

Climate policy when preferences are endogenous – and sometimes they are

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Abstract

Policy can change people’s preferences. For example, how cities are designed has an impact on future preferences about modes of transport, even after people move. We examine the normative significance of such preference formation for climate policy design, in which such effects are commonly ignored. Yet, on the long time scales that climate policy must consider, it is likely to change preferences. We argue that this is of high relevance for the adequate evaluation of mitigation options. We further argue that the orthodox approach of addressing environmental concerns with marginal pricing and Pigouvian taxes is missing a key element. Policies that change preferences can influence the cost of carbon mitigation, and hence change the optimal carbon tax rate. As an attempt to assist in policy making with endogenous preferences, we examine alternatives to preference satisfaction for normative economics. Some new arguments for and against established positions in welfare theory are considered. We conclude that substantive welfare criteria, or perhaps a reinterpretation of the standard liberal approach to welfare as about *fundamental* preferences, may serve as a better guide to policy where preferences are endogenous.

Keywords: endogenous preferences, preference formation, climate change mitigation, behavioural welfare theory, subjective well-being, low-carbon infrastructure

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1 Introduction

Consider a policy-maker designing a new urban district. She knows that the economy must be completely decarbonized sometime after 2050 and certainly before 2100 (IPCC, 2014). She also knows that the social and built environment shapes people’s preferences about mobility (Weinberger and Goetzke, 2010). How should she design the district? Her infrastructure decisions will change people’s choice sets and their choices (Sunstein, 2015). The infrastructure built has non-marginal effects (Dietz and Hepburn, 2013) and it is even likely to influence people’s broader preferences (Bowles, 1998). Currently observable choices are thus not necessarily a valid basis for the decision. What weight should be given to dominant preferences for driving conventional cars? And given the need for low-carbon transport options, how should the infrastructure enable electric cars on the one hand and non-motorized and public transport on the other?

This example highlights a normative difficulty for climate change mitigation that we address in this article: policy measures influence people’s preferences. This is almost routinely ignored in climate policy, possibly because addressing it requires rethinking standard positions in current welfare economics – the branch of economics that analyses how to evaluate economic outcomes from different ethical viewpoints.

Standard economics typically recommends that the core of the solution to mitigating climate change is to impose a price on carbon. The economic logic behind this claim is as follows: Emitting greenhouse gases is an “externality” because doing so harms unconcerned others and this harm is not taken into account by the emitters. The carbon price corrects this and provides an incentive not to pollute. Optimally, the price should be set at a level such that the (“marginal”) benefit derived from an additional unit of emitted carbon equals the (“marginal”) damage caused by an additional unit of carbon emitted. The price that achieves this equalization is called the Pigouvian level of the carbon price, after Cambridge economist Pigou (1920).

Most descriptive or normative work in economics is based on stable preferences of households. Descriptively, this means that individuals have fixed preferences over the consumption options available to them. It is only through changing prices of goods, not because of changes in tastes, that people’s choices change. Normatively, standard economics typically assumes the view that a state of the world is better than another state of the world if people’s preferences are fulfilled to a larger degree. That is, the more people get what they want, the better. This is referred to as the preference satisfaction view of welfare. Yet over time, preferences change. Bowles (1998) comprehensively surveys evidence for preference changes from various social sciences. He argues that preferences co-evolve with economic institutions and identifies various mechanisms of cultural transmission that give rise to

preference changes. He further claims that "...we can neither accurately predict nor coherently evaluate the likely consequences of new policies or institutions without taking account of preference endogeneity". [...] "Because our preferences have [...] effects on others, how we acquire them is a matter of public concern." (Bowles, 1998, pp. 75 and 105).

However, the normative and welfare-theoretic aspects of preference formation have rarely been explored in economics (exceptions are von Weizsäcker (1971, 2005); Bar-Gill and Fershtman (2005); Binder (2010)). If policy measures can change preferences, this is a difficulty for the standard evaluation of policies by the satisfaction of stable revealed preferences. The reason is that if policies shape preferences, they shape the scale by which they are to be evaluated. If policies shape their very standard of evaluation, the standard itself becomes unsound.

The aim of this article is twofold: First, we ask whether and, if so, to what extent the endogeneity of preferences matters for climate policy. We conclude that climate policy is different from many other fields of economic policy because it must deal with very long time scales. On time frames of decades or centuries much preference formation by policies will occur.¹ As we will see, an implication is that if climate policies shift preferences towards low-carbon consumption, the costs of mitigating climate change would be lower. Second, we examine whether the major approaches to welfare discussed in normative economics are adequate for assessing policies that shape preferences. We conclude that modified revealed preference approaches are unsuitable for evaluating the merit of long-term climate policies, and that more substantive notions of welfare, while also not entirely satisfactory, provide more useful guidance.

Our analysis differs from much recent work in climate ethics, which tends to focus more upon responsibilities for the burden of mitigation rather than on how competing mitigation options are evaluated (Gardiner et al., 2010; Hayward, 2012; Caney, 2014), but see Caney and Hepburn (2011). Non-consequentialist approaches hence prevail. In this article, we focus on a specific problem within normative economics, which traditionally has been consequentialist. However, our analysis is not irrelevant to non-consequentialist approaches to climate ethics whenever these consider preferences.

We proceed as follows: In Section 2, we illustrate why preference formation by policy is likely to be pervasive over the long time scales that climate policy evaluation must consider. In Section 3, we consider the major positions in economic welfare theory and assess what new arguments for and against them are provided by the case of preference formation through the lens of climate change mitigation. In Section 4, we discuss the implications of our arguments for climate policy. Section 5 concludes.

¹However, this is certainly not true for contextual factors influencing decision-making.

2 Policy really does change preferences

This section employs a series of empirical examples to demonstrate that policy really does change preferences over long time scales relevant for climate policy. Before moving to the examples, we clarify some of the key concepts.

Traditionally, households are assumed to maximise a utility function that represents stable preferences over different bundles of consumption. Preferences, the choice set and a budget constraint are the only inputs to determining choice in this model. Households' preferences can therefore be inferred from their observable choices. A utility function is *not* to be interpreted as a measure of subjective well-being or 'happiness', but rather as a function representing which options are preferred over other options. In contrast, behavioural economic research is more likely to view humans as altruistic and envious, often with incorrect beliefs, and using heuristics to reduce the cognitive load of decision making. Other factors, unrelated to the choice outcome, are also acknowledged to interfere with decision-making (Camerer et al., 2005; Camerer, 2008; Thaler and Sunstein, 2008; DellaVigna, 2009; Kahneman, 2011). Therefore, in addition to the choice set and preferences, beliefs and decision-making processes (DellaVigna, 2009) are required to be specified before preferences can be identified.²

Here, we focus on cases when the underlying preferences change, not the contextual factors in decision-making. Some examples for changes in preferences include: learning new habits from one's social environment (Weinberger and Goetzke, 2010), changes in consumption preferences due to prior consumption or maturation (Loewenstein and Ubel, 2008), changes in which social comparisons people adhere to (Frey, 2008) or changes in intrinsic and extrinsic motivation, including altruistic behaviour (Bowles and Polania-Reyes, 2012).

