Οικονομίας και Ανάπτυξης
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ΠΕΡΙΛΗΨΗ

Στην εποχή μας, είναι γενικά αποδεκτό ότι η ανθρώπινη δραστηριότητα, μέσω της παραγωγής και της κατανάλωσης αγαθών και υπηρεσιών, έχει σημαντικές επιπτώσεις στις αλλαγές του κλίματος και στη βιωσιμότητα του φυσικού κεφαλαίου. Στα πλαίσια της βαθύτερης κατανόησης της σχέσης μεταξύ της ανθρώπινης συμπεριφοράς και της προστασίας του περιβάλλοντος, τα επιτεύγματα από τον κλάδο της περιβαλλοντικής ψυχολογίας μας επισημαίνουν τη σημασία των κοινωνικών και ψυχολογικών παραγόντων ως προς την υιοθέτηση φιλικών προς το περιβάλλον συμπεριφορών. Εντούτοις, η πλειονότητα των ερευνών αυτών εστιάζει στις προθέσεις και στη συμπεριφορά των ατόμων, τόσο σε ατομικό όσο σε συλλογικό επίπεδο. Αντίθετα, η βιβλιογραφία ως προς τη σχέση μεταξύ κοινωνικό-ψυχολογικών μεταβλητών και τον τρόπο παραγωγής αγαθών και υπηρεσιών είναι περιορισμένη.

Η παρούσα διδακτορική διατριβή έχει σκοπό να ενισχύσει την υπάρχουσα βιβλιογραφία ως προς τον τρόπο λήψης αποφάσεων των παραγωγών. Συγκεκριμένα, υιοθετώντας την παραδοχή ότι οι παραγωγοί, ως άτομα, διαθέτουν ένα σύνολο κοινωνικών και ψυχολογικών χαρακτηριστικών και επιπλέον, βασιζόμενοι στη Θεωρία της Πλαισίωσης Στόχων (Goal-Framing Theory), η παρούσα διδακτορική διατριβή αναπτύσσει δυο θεωρητικά μοντέλα τα οποία εξετάζουν τις αποφάσεις των παραγωγών, υπό την ύπαρξη (εξωτερικών) οικονομικών κινήτρων. Πιο αναλυτικά, στο πρώτο θεωρητικό μοντέλο παρουσιάζονται οι αποφάσεις των παραγωγών - γεωργών ως προς την ποσότητα βιολογικού λιπάσματος για τη παραγωγή βιολογικών προϊόντων, υπό την υπόθεση ότι οι παραγωγοί έχουν τη δυνατότητα να παράγουν οι ίδιοι το βιολογικό λίπασμα. Στο μοντέλο αυτό θεωρούμε ότι τα οικονομικά κίνητρα έχουν τη μορφή μιας ανά εκτάριο επιδότησης που προσφέρεται από ένα σχεδιαστή περιβαλλοντικής πολιτικής, και μια υψηλότερης τιμής (price premium) που είναι διατεθειμένοι να πληρώσουν οι καταναλωτές για την αγορά βιολογικών προϊόντων. Στο δεύτερο θεωρητικό μοντέλο εξερευνάται η συμπεριφορά των επιχειρήσεων, που δραστηριοποιούνται σε συνθήκες τέλειου ανταγωνισμού, ως προς το επίπεδο υιοθέτησης τεχνολογίας για τη μείωσης της ρύπανσης. Στο μοντέλο αυτό, το οικονομικό κίνητρο έχει τη μορφή ενός φόρου επί των εκπομπών ρύπων, ο οποίος επιβάλλεται από ένα σχεδιαστή περιβαλλοντικής πολιτικής.

Τα σημαντικότερα αποτελέσματα που προκύπτουν από την ανάπτυξη των δυο αυτών μοντέλων είναι περιληπτικά τα ακόλουθα. Αρχικά, οι επιπτώσεις μιας υψηλότερης τιμής στην αγορά

βιολογικών προϊόντων στις αποφάσεις ενός παραγωγού – γεωργού ως προς την χρήση βιολογικού λιπάσματος και ως προς τον βαθμό παραγωγής του λιπάσματος αυτού από τον ίδιο διαφοροποιούνται από τις επιπτώσεις που έχει μιας ανά εκτάριο επιδότησης στις εν λόγο αποφάσεις. Συγκεκριμένα, μια ανά εκτάριο επιδότηση θα δημιουργεί πάντα μια σχέση ανταλλαγής μεταξύ της ποσότητας χρήσης βιολογικού λιπάσματος και του βαθμού παραγωγής του λιπάσματος αυτού από τον ίδιο τον παραγωγό - γεωργό. Αντίθετα, κάτι τέτοιο μπορεί να μη συμβαίνει στην περίπτωση που οι καταναλωτές είναι διατεθειμένοι να πληρώσουν μια υψηλότερη τιμή για την αγορά βιολογικών προϊόντων. Συνεπώς, στη περίπτωση που ένας σχεδιαστής περιβαλλοντικής πολιτικής ενδιαφέρεται να αυξήσει τόσο τη παραγωγή βιολογικών προϊόντων όσο και το βαθμό παραγωγής του βιολογικού λιπάσματος από τον ίδιο τον παραγωγό – γεωργό, έχει συμφέρον να μη παρέμβει μέσω της προσφοράς μια ανά εκτάριο επιδότησης και αντ' αυτού, να αφήσει την αγορά μέσω του μηχανισμού των τιμών να «κάνει τη δουλειά της». Επιπλέον, η ύπαρξη φόρου επί των εκπομπών ρύπων δε οδηγεί απαραίτητα τις επιχειρήσεις στην εφαρμογή τεχνολογίας μείωσης ρύπων. Υπό την υπόθεση ότι μια επιχείρηση χαρακτηρίζεται από αλτρουισμό, οι επιπτώσεις ενός περιβαλλοντικού φόρου στο επίπεδο μείωσης της ρύπανσης εξαρτάται από το πόσο ο φόρος αυτός επηρεάζει μια επιχείρηση στο να συμπεριφερθεί αλτρουιστικά. Συνέπεια του αποτελέσματος αυτού είναι ότι ένας φόρος που στοχεύει στο κοινωνικά άριστο επίπεδο μείωσης της ρύπανσης να διαφοροποιείται από τον παραδοσιακό φόρο Πιγκού. Τέλος, δεδομένης της ετερογένειας των επιχειρήσεων ως προς τον βαθμό αλτρουισμού, το μοντέλο που αναπτύσσεται στη παρούσα διδακτορική διατριβή τονίζει τη σημασία που έχει η εφαρμογή διαφοροποιημένων περιβαλλοντικών φόρων έναντι ενός ενιαίου φόρου επί των εκπομπών ρύπων.

Κλείνοντας, η παρούσα διδακτορική διατριβή τονίζει τη σημασία που έχει η εμπειρική επαλήθευση των θεωρητικών πορισμάτων που προκύπτουν από τα δυο αυτά θεωρητικά μοντέλα, προκειμένου οι υπεύθυνοι σχεδίασης περιβαλλοντικής πολιτικής να οδηγηθούν στη σχεδίαση οικονομικών και μη εργαλείων που θα είναι σε συνέπεια με έναν ρεαλιστικό και όχι κανονιστικό τρόπο που οι παραγωγοί λαμβάνουν τις αποφάσεις τους.

Ερευνητική περιοχή: Μικροοικονομική θεωρία

Λέξεις κλειδιά: συμπεριφορά παραγωγού, ενδογενή και εξωγενή κίνητρα, οικονομικά κίνητρα, θεωρία πλαισίωσης στόχων, φιλό-περιβαλλοντική συμπεριφορά

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INTRODUCTION

1. Dissertation's Description

1.1. The Scope

During the last decades, humanity has experienced many environmental catastrophes (e.g., floods, wildfires, ice melting, etc.) that yielded losses of environmental diversity. One of the most important determinants of the magnitude of these environmental catastrophes can be attributed to the climate change (Williams et al., 2003; Lloyd and Shepherd, 2020) due to the extensive anthropocentric activities. [(1)] In the light of these evidence, many scholars have advocated the need for developing theories and tools that can overcome environmental-related challenges, like climate changes mitigation, natural resource management, wild species protection, etc. (e.g., Brundtland, 1987; Flannery, 2009; Farrens, 2010; Scovronick et al., 2015).

1: That is, changes on the consumption and production patterns in the food, energy and other commodities, changes on the means of transport, etc.

Environmental economics is the sub-field of the economic discipline that deals with environmental issues by incorporating tools and methodologies from the economic theory. In its classical prescription lies the assumption of homo economicus agents. [(2)] However, there is a class of environmental problems (e.g., management of common pool resources, recycling, etc.) for which agents' behavior may deviate significantly from that description. Behavioral economics has been emerged from that need of understanding these deviations and, to explain agents' behavior in a more realistic manner, by incorporating elements form (social, cognitive, etc.) psychology. Thus, from a behavioral economics perspective deviations of agents' pro-environmental behavior can be explained by the concepts of (i) altruism, (ii) reciprocal fairness (i.e., reciprocity), (iii) social and personal norms and (iv) intrinsic motivation (Frey and Stutzer, 2008).

2: That is, agents are assumed to behave in a rational, pure self-interest manner. Specifically, consumers and producers are assumed to be utility and profit maximizers, respectively.

Furthermore, environmental psychology theories also developed for the better understanding of the link between environmental conservation and human actions. Among them, the theory of reasoned action (Fishbein, 1979) and -its descendant- the theory of planned behavior (Ajzen, 1991), the norm activation theory (Schwartz, 1977) and the value-belief-norm theory (Stern et al., 1999) have received the most attention. Only recently, Lindenberg and his colleagues (Lindenberg, 2001; Lindenberg and Steg, 2007; 2013; Steg, 2016; Steg et al., 2016) developed the goal-framing theory which can be seen as an integrated framework of the previously mentioned psychological theories. [3]

3: Chapters 2 - 6 briefly present these theories and how they can contribute on our understanding on human pro-environmental behavior.

There is a burgeoning empirical literature that supports these psychological theories. However, previous research has almost exclusively focused on individuals' pro-environmental behavior, like car use (Bamberg and Schmidt, 2003; Eriksson et al., 2006), use of unbleached paper and energy-saving light bulbs (Harland et al., 1999), consumption of "green" products (Paul et al., 2016; Shin et al., 2018), recycling (Tonglet et al., 2004), energy sources at a household level (Fornara et al., 2016), water conservation (W. Trumbo, 2001; Kumar Chaudhary et al., 2017), etc. Only recently researchers have expressed an interest on exploring the socio-psychological factors that determine producers' choices (Fielding et al., 2008; Howley, 2015; Senger et al., 2017; Tama et al., 2021) as well, even though the idea that producers may determine their choices in a non-self-interest fashion dates back to '60s (Leibenstein, 1966).

Thus, the purpose of this dissertation is to contribute to the current literature on producers' pro-environmental behavior by incorporating elements from recent advancements on the socio-psychological and behavioral economics domain. The rationale is that production choices are usually made by people (or by a group of people) who are likely to exhibit social and psychological characteristics, like altruistic preferences, a feeling to behave morally, preferences to comply with social (pro-environmental) norms etc. Consequently, it is reasonable to treat producers not as a pure profit-maximizers, but rather as individuals that take into consideration nonpecuniary factors when they determine their production choices. Such a formalization will enable policymakers to (a) understand in a more realistic context the consequences of their policy interventions on producers' behavior and (b) to design in a more efficient way policy measures upon environmental targets.

1.2. Methodology

In the core of this dissertation lies the assumption that producers' -like any other individual- exhibit various socio-psychological characteristics, that interplay with external situational factors in a non-monotonic fashion.

In particular, two theoretical model are developed that seek to explore producers' responses to external economic incentives for conservation. In the first one (chapter 7), this dissertation presents the impact of both land subsidies and price premiums on farmers' choices on organic input use, when vertical integration is also an option. In the second one (chapter 8), firms' abatement choices are also explored when emission taxes are imposed by a social planner.

Both these two models draw heavily on the Goal-Framing Theory (see chapter 6). The rationale of relying on GFT is that it encompasses overarching goals as the psychological mechanism that capture the dynamics of producers' choices in two dimensions. First, GFT integrates the concepts of values, norms, and self-interest motives that are present in the TPB, NAM and VBN theories in a solid manner (Steg et al., 2013; Steg, 2016). Second, the concept of overarching goals may explain in a more consistent way the behavior of producers, than the Motivation Crowding Theory (thereafter, MCT) (Frey, 1994; Frey and Jegen, 2001) proposes. Specifically, MCT argues that positive and negative economic incentives may affect differently individuals' sense of autonomy and/or their reciprocity, yielding different crowding effects. On the contrary, GFT does not make such a distinction, but rather it proposes that economic incentives alter the centrality (or focality) of producers' overarching goals by framing the gain-related aspects of a choice. We believe that such a rationale finds closer resemblance in the production rather than in a consumption domain and hence, GFT seems to be a more appropriate framework than MCT to explore production choices.

1.3. The Structure

The structure of this dissertation is as follow. Chapters 2 - 6 briefly review the most prominent theories on explaining pro-environmental behavior that draw for the (environmental) psychology domain. Specifically, chapter 2 presents the Theory of Planned Behavior, chapter 3 the Norm Activation Model, chapter 4 the Value-Belief-Norm Theory, chapter 5 the Motivation Crowding Theory and lastly, chapter 6 the Goal-Framing Theory.

Moreover, chapters 7 - 8 present the two theoretical models on production choices. Specifically, chapter 7 explores farmers' organic input choices when vertical integration is an option as well, whereas chapter 8 explores firms' abatement choices.

Finally, chapter 9 summarizes and illustrates areas for future research.

1.4. Acknowledgements

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THEORIES ON PRO-ENVIRONMENTAL BEHAVIOR

2. The Theory of Planned Behavior

2.1. Introduction

The Theory of Planned Behavior (TPB) developed by Ajzen (1991) as an extension of the Theory of Reasoned Action (TRA) (Fishbein, 1979). In the core of TRA lies the assumption that human pro-environmental behavior can be explained by their intentions, i.e., their willingness to engage in a specific (pro-environmental) behavior. According to TRA, human intentions are formed by *attitudes* and *subjective (social) norms*.

Specifically, Steg and Nordlund (2018) define attitudes as the extent to which engaging in a specific behavior is evaluated positively or negatively. Attitudes are based on the weighted costs and benefits of a behavior, where weights reflect the perceived importance been applied by an individual to the aspects of the behavior in question. [4] Furthermore, Steg and Nordlund (2018) define subjective (social) norm as someone's beliefs on whether (important) others will approve or disapprove a specific behavior and also, how willing is someone to comply with these beliefs. [5], [6]

TBP extends the aforementioned framework by introducing a third factor, namely *perceived behavioral control*, which refers to someone's perceived ability to perform the behavior in question (Ajzen, 1991). The TPB assumes that perceived behavior control affects behavior both directly and indirectly, by affecting someone's intentions for that behavior. [7] Furthermore, the impact of socio-demographic characteristics, values, etc. on behavior is also assumed to be indirect via intentions. For instance, strong altruistic values may enhance someone's subjective (social) norm in favor of recycling. Fig 2.1

4: For example, one can consider the case of organic tomatoes. A person thinks that an organic tomato has better taste, is more colorful and it is healthier, and she considers these aspects as not too important. On the contrary, she thinks organic tomatoes are expensive, and considers this aspect as highly important. This will result in an overall negative attitude towards the consumption of organic tomatoes, as the weighted costs exceed the weighted benefits.

5: Schwartz and Howard (1982) refer to subjective social norms as perceived social norms, whereas Thøgersen (2006) treats subjective social norms as a subset of the injunctive norms.

6: For instance, recycling is classified as a favorable subjective social norm if a person not only believes that others approve recycling but also, she cares for their

7: For example, an indirect impact of the perceived behavioral control on cycling is that someone may believe that she is not fit enough for cycling, decreasing her intentions to cycle. On the contrary, a direct impact if someone knows that the road has been seriously damage, making cycling impossible.

illustrates the TPB framework.

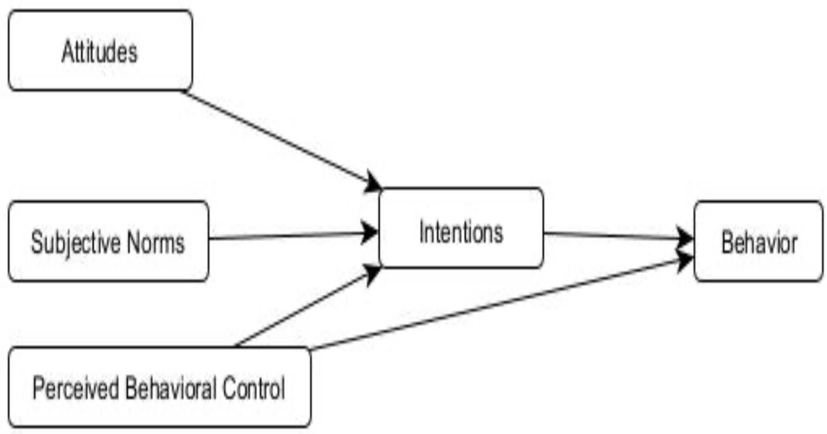

Fig 2.1: The TPB framework adapted by Steg and Nordlund (2018).

2.2. The TPB and Pro-Environmental Behavior

At the individual level, the TPB has successfully managed to explain many pro-environmental behaviors, including but not limited to the use of unbleached paper and energy-saving light bulbs (Harland et al., 1999), alternative means of transport (e.g., cycling (Muñoz et al., 2016)), electronic waste recycling (Echegaray and Hansstein, 2017), water (Lam, 2006) and energy conservation (Allen and Marquart-Pyatt, 2018), carbon consumption (Jiang et al., 2019), and many more (Gkargkavouzi et al., 2019). (8)

Research also exists on whether the TPB can explain production choices. For instance, Borges et al. (2014) explore the role of attitudes, subjective (social) norms and perceived behavioral control on the adoption of natural grassland. They conclude that all these three psychological constructs are positively and significantly correlated with farmers' intention to use improved natural grassland. Similarly, Senger et al. (2017) found that the TPB can explain farmers' intentions for diversifying their agricultural production. Finally, Bagheri et al. (2019) use the TPB to explore farmers' intentions on the adoption of pesticides for agricultural purposes. They conclude that the knowledge of pesticide hazard and moral norms are important determinant of farmers' intention on the pesticide use, by affecting their perceived behavioral control. Thus, they argue that the validity of the TPB can be improved by incorporating additional psychological constructs, like personal/moral norms, into the TPB framework. (9)

8: Yuriev et al. (2020) present a literature review on the use of TBP as the theoretical framework for explaining pro-environmental behavior. According to their research, the most frequent pro-environmental behaviors explained by TPB are related to modes of transportation, recycling and energy conservation.

Despite its usefulness, the TPB suffer from important limitations. For instance, Yuriev et al. (2020) stress that: (i) the TPB is inappropriate once mutli pro-environmental behaviors are under question; (ii) the outcome of TPB studies are difficult to be extrapolated, because questionnaires are designed with a specific (target) population in mind; (iii) there might be situations where the core assumptions of the TPB framework are violated, e.g., beliefs may directly influence behavior and not indirectly via intentions; (iv) responses to TPB-studies may be biased and hence, increasing the intention-behavior gap.

9: Such an argument is supported by many scholars as well. For instance, Yuriev et al. (2020) point that the most frequent additional constructs in the TPB are moral norms, past behavior, self-identity, habit, self-efficacy, anticipated emotions, environmental awareness, environmental values, sense of community, socio-

3. The Norm Activation Model

3.1. Introduction

The Norm Activation Model (NAM) introduced by Schwartz (1977) and his colleague (Schwartz and Howard, 1982) as an attempt to explain pro-environmental behaviors that are associated with high (monetary) costs and effort. In such cases, NAM proposes that individuals may behave pro-environmentally if they believe that acting in such a way is also their moral obligation, i.e., their personal norm.

In the core of NAM lies the assumption of personal norm activation, which finds close resemblance with the focus theory of normative conduct (Cialdini et al., 1991). [(10)] That is, moral obligation can motivate individuals to a specific pro-environmental behavior if their feeling to behave morally is activated, i.e., becomes focal. NAN argues that there are four factors that can activate personal norms: (i) *problem awareness*, (ii) *ascription of responsibility*, (iii) *outcome efficacy* and (iv) *self-efficacy* (similar to perceived behavioral control) (Steg and Nordlund, 2018). For instance, a personal norm is stronger when someone knows that a specific behavior causes environmental damage (problem awareness), she feels personally responsible for that damage (ascription of responsibility), she believes that by adopting a pro-environmental behavior can decrease the environmental problems (outcome efficacy) and also, she is able to engage in a specific pro-environmental behavior (self-efficacy). Fig 3.1 illustrates a sematic representation of the Norm Activation Model.

10: In the environmental domain, Cialdini et al. (1990) explore the influence of two types of the anti-littering norm -descriptive and injunctive- on reducing littering in public places.

The argument that different types of norms affect differently a specific (pro-environmental) behavior is supported by many scholars (e.g., Kallgren et al. (2000), Niemiec et al. (2020) and Thøgersen

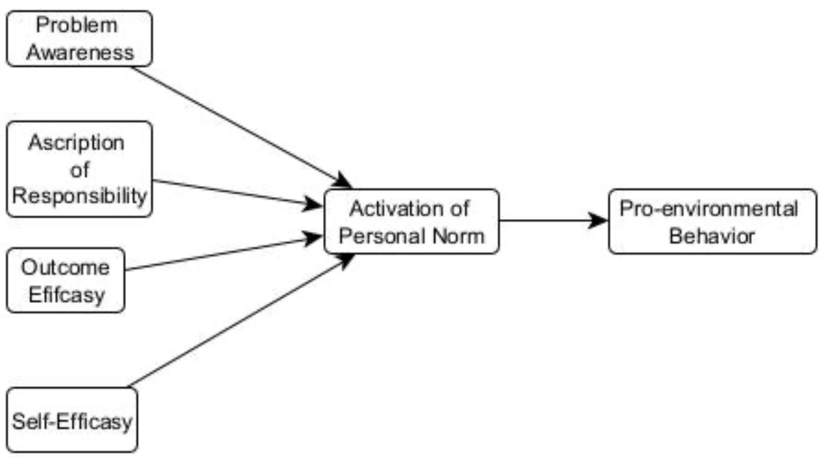

Fig 3.1: A sematic representation of the NAM model, inspired by Steg and Nordlund (2018).

