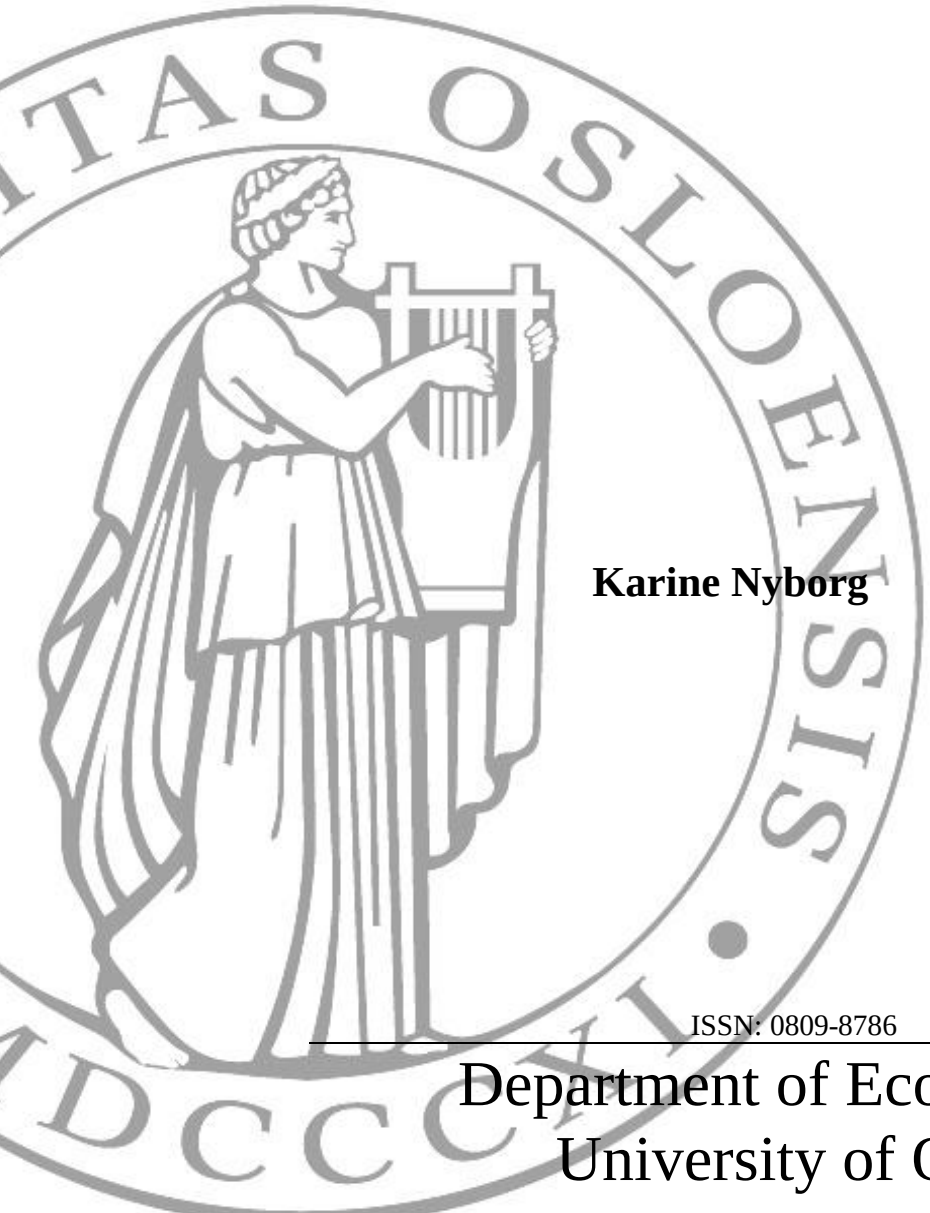
MEMORANDUM

No 07/2019
June 2019

No Man is an Island
Social Coordination and the Environment



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ISSN: 0809-8786

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This series is published by the
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No Man is an Island

Social Coordination and the Environment

Karine Nyborg[1]

Abstract

Humans are fundamentally social. Social activities require coordination, which may yield multiple equilibria in the form of stable, self-reinforcing patterns of herd behavior. Since environmental impacts can differ substantially between alternative equilibria, such self-reinforcing behaviors may, from an environmental perspective, be viewed as representing virtuous or vicious cycles. Environmental policies can help break the self-fulfilling expectations of vicious cycles, tipping the economy to more environment-friendly equilibria.