In the language of economic modelling, preferences become *endogenous* once there are other variables that influence them, in contrast to the conventional approach in which they are treated as being fixed (Fehr and Hoff, 2011). Once anyone influences any preference, one can speak of *preference formation*. Examples for policies that change preferences include awareness raising campaigns and advertisement as far as these not only provide information or raise the salience of an issue, but aim to change citizens' habits. Further examples are education policy or urban design. Choices to

²The decision-making process can involve maximising some utility function, but it can also consist in choosing a default or being influenced by the framing of a choice, for example. The distinction between decision-making and preferences is particularly important to this article. Much normative work, in particular about "nudging" (Thaler and Sunstein, 2008), has focused on the role of contextual factors in decision-making, such as the framing of a choice or setting a default. Further work has debated normative criteria in view of incoherent preferences, for example time-inconsistent preferences (Bernheim and Rangel, 2007). However, in both of these cases the phenomenon under consideration is a decision, rather than a preference, that is changed by policy or context.

allocate goods by markets or by other institutions may also unintentionally shape preferences (Bowles, 1998). Recently, Schumacher (2015) modeled the idea that societies might invest in an environmental culture that results in a stronger preferences for environmental quality, while Prieur and Bréchet (2013) consider the notion that investment in education reinforces such a preference.³

Preference formation: examples relevant for climate policy Equipped with the terminology just introduced, we now consider four cases of preference formation by policy that are relevant for the transition to a low-carbon economy. Bowles (1998) gives a comprehensive overview of how preferences co-evolve with economic institutions and the main mechanism by which preferences are shaped: cultural transmission. Here we focus on four examples particularly relevant to climate policy.

First, a recent strand of transportation research suggests that the urban environment one lives in shapes one's preferences about modes of transportation (Cao et al., 2007; Weinberger and Goetzke, 2010, 2011): when people move from a city with good public transport to a car-dependent city they 'export' their mobility habits. They are more likely to own fewer vehicles due to learned preferences for lower levels of car ownership (Weinberger and Goetzke, 2010, see also Mattauch et al., 2015 for a more detailed discussion).⁴

Based on this finding, reconsider the introductory example of an urban transport system that is to be developed. Suppose that transport system A is based on electric cars, while transport system B is based on non-motorized and public transport. Suppose that both systems are fuelled by energy from renewable sources. Both systems are hence low-carbon, yet they widely differ in their impact on urbanites' well-being on various dimensions, such as pri-

³We do not make any claims on the empirical matter of how fast a preference change can happen for an individual. There is some evidence that if people first encounter a good that is new to them, they form a preference about its value almost immediately (Ariely et al., 2003). What matters for our claims about climate policy assessment in this article is the time scale of preference changes across the population. Bowles (1998) comprehensively argues that the primary mechanism for preference formation is cultural evolution. Thus, aggregate preference changes will usually be slow.

⁴In the light of (Bowles, 1998), who argues that the primary channel for acquiring preferences is cultural transmission, one may wonder whether the preference change regarding car ownership is due directly to characteristics of the built environment or largely due to peer effects. While current studies (Cao et al., 2007; Weinberger and Goetzke, 2010) appear inconclusive about this, it seems clear that appropriate transport infrastructure is at least a precondition for sustainable mobility habits. For example, given people's basic transport needs, some transport systems will make living without a car impossible. Even if it is the case that people learn sustainable mobility habits only from their peers and their preferences do not change with characteristics of the built environment, appropriate infrastructures are required to make the learning of new mobility preferences possible (Weinberger and Goetzke, 2010).

vacy, health, comfort, subjective well-being and social cohesion (Woodcock et al., 2009; Martin et al., 2014; Anderson et al., 2015). Choices of urban design have very long-lasting impacts (Newman and Kenworthy, 1999; Masucci et al., 2013) and large-scale urbanization in the developing economies is a key driver of future greenhouse gas emissions: “The anticipated growth in urban population will require a massive build-up of urban infrastructure” (Seto et al., 2014, p.927). For this reason, our view is that urban design is perhaps the most important example of climate policy shaping preferences.⁵

Second, inducing people to make more healthy dietary choices is a recurrent topic in public health policy (Nestle and Jacobson, 2000; Story et al., 2008). For example, this includes a reduction in meat consumption (Singh et al., 2003; Walker et al., 2005), which would also reduce emissions from the agricultural sector (Stehfest et al., 2009; Popp et al., 2010). Food preferences are to a large degree culturally evolved (Rozin and Vollmecke, 1986; Birch, 1999). It follows that policy measures can have an influence on them (Pradhan et al., 2013), in particular through nutrition education of the young (Birch, 1999). In particular, adopting vegetarianism or veganism for ethical or health motives, is evidently an action that alters one’s preferences and whether this is to be promoted or not is also a policy choice.

Third, Bowles and Polania-Reyes (2012) and Bowles (2016) demonstrate that policy measures influence the degree to which people behave altruistically: for example, incentives designed to increase public good contributions are often counterproductive (Bowles and Polania-Reyes, 2012). In particular, they argue that incentives may “. . . affect the process by which people learn new preferences” (Bowles and Polania-Reyes, 2012). They survey nine experimental studies that indicate that beyond influences on the decision-making process, preferences are changed after a treatment. As part of the population is highly intrinsically motivated to contribute to climate protection (Diederich and Goeschl, 2014), the findings on changes in other-regarding preferences may evidently apply to climate policy. For instance, Frey and Stutzer (2008) discuss crowding-out of intrinsic motivation by policy measures that aim to protect the environment.

Fourth, the carbon-intensity of status symbols may change over time. While status-seeking behaviour is an anthropological phenomenon (Raleigh et al., 1984; Layard, 2011, Ch.10), what is considered a status symbol does vary over time (Frey, 2008). As the most prominent example Veblen (1899/2007) observed that for rich people of his time, leisure was a status symbol. On the contrary, in contemporary Western societies this is not the case: rather, too little leisure time may be taken because additional income

⁵While in many countries the power sector is the largest source of emissions, the potential for policy-induced preference changes is probably less important. However, there is already some anecdotal evidence from power suppliers that when consumers own their own power generation (e.g. rooftop solar panels) their behaviours change in relation to their energy use.

is needed to finance conspicuous consumption (Layard, 2006, 2011). It is also debated whether the recent decline in car use of younger generations in Western countries is in part due to reduced importance of the car as a status symbol or not (Goodwin, 2012; Kuhnimhof et al., 2012; Stokes, 2013). Over long time-horizons, what is considered to be a status-laden good or activity can change and is thus partially a choice of societies. One may hypothesize that the transition to the low-carbon economy may be easier if status symbols were low-carbon goods or activities.