3.2. The NAM and Pro-Environmental Behavior

The Norm Activation Model has successfully been applied in many pro-environmental domains, like energy conservation (Tyler et al., 1982; Black et al., 1985; van der Werff and Steg, 2015), willingness to pay for an improved environmental quality (Guagnano et al., 1994; Guagnano, 2001), recycling (Hopper and Nielsen, 1991; Bratt, 1999) and other pro-environmental behaviors (Nordlund and Garvill, 2002; Schultz et al., 2005).

However, the literature on the explanatory power of the NAM on production choices is limited. For instance, Rezaei et al. (2019) use an TPB-NAM integrated framework in order to explore farmers' integrated pest management choices. They conclude that personal norms can explain farmers' intentions towards the adoption of integrate pest management practices and additionally, they point that a TPB-NAM framework has greater explanatory power than TPB itself. Furthermore, Savari et al. (2021) implement an extended version of the NAM framework in order to study water consumption among farmers. They found that awareness of consequences and need, situational responsibility, outcome efficacy, self-efficacy, denial of responsibility, personal norm, pride and guild emotion had significant effects on farmers' water use, with the environmental concern being the most important factor. Moreover, Dalvi-Esfahani et al. (2017) adopt the NAM framework in order to investigate managers' intentions on the implementation of a "green" information system. [11] They conclude that mangers' morality explains managers' intentions on the adoption of a "green" information system, even though personal norm itself mediates the influence of the problem awareness and the ascription of responsibility. Finally, they also found that managers' focus on self-transcendence express stronger intentions to adopt a "green" information system.

11: Specifically, they study whether the constructs of the NAM can explain managers' intentions on the adoption of a green information system and, whether managers' value orientation moderates the impact of these constructs.

Similarly to the TPB, the NAM framework also characterized by important limitations. Particularly, (Tyler et al., 1982) stress that NAM can successfully explain pro-environmental behavior when the required actions entail low personal -for an individual- costs. Furthermore, Black et al. (1985) point that the predictive power of NAM is mediated by the nature of an action itself (e.g., constrained versus unconstrained actions). Moreover, Guagnano et al. (1994) explore individuals' stated willingness to pay for environmental protection. They conclude that the NAM can explain individuals' stated (or self-reported) WTP for environmental quality as long as the payment vehicle is not framed as (environmental) tax. Thus, the effectiveness of the NAM might be conditional on the type of the payment vehicle in question.

4. The Value-Belief-Norm Theory

4.1. Introduction

In the previous chapter we have mentioned that the NAM framework consists of four factors that influence individuals' morality (i.e., personal norm), which in turn it influences their pro-environmental behavior (see, Fig. 3.1). This type of the NAM can be interpreted as a "moderator model" (De Groot and Steg, 2009). However, the NAM can also be interpreted as a "mediator model", in which there is a causal relationship between these four constructs (De Groot and Steg, 2009). Fig. 4.1 illustrates these two interpretations of the NAM (by excluding outcome efficacy and self-efficacy).

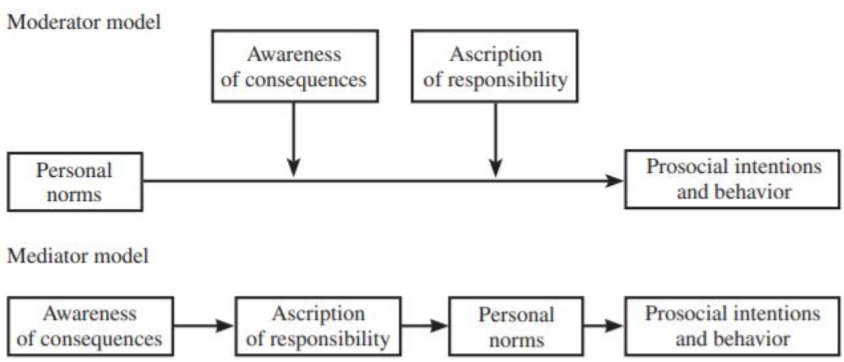

Fig. 4.1: The NAM framework as a moderator and mediator model, adapted by De Groot and Steg (2009).

The Value-Belief-Norm theory (VBN) (Stern et al., 1999) is an extension of the NAM framework that focus on the causal relationship between NAM's constructs and also, it incorporates values and ecological worldviews (12) as a key factors that influence problem awareness (or awareness of consequences). Fig. 4.2 illustrates the VBN theory.

12: Here, values refer to trans-situational goals that guide the life of a person (or any other social entity) (Steg and Nordlund, 2018).

In addition, ecological worldviews refer to beliefs regarding people's ability to disturb the balance of nature, the existence of limits of growth, and rejecting people's right to rule over flora and fauna (Steg and Nordlund, 2018).

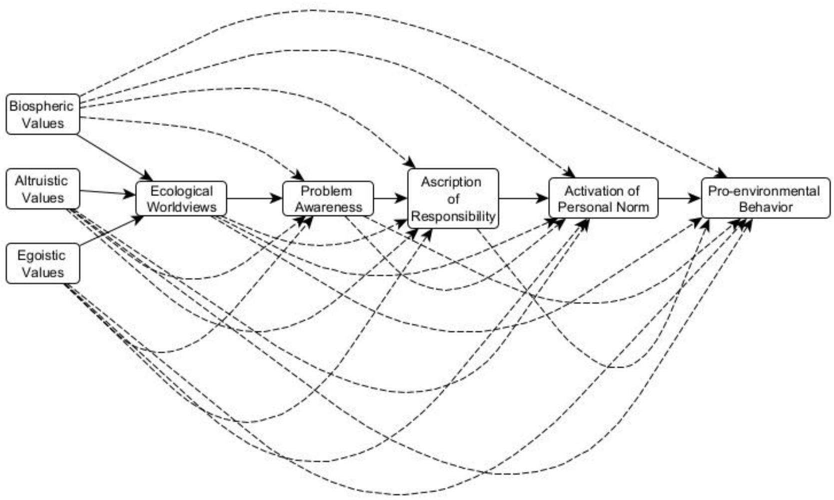

Fig 4.2: A representation of the VBN theory, adapted by Stern et al. (1999).

The VBN argues that both biospheric and altruistic values positively affect someone's ecological worldviews, whereas the impact of egoistic values on them is negative. In addition, it stresses that each factor in the causal chain is related to the next one (straight lines), even though a direct -but weaker- relationship may exists between factors further down on the causal chain (dotted lines, e.g., ecological worldviews may directly influence someone's moral obligation). This structural character of the VBN theory has been empirically supported (Steg et al., 2005; Jakovcevic and Steg, 2013; Chen, 2015).

4.2. The VBN Theory and Pro-Environmental Behavior

Similarly to the NAM framework, the VBN theory has successfully managed to explain low cost pro-environmental behaviors. For instance, the VBN framework has been used to study individuals' intentions to protect marine areas (Wynveen et al., 2015) and national parks (Van Riper and Kyle, 2014; Sharma and Gupta, 2020), on sustainable transportation choices (Eriksson et al., 2006; Lind et al., 2015), on energy use (Fornara et al., 2016; van der Werff and Steg, 2016) and general pro-environmental behaviors (Stern et al., 1999; Ghazali et al., 2019).

Notably, research exists on the extent to which the elements of the VBN can explain producers' pro-environmental choices. Rezaei-Moghaddam et al. (2020) utilize the VBN theory to explore farmers' intentions on the adoption of clean technology of local rich compost. Their study reveals that the most pro-environmental behavior among farmers was environmental activism and particularly, the support of organizations in promoting compost use. In addition, their study stresses that self-efficacy (i.e., perceived behavioral control), social and personal norms, and extension education have the most significant impact of farmers’ intentions on continuing producing local rich compost. Furthermore, Zhang et al. (2020) compare the predictability of the TPB and VBN on climate change mitigation and adaptation choices in agricultural production. They conclude that the VBN theory is more powerful on explaining pro-environmental behaviors from an altruistic point of view (e.g., climate change mitigation). Moreover, Johansson et al. (2013) utilizing VBN theory to specify the psychological characteristics that guide landowners’ choices for conservation of biodiversity in forests and agricultural areas. They argue that landowners who have participated in (voluntary) forest preservation and/or wetland restoration projects express a stronger problem awareness, they ascribe more responsibility for the environmental quality to themselves, and they show a stronger propensity for acting morally.

5. The Motivation Crowding Theory

5.1. Introduction

At this point, one should note that the theories presented in chapters 2 – 4 are merely psychological one. They present the psychological drivers of individuals' pro-environmental behavior without exploring any interplay between their psychological characteristics and external (to them) interventions.

The Motivation Crowding Theory (MCT) (Frey, 1994; 1997b; Frey and Jegen, 2001) is a theory that tries to explain (economic) agents' choices by incorporating elements from psychology into economic rationality. Specifically, MCT explores (a) how intrinsic and extrinsic motivation [(13)] guide agents' choices, and (b) the interplay (or interaction) between intrinsic and extrinsic motives. Particularly, Frey (1997b) argues that (a) any external intervention (either positive, e.g., subsidies, or negative, e.g., taxes, legislations) may affect agents' intrinsic motivation; (b) any external intervention can either foster (crowding-in), or undermine (crowding-out) [(14)], or leave unaffected someone's intrinsic motivation.

In a principal-agent setting, the MCT can be formalized as follow (Frey, 1994; 1997b; Frey and Stutzer, 2008). Let's $B(P,E)$, such that $B_P > 0$ and $B_{PP} < 0$ be agent's benefits defined as a function of her performance, P, and an external intervention, E (note that subscripts denote partial derivative). Accordingly, agent's cost of performing the activity in question (or task) is $C(P,E)$, such that $C_P > 0$ and $C_{PP} > 0$. The agent chooses her optimal level of performance, P^*, by maximizing her net benefit, $(B - C)$ and consequently, P^* solves $B_P(P^*,E) = C_P(P^*,E)$. Thus, the impact of an external intervention of agent's optimal performance is specified by differentiated agent's optimal condition with respect to E. It turns out that:

$$\frac{\mathrm{d}P^*}{\mathrm{d}E} = \frac{B_{PE} - C_{PE}}{C_{PP} - B_{PP}} \gtrless 0$$

13: Intrinsic motivation refers to a situation where someone performs an activity for its own sake (Deci and Ryan, 1985). On the contrary, extrinsic motivation refers to a situation where someone performs an activity for the sake of a reward (Deci and Ryan, 1985).

14: The negative impact of external interventions on intrinsic motivation is a well-established concept in the psychology literature. Lepper and Greene (2015) refer to it as "the hidden cost of rewards", Lepper et al. (1973) as "overjustification hypothesis", whereas Deci (1976) refer to it as "corruption effect".

where the value of $B_{PE} \gtreqless 0$ denotes the impact of the external intervention on agent's intrinsic motivation (i.e., the type of crowding effect been expected) and $C_{PE} \gtrless 0$ reflects the relative price effect.

Furthermore, a rational principal obtains a benefit from agent's performance, $X(P)$, such that $X_P > 0$ and $X_{PP} < 0$. In addition, the cost of intervention is $K(E)$, such that $K_E > 0$ and $K_{EE} > 0$. The principal knows that agent's optimal performance is P^*. Given that information, principal's problem is to choose the level of intervention, E^*, that maximizes her (net) utility $(X(P^*) - K(E))$. It turns out that E^* solves:

$$X_P \frac{dP^*}{dE} = K_E$$

Thus, the principal has an incentive to intervene up to that point where her marginal benefits from intervention (left-hand side) equals her marginal cost (right-hand side).

Frey and Jegen (2001) argue that the crowding effects can be explained by two psychological mechanisms: *the self-determination* and *the self-esteem*. The former refers to the extent of which agents feel responsible to perform the activity in question. The latter refers to the extent of which agents feel that their intrinsic motivation is acknowledged (or appreciated). Based on these two psychological mechanisms, Frey (1997b) and Frey and Jegen (2001) propose two psychological conditions that determine the type of a crowding effect been occurred:

(1) An external intervention *crowds-out* intrinsic motivation if agents affected perceive this intervention as *controlling*. In that case, self-determination and self-esteem are impaired, yielding in reduced intrinsic motivation. [(15)]

(2) An external intervention *crowds-in* intrinsic motivation if agents affected perceive this intervention as *supportive*. In that case, self-determination and self-esteem are fostered, yielding in increased intrinsic motivation.

15: When agents perceive an external intervention as reducing self-determination, intrinsic motivation is substituted by extrinsic control. Agent no longer feel responsible to perform the activity in question, but rather they shift that responsibility to the person imposes the intervention (Rotter, 1966). In such cases, intrinsic motivation is reduced because agents feel overjustified to maintain it.

Thus, a policy relevant question is which types of interventions trigger subjective perception on the controlling or supportive nature of them. Frey (1994; 1997b) stresses that an external intervention is more likely to be perceived as controlling and hence, to crowd-out agents' intrinsic motivation (i.e., $B_{PE} < 0$) if: (a) the relationship between a principal and an agent are strong; (b) the activity in question is perceived by agents to be interesting;

(c) agents' participation on the principal's decision processes is extensive; (d) the external intervention is uniformly distributed among agents; (e) the external intervention imposed as a form of "punishment" (e.g., regulations) rather than as a "reward" (e.g., subsidization); (f) the external intervention is contingent to agents' performance; (g) "hard" regulations are imposed by the principal instead of "soft" ones; [(16)] (h) the "message" that the external intervention conveys on the appreciation of agents' intrinsic motivation is weak.

16: "Soft" regulation is based on a degree of voluntary cooperation, meaning that the performance of the regulated parties may exceed that the law requires (Frey, 1997b)..

In the environmental domain, Frey and Stutzer (2008) argue that: (a) command and control environmental policy measures (e.g., regulations) tends to undermine agents' environmental morale (i.e., intrinsic motivation); (b) emissions tradable systems tend to strongly and negatively affect agents' intrinsic motivation; (c) the effect of environmental taxation on agents' environmental morale is also negative but less strongly from that of emission tradable systems; (d) "high" or "low" emission taxes are more likely to induce agents' environmental performance, whereas "intermediate" ones are likely to backfire; (e) appeals and extensive participation on the environmental policy design can foster agents' environmental morale in the short term. In the long term, environmental morale can be increased by (environmental) education; (f) agents' intrinsic motivation increases by the expressive function of legal regulations; [(17)] (g) the effect of (environmental) subsidization on agents' environmental morale is unambiguous.

17: Expressive function of legal regulation means that the main purpose of the law is to express officially a certain direction, i.e., that protecting the environment is the desirable behavior (Frey and Stutzer, 2008).

5.2. Experimental and Empirical Support of the MCT, and Pro-Environmental Behavior

The "Crowding-Out Hypothesis" (i.e., an external intervention undermines agents' intrinsic motivation when it is perceived as controlling) has been both experimentally and empirically tested in many domains and under different types of intrinsic motivation and interventions.

In social psychological literature, there are four meta-analyses (Rummel and Feinberg (1988), Wiersma (1992), Tang and Hall (1995), and especially that of Deci et al. (1999)) stating that the "hidden cost of rewards" (and consequently, the crowding-out hypothesis) is an actual phenomenon. Particularly, Deci et al. (1999) argue that in cases where an activity (or a task) is perceived to be interesting, tangible and verbal rewards have a negative and positive impact on agent's intrinsic motivation, respectively. However, they stress that tangible rewards do not affect intrinsic motivation when they are unexpected and/or not contingent on agents' performance. Overall, they state that rewards in many cases reduce agents' self-regulation, meaning that due to rewards agents take less responsibility on motivating themselves.

In economic research, the "Crowding-Out Hypothesis" has been empirically and experimentally studied in several settings (Bowles and Polania-Reyes, 2012), like voluntary cooperation (Fehr and Gächter, 2001), voluntary contributions to public goods (Andreoni, 1993; Chan et al., 2002; Reeson and Tisdell, 2008), work performance (Barkema, 1995; Andersen et al., 2008; Dickinson and Villeval, 2008), tax evasion (Bohnet et al., 2001; Torgler, 2005) and civic virtue (Frey, 1997a), in services (Gneezy and Rustichini, 2000a), and on general performance (Gneezy and Rustichini, 2000b; Kornhauser et al., 2020).

5.2.1. The MCT and Pro-Environmental Behavior

Many scholars advocate the applicability of the MCT on dealing with environmental issues and consequently, on environmental policy design (Frey, 1992; 1993; Bowles, 2008). Particularly, crowding effects -mainly the "crowding-out hypothesis- have been studied on pro-environmental behaviors related to "not-in-my-backyard" problems (Frey and Oberholzer-Gee, 1997), management of common pool resources (Cardenas et al., 2000; Rodriguez-Sickert et al., 2008; Velez et al., 2010), waste management and recycling (Feldman and Perez, 2012; Halvorsen, 2012; Ling and Xu, 2021), contribution to environmental quality (Goeschl and Perino, 2012), and general environmental conservation (Rode et al., 2015). Specifically, Rode et al. (2015) identify several psychological mechanisms that explain crowding-out [(18)] and crowding-in effects [(19)] for various types of environmental conservation.

Research on motivation crowding exists on producers' (e.g., farmers) pro-environmental behavior as well. For instance, Van Hecken and Bastiaensen (2010) explore the impact of payments for environmental services (PES) on farmers' adoption rates on silvopastoral practices. They argue that the adoption of a market-based logic of (monetary) rewards, "disconnected" to local institution, may undermine

18: These mechanisms are control aversion, reciprocal fairness, impaired image motivation, impaired internal satisfaction (low "warm-glow" effects), impaired ascription of moral responsibility, frame shifting, changes in the logic for environmental conservation. The difference between the last two mechanisms is that frame shifting is temporal, whereas changes in logic might be permanent.

19: These mechanisms are increased self-esteem, reinforced positive attitude (or trust), prescriptive effects on socially desirable actions, conditional cooperation.

environmental ethics (i.e., intrinsic motivation). Furthermore, Greiner and Gregg (2011) study farmers' willingness to adopt conservation practices. Particularly, they argue that (cattle grazing) farmers with high degrees of stewardship may experience stronger crowding-out effects of their intrinsic motivation by policy programs. In a recent study, Bopp et al. (2019) analyze the effects of both intrinsic and extrinsic motives on farmers' adoption rates of sustainable agricultural practices (tillage, improved fallow, stubble incorporation, use of manure and compost). They found a negative relationship between intrinsic and extrinsic motivation on adoption rates of sustainable agricultural practices. In addition, they also found that extrinsic motives have stronger impact on adoption rates of sustainable farming practices among farmers with low intrinsic motivation. On the contrary, the presence of extrinsic motives does not seem to significantly affect adoption choices of strongly intrinsically motivated farmers. Moreover, Moros et al. (2019) found that payments for ecosystem services (PES) (except for crop-price premium payments) positively affects conservation rates, even though their effect on farmers' intrinsic motivation is unequally distributed. Specifically, collective payments seem to crowding-in social motivations on forest protection, whereas (crop) price premiums seem to undermine intrinsic and guilt related motives. [(20)] Finally, Shirley (2010) explores the influence of social norms on firms' abatement choices. She argues that social norms, per se, cannot motivate (oligopolistic) firms to adopt abatement technologies. However, she stresses that if cooperation in production is feasible, then polluting firms partially adopt abatement.

20: The motivational crowding effects of PES have also be studied by Vollan (2008); Narloch et al. (2012); Midler et al. (2015); Salk et al. (2017); Handberg and Angelsen (2019); Kaczan and Swallow (2019).

6. The Goal-Framing Theory

6.1. Introduction

The Goal-Framing Theory (GFT) (Lindenberg, 2001; 2006; Lindenberg and Steg, 2007; 2013) is a theory of human pro-environmental behavior that tries to explain pro-environmental choices by utilizing the (psychological) mechanism of *overarching goals*. It proposes that the impact of (environmental) cues on norm conformity and hence, on pro-environmental behavior, depends on the influence of these cues on the relative strength of agents' *overarching goals*.

Lindenberg (2018) defines *goals* as "mental representations of desired future states, that are not pure cognitive, but they also mobilize certain kinds of motivations". Overarching goals are perceived to be abstract goals that can guide a larger set of subgoals and to influence psychological processes (Lindenberg, 2018). Lindenberg and Steg (2007; 2013) and Steg et al. (2016) argue that three overarching goals are relevant to pro-environmental behavior: *the gain goal* (i.e., to improve someone her personal resources), *the hedonic goal* (i.e., to feel good) and *the normative goal* (i.e., to act appropriately, conforming to norms). [(21)]

Kruglanski and Köpetz (2009) argue that goals can guide (pro-environmental) behavior only when they are activated. Goal activation can be occurred by signals either inside or outside of a person. Lindenberg (2001; 2008; 2018) emphasizes that at some degree all these three overarching goals are active and hence, they influence behavior. However, only one of them is focal (i.e., has the strongest activation), and that overarching goal is termed as *goal-frame*. [(22)] The remaining two overarching goals are pushed into person's cognitive background but still, they express some influence on the behavior in question. Particularly, Lindenberg (2006; 2008) and Lindenberg and Steg (2007) stress that the effects of the background overarching goals are not necessarily on the same direction with that of the goal-frame. If such a possibility arises, then foreground (i.e., the goal-frame) and background goals are said to be *compatible* and *incompatible* otherwise (Lindenberg, 2006). [(23)] Thus,

21: Example of gain subgoals are: increasing wealth, gaining status, making saving investments.

Examples of hedonic subgoals are reducing effort and to have fun.

Finally, examples of normative subgoals are: helping other people, protecting the environment (Lindenberg and Steg, 2007).

22: The "frame" suffix on the goal-frame is to emphasize on what concepts and chunks of knowledge are being activated, what we like/dislike, what alternatives we consider, what information we are sensitive to, and how we process that information (Bargh et al., 2001; Lindenberg, 2008).

it has been argued that a policy intervention can induce pro-environmental behavior by either increasing the compatibility among overarching goals and/or enhancing the relative strength of the normative goal (Steg et al., 2014).

