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The Role of Preferences in Disagreements over Scientific Hypothesis:

An Empirical Inquiry into Environmental and Economic Decision Making

Mitesh Kataria†

Abstract

The Porter hypothesis suggests that environmental regulations, such as restricting firms to reduce pollution, stimulates innovations and create a win-win situation for the environment and for firms. It has received a great deal of attention from academics as well as bureaucrats who disagree about the applicability of the Porter hypothesis. This study tests if part of such disagreement can be explained by a preference-expectation relationship and if people are more likely to believe in a scientific hypothesis that appeals to their preferences. The results show that individuals' who care more about the environment are more likely to believe in the Porter hypothesis. We also discuss the capacity of economic methodology to mitigate a preference-expectation bias and how it relates to the current practice in environmental economics.

Keywords: Porter Hypothesis, Subjective Beliefs, Economic Methodology
JEL classification: B4, Q00, Q5

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> *"After studying economics for six years I have reached the conclusion that there is no difference between discovery and creation"* [Graffiti by an unknown student] (Smith, 1982)

1. Introduction

A statement must at least meet three criteria in order to be considered knowledge: it must be justified, true, and believed, according to a common proposition in epistemology.[1] Ideally, people form beliefs according to what is appealing to rationality and evidence. Nonideally and perhaps more realistically, attitudes might bias belief formation. This could be especially true when individuals form beliefs about something that is at the edge of their knowledge. In this study we test if people are more likely to believe in a scientific hypothesis that appeals to their preferences.

The scientific hypothesis used to facilitate this empirical inquiry is the well-known and highly debated Porter hypothesis. It was formulated by the economist Michael Porter and developed further by Porter and van der Linde (1995) and is to date one of the most cited papers in environmental economics (Auffhammer, 2008). The conventional wisdom by economists at that time was that environmental regulations, such as forcing firms to reduce pollution, restricts their options and must therefore also reduce their profits. Porter and van der Linde (1995) illustrated with (non-random) empirical observations that "well-designed" environmental regulations can induce efficiency and encourage innovations that help firms to improve commercial competitiveness. Environmental policy was argued to be a "win-win" situation, and the traditional paradigm that firms are profit-maximizing entities able to take economically

[1] Epistemology can be defined as theory of knowledge in general as opposed to philosophy of science, i.e., the theory of scientific knowledge.

beneficial measures, find the most efficient way to produce, and take decisions that benefit the company in the long run was questioned.

The Porter hypothesis has received strong criticism from many economists, arguing that firms do not have to be triggered by an extra cost to utilize economic opportunities. In parts of the policymaking community, however, the perception is different. For example, the Porter hypothesis was endorsed by U.S. Vice President Al Gore (1992). Palmer et al., (1995) notes, "Not surprisingly, this view has also been warmly received by environmentalists and by regulators eager to avoid being seen as imposing unwanted costs on businesses or lower levels of government." On the other side of the dispute, Porter and van der Linde (1995) declared economists, as a group, to be unrealistic in their "static mindset that environmentalism is inevitably costly." Bromley (2004) notes that not believing in the Porter hypothesis puts some economists in a quite agreeable position to acquire profitable research contracts and consulting opportunities to calculate the cost and benefits of various projects. As an alternative explanation, Bromley (2004) also suggests that economists might believe that certain common positions, for example on the Porter hypothesis, are necessary to belong to the profession.[2]

As a complementary explanation to the disagreement over the Porter hypothesis, the motivation of this paper comes from social psychology, where it has been repeatedly shown that people can have biased belief formation according to what might seem desirable instead of what is appealing to rationality and evidence. Alloy and Abramson (1979, 1988) showed that depressed people may not view the world gloomier but that well-adjusted people might view the world in rosier colors than objectively warranted. This is known as *depressive realism* in the psychological literature. Subsequently, a significant amount of evidence has been presented

[2] This is in line with Boulding (1969) who pointed out that the scientific community is a subculture in society and, just like any other sub cultures characterized by a strong common value system.

supporting that the mere desire for a particular outcome can inflate its judged probability, which shows that optimism is a consequence of *wishful thinking*.[3] Granberg (1983) defined wishful thinking as "a preference-expectation link"[4] based on the expectation that people predict favorable outcomes according to their wishes. Three types of events have been used to study wishful thinking in the literature: 1) Personal life events, for example the probability not to be ill the whole winter. 2) Social events, such as the outcome of competitive sports events. 3) Aleatory events that are neutral unless externally endowed with value. As far as we know, scientific hypothesis has not been used before as an event of wishful thinking.