These four examples indicate that the standard strategy of evaluating policies by relying on fixed preferences is not valid on the long time scales that climate policy assessment must consider. In view of preference formation, a cost concept cannot be straightforwardly derived from the idea that welfare is the satisfaction of preferences if these change with the policies to be evaluated.

Why preference formation invalidates orthodox economic policy evaluation The rationale of economic climate policy assessment is to evaluate which among several feasible mitigation options is best. Typically, one sets an emission reduction target such as limiting global warming to an increase of 2° C in global mean temperature. Economic studies then examine which mitigation path – that is, which combination of technologies – is most *cost-effective* in reaching the target (IPCC, 2014). The cost of climate policies includes the opportunity costs of forgone consumption. But such opportunity costs are a function of people’s preferences for the goods foregone. This means that any normative strategy of assessing policies in terms of their cost to society is based on the idea that the monetary value that people attach to consumption is a reasonable normative criterion. However, the prices consumers are willing to pay for the goods offered to them depend on the preferences they have.⁶

This raises intricate normative questions: Assuming that preferences for low-carbon consumption facilitate a transition to the low-carbon economy, should society, from a moral point of view, try to change preferences? As a separate question, should a government be allowed to use the instruments to do that? There are some good reasons to believe that the answer to these questions is no. However, the above examples also indicate that in some domains of policy, such as infrastructure investment, any policy choice (including the absence of regulation!) will *inevitably* shape preferences and

⁶Further, intertemporal benefit-cost analysis relies on the assumption that projects to be evaluated are marginal, while large-scale infrastructure investments in the context of climate and energy policy may influence the growth path of the economy (Dietz and Hepburn, 2013). In this article we focus on an additional reason why standard benefit-cost analyses of such projects is unsuitable: when they shape preferences, the underlying welfare criterion of the satisfaction of stable revealed preferences is inadequate.

choices, (see Sunstein, 2015 for an elaborate discussion).⁷ By which normative criteria should policies be chosen in this context? It is to these questions that we turn in the next section.

3 Welfare criteria when preferences change

This section provides a summary of the three major positions in current economic welfare theory (Loewenstein and Ubel, 2008; Fleurbaey, 2009; Fleurbaey and Blanchet, 2013): preference satisfaction (Subsection 3.1), maximising a substantive objective such as subjective well-being (Subsection 3.2) and the capability approach (Subsection 3.3). Each position provides a different answer to the question: “What should policy aim to achieve?” – give citizens what they want, maximise their well-being, or maximise their capabilities. The typical starting point of economists is that policy should satisfy people’s preferences, but if those preferences are themselves shaped by policy, some meta-analysis is called for. Bowles (1998) concludes that “[...] a new welfare economics would of course have to confront the long-standing liberal philosophical reluctance to privilege some ends over others ...” (p. 105). We believe that this is not a forgone conclusion. Instead the difficulty of preference formation must be addressed in the light of the current approaches to welfare theory. The capabilities approach need not in principle privilege some ends over others, even if it does implicitly privilege the means. Nevertheless, our consideration of the arguments for and against the major positions leads us to conclude that the satisfaction of fundamental preferences or substantive welfare concepts are promising ways to address the challenge raised by endogenous preferences. Table 1 summarizes our discussion.

3.1 Preference satisfaction

The first normative position to consider is the idea that welfare consists in preference satisfaction. While there are competing views in economic theory and economic philosophy at which level preferences should matter (Gul and Pesendorfer, 2001; Hausman, 2012; Fleurbaey and Blanchet, 2013; Decancq et al., 2015; Dietrich and List, 2016), the standard approach in economics is to assume that preferences are revealed by choices. In this sense, standard economic welfare analysis assumes that “whatever people choose makes them better off” (Loewenstein and Ubel, 2008).

⁷Note that the standard charge of “paternalism” does not apply to thinking about policy modifying preferences in this way. The reason is that the behavioural account of decision-making implies that whatever the status of the built and social environment, it shapes decisions and preferences. So a government that refrains from choosing to influence it is no protection from the influence of the context on people’s choice. Rather, it endorses the status quo of the influence.

	Preference satisfaction	Substantive concepts, here: subjective well-being		Capability approach
General advantage	people are the best judges of what is good for them	happiness an integral part of welfare		larger evaluative space: freedom to choose
General disadvantage	preferences frequently unreliable: ill-defined and incoherent	paternalist or illegitimate		measurement of welfare underspecified, not a separate approach?
	Revealed preferences	Fundamental preferences		
Difficulties regarding preference formation by climate policy	largely question-begging	fundamental preferences not unchanging	insufficient forecasts	fundamental valuations not unchanging

Table 1: The three major approaches to welfare, their general advantages and disadvantages and specific difficulties regarding preference formation by policy

This orthodox approach has recently been undermined by the behavioural account of how humans make economic choices (Thaler and Sunstein, 2008; Kahneman, 2011), in addition to the problems of endogeneity addressed in this article. It is now clear that preferences are often inconsistent or undefined. Choices are systematically influenced by biases and factors that do not have normative significance. An entire canon of experimental and psychological evidence now suggests that there is a wedge between preference and choice as, for instance, preferences get distorted by the context of a choice. This, one might think, makes it difficult to sustain the position that whatever people choose makes them better off.

Yet an emerging theory attempts to save the idea that welfare consists in the satisfaction of preferences, even if preferences are not directly revealed in choices. Scholars have suggested modified preference satisfaction criteria that can take into account that choices are biased or shaped by contextual and framing factors (Bernheim and Rangel, 2007; Thaler and Sunstein, 2008; Bernheim and Rangel, 2009; Manzini and Mariotti, 2014) instead of equating preferences with choices.

However, this body of literature has not considered the situation addressed in this article in which preferences are influenced by policy (but see Sunstein, 1993). Loewenstein and Ubel (2008) note that “[a] concept of welfare based on preference has difficulty evaluating welfare in a situation of changing preferences, without privileging some preferences over others.” (p. 1798) We first consider modifications to the revealed preference approach in Subsection 3.1.1 and then the idea that welfare is the satisfaction of ‘fundamental’ preferences in Subsection 3.1.2.

3.1.1 Modifying the view that welfare consists in satisfying revealed preferences

A natural first attempt to deal with the difficulty that policy choices can form preferences would be to save as much of the idea that welfare is determined by the satisfaction of stable preferences. This may be particularly attractive if preferences changing in response to policy measures is a limited phenomenon. (Binder, 2010, Chapter 6.1) gives a comprehensive discussion of this strategy, here we focus on its application to climate policy.

The strategy for only minimally extending the standard revealed preference approach to make room for endogenously formed preferences is to find a way that yields “revealed” preferences suitable to the policy problem at hand. In many situations, people may entertain and can state meta-preferences over the basic preferences that a situation may shape.

