

University of Groningen

Strategic interactions in environmental economics

Heijnen, Pim

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2007

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Heijnen, P. (2007). *Strategic interactions in environmental economics*. [Thesis fully internal (DIV), University of Groningen]. s.n.

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Chapter 7

Conclusion

7.1 Summary

This thesis deals with the strategic interactions important to environmental economics. That includes a wide range of topics: environmental groups influencing or informing consumers, the reaction to taxation by car and fuel producers, the spread of an innovative tax and binary public good games.

Chapters 2 and 3 focus on an environmental group (EG) that can influence the preferences of consumers or inform the consumers. In both Chapters, a model of vertical product differentiation in which consumers care about the environmental damage per unit of production, is used. I consider two types of influence by the EG. First, in Chapter 2, the consumers are aware of the damage per unit of production, but their preferences can be influenced. The EG can increase the guilt felt by the consumers by campaigning. Second, in Chapter 3, the consumers are aware of their preferences, but not of the damage per unit of production. By campaigning the EG can convey information to the consumers. The main contrast here is between *persuasion* or *information transmission*.

Chapter 2 deals with persuasive advertising by the EG. Depending on the parameters, especially the start-up cost of an advertising campaign, there are three types of equilibria. The first type is accommodation. In this equilibrium type, the start-up cost is low and the EG will always start a campaign. Hence, the firm anticipates entry and will produce a clean product to minimize the loss of profit. The second type is entry deterrence. Here the start-up cost is sufficiently high for the EG to be a threat. However the firm can deter the advertising campaign by producing a clean good. In the case of entry deterrence, this is optimal for the firm. The third type is blockaded entry.

In this case, the start-up cost is high and, regardless of the product the firm produces, the EG will never start a campaign. As a consequence, the firm will produce a dirty product. It can be shown that the cleanest product is produced in case of entry deterrence. The entry deterrence equilibrium is appealing: not only does the firm produce a rather clean good, the EG does not advertise. If the EG abstains from advertising, then it also has no adverse effects on the utility of consumers. I tentatively conclude that the threat of an EG can be beneficial.

Chapter 3 proceeds with informative advertising. First, I consider the case in which damage per unit of production is given but unknown to the consumers (interpreted as the short-run). The usual problem with games with asymmetric information is encountered: there is a plethora of equilibria. I compare a benchmark equilibrium of no information transmission (i.e. advertising is prohibited) with a full information equilibrium with advertising. The result is paradoxical: *ex ante* both the firm and the consumer profit from the advertising, but not the EG. The explanation for this is that the cost of credibly transmitting information are too high.

Second, I examine what happens when environmental damage per unit of production is still unknown to the consumers, but the firm can now choose the level of damage (interpreted as the long-run). In the benchmark equilibrium of no advertising, the firm chooses to produce a very dirty product. If the EG is allowed to advertise, the situation changes completely. Now the EG can costlessly enforce that the firm chooses a much cleaner product. The EG achieves this by threatening to advertise if the firm decides to produce a dirty good. Since the consumers interpret the advertising as a signal that the product is dirty, it is optimal for the firm to produce a clean good. Consequently, the EG, the firm and the consumers profit.

Taxation for a variety of market structures including a non-competitive market is studied in Chapter 4. The markets in question are the automobile market and the market for the fuels that propel them. A main feature of the car market is that buyers have to decide whether to buy a gasoline car or a diesel car. Subsequently, they need to buy either gasoline or diesel. This links the two markets. The difference between the two types of cars is that diesel cars are more expensive to buy, but cheaper to drive than gasoline cars. The current system of taxation in the Netherlands (and most of Europe) is such that it enforces these price differences. The tax system helps car- and fuel producers to extract higher rent from consumers. Chapter 4 develops a model of these two markets. An important aspect in evaluating the equilibrium

outcome of the model is the amount of pollutants emitted by the consumption of fuel. The focus is on CO_2 -emissions and particulate-emissions. While diesel emits a relatively large amount of particulates, gasoline emits more CO_2 .

The first result is that a government, whose goal is to minimize emissions, might benefit from a non-competitive market. For instance, a monopolistic fuel market could drastically lower emissions compared to a competitive fuel market. The second result pertains to a change in tax policy. A frequently debated policy proposal is the abolishment of the differential tax treatment and, simultaneously, to make all car related taxes completely dependent on car use. The result is that while this tax treatment would lower total fuel use and CO_2 -emissions, it would also boost the emissions of particulates. The reason is that abolishing the differential tax treatment would cause a drastic shift from gasoline cars to diesel cars. The caveat of abolishing this tax treatment is that it might not be possible to do this without a loss of tax revenue.