Acknowledgments:

This paper is based on my David Pearce Lecture at the 23rd Annual Meeting of the European Association of Environmental and Resource Economists in Athens, June 30, 2017. I am grateful to Ian Bateman and Phoebe Koundouri for encouraging me to write an article based on the talk, to the Beijer Institute of Ecological Economics for sponsoring the artwork in Figures 1 and 2, and to artist Elsa Wikander, Azote, for granting me permission to use the figures. The author is part of CREE, Oslo Centre for Research on Environmentally friendly Energy, sponsored by the Research Council of Norway (RCN grant no. 209698).

Keywords:

Environmental policy, multiple equilibria, social interaction, tipping points.

JEL codes: D10, D62, D91, Q01, Q50, Q58.

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"No man is an island, entire of itself; every man is a piece of the continent, a part of the main" (Donne 1624, Ch.17).

Introduction

Homo sapiens is a social animal. We like to spend time together, to share laughter, opinions, experiences and knowledge, to work together, to take part in social and professional networks. Joint activities require coordination, however; and since there are usually numerous alternative ways to coordinate, everyday life is teeming with multiple equilibria.

When choosing which conferences and seminars to attend, or whether to have lunch in the cafeteria or the department lunchroom, we consider who else will be there. When choosing which languages to learn, or which one to speak in a specific context, we consider what languages others will be likely to know. When organizing our daily lives – housing, transportation, work, family responsibilities – we adapt to others' expected behaviors, trying to facilitate convenient and pleasant interaction.

This need for social coordination involves external effects: the individual benefits of adopting a specific behavior depend on the behaviors of others in ways not internalized in market prices. When such social externalities are sufficiently prominent, multiple equilibria can result – of which some impose heavier burdens on the natural environment than others. Under such circumstances, policy can play an important role by helping the economy coordinate on an environment-friendly equilibrium (Rege 2004; Nyborg and Rege 2003; Nyborg et al. 2006; Nyborg et al. 2016; Nyborg 2018).

The ground-breaking contributions of Ostrom (1990) and her collaborators placed social interaction on the agenda of economists interested in resource management. More recently, environmental and resource economists have increasingly turned their attention to social interaction (see, e.g., Allcott

2011; Dasgupta and Ehrlich 2013; Richter and Grasman 2013; Dasgupta et al. 2016; Schlüter et al. 2016; Farrow et al. 2017; Pal et al. 2017; Carratini et al. 2017; Czajkowski et al. 2017). My aim with the present essay is to draw attention to this fascinating and highly policy relevant field, hoping to encourage further research contributions.

Below, I first argue that by ignoring social interaction, the standard benchmark model of welfare economics may have obscured economists' alertness to the interactions between environmental and social externalities. I then explain what I mean by social coordination; I provide some examples, and sketch possible approaches to formal analysis. Finally, I discuss the potential role of environmental policy as a social coordination device.

Perfect competition: environmental and social isolation

In environmental economics models, nature is often introduced in terms of "environmental goods" or "ecosystem services", concepts focusing on nature's provision of inputs to production and consumption processes. A quite different perspective, pinpointed nicely by the philosopher Robert Goodin, is that the natural environment allows us to belong, to be part of something:

"The value of natural processes is to provide a context, outside of ourselves […], in which to set our lives. What is wrong with environmental despoliation is that is deprives us of that context; it makes the external world more and more one of our own (perverse) creation" (Goodin 1994, p. 587).

To be part of something is so basic that we rarely consider the alternative: isolation. Nevertheless, when an individual is isolated, deprived of normal sensory stimuli, she is soon likely to start hallucinating, struggle to pursue ordinary logical thought, and lose her usual conception of a self and her sense of time (Goldberger 1966; Ringach 2009; Bond 2014).

Like the environment, social interaction helps shape the very context of our lives. A life isolated from others is hardly imaginable. A lack of social relationships is associated with substantially increased

mortality risk (Berkman and Syme 1979; House et al. 1988; Eisenberger and Muscatell 2013). Widowhood is associated with depression (Umberson et al. 1992). Unemployment reduces self-reported happiness substantially, apparently mainly linked to non-pecuniary distress (Oswald 1997). The brain processes involved in *social* pains and pleasures, like feeling rejected or included, are highly similar to the brain processes involved in *physical* pains and pleasures caused by, e.g., physical injury or the pleasure of enjoying good food (Eisenberger et al. 2003; Eisenberger and Muscatell 2013; Lieberman 2013). Neuroscientists have found, moreover, that when thinking of nothing in particular, the mind tends to wander to social life – the 'default network' activated in the brain when resting being virtually identical to the network activated by social cognition (Lieberman 2013, Ch. 2).