23: For example, in the case of electric car use increasing compatibility means that a policymaker makes electric cars cheaper and more comfortable, given that the normative goal is the goal-frame.

Moreover, Lindenberg and Steg (2007) and Steg et al. (2014) state that the strength of overarching goals (i.e., the degree of activation) depends on the values that agents endorse and on situational factors. For instance, at a given situation strong biospheric and/or altruistic values are more like to activate agents' normative goal to a higher degree, elevating on the goal-frame status (Steg and Nordlund, 2018). In addition, Lindenberg (2018) argues that the degree at which overarching goals are activated depends on environmental cues and especially on: (a) the presence/absence of people in the environment; (b) objects that are related to a specific overarching goal; (c) visceral cues (very attractive/unattractive aspects in an environment). Fig. 6.1 illustrates the impact of environmental cues on agents' overarching goals.

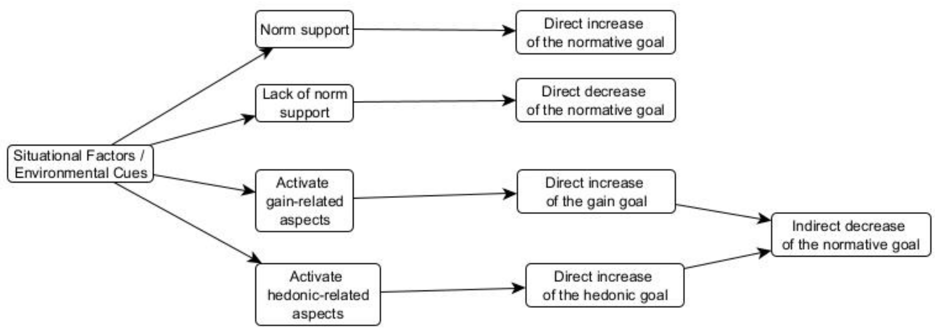

Fig. 6.1: A sematic representation of the impact of environmental cues on overarching goals, adapted by Lindenberg (2018).

6.2. The GFT and Pro-Environmental Behavior

Even though the GFT considered to be a "new" theory, some research exists regarding its predictability on explaining pro-environmental choices in domains like modes of transport (Rezvani et al., 2018; Bösehans and Walker, 2020; Westin et al., 2020), energy use (Bergquist et al., 2019; Hameed and Khan, 2020; Liobikienė and Minelgaitė, 2021), organic and sustainable consumption (Taghikhah et al., 2020; Tang et al., 2020), and on general pro-environmental behavior (Chakraborty et al., 2017).

The majority of these studies emphasize the motivational power of the normative goal, postulating the argument of Lindenberg and Steg (2007) on the importance of activating the normative goal when it comes to pro-environmental behaviors.

6.3. Reasons to Choose GFT for Analyzing Producers' Behavior

This part of the dissertation (i.e., chapters 2 – 6) presents a brief literature review of the most popular(psychological) theories on pro-environmental behavior. Thus, one may wonder why we should invest on another one, since research indicates that the current theoretical frameworks can successfully explain agents' pro-environmental choices.

In what follows, we summarize our rationale of utilizing the GFT on understanding producers' behavior. First, Lindenberg (2008) argues that humans decision-making is a modular process, meaning that there are hardwired and softwired subroutines (.e.g., face recognition) that make humans sensitive to a narrow spectrum of both internal and external information. He also stresses that goals are the more fundamental creator of modules that contain hardwired and sofrwired subroutines, as well (see also, sidenote 22). Producers' (e.g., farmers) as human beings may exhibit similar modularity with that of consumers when they determine the production choices and also, maybe characterized by multiple goals (Sumpsi et al., 1997; Sintori et al., 2009).

Second, research indicates that goals, among other factors, are significant determinants of adoption choices (Maybery et al., 2005; Brodt et al., 2006; Pannell et al., 2006; De Graaff et al., 2008; Ahnström et al., 2009).

Third, the brief literature review presented here shows that each theory on pro-environmental behavior suffers from its own limitations. In addition, there is not a single theory that can explain pro-environmental choices in any context. The GFT, on the contrary, is an integrated framework that combines psychological constructs that found in TPB, NAM/VBN in a solid manner (Steg et al., 2013; Steg, 2016). Particularly, theories on emotions and affect (e.g., Turner and Stets (2006)) are in line with the notion of hedonic goals, the TPB with gain goals and the NAM/VBN with the normative goal (Steg and Nordlund, 2018).

Finally, the MCT is the most used theory on economics on explaining interactions between intrinsic and extrinsic motives. MCT proposes that the expected crowding effect is conditional on how external interventions affect agents' sense of autonomy (i.e., how controlling they are perceived to be). Thus, we may observe different crowding effect not only between positive (e.g., subsidies) and negative (e.g., regulations, taxes) economic incentives, but also within the same class (e.g., between different types of PES). The GFT does not make such distinctions. Any economic incentive that "frames" gain aspects of the pro-environmental behavior in question (e.g., cues that emphasize the profitability of the behavior in question) will (indirectly) undermine the strength of the normative goal (Lindenberg, 2018). By nature, producers are interested in the profitability of their choices. Consequently, it is likely for producers to be more sensitive on external interventions that convey information regarding the consequence of the adaption of a pro-environmental behavior on their profits. In other words, we believe that in case of producers, an extrinsic motive may undermine their intrinsic motivation not because it is perceived as controlling, but rather because it centralizes gain related aspect of adopting a pro-environmental behavior.

THEORETICAL MODELS

7. The Influence of Personal and Social Norms on Policy Measures for Green Products: A Goal-Framing Approach*

*: An earlier version of this chapter was presented (poster) in the LEEPin2019 international conference, in Exeter, UK, in June 2019.

7.1. Introduction

Economic incentives primarily correspond to, and influence, a self-centered rationality (Ostrom, 2000). Notwithstanding, it is well known that humans often reveal a variety of non-selfish motives, which are often considered to explore and explain voluntary contributions to a public good, such as environmentally friendly practices that contributes to environmental quality. Frey and Stutzer (2008) argue that the main socio-psychological concepts that may explain such of contributions are: *(i) altruism, (ii) social norms and reciprocal fairness, (iii) internalized (i.e., personal) norms and (iv) intrinsic motivation*.

In particular, Andreoni (1990) put forward the "impure altruism model" to explain how the "warm glow effect" can capture the limitations of economic incentives in explaining voluntary blood donation. Brekke et al. (2003) propose the concept of "one's self-image" as a socially responsible person in trying to define social approved motives, which bears close resemblance to what Bénabou and Tirole (2006) refer to it as "reputational motive". In addition, Nyborg et al. (2016) advocate the motivational role of social norms, especially when it comes to environmental protection (Nyborg, 2018) and cooperation (Traxler and Spichtig, 2011). [24] More importantly, the motivational influence of social norms increases as the norm becomes internal to someone's self (Thøgersen, 2006; Niemiec et al., 2020) and consequently, the motivational driver is the anticipated feeling of pride or guilt that a person experiences by complying with or violating her moral obligation, i.e. personal norm (Schwartz, 1977). Finally, intrinsic motivation refers to the case where an activity is pursued for the sake of itself (Deci and Ryan, 1985; 2008). Such a concept is in contrast with extrinsic motivation, under which an individual perform a task or activity for the sake of a reward (Deci and Ryan, 1985; 2008). Extrinsic and intrinsic motives are not always in line (Bowles and Polania-Reyes, 2012). It is widely accepted in the scholarly literature that in many cases extrinsic motives undermine intrinsic ones (Frey and Oberholzer-Gee, 1997). Frey (1994) and Frey and Jegen (2001) argue that the underline mechanism for such a crowding-out effect is that external

24: One should note that in such cases, the underline motivational mechanism is that social norms impose informal sanctions, which are expressed in a form of social approval/disapproval.

interventions undermine someone's sense of autonomy or they decrease reciprocal fairness (i.e. reciprocity).

The purpose of this chapter is to extend the Frey and Stutzer (2008) proposal by introducing overarching goals as a fifth concept that may explain voluntary contributions to environmental protection. Based on the Goal-Framing Theory (GFT) (Lindenberg and Steg, 2007; 2013) this chapter develops a theoretical model that explores the power of overarching goals as a motivational mechanism towards pro-environmental behavior. Particularly, this chapter examines how economic incentives affect farmers' decisions regarding (i) the input use and (ii) the adaption of waste recycling and composting practices.

The rationale of relying on GFT is that farmers may have multiple goals (Sumpsi et al., 1997; Sintori et al., 2009) in a sense that they may evaluate not only the outcome of their production choices, but also how this outcome is obtained (Frey et al., 2004).The advantage of using GFT is that it encompasses goals as the psychological mechanism and hence, it is able to capture such dynamics in two dimensions. First, it integrates the concepts of values, norms, and self-interest motives in a solid manner (Steg et al., 2013; Steg, 2016). Second, the concept of overarching goals may explain in a more consistent way the behavior of a farmer, than the Motivation Crowding Theory (MCT) (Frey, 1994; Frey and Jegen, 2001) proposes. That is, it is not that an external intervention perceived by a farmer as controlling, but rather that such an intervention frames different aspects of a behavior, altering the centrality (or focality) of her overarching goals and consequently, determining her production choices.

Overall, this chapter makes three novel contributions to the scholarly literature. First, previous research on the motivational role of non-selfish motives on pro-environmental behavior focuses on consumer choices (e.g., see on recycling choices, Cialdini et al. (1990)), whereas research on farmer's non-selfish motivation is limited (Howley, 2015; Bopp et al., 2019) since they are typically perceived as profit-maximizers that are primarily driven by self-interested motives. In this chapter, we albeit such a restrictive assumption and farmers are conceived as procedural utility-maximizers (Frey et al., 2004), enabling us to combine selfish and non-selfish motives. Second, for the first time, to the best of our knowledge, the GFT framework is used to examine policy measures for production decisions. [25] Third, the theoretical model presented here brings new insights on the relative performance of different types of economic incentives for environmental conservation, namely land subsidies and

25: To date, previous research has employed the GFT to examine energy use, modes of transports and general pro-environmental behavior (see, section 6.2).

price premiums, shedding some light on the conditions under which these incentives undermine farmers' propensity to engage in waste recycling and composting practices and/or to expand organic farming.

Particularly, the analysis presented here points that the impact of a land subsidy on the expansion of organic farming depends jointly on the crowding in (out) possibilities and on the relative strength of the farmer's objectives. Previous literature fails to identify such a result (see, Jaime et al., 2016). In addition, a land subsidy always results in a trade-off between vertical integration (the in-house organic fertilizer production) and the expansion of organic farming. By stark contrast, such results are not necessarily valid when price premiums are used as a policy measure to enhance organic farming. Importantly, the chapter argues that only price premiums can simultaneously expand organic production and enhance vertical integration. The obtained results have profound policy implications that may guide policy makers towards appropriate re-design and a cost-effective targeting of conservation policies. [26]

26: The importance of targeting has been discussed previously in the literature (Hajkowicz et al., 2008).

The structure of this chapter is as follows. Next section presents the theoretical model and examines the role of economic incentives (land subsidies and price premiums) on the degree of vertical integration and on input use. Section 7.3 draws policy implications and concludes.

7.2. Theoretical Model

Consider a situation where a single farmer owns a piece of a land and produces an agricultural product, q. For simplicity, land is normalized to one and a single production input is assumed. A typical example of such a single input is the amount of nitrate fertilizer, x. Particularly, a farmer can use either conventional or organic fertilizers. By choosing a specific type of fertilizer, she primarily selects the type of farming system, and accordingly the per-hectare agricultural good is labeled as conventional, denoted by q_c, or organic, denoted by q_o. Formally, it is assumed that $q_j = \phi_j(x_j)$ with $j = c, o$, where ϕ_j is a well-defined production function, such that $\phi_j' > 0$ and $\phi_j'' < 0$ with respect to $x_j > 0$.

Conventional and organic farming systems have two notable differences. First, an organic farmer may produce organic fertilizers by herself and thus, she can vertically integrate her farming system. Waste recycling and composting epitomize vertical integration choices (Goncalves Da Silva et al., 2010). Here, $k \in [0,1]$ reflects the percentage of own produced organic fertilizer, i.e., the degree of vertical integration. Consequently, the cost producing a unit of the agricultural good is $x_o w_o(k)$, such that $w_o'(k) > 0$ and $w_o''(k) = 0$ for any $k \in [0,1]$, [(27), (28)] or $x_c w_c$ if an organic or a conventional farming system is used, respectively.

The limiting case of $k = 0$ means that no in-house production of organic fertilizer occurs, and consequently organic fertilizer is purchased from the market. Thus, $w_o(0) > 0$ is the market price of organic fertilizer. On the contrary, $k = 1$ means that all organic fertilizer is home produced, i.e., comes exclusively from the farm's vertical integration. Thus, $w_o(1) > 0$ is the unit cost of a complete vertically integrated organic system. In all other cases, $w_o(k)$ captures the unit cost of having a kth-degree vertically integrated organic system, in which $(1-k)$ percentage of the used organic fertilizer is purchased from the market. Likewise, $w_c > 0$ denotes the market price of conventional fertilizer.

Second, the in-house production of organic fertilizer is a procedure, which further contributes to environmental quality since own produced organic inputs are associated with lower ecological footprint compared to the purchased ones (Goldstein et al., 2017). Thus, by choosing a specific degree of vertical integration, k, the environmental benefits from organic production are denoted by $b(k) > 0$ for any $k \in [0,1]$, such that $b'(k) > 0$ and $b''(k) < 0$. [(29)]

A novel feature of the model presented here is that it draws heavily on social psychology theories. To begin with, pro-environmental protection is perceived as a special type of a norm (Lynne et al., 1988), which it can be varied from a pure personal norm to a pure social norm [(30)] (Thøgersen, 2006). As Kalish (2012) argues norms guide social preferences, so it is often assumed that the strength of pro-environmental preferences depends on the interplay between personal and social norms (Harring and Jagers, 2018). In our analysis, farmer's pro-

27: The rationale of $w_o' > 0 \Rightarrow w_o(1) > w_o(0)$ lies on the observation that an opposite assumption would elevate complete vertical integration as dominant strategy, which is not realistic.

28: A more realistic assumption would be that $w_o'' \geq 0$, since vertical integration is not effortless. However, a $w_o'' > o$ increases the complexity of our analysis without providing additional insights on farmer's

29: Notwithstanding, $b(0) > 0$ indicates that organic production, per se, has positive effects on the environment, even though the producer chooses to purchase the whole amount of organic fertilizer (Mondelaers et al., 2009).

30: Elster (1989) underlines that a social norm is a rule of behavior that is enforced through social interactions (rewards and punishments). By stark contrast, Vandenbergh (2004) perceives personal norm as a kind of obligation that is enforced through an internalized sense of duty and/or a guilt for failure to act accordingly.

Often, personal norms are experienced as a sense of moral obligations (Steg, 2016), so in the scholarly literature the term "moral norm" is used as a synonym with the personal norm (Nyborg, environmental preferences, $\rho \geq 0$, are determined according to the following additively separable linear function:

$$\rho(\beta) = \beta\rho^{m} + (1 - \beta)\rho^{so} \tag{7.1}$$

where $\rho^{m} \geq 0$ denotes farmer's environmental personal norm (i.e. her environmental morality), $\rho^{so} \geq 0$ denotes social environmental norm (i.e. social pro-environmental preferences) and $\beta \in [0,1]$ is *the locus of causality* of environmental protection (Heider, 1982; De Charms, 2013). In particular, the value of β shows whether environmental protection is conceived to be a moral obligation (i.e., personal norm) or social demand. In the former case, farmer's environmental preferences are likely to reflect her own environmental morality (i.e., $\rho(1) = \rho^{m}$). On the contrary, the latter case indicates that her pro-environmental preferences are likely to reflect social preferences for environmental protection (i.e., $\rho(0) = \rho^{so}$). A mixed case is possible as well, in which protecting the environment is both a matter of moral obligation and compliance with the social environmental norm.Another novelty of this chapter is that we reject the standard, albeit implicit, separability assumption, under which the value of β is fixed and unaffected by external incentives (Bowles and Polania-Reyes, 2012). Specifically, by assuming $\boldsymbol{s} = (s_1, s_2, \dots, s_n)$ to be a set of situational factors, often applied as subsidies or price premiums (thereafter, economic incentives). [31] In this chapter, it is assumed that each economic incentive, $s_i \in \boldsymbol{s}$ triggers a cognitive process by which a farmer tends to believe that she cares for environmental protection not because she is morally obliged, but rather because she is being paid to do so. In other words, economic incentives are assumed to swift the locus of causality from inside (i.e., farmer herself) to outside (i.e., to the society itself) (Heider, 1982; De Charms, 2013). The higher the payment is, the stronger that feeling becomes and consequently, the higher is the farmer's willingness to comply with the social demand for environmental protection and consequently, a smaller share of her own environmental morality (personal norm) will be reflected in her pro-environmental preferences. Formally, it is assumed that $(\partial\beta/\partial s_i) < 0$ for any $s_i \in \boldsymbol{s}$.However, such an assumption does not necessarily imply that farmer's pro-environmental preferences decrease as well. On the contrary, economic incentives have the potential to enhance them if social norms are strong enough (Fehr and Falk, 2002). Therefore, by differentiating (7.1) with respect to an economic incentive, s_i, we have:

$$\frac{\partial\rho}{\partial s_i} = (\rho^{m} - \rho^{so})\frac{\partial\beta}{\partial s_i} \tag{7.2}$$

31: These situational factors can include other types of interventions, like legislation, information-based strategies, and other type of incentives. However, in this chapter we limit our analysis only on economic incentives and especially, on subsidies and on price premiums.

It is straightforward that economic incentives enhance pro-environmental preferences if and only if social demand for environmental protection dominates producer's moral obligation to act pro-environmentally, i.e., $\rho^{so} > \rho^{m}$. The rationale is that economic incentives enhance pro-environmental preferences as they are perceived as impetus towards environmentally friendly adjustments. On the contrary, when personal (or moral) norms prevail over social norms (i.e., $\rho^{m} > \rho^{so}$), many people develop pro-environmental preferences, and analogous motivations, on the basis of moral commitment (Steg, 2016). This create a general predisposition to devalue the role of economic incentives since they are not an internal part of a position build around the notion of moral obligation, and hence incentives seem to reduce pro-environmental preferences (Bowles and Polania-Reyes, 2012).

Furthermore, following GFT farmer's production choices are guided by three overarching goals: the gain goal (i.e., to improve her financial resources, status, etc.), the hedonic goal (i.e. to feel good, to enjoy herself) and the normative goal (i.e., to act appropriately) (Lindenberg and Steg, 2007; 2013). However, we expect that the impact of hedonic preferences on production choices is insignificant and therefore, the gain and the hedonic goals are merged into one, namely the non-normative goal. [32]

32: Such an assumption is based on recent empirical evidence that fails to separate relational values (or eudemonic) from the instrumental ones (See et al., 2020).

One should recall that GFT argues that individual choices are guided by that overarching goal that is in individual's -and hence, in farmer's- cognitive foreground (i.e., the goal-frame) (Lindenberg and Steg, 2007; 2013). The elevation of a goal to a goal-frame status, depends jointly on farmer's pro-environmental preferences (i.e., on ρ) and on situational factors (i.e., on $\boldsymbol{s}$) (Lindenberg and Steg, 2007; 2013). In this chapter, the strength of the normative goal is denoted by $\theta = \theta[\rho(\beta), \boldsymbol{s}] \in [0,1)$ and consequently, the strength of the non-normative goal is denoted by $(1-\theta) \in (0,1]$. [33] However, economic incentives also influence the impact of personal norms on farmer's pro-environmental preferences. Therefore, by totally differentiating θ with respect to an economic incentive, s_i, we have that:

33: The open upper bound of θ (resp. the open lower bound of $(1-\theta)$) means that by her nature a producer always considers non-normative goals –gain and joy- and consequently, she will never base her decisions on a pure normative fashion.

$$\frac{\partial \rho}{\partial s_i} = \frac{\partial \theta}{\partial \rho}\frac{\partial \rho}{\partial \beta}\frac{\partial \beta}{\partial s_i} + \frac{\partial \theta}{\partial s_i} = (\rho^{m} - \rho^{so})\,\frac{\partial \beta}{\partial s_i}\,\frac{\partial \theta}{\partial \rho} + \frac{\partial \theta}{\partial s_i} \tag{7.3}$$

One should note that pro-environmental preferences are expected to frame normative actions, since they often considered to be legitimate social choices rooted in a feeling of normative obligation (Sabet, 2014). On the contrary, economic incentives are expected to frame non-normative actions, and especially gain-related behavior, since they provide a direct way of improving producer's personal wealth. Since there is a trade-off between normative and non-normative action, economic incentives are expected to decrease the relative influence of the normative goal by pushing that goal into farmer's cognitive background. The aforementioned dynamics are modeled by assuming: $(\partial\theta/\partial\rho) > 0$ and $(\partial\theta/\partial s_i) < 0$.

Consequently, by using (7.2) and (7.3) it is stated that:

Lemma 7.1: *Any economic incentive, s_i, brings about one of the following crowding effects:*

(i) a pure crowding-in effect, where both pro-environmental preferences and normative goal preferences are enhanced, if $(\rho^m - \rho^{so}) < \hat{\rho}_i$;

(ii) a pure crowding-out effect, where both pro-environmental preferences and normative goal preferences are reduced, if $\rho^m > \rho^{so}$;

(iii) a quasi-crowding-out effect, where pro-environmental preferences are enhanced, but normative goal preferences are reduced, if $\hat{\rho}_i < (\rho^m - \rho^{so}) < 0$,

where:

$$\hat{\rho}_i = -\left(\frac{1}{\partial\beta/\partial s_i}\right)\left(\frac{\partial\theta/\partial s_i}{\partial\theta/\partial\rho}\right)$$

Here, $\hat{\rho}_i$ is a threshold that resembles the weighted marginal rate of substitution between pro-environmental preferences and an economic incentive on the formation of normative goal preferences. Particularly, given the difference $(\rho^m - \rho^{so})$, the value of $\hat{\rho}_i$ specifies how likely is for an economic incentive to induce a particular crowding effect. [34]

34: Note that given the difference $(\rho^m - \rho^{so})$, the value of $\hat{\rho}_i$ specifies how likely is for an economic incentive, s_i, to induce a particular crowding effect.