This is not a satisfying solution if preference formation is more pervasive, as is suggested by the previous section, for the task of decarbonisation. Suppose we evaluate the merit of given urban design options by the number of people that move to or from similarly designed urban districts or by surveys of the sort of built environment people want. This may not address the problem that people’s preferences are already and will be formed by the policy choices in the following cases: people may not have meta-preferences about the different possible environments, they may not be aware that some of their preferences will be formed by the choice, or meta-preferences cannot be elicited.

More importantly, even if current meta-preferences are assumed to be normatively reliable, a further reason to reject such a criterion is that the policy choice will influence the preferences of the *future* people. It seems impossible to currently elicit any information about the direction in which way future people would want their preferences to be shaped, had they known that they are shaped by policy before their birth.⁸

We thus conclude that such attempts to resurrect revealed (meta-)preferences will be question-begging if (a) preference formation by policy is too pervasive to reasonably find enough possibilities of eliciting meta-preferences of the current population or (b) preference formation of future people is involved.

⁸It is beyond scope of the present article to take into account that society’s choices will change which future people come into existence, that is, the non-identity problem (Parfit, 1987; Roberts, 2015). It is true that global climate policy affects the identity and number of future people, not just the characteristics of their existence such as their preferences, as discussed here. Evidently, the non-identity problem complicates the task of normative climate economics (Kolstad et al., 2014). For instance, Broome (2016) argues that taking into account the non-identity problem invalidates preference- and substantive-approaches to welfare economics and instead recommends resourcism.

3.1.2 Fundamental preferences

A different solution that retains the preference satisfaction approach to welfare relies upon a distinction between preferences at a “fundamental” level and those at a “superficial” level (at least implicit in Lancaster, 1966 and Decanq et al., 2015). Most humans instinctively recognize their moment-to-moment choices can conflict with their fundamental desires, whether due to error, bias, weakness of the will or influence of context.

In this framework, welfare is defined as the satisfaction of fundamental preferences. People’s moment-to-moment choices reveal only their superficial preferences, which are not necessarily aligned with these deeper preferences, given all the distortions in decision-making identified by behavioural economics. If this distinction is accepted, the challenge is then how to identify these fundamental preferences. Patterns of choices, almost at an “anthropological” level, might be used to reveal fundamental preferences for comfort, reputation, meaning, security and so on. For instance, Dietrich and List (2013, 2016) model a decision-maker with stable fundamental preferences but where each specific decision is a function of the “motivationally salient” properties of the options, where such properties depend on the context (Dietrich and List, 2016).⁹

For instance, for the case of designing a transport system, one may hypothesize that people’s “fundamental” transport preferences are to desire a transport system that provides comfort, efficiency, reliability and privacy. The finding that urban infrastructure shapes preferences could arguably be understood at the superficial, not the fundamental level. This approach indicates a clear way out of the normative problem that policy measures may shape preferences: it holds that this is the case for “superficial” instead of fundamental preferences. When welfare is based on fundamental preferences, no difficulty for the preference view of welfare arises through the link between policies and superficial preferences.

However, the distinction between fundamental and superficial preferences may, in practice, provide less of a solution than first appears. Assume that policy instruments shape superficial preferences, leaving fundamental preferences intact. This leaves a great deal undetermined about the content of those fundamental preferences. The core challenge, as noted above, is identifying the fundamental preferences, and there is a scarcity of useful empirical research in this area. For instance, building an efficient, reliable and comfortable transport system will not settle all questions of urban design that must be decided. One may still need *substantive* welfare criteria for determining the details of policy choices. This is precisely what the preference approach wants to avoid. Once we move away from the assumption

⁹Bosworth et al. (2016) take a similar approach to explaining how different motives may be activated by different social settings, while Lecouteux (2015) (Chapter 5) considers games in which players choose their preferences in a precommitment game.

that what people choose makes them better off, it may not be possible to avoid “privileging some ends over others”.

Another objection to relying on preferences at a fundamental level is the point that even these may change over very long time scales. For example, the degree of risk aversion is an important normative parameter for economic evaluations. It seems unlikely that a theory of welfare as the satisfaction of fundamental preferences can be useful without a risk measure. However, it is well imaginable that risk aversion is something that changes from one generation to the next. So it seems conceivable that people’s fundamental desires will vary somewhat over time.¹⁰ Moreover, the current reality and future prospects of human enhancement including genetic engineering (Bostrom and Savulescu, 2009; Juengst and Moseley, 2016) cast doubt on the idea that one can rely on fundamental preferences as unchanging for the next century. For example, humans might enhance their capacities to be more altruistic, intelligent and resilient, including through taking drugs and genetic modifications (Savulescu et al., 2011) on a large scale. This highlights that over long time scales, even preferences about such fundamental goals as security, comfort and privacy might change to some degree.

In short, while there is some attraction in preserving preference satisfaction by unearthing fundamental preferences, this is not without its theoretical and practical challenges. If people’s fundamental preferences cannot be identified, policymakers will have to employ some substantive conception of welfare in order to make policy decisions.

3.2 Substantive welfare criteria

The second normative position is that welfare is to be equated with specific concepts of the good life. Substantive approaches equate welfare with concrete life goals, such as health, happiness meaning or wisdom (Loewenstein, 2009; Layard, 2011; Baumeister et al., 2013; Greene, 2013). They evaluate policies by their impact on these goals, instead of relying on the liberal principle that people themselves are the best judges of what is good for them.

The only substantive welfare conception that has received much attention by economists is the viewpoint that subjective well-being (“happiness”) should be maximised. Welfare is taken to be subjective well-being as measured in happiness research (Kahneman and Krueger, 2006; Krueger et al., 2009; Layard, 2011). This branch of social psychology finds that the measurement of subjective well-being is reliable: self-reported experience of one’s quality of life and one’s feelings are reasonably accurate characterizations of

¹⁰Further, people seek subjective well-being (Benjamin et al., 2012; Fleurbaey and Schwandt, 2015), but not exclusively (Benjamin et al., 2012) because meaning (Baumeister et al., 2013) also matters, for instance. It is possible that the degree to which people seek these goals changes over time.

people's life satisfaction and present mood (Kahneman and Krueger, 2006; Frey, 2008; Diener et al., 2009; Kahneman, 2011; Layard, 2011). The claim of reliability rests upon the observation that higher values in such surveys correlate with, for example, more genuine smiles, being seen as happier by peers as well as lower risk of suicide (Kahneman and Krueger, 2006; Frey, 2008; Layard, 2011). The viewpoint that welfare is happiness is different from the idea that welfare consists in preference satisfaction because it is a robust finding of the behavioural sciences that human beings make decisions that do not maximise their subjective well-being (Hsee and Hastie, 2006).

