MITIGATING CLIMATE CHANGE: AN EVALUATIVE APPRAISAL INTO HOW DIFFERENT THEORETICAL BEHAVIOURAL MODELS INFLUENCE HOUSEHOLD CONSUMPTION RELATED BEHAVIOUR

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Abstract

A wide-body of empirical and experimental research on recognising and explaining the behaviour of household energy bill payers suggests that household energy bill payers do not always abide by the postulation of having unchanging preferences. The particular research explored in this dissertation suggests that social preferences support rational choice theory, create reductions in household energy consumption, and encourage the purchase of carbon labelled products.

For an explanation for why this decrease in energy consumption occurs, this thesis takes the stance that preferences are malleable and context-dependent and, at times, endogenous. To broaden the research on endogenous preferences in the explanation of household energy bill payers related behaviour, I champion a *social preference extension strategy* that allows context-dependent preferences to complement the behaviour of household energy bill payers by attaching the social preference extension strategy to rational choice theory.

The premise of having malleable preferences creates options where the policymakers rely on persuasion and context manipulation to change preference orderings as well as the tools of rational choice theory that advocates the preference for more over less with given preference.

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CHAPTER 1

Introduction

This dissertation explores the potential effects of context-dependent consumer preferences when these preferences are attached to the framework of rational choice theory. The economic principles of rational choice theory specify that consumer preferences are transitive and complete and follow the basic rational principle of wanting *more* over *less*. Context-dependent preferences occur when situational cues, 'determine appropriate behaviour in any given setting' and furthermore, 'we evaluate outcomes from a particular point of view, namely, our current state or the state experienced by members of our reference group' (Bowles, 2004, p.97).

Framed in the context of household electricity consumption and carbon footprint labels is textbook rational choice theory. The selection of these items is because individuals use electricity everyday in households across most of the world, and the same individuals purchase food everyday across most of the world. Given the magnitude of household electricity use, and the participation in the purchase of foodstuffs, savings in carbon related behaviour could have an impact on slowing down the progression of climate change.

Climate change occurs due to the existence of greenhouse gases found in the atmosphere; an increase in greenhouse gases is increasing the average global temperature of the earth. The impacts of global warming may include a rise in sea levels, more severe tropical storms, crop failure and the disappearance of coral reefs (IPPC, 2011). Greenhouse gases accumulate in the atmosphere because, in part, our busy lives of coming and going are releasing more and more greenhouse gases into the atmosphere. Anthropogenic (man-made) greenhouse gases include carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrocarbons, and perfluorocarbons. The greenhouse effect is accelerated by anthropogenic interference from

people's dependency on fossil fuels such as coal, oil, and gas (IPCC, WGIII, 2011). The Summary for Policymakers (IPCC, WGIII, 2011, p.3) states that 'most of the observed increase in global average temperature since the mid-20th century is very likely[1] due to the observed increase in anthropogenic greenhouse gas concentrations'.

Mitigating climate change is not one single country's problem; it is an international problem, requiring cooperation between governments. The reason that no one single country is immune from climate change is because the air, which we breathe, has some unique characteristics that fall under the definition of public goods. Public goods are non-rival and non-excludable. Non-rival means that one individual's consumption of the air does not stop other individuals breathing in the air. Non-excludable means no individual is excluded from using the air to breathe, despite whether that individual helps to pay to have fewer greenhouse gases present within the air or not. Given the very nature of the public good, it becomes increasingly easy for individuals to free ride on the public good, for the transaction costs of finding out whether individuals are 'doing their bit' becomes too high. Of all the greenhouse gases, carbon dioxide is perhaps one of the worst in terms of air pollution emissions. Approximately 84% of emissions were carbon dioxide in 2009 in the UK (DECC, 2011).

This dissertation champions 4 research questions in the mitigation of climate change. Research questions 1 and 2 are the focus of Chapter 2. These research questions test for whether consumers make choice predictions that are rational and obey transitivity. Chapter 3 deals with the 3rd research question by using consumer rationality to help form a social preference extension strategy based on these predictions of consumer rationality and the verification of transitivity. Chapter 4 looks at the 4th research question by seeking ways to mitigate free riders from local communities through a Four-Grid Repetitive Game

[1] 'very likely' refers to a >90% assessed probability of occurrence.

Payoff Matrix (Chapter 4, Figure 4, p.73) that conforms to consumer rationality and transitivity.

Chapter 2 and research questions 1 and 2

Before remodelling (but not violating) the assumptions of rational choice theory with a social preference extension strategy, modelling commences to prove that household energy bill payers are rational and abide by the assumptions of rational choice theory. Chapter 2 seeks to validate rational choice theory by searching for rationality in household energy bill payers' choices by measuring rationality against two variables. The first is the price of electricity; the second is information on electricity. The research questions (RQ) are:

> RQ1: Do household energy bill payers make rational choices when faced with an increase in the price of household electricity?
> RQ2: Do household energy bill payers make rational choices when exposed to information on energy consumption in the household?

Research questions 1 and 2 strike at the very heart of rational choice theory, because these research questions aim to prove that *more* over *less* is preferred in the pursuit of utility maximisation. Research questions 1 and 2 fall under the main beliefs explained by Neoclassical Rational Choice Theory. Neoclassical Rational Choice Theory has its origins in the ideas of Smith (1776), Mill (1836), Knight (1921), Samuelson (1947) and Becker and Stigler (1977).

Central to rational choice theory is economic man. Economic man is a man who is almost completely motivated by self-interest and the pursuit of utility-maximisation. Assumed in research questions 1 and 2 of this dissertation is the belief that policymakers do not target household energy bill payers' individual preferences, because household energy bill payers always want 'the best deal' subject to price and income, and that this *best deal* is found by assuming that preferences are transitive and complete (Becker and Stigler, 1977). To declare that household energy bill payers want *nothing* over *something*

is to declare household energy bill payers irrational. Furthermore, policymakers assume this of all households in that preferences are individual but homogeneous (Veblen, 1919).

Chapter 3 and research question 3

The research then continues by looking at how rational choice theory has the opportunity to include social preferences in the manipulation of consumer choices over household energy consumption. Chapter 3 provides the structure for this manipulation in the form of a social preference extension strategy that shall attach itself to rational choice theory. I define the social preference extension strategy as:

The social preference extension strategy is an approach that uses peer pressure and social norms to make consumer choices context-dependent on the choices of other consumers.

If research questions 1 and 2 confirm rationality and transitivity in household energy bill payers' actions (ie want more over less), then research question 3 moves to suggest that this rationality not only influences quantitative axioms of rational preference (eg £10 is preferred to £5) but also qualitative axioms (eg social preference, like fairness is preferred to unfairness). To attach social preferences to rational choice theory requires introducing social man. Social man forms part of Social-Economic Man that describes how household energy bill payers make choices from two different premises. On the one premise, economic man is self-interested with individualistic preferences. On the other premise, social man is self-interested but with preferences that are context-dependent on other household energy bill payers' preferences (Duesenberry, 1949; Leibenstein, 1950; Lichtenstein and Slovic, 1971; Loomes and Sudgen, 1982; Davis and Holt, 1993; Bereby-Meyer and Erev, 1998; Loomes, 1998, 1999; Benabou and Tirole, 2002; Bowles, 2004; Akerlof and Kranton, 2005).

Chapter 2 investigates whether household energy bill payers have rational individualistic preferences. Chapter 3 investigates whether household energy bill payers have rational individualistic preferences

as well as rational context-dependent preferences, therefore, research question 3 asks:

> RQ3: Does a social preference extension strategy have an effect on household energy bill payers' electricity consumption?

Research question 3 introduces social preferences into the model of rational choice theory for the purpose of manipulating household energy bill payers' choices in the understanding that household energy bill payers' preferences might be malleable and context-dependent on the preferences of other household energy bill payers.

The idea of incorporating social preferences into rational choice theory is not completely new. Many leading economists have extensively discussed how consumer preferences ought to be viewed as context-dependent (cf Bowles, 2004; Fehr and Schmidt, 1999; Charness and Rabin, 1999; Bolton and Ockenfels, 1999; Falk and Fishbacher, 1998; Rabin, 1993). However, although the social preference extension strategy discussed in Chapter 3 takes and supports these views of other economists, it differs in the sense that household energy bill payers' choices are broken-down into their component parts detailing when social preferences become relevant and active. What is of fundamental critical importance is that the presence of the social preference extension strategy does not violate the laws governing rational action (Bowles, 2004) either when social preferences are used, or when social preferences are not used in the choice process. The social preference extension strategy is designed to extend and attach itself to the choice options of household energy bill payers, but the household energy bill payer remains rational in his or her choices. By using the social preference extension strategy, it does not mean that hundreds upon thousands of new and confusing variables have to be justified, interpreted, and defined into the choices of the household energy bill payer. The social preference extension strategy simply represents the times when the household energy bill payer has

preferences that are context-dependent on other household energy bill payers' preferences.

Chapter 4 and research question 4

Chapter 4 uses the social preference extension strategy and the rationale of context-dependent preferences to challenge the boundaries of rational choice theory, because consumer choices are context-dependent on the choices of other consumers. To engage how 'context-dependency' affects consumer choices a Four-Grid Repetitive Game Payoff Matrix is constructed (Chapter 4, Figure 4, p.73). The Four-Grid Repetitive Game Payoff Matrix shows individuals following options to purchase or not to purchase products that have carbon footprint labels. The final research question is:

> RQ4: Can a social preference extension strategy help to put off free riders and maintain a Pareto-improvement in the purchase of low carbon information footprint labelled products?