1.2.1. External Interventions to foster organic farming: The case of economic incentives

Let us assume a social planner who wishes to facilitate the expansion of organic farming by providing a land-based subsidy, $s_L > 0$ (Feinerman and Gardebroek, 2007). Such payment reflects society's acknowledgment for the provision of environmental benefits and belongs to a family of transfers known collectively as green payments (Horan and Claassen, 2007), or payments for environmental services (Engel et al., 2008). Beyond regulatory policies, consumers are willing to pay a price premium, $s_P > 0$, for organic goods, on the basis that they perceive organic products as being differentiated products (healthier and more safe products) in comparison to conventional produce

(Endres, 2007). [35] The price premium is only paid for goods certified as organic and sold under the analogous label. An independent third body, upon routinely inspecting producer's compliance with organic farming prerequisites, issues such a certification. The fixed cost of such a certification denoted by $\psi > 0$ is assumed to be borne by producers. In its simplest case, such an eco-certification involves the identification of some traits in the production process, which are (imperfectly) correlated with the product's "environmental friendliness" (Mason, 2011). [36] Thus, farmer's procedural utility (Frey et al., 2004), u, is assumed to have the following functional form:

35: Suffice to say that such a claim is primarily based on subjective perceptions (Apaolaza et al., 2018), whereas the majority of meta-analyses do not support any causality between food quality and/or food safety and organic produce (Magkos et al., 2006; Dangour et al., 2009; Benbrook, 2013).

36: The complex issues of random monitoring, uncertainty in signals and probabilistic certification are ignored in our analysis. For a thorough analysis, see Hamilton and Zilberman (2006) and Mason (2013).

$$u_j = \begin{cases} (1-\theta)[(p_c + s_P)q_o - x_o w_o(k) + s_L - \psi] + \theta b(k), & j = o \\ (1-\theta)(p_c q_c - w_c x_c), & j = c \end{cases} \tag{7.4}$$

1.2.1.1. Incentives put forward by the Social Planner: the case of a land subsidy

A social planner knows that farmer's optimal organic production choice, (x_o^*, k^*), solves:

$$\underset{(x_o,k)}{\operatorname{argmax}}\, u_o(x_o, k; \theta) \qquad \text{s.t.} \qquad u_o(x_o^*, k^*; \theta) \geq u_c(x_c^*; \theta) \tag{7.5}$$

Standard comparative statics (see Appendix for the proof) reveals that the impact of a land subsidy on the optimal degree of in-house production organic fertilizer, k^*, when $\theta \in (0,1)$ is:

$$\frac{\partial k^*}{\partial s_L}\left[\frac{b''(k^*)}{w_o'(k^*)} - \left(\frac{1-\theta}{\theta}\right)\frac{\partial x_o^*}{\partial k^*}\right] = -\frac{x_o^*}{\theta^2}\frac{\mathrm{d}\theta}{\mathrm{d}s_L} \tag{7.6}$$

whereas its impact on the optimal use of organic fertilizer, x_o^*, is:

$$\frac{\partial x_o^*}{\partial s_L} = \frac{\partial k^*}{\partial s_L}\frac{\partial x_o^*}{\partial k^*} \tag{7.7}$$

There are a number of worth-noting points in (7.6) and (7.7) that carry a number of implications: First, it is evident (see Appendix for the proof) that $(\partial x_o^*/\partial k^*) < 0$ and therefore, $(\partial k^*/\partial s_L)$ and $(\partial x_o^*/\partial s_L)$ have opposite signs. The rationale is that a land subsidy always triggers a trade-off between the expansion of organic production and the in-house production of organic fertilizer. If output is a monotonic and increasing function of the inputs used, then a reduction in inputs brings about a reduction in the output, and vice versa. Typically, changes in the output are attributed to changes in the input intensity, known as intensive margin changes, and or to changes in the cropping pattern, known as extensive margin changes (Fang and Rogerson, 2009). However, the current modeling framework does not allow us to separate these two changes. [37]

In other words, (7.6) indicates that land subsidies cannot simultaneously enhance vertical integration and the expansion of organic production. An increase in the in-house production of organic fertilizer brings extra satisfaction to the farmer since she produces extra environmental benefits. The value of these benefits cancels off, at the margin, the output loss due to reduced inputs, and consequently $(\partial x_o^*/\partial k^*) < 0$.

37: Nonetheless, we get around this by assuming that in the short run, each farm has fixed proportions production and pollution functions, i.e., a "putty-clay" technology (Gächter and Fehr, 1999; Zilberman, 2014). Under such an assumption, an ex-ante well behaved production function (i.e., Cobb-Douglas) determines the technology (organic or conventional) and an ex post Leontief function follows (Caparrós et al., 2015). Hence, in the short run, as soon as organic farming is selected, only extensive margin changes are possible, so changes in input use bring about expansion (or reduction) of

Second, (7.6) points that:

$$\frac{b''(k^*)}{w_o'(k^*)} - \left(\frac{1-\theta}{\theta}\right)\frac{\partial x_o^*}{\partial k^*} > 0 \Rightarrow$$
$$\frac{1-\theta}{\theta} > \hat{\theta} \equiv \frac{b''(k^*)}{w_o'(k^*)}\left(\frac{1}{\partial x_o^*/\partial k^*}\right) \tag{7.8}$$

where $\hat{\theta}$ reflects the ratio between the rate at which the environmental benefits increase over the increased marginal cost of in-house production, where the inverse of the magnitude of the trade-off between the expansion of organic farming and the degree of in-house production of organic fertilizer is the weighted factor.

The implication of (7.6) and (7.8) is that in order to assess the likely impact of land subsidy on vertical integration and the expansion of organic farming, we must be able to identify both the relative (i.e., the type of the crowding effect) and the absolute (i.e., the value of θ once a land subsidy is introduced) size of the crowding effect. This is consistent with the proposal of Folmer and Johansson-Stenman (2011). Hence, it is proposed (see Appendix for the proof):

Proposition 7.1: *By using lemma 7.1 and (7.6) – (7.8) it is proposed that a land subsidy: (i) triggers a trade-off between the expansion of organic farming and in-house production of organic fertilizer; (ii) induces in-house production of organic fertilizer if conditions C1 or C2 holds, where:*

C1: A pure crowding-in effect is expected and $(1-\theta)/\theta < \hat{\theta}$.

C2: A pure or a quasi-crowding out effect is expected and $(1-\theta)/\theta > \hat{\theta}$.

Fig. 7.1 illustrates the impact of a land subsidy on in-house organic fertilizer production for different relative and absolute crowding effects, for which $h(\theta) = (1-\theta)/\theta$, with $\theta \in (0,1)$.

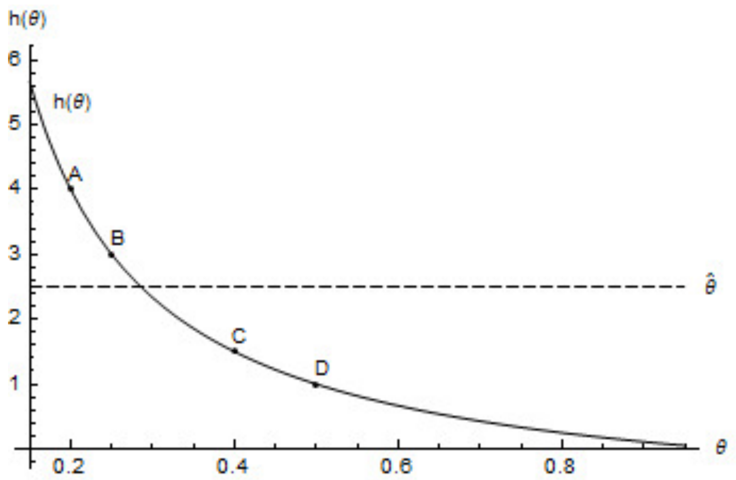

Fig. 7.1: Production choices upon vertical integration under a land subsidy.

Particularly, let us assume that prior to the introduction of a land subsidy, a farmer has a ratio between normative and non-normative actions that corresponds to the point A. If a crowding-in is expected, proposition 7.1 states that a land subsidy induces in-house organic fertilizer production if the farmer moves to points C or D. On the contrary, if the crowding in effect is weak (i.e., a movement from A to B), then a land subsidy induces only the expansion of organic farming. Following a similar reasoning, a farmer who was initially at the point D has an incentive to increase the in-house organic fertilizer production, if the crowding out or the quasi-crowding out effect is strong, such that to end in points A or B.

To recapitulate, the effect of land subsidy on the expansion of organic farming simultaneously depends on the crowding in (out) possibilities and on the relative strength of farmer's objectives. From the cases characterized above, it seems that the interplay between social and personal norms with the hierarchy of individual overarching goals is rather complex. Beyond that, as Delaney and Jacobson (2016).

1.2.1.2. Incentives driven by consumers' choices: the case of price premium

This section examines how price premium affect producer's decisions regarding the input use and the degree of in-house organic fertilizer production. The impact of a price premium on the optimal solution, (x_O^*, k^*), is assessed by differentiating the first-order conditions with respect to s_P. It turns out that the relationship between price premiums and the optimal degree of in-house organic fertilizer production is given by (see Appendix for the proof):

$$\frac{\partial k^*}{\partial s_P}\left[\frac{b''(k^*)}{w_o'(k^*)}-\left(\frac{1-\theta}{\theta}\right)\frac{\partial x_o^*}{\partial k^*}\right]=-\left[\left(\frac{1-\theta}{\theta}\right)\frac{\phi_o'}{(p+s_P)\phi_o''}+\frac{x_o^*}{\theta^2}\frac{\mathrm{d}\theta}{\mathrm{d}s_P}\right] \tag{7.9}$$

whereas the total impact of a price premium on the optimal input use is:

$$\frac{\partial x_o^*}{\partial s_P}=\frac{\partial k^*}{\partial s_P}\frac{\partial x_o^*}{\partial k^*}-\frac{\phi_o'}{(p+s_P)\phi_o''} \tag{7.10}$$

and hence,

$$\frac{\partial x_o^*}{\partial s_P}>0\Rightarrow\frac{\partial k^*}{\partial s_P}<\frac{\phi_o'}{(p+s_P)\phi_o''}\left(\frac{1}{\partial x_o^*/\partial k^*}\right) \tag{7.11}$$

Note that (7.10) implies that a price premium affects input use both directly (second term) and indirectly (first term). The effect of this direct impact is twofold. First, it enhances any positive indirect impact and at the same time, it mediates the negative influence of the indirect one.

The implication of this direct – indirect interplay does not necessarily trigger a trade-off between optimal input use and the optimal degree of own-produced organic fertilizer. Specifically, (7.11) points that a price premium increases input use in two cases: (a) if it reduces the in-house organic fertilizer production, i.e., $(\partial k^*/\partial s_P)<0$ or (b) if it enhances the in-house organic fertilizer production, but in a non-significant way, i.e., $(\partial k^*/\partial s_P)>0$ but $|\partial k^*/\partial s_P|$ is small.

Contrary to (7.6), the sign of the RHS of (7.9) is determined by whether farmer's normative overarching goal preferences exceed a threshold, $\tilde{\theta}$. Particularly, provided that $\theta\in(0,1)$

$$-\left[\left(\frac{1-\theta}{\theta}\right)\frac{\phi_o'}{(p+s_P)\phi_o''}+\frac{x_o^*}{\theta^2}\frac{\mathrm{d}\theta}{\mathrm{d}s_P}\right]>0\Rightarrow\frac{1-\theta}{\theta}>\tilde{\theta},\ \ \tilde{\theta}=-\frac{x_o^*}{\theta^2}\frac{\mathrm{d}\theta}{\mathrm{d}s_P}\Big/\frac{\phi_o'}{(p+s_P)\phi_o''} \tag{7.12}$$

Since $\phi_o'>0$ and $\phi_o''<0$, the sign of $\tilde{\theta}$ depends on the expected crowding effect (see, lemma 7.1). Specifically, if a pure/quasi crowding-out effect is expected and consequently, $(\mathrm{d}\theta/\mathrm{d}s_P)<0$, then $\tilde{\theta}<0$ and (7.12) holds. On the contrary, if a crowding in effect is expected and consequently, $(\mathrm{d}\theta/\mathrm{d}s_P)>0$, then (7.12) is satisfied if the value of $\tilde{\theta}$ is relatively low. Such a situation arises if the crowding-in effect is weak or if the direct impact a price premium on input use is rather strong. Therefore, it is proposed that:

Proposition 7.2: *By using lemma 7.1, (7.8), (7.9) and (1.11), the introduction of a price premium triggers the following effects: (i) enhances both input use and in-house organic fertilizer production, if* $(\partial k^*/\partial s_P)>0$ *but* $|\partial k^*/\partial s_P|$ *is small; (ii) it enhances in-house organic fertilizer production if conditions C3 or C4 holds, where:*

C3: A pure or a quasi-crowding-out effect is expected and $(1-\theta)/\theta>\hat{\theta}$.

C4: A pure crowding in effect is expected and (a) $(1-\theta)/\theta > \max\{\tilde{\theta},\hat{\theta}\}$ *or (b)* $(1-\theta)/\theta < \min\{\tilde{\theta},\hat{\theta}\}$.

A comparison between propositions 7.1 and 7.2 points that in cases where a pure/quasi crowding out is expected, condition C2 and C3 are identical. In other words, farmer's responses towards in-house organic fertilizer production are the same, whether she receives a land subsidy or a price premium. However, the situation becomes more complex when a crowding in effect is expected instead. For instance, condition C4(b) is stricter than C1, since it also requires that $(1-\theta)/\theta < \tilde{\theta}$. If such a requirement is violated, then a "paradox" arises in which land subsidies induce in-house of organic fertilizer production, whereas price premiums undermine it. This "paradox" is illustrated in Fig. 7.2.

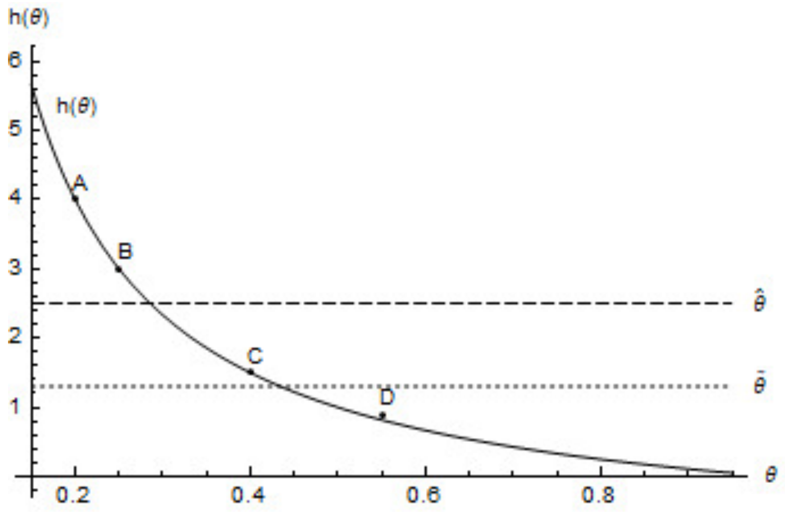

Fig. 7.2: Production choices upon vertical integration under a price premium.

Again, let us assume that initially a producer is at point A. If a pure crowding-in is expected, then any movement to points C or D will induce in-house organic fertilizer production, as long as a land subsidy is offered. On the contrary, if a price premium is implemented, then proposition 2 points a producer has an incentive to increase the degree of in-house organic fertilizer proposition if the crowding-in effect is either weak (from A to B, condition C4(a)) or if it is quite strong (from A to D, condition C4(b)). For an "intermediate" crowding in effect (from A to C), the "paradox" arises, since C1 holds, whereas C4 (b) is violated. Importantly, a movement from A to B also increases the input use (see, (7.11)) a feature of price premiums that it is absent in land subsidies.

7.3. Discussion and Conclusion

This chapter explores farmer's decisions regarding the expansion of green products and the degree of vertical integration. Using a theoretical synthesis of the concepts of norms, the motivation crowding theory and the goal-framing theory we can derive a number of novel results which broaden our understanding on the interplay between social and personal norms and how these affect farmer's motivation and consequently their choices.

In particular, the analysis presented here redefines the concept of the crowding effects, which encompasses both changes in environmental preferences and in normative preferences. Contrary to the current literature that focuses on whether external interventions enhance or undermine someone's pro-environmental preferences, our analysis highlights the importance of the influence of policy measures for conservation on farmers' overarching goals. In other words, a social planner should consider not only whether an economic incentive strengthens or weakens farmer's propensity to act pro-environmentally, but also and more importantly, which are the effects of such an intervention on farmer's normative goal preferences. Specifically, our analysis suggests that normative preferences might be a more important determinant of farmers' behavior than pro-environmental preferences, per se.

Another novel contribution concerns the result where land subsidies and price premiums may yield controversial production choices, especially in cases where only a single policy measure is politically and/or technically feasible. In particular, propositions 7.1 and 7.2 stress that the efficiency of both land subsidies and price premiums to induce vertical integration and/or the expansion of green production depends upon the expected crowding effect. Lemma 7.1 illustrates that the character (i.e., direction and strength) of the likely crowding effect depends upon the provider of the incentive (i.e., social planner or consumers). Consequently, the policy design should account for such a result.

A third novelty of our analysis is that it emphasizes the trade-off between the expansion of green production and vertical integration always exists under a land subsidy. However, under price premiums such a trade-off does not necessarily arise. Specifically, if the social planner wants to expand the vertical integration and at the same time to increase the green production, then she needs to design incentives that generate weak crowding-in effects.

To sum up, the main conclusion that can be drawn from the present analysis is that in cases where a single policy measure (price premium or land subsidy) is feasible, the choice depends on both the objectives of the social planner and on the expected crowding effect. Particularly, when a strong pure crowding-in or a pure/quasi-crowding-out effect is expected, then farmer's production choices are the same, regardless the policy measure applied (land subsidy or a price premium). In such a case, the social planner knows that she cannot simultaneously raise vertical integration and expand organic production. Consequently, the rule that guide the choice of the economic incentive is determined by which of these two targets (i.e., increase input use versus increase vertical integration) she wants to meet.

On the contrary, if a small or intermediate crowding-in effect is expected, then the choice of the economic incentive matters. Therefore, the social planner should consider not only her objectives, but also how strong is such an effect. Specifically, if both policy measures yield a small crowding-in effect, then price premiums are preferred over land subsidies, since they induce both vertical integration and input use of organic fertilizer. On the other hand, if intermediate crowding-in effects are expected, then land subsidies are preferred, since price premiums are likely to backfire.

At last, few words about the main limitations of this article are necessary. First, the present analysis is static, and ignores agent's heterogeneity. Usually, environmental improvements come much later than their associated costs. Future developments may overcome these limitations.

8. Emission Taxes for Genuine Altruistic Firms*

*: During the writing of this dissertation, this chapter was submitted to Annals of Public and Cooperative Economics, with current status of "revise and resubmit".

8.1. Introduction

The standard economic recipe to control externalities refers to a system of taxes (or subsidies) that force polluters to consider the full marginal costs of their activities, including environmental damage costs (Baumol and Oates, 1988). The optimality condition, the so-called Pigouvian tax, under which the pollution tax equals the marginal environmental damages at the optimal emission level, depends on three crucial assumptions: (i) a benevolent regulator maximizes a utilitarian social welfare function; (ii) pollution taxes are transfer payments; (iii) the administrative costs of assessing and collecting emission taxes are negligible.

Previous research has shown that the optimal emission tax deviates from the Pigouvian rule, once one or more of these assumptions are relaxed. For instance, Hahn (1990) relaxes the assumption of a benevolent regulator, while the assumption of transfer payments very often is modified (see, Fullerton and Wolverton, 2005; Jaeger, 2011; Pang and Shaw, 2011). The issue of monitoring and enforcement cost was considered by Cremer and Gahvari (2002), and Schmutzler (1996). At the same time, examples where more than one assumption is relaxed can be found in Gomez (2001), Parry (2013) and Kampas and Horan (2016).

Above and beyond that, there is a burgeoning literature that postulate that such deviations can be explained by agents' social and psycho logical characteristics. For instance, for the case of altruism, Johansson (1997) explores the impact of various altruism types on the design of an externality-correcting tax. He concludes that whether optimal tax on the consumption of a "dirty" good deviates from the Pigouvian rule depends on how altruism is modeled. In a similar context, Heyes and Kapur (2011) compare quantity-based and price-based (taxes) policy instruments for dealing with negative externalities, under the assumption of impure altruistic consumers. They found that altruism lowers the optimal tax relative to the egoistic Pigouvian prescription. Similarly, Daube and Ulph (2016) argue that even though altruism and agents' propensity for altruistic actions do not affect the optimal consumption taxes, they can motivate consumers to decrease the consumption of a ``dirty good'' when such taxes are not set correctly.

However, the literature on the effects on such constructs, like altruism, on optimal emission taxes (and more generally, on externality-correcting taxes) when polluters are firms is limited. The reason might be devoted to the claim that even though firms may not determine their choices in a pure profit-maximizing fashion (Leibenstein, 1966), their behavior is less likely to be constrained by altruistic (or ethical/altruistic) considerations (Prasad, 2009). By contrast, the work of Renstrom et al. (2019), incorporates the concept of impure altruism (Andreoni, 1990) in order to explore the impact of firm's investors impure altruistic preferences on pollution taxes imposed to firms. They conclude that the stronger these preferences are, the lower are both the rate of the first-best pollution tax and firms' pollution intensity, implying that firms may share investors' altruistic characteristics.

