

Department for Environment, Food and Rural Affairs

Behavioural Economics in Defra:

Applying Theory to Policy

July 2013

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Summary of findings

1. A criticism sometimes made of traditional economic theory is that it assumes that people in the theoretical models behave in a purely 'rational' and self-interested manner, making perfect use of all the information available. However, in many circumstances traditional models built on this assumption can give poor predictions of how people behave. Moreover, **people may depart from rational behaviour in systematic, predictable ways** such as procrastination and loss aversion – often referred to as predictable irrationality. Indeed, the marketing industry has used such insights for decades.
2. Following from this, Behavioural Economics can be defined as “**the combination of psychology and economics that investigates what happens in markets in which some of the agents display human limitations and complications**”¹. It is worth adding that, as well as not demonstrating perfect rationality in decision making, people also demonstrate preferences for fairness, reciprocity, and conformity.
3. In this paper, key theories and empirical studies are investigated within the field of behavioural economics, and then provide an initial stock-take of where they have been (or could be) applied to Defra policies. The conclusion is that there is certainly a role for behavioural economics both in 'fine tuning' existing policies such as informing tax design, and in thinking about how best to design new policies based on existing policy instrument selection such as labelling/information schemes. Indeed, such policy developments could lead to highly cost-effective solutions, and help to reduce regulatory burden – relevant for the Government's Red Tape Challenge.

Brief literature review of behavioural economics

4. A number of theories and empirical studies have been developed within the field of behavioural economics. Many of these emanate from thinking through how insights from psychology^A can be applied to traditional economic theory – a key motivation for this has been that the results from a number of empirical studies appeared to contradict the predictions of mainstream theory. To explain the development of behavioural economics, in this section a brief history of the key theories and empirical studies is set out below – and then consideration is given to how to take forward key concepts for potential application to Defra policies. It is worth noting that what is explored in this paper is a narrower definition than that encompassed by the full suite of tools covered by ‘behavioural science’ (including behavioural economics, social research, psychology, neuroscience). The fuller suite of tools/disciplines were used to inform the recent House of Lords Select Committee report on Behaviour Change². Instead the traditional economic framework is used as a starting point and then refine that framework, by utilising other disciplines. In addition, it is worth noting that the primary focus of this paper concerns how individuals behave – rather than how institutions behave and make choices.

Review of traditional literature

5. The origins of microeconomics were similar in nature to psychology. For example, the **classical economists** Adam Smith³ and Jeremy Bentham discussed how individual behaviour and utility are fundamentally affected by psychology. **Neo-classical economists**, such as Edgeworth, Pareto and Tarde⁴, subsequently focused on the notion ‘homo economicus’, where people in the theoretical models were assumed to have self interested preferences and make perfectly rational decisions. For example, expected utility theory, developed by Bernoulli, von Neumann and Morgenstern, helped explain and predict how people make rational choices under conditions of risk and uncertainty. Similarly, exponential discounting models were developed to explain and predict how rational/time consistent decisions are made when costs and benefits occur in different periods.
6. However, the predictions of expected utility theory were found to be inconsistent with the results of a number of decision choice experiments, carried-out in the 1950s by Allais⁵. This became known as the ‘Allais Paradox’, where individuals systematically violate the ‘independence axiom’ of expected utility theory – so if the same outcome is added to two choices it does affect the decision, whereas according to the independence axiom it should have no impact on the ranking of different choices. One possible explanation is that people’s attitudes towards risk are affected by the degree of certainty, with certain outcomes given too much weight. Further theories were developed by Tversky, Kahneman and others (see paragraph 8 below) to try and reconcile these apparent differences. Another example of where the predictions of expected utility theory are violated, is the Ellsberg Paradox. A key issue is to gain a