Still, the standard benchmark model of welfare economics implicitly requires that, aside from trade flows, each individual is completely isolated from nature as well as others (Nyborg 2019).

The perfectly competitive market – a situation with no market failures, providing the basis for the two fundamental welfare theorems – may seem an intuitively simple construction. However, its underlying assumptions depart so dramatically from the world as we know it that grasping the full implications is extremely hard. I know – because I tried. In addition to being an economics professor, I am also a fiction writer, and one of my books (Nyborg 2016) includes a science fiction story about two young people travelling to the perfectly competitive market for their honeymoon.[2]

Writing this story was surprisingly hard; eventually, the work turned into an economics research project of its own (Nyborg 2019). A world with human presence, but no market failure, would have to be an extraordinarily strange place.[3] In particular, normal social life would not exist. Each individual would have to be isolated from others, as well as from any shared environment – at least

[2] An English translation is available in Nyborg (2019, Part II).

[3] Unless one imposes extremely strict assumptions, such as willed learning being infeasible, the requirements of 'no asymmetric information' and 'no external effects' are actually mutually inconsistent: when learning something, one either creates asymmetric information (if the new knowledge is not shared) or external effects (if it is shared with all others) (Nyborg 2019).

until fully specified trade contracts, governing all aspects of joint surroundings and interpersonal encounters, had been established.

Of course, the perfectly competitive market is not meant to serve as a description of the real world. Its role is that of a stylized benchmark model, not providing realism. Nevertheless, by repeatedly returning to this benchmark when introducing new market failures to students, we may unintendedly create the impression that the benchmark case is also the 'normal' case, while at the same time providing insufficient training in analyzing the interactions between different market failures. As a consequence, economists may end up paying insufficient attention to the social drivers of environmental damage.

Social norms, conventions, network effects

When using the term 'social coordination', what I have in mind are the equilibria of *N*-person coordination games: the various situations in which we adapt to each other's behavior and plans such that, given others' strategies and beliefs, no-one has reason to change their strategies and beliefs. The main idea is captured by Young (1998, p.821):[4] "[...] an established and self-reinforcing pattern of behaviour: everyone wants to play their part given the expectation that everyone else will continue to play theirs. It is, in short, an equilibrium of a game".

Social norms, conventions, and multiple equilibria caused by network effects are examples of this. The key mechanism is similar: if the net individual benefit of adopting a specific behavior (or behavioral pattern) increases sufficiently in the share of others adopting the same behavior (or behavioral pattern), people will prefer to behave like the others, and herd behavior arises. In such situations, expectations can become self-fulfilling: if a certain behavior is generally expected, this behavior is generally chosen precisely because it is expected (Young 2015).

[4] In the context of the quote, Young uses the term 'norm' for what I call 'social coordination'.

A *convention* can be viewed as an equilibrium of an N-person coordination game where it is commonly known that this particular equilibrium is customarily being played – for example, driving on the right rather than the left side of the road, or using the local language (Sugden 1989; Young 1998). A convention does not necessarily involve social sanctions; it is primarily enforced through the individual benefits of coordinating one's behavior with others'.

A *social norm*, on the other hand, is usually taken to be enforced at least partly through social feedback such as stigma or praise (Gintis 2010; Young 2015). Nyborg et al. (2016, p.42) define a social norm as "a predominant behavioral pattern within a group, supported by a shared understanding of acceptable actions and sustained through social interactions within that group" (where 'social interactions' can be understood as referring to social approval and disapproval). Note that psychologists and game theorists tend to use the term differently, though (see Nyborg 2018): following Cialdini et al. (1991), psychologists distinguish between descriptive social norms, guiding behavior via perceptions of how most others behave, and injunctive social norms, guiding behavior via perceptions of how most others would approve/disapprove of the behavior, with no requirement that norms represent equilibria. Game theorists, on the other hand, often view a social norm as an equilibrium of a coordination game, enforced through social approval and disapproval (Sugden 1989; Bicchieri 2006; Gintis 2010; Young 2015).