Another important limitation of the current literature is that the models of altruism, similar to Johansson (1997) and Daube and Ulph (2016), treat consumers' behavior, and more importantly, the degree of altruism and/or the propensity for altruistic actions, as independent of the implemented policy (i.e., the tax). However, empirical evidence suggests that such constructs are responsive to an agent's external factors, like an environmental policy (Rode et al., 2015). In respect to environmental taxes, particularly, many scholars advocate that such policy instrument undermines agents' intrinsic motivation to act pro-environmentally, making environmental taxes counterproductive (e.g., Frey and Oberholzer-Gee, 1997; Frey, 1999; Nyborg, 2010; Lanz et al., 2018; Grieder et al., 2020).

Our analysis tries to fill these gaps by incorporating the altruistic dimension of altruism in the design of optimal emission taxes for heterogeneous firms. Renstrom et al. (2019) assume that firms' altruistic preferences reflect their investors' impure altruism considerations, in a sense that investors receive a warm glow when firms behave altruistically. Our analysis explores another type of altruism, namely the genuine altruism, under which those who are responsible for firms' operation (i.e., managers, investors, etc.) do not receive any particular benefit from firms' altruistic behavior (Johansson, 1997). The rationale of relying on the genuine altruism assumption is that such a construct is in line with the notion of a social responsible firm, as one that integrates social, environmental, ethical, human rights and consumer concerns into its business operation (Crifo and Forget, 2015). On the contrary, other types of altruism, like impure altruism, can be attributed to the notion of external rewards (i.e., a firm behaves altruistically for its investors to receive a warm glow).

In this article, firms are assumed to determine their abatement choices by maximizing the sum of their self-interest objective (i.e., profits) plus a genuine altruistic objective. The inclusion of genuine altruism into firm’s maximand is similar to how Johansson (1997) models genuine altruism regarding individual consumption choices. In addition, such an approach is consistent with the multi-objective programming framework (Marler and Arora, 2010) that it is usually be employed when the hypothesis of imperfect maximization firms is discharged (Ehrgott and Wiecek, 2005). The novelty of our approach is that firms' genuine altruism objective does not only reflect firms' acknowledgement on the negative externalities (i.e., the damage) that their emissions cause to others' well-being, but also it reflects firms' propensity (i.e., willingness) to account for these externalities when they determine their abatement choices, i.e., to act altruistically. In such a setup, emitting becomes costly not only from a self-interest point of view (through an emission tax imposed by a social planner), but also from an altruistic point of view. Thus, our analysis proposes the concept of the “altruistic cost” of emissions (i.e., the weighted cost that a firm knows it imposes on others' well-being by choosing to emit), as an additional mechanism that interplays with emission taxes upon the determination of firms' abatement choices.

The inclusion of the altruistic cost of emissions in the design of emission taxes produces some interesting results have not been identified by the scholarly literature. First, in a market comprising by a not sufficiently large number of heterogeneous firms always there exists a subset of firms that are willing to undertake abatement activities, as long as their marginal altruistic cost of emissions is positive. Second, in cases where sufficiently high emission taxes are technically and/or politically infeasible, a low emission tax induces abatement relative to the status quo (i.e., no emission tax is imposed) when a firm is labeled as egoistic (i.e., in the absence of an emission tax, a firm does not exhibit a propensity to act altruistically) or if its altruistic cost of emissions has a concave structure. On the contrary, convex altruistic firms (i.e., firms that before the tax exhibit a propensity for altruistic actions, and that propensity has a convex structure) require intermediate emission taxes in order to increase their level of abatement. Third, the effect of firms' altruistic cost of emissions on the emission tax that induces the socially optimum abatement is also conditional on how such altruistic cost is structured. Specifically, the optimal emission tax is more likely to be lower if firms' altruistic cost of emissions has a concave structure, since such firms are less responsive to environmental taxation than convex altruistic firms. More importantly, social planner's best response to firms' altruistic cost of emissions is to impose a Pigouvian emission tax if she knows that under such a level a firm determines its abatement choices in a pure profit-maximizing fashion. Fourth, the analysis presented here postulates that the finding of Daube and Ulph (2016) concerning the firms' compliance with the socially optimum does not necessarily indicate that firms' environmental performance (i.e., the level of abatement) is always improved. More importantly, our analysis highlights the policy-related advantages of implementing differentiated emission taxes, especially when markets are small or medium, and when sufficiently high uniform emission taxes are neither technically and/or politically feasible, nor they cannot be correctly set.

This article's structure is as follows: Section 8.2 presents the model's assumptions and structure, and also, it derives the main results and discusses its policy implications. Section 8.3 summarizes and concludes.

8.2. Theoretical Model

Following Xepapadeas (1997), consider a competitive market comprising N number of firms, with $i = 1,2,\ldots,N$. Each firm utilizes $x_i^p = (x_{i1}^p, x_{i2}^p, \ldots x_{iM}^p)$ inputs for producing a homogeneous good, $q_i = f_i^p(x_i^p) \geq 0$, and $x_i^a = (x_{i1}^a, x_{i2}^a, \ldots x_{iA}^a)$ inputs for abatement activities, $a_i \leq f_i^a(x_i^a)$, where both f_i^p and f_i^a are twice-differentiable and strictly concave functions in their arguments. Thus, a *derived benefit function* for the firm i with respect to the level of abatement a_i is defined as: [38]

38: where $p > 0$ is the market price of the good and $w^p = (w_1^p, w_2^p, \ldots, w_M^p)$ is a vector of the unit cost of inputs being used for the production.

$$B_i(a_i) = \underset{x_i^p}{\operatorname{argmax}}\ p f_i^p(x_i^p) - w^p x_i^p - c_i(a_i)\,, \qquad B_i' < 0, B_i'' < 0 \tag{8.1}$$

where $c_i(a_i)$ is firm's private cost of abatement, defined as: [39]

$$c_i(a_i) = \underset{x_i^a}{\operatorname{argmin}}\ w^a x_i^a \quad \text{s.t.}\ \ a_i \leq f_i^a(x_i^a), \qquad c_i' > 0, c_i'' > 0 \tag{8.2}$$

Firms are assumed to be price-takers while they have different propensity for acting altruistically. The latter means that firms know that emissions (negatively) affect others' well-being (i.e., consumers and other firms), including the environment, per se. However, such a concern is not transformed to (altruistic) attitude unless a certain threshold of their altruistic and biospheric values is exceeded. For brevity and simplicity, the sum of firms' altruistic and biospheric values are denoted by $v_i \geq 0$, and their propensity for altruistic actions is denoted by $\mu_i \geq 0$. Consequently, we classify firms into two domains, namely "egoistic" and "altruistic" according to the following definition:

39: Similarly, $w^a = (w_1^a, w_2^a, \ldots, w_A^a)$ is a vector of the unit cost of inputs used for abatement activities.

Definition 8.1: If $v_i \in [0, \underline{v})$, then $\mu_i = 0$. In such a case, a firm i is labeled as "egoistic", subscripting by $i = m+1, m+2, \ldots, N$. On the contrary, if $v_i \in [\underline{v}, \overline{v}]$, then:

$$\mu_i(t) = \int_{\underline{v}}^{\overline{v}} f_i^{\mu}(v_i|t)dv_i\,, \qquad \mu_i(0) > 0$$

In such a case, a firm i is labeled as "altruistic", subscripting by $i = 1,2,\ldots,m$.

Here, $\underline{v} > 0$ denotes a tipping point under which firms' non-egoistic values (i.e., altruistic and biospheric values) are strong enough to spur altruistic actions, $\overline{v} > 0$ denotes the maximum possible level of non-egoistic values, $t \geq 0$ is an emission tax imposed by a social planner and $f_i^{\mu}(\cdot)$ is a density function, conditional on the environmental taxation.

In line with the *crowding-out hypothesis* (Frey, 1994; Frey and Jegen, 2001), an emission tax is likely to undermine firms' propensity to act altruistically. Lindenberg and Steg (2007; 2013) argue that the underlining (psychological) mechanism for such an effect is that environmental taxation triggers a (psychological) process by which profit-seeking behavior becomes focal (i.e., the goal-frame). Thus, once an emission tax is introduced those who are responsible for the operation of a firm will tend to under-evaluate the effect of emissions on others and instead, they focus on how emission taxes affect firm's profitability. Consequently, the likely predisposition to act altruistically declines. In this article, the aforementioned dynamics between an emission tax and firms' inclination towards altruistic actions are modelled by assuming $\mu_i(t)$ to be a twice differentiable function in t, such that: (i) $\mu_i'(t) < 0 \Rightarrow \mu_i(t) < \mu_i(0)$ and $\mu_i''(t) \gtreqless 0$ for any $t < \hat{t}_i$; (ii) $\mu_i'(t) = 0$ for any $t > \hat{t}_i$, where $\hat{t} = \min\{t|\mu_i(t) = 0\}$.

8.2.1. Firms

In the absence of any abatement activity (i.e. $x_i^a = \emptyset$), a firm emits $\bar{e}_i \equiv e(\bar{x}_i^p)$, where $\bar{x}_i^p = (\bar{x}_{i1}^p, \dots, \bar{x}_{iM}^p) \in argmax\{pf_i^p(x_i^p) - w^p x_i^p\}$. However, firms may undertake abatement activities and in such a case the actual emissions are defined as $\varepsilon_i = \bar{e}_i - a_i$. Consequently, for any level of emission tax imposed by the social planner, firms' profits from abatement are defined as:

$$\pi_i(a_i;t) = B_i(a_i) - (\bar{e}_i - a_i)t, \qquad \pi_a^i(t) \equiv \frac{\partial \pi_i(a_i)}{\partial a_i} \tag{8.3}$$

Typically, a firm chooses to abate up to that point where its profits are maximized. However, in a multi-objective framework a firm may consider non-self-interest objectives, like how its emissions affect others, without receiving any profit (or benefit) from acting in such a way. Usually, the legitimacy of firms' multiple objectives is justified on normative grounds (e.g., Mitchell et al., 2016) or environmental responsiveness (Valentinov et al., 2021). Johansson (1997) refers to such an altruistic objective as "Genuine Altruism". In his analysis, agents determine their choices by maximizing the sum of their utility plus a function of the total utility of all others. Analogously, it is assumed that firms determine their abatement activities by maximizing the sum of their (weighted) profits (i.e., self-interest objective) minus a (weighted) function of the damage that their emissions impose on others' well-being (i.e., altruistic objective). Consequently, firms' optimal level of abatement, $a_i^F(t) \geq 0$, is defined as: [40]

40: Here, unitary weights are assumed.

$$a_i^F(t) \in \underset{a_i \geq 0}{\operatorname{argmax}}\, \pi_i(a_i;t) - M_i[z_i(\varepsilon_i|N);t] \tag{8.4}$$

where $M_i(\cdot) \geq 0$ is firms' altruistic cost of emissions, defined as:

$$M_i[z_i(\varepsilon_i|N);t] = \mu_i(t)z_i(\varepsilon_i|N), \qquad M_\varepsilon^i(t) \equiv \frac{\partial M_i(\cdot)}{\partial \varepsilon_i} \geq 0 \tag{8.5}$$

In particular, $z_i(\cdot)$ is the damage (or disutility) that each firm *believes* that it causes to all other members of the society, including the environment, by emitting ε_i, given that the total number of firms operate in the market is N. In such a setup, $M_i(\cdot)$ denotes firms' willingness not only to acknowledge negative externalities that their production activities yield to others (through z_i) but also, to account for these externalities when the firms determine their abatement choices (through μ_i).

In addition, the followings are assumed: (i) $z_i \geq 0$, with equality if $\varepsilon_i = 0$; (ii) $z_i' \equiv (\partial z_i/\partial \varepsilon_i) \geq 0$, with equality if $N \geq \overline{N}$ (41) and (iii) $z_i'' \equiv (\partial^2 z_i/\partial \varepsilon_i^2) = 0$. (42)

That is, individual emissions are perceived by a firm to be detrimental to the society, if the number of firms is not sufficiently large. The rationale is that a firm knows that any member of the society is affected by its emissions and also, by the emissions of the $N-1$ firms. Thus, the higher N is, the more negligible the influence of firm's own emissions to the well-being of others is perceived to be.

41: H Note that the underline assumption is that $(\partial^2 z_i/\partial N \partial \varepsilon_i) < 0$.

42: A more realistic assumption would be that $z_i'' \geq 0$. However, a $z_i'' > 0$ increases the complexity of the notation, without providing any insight upon the impact of an emission tax on firms' optimal abatement.

For an interior solution, $a_i^F(t)$ must satisfy the first-order condition:

$$\pi_a^i(t) + M_\varepsilon^i(t) = 0 \tag{8.6}$$

From (8.1) we have that $B_i' = -c_i'$ and so, by using (8.3) and (8.5) it emerges that $a_i^F(t)$ solves:

$$c_i'[a_i^F(t)] = t + \mu_i(t)z_i' \tag{8.7}$$

In words, a rational firm chooses to abate up to that point where its marginal cost of abatement equals the sum of its marginal private cost of pollution and its altruistic cost of emissions.

Few things are noteworthy here. First, when no emission tax is imposed (i.e., $t = 0$), (8) indicates that $a_i^F(0) \geq 0$ with equality if $M_\varepsilon^i(0) = \mu_i(0)z_i' = 0$. In other words, in the absence of an emission tax a firm is *not* willing to undertake abatement activities if and only if its abatement choices are determined in a pure self-interest fashion. Such a situation arises if a firm is egoistic (i.e., $v_i < \underline{v} \Leftrightarrow \mu_i(0) = 0$) and/or the number of firms is sufficiently large (i.e., $N > \overline{N} \Leftrightarrow z_i' = 0$).

The policy implication of such an observation is twofold. First, it stresses that the social planner can induce abatement without imposing an emission tax, as long as

43: Such a policy might take the form of an information-based strategy, like information disclosure. The usefulness of incorporating information-based strategies into environmental policy design has been advocated by many scholars (e.g., Brekke et al., 2003).

she can facilitate a policy, y, such that $M_\varepsilon^i(0; y) > 0$. [(43)] More importantly, it emphasizes that the design of y is affected by both the type and the number of firms. For instance, if N is not sufficiently large (e.g., regulated markets), then $z_i' > 0$ for all firms. In such a case, (8) points that $a_i^F(0) > 0$ for any $i = 1,2, \dots, m$, whereas $a_i^F(0) = 0$ for any $i = m+1, m+2, \dots, N$. That is, the primary target of the policy y should be to (instrumentally) increase egoistic firms' propensity for altruistic actions, by -for instance- increasing their environmental values. On the contrary, if N is sufficiently large (e.g., in competitive markets), then $z_i' = 0$ for all firms. In such a case, the policy y should not only increase egoistic firms' propensity for altruistic actions, but also it needs to increase the value of z_i' for both altruistic and egoistic firms. The latter might be achieved by information campaigns that emphasize the potential social benefits that are associated with emission reduction, even in cases where emissions emanate from many sources.

Second, an important policy question is related to the impact of an emission tax on firms' optimal abatement choices relative to the status quo (i.e., no emission tax is imposed). Since $c_i(a_i)$ is an increasing and convex function in abatement, (8) indicates that:

Lemma 8.1: *An emission tax, $t > 0$, yields $a_i^F(t) \geq a_i^F(0)$ if and only if $t \geq \Delta M_\varepsilon^i(t)$, where $\Delta M_\varepsilon^i(t) = [\mu_i(0) - \mu_i(t)]z_i'$.*

In words, lemma 8.1 argues that an emission tax instigates abatement if it exceeds the differences of firms' marginal altruistic cost of emissions before and after the tax. It is straightforward that $a_i^F(t) > a_i^F(0)$ for any $t > 0$ if firms are egoistic [(44)] and/or the number of firms is sufficiently large (i.e., $N > \overline{N} \Leftrightarrow z_i' = 0$). However, the situation is inconclusive if the market is consisted by altruistic firms, and the number of all firms is not too large. In such a case, lemma 1 implies that for any altruistic firm it exists an emission tax $t_i' > 0$ under which altruistic firms' abatement choices before and after the tax remain the same, i.e., $t_i' = \Delta M_\varepsilon^i(t_i') \Rightarrow a_i^F(t_i') = a_i^F(0)$.

44: Recall that for an egoistic firm, $\mu_i(0) = 0$. Since $\mu_i'(t) < 0$ and $\mu_i(t) \geq 0$ it emerges that $\mu_i(t) = 0$ for any $t \geq 0$.

At this point, one should recall that for any altruistic firm there exists an emission tax, $\hat{t}_i$ that yields $\mu_i(\hat{t}_i) = 0$. Hence, if $t_i' > \hat{t}_i$, then it could be stated that an emission tax of t_i' fully "privatize" firms' initial marginal altruistic cost of emissions (i.e., $t_i' = M_\varepsilon^i(0)$). In such a case, a firm does not exhibit any altruistic considerations and therefore, any $t > t_i'$ yields $a_i^F(t) > a_i^F(t_i') = a_i^F(0)$. On the contrary, if $t_i' < \hat{t}_i$, then a firm continuous to exhibit a propensity for altruistic actions and so, it could be stated that t_i' "privatizes" the loss of firms' marginal altruistic cost of emissions (i.e., $t_i' =$

$\Delta M_{\varepsilon}^{i}(t_i'))$. In this latter case, lemma 1 implies that there will be another threshold, $t_i'' > \hat{t}_i$, such that $t_i'' = M_{\varepsilon}^{i}(0) \Rightarrow a_i^F(t_i'') = a_i^F(0)$. The following lemma summarizes the previous discussion.

Lemma 8.2: *Provided that $N < \overline{N}$, for any altruistic firm $i = 1,2,\dots,m$ exists a pair (t_i', t_i'') such that $a_i^F(t_i') = a_i^F(t_i'') = a_i^F(0)$, given that $t_i' < \hat{t}_i$. On the contrary, if $t_i' > \hat{t}_i$, then t_i' converges to t_i''.*

Thus, by using lemmas 8.1 and 8.2 it is proposed that (see Appendix for the proof):

Proposition 8.1: *An emission tax $t > 0$ yields $a_i^F(t) > a_i^F(0)$: (i) for any egoistic firm; (ii) for all firms, provided that $N \geq \overline{N}$; (iii) for an altruistic firm if condition $\{t \notin (t_i', t_i'')$ and $\mu_i''(t) < 0\}$ or $\{t > t_i'$ and $\mu_i''(t) > 0\}$ holds, provided that $N < \overline{N}$.*

Proposition 8.1 suggests that the impact of a small (i.e., $t < t_i'$) to intermediate (i.e., $t \in (t_i', t_i'')$) emission tax on altruistic firms' optimal abatement choices is conditional on the structure of their propensity to act altruistically. In this article, it is assumed that such a propensity has either a convex (i.e., $\mu_i'' > 0$ and thereafter, the altruistic firm is labeled as "convex") or a concave (i.e., $\mu_i'' < 0$ and thereafter, the altruistic firm is labeled as "concave") structure. Proposition 1 argues that low emission taxes are sufficient policy measures towards emission reduction, provided that altruistic firms are concave. In the case of convex altruistic firms, however, proposition 1 claims that intermediate emission taxes should be imposed instead.

The rationale is that an emission tax increases firms' private cost of pollution and at the same time, it decreases their altruistic cost of emission, through a decreased propensity for altruistic actions. Concavity implies that firms' propensity for such actions is not responsive to a low emission tax, meaning that the change of firms' propensity for altruistic actions before and after the tax is negligible. Consequently, the increased private cost of pollution can "cancel-off" that change, forcing the firm to further expand its abatement activities. Following the terminology of Lindenberg (2001) a low emission tax prompts abatement to concave firms because concavity induces *compatibility* between firms' profit-seeking and altruistic-compliance behavior, i.e., increasing abatement is desirable from both a profit-seeking and an altruistic point of view. On the contrary, convexity implies that firms' propensity for altruistic actions is responsive to low emission taxes, meaning that the change on firm's propensity for altruistic actions before and after the tax is non-negligible. In such a case, a firm's private cost of emissions cannot "cancel-off" that change, forcing a convex firm actually to increase its emissions relative to the status quo. Lindenberg (2001) attributes such a *crowding-out effect* on the *incompatibility* between firm's overarching goal, meaning that once an emission tax is imposed, abatement becomes desirable from a profit-seeking but less desirable from a altruistic perspective.

More importantly, proposition 1 reveals that if the social planner's primarily objective is to induce abatement to any firm, then differentiated emission taxes should be imposed, unless sufficiently large emission taxes are technically and/or politically feasible, or the number of firms is large enough. To date, the usefulness of differentiated emission taxes is usually justified by social equity concerns (Abrell et al., 2018) or by virtue of the fact that externalities are regionally differentiated (Claassen and Horan, 2001; Kuwayama and Brozović, 2013). Our analysis identifies another reason, the agent's altruistic heterogeneity in terms of the structure of their altruistic cost of emissions, as it is defined by (8.5). On the contrary, the social planner may instead be interested in increasing aggregate abatement, defined as $A^F(t) = \sum a_i^F(t)$, regardless of firms' own abatement is increased or not. In such a case, it could be argued that a small to intermediate uniform emission tax, $t_u > 0$, is weakly preferred over a differentiated emission tax, $t_d = (t_1, t_2, \dots, t_N)$, such that $a_i^F(t_i) > a_i^F(0)$ for any $i = 1,2,\dots,N$, if and only if $A^F(t_u) \geq A^F(t_d)$. The following proposition summarizes the above discussion:

Proposition 8.2: *A social planner should:*

(i) *impose differentiated emission taxes if she wants to facilitate abatement to all firms, provided that their number is not sufficiently large. In particular, egoistic and concave altruistic firms should be taxed by a low emission tax, whereas convex altruistic firms should be taxed by an intermediate emission tax.*

(ii) *impose uniform emission taxes if the number of firms is sufficiently large and/or sufficiently high emission taxes are technically and/or politically feasible. Otherwise, the choice between differentiated and small to intermediate uniform emission taxes is determined by whether* $A^F(t_u) \gtrless A^F(t_d)$.

Proposition 8.2 bears a close resemblance to the postulate of Gneezy and Rustichini (2000b), according to which small to intermediate uniform fines are likely to backfire. The analysis presented here argues that such a backfire effect can be attributed to agents' convex altruistic preferences (see lemma 1), provided that the number of agents is small. Consequently, the policy recommendation that arises here is that the social planner should "tax enough or should not tax at all" if she knows that the market is comprising by both egoistic and convex altruistic firms. Instead, if altruistic firms characterized by concave altruistic preferences, then the policy recommendation is "tax but not enough". Finally, if the market is comprising of both egoistic, convex and concave firms, then the policy recommendation is ``use differentiated emission taxes, t_d, unless $A^F(t_u) > A^F(t_d)$.