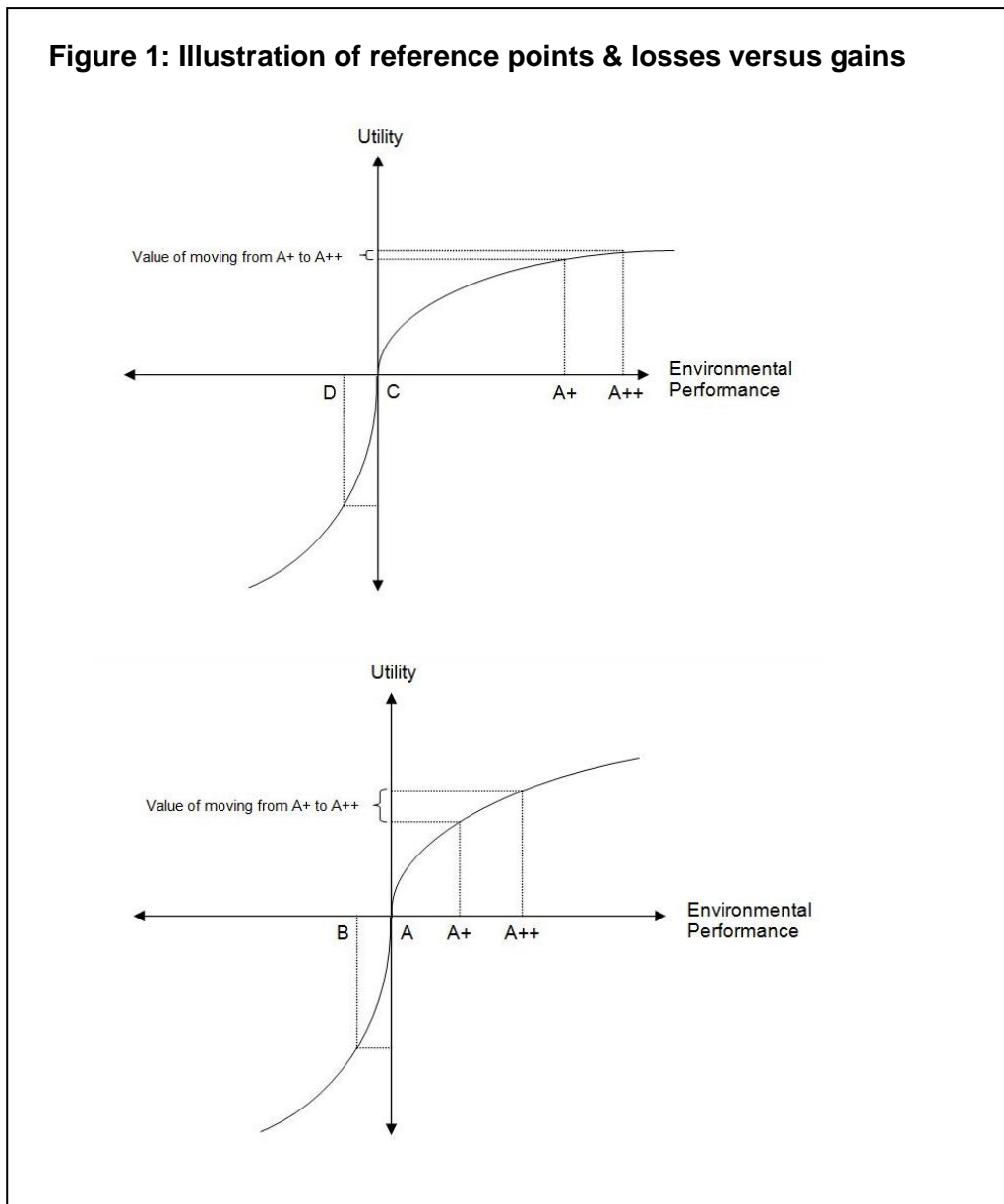
better understanding about whether any such deviations from rational behaviour are systematic and predictable across individuals.