The aim of this study is to test if beliefs about the Porter hypothesis can be explained by a preference-expectation link. We test if individuals that have stronger environment preferences (measured by the *environmental apathy* variable) also believe more in the Porter hypothesis. Assuming that knowledge about the applicability of the Porter hypothesis is uncorrelated with environmental preferences the preference-expectation relationship (bias) is tested.[5]

A few studies have empirically found that there is a strong correlation between economists' policy positions and their ideological values (e.g., Fuchs et al., 1998; Mayer, 2001). Friedman (1953) discussed the role of subjective judgment in economics and argued that the background of a scientist is not irrelevant to the judgment she reaches. One reason for this, he argued, could be that evidence in economics is seldom conclusive. Another reason mentioned

[3] For readers interested in this literature in psychology see e.g., Weinstein, 1980, 1982; Babad, 1987; Babad and Katz, 1991; Babad and Yacobos, 1993; Fischer and Budescu, 1995. Bar-Hillel and Budescu (1995), found little evidence of wishful thinking bias and concluded that wishful thinking is hard to isolate from background and prior knowledge. Bar-Hillel et al. (2008) suggest that wishful thinking might work indirectly with the causal link: "I wish for, therefore I focus on, therefore I believe in." This suggests that wishful thinking may be related to confirmation bias, i.e., the tendency to interpret evidence to fit existing beliefs.

[4] In psychology, preferences are evaluative judgments in the sense of liking or disliking a stimulus. For the remainder of this article we will apply this definition.

[5] There are no reasons to believe that the subjects of this study have knowledge about the applicability of the Porter hypothesis. Especially considering that it is a complex issue still under investigation which most people, irrespective of their environmental preferences, are not aware of.

was the possibility of researchers becoming persuaded by conformity in accepting a hypothesis. Based on the results of this paper a second aim is to discuss if and how economic methodology offers control against a preference-expectation bias. Hence, if a preference-expectation bias is found it is important to understand features in scientific methodology that could prevent biased judgments in science and of scientists. Finally, we end with a discussion about how our findings relate to the practice in environmental economics by linking our results to Folmer and Johansson-Stenman (2011) that offers a sober review of this literature.

The rest of this paper is organized as follows. Section 2 presents the research hypothesis. The survey design is presented in section 3. Section 4 presents the results. Section 5 discusses how economic methodology offers control against a preference-expectation relationship. Section 6 concludes the paper.

2. Hypothesis

Our main hypothesis states that individuals who care more about the environment are more likely to believe in the Porter hypothesis. The more an individual cares about the environment, the more she would like to see strict policies to preserve it. Such policies might, however, be rejected if they are unreasonably costly for the firms. The Porter hypothesis overcomes such obstacles as it de-emphasizes the trade-off between the environment and the firms. Hence, to believe in the Porter Hypothesis is certainly appealing for someone with strong environmental preferences and could distort their beliefs proportionally to the strength of their preferences. Alternatively, the preference-expectation relationship can also be explained by cognitive dissonance theory (Festinger and Carlsmith, 1959). Dissonance occurs when someone perceives a logical inconsistency in their beliefs that causes an uncomfortable psychological

tension. The trade-off between economy and environment could potentially cause such psychological tension. Individuals that care less about the environment and more about the firms (and possibly the owners of the firms) can, according to the theory, reduce feelings of dissonance by exaggerating the cost[6] of environmental policy and only recall evidence that disconfirms the Porter hypothesis. Hence, while wishful thinking can make people exaggerate their beliefs that the Porter hypothesis is true, cognitive dissonance can make them understate their beliefs.

Thompson and Barton (1994) found that individuals who are *ecocentric* (i.e. individuals that value nature for its own sake) are more likely to engage in conservation while *anthropocentric* individuals (i.e. individuals that value nature because of material or physical benefits it can provide for humans) are less likely to conserve. Based on these relationships, two ancillary hypotheses are also put forward: the first holds that ecocentric individuals are more likely to believe in the Porter hypothesis and the second holds that anthropocentric individuals are less likely to believe in the Porter hypothesis.