In general, whether one prefers a "substantive" welfare conception over a "liberal" approach to welfare depends on weighing two key considerations. On the one hand, supporters of the "liberal" approach argue that substantive concepts are too "paternalist". People legitimately have other goals than those in the philosopher's conception of the good life (Crisp, 2005, Section 4.3). Specifically, the idea that welfare is happiness is rejected – the definition of a flourishing life will vary from person to person, and may not necessarily maximise happiness (Fleurbaey and Blanchet, 2013). Furthermore, subjective well-being is not necessarily a good representation of severe (material) deprivation (Sen, 1985) – psychological adaptation (Frederick and Loewenstein, 1999) can create 'happy peasants' – but eliminating such deprivation may be socially desirable.

On the other hand, supporters of the "substantive" approach note that "liberal" approaches ignore the large influence of cognitive biases that may distort people's choices (Loewenstein and Ubel, 2008). Further, the cases in which individuals have goals in life different from their own reported well-being may be irrelevant for most practical policy applications (see Greene, 2013, for a related view), in particular related to mitigation options.

For the purposes of this article on endogenous preferences, substantive welfare conceptions have the great advantage that the influence of policy on preferences does not complicate the evaluation at all (cf. Binder, 2010, Ch. 6.1). For instance, deciding on urban infrastructure projects on the merit of making the population as happy as possible would need to consider preference formation as part of the long-term impact of a policy instrument, but not as part of the normative analysis. In practice, a particular caveat from the viewpoint of seeking to evaluate preference changes over long time periods is that little is known how determinants of happiness or meaning may change. Some determinants of happiness are biological, but many other aspects, as well as most aspects of meaning are cultural and thus will also change in the long-term. While this is not an objection to substantive welfare conception in principle, it may be one that is very relevant in practice, when applying this normative viewpoint to evaluate climate policy measures: one may not have forecasts of how social change will influence the cultural determinants of happiness and meaning.

3.3 The capability approach

The third major position on welfare is the capability approach. This approach holds that the basic unit of assessment for human well-being is “capabilities” and not preferences, nor subjective well-being. In the version of the approach of Sen (1985), “functionings” are all sort of doings and beings of a person. “Capabilities” are the possible combinations of these functionings that a person is able to achieve (Sen, 1985, 2001). Welfare can be seen as an aggregation of valuation functions that individuals have over the capabilities, their possible functioning vectors (Sen, 1985, Ch. VII, see also Fleurbaey and Blanchet, 2013, Ch. 6.2, for an elaborate discussion).

Freedom is emphasized as a key consideration of the capability approach in two ways. First, the focus on capabilities instead of functionings incorporates people’s freedom to choose between different achievements (Sen, 1985). Second, the weight given to different capabilities should be determined by people’s own valuations that have to be aggregated through social choice (Sen, 2001), not evaluated by substantive concepts of what the good life is. The approach seeks to avoid both a metric of happiness and a metric of how resources fulfil preference, emphasizing that the right space for evaluating policies is that of capabilities. For example, happiness can be seen as one functioning among the others, while including all possible valuations of many dimensions of life (Sen, 1985). Therefore, what is generally seen as attractive about this approach is that it broadens the scope of welfare analysis to more dimensions of life than could be monetized or are related to happiness.¹¹

The capability approach is celebrated primarily for broadening the space of evaluations of policy to functionings and capabilities instead of the narrower metrics of subjective well-being or preference satisfaction. It is an extremely appealing idea. However, using the capability approach in practice to measure welfare and assess economic policy has always been considered its weaker part (Fleurbaey and Blanchet, 2013, Ch. 6). In general, we agree with the critique of the capability approach put forth by Fleurbaey and Blanchet (2013): despite the change of focus of the evaluative space to capabilities, for the task of assessing welfare, the approach still needs

¹¹A different version of the capability approach is advocated by Nussbaum (see Nussbaum, 2011 for a recent treatment): while she also advocates people’s *possible* achievements as the right domain for evaluating policy, her focus is on finding an explicit list of dimensions of life in which capabilities should matter. Policy should then ensure the possibility of basic achievements in each dimension. Nussbaum’s version of the capability approach is thus explicitly pluralist about values. The capabilities that matter for people are seen as incommensurable and cannot without distortion be aggregated (Nussbaum, 2011, p. 18f.). Thus, it does not endorse the method that policies must be judged based on one single scale, which is the focus of this article. One objection to this approach from the point of view of doing economics is that it has little to say about policy decisions that involve trade-offs between the dimensions.

a metric that allows to weigh the capabilities people value. It insists that people's valuations of capabilities should be considered at a fundamental level (Sen, 1985). However, once a valuation system is chosen, for example by a democratic procedure (Sen, 2001), Sen (1985, 2001) insists that different individuals' welfare should be valued by one aggregate metric. It would therefore be vulnerable to the objections raised to substantive concepts in the previous subsection. If, instead, people's individual valuations of their capabilities were respected, then the capability approach likely collapses into a preference-based approach to welfare with a broadened domain (Fleurbaey and Blanchet, 2013, Ch. 6). In short, it would need people's fundamental preferences over their capabilities as an input to assess welfare.

Therefore, in our view, the approach faces similar practical objections as the idea of assessing welfare by fundamental preferences above: First, for practical policy applications such as low-carbon urban design, relying on fundamental preferences practically leaves too much undecided. Second, given past and expected changes in the human condition, it is not clear that one should take fundamental preferences as unchanging on long time scales. In sum, the move to functionings and capabilities as the evaluative space for welfare may initially sound promising for the issue preference formation by policy. However, practical limitations imply that it may not help much.

4 Implications for climate policy

We have established that (i) policy can and does shape preferences, (ii) that this likely matters for climate policy; (iii) that government cannot avoid it and hence (iv) must have some framework for evaluating the best way in which to shape preferences. We argued in section 3 that the most plausible approaches were to attempt to unearth fundamental preferences, or perhaps more practically, look to substantive concepts of welfare to provide guidance when preferences are endogenous. However, irrespective of the approach, there are two important and immediate implications of the endogeneity of preferences for climate policy.

First, conclusions about optimal levels of greenhouse gas emissions are affected by preference endogeneity. This is because if policy induces stronger preferences for low-carbon consumption goods, the costs of decarbonisation fall. Models that do not factor such shifts in preferences overestimate the cost of mitigating climate change, and hence arrive at conclusions that less mitigation is optimal as a consequence. This is not a mere theoretical issue. The early integrated assessment models (Nordhaus, 1994; Edenhofer et al., 2005) eschewed the problem of preference changes, modelling consumption as a generic good. They considered decarbonisation as a supply-side problem, that is, see the solution space for mitigation options in a transformation of the energy system (see Creutzig et al., 2016). More current generations

of Integrated Assessment and global land use models do sometimes consider exogenous demand changes in carbon-intensive sectors of the economy – notably in the food (Stehfest et al., 2009; Popp et al., 2010), less so in the transport (Creutzig et al., 2015; McCollum et al., 2016) sector – as part of the space of mitigation options. Yet, as far as we are aware, no single Integrated Assessment model, or even most theoretical models in environmental economics, consider how climate policy may induce preference changes themselves. If, indeed, stronger preferences for low-carbon consumption goods are induced by some technological options, the costs of decarbonisation would be overestimated by those models as a consequence.