Chapter 5 examines the effects of introducing a new form of taxation. In particular, the Chapter focuses on municipal waste disposal taxation. A system, where the tax is dependent on the amount of waste a household produces, has become more and more prevalent in the Netherlands in the last fifteen years. A casual glance at the data suggests that a municipality is more likely to introduce this kind of taxation if more neighboring municipalities have already introduced it. The empirical analysis of the panel data, which consists of the date of introduction of this kind of taxation in Dutch municipalities in the period 1998–2005, data on the bordering municipalities of a municipality as well as other minor variables, provides strong support for this hypothesis. A possible explanation offered by the Chapter is the following: if the height of the tax depends on the amount of waste produced, then (illegal) dumping of waste becomes attractive. However, this dumping is not limited to the municipality that has introduced the tax. For a neighboring municipality, one way of countering this dumping is to introduce a similar tax. From this particular theory, I conclude that not only the number of neighboring municipalities that have introduced this kind of taxation, but also the number of inhabitants of these municipalities should increase the probability that this kind of taxation is introduced. However, the analysis of the data suggests that the relative number of inhabitants of neighboring municipalities that have introduced this tax is not important in explaining the municipalities' decision to introduce the tax.

In Chapter 6 a binary public good game is discussed. The structure of this

game is very simple: it is optimal for each player to contribute to the public good if and only if none of the other players contributes to the public good. In the symmetric mixed Nash equilibrium, the probability that the public good is provided (i.e. at least one player contributes) tends to be decreasing in the number of players. I give several sufficient conditions for this to happen. From these conditions, I conclude that this undesirable result is very robust to perturbations in the payoff structure. Furthermore, I apply these results to three (economic) examples of which I shall discuss the one relevant to environmental economics below.

As an example I investigate oil spills in international waters. The conclusion is that, especially if the cost of cleaning up the oil after the oil has reached the coast are large compared to cleaning it immediately, the probability of an environmental disaster increase if more countries are involved.

7.2 Policy recommendations

For policy makers, the relevant questions that arise from Chapters 2 and 3 are whether environmental groups are useful and whether the government should encourage these initiatives via subsidies. As Chapter 2 shows, the threat of an EG can be a useful instrument for the government. The possibility of action by an EG can, much like the threat of stricter government regulation, induce firms to produce environmentally friendly goods. The advantage of an EG might be the fact that it is a relatively flexible grassroots organization and it might therefore be more inclined to take action than the government.

Chapter 3 presents a more pessimistic view of EG. While the long-run view is still beneficial, information transmission in the short-run is effective but costly. Specifically, for the EG the cost outweighs the benefits. The conclusion is that while the EG provides useful information to the consumers, it is just too costly. For the government, credibly transmitting information seems to be less problematic. An example is the (eco)labeling of products. The label guarantees that the product meets certain standards, since the claim can be verified in a court of law.

As discussed in Chapter 1, some advertising campaigns by the EG may be predominantly persuasive, while other campaigns are mostly informative, and subsequently it is difficult to answer the question whether environmental groups are useful. Examining the performances of EGs in the real world, a mixed bag is observed. Take corporate social responsibility and the role of EGs as an example. While some companies have successfully shifted to

more environmentally-friendly policies due to pressure from EGs or due to increased environmental awareness of their CEOs, other companies have been less fortunate. An example of a successful shift is BP, an oil company that is not only a clean firm relative to other firms in the oil industry, but also one of the more profitable firms. As mentioned before, other firms have been less fortunate. When Shell decided to dispose the oil platform Brent Spar, they attempted to act socially responsible and dispose of it in an environmentally-friendly fashion. However, this plan backfired since the EG, Greenpeace in this case, preferred other alternatives. The ensuing campaign by the EG hurt both Shell's reputation and profit, but did not yield a considerate improvement in the manner in which the oil platform was disposed. It is hard to interpret the action of the EG in this case as beneficial to society as a whole.¹

The policy recommendation that follows from Chapter 4 is to abolish the differential tax treatment. It has the adverse effect that it reinforces price discrimination of consumers, which results in a more uneven distribution of surplus. Moreover, it leads to a larger proportion of consumers to drive a fuel-inefficient car. The purpose of car taxation is to battle pollution and congestion. From this viewpoint, car taxation should be mileage based. With mileage-based taxation, taxation is based on which car is driven, where, at what time and how much.