Network effects are often considered a purely economic rather than social phenomenon. Liebowitz and Margolis (1994, p.135) explain that network effects are present when "the net value of an action (consuming a good, subscribing to telephone service) is affected by the number of agents taking equivalent actions" (reserving the term 'network externalities' to the case where network effects are not being fully internalized in market equilibrium). Note, however, that if replacing the word 'value' by 'benefit' and using slightly different examples – driving to the left, littering, indoor smoking – their explanation could also serve as a description of conventions or social norms.

Just as with social norms and conventions, sufficiently strong and positive network effects yield multiple equilibria. For example, if few others drive electric cars, charging stations are likely to be few, making the purchase of an electric car less attractive. If most cars are electric, on the other hand, gas stations may soon become scarce, making the purchase of a fossil-fueled car unattractive.

If the purpose of one's analysis is to understand traffic rules, social psychological phenomena, or industry competition policies, it may be necessary to distinguish between conventions, social norms, and network effects. If the purpose is to understand a specific environmental problem, however, and how this problem may be solved, these distinctions may be less important. It then seems more pressing to ask whether the situation at hand does indeed represent a coordination game; if it does, whether a preferable equilibrium is likely to exist; and if so, how this alternative equilibrium can be realized.

Modelling a social norm: contributing to environmental quality

Formal models of social interaction are often quite mathematically complex. Nevertheless, some main ideas can be presented in very simple ways. Below, I outline an example: a slight modification of Andreoni's (1990) impure altruism model yields a framework capturing a social norm for contributing to environmental quality.[5]

Consider a society consisting of a large number of identical individuals, where each individual i has preferences for her own private consumption x_i and environmental quality G, a pure public good, as follows:

$$(1)\ U_i = u(x_i) + v(G) + s_i\,.$$

Here, u and v are strictly increasing and concave functions, s_i is the social approval i receives from others, while linear separability is assumed for simplicity. Assume that every i has a fixed income that

[5] See Nyborg (2018) for a more elaborate presentation.

she divides between consumption and contributions towards the public good, denoted g_i. Furthermore, let the contribution variable be binary: either the individual contributes to the public good, $g_i = 1$, or she does not, $g_i = 0$.

Assume that i neither expects to be able to perceptibly affect environmental quality nor others' contributions, thus essentially considering G fixed. Contributing to the environment may, however, increase the social approval one gets from others. Let contributions be easily observable by one's peers, and assume that when two contributors meet, they provide social approval to each other (e.g., by smiling approvingly). Non-contributors neither give nor receive social approval. Let the social approval received by individual i be given by

$$(3) \quad s_i = aKg_i,$$

where $K > 0$ is a fixed constant and a is the share of contributors in the population. Let the population be large enough that the individual can reasonably regard a as exogenous, independent of her own contribution choice.

In such an economy, the only motive to contribute voluntarily is to gain social approval. However, the strength of this motive depends on what most others do: eq. (3) makes clear that if no-one else is contributing, contributing yields no approval; if $a = 1$, on the other hand, contributing yields social approval K.

Hence, a utility-maximizing person prefers contributing if the gain in terms of social approval outweighs the cost in terms of lost consumption, which is the case if K is sufficiently large. Consequently, with a large enough K, there are two pure strategy Nash equilibria: i) no-one contributes, leaving no-one there to approve of contributors, making no-one prefer to contribute – a vicious cycle; and ii) everyone contributes, each approving other contributors, making everyone prefer to contribute – a virtuous cycle.

The above is a simple example of an N-person coordination game. Since the model is static, it is silent on equilibrium selection. Imagine, however, an economy in which contributing is customary and this fact is generally known. Such knowledge would make the contribution equilibrium stand out as a reasonable candidate for efforts to coordinate: in the terminology of Schelling (1960), knowledge of the custom makes the contribution equilibrium a focal point.

Denote by $\hat{a}$ the share contributing such that everyone is exactly indifferent between contributing and not contributing. If K is large enough to secure two pure strategy Nash equilibria in the above game, $a = \hat{a}$ is also a Nash equilibrium. This situation could come about by everyone pursuing a mixed strategy, contributing with probability $\hat{a}$, or by a share $\hat{a}$ of the population following the pure strategy of contributing, while the rest follow the pure strategy of not contributing. Starting from a situation with $a = \hat{a}$, however, a small increase in a would make everyone prefer to contribute; a small decrease in a would make everyone prefer not to contribute. Thus, although the framework is static, there is a certain sense in which this third equilibrium is unstable, representing a tipping point in the model.