Review of later literature

7. In the 1960s, Vernon Smith⁶ carried out a number of market based lab experiments. In these experiments markets quickly converged to the competitive equilibrium – the prediction based upon the self-interest hypothesis. These results suggested that more complex and realistic preferences were not required as they would simply complicate the analysis without significantly improving the predictive power of the theory.
8. However a number of lottery choice experiments produced results that were inconsistent with mainstream theory. Kahneman and Tversky⁷ developed theories, using cognitive psychology in the late 1970s, which were more consistent with these findings. **Prospect Theory** was developed as an alternative to expected utility theory in order to analyse and predict decision making in conditions of risk and uncertainty. The major differences were in the way the outcomes and probabilities were adjusted. For instance, the theory assumes that people overweight low probabilities so will be biased towards outcomes where there is a small chance (or probability) of a large gain. Conversely, it assumes that people overweight certain outcomes compared with probable outcomes. Prospect theory also improves our understanding of loss aversion as outlined below, as well as how people are frequently risk averse when facing gains but risk loving when facing losses (see also sub-section on experiments and valuation techniques for further detail on prospect theory).
9. The notion of loss aversion implies that there is likely to be a stronger behaviour change response, by focussing on losses rather than gains. This is more extreme than diminishing marginal utility of income as predicted by traditional economics, in terms of its implications for loss aversion – for instance because the utility function is much steeper in losses than for gains (see Figure 1, below).
10. In addition, the value of changing from one thing to another by individuals, depends on the perceived reference point, and how big or small the change appears from this reference point (again refer to Figure 1). This is different from traditional economics, which assumes that people will be concerned with the final absolute level rather than separating out the gains or losses. This has important implications for policy design, such as labelling of products – see example below which is applied to Defra’s policy area on energy using products.
11. Figure 1 illustrates the behavioural economics concepts associated with the importance of (i) reference points and (ii) losses versus equal gains. These two concepts are illustrated using an Energy using Products example.
12. In the top graph, where the **reference point** for the consumer is currently to purchase a ‘C’ rated product, the change in value associated with shifting from purchasing an ‘A+’ to ‘A++’ rated is *less* than if the reference point had been currently purchasing an

'A' rated product. Note also that in the bottom graph, the 'C' rated product (which would lie to the left of the 'B' rated product) would now be treated as a loss – and hence if the status quo is treated as a loss, then people are more likely to switch to the more energy efficient product.

13. In addition, due to the relative flatness of the part of the curve associated with gains, compared to losses, this suggests that **individuals are negatively affected more by losses as compared with equal gains** (i.e. this is more pronounced than under traditional theory).



14. Another relevant theory is “**bounded rationality**” developed by Herbert Simon to explain that assumptions of conventional economics may be violated due to people’s cognitive limitations⁸ (due to difficulties in calculating costs and benefits, particularly into the longer term).

15. Becker assumed that people are rational utility maximisers, but he developed thinking to breakdown the assumption of narrow self-interest in his 1992 paper⁹ – suggesting that behaviour is driven by a much richer set of values and preferences (whether the individual be selfish, altruistic, loyal, spiteful, or masochistic), and that individuals' behaviours are forward-looking and consistent over time.
16. Other economists have produced work on other-regarding preferences such as altruism, fairness and reciprocity – Andreoni on altruism (1990)¹⁰, Fehr and Schmidt on fairness and reciprocity (2002)¹¹, and Rabin on intentions and reciprocity (1993)¹². An example of an experiment that is often used to demonstrate that people's behaviour is inconsistent with the self interest hypothesis is the Ultimatum Bargaining Experiment. In this experiment individual 'A' is given £10 and then allowed to chose how much to allocate to individual 'B' – person B can then accept (in which case both individuals keep their money) or reject in which case neither get anything. Results have shown frequently, that if individual B gets an offer of £2 or less, then this will be rejected around 50% of the time – despite the fact that this will result in that individual getting zero. This result holds for small and large amounts of money. Similar results hold where the implications are reversed – i.e. where experiments are set-up to test if altruism will hold. These findings maintain the assumption of consistency in preferences, but contradict the self interest hypothesis. Instead they are more consistent with theories built on the assumption that people have preferences for fairness and reciprocity, which they are trying to maximise.
17. Vernon Smith also applied experimental economics to **Auction Theory**, to test for differences and similarities between different types of auction – subsequently demonstrating that different outcomes are arrived at depending on the type of auction used. The main types of auction are as follows: (i) English Auction where buyers bid in sequence and in increasing order until no higher bid is placed; (ii) Second Price Sealed Bid, known as a Vickrey Auction, where the buyer pays only the second highest bid; and (iii) Open Descending Bid, known as a Dutch Auction, where the seller's initial bid is lowered until a buyer shouts 'buy'. The reason for different outcomes may be explained by behavioural economic concepts such as the difference in reference/starting points, or alternatively through risk/loss aversion under certain conditions. Paragraph 20 below, provides a further example of different types of auctions and subsequent outcomes.