The crux of research question 4 builds on the premises of all the other research questions before it. To prove research question 4 correct or incorrect requires a shift towards the use of social norms and peer pressure that promotes fairness and the desire to reciprocate that fairness (Guth *et al.*, 1982 and Rabin 1993) within communities and not to free ride on others that is common practice when public goods are the target of concern. Research question 4 does this by seeking ways in which the Nash dominant equilibrium option does not automatically become the default option of choice (Nash, 1950).

To help persuade consumers from defaulting to the dominant Nash equilibrium, Chapter 4 uses repetitive games and conditional cooperation. According to Chaudhuri (2007, p.5), 'Conditional cooperation is defined as one whose contribution to the public good is positively correlated with his belief about the contributions to be made by other group members.' Therefore, conditional cooperation activates mutual context-dependency when small local community groups work together and trust each other, but at the same time, have the power to

administer punishment to those in the group that do not conform (Alpizar, Carlsson and Johanssson-Stenman, 2008; Cialdini, 2003; Fischbacher, Gacther and Fehr, 2001; Frey and Meier, 2004; Shang and Croson, 2004).

Community action is context-dependent because social norms and peer pressure both provide for the opportunity to use, to regulate, and if need be, to enforce cooperation on small local community groups (Cialdini, 2003; Goldstein, Cialdini and Griskevicius, 2008; Gerber and Rogers, 2009; Cialdini, Reno and Kallgren, 1990). From this context-dependency comes the desire, want, not to free ride on other group members' efforts. These conditions are what policymakers can use to help reinforce policy so that it is not simply price structured in that I argue that the social preference extension strategy only requires an initial incentive (eg environmental cause) for the community to respond into action, supported by social norms and peer pressure.

Conclusion

Chapter 1 has introduced the structure of this dissertation and its research questions. Research questions 1 and 2 form the bases on which rational choice theory resides by seeking to find out whether consumers do want *more* over *less* with given preferences. If consumers do want more over less, then the reality of wanting more over less is applied to context-dependent preferences.

Research questions 3 and 4 both intend to investigate how context-dependent preferences do, or do not, support rational choice theory by attaching the social preference extension strategy to rational choice theory.

What follows in Chapter 2 is a look at whether household energy bill payers are rational, by finding out if household energy bill payers do seek more over less.

CHAPTER 2

How Rational Choice Theory Explains Household Energy Bill Payers' Choices: Theoretical and Empirical Investigations into Household Energy Consumption Related Behaviour

Introduction

The most logical starting point in the remodelling of economic behaviour is to begin with what we know, and then elaborate on this knowledge. The 'what we know' relates to rational choice theory, perhaps the most recognised behavioural economic model in economics. Integral to rational choice theory is the assumption that individuals act rationally. Discussed later in Chapter 3 is the social preference extension strategy [that shall attach itself to rational choice theory] that assumes individuals act rationally. Rationality requires proving, therefore. This Chapter seeks to prove rationality by using the rational choice theory model of behaviour in relation to how household energy bill payers decrease household energy consumption when under the influence of household energy information and electricity prices. The research aim is, thus, to investigate to what extent the assumptions and components of rational choice theory may change household energy consumption, and if there is a case for change, then how effective are these assumptions and components in changing choices in relation to decreasing household electricity consumption?

To support this Chapter's research aim, Chapter 2 uses research objectives (ie what is going to be done) and strategies (ie how it is going to be done). These objectives and strategies are devised so that answers are obtained for the first two research questions:

- Q1: Do household energy bill payers make rational choices when faced with an increase in the price of household electricity?
- Q2: Do household energy bill payers make rational choices when exposed to information on energy consumption in the household?

To answer research questions 1 and 2 (p.14), this Chapter begins with an explanation for what rational choice theory is (Becker. 1976). An understanding of rational choice theory is a prerequisite for the reader so that the reader can understand how research questions 1 and 2 relate to rational choice theory, and later on in this dissertation, to the social preference extension strategy. From this premise, the assumptions and components of rational choice theory are set out at the beginning of this Chapter.

From here, the research objectives take hold. The research objectives are set in place to test rational choice theory in relation to household energy bill payers' electricity consumption in the household. To test the hypothesis of rational choice theory, research strategies are set out to explain how the research questions are answered set around two models. The first model is Figure 1 (p.21) and explains how the household energy bill payer makes choices when exposed to an increase in the price of electricity supplied to the domestic home (cf Taylor, 1975; Maddala, 1997; Garcia-Cerratti, 2000; Espey and Espey, 2004). The second model is Figure 2 (p.29), and explains how the household energy bill payer makes choices when exposed to information that relates to the electricity used in the household.

Research question 1 relates to Figure 1 (p.21), and conforms to the conventional thinking that surrounds rational choice theory, namely prices, incomes, given preferences and perfect information. Figure 1 (p.21) maps each stage of the household energy bill payer's choices. To test whether Figure 1 (p.21) supports or negates whether an increase in the price of household electricity leads to a decrease in electricity consumption, empirical evidence is discussed on what happens to electricity consumption when households are exposed to electricity price increases. Research question 2 relates to Figure 2 (p.29) and demonstrates how information has the potential to affect how much household energy is consumed in the household based on the flow of

information being disseminated to households. However, though the focus of the research is to seek responses from household energy bill payers' reactions to price increases. Households could maintain current household energy consumption and make changes outside the parameters of energy use. These changes could be, for example, to eat out fewer times per month, or visit fun-parks fewer times. In essence, the option to decrease or increase household energy has an associated monetary cost and this monetary cost could be found by substituting one activity for another activity. This substitution is dependent upon the cross-elasticity of demand of the household energy bill payer and its associated opportunity cost.

To confirm the hypothesis of both research questions 1 and 2, the research should find that household energy bill payers do decrease household energy use when exposed to increases in the prices of electricity or are informed that their choices are inefficient in their control over electricity consumption in the household. The measure of validation is whether the empirical evidence complements Figures 1 (p.21) and 2 (p.29) and the axioms of rationality, namely transitivity and completeness, indicating that household energy bill payers are rational when making household electricity consumption decisions by preferring more savings over less savings.

Economic man

John Stuart Mill (1836) first used the phrase ‘economic man’. Over the years, economic man's representation and interpretation has taken numerous different forms. Philosophers and others have been trying to explain how consumer choices are made for centuries. One of the first was Bernard Mandeville (1705) whom proclaimed that *whole man* has many personality layers that drive household consumers to maximise spending patterns. It is, however, Adam Smith's *Wealth of Nations* (1776) to whom the credit is often given for delivering economic man into the arena of economics.

According to Adam Smith, and taken in its most narrow market transaction interpretation, economic man is a man who is almost completely motivated by self-interest and the pursuit of utility-maximisation. Set in the context of economics, utility is to mean the satisfaction elicited from an activity. Self-interest is to mean the pursuit of private interest. Private-interest is not the result of pure selfish behaviour insofar as private interest is to hanker after personal gain. Personal gain is to mean how man weighs up his costs and benefits which are derived from making choices, but these choices rely on cooperative behaviour in market transactions between different parties, for example the proprietor of a bakery and his/her customers. Economic man is assumed to have exogenous and fixed preferences, and is perfectly rational. Rational is to mean consistent in the ability to rank all alternatives (ie more over less) and to choose the one that provides the greatest utility.

The assumptions and components of rational choice theory

The essential assumptions of rational choice theory are twofold. Firstly, rational choice theory assumes that consumers have utility functions showing levels of satisfaction or utility that consumers derive, having chosen from every possible set combination of goods and services. Secondly, these 'choices' are rational. Rationality suggests that these consumers are the finest judges of their own interests. Rational choice theory is the brainchild of the Noble Prize winner Gary Becker. Becker postulated that individuals respond in the same behavioural manner when exposed to different opportunities when observed under decision-making and choice evaluations. Rational choice theory assumes that individuals are rational. Becker himself ‘credits people with enough rationality’ when making choices (Becker, 1995, p.650). Becker postulates that selfish motivation and altruism are not characteristically inherent in the functioning of individual choices. Becker concludes that rational behaviour is found consistently in all areas of business and personal activities, ranging

from business organizations to households. Becker postulated that individuals, irrespective of whether they are situated in households or functioning in a business, behave in a way that is deemed rational with the direct goal, or pursuit, to maximize utility or wealth.

There are essential assumptions and components that explain rational choice theory. This dissertation uses a model of rational choice theory that assumes:

- The consumer has complete information.
- The consumer has given preferences of wanting more over less.
- The consumer has diminishing returns of satisfaction.
- Consumers always act rationally.
- Preferences are given or fixed.

In addition to the assumptions listed above, the model also includes certain components that add to its structure, and these components are:

- Consumers have a budget line based on individual incomes.
- Indifference curves map the purchase of goods.
- When consumers have more than one choice, choices are 'complete' and 'transitive'.

The first assumption listed above states that information is complete, but information has an associated cost; in others words, a transaction cost. Transaction costs occur when gathering information is costly and these costs outweigh the benefits of the action. The rational choice theory model in Figure 1 (p.21) assumes that transaction costs are very low, that information is freely available with little effort to find. Furthermore, as stated in the assumptions just discussed, rational choice theory assumes preferences are fixed. Fixed preferences are pre-defined and unchanging. The idea of fixed preferences follows the important economic principles of transitivity and completeness (Morgenstern and Von Neumann, 2004). Transitivity simple states that consumers want more over less when presented with a set of choices. In the context of the two research questions under investigation in this Chapter, this means that when

household energy bill payers are exposed to increases in the price of electricity more savings in household electricity consumption are preferred to fewer savings in household electricity consumption.

Furthermore, in the face of an increase in the price of electricity, households weigh up choices that are to either increase electricity or decrease electricity or remain constant in the consumption of electricity. These choices follow rational behaviour and comply with transitivity in that:

↓E Preferred to NCIEC Preferred to ↑E, then ↓E preferred to ↑E

Where:
↑ = increase; ↓ = decrease; E = electricity
NCIEC = no change in electricity consumption
Therefore, a decrease in electricity consumption is preferred to an increase in the electricity consumption when exposed to increases in the price of household electricity.