Modelling smoking norms

Although the above model is concerned with monetary contributions, it can be generalized to cover contributions in terms of time (see Czajkowski et al. 2017, Section 3 and footnote 3). Similarly, such 'vicious' or 'virtuous' cycles can easily arise for other types of everyday behaviors as well.

One example is considerate versus inconsiderate smoking behavior. Inspired by an apparent norm change in Norway in the years following a major smoking law amendment in 1988, Nyborg and Rege (2003) demonstrated how both a social norm allowing indoor smoking and a norm disallowing the same may represent stable equilibria.

In the model, the share of smokers in the population is exogenous. Smokers choose whether to smoke outdoors or indoors, in the latter case exposing others to passive smoking. Non-smokers make

no active choices in the model, but react negatively (spontaneously, possibly involuntarily) when exposed to tobacco smoke. Smokers, on their part, dislike being faced with these reactions.

A key question for multiple equilibria to arise is, as indicated above, whether there is a positive, sufficiently strong relationship between the individual net benefits of adopting a behavior and the share adopting that same behavior. In the monetary contribution model above, such a relationship was ensured by contributors approving of each other. Here, the mechanism is slightly more indirect: non-smokers' negative reactions tend to be stronger if they are not used to passive smoking.

Figure 1. **Virtuous and vicious cycles of considerate smoking behavior**.

If indoor smoking is uncommon, smokers face strong social reactions if they do smoke indoors, since non-smokers are not accustomed to it (Figure 1). Smokers are thus more inclined to bring their cigarettes outdoors, making non-smokers unaccustomed to passive smoking – completing the virtuous cycle (viewed from non-smokers' perspective). A vicious cycle could also be self-reinforcing,

however: if indoor smoking is common, non-smokers' reactions are weak, making indoor smoking relatively pleasant – keeping smokers indoors, completing the cycle.[6]

In Nyborg and Rege (2003), we modelled the dynamic movement between equilibria using evolutionary game theory (Weibull 1999). To describe how smokers' behavior changes over time in response to non-smokers' social reactions, we use the replicator dynamics (Taylor and Jonker 1978), assuming that the popularity of a strategy increases in the difference between the strategy's current payoff and the average current payoff in the population. This is consistent with myopic smokers revising their strategy only occasionally, and when revising, choosing their new strategy on the basis of how well they would fare with each alternative.

The smoking norm model also has an unstable equilibrium – a tipping point – somewhere in between the two pure strategy equilibria. Assume that the economy is in the non-considerate equilibrium. If, for some reason, a few more smokers go outdoors, the economy will soon slide back to the non-considerate equilibrium unless the tipping point is passed. If it is passed, however, a snowball effect gradually pushes the economy all the way to the considerate equilibrium, in which it comes to rest. Although a social norm for inconsiderate smoking behavior may be very stable over time, changes can be abrupt, substantial, and lasting once the tipping point is passed.

More than social norms

Here is another possible example of virtuous and vicious cycles: eating habits.

If most others are meat-eaters, it is cumbersome to be a vegetarian; conversely, if most others are vegetarians, it is cumbersome to be a habitual meat-lover. Those keeping a different diet than most may have a hard time finding what they need in grocery stores and restaurants; they will find cooking

[6] In the early 1980's, I worked as an untrained nurse assistant in an Oslo hospital. During staff meetings – which took place in a small, crowded room located few meters from patients' rooms – about half of the present nurses would typically smoke. Such behavior was considered completely normal; if fellow nurses were bothered, this was viewed as one of the sad facts of life.

for shared meals cumbersome, requiring more work; their rejection of the foods others enjoy may be seen as a sign of social distance; and for the same reasons, others may avoid including them in occasions involving shared meals (Nyborg et al. 2016).

Like in the smoking norm example, it may matter what people are used to. If diet preferences were fully flexible (and allergies and the like were no problem), the above problem would hardly be substantial: when a vegetarian joined a group of meat-eaters for dinner, the meat-eaters could happily for once forego their meat. If tastes develop over time, however, making us prefer the diets we are used to, flexibility is more limited. Meat-eaters may still forego meat out of politeness or kindness towards the vegetarian, but their enjoyment of the meal is reduced. Again, the key for multiple equilibria to arise is whether the net individual benefit of adopting a specific behavior is increasing, and sufficiently so, in the share of others adopting the same behavior (Fig. 2).