Experiments and valuation techniques

18. Prospect theory provides the underpinnings for a number of experiments. For example:
- the presentation of a loss or amount of “cash-back” if separated out can lead to greater influence overall than if included in the overall package;
 - losses have a more pronounced impact than equal gains; and
 - the reference/starting point can materially affect the perceived value of a gain.

19. It is worth bearing in mind that laboratory experiments can be subject to bias, but efforts are taken where feasible to avoid this in the experiment design. For instance, one concern may be that different choices will be made depending on whether the money is real or hypothetical.
20. Auction Theory is used to inform auction design, particularly when selling off public assets to the private sector. For instance, Virginia used auction theory to understand how best to design an auction for selling permits to emit nitrous oxide into the atmosphere within scientifically defined maximum emissions limits. It demonstrates that certain designs of auction outperform others. The conclusion is that out of three types of auction mechanism tested (all variants of the four main types outlined above), two clearly outperformed the other in terms of the revenue generated and efficiency in the sale of two types of nitrous oxide allowances. The 'Sequential English Clock' and 'Combination English Clock' auctions, were superior to the 'Combination Sealed Bid' auction when demand is relatively responsive to price changes¹³.
21. There is also a vast literature dedicated to **hypothetical choice experiments**. One application of these experiments is to elicit individuals' preferences (stated preference surveys) for the environment – in order to place monetary values on environmental goods and services. These surveys are carefully designed in order to iron out various inconsistencies and problems that relate to individuals' responses.
22. There are a number of conclusions derived from the analysis of such studies – a key one is that individuals tend to state higher values when asked what their 'willingness to accept' (WTA) compensation is, compared to their 'willingness to pay' (WTP) for that same environmental good/service – referred to as the endowment effect once a property right to the good has been established (although recent developments suggest that this may not always be the case)¹⁴. This is inconsistent with the assumptions of neo-classical economics – although could be explained by the fact that individuals' WTP is bounded by their disposable income, whereas WTA compensation is unbounded, or that equal losses are perceived differently to equal gains (see below).