The other logical and important assumption about preferences is that choices are complete in that household energy bill payers follow the principles of…

A is preferred to B
B is preferred to A
A is indifferent to B

Where:
A is to save on electricity use
B is not to save on electricity use

In the context of deriving utility from household electricity consumption, completeness means that the household energy bill payer has the ability to rank all choices so that:

Savings are preferred to no saving

No savings are preferred to savings

Savings or not, it makes no difference

Research Question 1

Do household energy bill payers make rational choices when faced with an increase in the price of household electricity?

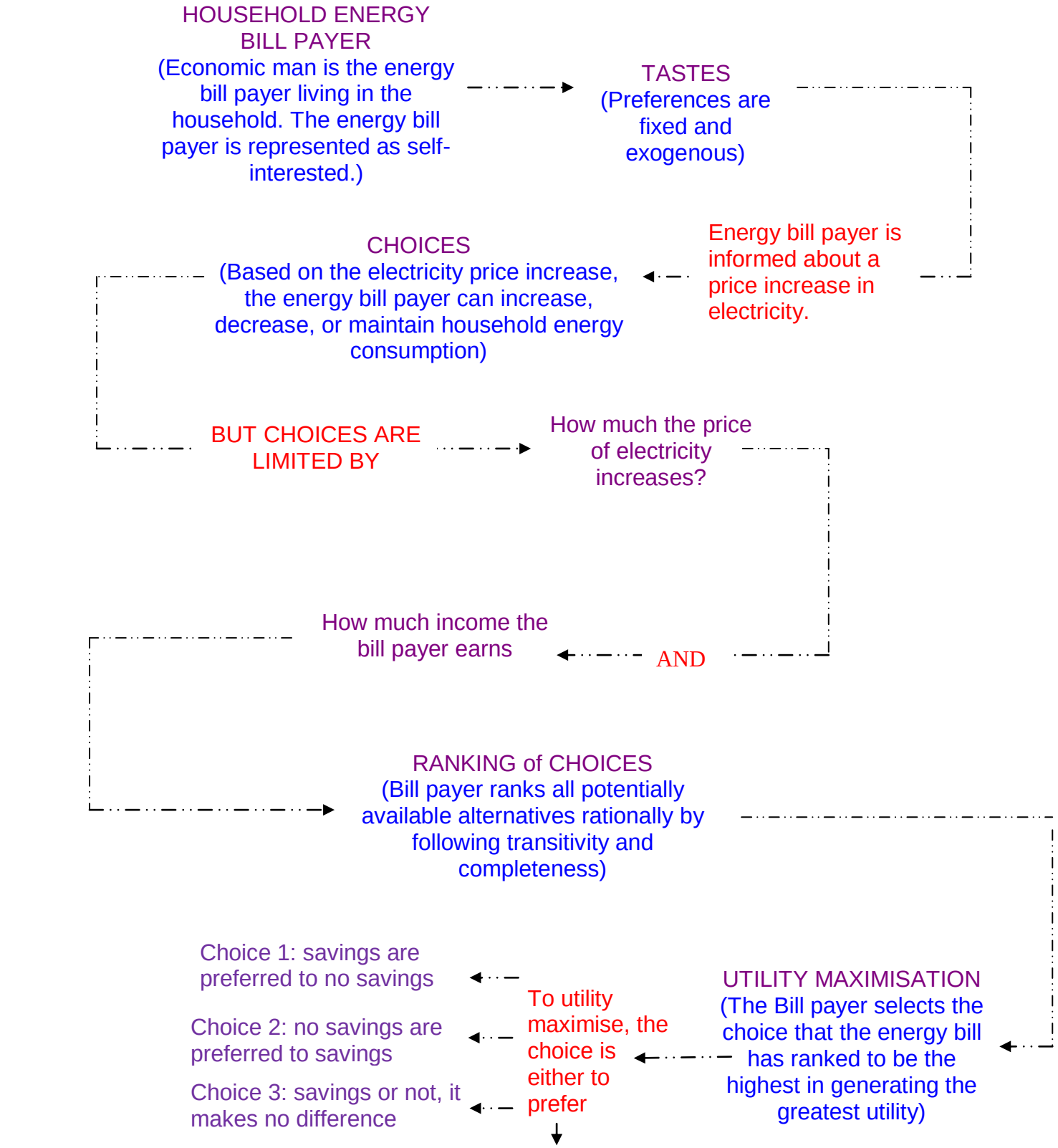
With the assumptions and components of rational choice theory explained, this section turns to placing these assumptions and components of rational choice theory in the context of household electricity consumption to test whether they are true, and if so, whether they are effective in reducing household energy consumption.

Figure 1 (p.21) frames research question 1 in relation to rational choice theory.

Figure 1

A rational choice theory utility maximising energy consumption household model

Do household energy bill payers make rational choices when faced with an increase in the price of household electricity?



Source: author of dissertation

Figure 1 (p.21) assumes that the household energy bill payer operates in a world where perfect information is available on the different costs and benefits of consuming different quantities of household energy. Alternatively, if the energy bill payer does not know this information, such information is available for free, immediately, accurate, relevant, and forms the bases upon which the energy bill payer can rank all energy consumption choices rationally, choosing the one that ranks highest in utility. Figure 1 (p.21) follows the standard rational choice theory model for explaining how the household energy bill payer should utility maximise based on knowing the prices of electricity.

At the top of Figure 1 (p.21) is the household energy bill payer. The household energy bill payer represents the traits of self-interest. Given the household energy bill payer shall want to maximise his or her utility, based on the price of electricity, income and available information, the energy bill payer has three choices that shall determine whether to become more energy efficient at home based on receiving information on the 'rational' benefits of saving household energy. Firstly, not to acknowledge or recognise energy efficient information, thereby households continue to waste energy (eg by not switching off lights). Secondly, to acknowledge and positively respond to energy efficient information (eg by actively switching off unused lights); and three, to recognise the energy efficient information but not believe in the rational benefits and so continue to leave unused lights switched on.

Furthermore, in Figure 1 (p.21), the price of electricity and income of the household energy bill payer are both determiners in how the information on energy efficiency is interpreted and acted upon. The household energy bill payer may actively respond to the information more positively if the price for electricity is high and the household energy bill payer’s income is low.

In addition, information on ways in which to become more household energy efficient (eg by switching off unused lights) may lead to choices

that increase the household energy bill payers' utility by increasing the rational benefit from experiencing savings on the electricity bill. The bill payer, based on energy efficient information, ranks all choices rationally and selects the choice that provides the greatest utility maximisation benefit. This is shown in the latter part of Figure 1 (p.21) under 'ranking of choices' and 'utility maximisation'. By following Figure 1 (p.21), the household energy bill payer comes to the end of Figure 1 and considers whether the household energy bill payer should decrease or increase, or do neither. For the answer, it depends on how the household energy bill payer responds (eg electricity savings preferred over no electricity savings) to the increase in price. Information on energy efficiency and market prices for electricity both act as the conduit between ranking rational choices and selecting the highest rational benefit.

Information on the increase in the price of electricity is important. For by disseminating the price of electricity to the household energy bill payer, this dissemination is able to provide the household energy bill payer with information on the costs of household energy. If information on energy bills and prices are framed together, then research suggests that household energy bill payers respond more positively to reducing energy consumption when in the belief that monetary gain shall be achieved as opposed to a monetary loss (Shipworth, 2002; Yates, 1983). This assumption that the self-interested rational household energy bill payer prefers a 'monetary gain' to a 'monetary loss' is explicit in Figure 1 (p.21). This inherent explicitness is because rational choice theory assumes that the household energy bill payer shall want to maximise utility by deriving the highest utility from whatever currency is spent on household energy consumption.

According to the studies by Shipworth (2002) and Yates (1983), if monetary gain is preferred over a monetary loss, then as the price of electricity increases, demand should decrease: this is the Law of

Demand. Research compiled in the UK on household electricity use by the BERR (2008) presents the annual percentage change of domestic electricity demanded as set against the retail price between December 1997 and December 2008. The data looked at residential tariffs suppliers' offered along with the suppliers' incentives to persuade household energy efficiency. According to this research by the BERR, the trend in domestic electricity demand, on average, does increase (along with a decrease in the price of electricity), or decrease, (along with an increase in the price of electricity), depending on the fluctuations in the retail price changes in electricity. The study supports the postulation that the household energy bill payer is consumer rational; this rationality decreases electricity consumption, given the increase in the unit price of electricity.

Given the BERR's study that supports an inversely proportional relationship between the price of electricity and household energy consumption. 'Utility maximisation' in Figure 1 (p.21) supports the postulation that the rational energy bill payer should respond with a decrease in household energy consumption in response to an increase in the price of electricity. The household energy bill payer is price sensitive if measured against the price elasticity of demand (PED). The price elasticity of demand measures the proportionate responsiveness of demand to changes in price. In the context of Figure 1 (p.21), the household energy bill payer has three choices in response to a price change in electricity, *ceteris paribus*, and these three choices are:

- Choice 1: reduce energy consumption (ie savings are preferred to no savings)
- Choice 2: increase energy consumption by using more electricity (ie no savings are preferred to savings)
- Choice 3: maintain energy consumption by not choosing to increase or decrease electricity household consumption (ie savings or not, it makes no difference)
- Choice 4: the opportunity to purchase efficient household appliances that save on energy and therefore on costs

Choice 2 would be unlikely given the sensitivity to price. Choice 3 is possible, if the household energy bill payer were to make sacrifices somewhere else, for example, dining out fewer times per month and using this saved money to pay for electricity bills instead. Choice 4 is an option, but the cost of purchasing other appliances for the household would probably only be considered if the energy price increase was exceptionally high, since time is a factor of price elasticity of demand. Therefore, for the short timeframe, the household energy bill payer is more inelastic to options of changing appliances, but if the price of electricity were to increase regularly, the household energy bill becomes more price elastic as the household energy bill payer becomes more sensitive to energy price increases and seeks alternative methods to save on energy consumption.