Second, the design of policies to reduce emissions is affected. Consider emission pricing, for instance, whether through taxation or a trading system. Should the carbon price be applied upstream (on firms that extract carbon), at the point of emission (as is currently the case around the world), or on final consumers of the goods that cause the emissions? One might think it does not make much difference – the price should radiate up or down the supply chain in any case, triggering behaviour changes by producers and consumers. For instance, an increase the carbon price (whether raising the tax rate or by tightening the emissions cap) on producers should be transferred to consumers (Hepburn et al., 2013). However, if preferences can change in response to climate policy, one may speculate that the salience of the carbon price may be relevant. If the price is made explicit to consumers, they may become more aware of dangers associated with climate change, and voluntarily decide to take more action than might be expected by the pure price signal.

The consequences of any change in preferences would differ between a tax and trading scheme. Suppose pricing emissions crowds in intrinsic motivation to protect the environment. With a tax, more mitigation than would have happened had preferences not changed occurs, and the price remains fixed. With a trading scheme, the amount of mitigation is fixed, and the shift in preferences would simply reduce market emission prices. In contrast, if pricing emissions crowds out intrinsic motivation, the opposite effects arise – less mitigation with a tax, and higher carbon prices under a trading scheme. The literature on instrument choice (Weitzman, 1974; Hepburn, 2006) to our knowledge has not considered this point. The carbon price that is optimal when the policy triggers no net change in preferences emerges as a special case. That said, we doubt these effects are particularly strong – and empirical evidence of the magnitude of them is not yet available. In contrast, climate policies concerning the built and social environment clearly do influence how preferences are formed and the effects will be relevant to policy design. Shifting preferences may well be relevant to the ex post political acceptability of the policy – a brave politician could introduce more stringent climate policy on the grounds that, once introduced, voters will approve of it, even if they do not ex ante.

5 Conclusion

This article argued that preference formation by policy measures is a difficulty for normatively sound evaluations of climate policy. It first surveyed the empirical evidence for the premise that, in the long term, preference formation by climate policy is pervasive. From this premise we derived the conclusion that the focus of normative climate economics on Pigouvian pricing is somewhat misplaced for normative reasons. Instead those policies that shape the built and social environment of choices such as infrastructure investments and urban design must be considered as equally important in welfare analysis. We further argued that the possibility of preference formation by policy requires a re-evaluation of the standard positions on welfare. From our survey of the current welfare-theoretic positions we concluded that identifying welfare with the satisfaction of *fundamental* preferences or with substantive concepts such as subjective well-being are promising strategies, but need to be further explored. The analysis in this article could be extended in at least two ways. First, future empirical and philosophical work may be needed to clarify how much weight can be put on the distinction between superficial and fundamental preferences. Second, how specific tastes derive from more fundamental preferences over long time scales and conditional on the decision environment seems to us a topic that is not considered enough in formal economic work.

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References

- Anderson, M. L., Lu, F., Zhang, Y., Yang, J., Qin, P., 2015. Superstitions, street traffic, and subjective well-being. NBER working paper no. 21551.
- Ariely, D., Loewenstein, G., Prelec, D., 2003. “Coherent arbitrariness”: Stable demand curves without stable preferences. *Quarterly Journal of Economics* 118(1), 73–105.
- Bar-Gill, O., Fershtman, C., 2005. Public policy with endogenous preferences. *Journal of Public Economic Theory* 7(5), 841–857.
- Baumeister, R. F., Vohs, K. D., Aaker, J. L., Garbinsky, E. N., 2013. Some key differences between a happy life and a meaningful life. *The Journal of Positive Psychology* 8(6), 505–516.

- Benjamin, D. J., Heffetz, O., Kimball, M. S., Rees-Jones, A., et al., 2012. What do you think would make you happier? What do you think you would choose? *American Economic Review* 102(5), 2083.
- Bernheim, B. D., Rangel, A., 2007. Behavioral public economics: Welfare and policy analysis with nonstandard decision-makers. In: Diamond, P., Vartiainen, H. (Eds.), *Behavioral Economics and Its Applications*, pp. 7–77, Princeton University Press, Princeton.
- Bernheim, B. D., Rangel, A., 2009. Beyond revealed preference: choice-theoretic foundations for behavioral welfare economics. *Quarterly Journal of Economics* 124(1), 51–104.
- Binder, M., 2010. *Elements of an evolutionary theory of welfare: assessing welfare when preferences change*. Routledge, Abingdon.
- Birch, L. L., 1999. Development of food preferences. *Annual review of nutrition* 19(1), 41–62.
- Bostrom, N., Savulescu, J. (Eds.), 2009. *Human enhancement*. Oxford University Press, Oxford.
- Bosworth, S. J., Singer, T., Snower, D. J., 2016. Cooperation, motivation and social balance. *Journal of Economic Behavior and Organization* Volume 126, Part B, 7294.
- Bowles, S., 1998. Endogenous preferences: The cultural consequences of markets and other economic institutions. *Journal of Economic Literature* 36(1), 75–111.
- Bowles, S., 2016. *The moral economy. Why good incentives are no substitute for good citizens*. Yale University Press, New Haven.
- Bowles, S., Polania-Reyes, S., 2012. Economic incentives and social preferences: substitutes or complements? *Journal of Economic Literature* 50(2), 368–425.
- Broome, J., 2016. Efficiency and future generations. mimeo.
- Camerer, C., 2008. The case for mindful economics. In: Chaplin, A., Schotter, A. (Eds.), *The foundation of positive and normative economics. A Hand Book.*, pp. 43–69, Oxford University Press, Oxford.
- Camerer, C., Loewenstein, G., Prelec, D., 2005. Neuroeconomics: How neuroscience can inform economics. *Journal of Economic Literature* 43(1), 9–64.
- Caney, S., 2014. Two kinds of climate justice: avoiding harm and sharing burdens. *Journal of Political Philosophy* 22(2), 125–149.
- Caney, S., Hepburn, C., 2011. Carbon trading: Unethical, unjust and ineffective? *Royal Institute of Philosophy Supplement* 69, 201–234.
- Cao, X., Mokhtarian, P. L., Handy, S. L., 2007. Cross-sectional and quasi-panel explorations of the connection between the built environment and auto ownership. *Environment and Planning A* 39(4), 830–847.
- Creutzig, F., Fernandez, B., Haberl, H., Khosla, R., Mulugetta, Y., Seto, K. C., 2016. Beyond technology: demand-side solutions to climate change mitigation. under review.
- Creutzig, F., Jochem, P., Edelenbosch, O. Y., Mattauch, L., van Vuuren, D. P., McCollum, D., Minx, J., 2015. Transport: a roadblock to climate change mitigation? *Science* 350(6263), 911–912.