8.2.2. Social Planner

The main purpose of the previous section was to explore firms' responses to an emission tax and specifically, to determine under which conditions such a policy prompts firms to increase their abatement activities. In this section, the analysis presents how emission taxes should be designed to induce the socially desirable level of abatement.

To begin with, the social planner knows that firms' profits from abatement are $\pi_i(a_i;t)$ and also, she knows that firms determine their abatement choices by (8.6). In addition, she also knows that the emissions generated by all firms through their production and abatement activities create a social damage, $D(E) > 0$, with $E = \sum \varepsilon_i$, such that $D'(E) > 0$ and $D''(E) > 0$. Moreover, by imposing an emission tax, $t > 0$, the social planner knows that the social net benefit of emissions of are $tE - D(E)$. 0 [45] Thus, the problem for the social planner can be described as: [46]

$$\max_{\{a_i,t\}} \sum \pi_i(a_i;t) + tE - D(E), \text{ s.t. } \pi_a^i(t) + M_\varepsilon^i(t) = 0 \tag{8.8}$$

It can be shown (see Appendix for the proof) that:

Lemma 8.3: *For any firm $i = 1,2,\dots,N$, it exists a pair (a_i^S, t_i^*) such that $(a_i^S, t_i^*) = (a_i^F, t_i^*)$, where the triplet $(a_i^S, t_i^*, \lambda_i^*)$ solves the first-order conditions: $c_i'(a_i^S) = D'(E^*)$; $t_i^* = D'(E^*) - \mu_i(t_i^*)z_i'$; $\lambda_i^* = 0$, with $E^* = \sum(\bar{e}_i - a_i^S)$.*

In words, lemma 8.3 states that the society demands from each firm to abate up to the point where the firm's marginal cost of abatement equals the marginal social damage. Since firms' actual abatement choices are determined by (2.6), lemma 8.3 argues that the social planner knows that each

45: Note that this benefit of emissions can be zero in case where the total (emission) tax revenues equal the total damage. This limiting case is also known as the budget balancing property of (emission) taxes (Horan et al., 1998).

46: Note that this is a simplified form of the social planner's objective function since it does not account for the socially optimal production level. A compete definition of it could be: $\int_0^Q P(Q)dQ + \sum \pi_i(a_i;t) + tE - D(E)$, where $P(Q)$ is the inverse demand function and $Q = \sum q_i$.

firms has an incentive to comply with the social demand (i.e., $a_i^F = a_i^S$) if it is taxed by an emission tax $t^* = (t_1^*, t_2^*, \dots, t_N^*)$.

Few things are noteworthy here. To begin with, one can easily observe that the value of the optimal emission tax, t_i^*, is conditional on the firm's marginal altruistic cost of emissions, $M_\varepsilon^i(t)$. Specifically, if $M_\varepsilon^i(0) = 0$, then $t_i^*[M_\varepsilon^i(0)] = D'(E^*)$. In words, if a firm is egoistic (i.e., $v_i < \underline{v} \Leftrightarrow \mu_i(0) = 0$) or if the number of firms is sufficiently large (i.e., $N \geq \overline{N} \Leftrightarrow z_i' = 0$), then the social planner can induce the socially optimum abatement to that firm by imposing an emission tax that equals the marginal social damage, i.e., by imposing a Pigouvian emission tax. Such a statement could also be made in situations where $M_\varepsilon^i(0) > 0$. Specifically, by denoting $t^P \equiv D'(E^*)$ it is argued that (see Appendix for the proof):

Lemma 8.4: *Provided that $N < \overline{N}$, the Pigouvian emission tax, t^P, yields $a_i^F(t^P) = a_i^S$ for any altruistic firm $i = 1,2,\dots,m$ if $t^P \geq \hat{t}_i$. On the contrary, if $t^P < \hat{t}_i$, then $t_i^* < t^P$.*

In words, lemma 8.4 indicates that if the social planner knows that under a Pigouvian emission tax firms' marginal altruistic cost of emissions is completely crowded-out (i.e., $M_\varepsilon^i(t^P) = 0$) then she can induce the socially optimum abatement by imposing that Pigouvian emission tax. On the contrary, if she knows that the firm continues to exhibit a propensity for altruistic actions after the Pigouvian tax (i.e., $\mu_i(t^P) > 0$) then a lower to Pigouvian emission tax should be used instead. This observation partially confirms the finding of Johansson (1997), who claims that if agents are characterized by genuine altruistic preferences, then the optimal tax is always lower than the standard Pigouvian one. Our analysis reveals that such a result is valid only if firms' propensity for altruistic actions is not responsive to emission taxes, meaning that under t_i^* a firm determines its abatement choices from both a profit-seeking and altruistic-compliance point of view. Such a situation is more likely to arise if altruistic firms are concave. Thus, we can redefine the result of Johansson (1997) by asserting that under the assumption of genuine altruistic preferences, optimal (emission) tax should be lower than the Pigouvian one, if agents' (i.e., firms) altruistic preferences have a concave structure with respect to (environmental) taxation.

Furthermore, lemma 8.3 reveals that there exists a subset of firms that are willing to abate at the socially optimum level without requiring any emission tax to induce them. Specifically, it is straightforward to show that if $\mu_i(0) \geq D'(E^*)/z_i' \Leftrightarrow M_\varepsilon^i(0) \geq D'(E^*)$, then the optimal emission tax is $t_i^* = 0$. In other words, if firms' initial (i.e., before the tax) marginal altruistic cost of emissions equals, at least, the marginal social damage at the optimum level of (actual) emissions, then it is of the social planner's best interest to impose nothing. By using lemma 4 and the aforementioned discussion it is proposed that:

Proposition 8.3: *A social planner who wants to induce the socially optimum abatement should impose* $t_i^* = t^P$ *to any firm, provided that* $N \geq \overline{N}$*. If* $N < \overline{N}$*, however, then she should impose an emission tax* $0 \leq t_i^* \leq t^P$*, with* $t_i^* = 0$ *to those altruistic firms characterized by* $M_\varepsilon^i(0) \geq D'(E^*)$*, and with* $t_i^* = t^P$ *to both egoistic and altruistic firms that characterized by* $t^P \geq \hat{t}_i$*.*

Proposition 8.3 contributes to the discussion regarding the importance of targeted environmental policies that take into account agents' characteristics, namely their altruistic cost of emissions as it is prescribed by firms' propensity for altruistic actions and firms' beliefs regarding the damage that their emissions cause on others' well-being (see (8.7)). In particular, one should recall that convex altruistic firms are responsive to an emission tax compared to concave altruistic ones. Thus, a situation of $t^P \geq \hat{t}_i$ is more likely to be arise in situations where firms' propensity to act altruistically has a convex structure. Thus, the prescription that emanates from proposition 3 is that both egoistic and altruistic convex firms should be taxed by a Pigouvian tax, whereas concave altruistic firms should be taxes by a lower one. In cases, however, where the initial propensity for altruistic action (and consequently, their initial marginal altruistic cost of emissions) of any altruistic firm is sufficiently large, then only egoistic firms should be taxed.

Furthermore, one should note that compliance with the social optimum abatement does not necessarily mean that each and every firm improves its environmental performance. Proposition 1 indicates that in case of a concave altruistic firm an emission tax t_i^* yields $a_i^F(t_i^*) = a_i^S > a_i^F(0)$ if $t_i^* \notin (t_i', t_i'')$, whereas in the case of a convex altruistic firm a similar result is obtained if $t_i^* > t_i'$.

Last but not least, the social planner may not has the means to correctly set the optimal tax t_i^*. In such a case, Daube and Ulph (2016) argue that for any $t \neq t_i^*$ firms' actual abatement is always sub-optimal (i.e., $a_i^F(t) < a_i^S$). Our analysis contradicts this result. Specifically, by using (2.7) and given that $c_i(a_i)$ is an increasing and convex function in abatement, it is stated that:

Lemma 8.5: *An emission tax* $t \neq t_i^*$ *yields* $a_i^F(t) \geq a_i^S$ *if and only if* $\Delta t_i \geq \Delta\mu_i z_i'$*, where* $\Delta t_i = t - t_i^*$ *and* $\Delta\mu_i = \mu_i(t_i^*) - \mu_i(t)$*.*

Particularly, if $|\Delta t_i|$ is small, then the difference between firms' actual and the social optimum abatement can be approximated by using Taylor approximation. Specifically, we have that (see Appendix for the proof):

$$T_{t_i^*,(k)} \equiv a_i^F(t) - a_i^S \approx \frac{(t - t_i^*)\left(1 + z_i' S_{i,(k)}\right)}{c_i''\left(a_i^F\right)}, \qquad S_{i,(k)} = \sum_{k=1} \frac{\mu_i^{(k)}(t)(t - t_i^*)^{k-1}}{k!} \tag{8.9}$$

where $k \geq 1$ is the kth order derivative under which the difference between firms' actual and the social optimum abatement is approximated. [47] In other words, for any $t > 0$ that it is closed to the optimal emission tax, t_i^*, the value of $T_{t_i^*,(k)}$ approximates the impact -in terms of abatement- of social planner's inefficiency to set emission taxes correctly. It is straightforward that:

47: Note that k can also be interpreted as the degree of accuracy of the approximated value, meaning that the higher k is, the closer the approximated value is to the

Lemma 8.6: *If* $S_{i,(k)} \geq -1/z_i'$, *then* $T_{t_i^*,(k)} \geq 0 \Rightarrow a_i^F > a_i^S$ *and opposite otherwise, provided that* $t > t_i^*$. *A similar result is obtained if* $S_{i,(k)} < -1/z_i'$, *provided that* $t < t_i^*$.

Lemmas 8.5 and 8.6 draw an important policy implication. By imposing an emission tax $t \neq t_i^*$ to any firm $i = 1,2, \dots, N$, the social planner knows that she cannot achieve the socially optimum abatement at a firm-level. However, it may be possible to achieve it in aggregate level, as long as the equality $\sum T_{t_i^*,(k)} = 0$ is satisfied.

8.3. Discussion and Conclusion

In this article, a theoretical model was presented that seeks to describe firms' abatement choices, provided that their altruistic cost of emissions -if any- has either a concave or a convex structure. The contribution of this article to the current literature on the design of emission taxes can be summarized in the following:

First, an important policy question is how strict an emission tax should be in order to induce emission abatement relative to the status quo (i.e., no emission tax is imposed). Clearly, if sufficiently high emission taxes are technically and/or politically feasible, then firms' altruistic cost of emissions is a negligible factor. On the contrary, for small to intermediate emission taxes the analysis presented here argues that whether such policy measures instigate abatement is conditional on both the number of firms and on the structure of (altruistic) firms' propensity to act altruistically. Specifically, if the number of firms is sufficiently large, then even a small emission tax can instigate abatement to any firm, regardless of the structure of firms' altruistic cost of emissions -if any. On the contrary, if the number of firms is not so large, then small emissions taxes should be used for egoistic and concave altruistic firms, whereas intermediate emission taxes should be imposed to convex altruistic firms (see proposition 8.1). This result stresses the importance of implementing differentiated emissions taxes, especially when the size of the market is small to medium. If, however, differentiated emission taxes are not feasible, a uniform small/intermediate emission tax might induce abatement, but only at the aggregate level.

Second, another policy-relevant question is related to the optimal tax that induces the socially optimum level of abatement. Typically, these optimal taxes are set to be equal to the marginal social damage (i.e., Pigouvian taxes). If we incorporate genuine altruism into the analysis, the conclusion is ambiguous. Models similar to Johansson (1997) argue that the optimal (emission) taxes should be lower than the Pigouvian one, whereas others find no effect of genuine altruism on the tax that induces the socially optimum behavior (Daube and Ulph, 2016). In our analysis, we model genuine altruism (i.e., altruistic cost of emissions) as the product of firms' beliefs regarding the damage that their emissions cause to others and the propensity that these firms exhibit to account for these beliefs when they determine their abatement choices, where such propensity is responsive to external factors, i.e., an emission tax. In such a setup, our analysis reveals that the optimal emissions taxes lie somewhere in between. Specifically, Pigouvian emission taxes should be imposed to both egoistic and altruistic firms, provided that altruistic firms' propensity (and hence, its marginal altruistic cost of emissions) to act altruistically is completely crowding-out (see proposition 8.3). On the contrary, firms that are characterized by concave altruistic preferences should be taxed by a lower emission tax, whereas those firms whose initial (i.e., before the tax) marginal altruistic cost of emissions is sufficiently large, should be not taxed at all (see proposition 8.3).

Third, Daube and Ulph (2016) argue that for any emission tax rate different than the optimal one, agents' performance is always sub-optimal, regardless their altruistic/altruistic preferences. The analysis presented here contradicts this result. In particular, it argues that even the social planner may not be able to set the optimal tax correctly, she still may be able to achieve the socially optimum abatement, but only at the aggregate level (see lemmas 8.5 and 8.6).

The rationale is that firms may not only be heterogeneous with respect to their initial propensity for altruistic actions, but most importantly, on how responsive such propensity is to emission taxes. When optimal emission taxes are imposed, a firm adjusts its abatement choices around the socially optimum, meaning that a firm may decrease its abatement relative to the status quo. If, however, a non-optimal taxes imposed instead, a firm may be less responsive than under the optimal one, arising a situation where some firms over-abate where others do not (see lemma 8.5), making possible for the aggregate socially optimum abatement to be achieved.

Finally, the limitations of our analysis should be spelled out. In this article, abatement choices are static and also, they exclude any effects that derive from interaction among firms. Lindenberg and his colleagues (Lindenberg, 2001; Lindenberg and Steg, 2007; 2013) argue that agents' goals are chronically active, meaning that the strength of agent's overarching goals are not fixed across time. In that context, firms' propensity for altruistic action might also be time and space specific. Future extensions will address these issues.

CONCLUSION

9. Summary and Future Research

9.1. Summary

The purpose of this doctoral dissertation was to contribute to the current literature on producers' behavior by incorporating elements from psychology into economic rationality. Specifically, the brief literature review of psychological theories on pro-environmental behavior (chapters 2 – 6) emphasizes (a) the mighty role of psychological constructs, like attitudes, values, norms, (overarching) goals, on pro-environmental choices for both individuals and producers; (b) the importance of analysis simultaneously the effects of intrinsic and extrinsic motives on pro-environmental behaviors; (c) the usefulness of utilizing the Goal-Framing Theory over the Motivation Crowding Theory in explaining producers' (pro-environmental) behavior.

The main results that are drawn from the two theoretical models (chapters 7 – 8) can be summarized on the following. First, it might be more important to explore crowding effects on normative goal preferences rather than on environmental morale, per se, since environmental preferences affect production choices indirectly through their impact on the relative strength of producers' normative goal. Second, production choices may be conditional on the type of the incentive provider. For instance, price premiums may convey a stronger signal over normative actions, since organic consumption is desirable by the wider society (Frey, 1992). Consequently, the likelihood for a crowding-out effect on producers' normative goal preferences might be weak over price premiums than land subsidies. In such cases, social planner's intervention should be kept at the minimum, because price mechanisms can foster producers' environmental performance. More importantly, in cases where only a single payment is feasible, the choice between land subsidies and price premiums depends on social planner's objectives. If a social planner wants to foster both organic input use and vertical integration, then no intervention is necessary. Price premiums can yield the desire outcome by themselves. On the contrary, if a social planner cares only for one of the two pro-environmental behaviors, then the choice between land subsidies and price premiums is specified by the crowding effect been expected under each incentive, both in absolute and relative terms.

Third, the model on firms' abatement choices emphasizes the mighty role of the "sensitivity" of intrinsic motives to external interventions. Thus, firms' responses to an emission tax might be conditional on its size, especially when too high emission taxes are technically and/or politically infeasible. The policy implication is that uniform emission taxes might increase abatement only an aggregate level, since at the firm level some of them may increase whereas others may decrease their abatement relative to the status quo (no emission tax is imposed). Fourth, emission taxes that induce the socially optimum abatement level might be lower than the Pigouvian tax for those firms that their intrinsic motives are not so “sensitive” to environmental taxation. Finally, current literature shows that when optimal emission taxes cannot be set correctly, then performance (i.e., level of abatement) is suboptimal. Our model supports this view but only at a firm level. In cases where uniform, ill-defined emission taxes are the only feasible choice, socially optimum abatement can be achieved at the aggregate level, as long as the difference between that uniform tax and the optimal one is low enough.

9.2. Future Research

During the last years, academia expresses a strong interest on empirically and experimentally identifying any psychological factors that guide producers’ choices. (48) Thus, a potential area for future research could be the experimental and/or empirical support of the theoretical results presented in chapters 7 – 8. Secondly, the theoretical models presented in this dissertation are static with respect to both time and space. In many cases, the environmental benefits come much latter than their associated costs. Thus, producers may adopt a more “myopic” view on their engagement on pro-environmental behavior. In addition, space also matters. For instance, producers who operate closer to nature may express stronger pro-environmental preferences and consequently, the relative strength of their normative goal might be stronger as well compared to those operate in e.g., urban areas. Finally, the analysis presented here does not count foe any interactions among producers (farmers or firms). In reality, however, people are sensitive on peers’ behavior. For instance, a farmer who successfully managed to adopt organic farming practices may influence other farmers to switch to organic farming, even though their propensity for behaving pro-environmentally is low. We leave to future research to deal with these questions.

48: For instance, in its special issue the European Review of Agricultural Economics presents how the agricultural policy can be benefit by utilizing experimental methods on understanding farmers’ behavior (Thoyer and Préget,

APPENDIX

A. Proof of lemmas and propositions on input use and vertical integration

Deriving the impact of s_L on the optimal solution, (x_o^*, k^*)

Note that (x_o^*, k^*) satisfies the first order condition:

$$\frac{\partial u_o}{\partial x_o} = (1-\theta)[(p+s_P)\phi_o'(x_o^*) - w_o(k^*)] = 0 \Rightarrow \phi_o'(x_o^*) = \frac{w_o(k^*)}{p+s_P} \qquad (A.1)$$

and

$$\frac{\partial u_o}{\partial k} = -(1-\theta)x_o^* w_o'(k^*) + \theta b'(k^*) = 0 \Rightarrow \frac{b'(k^*)}{w_o'(k^*)} = \left(\frac{1-\theta}{\theta}\right)x_o^* \qquad (A.2)$$

Given that $w_o''(k) = 0$, a differentiation of both sides of (A.2) with respect to s_L yields:

$$\frac{b''(k^*)}{w_o'(k^*)}\frac{\partial k^*}{\partial s_L} = x_o^* \frac{\partial\left(\frac{1-\theta}{\theta}\right)}{\partial\theta}\frac{\mathrm{d}\theta}{\mathrm{d}s_L} + \left(\frac{1-\theta}{\theta}\right)\frac{\partial x_o^*}{\partial k^*}\frac{\partial k^*}{\partial s_L} \Rightarrow \frac{\partial k^*}{\partial s_L}\left[\frac{b''(k^*)}{w_o'(k^*)} - \left(\frac{1-\theta}{\theta}\right)\frac{\partial x_o^*}{\partial k^*}\right] = -\frac{x_o^*}{\theta^2}\frac{\mathrm{d}\theta}{\mathrm{d}s_L} \quad (A.3)$$

Moreover, a differentiation of both sides of (A.1) with respect to s_L yields:

$$\phi_o''(x_o^*)\frac{\partial x_o^*}{\partial s_L} = \frac{\partial\left(\frac{w_o(k^*)}{p+s_P}\right)}{\partial k^*}\frac{\partial k^*}{\partial s_L} \Rightarrow \frac{\partial x_o^*}{\partial s_L} = \frac{w_o'(k^*)}{\phi_o''(x_o^*)(p+s_P)}\frac{\partial k^*}{\partial s_L} \qquad (A.4)$$

However, also note that a differentiation of both sides of (A.1) with respect to k^* yields:

$$\phi_o''(x_o^*)\frac{\partial x_o^*}{\partial k^*} = \frac{\partial\left(\frac{w_o(k^*)}{p+s_P}\right)}{\partial k^*} \Rightarrow \frac{\partial x_o^*}{\partial k^*} = \frac{w_o'(k^*)}{\phi_o''(x_o^*)(p+s_P)} < 0 \qquad (A.5)$$

Thus, it turns out that:

$$\frac{\partial x_o^*}{\partial s_L} = \frac{\partial x_o^*}{\partial k^*}\frac{\partial k^*}{\partial s_L} \qquad (A.6)$$

Deriving the impact of $\boldsymbol{s_P}$ on the optimal solution,$(\boldsymbol{x_o^*}, \boldsymbol{k^*})$

Likewise, given that $w_o''(k) = 0$, a differentiation of both sides of (A.2) with respect to s_P yields:

$$\frac{b''(k^*)}{w_o'(k^*)}\frac{\partial k^*}{\partial s_P} = x_o^* \frac{\partial\left(\frac{1-\theta}{\theta}\right)}{\partial\theta}\frac{\mathrm{d}\theta}{\mathrm{d}s_P} + \left(\frac{1-\theta}{\theta}\right)\frac{\partial x_o^*}{\partial s_P} \qquad (A.7)$$

whereas a differentiation of both sides of (A.1) with respect to s_P yields:

$$\phi_o''(x_o^*)\frac{\partial x_o^*}{\partial s_P} = \frac{\partial\left(\frac{w_o(k^*)}{p+s_P}\right)}{\partial s_P} \Rightarrow \phi_o''(x_o^*)\frac{\partial x_o^*}{\partial s_P} = \frac{w_o'(k^*)(p+s_P)\frac{\partial k^*}{\partial s_P} - w_o(k^*)}{(p+s_P)^2} \Rightarrow$$

$$\frac{\partial x_o^*}{\partial s_P} = \frac{w_o'(k^*)\frac{\partial k^*}{\partial s_P}}{\phi_o''(x_o^*)(p+s_P)} - \frac{w_o(k^*)}{\phi_o''(x_o^*)(p+s_P)^2} \qquad (A.8)$$

Thus, by using (A.1) and (A.5), equation (A.8) is equivalent to

$$\frac{\partial x_o^*}{\partial s_P} = \frac{\partial x_o^*}{\partial k^*}\frac{\partial k^*}{\partial s_P} - \frac{\phi_o'(x_o^*)}{\phi_o''(x_o^*)(p+s_P)} \qquad (A.9)$$

Therefore, by substituting (A.9) into (A.7) we get that:

$$\frac{b''(k^*)}{w_o'(k^*)}\frac{\partial k^*}{\partial s_P} = x_o^* \frac{\partial\left(\frac{1-\theta}{\theta}\right)}{\partial\theta}\frac{\mathrm{d}\theta}{\mathrm{d}s_P} + \left(\frac{1-\theta}{\theta}\right)\left(\frac{\partial x_o^*}{\partial k^*}\frac{\partial k^*}{\partial s_P} - \frac{\phi_o'(x_o^*)}{\phi_o''(x_o^*)(p+s_P)}\right) \Rightarrow$$

$$\frac{\partial k^*}{\partial s_P}\left[\frac{b''(k^*)}{w_o'(k^*)} - \left(\frac{1-\theta}{\theta}\right)\frac{\partial x_o^*}{\partial k^*}\right] = -\left[\left(\frac{1-\theta}{\theta}\right)\frac{\phi_o'}{(p+s_P)\phi_o''} + \frac{x_o^*}{\theta^2}\frac{\mathrm{d}\theta}{\mathrm{d}s_P}\right] \qquad (A.10)$$

B. Proof of lemmas and propositions on abatement choices

Proof of Proposition 8.1

Comparative statics of (8.8) yields that:

$$h_i(t) \equiv \frac{\mathrm{d}a_i^F(t)}{\mathrm{d}t} = \frac{\mu_i'(t)z_i'}{c_i''(a_i^F)} \qquad (B.1)$$

If a firm is egoistic or $N \geq \overline{N}$, then the numerator of h_i becomes zero and so, $h_i(t) > 0$ for any $t > 0$. A similar result is obtained for altruistic firms as well, as long as $t > t_i'' \Rightarrow \mu_i(t) = 0$. On the contrary, for any $t < t_i''$, firms' abatement choices can be analyzed on the intervals $(0, t_i')$ and (t_i', t_i''). Since $\mu_i(t_i') > 0$ and $a_i^F(t_i') = a_i^F(0)$ it emerges that $h_i(t_i') = 0$. In addition, $h_i'(t) = \mu_i''(t)/c_i''(a_i^F)$. Hence, $\mu_i''(t) > 0 \Rightarrow h_i'(t) > 0$ and opposite otherwise. Thus, any $t > t_i' \Rightarrow h_i(t) > h_i(t_i') \Rightarrow h_i(t) > 0$, provided that $\mu_i''(t) > 0$. Following the similar reasoning we can show that any $t < t_i'$ yields the same result, whereas a $t > t_i'$ yields the opposite result, provided that $\mu_i''(t) < 0$.