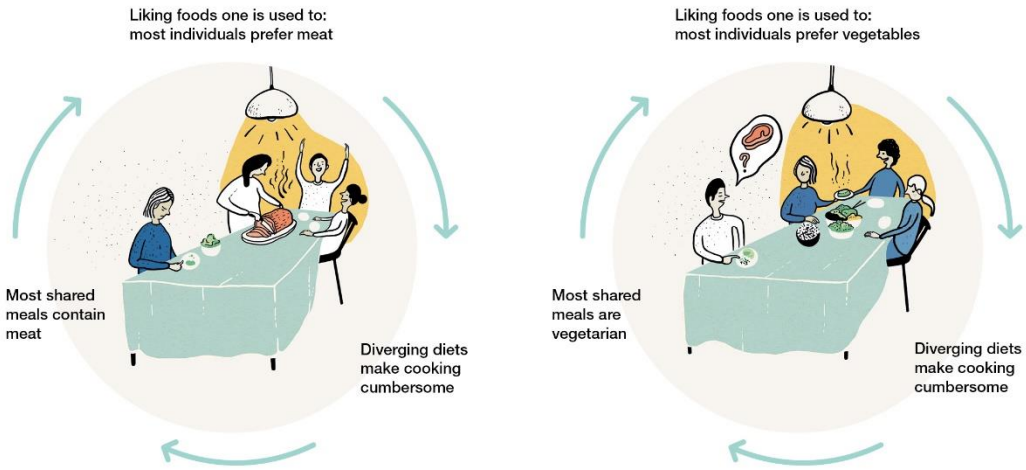

Figure 2. **Virtuous and vicious cycles of eating habits.**

Recall, now, the previously cited definition of a social norm of Nyborg et al. (2016): “a predominant behavioral pattern within a group, supported by a shared understanding of acceptable actions and sustained through social interactions within that group”. Customary eating habits may obviously represent “predominant behavioral patterns within a group”, and might also be “supported by a

shared understanding of acceptable actions" and "sustained through social interactions". Note, however, that if the practical benefits of coordinating with others are strong enough, such as cooking being more convenient if everyone accepts the same food, herd behavior can arise even in the absence of social sanctions. If social sanctions are not present, or are not needed to sustain the equilibrium, the eating habits example may be viewed as representing a convention rather than a social norm.

My point here is not to discuss definitions, however, but rather to emphasize that social coordination is not only caused by mechanisms involving approval and disapproval. This is even more obvious when considering the network effects involved in markets for electric, hydrogen- or fossil-fueled cars: here, environmentally vicious or virtuous cycles may arise in the presence or absence of social sanctions.

Another difference between my examples is worth noting. In the smoking example, the environmental externality arises immediately, affecting those present when the behavior occurs; the negative social feedback is a direct reaction from those exposed to the externality. In the eating habits and car purchase examples, environmental externalities are more indirect, not affecting one's immediately close peers in particular. This does not preclude the existence of vicious or virtuous cycles caused by social coordination, however. In the car purchase example, multiple equilibria are sustained by the product's dependence on infrastructure investments, the environmental impacts arising as possibly unintended side effects. Similarly, individuals' reasons for choosing vegetarian or low-meat foods in the equilibrium illustrated on the right-hand side of Figure 2 may be entirely unrelated to concerns for environmental protection, animal welfare, or health: people may simply conform to socially predominant eating habits to share convenient and pleasant meals with others, making the environmental impacts a possibly unintended side-effect (Nyborg et al., 2016). Of course, social approval or disapproval may further strengthen such mechanisms.

Policy as a coordination device

If environmental damages differ substantially between the alternative equilibria, a potential role for policy is to help coordinate the economy on a more environment-friendly one (Rege 2004; Nyborg 2018).

Nyborg and Rege (2003) show theoretically how, starting from the non-consideration equilibrium, a smoking regulation can help push the economy past the tipping point – thus establishing a new and stable norm of considerate smoking behavior.[7] Assume that a formal regulation is introduced, prohibiting smoking in places such as public transport and workplaces, and that the regulation is strictly enforced. This makes non-smokers less used to passive smoking, thus strengthening their negative reactions when exposed to tobacco smoke in unregulated areas. If sufficiently powerful, this effect can make the non-consideration norm cease to be an equilibrium: then, the enforced regulation makes non-smokers' reactions strong enough that smokers reconsidering their strategy prefer going outdoors in *unregulated* areas, even if they do not expect other smokers to do so. Consequently, over time more and more smokers become considerate – until a stable norm of considerate smoking behavior has been established.