3. Survey Design

3.1 Participants and procedure

In 2010, an online survey was conducted in Jena, Germany. The subjects were undergraduate students, who were recruited using the Online Recruitment System for Economic Experiments (ORSEE). They were told that the survey was expected to take around 15 minutes to complete. The recruitment letter as well as the survey makes clear that the answers from the

[6] Shu and Bazerman (2010) argues that climate change skeptical has changed their beliefs from "there is no problem" to "we aren´t responsible" to "it´s too expensive to fix" and they relate this behavior to cognitive biases.

survey would be used for research purposes only. The survey is non-consequential[7] and there were no incentives for the respondents not to tell the truth. The subjects were incentivized by a lottery procedure with a 10 percent probability to win 10 euros. In total 290 subjects were recruited, about one half of them students of economics and business administration and the other half students of science (i.e., biology, medicine, chemistry, and physics). As in all experiments, one should of course be careful and not blindly generalize results from a student sample to the wider population. One could, however, argue that the evidence in this study is suggestive of how students form beliefs about scientific hypotheses under limited knowledge and discuss reasons why certain groups of individuals, such as policymakers or scientists, would be an exemption to such observed behavior.[8]

3.2 Survey and measures

The survey is divided in two parts. In the first part, the subjects are informed about the Porter hypothesis. This is followed by a question to elicit their beliefs about the Porter hypothesis. The information script read as follows[9]:

[7] Non-consequential means that the responses to the survey question were not intended to be used as input to policy and thereby bear any direct consequences to the survey participants.

[8] Basically there are two possibilities of why scientist might be immune to preference-expectation bias. They could either have a personal trait that makes them immune to distorted judgments or it could be something in the scientific methodology that offers control against the preference-expectations bias. We will explore the latter possibility in this study.

[9] Some people have raised the objection that the Porter hypothesis only applies to "well-designed" regulations. Of course by defining "well-designed" regulations as something that makes the Porter hypothesis to be true, one could only conclude that the Porter hypothesis is true and any empirical investigation of the likelihood of it being true would be redundant.

Fig. 1. Information script about the Porter Hypothesis

Recently, there has been a debate considering the economic effects of governmental interventions. One view is that governmental interventions in the form of environmental regulation make firms worse off. This position assumes that firms are successful at profit maximizing and that interventions therefore make the firms worse off. This position argues that environmental protection comes at a cost.

Another view, known as the *Porter Hypothesis*, is that stringent environmental regulations can induce innovations that in the long term will make the firms as well as the environment better off. This view puts forward a win-win situation (i.e., everyone is better off). It assumes that firms systematically overlook profitable opportunities for innovation and that the government can therefore use restrictions to help them focus on financial opportunities that also are good for the environment. This position argues that environmental protection, properly pursued, is often for free.

Tougher environmental regulations can be expected in the future if the Porter Hypothesis is shown to be correct.

Immediately after reading the information script the subjects are asked about how likely they think the Porter hypothesis is true in a scale between 0 and 100. Of course one cannot exclude that the wording of the information script is leading and thus influential in eliciting the responses and that the script presents a very simplified view of the Porter hypothesis. On the other hand, the interest of this study is not on students subjective beliefs about the Porter hypothesis per se but to test if beliefs about the Porter hypothesis can be explained by a preference-expectation link.

In the second part, the respondents are asked questions about their environmental attitude using the psychometric scale developed in Thompson and Barton (1994). Twelve items are used to measure ecocentrism. The items measure appreciation of nature for its own sake, positive affect and stress reduction associated with being out in nature, and the connectedness between humans and animals. Nine items are used to measure anthropocentrism. This reflects concerns with environmental issues because of the demands of human utility but not those of animal welfare. Finally, apathy toward the environment is measured using nine items. These reflect lack

of interest in environmental issues and a belief that environmental threats have been exaggerated. The items of all scales are answered on a five-point rating scale ranging from 'strongly disagree' to 'strongly agree.' All items are listed in the appendix.

4. Results

Descriptive statistics for the dependent variable (subjective beliefs) and the explanatory variables (Ecocentrism, Apathy, and Anthropocentrism) are summarized in table 1. First of all, we want to test if the explanatory variables are independent and unaffected by the information about the Porter hypothesis. Therefore, table 1 distinguishes two samples: the main sample informs about the Porter hypothesis and elicits subjective beliefs before asking questions about environmental attitudes, while the second sample reverses the order by asking questions about environmental attitudes before eliciting subjective beliefs. The hypothesis of equal mean values across the two samples cannot be rejected for any conventional significance level for any of the explanatory variables using the t-test.[10] This means that the explanatory variables are independent to the information about the Porter hypothesis. Turning to the dependent variable, using a one-tailed t-test the mean subjective beliefs is shown to be significantly higher in the second sample. It is possible that the series of questions about environmental attitudes in the beginning of the survey triggers wishful thinking bias and inflates the subjective beliefs. Therefore, we focus on the main sample to begin with and pool the two samples in a later stage.