Behavioural finance & systematic deviations from classical assumptions

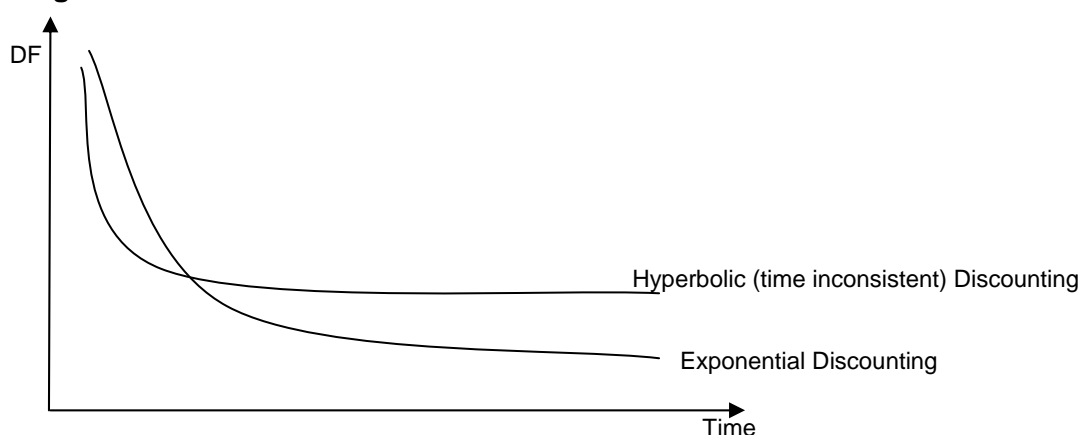
23. Quantitative behavioural finance uses mathematical and statistical methods to understand behavioural biases – significant deviations from classical theories. In the late 1990s models based on overconfidence were developed to explain security market under and overreactions. These models assume that errors/biases are systematic deviations in the same direction across people, so that they do not cancel out overall. For instance people may jointly listen to the advice of an analyst, or have a common bias. Such under or overreactions to information, can in extreme cases cause bubbles or crashes in markets.

24. More generally, cognitive biases may create society-wide irregularities causing collective euphoria or fear, leading to phenomena such as ‘herding’ and ‘groupthink’. Small groups of individuals can have substantial market-wide effects¹⁵.
25. Another issue, with clear links to prospect theory, is that loss aversion can lead to investors not wanting to sell shares or other equities, if doing so would result in a small loss. It may also help explain why house prices frequently don’t reduce to market clearing levels during periods of low demand. This is referred to as the ‘disposition effect’ – see Odean 1998¹⁶, where people hold onto losers for too long.
26. Critics such as Eugene Fama typically support the **efficient-market hypothesis**¹⁷. They contend that behavioural finance is more a collection of irregularities than a true branch of finance – and that these irregularities are frequently quickly priced out of the market (hence they are not systematic deviations). However, where such irregularities stimulate further similar behaviours and therefore shift prices further from equilibrium, this reinforces the arguments put forward by behavioural finance.

Other key concepts from behavioural economics

27. People can seem relatively patient between medium and long-term rewards, but incredibly impatient between immediate rewards and rewards in the future (see figure 2 below – demonstrating time inconsistent preferences). If for instance an individual states that they will start eating healthily in two days time, but then a day later they delay that starting point for healthy eating. In this case, the individual will have adjusted their preferences in a way that is time inconsistent (and therefore not in their own best interest). Evidence suggests that people frequently do this and put **too much weight on upfront costs and benefits**, as demonstrated by Frederick et al¹⁸. Note that it is consistent with rational choice models for an individual to eat unhealthily for a several years if the discounted benefit is greater than the discounted costs. It is only inconsistent if the starting point for eating healthily keeps getting delayed and there is no new information about the costs and the benefits.

Figure 2: Time Inconsistent Preferences



28. People allocate money to different notional accounts (for instance by separating different pots of cash for holidays and food) – spending is constrained by the amount of money in a specific notional account, regardless of the budget in the other notional accounts. In addition, isolating a specific gain in an overall package of losses can change the perception of that package.
29. People make different choices depending on **how the choice is framed** – for instance, in stated preference valuation studies, if a high indicative value is used to steer the respondents' monetary valuations, it can affect the result strongly. Alternatively, the extent to which a tax is salient in a purchase can affect peoples' choices – work by Chetty et al. in 2008¹⁹ suggests that if the overall price identifies the proportion of tax, then this can have a significant impact on behaviour.
30. People may fail to respond to financial incentives and they can actually make things worse. The argument here is that sometimes an extrinsic reward (i.e. a payment) can crowd out the intrinsic reward from carrying out a task.