Proof of Lemma 8.3

By using the Langragian method and (8.4), social planner's problem becomes:

$$\max_{\{a_i, t_i, \lambda_i\}} \mathcal{L} = \sum B_i(a_i) - D(E) - \sum \lambda_i[B_i'(a_i) + t_i + \mu_i(t_i)z_i'] \qquad (B.2)$$

where the first-order conditions for an interior optimum are:

$$\frac{\partial \mathcal{L}}{\partial a_i} = B_i'(a_i) + D'(E) - \lambda_i B_i''(a_i) = 0 \qquad (B.3)$$

$$\frac{\partial \mathcal{L}}{\partial t_i} = -\lambda_i = 0 \qquad (B.4)$$

$$\frac{\partial \mathcal{L}}{\partial \lambda_i} = -[B_i'(a_i) + t_i + \mu_i(t_i)z_i'] = 0 \qquad (B.5)$$

Thus, from (1), (2) and for $\lambda_i = 0$, (B.3) indicates that for any firm is exists an abatement level a_i^S that solves $c_i'(a_i^S) = D'(E^*)$, with $E^* = \sum(\bar{e}_i - a_i^S)$. In addition, from (B.3) and (B.5) it emerges that given a_i^S, it exists an emission tax, t_i^* that solves $D'(E^*) = t_i^* + \mu_i(t_i^*)z_i' \Leftrightarrow t_i^* = D'(E^*) - \mu_i(t_i^*)z_i'$. Furthermore, firms' actual abatement is determined by (8), which for $t = t_i^*$ it becomes: $c_i'[a_i^F(t_i^*)] = t_i^* + \mu_i(t_i^*)z_i' \Leftrightarrow c_i'[a_i^F(t_i^*)] = D'(E^*) - \mu_i(t_i^*)z_i' + \mu_i(t_i^*)z_i' \Leftrightarrow c_i'[a_i^F(t_i^*)] = D'(E^*)$. However, we know that $c_i'(a_i^S) = D'(E^*)$. Consequently, under an emission tax of t_i^* we obtain that $c_i'[a_i^F(t_i^*)] = c_i'(a_i^S) \Leftrightarrow a_i^F(t_i^*) = a_i^S$.

Proof of Lemma 8.4

Recall that any $t \geq \hat{t}_i$ yields $\mu_i(t) = 0$. Thus, if $t^P \geq \hat{t}_i$, then the equality $t_i^* = D'(E^*) - \mu_i(t_i^*)z_i'$ is satisfied for $t_i^* = t^P$. On the contrary, if $t^P < \hat{t}_i$, then $\mu_i(t^P) > 0$ and consequently, the aforementioned equality is violated for $t_i^* = t^P$, whereas the inequality $t_i^* < t^P$ is satisfied.

Deriving the value of $T_{t_i^*,(k)}$

By using Taylor approximation, the value of $a_i^F(t)$ close to t_i^* is approximated as:

$$a_i^F(t) \approx$$
$$a_i^F(t_i^*) + a_i^{F(1)}(t)(t - t_i^*) + \frac{a_i^{F(2)}(t)(t - t_i^*)^2}{2} + \frac{a_i^{F(3)}(t)(t - t_i^*)^3}{6} + \cdots + \frac{a_i^{F(k)}(t)(t - t_i^*)^k}{k!} \quad (B.6)$$

where $a_i^{F(k)}$ is the kth derivative of $a_i^F(t)$ with respect to an emission tax, t.

Furthermore, recall that $a_i^F(t_i^*) = a_i^S$. In addition, $a_i^{F(1)}(t) = (1 + \mu_i'(t)z_i')/c_i''(a_i^F)$ (see Appendix, proof of proposition 1) and so, $a_i^{F(2)}(t) = \mu_i''z_i'/c_i''(a_i^F)$, $a_i^{F(3)}(t) = \mu_i'''z_i'/c_i''(a_i^F)$ and so on, since by assumption $c_i^{(k)}(a_i) = 0$ for any $k > 2$. Consequently, (B.6) becomes:

$$a_i^F(t) - a_i^F(t_i^*) \approx (t - t_i^*)\left[\frac{1 + \mu_i'(t)z_i'}{c_i''(a_i^F)} + (t - t_i^*)\frac{1 + \mu_i''(t)z_i'}{2c_i''(a_i^F)} + \cdots + (t - t_i^*)^{k-1}\frac{1 + \mu_i''(t)z_i'}{k!\,c_i''(a_i^F)}\right]$$

$$a_i^F(t) - a_i^F(t_i^*) \approx$$
$$\left(\frac{t - t_i^*}{c_i''(a_i^F)}\right)\left[1 + z_i'\left(\mu_i'(t) + \frac{(t - t_i^*)\mu_i''(t)}{2} + \frac{(t - t_i^*)^2\mu_i'''(t)}{6} + \cdots + \frac{(t - t_i^*)^{k-1}\mu_i^{(k)}(t)}{k!}\right)\right]$$

$$a_i^F(t) - a_i^F(t_i^*) \approx \frac{(t - t_i^*)\left(1 + z_i'S_{i,(k)}\right)}{c_i''(a_i^F)}, \qquad \text{where} \quad S_{i,(k)} = \sum_{k=1} \frac{(t - t_i^*)^{k-1}\mu_i^{(k)}(t)}{k!}$$

BIBLIOGRAPHY

Here is the list of references in alphabetical order:

Abrell J, Rausch S and Schwarz GA (2018), How robust is the uniform emissions pricing rule to social equity concerns?, *Journal of Environmental Economics and Management* **92**, 783–814.

Ahnström J, Höckert J, Bergeå HL, Francis CA, Skelton P and Hallgren L (2009), Farmers and nature conservation: What is known about attitudes, context factors and actions affecting conservation?, *Renewable agriculture and food systems* **24**(1), 38-47.

Ajzen I (1991), The theory of planned behavior, *Organizational behavior and human decision processes* **50**(2), 179-211.

Allen S and Marquart-Pyatt ST (2018), Workplace energy conservation at Michigan state university, *International Journal of Sustainability in Higher Education*.

Andersen LB, Jacobsen CB and Möller AL (2008), The effects of regulation on the work effort of researchers: Crowding in or crowding out?, in Danish Public Choice Workshop, Aarhus School of Business, University of Aarhus, Aarhus, January.

Andreoni J (1990), Impure altruism and donations to public goods: A theory of warm-glow giving, *The economic journal* **100**(401), 464–477.

Andreoni J (1993), An experimental test of the public-goods crowding-out hypothesis, *The American Economic Review*, 1317-1327.

Apaolaza V, Hartmann P, D'Souza C and López CM (2018), Eat organic–Feel good? The relationship between organic food consumption, health concern and subjective wellbeing, *Food Quality and Preference* **63**, 51–62.

Bagheri A, Bondori A, Allahyari MS and Damalas CA (2019), Modeling farmers' intention to use pesticides: An expanded version of the theory of planned behavior, *Journal of Environmental Management* **248**, 109291.

Bamberg S and Schmidt P (2003), Incentives, morality, or habit? Predicting students' car use for university routes with the models of Ajzen, Schwartz, and Triandis, *Environment and behavior* **35**(2), 264-285.

Bargh JA, Gollwitzer PM, Lee-Chai A, Barndollar K and Trötschel R (2001), The automated will: nonconscious activation and pursuit of behavioral goals, *Journal of personality and social psychology* **81**(6), 1014.

Barkema H (1995), Do Executives Work Harder When They Are Monitored?, *Kyklos: international review for social sciences*, 19-42.

Baumol WJ and Oates WE (1988), *The Theory of Environmental Policy*, Cambridge University Press.

Bénabou R and Tirole J (2006), Incentives and prosocial behavior, *American Economic Review* **96**(5), 1652–1678.

Benbrook C (2013), Are organic foods safer or healthier?, *Annals of Internal Medicine* **158**(4), 296–297.

Bergquist M, Nilsson A and Ejelöv E (2019), Contest-Based and Norm-Based Interventions:(How) Do They Differ in Attitudes, Norms, and Behaviors?, *Sustainability* **11**(2), 425.

Black JS, Stern PC and Elworth JT (1985), Personal and contextual influences on househould energy adaptations, *Journal of applied psychology* **70**(1), 3.

Bohnet I, Frey BS and Huck S (2001), More order with less law: On contract enforcement, trust, and crowding, *American political science review* **95**(1), 131-144.

Bopp C, Engler A, Poortvliet PM and Jara-Rojas R (2019), The role of farmers' intrinsic motivation in the effectiveness of policy incentives to promote sustainable agricultural practices, *Journal of Environmental Management* **244**, 320–327.

Borges JAR, Lansink AGO, Ribeiro CM and Lutke V (2014), Understanding farmers' intention to adopt improved natural grassland using the theory of planned behavior, *Livestock Science* **169**, 163-174.

Bösehans G and Walker I (2020), Do supra-modal traveller types exist? A travel behaviour market segmentation using Goal framing theory, *Transportation* **47**(1), 243-273.

Bowles S (2008), Policies designed for self-interested citizens may undermine" the moral sentiments": Evidence from economic experiments, *science* **320**(5883), 1605-1609.

Bowles S and Polania-Reyes S (2012), Economic incentives and social preferences: substitutes or complements?, *Journal of Economic Literature* **50**(2), 368–425.

Bratt C (1999), The impact of norms and assumed consequences on recycling behavior, *Environment and behavior* **31**(5), 630-656.

Brekke KA, Kverndokk S and Nyborg K (2003), An economic model of moral motivation, *Journal of Public Economics* **87**(9-10), 1967–1983.

Brodt S, Klonsky K and Tourte L (2006), Farmer goals and management styles: implications for advancing biologically based agriculture, *Agricultural systems* **89**(1), 90-105.

Brundtland GH (1987), Our common future—Call for action, *Environmental Conservation* **14**(4), 291-294.

Caparrós A, Just RE and Zilberman D (2015), Dynamic Relative Standards versus Emission Taxes in a Putty-Clay Model, *Journal of the Association of Environmental and Resource Economics* **2**(2), 277–308.

Cardenas JC, Stranlund J and Willis C (2000), Local environmental control and institutional crowding-out, *World Development* **28**(10), 1719-1733.

Chakraborty A, Singh MP and Roy M (2017), A study of goal frames shaping pro-environmental behaviour in university students, *International Journal of Sustainability in Higher Education*.

Chan KS, Godby R, Mestelman S and Muller RA (2002), Crowding-out voluntary contributions to public goods, *Journal of Economic Behavior & Organization* **48**(3), 305-317.

Chen MF (2015), An examination of the value-belief-norm theory model in predicting pro-environmental behaviour in T aiwan, *Asian Journal of Social Psychology* **18**(2), 145-151.

Cialdini RB, Kallgren CA and Reno RR (1991), *A focus theory of normative conduct: A theoretical refinement and reevaluation of the role of norms in human behavior*, in Advances in Experimental Social Psychology: Elsevier, 201-234.

Cialdini RB, Reno RR and Kallgren CA (1990), A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places, *Journal of personality and social psychology* **58**(6), 1015.

Claassen R and Horan RD (2001), Uniform and non-uniform second-best input taxes, *Environmental and Resource Economics* **19**(1), 1–22.

Cremer H and Gahvari F (2002), Imperfect observability of emissions and second-best emission and output taxes, *Journal of Public Economics* **85**(3), 385–407.

Crifo P and Forget VD (2015), The economics of corporate social responsibility: A firm-level perspective survey, *Journal of Economic Surveys* **29**(1), 112–130.

Dalvi-Esfahani M, Ramayah T and Rahman AA (2017), Moderating role of personal values on managers' intention to adopt Green IS: Examining norm activation theory, *Industrial Management & Data Systems*.

Dangour AD, Dodhia SK, Hayter A, Allen E, Lock K and Uauy R (2009), Nutritional quality of organic foods: a systematic review, *The American Journal of Clinical Nutrition* **90**(3), 680–685.

Daube M and Ulph D (2016), Moral behaviour, altruism and environmental policy, *Environmental and Resource Economics* **63**(2), 505–522.

De Charms R (2013), *Personal causation: The internal affective determinants of behavior*, Routledge.

De Graaff J, Amsalu A, Bodnar F, Kessler A, Posthumus H and Tenge A (2008), Factors influencing adoption and continued use of long-term soil and water conservation measures in five developing countries, *Applied Geography* **28**(4), 271-280.
De Groot JI and Steg L (2009), Morality and prosocial behavior: The role of awareness, responsibility, and norms in the norm activation model, *The Journal of social psychology* **149**(4), 425-449.
Deci EL (1976), The hidden costs of rewards, *Organizational Dynamics* **4**(3), 61-72.
Deci EL, Koestner R and Ryan RM (1999), A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation, *Psychological bulletin* **125**(6), 627.
Deci EL and Ryan RM (1985), *Cognitive evaluation theory*, in Intrinsic motivation and self-determination in human behavior: Springer, 43–85.
Deci EL and Ryan RM (2008), Self-determination theory: A macrotheory of human motivation, development, and health., *Canadian Psychology* **49**(3), 182.
Delaney J and Jacobson S (2016), Payments or persuasion: common pool resource management with price and non-price measures, *Environmental and Resource Economics* **65**(4), 747–772.
Dickinson D and Villeval M-C (2008), Does monitoring decrease work effort?: The complementarity between agency and crowding-out theories, *Games and Economic behavior* **63**(1), 56-76.
Echegaray F and Hansstein FV (2017), Assessing the intention-behavior gap in electronic waste recycling: the case of Brazil, *Journal of Cleaner Production* **142**, 180-190.
Ehrgott M and Wiecek MM (2005), *Mutiobjective Programming*, in Multiple Criteria Decision Analysis: State of the Art Surveys: Springer, 667-708.
Elster J (1989), Social norms and economic theory, *Journal of Economic Perspectives* **3**(4), 99–117.
Endres AB (2007), An Awkward Adolescence in the Organics Industry: Coming to Terms with Big Organics and Other Legal Challenges for the Industry's Next Ten Years, *Drake Journal of Agricultural Law* **12**, 17.
Engel S, Pagiola S and Wunder S (2008), Designing payments for environmental services in theory and practice: An overview of the issues, *Ecological Economics* **65**(4), 663–674.
Eriksson L, Garvill J and Nordlund AM (2006), Acceptability of travel demand management measures: The importance of problem awareness, personal norm, freedom, and fairness, *Journal of environmental psychology* **26**(1), 15-26.
Fang L and Rogerson R (2009), Policy analysis in a matching model with intensive and extensive margins, *International Economic Review* **50**(4), 1153–1168.
Farrens TC (2010), Shrinking Ice, Growing Problems: Why We Must Act Now to Solve Emerging Problems Posed by an Ice-Free Arctic, *Transnat'l L. & Contemp. Probs.* **19**, 655.
Fehr E and Falk A (2002), Psychological foundations of incentives, *European Economc Review* **46**(4-5), 687–724.
Fehr E and Gächter S (2001), Do incentive contracts crowd out voluntary cooperation?, *Available at SSRN 289680*.
Feinerman E and Gardebroek C (2007), Stimulating organic farming via publicly provided services and an auction-based subsidy, *European Review of Agricultural Economics* **34**(2), 141–159.
Feldman Y and Perez O (2012), Motivating environmental action in a pluralistic regulatory environment: An experimental study of framing, crowding out, and institutional effects in the context of recycling policies, *Law & Society Review* **46**(2), 405-442.
Fielding KS, Terry DJ, Masser BM and Hogg MA (2008), Integrating social identity theory and the theory of planned behaviour to explain decisions to engage in sustainable agricultural practices, *British journal of social psychology* **47**(1), 23-48.
Fishbein M (1979), A theory of reasoned action: some applications and implications.

Flannery T (2009), *Now or never: Why we must act now to end climate change and create a sustainable future*, Open Road+ Grove/Atlantic.
Folmer H and Johansson-Stenman O (2011), Does Environmental Economics Produce Aeroplanes Without Engines? On the Need for an Environmental Social Science, *Environmental and Resource Economics* **48**, 337–361.
Fornara F, Pattitoni P, Mura M and Strazzera E (2016), Predicting intention to improve household energy efficiency: The role of value-belief-norm theory, normative and informational influence, and specific attitude, *Journal of environmental psychology* **45**, 1-10.
Frey B and Stutzer A (2008), The Cambridge Handbook of Psychology and Economic Behaviour: Environmental morale and motivation, in.
Frey BS (1992), Pricing and regulating affect environmental ethics, *Environmental and Resource Economics* **2**(4), 399–414.
Frey BS (1993), Motivation as a limit to pricing, *Journal of Economic Psychology* **14**(4), 635-664.
Frey BS (1994), How intrinsic motivation is crowded out and in, *Rationality and society* **6**(3), 334–352.
Frey BS (1997a), A constitution for knaves crowds out civic virtues, *The economic journal* **107**(443), 1043-1053.
Frey BS (1997b), *Not Just for the Money*, Edward Elgar Publishing.
Frey BS (1999), Morality and rationality in environmental policy, *Journal of consumer policy* **22**(4), 395–417.
Frey BS, Benz M and Stutzer A (2004), Introducing procedural utility: Not only what, but also how matters, *Journal of Institutional and Theoretical Economics* **160**(3), 377–401.
Frey BS and Jegen R (2001), Motivation crowding theory, *Journal of Economic Surveys* **15**(5), 589–611.
Frey BS and Oberholzer-Gee F (1997), The cost of price incentives: An empirical analysis of motivation crowding-out, *The American Economic Review* **87**(4), 746–755.
Fullerton D and Wolverton A (2005), The two-part instrument in a second-best world, *Journal of Public Economics* **89**(9-10), 1961–1975.
Gächter S and Fehr E (1999), Collective action as a social exchange, *Journal of Economic Behavior Organization* **39**(4), 341–369.
Ghazali EM, Nguyen B, Mutum DS and Yap S-F (2019), Pro-environmental behaviours and Value-Belief-Norm theory: Assessing unobserved heterogeneity of two ethnic groups, *Sustainability* **11**(12), 3237.
Gkargkavouzi A, Halkos G and Matsiori S (2019), Environmental behavior in a private-sphere context: Integrating theories of planned behavior and value belief norm, self-identity and habit, *Resources, conservation and recycling* **148**, 145-156.
Gneezy U and Rustichini A (2000a), A fine is a price, *The journal of legal studies* **29**(1), 1-17.
Gneezy U and Rustichini A (2000b), Pay enough or don't pay at all, *The Quarterly journal of economics* **115**(3), 791–810.
Goeschl T and Perino G (2012), Instrument choice and motivation: evidence from a climate change experiment, *Environmental and Resource Economics* **52**(2), 195-212.
Goldstein B, Birkved M, Fernández J and Hauschild M (2017), Surveying the environmental footprint of urban food consumption, *Journal of Industrial Ecology* **21**(1), 151–165.
Gomez CMG (2001), On optimal environmental taxation and enforcement: information, monitoring and efficiency, *Natural Resource Modeling* **14**(1), 5–30.
Goncalves Da Silva MA, Roque SAT, Muniz AS, Marchetti ME, Da Matta JDDV and Pelisson N (2010), Efficiency of organic compost from Agri-Industrial wastes as fertilizer for corn and wheat, *Communications in Soil Science and Plant Analysis* **41**(21), 2517–2531.