[10] The reversed order sample contains students in economics and business administration. If we compare this sample with economics and business administration students in the main sample, we still conclude that subjects have the same environmental attitudes and subjective beliefs across the two samples.

Table 1. Descriptive statistics for the independent and dependent variables

Variable	Mean	Std. Dev.	Min	Max	Number of Obs.
Main Sample; Part 1 followed by Part 2					
Subjective Beliefs	61	25	0	100	246
Apathy	18	5	9	40	246
Ecocentrism	46	6	30	59	246
Anthropocentrism	27	4	11	37	246
Reversed Order Sample; Part 2 followed by Part 1					
Subjective Beliefs	66	22	5	100	44
Apathy	18	4	10	27	44
Ecocentrism	45	6	30	58	44
Anthropocentrism	27	4	16	37	44

The scale reliability coefficient (Cronbach's alpha) takes the value of 0.76 for apathy and 0.74 for ecocentrism, suggesting that the items have relatively high internal consistency. The scale reliability coefficient for anthropocentrism is lower and takes the value of 0,61. Since the internal consistency for anthropocentrism is poor and does not exceed the recommended rule-of-thumb value of 0.7 (Nunally, 1978), we limit ourselves to testing the first of the two ancillary hypotheses.

We now turn to the main part of the analysis. Figure 2 shows a two-way scatter plot, where the y-axis represents the degree of beliefs about the Porter hypothesis and the x-axis represents environmental apathy. Figure 3 shows a similar relationship but with ecocentrism in the x-axis. Finally, for scrutiny we also present figure 4 showing the relationship between subjective beliefs and anthropocentrism. These figures are self-explaining and in line with the econometric results. Turning to these results, the main results from the OLS regressions[11] are presented in table 2. Regression 1 shows that environmental apathy makes people believe less in the Porter hypothesis. Regression 2 shows that ecocentrism makes people believe more in the

[11] Since the amount of observations on the censoring points is very limited with only two subjects that stated a subjective belief of zero and two that stated one hundred, we use a simple OLS instead of a Tobit model.

Porter hypothesis. Because of correlation (Pearson correlation coefficient = -0.51), these two variables do not enter the same regression simultaneously. The remaining two regressions in table 2 include education and gender as control variables. Students of economics were expected to believe less in the Porter hypothesis compared to students of science. However, regressions 3 and 4 show that this is not the case. Finally, a gender effect is apparent from regressions 3 and 4. Males believe significantly more in the Porter hypothesis compared to females, who are more uncertain. For example, the predicted subjective belief from regression 3 for females is 0.57 while for males it is 0.65. Table 3 presents four regressions using the pooled dataset. Possible differences between the two samples are captured by intercept dummies in regressions 5 and 6, while regressions 7 and 8 also include slope-dummy interactions. Based on table 3, we can conclude that the results from the two samples are not significantly different since all dummy variables are insignificant. As we explore the practical significance of our study, predictions show that individuals that are most apathetic toward environmental issues expect the probability of the Porter hypothesis being true to be around 25 percent while individuals that are least apathetic would expect around 75 percent. In summary, the results suggest that individuals with stronger environmental preferences believe significantly more in the Porter hypothesis.