Summary of literature review findings

31. To summarise the findings of the brief literature review above, there have been a number of theories that both support and counter the belief, that individuals act in a manner which is consistent with the predictions of theories built on the assumptions of perfect rationality and narrow self interest. For example expected utility theory, which has been upheld by many economists has been countered by prospect theory and the notions of bounded rationality, and inconsistent preferences over time.
32. As a response to this difference in views, a number of empirical studies have been conducted – some generating data through laboratory experiments on individuals' choices, and others based on real world data in the field of behavioural finance. The former is known as experimental economics, and tests whether or not the neo-classical economic assumptions of perfect rationality hold. Where they are disproven, this along with the theoretical underpinnings is the basis of behavioural economics.
33. Many theories/concepts and experimental findings have been highlighted in the literature review above. These provide a basis for re-thinking how policies could be designed in order to maximise the quality of our environment at the lowest cost achievable, and in turn maximise society's welfare. In the following section, the potential application of such concepts to Defra policies are explored.

Applying the Theory to Defra Policies

34. Defra policy on **Energy Using Products** aims to increase the energy efficiency of products placed on the UK market. The case for adjusting policy relating to Energy

Using Products has been made at a conceptual level earlier in this paper (see figure 1 and the accompanying text). In addition, Defra has had a research project “Behavioural Economics and Energy Using Products”²⁰ carried out that arrives at a number of suggestions, which are included below. Given the arguments made for losses resonating more strongly than equal gains, one recommendation would be to present labelling in a different way – e.g. focus on the losses resulting from not moving to an A rated product, as opposed to the gains to be made from making the shift. A key label being used for energy using products is the EU mandatory label which cannot be altered in a manner specific to the UK. For this reason, other alternatives such as voluntary schemes to display such information in retail stores, adjusting existing UK voluntary labelling schemes, or providing such information on the relevant internet fora are possibilities.

35. Given the arguments made about time inconsistent preferences, an alternative option could include encouraging companies to design ways of merging running costs with purchase decisions. For instance, by hiring an energy efficient product that on a 5 year basis provides an overall net benefit (where it is returned to the company afterwards), the cost could somehow be smoothed-out over the five years, in order that an oversensitivity to upfront costs is avoided and the net-beneficial purchase occurs. Although leasing is not a new idea and has been offered by retailers in the past, in future a similar model could be used to encourage purchase of energy efficient products. A similar but softer option, could involve highlighting long-run costs at the point of sale, or providing information on a break-even point.
36. Another application of behavioural economics could be to **Water Policy**. The recent Water White Paper identified the need to develop a more flexible abstraction regulation system to address future challenges of increasing water scarcity. Defra is carrying out analysis to test abstraction regulation reform options through an innovative agent-based modelling framework. This framework has the capability of modelling many of the principles outlined in this paper, particularly the impact of social interaction between abstractors as well as inertia, imperfect information processing capability and loss aversion.
37. Behavioural economics concepts could also be applied to **Waste Policy**. For instance, take the example of recycling where households don't pay for rubbish to be taken away at the point of consumption (the payment is subsumed within the council tax and is constant for the household, regardless of the amount of waste generated). Although economics would predict traditionally that this will lead to 'free-riding' behaviour, some evidence shows that by making citizens aware of the impact of their behaviour on the general community, this can lead to conditional cooperation²¹ (potentially due to a notion of fairness, reciprocity, or socially beneficial behaviour being the norm). By explaining that increasing the amount of household waste separated out into recycling contributes to overall reductions in Local Authority funding spent on Landfill Tax (already carried out in some Local Authorities), this could encourage households to recycle more and indirectly save money on landfill tax as well as on the costs

associated with taking waste to landfill (even though the household financial benefits will be negligible).