Choice 1 embraces the inherent explicitness of household energy bill payers by preferring monetary savings to monetary losses, as assumed in Figure 1 (p.21). If monetary savings are preferred to monetary losses in the purchase of electricity, then the price elasticity of demand should be inelastic in response to a price increase in electricity, because electricity is a necessity and has few substitutes. Empirical studies are presented in support of Choice 1, and the choice to choose 'savings are preferred to no savings' (Figure 1, p.21) *ceteris paribus*.

<u>Empirical case studies on price inelasticity showing household energy bill payers are inelastic to residential electricity consumption: evidence to support Choice 1 (p.23)</u>

The evidence provided in the empirical findings provides results that show household energy bill payers are inelastic to increases in the price of electricity. To have inelastic demand, the empirical studies must find that for every 1% increase in the price of electricity, household energy consumption decreases by less than 1%. The price elasticity of demand (PED) is calculated as the $\%\Delta Qd/\%\Delta P$. [Read as the percentage change in quantity demanded divided by the percentage change in price.]. The empirical findings all have values

that are below 1 and thus are inelastic. The explanation for this is the correlation between information and price. In the short-run, when household energy bill payers are exposed to a price increase, they seek to make reductions, but changes in demand for electricity are less sensitive to changes in price, perhaps because, household energy bill payers consider the price may decrease soon. In the long run, the opposite of this is true. When the price continuously rises and households are aware of this prolonged increase, then households become more sensitive to these continuous price rises. In these cases, households are more price elastic to household energy price increases.

The studies on the price elasticity of demand for residential electricity show that there is a significant long-term statistical truth to the postulation that household energy bill payers do act rationally (as explained by the choice options given in Figure 1, p.21), because household energy bill payers decrease electricity consumption when faced with a price increase in household electricity.

Reiss and White (2002) provide data on PED and residential electricity consumption based on data published in the *Department of Energy*. The in-home interviews were between 1993 and 1997 in California, with a sample size of 1,307. They found that changes in the prices of residential electricity lead to an inelasticity in price of 0.39.

Filippini (1999) reviewed data on electricity consumption in 40 Swiss residential households between 1987 and 1990, and found an average price inelasticity of 0.30.

King and Chatterjee (2003) reviewed data on 35 case studies between 1980 and 2003 on residential and small commercial electricity consumption, and found an average price inelasticity of 0.3.

Maddala *et al.* (1997) estimated the price elasticity of residential electricity consumption presented as statistical means in 49 USA states. For the short-term the mean was 0.16 and for the long-term 0.24. Garcia-Cerratti (2000) also estimated the price elasticity for

residential electricity in California, and found a price inelasticity of 0.17.

Taylor (1975) reviewed some existing studies on residential, commercial, and industrial electricity demand in the USA. Taylor found that the price inelasticity of demand on residential electricity consumption was between 0.90 in the long-term and 0.13 in the short-term.

Bohi and Zimmerman (1985) conducted wide-ranging reviews on 18 studies of residential electricity consumption in the USA and found a price inelasticity of 0.2 in the short term and 0.7 in long-term.

According to a more recent study on residential demand for energy, Espey and Espey (2004) reviewed 36 studies on residential electricity consumption and found a price inelasticity of 0.28 in the short-run and 0.81 in the long run.

Given the research on the sensitivity of price and household energy consumption, do household energy bill payers make rational choices when faced with an increase in the price of household electricity? Yes, in that, the theoretical evidence postulated and the empirical evidence showed that household energy bill payers were transitive in choice by preferring more savings to fewer saving on electricity consumption. Furthermore, given that the empirical studies have found that the household energy bill payer is sensitive to changes in the market price for residential electricity; he or she becomes a prime target for the promotion of awareness in the use of household energy efficiency and electricity prices. Research question 2 addresses the exposure to information on electricity efficiency and price.

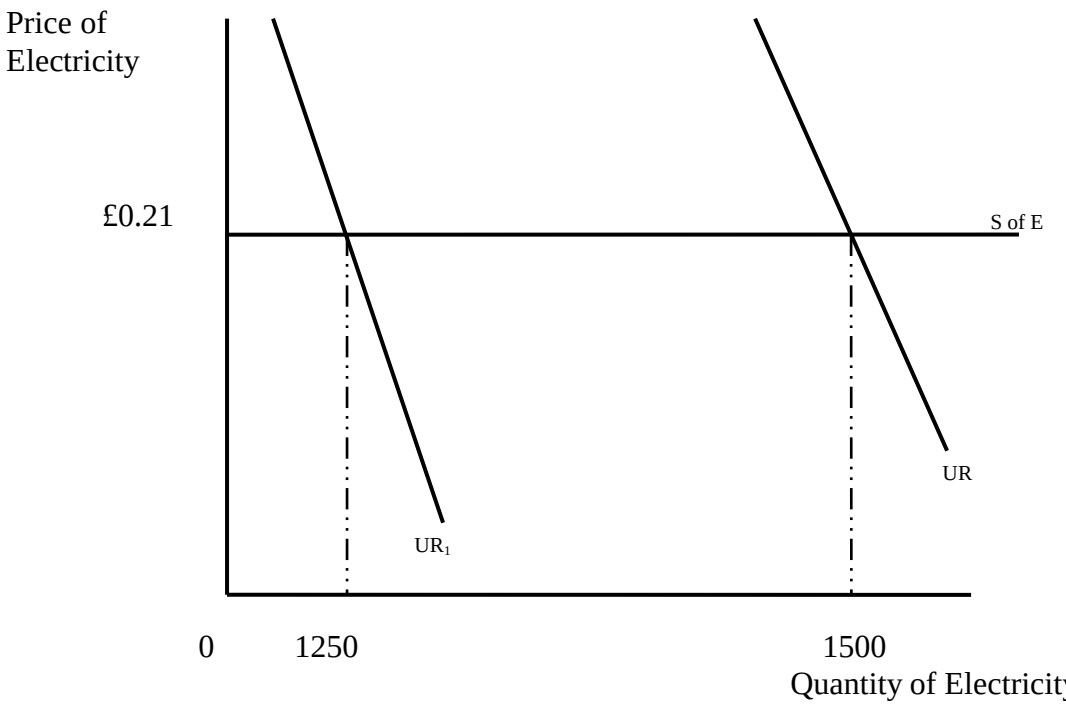
Research Question 2

Do household energy bill payers make rational choices when exposed to information on energy consumption in the household?

By promoting cost savings through informing the energy bill payer of the rational benefits by selecting the choice that provides the greatest utility consumption rate at a given price for electricity leads to more active choices in support of energy savings by switching off unused electrical fixture and fittings in the home. Information, however, must be framed in the context of providing information on making choices that are more *electricity efficient* compared with choices that are *inefficient*. The electricity efficient choice compared with the inefficient choice represents a divergence between the efficient usage rate of electricity and the inefficient usage rate of electricity. The divergence is present at any point when electricity is being consumed for no real purpose (eg leaving lights switched on in a room that is vacant for prolonged periods). The electricity efficient usage rate of electricity is individualistic in that 'efficiency' is based solely on the choices (eg to choose to switch off unused lights) of the individuals living in the home, *ceteris paribus*. The theoretical divergence between *efficient* and *inefficient* household energy consumption usage rates are illustrated in Figure 2 (p.29).

Though switching off unused lights would result in household energy savings, it is worth mentioning that it is not a costless activity to undertake. Changing regular behaviour requires significant effort and the breaking of habits that over the prolonged period of time would be difficult to maintain.

Figure 2: The divergence between efficient and inefficient household energy consumption



Inefficient use of electricity:
UR = 1,500 x £0.21 = £315

Efficient use of electricity:
UR_1 = 1,250 x £0.21 = £262.5

Literature providing evidence for households actively seeking to become more energy efficient in the support of the theoretical shift from UR to WRCUR include studies by Seligman and Darley, 1977; Winett et al., 1982; Hebrelein and Baumgartner, 1985; Haakana et al., 1997; Wilhite, 1997; Brandon and Lewis, 1999; McCalley and Midden, 2002 and Mountain, 2006)

Given the previously discussed studies (Taylor 1975; Bohi and Zammerman, 1985; Maddla, 1997; Garcia-Cerratti, 2000; Espey and Espey, 2004; Filippini, 1999; King and Chatterjee, 2003; Reiss and White, 2002) that provide statistical evidence that the residential electricity bill payer is price sensitive, information that highlights and informs the energy bill payer of the price for electricity could provide the encouragement and incentive to switch off unused lights. This could be done with slogans, written on the energy bill, such as:

'Are you economising your energy bills by being energy efficient?'

Key to the abbreviations in Figure 2

UR stands for the *Usage Rate* of electricity in the household. S of E stands for the *Supply of Electricity* from the supplier to the household.