- Crisp, R., 2005. Well-being. In: Zalta, E. N. (Ed.), *The Stanford Encyclopedia of Philosophy*, spring 2008 edition.
- Decancq, K., Fleurbaey, M., Schokkaert, E., 2015. Happiness, equivalent income and respect for individual preferences. *Economica* 82(s1), 1082–1106.
- DellaVigna, S., 2009. Psychology and economics: Evidence from the field. *Journal of Economic Literature* 47(2), 315–372.
- Diederich, J., Goeschl, T., 2014. Willingness to pay for voluntary climate action and its determinants: Field-experimental evidence. *Environmental and Resource Economics* 57(3), 405–429.
- Diener, E., Oishi, S., Lucas, R. E., 2009. Subjective well-being, the science of happiness and life satisfaction. In: Lopez, S. J., Snyder, C. R. (Eds.), *Oxford Handbook of Positive Psychology*, pp. 187–194, Oxford University Press, Oxford.
- Dietrich, F., List, C., 2013. Where do preferences come from? *International Journal of Game Theory* 42(3), 613–637.
- Dietrich, F., List, C., 2016. Reason-based choice and context-dependence: An explanatory framework. *Economics and Philosophy* 32, 175–229.
- Dietz, S., Hepburn, C., 2013. Benefit–cost analysis of non-marginal climate and energy projects. *Energy Economics* 40, 61–71.
- Edenhofer, O., Bauer, N., Kriegler, E., 2005. The impact of technological change on climate protection and welfare: Insights from the model mind. *Ecological Economics* 54(2), 277–292.
- Fehr, E., Hoff, K., 2011. Introduction: Tastes, castes and culture: the influence of society on preferences. *The Economic Journal* 121(556), F396–F412.
- Fleurbaey, M., 2009. Beyond GDP: The quest for a measure of social welfare. *Journal of Economic Literature* 47(4), 1029–1075.
- Fleurbaey, M., Blanchet, D., 2013. *Beyond GDP: Measuring Welfare and Assessing Sustainability*. Oxford University Press, Oxford.
- Fleurbaey, M., Schwandt, H., 2015. Do people seek to maximize their subjective well-being? IZA Discussion Paper No. 9450.
- Frederick, S., Loewenstein, G., 1999. Hedonic adaptation. In: Kahneman, D., Diener, E., Schwarz, N. (Eds.), *The foundations of hedonic psychology*, pp. 302–329, Russell Sage Foundation, New York.
- Frey, B., 2008. *Happiness. A revolution in economics*. MIT Press, Cambridge (MA).
- Frey, B. S., Stutzer, A., 2008. Environmental morale and motivation. In: Lewis, A. (Ed.), *The Cambridge Handbook of Psychology and Economic Behaviour*, pp. 406–28, Cambridge University Press, Cambridge.
- Gardiner, S., Caney, S., Jamieson, D., Shue, H. (Eds.), 2010. *Climate ethics: Essential readings*. Oxford University Press, Oxford.
- Goodwin, P., 2012. Peak travel, peak car and the future of mobility. evidence, unresolved issues, policy implications and a research agenda. *International Transport Forum Discussion Paper No. 2012-13*.

- Greene, J. D., 2013. *Moral Tribes: Emotion, Reason, and the Gap Between Us and Them*. Penguin, New York.
- Gul, F., Pesendorfer, W., 2001. Temptation and self-control. *Econometrica* 69(6), 1403–1435.
- Hausman, D. M., 2012. *Preference, value, choice, and welfare*. Cambridge University Press.
- Hayward, T., 2012. Climate change and ethics. *Nature Climate Change* 2(12), 843–848.
- Hepburn, C., 2006. Regulation by prices, quantities, or both: a review of instrument choice. *Oxford Review of Economic Policy* 22(2), 226–247.
- Hepburn, C. J., Quah, J. K.-H., Ritz, R. A., 2013. Emissions trading with profit-neutral permit allocations. *Journal of Public Economics* 98, 85–99.
- Hsee, C. K., Hastie, R., 2006. Decision and experience: why don't we choose what makes us happy? *Trends in Cognitive Sciences* 10(1), 31–37.
- IPCC, 2014. *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O, R. Pichs-Madruga, Y. Sokona, Y., E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schloemer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Juengst, E., Moseley, D., 2016. Human enhancement. In: Zalta, E. N. (Ed.), *The Stanford Encyclopedia of Philosophy*, spring 2016 edition.
- Kahneman, D., 2011. *Thinking, fast and slow*. Penguin, London.
- Kahneman, D., Krueger, A. B., 2006. Developments in the measurement of subjective well-being. *The Journal of Economic Perspectives* 20(1), 3–24.
- Kolstad, C., Urama, K., Broome, J., Bruvoll, A., Cariño-Olvera, M., Fullerton, D., Gollier, C., Hanemann, W. M., Hassan, R., Jotzo, F., Khan, M. R., Meyer, L., Mundaca, L., 2014. Social, economic and ethical concepts and methods. In: Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Farahani, E., Kadner, S., Seyboth, K., Adler, A., Baum, I., Brunner, S., Eickemeier, P., Kriemann, B., Savolainen, J., Schlömer, S., von Stechow, C., Zwickel, T., Minx, J. (Eds.), *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 207–282, Cambridge University Press, Cambridge, UK and New York, NY, USA.
- Krueger, A. B., Kahneman, D., Schkade, D., Schwarz, N., Stone, A. A., 2009. Rejoinder. In: Krueger, A. B. (Ed.), *Measuring the Subjective Well-Being of Nations: National Accounts of Time Use and Well-Being*, pp. 243–251, University of Chicago Press, Chicago and London.
- Kuhnimhof, T., Armoogum, J., Buehler, R., Dargay, J., Denstadli, J. M., Yamamoto, T., 2012. Men shape a downward trend in car use among young adultsevidence from six industrialized countries. *Transport Reviews* 32(6), 761–779.
- Lancaster, K. J., 1966. A new approach to consumer theory. *Journal of Political Economy* 74(2), 132–157.