What if the smoking regulation is later abolished? The initial no-consideration situation would then again become an equilibrium. Nevertheless, there is little reason to expect the economy to revert back to its previous state: the new full consideration state is, after all, an equilibrium too, and there is no particular reason why the economy would stray away from it.

The argument above hinges on the initial smoking regulation being enforced: this is why the regulation makes non-smokers less used to passive smoking in the first place. But what if the

[7] In the static part of the Nyborg and Rege (2003) model, 'equilibrium' means Nash equilibrium; in the dynamic analysis we use the concept of asymptotically stable states.

regulation is *not* being enforced? This was, in fact, at least partly the case with respect to the Norwegian 1988 smoking law amendment.

A policy may still be effective, however, if its introduction changes expectations. A slightly different interpretation of the Norwegian case is that even without formal enforcement, smokers began expecting stronger social sanctions from non-smokers, at least in regulated areas. This may have caused sufficiently many to stop smoking in regulated areas, increasing non-smokers' reactions, setting off a snowballing effect as described above.

Changing expectations, however, is no straightforward task. In Greece, the introduction of an unenforced smoking regulation in 2010 appeared to have only minor and temporary effects (Vardavas et al. 2013), consistent with smokers' expectations being largely unaffected by the regulation.

Nevertheless, survey data reported in Nyborg and Rege (2003) indicates that abrupt and substantial behavioral changes did indeed occur soon after the Norwegian 1988 smoking law amendment. In 1999, we asked smokers whether, when visiting friends, they would usually smoke indoors without asking for permission; smoke indoors after asking for permission; or go outdoors. Lacking time series data, we also asked how they would have responded to the same question ten to fifteen years earlier. While less than 2 percent reported to currently smoke indoors in others' homes without asking for permission, 37 percent said they usually did so ten to fifteen years earlier. Among non-smokers, responses were even more striking: 12 percent reported that currently, their smoking guests usually smoked indoors without asking; as much as 74 percent, however, claimed that this was smoking guests' most common behavior ten to fifteen years earlier.

Environmental coordination policies

Consider now the following, possibly familiar situation: the local school is not far away from your house, within easy reach by bike. If traffic was not too heavy, you would have preferred to let your

kids bike to school together with the neighboring kids: it would be good for their health, bolster their friendship, and be easier for you than bringing them by car. However, due to the heavy car traffic around the school, you find it too risky; hence you drive them, contributing to traffic jams, accident risk, and air pollution.

Why might this be a coordination game? Perhaps most of the traffic is caused by the other parents driving their kids to school – by the same reasoning as yours. If so, a mutually preferable equilibrium may be feasible, namely the situation where all or most kids are biking or walking to school.

The next question is how to get there. First, local authorities may make the current situation cease to be an equilibrium by, e.g., prohibiting car traffic close to the school during start and end times. Driving kids to school would then become impractical, while biking and walking would become safer. If the situation in which most kids bike is indeed a stable equilibrium, even a temporary traffic ban would do the job, breaking the established vicious cycle.

The second potential way of breaking a vicious cycle, pushing the economy past the tipping point to arrive at a more environment-friendly equilibrium, is to change people's expectations. Imagine that the headmaster of the school informs all parents that from next week on, all students are expected to bike or walk to school, while parents are strongly discouraged from driving their kids. Instead, the school will organize biking and walking groups, making sure that at least one parent participates in each group until a new custom has been firmly established. The latter not only protects kids' safety, but also ensures that deviant behavior can be observed, thus allowing social sanctions by other parents. If the headmaster succeeds in changing expectations, this can suffice to make parents coordinate on the biking solution.

Just like in the eating habit example, a biking equilibrium may or may not depend on social sanctions. If everyone really prefers not to drive kids to school given that traffic is low, the issue may be a matter of straightforward coordination. It might be, however, that some parents still find it tempting to drive, for example because they tend to be too late in the morning. If so, biking may not be an

equilibrium after all – or it may be an equilibrium only if supported by a shared understanding that driving to school is socially unacceptable, combined with social sanctions enforcing this rule – such as parents in walking groups expressing disapproval towards those driving.