Fig. 2. Subjective beliefs VS Apathy

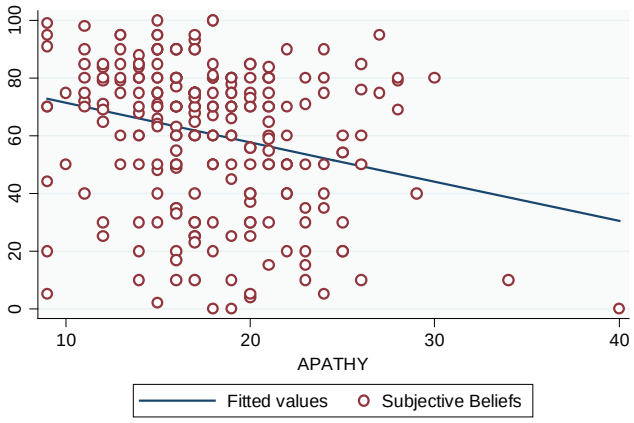

Fig. 3. Subjective beliefs VS Ecocentrism

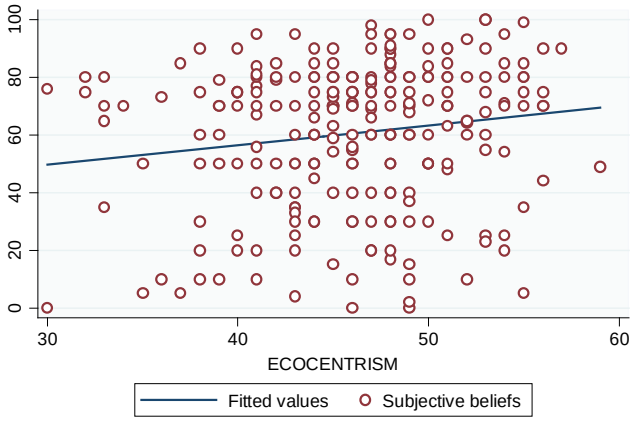

Fig. 4. Subjective beliefs VS Anthropocentrism

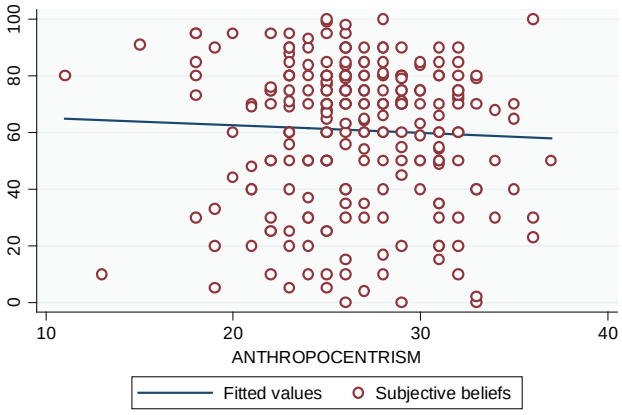

Table 2. Main regressions: test of the relationship between beliefs about the Porter hypothesis with environmental apathy/ecocentrism

	Regression I			Regression II			Regression III			Regression IV		
	Subjective beliefs that the Porter hypothesis is true											
	Coeff.	Std.Err.	P-val	Coeff.	Std.Err.	P-val	Coeff.	Std.Err.	P-val	Coeff.	Std.Err.	P-val
Intercept	85.128	6.124	0.000	29.368	13.227	0.027	83.402	6.305	0.000	17.532	14.078	0.214
Apathy	-1.367	0.332	0.000				-1.522	0.335	0.000			
Ecocentrism				0.680	0.285	0.018				0.852	0.295	0.004
Science							1.828	3.055	0.550	0.864	3.149	0.784
Male							7.652	3.108	0.015	7.512	3.245	0.004
Adjusted R-squared	0.06			0.02			0.08			0.04		
Nr. Obs.	246											

Table 3. Robustness check: test of order effect

	Regression V			Regression VI			Regression VII			Regression VIII		
Dep Var.	Subjective beliefs that the Porter hypothesis is true											
	Coeff.	Std.Err.	P-val	Coeff.	Std.Err.	P-val	Coeff.	Std.Err.	P-val	Coeff.	Std.Err.	P-val
Intercept	84.133	5.793	0.000	19.931	12.428	0.087	75.214	9.775	0.000	24.504	20.705	0.238
Apathy	-1.560	0.302	0.000				-1.065	0.531	0.046			
Ecocentrism				0.780	0.261	0.002				0.698	0.447	0.120
Science	1.829	2.977	0.540	0.928	3.081	0.764	14.760	12.325	0.232	-11.075	26.420	0.675
Male	7.522	2.777	0.007	7.441	2.901	0.011	7.721	2.810	0.006	7.611	2.926	0.010
Reversed order	6.182	4.177	0.137	6.888	4.264	0.110	19.531	17.654	0.270	13.522	35.018	0.700
Apathy*Reversed order							-0.753	0.976	0.441			
Apathy*Science							-0.725	0.670	0.281			
Ecocentrism*Reversed order										-0.146	0.765	0.848
Ecocentrism*Science										0.260	0.571	0.649
Adjusted R-squared	0.09			0.04			0.09			0.03		
Nr. Obs.	290											

5. Subjective Judgments and the Methodology of Economics

Could disagreement in beliefs about competing theories with normative implication[12] and policy recommendation by academic economists also be explained by a preference-expectation relationship, or does this explanation only hold for the sample of students?[13] The aim of this section is to discuss how economic methodology offers control against a preference-expectation bias in general and how our results link to the practice in environmental economics in particular.