Source: diagram and diagram contents are the ideas of the dissertation author

The numbers provided in Figure 2 (p.29) are arbitrary. Any figures could have been used to illustrate the divergence between efficient and inefficient uses of electricity in the household. On the y-axis in Figure 2 (p.29) is the price of electricity per unit supplied to the household. Figure 2 assumes that the price of electricity is supplied at a constant price of £0.21 per unit of electricity; therefore, the supply curve is perfectly elastic. On the x-axis is the number of electricity units consumed in the household. In Figure 2 (p.29), without executing efficiency measures, the household energy bill payer uses 1500 units of electricity at a price of £0.21 per unit of supplied electricity. With a price of £0.21 per unit and at an electricity household consumption rate of 1500 units, the household energy bill payer uses £315 worth of electricity. However, information disseminated to the household energy bill payer that provides information on electricity efficiency and the potential savings available by being aware of the use of electricity in the home highlights potential inefficiency behaviour. Therefore, UR shifts to UR_1 and the number of electricity units used decreases. The shift in demand comes from household energy bill payers responding to preferring more savings over less savings as outlined by rational choice theory. By shifting the usage rate to UR_1, the household energy bill payer has reduced the electricity bill by £52.50, having a new total of £262.50. The decrease in the electricity bill stems from the choice to switch off unused lights and unused electrical appliances.

Though Figure 2 (p.29) represents only a theoretical shift in the use of electricity, empirical studies on the awareness of energy efficiency have proved successful in saving money on household energy bills. Discussed below, these studies do support a relationship between the evidence that suggests that the household energy bill payer is price sensitive by the means of using this sensitivity as an incentive to encourage energy users to become more household energy efficient. This relationship, along with the case studies presented below, supports the theoretical shift from UR to UR_1 in Figure 2 (p.29).

Empirical case studies to support research question 2: do household energy bill payers make rational choices when exposed to information on energy consumption in the household?

Information has (based on the ways in which to reduce household electricity consumption) provided some positive results in households becoming more energy efficient. The wide-body of literature discussed below uses a variety of different strategies to reach, or aspire to reach, ways that may change household energy behaviour so that household energy bill payers want to remain at point UR_1 in Figure 2 (p.29).

However, by using different mediums to disseminate information, this requires the weighing up of transaction costs. If the dissemination of providing information to household energy bill payers exceeds the savings that could be potentially made, then the information is too expensive, because household energy bill payers would not actively seek energy reductions if the cost of finding the information exceeds the benefits of changing behaviour.

Studies using informative billing

One method of convincing household energy bill payers to shift from UR to UR_1 (Figure 2, p.29) is to use informative billing. Informative billing is providing the household energy bill payer with information on the use of electricity and its associated costs. Over time, informative billing provides feedback that allows for educational learning on the ways that can lead to electricity savings. By informing household energy, bill payers of this informative billing may lead to reductions in electricity use. Winett *et al.* (1982) undertook a study in the USA on improving household electricity consumption based on daily informational feedback from videotape recordings that demonstrated alternatives for comfort without having to increase the air-conditioning or heating in the home. The survey was undertaken in the summer and the winter with samples sizes of 53 and 85 respectively. According to this study, one effective method of delivering

energy messages to household energy users is to use closed-circuit video programs that provide information on how energy choices can lead to energy savings. The study found that energy savings were around 15 per cent as a result from watching video information on energy conservation.

Another method of informative billing is to use brochures and notices. Hebrelein and Baumgartner (1985) carried out comparison studies in the USA on household energy efficiency using brochures and notices included with the energy bill or a more detail information package that included monitoring advice and detailed information on energy rates. According to this study, comprehensive information packages tailored to time-of-use supports household energy efficiency. The study found that households saved between 10 and 15 per cent on household energy bills.

Regular informative billing as provided some positive results for reductions in electricity use. A study by Haakana *et al.* (1998) of 105 households in Finland, by the Department of Home Economics, on supplying information on energy efficiency by sending monthly feedback of meter readings found that 54% of the 105 households actively switched off unused lights. When asked why, the study found that 68% of the sample said switching off lights culminated in monetary savings on household energy bills. Further results of the Haakana *et al.* study found that household energy consumption feedback encouraged 40% of the sample to become more aware than they were before the survey of current household energy consumption rates.

If household energy bill payers respond to awareness over time, then the time-period may have an impact of how effective these energy reductions are. Palmer, Lloyd, and Lloyd (1977) suggest using daily prompts as the focus on informative billing by using information on electricity consumption as daily prompts. The study consisted of four households in Iowa and lasted for 106 days. The informational

feedback consisted of a card placed on a window of each household each night detailing the consumption of electricity for that day as measured by the baseline that looked at the average consumption for that household. In addition to the card information was the monetary cost information for the month based on current usage rate. Across the household, the average reductions of household electricity consumption were 16 per cent.

Studies using informative billing and monetary or goal incentives

The results from informative billing prove that a theoretical shift from UR to UR_1 in Figure 2 (p.29) is possible when using informative billing. However, further results show that positive results are obtained when the household energy bill payer uses not only feedback but links this feedback with monetary incentives to create monetary-incentive-feedback or goal-incentive-feedback. The goal could be a simple one such as using less household energy than the neighbours use. Konhlenberg *et al.* (1976) investigated the effects of information feedback and feedback plus monetary incentives (money reductions if the survey participants reduced energy consumption) on household electricity consumption during peak times. The study involved three households in Seattle, USA, and lasted for three months between January and March in 1976. The research consisted of 24-hour chart recorders placed in each of the residence homes to monitor each household's electricity consumption every 15 minutes. Information was fed to households, when these households were using excessive electricity as measured by a baseline of electricity use. The study found that information coupled with monetary incentives reduced household electricity consumption by 50 per cent in peak times of use. Therefore, when information is coupled with rational choices (in this case a monetary incentive to reduce electricity consumption), significant results are obtained. According to the research however, when information alone was used, the study found little difference in the consumption of electricity at peak times.

Becker (1978) used the dissemination of information in conjunction with goal setting to reduce electricity consumption. The dissemination of information consisted of an information sheet detailing the electricity use of different appliances in the study group. The study involved 100 families in New Jersey over the months between June and August. To find the baseline, researchers recorded meter readings of average electricity consumption for 9 weeks. The study groups were asked to set goals as to how much electricity they could save over the experimental period. The findings of the research concluded that the highest saving was 13 per cent based on the goal to reduce electricity consumption by 20%.

Hayes and Cone (1977) used informative billing and the economic principle of transitivity (ie wanting more over less) to analyse the effects of electricity consumption. The study involved feedback information and cash-back. Cash-back was rewarded to participants that made reductions between 10 per cent to more than 50 per cent (eg a reduction of between 20%-29% was rewarded with a cash-back of $6). The study was between January and May and consisted of one group of students at the West Virginia University. Feedback was on electricity consumption for cooking, refrigeration, ventilation, and fans and was recorded using group meters. These readings acted as the baselines for consumption above or below the baseline. The findings from the research found savings of between 15 and 20 per cent.

Studies using technology such as electricity meters and computers

Given that most, if not all, households have electricity meters. Meter reading feedback has the potential to provide effective reductions in household energy use to create a shift from UR to UR_1 in Figure 2 (p.29). Seligman and Darley (1977) examined the effects of meter reading feedback. The baseline was based on meter readings taken prior the study over 5 weeks. The monitors were attached to an outside window of each house. The study consisted of four homes

using air conditioning, lighting and refrigeration. The study lasted for three months beginning in July and ending in September. The results of the study found that the group receiving the feedback used 11 per cent less electricity than the group that did not receive any feedback.

Given that meters are in most households, it is prudent to encourage the homeowner to monitor their own electricity meter and therefore self-learn to reduce electricity consumption. Wilhite (1997) examined the effects of households reading their own utility meters and sending the information to the utility supplier. Informative billing information was sent to these households detailing their electricity consumption. The purpose of the study was to use information about electricity consumption to create awareness. The study ran from March 1995 to December 1996, and was in Norway, with a sample size of 2000. Three years after the experimental awareness study had taken place; informative billing had the effect of reducing household electricity consumption by 8 per cent.

Using regular meter-reading feedback to support the learning process was central to Wilhite and Ling (1995). The idea here is to make sure household energy bill payers do not relapse on the reductions once they are made (ie maintain the position of UR_1 in Figure 2, p.29). Whilhite and Ling investigated how often dissemination of information can affect household electricity consumption. The Norway study consisted of information supplied to the studied groups six times a year based on meter readings along with basic written text and graphics presenting each phase compared with the previous year. With a sample size of 675 and project duration of three years, results were a 10 per cent saving.

Current regular informational feedback in the home was the focus of Mountain (2006). The idea here is that the household energy bill payer can monitor electricity use and adjust accordingly based on previous efforts in the hope to maintain a constant reduction in household

electricity use. Mountain investigated the use of electricity information consumption using monitors placed in the household. These monitors provide instantaneous information about the amount of electricity currently consumed and the price of electricity. The Canadian study lasted for 2.5 years with a sample size of 505. The results showed that a 6.5 per cent saving was achieved.

Another study on in-home monitors also provided reductions in household electricity use. McClelland and Cook (1979-80) examined how the use of information on in-home electricity monitors affects household electricity consumption. The study consisted of 101 family homes over an 11-month period in the USA. The results of the study found a 12 per cent saving for the homes that were equipped with the in-home electrical monitors.

It has been discussed that electricity meters are a very effective and useful tool for monitoring household electricity use, Brandon and Lewis (1999) examined the effects of information disseminated directly to the home via the personal computer. The UK study consisted of 120 persons in groups of eight and lasted for 9 months. According to the research study, the authors claim that having the ability to view and obtain feedback from the supplier of electricity on the usage rates and times of use provides savings in the magnitude of 12 per cent over the study period.

Benders *et al.* (2006) also uses technology to aid in the awareness of maintaining household energy reductions and thus providing the incentive to stay at point UR_1 in Figure 2 (p.29). Benders et al. investigated the role of information and technology as a tool for informing electricity usage. With a sample size of 137 households over a research period of 5 months in the Netherlands, the study consisted of an informative based web site which consisting of three parts. These three parts were questionnaire measuring the energy prerequisite before commencement of the experiment, information

requirements on how to reduce energy options and a feedback segment viewing the effects of the changed behaviour. As a result, the experiment found that household energy savings were 8.5 per cent over the study period.