38. Alternative applications to waste policy could be through providing messages, at key fly-tipping areas, about the damage to the environment that is caused through such actions (based on the notion of focussing on losses to the environment and social norms). However, it is likely that fly-tippers are not among the more altruistic or conforming members of society; and there is a risk that such messages simply draw attention to potential fly-tipping sites. If it is believed that informed decisions have been made to fly-tip in particular areas, as they are already heavily littered, then tougher policy leavers could be required. It is worth noting in general that any proposals would need to pass the criterion, stated earlier in this paper, around ensuring that a systematic deviation from traditional economic thinking is being corrected for – i.e. that such a proposal would affect a large majority of the target audience in a similar manner.
39. If the policy area of **Resource Efficiency** more broadly is analysed, Defra published evidence in 2011 that estimates a potential for £23bn of financial savings if UK businesses take-up (energy, waste and water) resource efficiency measures that pay back within the year²². Although these measures are expected to payback financially within a year, it should be noted that time/hassle costs were not factored into the analysis, and so the real payback period will often be longer, before net financial gains can be made. There are a number of reasons why these relatively simple payback measures may not be taken-up, including information and behavioural barriers. Behavioural barriers are likely to include an oversensitivity to upfront costs and benefits (time inconsistent preferences), as well as potential difficulties in calculating longer term costs and benefits. Potential policy interventions to address these barriers could include the ideas suggested above (for energy using products, to address time inconsistent preferences), including highlighting long-run costs at the point of sale, or providing information on break-even points, or finding ways to create binary decision points which force firms to consider the low but reducible costs of their resource use – e.g. comply or explain.
40. Another Defra policy area where behavioural economics could be applied, relates to **‘Payments for Eco-System Services’ (PES)**²³. This is an innovative way of addressing policy, for instance by providing payments to land managers and others to undertake actions that increase the quantity and quality of desired ecosystem services. Behavioural economics can help to think about how best to design such approaches. For instance there is a risk that the introduction of an extrinsic reward (such as money) into environmental decisions can crowd-out other motivators towards protecting the environment, and so the mitigation of crowding out should be considered simultaneously. Small payments may be particularly damaging where other motivations are involved. The role of using an intermediary in PES design can help. An example of previous success is where Vittel Water paid farmers to maintain clean water upstream for the benefit of an aquifer in North East France. This involved financial incentives as well as trust building through an intermediary.

41. Similar to PES above, the '**Campaign for the Farmed Environment**' has parallels, e.g. payment versus non-payment motivations need to be considered simultaneously.
42. Farming is a policy area where behavioural insights have been under-used; but where some recent Defra work (e.g. attempting to segment different types of farm business; and analysis of the relative success of different farm advice mechanisms) could prove useful. It is often said that farming involves decisions that are not driven purely by motivations of maximising profits – there are likely to be other factors involved, including conformity, a sense of belonging, and opting for a particular lifestyle with non-financial benefits. For example, the decoupling of Common Agricultural Policy (CAP) payments from sectoral production in the 2005 round of CAP reform did not have as significant a downward impact on livestock numbers as would have been expected on the basis of purely financial drivers; farms continued to engage in activities which reduced their incomes.
43. The current CAP reform discussions may not have as significant an impact on farm behaviour, but some issues could benefit from behavioural insights. The proposal to make 30% of direct payments contingent on specified environmental behaviours (“greening”) raises questions about the best way to secure genuine engagement and commitment from farm businesses. The mechanism could be made relatively compulsory, with penalties for non-compliance applying not just to the 30% of payments, but potentially to the remainder of direct payments as well – in which case, higher levels of formal compliance might be achieved. Or it could be made more voluntary, with farmers able to decide whether or not to accept the implicit deal on the basis of their own business strategy – in which case, there could be a slight reduction in coverage, but possibly more whole-hearted delivery of both the formal requirements and the environmental objectives underlying them. Attention should also be given to the way in which loss aversion affects different farmer responses – with farm businesses seeing future CAP payments as already “theirs”, and any reduction in those payments being “taking away their money”.
44. Behavioural economics may also apply to **Fisheries Policy**. The basic problem stems from the fact that there is open access to the oceans/seas, leading to a lack of incentives to fish in a manner that maintains stocks and profitability of the industry in the longer term. The existing management system, which has been reviewed, gave individuals incentives to behave in ways that damage aggregate profitability and sustainability – for instance, where a fisherman’s catch exceeded the allowable quota, typically because nets cannot select fish that conform to the quota, the solution has been to throw dead fish back into the sea. Resolving these problems will involve rebuilding stocks, probably in the context of a reformed management system that enables fishermen, individually and collectively, to maximise the value of the resource – with a credible monitoring and enforcement mechanism, as far as this is achievable.
45. Issues from behavioural economics that could inform future policy design include recognising that fishermen may be very attached to their stake in the existing system, and indeed may value this more than a share in a reformed system that objectively