Greiner R and Gregg D (2011), Farmers' intrinsic motivations, barriers to the adoption of conservation practices and effectiveness of policy instruments: Empirical evidence from northern Australia, *Land use policy* **28**(1), 257-265.
Grieder M, Bärenbold R, Schmitz J and Schubert R (2020), The Behavioral Effects of Carbon Taxes–Experimental Evidence, *Available at SSRN 3628516*.
Guagnano GA (2001), Altruism and market-like behavior: An analysis of willingness to pay for recycled paper products, *Population and Environment* **22**(4), 425-438.
Guagnano GA, Dietz T and Stern PC (1994), Willingness to pay for public goods: A test of the contribution model, *Psychological Science* **5**(6), 411-415.
Hahn RW (1990), The political economy of environmental regulation: Towards a unifying framework, *Public Choice* **65**(1), 21–47.
Hajkowicz S, Higgins A, Miller C and Marinoni O (2008), Targeting conservation payments to achieve multiple outcomes, *Biological Conservation* **141**(9), 2368–2375.
Halvorsen B (2012), Effects of norms and policy incentives on household recycling: An international comparison, *Resources, conservation and recycling* **67**, 18-26.
Hameed I and Khan K (2020), An extension of the goal-framing theory to predict consumer's sustainable behavior for home appliances, *Energy Efficiency* **13**(7), 1441-1455.
Hamilton SF and Zilberman D (2006), Green markets, eco-certification, and equilibrium fraud, *Journal of Environmental Economics and Management* **52**(3), 627–644.
Handberg ØN and Angelsen A (2019), Pay little, get little; pay more, get a little more: A framed forest experiment in Tanzania, *Ecological Economics* **156**, 454-467.
Harland P, Staats H and Wilke HA (1999), Explaining proenvironmental intention and behavior by personal norms and the Theory of Planned Behavior 1, *Journal of applied social psychology* **29**(12), 2505-2528.
Harring N and Jagers SC (2018), Why do people accept environmental policies? The prospects of higher education and changes in norms, beliefs and policy preferences, *Environmental Education Research* **24**(6), 791–806.
Heider F (1982), *The psychology of interpersonal relations*, Psychology Press.
Heyes A and Kapur S (2011), Regulating altruistic agents, *Canadian Journal of Economics/Revue canadienne d'économique* **44**(1), 227–246.
Hopper JR and Nielsen JM (1991), Recycling as altruistic behavior: Normative and behavioral strategies to expand participation in a community recycling program, *Environment and behavior* **23**(2), 195-220.
Horan RD and Claassen R (2007), Targeting green payments under a budget constraint, *Land Economics* **83**(3), 319–330.
Horan RD, Shortle JS and Abler DG (1998), Ambient taxes when polluters have multiple choices, *Journal of Environmental Economics and Management* **36**(2), 186–199.
Howley P (2015), The happy farmer: the effect of nonpecuniary benefits on behavior, *American Journal of Agricultural Economics* **97**(4), 1072–1086.
Jaeger WK (2011), The welfare effects of environmental taxation, *Environmental and Resource Economics* **49**(1), 101–119.
Jaime MM, Coria J and Liu X (2016), Interactions between CAP agricultural and agri-environmental subsidies and their effects on the uptake of organic farming, *American Journal of Agricultural Economics* **98**(4), 1114–1145.
Jakovcevic A and Steg L (2013), Sustainable transportation in Argentina: Values, beliefs, norms and car use reduction, *Transportation Research Part F: Traffic Psychology and Behaviour* **20**, 70-79.
Jiang X, Ding Z and Liu R (2019), Can Chinese residential low-carbon consumption behavior intention be better explained? The role of cultural values, *Natural Hazards* **95**(1), 155-171.

Johansson M, Rahm J and Gyllin M (2013), Landowners' participation in biodiversity conservation examined through the Value-Belief-Norm Theory, *Landscape Research* **38**(3), 295-311.
Johansson O (1997), Optimal Pigovian Taxes Under Altruism, *Land Economics*, 297–308.
Kaczan DJ and Swallow BM (2019), Forest conservation policy and motivational crowding: Experimental evidence from Tanzania, *Ecological Economics* **156**, 444-453.
Kalish CW (2012), Generalizing norms and preferences within social categories and individuals., *Development Psychology* **48**(4), 1133.
Kallgren CA, Reno RR and Cialdini RB (2000), A focus theory of normative conduct: When norms do and do not affect behavior, *Personality and social psychology bulletin* **26**(8), 1002-1012.
Kampas A and Horan R (2016), Second-best pollution taxes: revisited and revised, *Environmental Economics and Policy Studies* **18**(4), 577–597.
Kornhauser L, Lu Y and Tontrup S (2020), Testing a fine is a price in the lab, *International Review of Law and Economics* **63**, 105931.
Kruglanski AW and Köpetz C (2009), What is so special (and nonspecial) about goals, *The psychology of goals*, 27-55.
Kumar Chaudhary A, Warner LA, Lamm AJ, Israel GD, Rumble JN and Cantrell RA (2017), Using the Theory of Planned Behavior to Encourage Water Conservation among Extension Clients, *Journal of Agricultural Education* **58**(3), 185-202.
Kuwayama Y and Brozović N (2013), The regulation of a spatially heterogeneous externality: Tradable groundwater permits to protect streams, *Journal of Environmental Economics and Management* **66**(2), 364–382.
Lam SP (2006), Predicting intention to save water: Theory of planned behavior, response efficacy, vulnerability, and perceived efficiency of alternative solutions 1, *Journal of applied social psychology* **36**(11), 2803-2824.
Lanz B, Wurlod J-D, Panzone L and Swanson T (2018), The behavioral effect of pigovian regulation: Evidence from a field experiment, *Journal of Environmental Economics and Management* **87**, 190–205.
Leibenstein H (1966), Allocative efficiency vs." X-efficiency", *The American Economic Review* **56**(3), 392–415.
Lepper MR and Greene D (2015), *The hidden costs of reward: New perspectives on the psychology of human motivation*, Psychology Press.
Lepper MR, Greene D and Nisbett RE (1973), Undermining children's intrinsic interest with extrinsic reward: A test of the" overjustification" hypothesis, *Journal of personality and social psychology* **28**(1), 129.
Lind HB, Nordfjærn T, Jørgensen SH and Rundmo T (2015), The value-belief-norm theory, personal norms and sustainable travel mode choice in urban areas, *Journal of environmental psychology* **44**, 119-125.
Lindenberg S (2001), Intrinsic motivation in a new light, *Kyklos* **54**(2-3), 317–342.
Lindenberg S (2006), *Prosocial behavior, solidarity, and framing processes*, in Solidarity and prosocial behavior: Springer, 23-44.
Lindenberg S (2008), Social rationality, semi-modularity and goal-framing: What is it all about?, *Analyse & Kritik* **30**(2), 669-687.
Lindenberg S (2018), How cues in the environment affect normative behaviour, *Environmental Psychology: an introduction*, 144-153.
Lindenberg S and Steg L (2007), Normative, gain and hedonic goal frames guiding environmental behavior, *Journal of Social issues* **63**(1), 117–137.
Lindenberg S and Steg L (2013), Goal-framing theory and norm-guided environmental behavior, *Encouraging sustainable behavior*, 37–54.

Ling M and Xu L (2021), Incentivizing household recycling crowds out public support for other waste management policies: A long-term quasi-experimental study, *Journal of Environmental Management* **299**, 113675.
Liobikienė G and Minelgaitė A (2021), Energy and resource-saving behaviours in European Union countries: The Campbell paradigm and goal framing theory approaches, *Science of The Total Environment* **750**, 141745.
Lloyd EA and Shepherd TG (2020), Environmental catastrophes, climate change, and attribution, *Annals of the New York Academy of Sciences* **1469**(1), 105.
Lynne GD, Shonkwiler JS and Rola LR (1988), Attitudes and farmer conservation behavior, *American Journal of Agricultural Economics* **70**(1), 12–19.
Magkos F, Arvaniti F and Zampelas A (2006), Organic food: buying more safety or just peace of mind? A critical review of the literature, *Critical Reviews in Food Science and Nutrition* **46**(1), 23–56.
Marler RT and Arora JS (2010), The weighted sum method for multi-objective optimization: new insights, *Structural and multidisciplinary optimization* **41**(6), 853–862.
Mason CF (2011), Eco-labeling and market equilibria with noisy certification tests, *Environmental and Resource Economics* **48**(4), 537–560.
Mason CF (2013), The economics of eco-labeling: Theory and empirical implications, *International Review of Environmental and Resource Economics* **6**, 341–372.
Maybery D, Crase L and Gullifer C (2005), Categorising farming values as economic, conservation and lifestyle, *Journal of Economic Psychology* **26**(1), 59-72.
Midler E, Pascual U, Drucker AG, Narloch U and Soto JL (2015), Unraveling the effects of payments for ecosystem services on motivations for collective action, *Ecological Economics* **120**, 394-405.
Mitchell RK, Weaver GR, Agle BR, Bailey AD and Carlson J (2016), Stakeholder agency and social welfare: Pluralism and decision making in the multi-objective corporation, *Academy of Management Review* **41**(2), 252–275.
Mondelaers K, Aertsens J and van Huylenbroeck G (2009), A meta-analysis of the differences in environmental impacts between organic and conventional farming, *British Food Journal* **111**(10), 1098–1119.
Moros L, Vélez MA and Corbera E (2019), Payments for ecosystem services and motivational crowding in Colombia's Amazon Piedmont, *Ecological Economics* **156**, 468-488.
Muñoz B, Monzon A and López E (2016), Transition to a cyclable city: Latent variables affecting bicycle commuting, *Transportation Research Part a: Policy and Practice* **84**, 4-17.
Narloch U, Pascual U and Drucker AG (2012), Collective action dynamics under external rewards: experimental insights from Andean farming communities, *World Development* **40**(10), 2096-2107.
Niemiec RM, Champine V, Vaske JJ and Mertens A (2020), Does the impact of norms vary by type of norm and type of conservation behavior? A meta-analysis, *Society and Natural Resources*, 1–17.
Nordlund AM and Garvill J (2002), Value structures behind proenvironmental behavior, *Environment and behavior* **34**(6), 740-756.
Nyborg K (2010), Will Green Taxes Undermine Moral Motivation?, *Public Finance and Management* **10**(2), 331.
Nyborg K (2018), Social norms and the environment, *Annual Review of Resource Economics*.
Nyborg K, Anderies JM, Dannenberg A, Lindahl T, Schill C, Schlüter M, Adger WN, Arrow KJ, Barrett S, Carpenter S and others (2016), Social norms as solutions, *science* **354**(6308), 42–43.
Ostrom E (2000), Collective action and the evolution of social norms, *Journal of Economic Perspectives* **14**(3), 137–158.

Pang A and Shaw D (2011), Optimal emission tax with pre-existing distortions, *Environmental Economics and Policy Studies* **13**(2), 79–88.

Pannell DJ, Marshall GR, Barr N, Curtis A, Vanclay F and Wilkinson R (2006), Understanding and promoting adoption of conservation practices by rural landholders, *Australian journal of experimental agriculture* **46**(11), 1407-1424.

Parry I (2013), *Green Tax Design in the Real (Second-Best) World*, in Shogren, J. F., ed., Encyclopedia of Energy, Natural Resource, and Environmental Economics, Waltham: Elsevier, 161-168.

Paul J, Modi A and Patel J (2016), Predicting green product consumption using theory of planned behavior and reasoned action, *Journal of retailing and consumer services* **29**, 123-134.

Prasad M (2009), *Taxation as a regulatory tool: Lessons from environmental taxes in Europe*, in Government and Markets: Toward a New Theory of Regulation: Cambridge University Press, 363–390.

Reeson AF and Tisdell JG (2008), Institutions, motivations and public goods: An experimental test of motivational crowding, *Journal of Economic Behavior & Organization* **68**(1), 273-281.

Renstrom T, Spatarom L and Marsiliani L (2019), Optimal taxation, environment quality, socially responsible firms and investors., *International review of environmental and resource economics.* **13**(3-4), 339–373.

Rezaei-Moghaddam K, Vatankhah N and Ajili A (2020), Adoption of pro-environmental behaviors among farmers: application of Value–Belief–Norm theory, *Chemical and Biological Technologies in Agriculture* **7**(1), 1-15.

Rezaei R, Safa L, Damalas CA and Ganjkhanloo MM (2019), Drivers of farmers' intention to use integrated pest management: Integrating theory of planned behavior and norm activation model, *Journal of Environmental Management* **236**, 328-339.

Rezvani Z, Jansson J and Bengtsson M (2018), Consumer motivations for sustainable consumption: The interaction of gain, normative and hedonic motivations on electric vehicle adoption, *Business Strategy and the Environment* **27**(8), 1272-1283.

Rode J, Gómez-Baggethun E and Krause T (2015), Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence, *Ecological Economics* **117**, 270–282.

Rodriguez-Sickert C, Guzmán RA and Cárdenas JC (2008), Institutions influence preferences: Evidence from a common pool resource experiment, *Journal of Economic Behavior & Organization* **67**(1), 215-227.

Rotter JB (1966), Generalized expectancies for internal versus external control of reinforcement, *Psychological monographs: General and applied* **80**(1), 1.

Rummel A and Feinberg R (1988), Cognitive evaluation theory: A meta-analytic review of the literature, *Social Behavior and Personality: an international journal* **16**(2), 147-164.

Sabet M (2014), 'MORAL OFFSET' Competing framings of pro-environmental lifestyle choices, *Critical Discourse Studies* **11**(1), 95–116.

Salk C, Lopez MC and Wong G (2017), Simple incentives and group dependence for successful payments for ecosystem services programs: evidence from an experimental game in rural Lao PDR, *Conservation Letters* **10**(4), 414-421.

Savari M, Abdeshahi A, Gharechaee H and Nasrollahian O (2021), Explaining farmers' response to water crisis through theory of the norm activation model: Evidence from Iran, *International Journal of Disaster Risk Reduction* **60**, 102284.

Schmutzler A (1996), Pollution control with imperfectly observable emissions, *Environmental and Resource Economics* **7**(3), 251–262.

Schultz PW, Gouveia VV, Cameron LD, Tankha G, Schmuck P and Franěk M (2005), Values and their relationship to environmental concern and conservation behavior, *Journal of cross-cultural psychology* **36**(4), 457-475.

Schwartz SH (1977), Normative influences on altruism, *Advances in Experimental Social Psychology* **10**(1), 221–279.
Schwartz SH and Howard JA (1982), *Helping and cooperation: A self-based motivational model*, in Cooperation and helping behavior: Elsevier, 327-353.
Scovronick N, Dora C, Fletcher E, Haines A and Shindell D (2015), Reduce short-lived climate pollutants for multiple benefits, *The Lancet* **386**(10006), e28-e31.
See SC, Shaikh SFEA, Jaung W and Carrasco LR (2020), Are relational values different in practice to instrumental values?, *Ecosystem Services* **44**, 101132.
Senger I, Borges JAR and Machado JAD (2017), Using the theory of planned behavior to understand the intention of small farmers in diversifying their agricultural production, *Journal of rural studies* **49**, 32-40.
Sharma R and Gupta A (2020), Pro-environmental behaviour among tourists visiting national parks: Application of value-belief-norm theory in an emerging economy context, *Asia Pacific Journal of Tourism Research* **25**(8), 829-840.
Shin YH, Im J, Jung SE and Severt K (2018), The theory of planned behavior and the norm activation model approach to consumer behavior regarding organic menus, *International Journal of Hospitality Management* **69**, 21-29.
Shirley HJ (2010), Social norms and emission tax multiple equilibria in adopting pollution abatement device, *Applied Economics* **42**(1), 97-105.
Sintori A, Rozakis S and Tsiboukas K (2009), Multiple goals in farmers' decision making: The case of sheep farming in Western Greece, in: Agricultural Economics Society.
Steg L (2016), Values, norms, and intrinsic motivation to act proenvironmentally, *Annual Review of Environment and Resources* **41**, 277–292.
Steg L, Bolderdijk JW, Keizer K and Perlaviciute G (2014), An integrated framework for encouraging pro-environmental behaviour: The role of values, situational factors and goals, *Journal of environmental psychology* **38**, 104-115.
Steg L, Dreijerink L and Abrahamse W (2005), Factors influencing the acceptability of energy policies: A test of VBN theory, *Journal of environmental psychology* **25**(4), 415-425.
Steg L, Lindenberg S, Keizer K and others (2016), Intrinsic motivation, norms and environmental behaviour: the dynamics of overarching goals, *International Review of Environmental and Resource Economics* **9**(1–2), 179–207.
Steg L and Nordlund A (2018), Theories to explain environmental behaviour, *Environmental Psychology: an introduction*, 217-227.
Steg LE, Van Den Berg AE and De Groot JI (2013), *Environmental psychology: An introduction.*, BPS Blackwell.
Stern PC, Dietz T, Abel T, Guagnano GA and Kalof L (1999), A value-belief-norm theory of support for social movements: The case of environmentalism, *Human ecology review*, 81-97.
Sumpsi J, Amador F and Romero C (1997), On farmers' objectives: A multi-criteria approach, *European Journal of Operational Research* **96**(1), 64-71.
Taghikhah F, Voinov A, Shukla N and Filatova T (2020), Exploring consumer behavior and policy options in organic food adoption: Insights from the Australian wine sector, *Environmental science & policy* **109**, 116-124.
Tama RAZ, Ying L, Yu M, Hoque MM, Adnan KM and Sarker SA (2021), Assessing farmers' intention towards conservation agriculture by using the Extended Theory of Planned Behavior, *Journal of Environmental Management* **280**, 111654.
Tang SH and Hall VC (1995), The overjustification effect: A meta-analysis, *Applied Cognitive Psychology* **9**(5), 365-404.
Tang Y, Chen S and Yuan Z (2020), The effects of hedonic, gain, and normative motives on sustainable consumption: Multiple mediating evidence from China, *Sustainable Development* **28**(4), 741-750.

Thøgersen J (2006), Norms for environmentally responsible behaviour: An extended taxonomy, *Journal of environmental psychology* **26**(4), 247–261.
Thoyer S and Préget R (2019), Enriching the CAP evaluation toolbox with experimental approaches: introduction to the special issue, *European Review of Agricultural Economics* **46**(3), 347-366.
Tonglet M, Phillips PS and Read AD (2004), Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth, UK, *Resources, conservation and recycling* **41**(3), 191-214.
Torgler B (2005), Tax morale in latin america, *Public Choice* **122**(1-2), 133-157.
Traxler C and Spichtig M (2011), Social norms and the indirect evolution of conditional cooperation, *Journal of Economics* **102**(3), 237–262.
Turner JH and Stets JE (2006), Sociological theories of human emotions, *Annu. Rev. Sociol.* **32**, 25-52.
Tyler TR, Orwin R and Schurer L (1982), Defensive denial and high cost prosocial behavior, *Basic and Applied Social Psychology* **3**(4), 267-281.
Valentinov V, Roth S and Pies I (2021), Social goals in the theory of the firm: a systems theory view, *Administration & Society* **53**(2), 273–304.
van der Werff E and Steg L (2015), One model to predict them all: Predicting energy behaviours with the norm activation model, *Energy Research & Social Science* **6**, 8-14.
van der Werff E and Steg L (2016), The psychology of participation and interest in smart energy systems: Comparing the value-belief-norm theory and the value-identity-personal norm model, *Energy Research & Social Science* **22**, 107-114.
Van Hecken G and Bastiaensen J (2010), Payments for ecosystem services in Nicaragua: do market-based approaches work?, *Development and Change* **41**(3), 421-444.
Van Riper CJ and Kyle GT (2014), Understanding the internal processes of behavioral engagement in a national park: A latent variable path analysis of the value-belief-norm theory, *Journal of environmental psychology* **38**, 288-297.
Vandenbergh MP (2004), Order without social norms: How personal norm activation can protect the environment, *Northwestern University Law Review* **99**, 1101.
Velez MA, Murphy JJ and Stranlund JK (2010), Centralized and decentralized management of local common pool resources in the developing world: experimental evidence from fishing communities in Colombia, *Economic Inquiry* **48**(2), 254-265.
Vollan B (2008), Socio-ecological explanations for crowding-out effects from economic field experiments in southern Africa, *Ecological Economics* **67**(4), 560-573.
W. Trumbo GJOK, Craig (2001), Intention to conserve water: Environmental values, planned behavior, and information effects. A comparison of three communities sharing a watershed, *Society & Natural Resources* **14**(10), 889-899.
Westin K, Nordlund A, Jansson J and Nilsson J (2020), Goal Framing as a Tool for Changing People's Car Travel Behavior in Sweden, *Sustainability* **12**(9), 3695.
Wiersma UJ (1992), The effects of extrinsic rewards in intrinsic motivation: A meta-analysis, *Journal of occupational and organizational psychology* **65**(2), 101-114.
Williams SE, Bolitho EE and Fox S (2003), Climate change in Australian tropical rainforests: an impending environmental catastrophe, *Proceedings of the Royal Society of London. Series B: Biological Sciences* **270**(1527), 1887-1892.
Wynveen CJ, Wynveen BJ and Sutton SG (2015), Applying the value-belief-norm theory to marine contexts: Implications for encouraging pro-environmental behavior, *Coastal Management* **43**(1), 84-103.
Xepapadeas A (1997), *Advanced principles in environmental policy.*, Edward Elgar Publishing Ltd.

Yuriev A, Dahmen M, Paillé P, Boiral O and Guillaumie L (2020), Pro-environmental behaviors through the lens of the theory of planned behavior: A scoping review, *Resources, conservation and recycling* **155**, 104660.
Zhang L, Ruiz-Menjivar J, Luo B, Liang Z and Swisher ME (2020), Predicting climate change mitigation and adaptation behaviors in agricultural production: A comparison of the theory of planned behavior and the Value-Belief-Norm Theory, *Journal of environmental psychology* **68**, 101408.
Zilberman D (2014), Fellows Address: The Economics of Sustainable Development, *American Journal of Agricultural Economics* **96**(2), 385–396.