Given the vast array of modern appliances found in the home, technology is also useful in finding out how much electricity these appliances use and by finding this out, it may help to change the way in which households use them, and this information supports the shift from WR to UR_1 in Figure 2 (p.29). Households require information on how much energy these appliances use. Targeting appliances was the focus of a study by McCalley and Midden (2002) who examined electricity use and washing machines. The study consisted of 20 washing trails with a sample size of 100 that measured electricity consumption per wash in a computerised machine-washing simulation. These lab experiments were also undertaken in the field to target behaviour that would focus the attention on the load and temperature settings. The field experiments found that by installing energy meters on washing machines household energy bill payers focused more on the costs of running washing machines. This attention and focus created an 18 per cent saving through being more efficient, in terms of water temperature, spinning speed, and the duration of the wash.

Conclusion

This Chapter began by asking two research questions, these questions were:

- Q1: Do household energy bill payers make rational choices when faced with an increase in the price of household electricity?
- Q2: Do household energy bill payers make rational choices when exposed to information on energy consumption in the household?

These questions were designed to test the hypothesis of rational choice theory. In particular, do household energy bill payers abide by the axioms of transitivity and completeness?

For research question 1, the research found that household energy bill payers are sensitive to price changes in electricity so that when the price of electricity increases demand decreases. Therefore, given the empirical findings, the answer to research question 1 is that when the price of electricity increases, consumption of household electricity decreases. The fall in electricity consumption provides the evidence that rational choice theory is validated in that household energy bill payers seek to maximise utility by choosing the option 'savings are preferred to no savings' in household electricity use (Figure 1, p.21). This choice supports transitivity and completeness.

For research question 2, information fell under the spotlight. In particular, how information can affect household electricity consumption. The empirical evidence suggests that when household energy bill payers become aware of electricity use in the home, household energy bill payers seek to make reductions in electricity consumption to maximise efficiency as set against the cost of electricity. From a rational choice theory perspective, the research on households making savings on energy use through computer technology is worth pursuing in that the results from this area are encouraging. The primary reason for this is that it is easier to make rational choices if these choices are visibly seen so that comparisons can be made. By having information fed to homes, perhaps via email, transaction costs remain low. Furthermore, technology allows homes to have devices placed in the home that glow when a lot of energy is being used above the common usage baseline for that household.

Rational choice theory has been validated in that household energy bill payers wish to make changes to consumption that allow for utility

maximisation by setting in motion activities that allow for savings to be preferred to no savings in household electricity use (Figure 1, p.21).

Chapter 3 expands the rational choice model to include social preferences in the form of the social preference extension strategy. The purpose of the social preference extension strategy is to support rational choice theory, but at the same time, expand its borders that shall help to persuade household energy bill payers to reduce electricity use in the home.

CHAPTER 3

The Attachment of a Social Preference Extension Strategy to Rational Choice Theory in Relation to Household Related Energy Consumption: Theoretical and Empirical Investigations into Household Energy Conservation

Introduction

Chapter 2 portrayed household energy bill payers as rational actors making rational choices. Chapter 2 found that household energy bill payers do abide by rational choices when exposed to an increase in the price of household electricity.

The first two research questions in Chapter 2 have laid the foundation to allow for the third research question. The 3rd research question is:

Q3: Does a social preference extension strategy have an effect on household energy bill payers' electricity consumption?

Research question 3 brings into the mix of rational choice theory the side of the household energy bill payer that is social. Until now, it has been assumed that the household energy bill payer makes choices based only on the premise of wanting to save money, and that these choices are only influenced by price. The social side of the household energy bill payer represents the times when the household energy bill payer allows for context-dependent preferences to affect the choice of what bundle set is chosen. Therefore, with the aid of the social preference extension strategy, economic man morphs into Social-Economic Man.

Social-Economic Man only represents one household energy bill payer at any one time, but this energy bill payer has different choice traits, some of which are purely economic, whereas others are more social. The idea of Social-Economic Man is not a new one (cf Duesenberry, 1949; Leibenstein, 1950; Lichtenstein and Slovic, 1971; Loomes and Sudgen, 1982; Davis and Holt, 1993; Bereby-Meyer and Erev, 1998; Loomes, 1998, 1999; Benabou and Tirole, 2002; Bowles, 2004 and

Akerlof and Kranton, 2005). However, the insights into research question 3 bring new dimensions to an old problem of using only exogenous preferences in that research question 3 breaks down how household energy bill payers' economic and social sides view the decision process from different angles and perspectives, allowing for wider endogenous influences to affect choices.

The research objective of Chapter 3 is to design a model that incorporates the social preference extension strategy (Figure 3, p.50). To meet the research objective, the research strategy is to map how the household energy bill payer makes choices under the premise of rational choice theory and secondly, how the household energy bill payer maps choices when influenced by the social preference extension strategy. Empirical evidence on social preferences shall test the model (Figure 3, p.50) to assess its robustness. The measure of success shall be if the social preference extension strategy in Figure 3 (p.50) provides potential real-world application based on whether the social preference extension strategy can decrease household energy consumption. The judge of this potential real-world application is whether the theoretical model of Figure 3 (p.50) complements the research literature on peer pressure and social norms (ie social preferences).

However, before peer pressure and social norms can be incorporated into Figure B in Figure 3 (p.50), is there any empirical evidence to suggest that social preferences do exist and have the potential to affect household energy bill payers' choices?

Literature review on social preferences

Chapter 2 supported the view that, under the right conditions, rational choice theory provides an explanation for why household energy bill payers would want to opt to conserve household electricity, based on given preferences and rational choices. However, a wave of economic literature has been provided to show support that social

preferences are also used when choices are being made. Social preferences are preferences that are partly determined by what others have chosen. Research in the field of behavioural economics has provided countless experiments for when social preferences affect the choices of the participating parties (Duesenberry, 1949; Leibenstein, 1950; Lichtenstein and Slovic, 1971; Loomes and Sudgen, 1982; Davis and Holt, 1993; Bereby-Meyer and Erev, 1998; Loomes, 1998, 1999; Benabou and Tirole, 2002; Bowles, 2004; Akerlof and Kranton, 2005).

According to Duesenberry (1949), individuals have systematically context-dependent utilities that suggest individuals shall make choices that are partly determined by the choices of others in that these choices are observed and then copied.

Leibenstein (1950, p.190) researched observed consumption. Leibenstein used the term 'bandwagon effect' to describe how individuals copy the choices of other individuals. The bandwagon effect is underpinned by the assumption that individuals want to conform and makes choices that represent people like themselves.

Wanting to conform to others like themselves was the focus of research by Akerlof and Kranton (2005). The idea situated around the premise is that non-pecuniary incentives are correlated with individual identity so that the understandings that preferences are exogenous and stable are questioned. Individual identity is the awareness individuals have of themselves, and how this awareness is interpreted and observed by other individuals. The research found that individual identity could seriously affect people's choices. Based on their research, if an individual is environmentally aware, but not actively environmental, then this individual is more likely to reduce domestic household energy consumption if friends or family has chosen to reduce household energy consumption. If individuals are copying the choices of other individuals, then preferences are not

fixed, because the choice to reduce household energy consumption is not solely because of changes in the price of electricity, though price plays its part, but friends and family who have already reduced household energy consumption also affect the change in household electricity consumption.

Being influenced by others was the interest of Camerson and Thaler (1995). The context of the experiment was that X has received a fixed sum of money that he must distribute between himself and another player; Y. X can make any offer to Y, but if Y rejects this offer, then both players receive nothing. According to the research, the majority of offers were between 30% – 40% of the original sum of money, with some of X's offers 50% of the original sum of money. When, however, X offered less than 20% of the original sum of money, Y tended to reject these offers. These rejections allow for the possibility that Y is choosing whether to reject or accept based on the choice of offer given by X. If this is the case, then Y's choices are partly being determined by X's choices, and therefore Y's preferences are no longer exogenous and stable, but partly represented by the manipulation from X's choices. The core of the research suggests that players are willing to invest in the stabilisation of social norms by sacrificing gain to correct an unfair exchange. Hoffman *et al.* (1996) provided an interesting extension to the experiment in that Hoffman removed Y's ability to reject any offer from X. The game now becomes a dictatorship. When the experiments were again run as a dictatorship, the offer to Y was much less, but it was not zero. According to Hoffman, the reason for this tendency was for X to place greater importance on what the experimenter thought of X. From this premise, offers were being manipulated by social preferences based on what X thought the experimenter would do under the same circumstances, X was trying to copy this theoretical experimenter's choice.

Similar research by Loomes (1999) supports the results by Camerson and Thaler. Loomes (1999, F42) provided an experiment in which £10 was divided between two people. Loomes undertook two experiments.

The experiments consisted of two players. The instructions of the experiment were that one of the players had to divide £10 between himself and player 2, using any monetary denomination. Player 2 had two choices. Player 2 could either accept the offer from Player 1, or reject it. If Player 2 rejected the offer from Player 1, then both players received nothing.

Table 1 (p.41) presents the offers. The first letter in the series represents the sum of money (ie a, b, c, or d) kept by Player 1 (the subscript, $_{p1}$). The second letter represents the offer to Player 2 ($_{p2}$) that is accepted or rejected. The letter 'R' denotes that Player 2 chose not to accept the offer from Player 1. The combinations of letters in red represent the offer, acceptance, or rejections between both Players 1 and 2 in each experiment. The premise of the experiment is to assume that both players are not affected by the choice of offer or choice of rejection of each of the other players in the game. (That is, they are individually playing their own game so that they can each maximise utility.) An adapted recreation of the experiment is below.