- Layard, R., 2006. Happiness and public policy: a challenge to the profession. *The Economic Journal* 116(510), C24–C33.
- Layard, R., 2011. *Happiness: Lessons from a new science*. Penguin UK, 2nd edition.
- Lecouteux, G., 2015. Reconciling normative and behavioural economics. Ph.D. thesis, Ecole Polytechnique.
- Loewenstein, G., 2009. That which makes life worthwhile. In: Krueger, A. B., Kahneman, D., Schkade, D., Schwarz, N., Stone, A. A. (Eds.), *Measuring the Subjective Well-Being of Nations: National Accounts of Time Use and Well-Being*, pp. 87–106, University of Chicago Press, Chicago and London.
- Loewenstein, G., Ubel, P. A., 2008. Hedonic adaptation and the role of decision and experience utility in public policy. *Journal of Public Economics* 92(8), 1795–1810.
- Manzini, P., Mariotti, M., 2014. Welfare economics and bounded rationality: the case for model-based approaches. *Journal of Economic Methodology* 21(4), 343–360.
- Martin, A., Goryakin, Y., Suhrcke, M., 2014. Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey. *Preventive Medicine* 69, 296–303.
- Masucci, A. P., Stanilov, K., Batty, M., 2013. Limited urban growth: London’s street network dynamics since the 18th century. *PLoS One* 8(8), e69469.
- Mattauch, L., Ridgway, M., Creutzig, F., 2015. Happy or liberal? Making sense of behavior in transport policy design. *Transportation Research Part D: Transport and Environment* 45, 64–83.
- McCollum, D. L., Wilson, C., Pettifor, H., Ramea, K., Krey, V., Riahi, K., Bertram, C., Lin, Z., Edelenbosch, O. Y., Fujisawa, S., 2016. Improving the behavioral realism of global integrated assessment models: An application to consumers vehicle choices. *Transportation Research Part D: Transport and Environment*, doi:10.1016/j.trd.2016.04.003 .
- Nestle, M., Jacobson, M. F., 2000. Halting the obesity epidemic: a public health policy approach. *Public health reports* 115(1), 12–24.
- Newman, P., Kenworthy, J., 1999. *Sustainability and cities: overcoming automobile dependence*. Island Press, Washington, DC.
- Nordhaus, W. D., 1994. *Managing the global commons: the economics of climate change*. MIT Press, Cambridge, MA.
- Nussbaum, M. C., 2011. *Creating capabilities*. Harvard University Press, Cambridge, MA.
- Parfit, D., 1987. *Reasons and persons*. Oxford University Press, Oxford.
- Pigou, A. C., 1920. *The economics of welfare*. Palgrave Macmillan, Basingstoke.
- Popp, A., Lotze-Campen, H., Bodirsky, B., 2010. Food consumption, diet shifts and associated non-CO2 greenhouse gases from agricultural production. *Global Environmental Change* 20(3), 451–462.
- Pradhan, P., Reusser, D. E., Kropp, J. P., 2013. Embodied greenhouse gas emissions in diets. *PloS one* 8(5), e62228.

- Prieur, F., Bréchet, T., 2013. Can education be good for both growth and the environment? *Macroeconomic Dynamics* 17(05), 1135–1157.
- Raleigh, M. J., McGuire, M. T., Brammer, G. L., Yuwiler, A., 1984. Social and environmental influences on blood serotonin concentrations in monkeys. *Archives of General Psychiatry* 41(4), 405–410.
- Roberts, M. A., 2015. The nonidentity problem. In: Zalta, E. N. (Ed.), *The Stanford Encyclopedia of Philosophy*, winter 2015 edition.
- Rozin, P., Vollmecke, T. A., 1986. Food likes and dislikes. *Annual review of nutrition* 6(1), 433–456.
- Savulescu, J., ter Meulen, R., Kahane, G. (Eds.), 2011. *Enhancing human capacities*. Wiley-Blackwell, Chichester.
- Schumacher, I., 2015. The endogenous formation of an environmental culture. *European Economic Review* 76, 200–221.
- Sen, A., 1985. *Commodities and Capabilities*. North-Holland, Amsterdam.
- Sen, A., 2001. *Development as freedom*. Oxford University Press, Oxford.
- Seto, K. C., Dhakal, S., Bigio, A., Blanco, H., Delgado, G. C., Dewar, D., Huang, L., Inaba, A., Kansal, A., Lwasa, S., McMahon, J. E., Müller, D. B., Murakami, J., Nagendra, H., Ramaswami, A., 2014. Human settlements, infrastructure and spatial planning. In: Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Seyboth, K., Matschoss, P., Kadner, S., Zwickel, T., Eickemeier, P., Hansen, G., Schloemer, S., von Stechow, C. (Eds.), *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 923–1000, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Singh, P. N., Sabaté, J., Fraser, G. E., 2003. Does low meat consumption increase life expectancy in humans? *The American journal of clinical nutrition* 78(3), 526S–532S.
- Stehfest, E., Bouwman, L., van Vuuren, D. P., den Elzen, M. G., Eickhout, B., Kabat, P., 2009. Climate benefits of changing diet. *Climatic change* 95(1-2), 83–102.
- Stokes, G., 2013. The prospects for future levels of car access and use. *Transport Reviews* 33(3), 360–375.
- Story, M., Kaphingst, K. M., Robinson-O'Brien, R., Glanz, K., 2008. Creating healthy food and eating environments: policy and environmental approaches. *Annual Review of Public Health* 29, 253–272.
- Sunstein, C. R., 1993. Endogenous preferences, environmental law. *The Journal of Legal Studies* 22, 217–254.
- Sunstein, C. R., 2015. The ethics of nudging. *Yale Journal on Regulation* 32, 413–591.
- Thaler, R. H., Sunstein, C. R., 2008. *Nudge: Improving decisions about health, wealth, and happiness*. Yale University Press, New Haven.
- Veblen, T., 1899/2007. *The theory of the leisure class*. Oxford University Press, Oxford.
- von Weizsäcker, C. C., 1971. Notes on endogenous change of tastes. *Journal of Economic Theory* 3(4), 345–372.

- von Weizsäcker, C. C., 2005. The welfare economics of adaptive preferences. MPI Collective Goods Preprint 2005/11.
- Walker, P., Rhubart-Berg, P., McKenzie, S., Kelling, K., Lawrence, R. S., 2005. Public health implications of meat production and consumption. *Public health nutrition* 8(04), 348–356.
- Weinberger, R., Goetzke, F., 2010. Unpacking preference: How previous experience affects auto ownership in the United States. *Urban studies* 47(10), 2111–2128.
- Weinberger, R., Goetzke, F., 2011. Drivers of auto-ownership: the role of past experience and peer pressure. In: Lucas, K., Blumberg, E., Weinberger, R. (Eds.), *Auto Motives: Understanding Car Use Behaviours*, pp. 121–136, Emerald, Bingley.
- Weitzman, M. L., 1974. Prices vs. quantities. *The Review of Economic Studies* 41(4), 477–491.
- Woodcock, J., Edwards, P., Tonne, C., Armstrong, B. G., Ashiru, O., Banister, D., Beevers, S., Chalabi, Z., Chowdhury, Z., Cohen, A., Franco, O. H., Haines, A., Hickman, R., Lindsay, G., Mittal, I., Mohan, D., Tiwari, G., Woodward, A., Roberts, I., 2009. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *The Lancet* 374(9705), 1930–1943.