may seem more valuable. As with the Energy Using Products example above, one option could be to present the impact of a reformed system in terms of the overall losses where reform isn't implemented. Another issue is that the short-term sacrifice involved in rebuilding stocks may appear more significant, relative to the long term gain, than one might anticipate from a straightforward consideration of net present value (due to time inconsistent preferences as discussed earlier). Finally, the possibility should also be recognised that, at least in some situations, particularly in small communities, a strong sense of fairness may make community management and enforcement feasible, and potentially the most effective option.

46. Together, the ideas in this section as well as the conceptual ideas presented earlier in the paper, should provoke further thinking on whether there is a role for using behavioural economics in designing future policies. The remainder of this section briefly explores some further considerations when thinking about the future use of behavioural economics in policy design.
47. Existing policies may have already changed the reference point. A stylised example could be considered, where the historic amount of policy related to river cleanliness in Germany versus the UK is compared. Assuming Germany has traditionally maintained a very high level of water cleanliness due to its policy interventions, a reduction in that level of cleanliness from say 'low' to 'very low' quality would be perceived as extremely damaging. This is because German citizens' reference point is very clean rivers and hence any damage is seen as extremely painful. In the UK, the level of water cleanliness is lower and so a shift from 'low' to 'very low' quality would not be perceived as so damaging. A distinction is made here between different reference points, as opposed to German citizens' stronger preference for clean water.
48. It is also worth noting that there are ways to define policies that allow for some of those affected to have 'rational' preferences and others to have preferences in line with behavioural economics, in a way that still enhances welfare. This is commonly referred to 'asymmetric paternalism' – for instance a policy that allows individuals to 'opt-out' of pensions if they are well aware of their high discount rate, and be automatically opted-in otherwise. This allows for a choice where those who do nothing are assumed to have time inconsistent preferences that can be corrected through policy, without imposing a welfare loss on those with time consistent preferences.

Conclusions

49. There is certainly a role for behavioural economics both in 'fine tuning' existing policies, and in thinking about how best to design new policies based on existing policy instrument selection. This is because in a number of examples individuals depart from rational behaviour in systematic, predictable ways – where any deviations in different directions do not cancel each other out. Proposals that are designed to account for systematic and predictable departures from traditional economic thinking, can potentially fine-tune policy in a highly cost-effective manner.

50. For instance if further investigation into adjusting energy using products information to focus on losses rather than gains, demonstrated that adjustments could be made at the same cost (but with additional resulting behaviour change), then this would provide better value for money. In this respect, such policy redesign may also help to reduce regulatory burden if innovative policies are carefully developed.

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Notes

- A. Note that although the discipline of social psychology – i.e. “nurture” – is typically drawn upon in this context, there may well also be further issues to consider based on what can be learnt from “nature” – e.g. the study of neuroscience in that the brain is conditioned to make decisions based on habits rather than the rational assessment of costs versus benefits

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The author, Andrew Cotterill, would like to express his gratitude to the peer reviewer, Jon Guest, for his expert guidance in peer reviewing this discussion paper.

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PB number 13986