A cheap and crude implementation of this system would be to raise the excise tax on diesel and gasoline alike. The rough calculations in Chapter 4 suggest that an excise tax of approximately two euro per liter should be enough for a budget-neutral implementation. Another implementation would be to record how much each car drives and tax according to the type of car. This allows the government to give incentives to consumers to buy fuel efficient, clean cars. While there are cost and privacy issues, one ideally would want to equip a car with a device that transmits information where the car is and base taxation on all information available (including potentially a charge for driving on congested roads).

Chapter 5 should be read as a cautionary tale of the autonomy of local governments. An important role for governments is to correct for externalities. In order to do this effectively its jurisdiction and the extent of the externalities should coincide. The evidence in Chapter 5 suggests that for municipal governments in the Netherlands this is not the case: the dumping of household waste affects neighboring municipalities. There are, of course,

¹See Heal (2005) for more examples and a discussion of corporate social responsibility.

reasons for granting a municipality this autonomy. The optimal form of taxation depends on the cost the municipalities associates with more waste. If municipalities are heterogeneous, then while some municipalities want to introduce differentiated waste disposal taxes, others might not. As the empirical analysis shows municipalities, that *a priori* were unlikely to introduce differentiated waste disposal taxes, have nevertheless introduced this kind of taxation. While the introduction of the differentiated taxes might have been beneficial for the country as a whole, it does not imply that it is an improvement for all municipalities.

Chapter 6 stresses the need for cooperation. It shows a public good game with undesirable outcomes. In the symmetric mixed strategy equilibrium, there is a probability that the public good is not provided and this probability is increasing in the number of players. Although there is an asymmetric pure equilibrium where the public good is always provided, this equilibrium is unfair in the sense that the cost of effort is not shared by the players. Neither outcome is desirable. Cooperation, where the player that provides the public good is financially supported by the other players, leads to efficient and fair outcomes. Returning to the oil spill example, the countries surrounding the North Sea could create an agency that cleans oil spills and split the cost of this agency.

7.3 Suggestions for further research

An obvious avenue for further research is to extend the analysis in Chapters 2 and 3 to a market with two or more firms. This changes the problem in the following manner: if consumers want to buy the good, then the influence of the EG is to direct these people to the cleanest product. While the monopolistic firm ‘competes’ with the option of not consuming, the oligopolistic firm competes with the option, that consumers have to buy another, possibly, cleaner product from another firm. If one firm decides to offer a cleaner product, then the other firm could well do the same thing. By focusing on a monopolistic market, and thus ignoring the incentive firms have to have the cleanest product, it seems that the effect of an EG is underestimated.

One of the drawbacks of Chapter 3 is that it requires sophisticated consumers. In particular, the consumers are assumed to be perfectly able to interpret the messages of the EG. The credibility of these messages is based only on the amount of money the EG spends. It seems more reasonable that the credibility of the EG is tied to its reputation as well. One could think of

a model in which in each period the EG can broadcast an advertisement and the EG is occasionally verified by a trustworthy authority.

For Chapter 4, one could also extend the model with multiple car producers. However, I do not think that this will be an important direction of research. Recall that the model only gives an expression for the price difference between gasoline and diesel cars. The (exogenous) price of a gasoline car could still be determined by competition. As Verboven (1999) notices: while there may be competition in the market for the base good (a gasoline car in this case), in the market for the add-ons (an upgrade to a diesel car) the sellers could well be monopolists (cf. Lal and Matutes, 1994). Further research should be along the lines of the original aim of the Chapter: to extend the model of Verboven (2002) *and* estimate it.

Chapter 5 presents a statistical relation between the number of neighboring municipalities that have introduced a certain tax and the probability that a municipality introduces a similar tax. Neither causality, nor the underlying cause, however, are entirely clear. These two problems warrant attention. First, in order to establish causality, some kind of instrument is needed. If, for instance, in one province legislation is introduced that stimulates the introduction of this particular kind of taxation, then we have an event that is reasonably exogenous and only influences some municipalities. This data could then be used as an instrument. Second, in order to test the theory that waste dumping is the underlying cause, data on the prevalence of waste dumping is needed, preferably before and after the introduction of this kind of taxation in neighboring municipalities. An increase in the dumping of waste caused by the introduction of this kind of taxation in a neighboring municipality should then lead to a higher probability of introducing this kind of taxation.

Chapter 6 tries to characterize the set of the participation games for which the probability that the public good is provided is decreasing in the number of players. The Chapter only gives sufficient conditions. Clearly, necessary conditions or a full characterization of the set of parameters, for which the aforementioned probability is decreasing, are the next step. The notion of participation games can also be generalized further to include, for instance, incomplete information about the cost of participation.