Making the current situation cease to be an equilibrium is a question of incentives. Thus, quite standard instruments such as taxes, subsidies and prohibitions may be used. Infrastructure investments (bike lanes, charging stations, metro lines) may also be an important part of this. For example, if roads are well developed while bicycle lanes and public transportation are missing, car traffic will be heavy, biking dangerous and unpleasant, and bus traffic slow; moreover, if voters do not expect biking or bus transport to become attractive any time soon, they may support further road construction rather than bike lanes and public transport (Nyborg et al. 2016). If bike lanes make biking easy and convenient, more people become bikers, increasing political support for construction of bike lanes; over time, bikers become more fit, enabling them to use their bikes even for longer distances, further reducing car use, making biking even more attractive.

When policies can help push the economy past a tipping point, thus inducing lasting reductions in environmentally damaging behaviors, quite strong, temporary policies can in fact be optimal (Greaker and Midttømme 2016). Subsidizing electric cars, for example, may seem unreasonable given that even electric cars cause environmental damage. If policy makers are trying to overcome a tipping point caused by network effects, however, each new electric car is a contribution towards that goal, potentially involving substantial positive environmental externalities.[8]

Changing expectations is less straightforward than changing incentives. However, instruments such as taxes, subsidies, prohibitions, standards and infrastructure investments may also change expectations about others' behavior: after all, people know that such instruments affect others' incentives as well as their own (Nyborg et al., 2016). In particular, infrastructure investments can

[8] In general, costs and benefits (including transition costs) should, of course, be considered carefully before using policy to tip the economy to a different equilibrium; this is in itself a complex issue which I will not elaborate on here.

serve as a commitment that a policy will prevail: a network of bike lanes, for example, is unlikely to be demolished once it has been established.

Laws (even, possibly, if unenforced), institutional frameworks, and information campaigns may also affect expectations. Note, however, that information campaigns providing knowledge about others' behavior may backfire: if most others are currently not making the environment-friendly choice, information making this clear will tend to reinforce existing behavioral patterns.

Conclusions

Standard economic models often ignore human interaction other than market transactions. Nevertheless, demand and supply of both market and non-market goods are influenced by the social nature of human life. In particular, when the individual net benefits of adopting a behavior increase in others' adoption of the same behavior, coordination games can arise, displaying multiple equilibria. Environmental impacts may differ substantially between these equilibria. If so, which one the economy coordinates on can be crucial for environmental quality.

Multiplicity of equilibria may arise due to standard coordination benefits (travelling to those conferences fellow experts are expected to attend); social sanctions (non-smokers reacting more negatively to indoor smoking the less used they are to it); infrastructure and/or network effects (bike lanes making people bike more, in turn increasing political support for improving the network of bike lanes). Multiple equilibria can also arise as part of more complex and/or indirect mechanisms, such as society-wide cultures of trust or mistrust, corruption or honesty (Basu 2000, Tabellini 2008), providing self-reinforcing political support to policies such as either wide-reaching or minimal welfare states (Benabou and Tirole 2006, Lindbeck et al. 1999).

Patterns of social coordination tend to be stable over time. However, once changes occur, they can be abrupt and substantial. Environmental policy can play an important role in helping push the economy past such tipping points, moving the economy to more environment-friendly equilibria. This

can basically happen in two ways: first, by (temporarily) making the current situation cease to be an equilibrium, exemplified by the enforced smoking law discussed above; second, although less straightforward, by changing expectations about others' behavior – exemplified by my discussion of an unenforced but still successful smoking regulation.

The opportunities for environmental policy offered by social coordination deserve further exploration by environmental economists. When confronted with an environmental problem, the following four questions may be helpful: Is the current situation likely to represent a coordination game? If yes, is there a preferable equilibrium? If so, what policies could help push the economy past the tipping point? Finally, considering all expected costs and benefits, would the endeavor be worthwhile?

Given the fundamental social nature of human interaction, there are bound to be many more examples of environmentally relevant social coordination than the ones mentioned here. As a final remark, however, note that examples such as alternative smoking norms may come easily to mind precisely because we have seen, in practice, one equilibrium being replaced by another. Since coordination equilibria tend to be stable over time, such examples may be relatively few. To discover the various ways we coordinate and how those ways might be changed, even in cases where such changes are yet to be seen, quite some imagination may be required.

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