Table 1: The £10 experiment of choice

E = even; U = uneven; R = rejected offer; A = accept; P1 = Player 1; P2 = player 2; a = £9; b = £5; c = £1; d = £0

Exogenous, Fixed Preferences			Endogenous, Social Preferences		
Experiment 1			Experiment 2		
	A A			**A A**	
E	b_{p1}, b_{p2}	→ £5 each	**E**	b_{p1}, b_{p2}	→ £5 each
	A R			**A R**	
U	a_{p1}, c_{p2}	→ Player 1 £9, player 2 £1	**U**	a_{p1}, c_{p2}, R	→ Player 1 £9, Player 2 £1, rejection 'R' from player 2, both receive nothing.

Source: adapted from Loomes (1999, F42)

Experiment 1 demonstrates Player 2 chooses the option that displays the axioms of self-interest and fixed preferences along with not

questioning or considering why Player 1 has made such an offer. Player 1 selects the preferred choice (ie the one in red) by rationally ranking all the alternatives and selecting the one that provides the greatest utility from all choices offered, irrespective of what the other player has said, done, or offered. In Experiment 1, depending on the offer from Player 1, Player 2 shall choose (E, A) over (U, A). This is because in terms of the offer (E, A), b > c (ie 'b' has a monetary value of £5 whereas 'c' has a monetary value of £1) when compared to the offer of (U, A) which has c > d (ie 'c' has a monetary value of £1 whereas 'd' has a monetary value of £0). Player 2 would not have refused the offer of (U, A), just because it has a less monetary value. Player 2 prefers to have *some* money as opposed to receiving *no* money, and shall rank preferences rationally according to the utility received from each offer under the premise more is preferred to less.

Experiment 2 includes social preferences in the choice ranking process. Experiment 2 found that when Player 2 considers the offer of (U, R), Player 2 also evaluated how *fair* the choice offer is (given as 'ap1, cp2' in Experiment 1, and 'ap1, $cp2_R$' in Experiment 2), and, based on this measure of fairness, rejects the offer. Player 2 is not exhibiting exogenous and fixed preferences, but social preferences. Player 2 has decided to prevent Player 1 from receiving the full £9 by sacrificing the £1 Player 2 would have received. Player 2's choice is partly based on the decision that Player 1 only choose to offer Player 2 £1 of the £10.

Unlike Loomes's experiment designed to test the presence of social preferences in a controlled experiment, Sagoff (2004) discusses social preferences in a real-world context. This context was when a scout arrived at his home knocking on the door brandishing cookies for sale. Sagoff explains that he purchased some cookies from the scout. Sagoff then goes on to explain that he does not care for cookies: he took the cookies to work for his friends to eat. The circumstances surrounding

this transaction are important. The scout lived in his neighboured; in fact, the scout lived next door to Sagoff. The scout had frequented other residents' homes in the scout's own neighboured. Sagoff bought cookies purely because this was the choice of his neighbours. Social preferences have persuaded him to copy his neighbours, because he felt he ought to buy cookies.

From the literature, it is evident that social preferences do exist and are capable of influencing household energy bill payers' choices and are therefore vindicated for the use in Figure B within Figure 3 (p.50).

Though the discussion around these different experiments have provided evidence of social preferences to help explain individual choices, this Chapter suggests that the reason economics views individuals as not having, or not including social preferences, in models explaining choices, is because 'economic man' and 'social man' are often interpreted as separate individuals when deriving and making choices. Therefore, this separation of decisions culminates into different interpretations, as for how choices are selected. This separation is the focus of the next section.

The difference between the characteristics underpinning exogenous preferences and endogenous preferences

This Chapter suggests that the household energy bill payer is part 'economic' and part 'social', and derives choices based sometimes on purely economic choice traits (eg more is preferred to less) and sometimes on social choice traits (eg conforming to the social norm in small local communities). By bringing these choice traits of economic man and social man together, this bringing togetherness creates Social-Economic Man. Social-Economic Man is *only* one man. The choices over goods and services used or consumed are based on choices that are underpinned by all the characteristics inherent in this one man. Characteristics like self-interest, exogenous and endogenous preferences, and rational behaviour.

Whereas Chapter 2 primarily discussed and documented the choice traits of solely a household energy bill payer as a bill payer who has exogenous and given preferences, and is almost completely motivated by self-interest in the pursuit of utility-maximisation, social man is too a household energy bill who is guided by self-interest, but does not have exogenous or given preferences. The key that differentiates the characteristics between the two sides of Social-Economic Man is the fact that on the side of social man his choices are malleable, because choices are influenced by persuasion and imitation of others, both of which affect which option Social-Economic Man shall choose. Given that social man's choices are partly determined by what other individuals choose, preferences are endogenous. I define endogenous preferences as:

Definition of Endogenous preferences

Preferences are endogenous when the individual allows his or her choices to be a function of context-dependency insofar as this context-dependency affects choices over time based on what other individuals have chosen in the past, what other individuals choose at the present, or what other individuals shall choose at some known point in the known future.

Source: This definition is based on (Bowles, 2004, p.97).

When preferences are endogenous, preferences are represented from inside the household energy bill payer's utility model. A further characteristic underpinning endogenous preferences is that the ranking of preferences can be determined by social norms and peer pressure. Social norms and peer pressure are outside the boundaries of the conventional consumer utility model that relies on given preferences and choices that solely change because of increases or decreases in prices.

Furthermore, when framed endogenously, preferences are not stable, because household energy bill payers' preferences are influenced by the choices of other household energy bill payers' preferences insofar as one energy bill payer shall copy from another energy bill payer by

choosing the same choice based on what the other energy bill payer chose, therefore, imitating the same choice. A change in choice stems from a change in preference by having household energy bill payers introduce a new preference (ie one that was not present before) into the household energy bill payer's utility model. This ‘new preference’ is the reason behind why household energy bill payers rank preferences differently in that endogenous preferences can change choice through the imitation and persuasion of others that in turn can change the ranking of preferences.

In contrast, when preferences are framed exogenously, preferences are stable in that preferences are not influenced by the choices of other household energy bill payers. Therefore, by having existing unchanging preferences (ie preferences that are not open to persuasion or imitation from others), choices only change the ranking of fixed preferences (eg A preferred to B) when prices and incomes increase or decrease. Preferences remain fixed. Research question 3 challenges this 'remain fixed' assumption.

Research Question 3

Does a social preference extension strategy have an effect on household energy bill payers' electricity consumption?

Loomes's £10 experiment (Table 1, p.41) shows that there are identifiable differences between preferences that are exogenous and given and preferences that are endogenous and malleable.

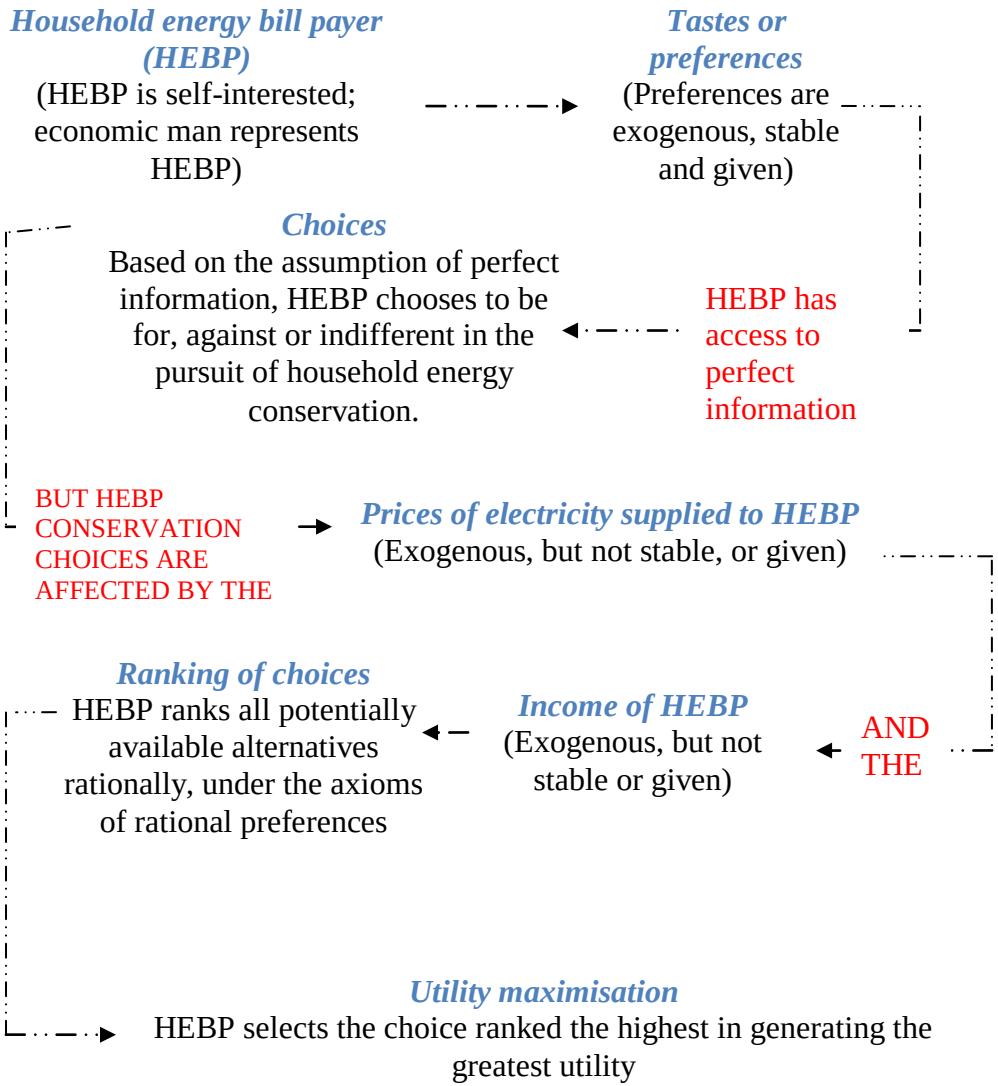
Chapter 2 only discussed household energy conservation in terms of when preferences are exogenous and given. Choices to reduce household energy consumption were solely based on the changes of the price of electricity and that the increase in the price of electricity does provide the incentive for the household energy bill payer to become more efficient in electricity use in the household by switching off unused lights. Apart from the price of electricity, no other

considerations were taken into account for decreasing electricity consumption in the household in Figure 1 (Chapter 2, p.21).