5.1 Theory, deductive methods, and wishful thinking bias

Polanyi (1973) explains the role of theory in an illuminating way by saying that freshman students in medicine would not be able to give any diagnose from viewing x-rays unless they thoroughly understood theory in medicine. Expressed differently, there is no information value in observations on its own. In economics, deductive models provide rigorous definitions of assumptions and guide empirical work by pointing out plausible explanations to observations made and interesting hypotheses to test. On its own, however, the deductive method can neither reject nor confirm the Porter hypothesis unless it also convincingly affirms that the conclusions are not driven by crucial and unrealistic assumptions.[14] Putting it differently, a deductive argument is truth preserving only if the assumptions/premises of the argument are true. Working at the edge of the contemporary knowledge, however, a realistic set of assumptions might be

[12] Many issues in economics have a normative nature, for example, environmental, health, and unemployment related issues. Such issues are believed to be more sensitive to a preference-expectation bias compared to non-normative investigations.

[13] Winston Churchill is supposed to have complained that whenever he asked Britain's three leading economists for advice about economic policy, he received four different opinions. Fuchs et al. (1998) questioned if the popular image is justified and confirmed a very high level of disagreement among economists in various policy recommendations.

[14] That a model contains at least some unrealistic features is of course unavoidable as it purposes to give a simplified representation of the real world. Nagel (1963) distinguished three ways a statement can be unrealistic: 1) It does not give an exhaustive description. 2) It is believed to be either false or highly improbable on the available evidence. 3) It consists of idealizations and therefore does not refer to anything actual.

hard to identify. This is where wishful thinking bias might cause problems in deductive reasoning. To the extent the analyst has preference for a conclusion in deductive reasoning, it could cause problems where the set of assumptions that generates preference appealing conclusion could gain acceptance, and the conclusion will be mathematically proved. This would only require the ability of backward induction. More specifically, after the observation of certain phenomena, for example that "well-designed" environmental regulations can induce efficiency, a theory with overgeneralized assumptions and wide implications can be put forward to explain these observations. The analyst might believe in the model that generates an appealing conclusion, similar to the subjects that were told about assumptions behind the Porter hypothesis and had their subjective beliefs distorted by their preferences.

A key question is what - if anything - can correct distorted beliefs? Blaug (2002) suggests that empirical predictions are the ultimate test of the truth in economic theories independently of our wishes and intellectual preferences. However, as we discuss next, this is not a unanimous position among economists.

5.2 Empirics, experiments, and wishful thinking bias

Francis Bacon, known as the father of empiricism, discussed scientific method and some fallacies in scientific reasoning already in 1620 in his book Novum Organum. One of the fallacies he discussed is the tendency of scientists to rationalize and see regularities in nature when no regularities exist. Experiments and observations were suggested by him to have a central role in overcoming the fallacies of scientific reasoning.

The opinions among economists toward testing theories based on observations are more complex. Kagel (1987, p. 162) quotes a colleague to illustrate a common perception: "…I am a 'true believer' in microeconomic theory, and as a result I am perfectly willing to accept

mathematical proofs without experimental evidence." Rubinstein (2001) argues that it is "hopeless and, more importantly, pointless to test the predictions of models in economic theory" (p. 618). Instead, he suggests that the scientist's intuition should guide whether a theory is good or bad: "If a phenomenon is robust, we intuitively recognize it as such. It strikes a chord upon us. If we are honest with ourselves we can feel that it is true" (p. 216).[15] Such a position follows the methodological tradition of Robbins (1935) that the central principles of economic theory could be deduced from a few self-evident axioms and definitions. A key question, then, is to what extent do such self-evident axioms and definitions exist?

Sugden (2009) views the idea that substantive conclusions about economic reality can be deduced from indisputable facts of experience to be a mirage. Taking the instrumental view advocated by Friedman (1953), he claims that assumptions are acceptable to the extent that they lead to predictions that are confirmed. Shogren and Novell (1992) offer an intriguing comparison between the scientific methodologies in economics and ecology. They conclude that while economics has devoted the majority of research effort to abstract theory, with experimentation coming in a distant second, the methodology in ecology consists mainly of observation-based experiments. Morgan (1988) compared five disciplines (economics, political science, sociology, chemistry, and physics) based on the published work in highly regarded field journals[16] and found economics and chemistry to be extremes; in economics approximately half of the papers

[15] To the extent researchers insist on empirical validity, Rubinstein (2001) argues that it is the assumptions that should be tested and not the implications of a theory. Mäki (2009) argues that no "direct" testing of assumptions from a model are available since: "when one seeks to test an assumption, one has to construe an argument in which that assumption serves as one of the major premises and which entails a predictive implication that one then compares with evidence." (p. 96). The set of assumptions will therefore be confounded, and the test of assumptions is nothing more than another domain of testing by implications. The argument relates to the well-known Duhem-Quine thesis that the empirical claims of hypothesis arise from the conjunction of hypothesis and background knowledge and that no single hypothesis can be taken in isolation but that only unfocused refutation is plausible.

[16] Economic data was gathered from the American Economic Review and Economic Journal. Political science data are from the American Political Science Review. Sociology data are from the American Sociological Review. Data for the field journal in chemistry was collected from Journal of the American Chemical Society; for physics the data was gathered from Physical Review.

were theory-without-data while in chemistry none of them were. The other disciplines string out along the way between these extremes: in order from economics come political science, sociology, and then physics. Smith (1989) suggests that economics is more theory-intensive and less observation-intensive than perhaps any other science. This development might be a reflection of the difficulties to test theories in economics. This is not necessarily a problem; Darwin's successful theory of evolution also lacks falsifiable predictions.[17] It does imply, though, that economic methodology has less control against wishful thinking bias than many other sciences.

How about the practice of environmental economics? In a recent and critical review of conventional environmental economics, Folmer and Johansson-Stenman (2011) notes that there is a tendency for theory and empirics to live rather separate lives in environmental economics. They conclude that standard theory offers too narrow a perspective for many real world problems and that many theories are not empirically tested. They welcome a development which includes 'logical duels' between competing theories, more interaction between theory and empirics, and more integration between the social sciences. They argue that this is needed to link theories to facts and in the development of adequate policy issues. In fact, the strong normative orientation in environmental economics makes it potentially even more vulnerable to distorted beliefs and a preference-expectation bias compared to other subfields.

Is evidence a cure against distorted beliefs? In the past years, there has, after all, emerged an ample amount of empirical studies that tests the Porter hypothesis (for an overview, see Brännlund and Lundgren, 2009). Bayesian theory tells us that subjective beliefs about hypotheses are bound to change in the face of new relevant data. There are, however, many

[17] Theories are valuable for many different reasons. They could, e.g., be descriptive or discover inconsistencies in previous theories.

obstacles. Whenever we face evidence confirming our beliefs, we might be more apt to accept it, while disconfirming evidence might be met with skepticism and a demand for more evidence, better analysis, and more control. In fact, control is a key issue in both experimental and empirical studies. Econometric and non-experimental studies will be challenged to justify the sampling procedure, omitted variables, functional form and miss-specification of the error term. Articles about data mining (i.e., Lovell 1983; Leamer 1983; Ziemer 1984) criticize that empirical researchers often test several model specifications and, without discussing the long and vigilant search process, subjectively select a final model to be included in the paper. Even if researchers do not suffer from distorted beliefs and favor a model that confirms preconceived opinions, this creates a problem if it leaves room for skepticism. Duhem-Quine problem also gives scientists reasons to be careful with hoping that experiments can control wishful thinking since it will be a matter of judgment whether an observation that rejects certain hypothesis of a theory offers high degree of control or if the observation is a byproduct of some auxiliary assumptions that is made to construct empirical hypothesis associated with the theory.[18]

In conclusion, looking into the economic practice in general we will not find a unanimous position on how to prevent distorted beliefs. An appealing suggestion is, however, that empirical predictions are the ultimate test of the truth in theories independently of our wishes and intellectual preferences. Based on this criterion, both the economic and environmental economic practice seems to offer less control to wishful thinking bias in comparison to other disciplines.

On the other hand, science is not an act in isolation but rather a dynamic, interactive process with individuals eager to educate, criticize, and discipline each other. Including these

[18] Whether or not the instructions are clear and the incentives sufficient are for example two recurrent auxiliary assumptions in economic experiments.

cultural aspects as part of scientific methodology could be crucial to understand progress in science and foster convergence of scientific consensus.

6. Conclusions

Anyone that ever has listened to policy discussions between economists can witness that disagreement about economic facts seems almost as common as disagreements about economic goals. A careful observer would also notice that sometimes it even seems like that beliefs about what is true is correlated with individual preferences. To explain these observations we need to turn to the theory of cognitive biases in psychology which goes beyond the view of rational beliefs.

In this study we use one of the most influential hypotheses in environmental economics, namely the Porter hypothesis, to test the existence of a preference-expectation relationship in the formation of belief of scientific hypothesis. The Porter hypothesis suggests that environmental regulations, such as restricting firms to reduce pollution, stimulates innovations and create a win-win situation for the environment and for firms. Our results show that individuals' who care more about the environment are more likely to believe in the Porter hypothesis.

After having found a preference-expectation bias among students we raise the question if certain groups of individuals, such as scientists, would be an exemption to such observed behavior. Basically there are two possibilities of why scientist might be immune to preference-expectation bias. They could either have a personal trait that makes them immune to distorted judgments (which seems rather unlikely) or it could be something in the scientific methodology that offers control against the preference-expectations bias. According to Blaug (2002) this "something" is empirical predictions which serve as the ultimate test of the truth in economic theories and could ideally distinguish truth from wishes and intellectual preferences.

In a critical review of the environmental economic literature Folmer and Johansson-Stenman (2011) observe the tendency for theory and empirics to live rather separate lives in environmental economics. We illustrate why the current practice is problematic by showing the preference-expectation relationship in the beliefs of the Porter hypothesis and by discussing the interplay between beliefs and knowledge.

Bonilla (2002) discusses that economists assume science progresses like a “free market” in which competition causes bad theories to be replaced with good theories, resembling the “invisible hand” metaphor. An obstacle to such development is that scientists derive utility from having their theories accepted, which could be partly in conflict with the utility derived from producing knowledge (Bonilla, 2002). Young et al. (2008) discuss that the incentive structures in science favor the publication of dramatic results, which may turn out to be incorrect and create publishing bias. Using a student sample, this study has aimed to isolate and test the preference-expectation link free from biases caused by the pressure to publish. Our result suggests that it is not necessary incentives that create the problem of accepting wrong policies and theories but that judgment can also be distorted by a preference-expectation relationship.

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Appendix

Table A1. Psychometric measures and Item

Psychometric Measures	Items
Ecocentric	One of the worst things about overpopulation is that many natural areas are getting destroyed for development
Ecocentric	I can enjoy spending time in natural settings just for the sake of being out in nature
Apathy	Environmental threats such as deforestation and ozone depletion have been exaggerated
Anthropocentric	The worst thing about the loss of the rain forest is that it will restrict the development of new medicines
Ecocentric	Sometimes it makes me sad to see forests cleared for agriculture
Apathy	It seems to me that most conservationists are pessimistic and somewhat paranoid
Ecocentric	I prefer wildlife reserves to zoos
Apathy	I do not think the problem of depletion of natural resources is as bad as many people make it out to be
Apathy	I find it hard to get too concerned about environmental issues
Anthropocentric	It bothers me that humans are running out of their supply of oil
Ecocentric	I need time in nature to be happy
Anthropocentric	The thing that concerns me most about deforestation is that there will not be enough lumber for future generations
Apathy	I do not feel that humans are dependent on nature to survive
Ecocentric	Sometimes when I am unhappy I find comfort in nature
Apathy	Most environmental problems will solve themselves given enough time
Apathy	I don't care about environmental problems
Apathy	I'm opposed to programs to preserve wilderness, reduce pollution, and conserve resources
Ecocentric	It makes me sad to see natural environments destroyed
Anthropocentric	The most important reason for conservation is human survival
Anthropocentric	One of the best things about recycling is that it saves money
Anthropocentric	Nature is important because of what it can contribute to the pleasure and welfare of humans
Apathy	Too much emphasis has been placed on conservation
Ecocentric	Nature is valuable for its own sake
Anthropocentric	We need to preserve resources to maintain a high quality of life
Ecocentric	Being out in nature is a great stress reducer for me
Anthropocentric	One of the most important reasons to conserve is to ensure a continued high standard of living
Ecocentric	One of the most important reasons to conserve is to preserve wild areas
Anthropocentric	Continued land development is a good idea as long as a high quality of life can be preserved
Ecocentric	Sometimes animals seem almost human to me
Ecocentric	Humans are as much a part of the ecosystem as other animals