Given the support for social preferences, what is proposed is a social preference extension strategy that allows peer pressure to influence the amount of electricity used in the household. Peer pressure is when the community or society in general place pressure on others in the community to conform by following the choices that represent the choices of the majority of the community. Figure 3 (p.50) provides the contrast between rational choice theory with and without the social preference extension strategy.

Figure 3: The divergence between consumer and rational choice theory and consumer and rational choice theory with a social preference extension strategy: household energy conservation

Figure A: Consumer and rational choice theory: household energy conservation



Source: author of dissertation

Figure B: Consumer and rational choice theory with a social preference extension strategy: household energy conservation

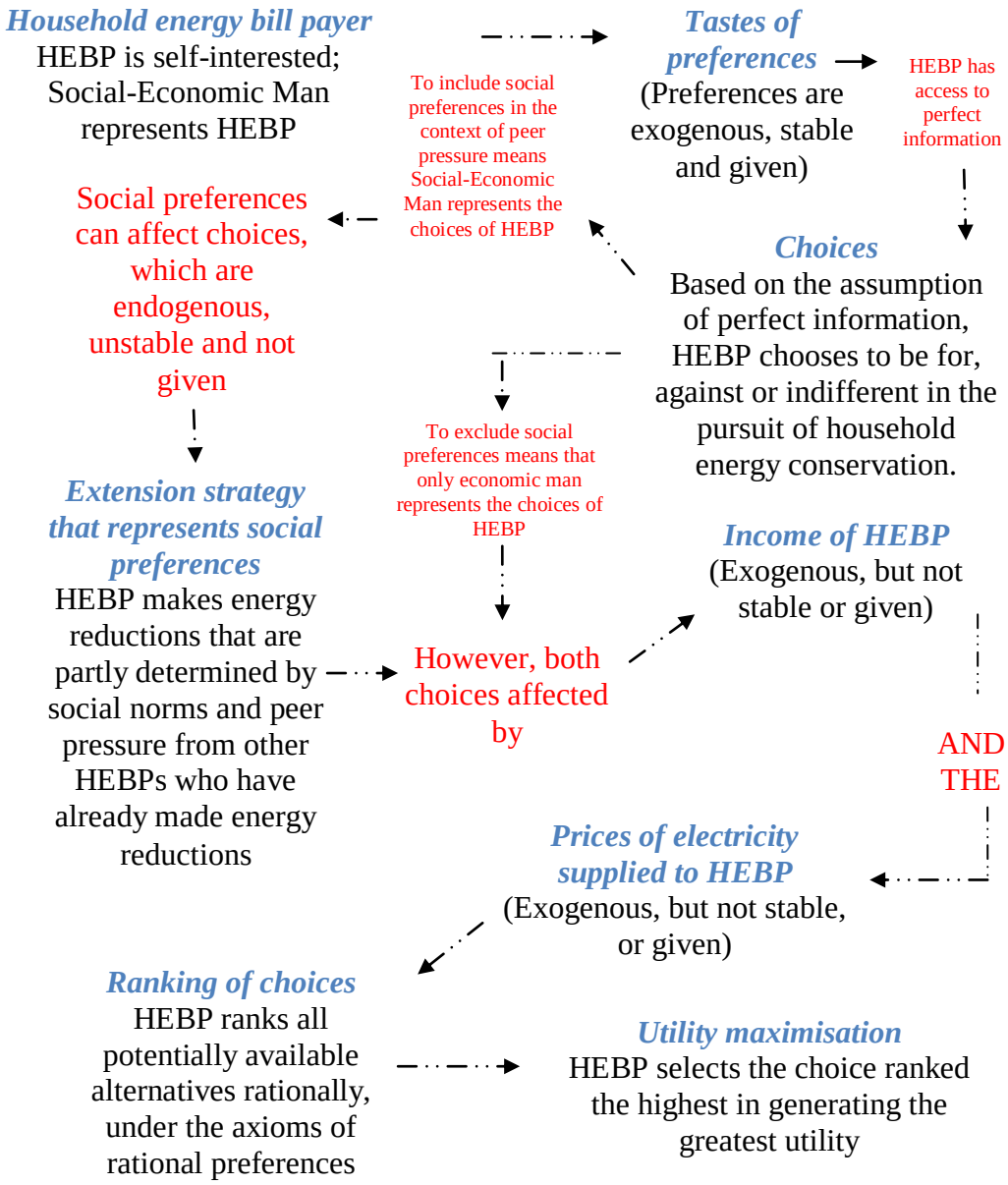


Figure 3 (p.50) compares and explains the theoretical divergence between consumer and rational choice theory and consumer and rational choice theory with social preferences. In Figure 3 (p.50), lies Figure A. Figure A displays the choices of the household energy bill payer from a purely exogenous, stable and given preference premise. Chapter 2 extensively explained exogenous preferences in the context of household energy conservation. The sequence on the right, Figure B, (in Figure 3, p.50), includes the social preference extension strategy.

The social preference extension strategy incorporates the times when choices are influenced by the choices of other household energy bill payers. The social preference extension strategy does not exclude the premise that some household energy bill payers would not take into account what other household energy bill payers have chosen. Figure B (p.50) begins from a similar starting point as Figure A (p.50), though there is a divergence. The divergence occurs after the household energy bill payers weigh up the choices as being for, against or indifferent to energy conservation. At this point, household energy bill payers could decide that social preferences are not important and omit the effects of them from the choice decision. If this were the case, then the sequence is no different from Figure A (p.50). However, if the household energy bill payer allows social preferences to interfere with the household energy bill payer's decision and choice sequence then the choice outcome is different.

This difference in path creates the divergence between Figures A and B (p.50). In Figure A, choices are price and income based. In Figure B, the household energy bill payer is still for, against or indifferent and shall rank, rationally, these choices and select the one that provides the greatest utility, however, the way in which these choices are ranked is different. Following the choice of Figure A (p.50), the household energy bill payer would rank choices of reducing household energy consumption as *for energy conservation* is preferred to *against*

energy conservation or *against energy conservation* is preferred to *for energy conservation* in the pursuit of the energy bill payer reducing electricity consumption in the household. In Figure 3, Figure A (p.50), the choice as to which is chosen would depend upon electricity prices (ie potential savings on electricity household bills) and income (ie the proportion of income spent on household electricity bills), and nothing else. The household energy bill payer represented in Figure A (p.50) is not interested in what other household energy bill payers think or choose. Figure A (p.50) represents rational choice theory, but is incomplete in that most decisions are not solely determined by the price of electricity and the household energy bill payer's income. However, Figure A (p.50) is not wrong, but simply underdeveloped, in explaining household energy bill payers' choices, for many choices are perfectly explained by how much things cost and whether or not it is affordable. However, notwithstanding there is underdevelopment.

Figure B (p.50) addresses this underdevelopment in the aid to help formulate policy that can target social preferences for reductions in household energy consumption. The social preference extension strategy in Figure B (p.50) allows for the possibility that other factors are important in the choice making process and may influence choice to switch unused lights off in the household. When framed in the context of what the community is doing, the household energy bill payer who uses more energy than the rest of the community might feel peer pressure to conform to the rest of the community. Household energy bill payers' choices are, therefore, endogenous (ie are formed from inside the utility model) are unstable (ie are completely new) and are not given (ie social preferences are not intrinsic because they only exist if the household energy bill payers want to create them, acknowledge them, and act on them). Overall, Table 2 (p.53) below distinguishes the differences between Figure A and Figure B in Figure 3 on page 50.

Table 2

The differences between Figures A and B in Figure 3 on page 50

Figure A	Figure B	Differences between Figures A and B
HEBP is self-interested; economic man represents HEBP Preferences are: Exogenous and fixed Choices are: Income and price limit choices. Ranking of choices follow that: The ranking of choice follows the axioms of rational preferences (ie transitivity and completeness)	HEBP is self-interested; Social-Economic Man represents HEBP Preferences are: Partly or entirely exogenous and fixed, but also potentially endogenous, unstable and not given. Choices are: Income and price limit choices, but social preferences also affect choices in that HEBP's choices are in part determined by other HEBP's choices. Social preferences represent the extension strategy. Ranking of choices follow that: The ranking of choice follows the axioms of rational preferences (ie transitivity and completeness)	Figure B concludes that ➢ HEBP is partly economic man and partly social man ➢ Preferences are not exclusively exogenous all the time, but can be endogenous at times ➢ Choices are not limited by income and price, but are also affected by social preferences

HEBP = household energy bill payer

Source: author of dissertation

Table 2 (p.53) provides the summary of the differences between Figure A and Figure B within Figure 3 (p.50). To support Figure B within Figure 3 (p.50), empirical evidence is given to prove that the household energy bill payer does not only make choices that are solely bounded by the limitations of energy prices and income in the pursuit to maximise household energy conservation.

In support, and to appeal to the 'social' side of Social-Economic Man (Figure B in Figure 3, p.50), a number of household energy conservation studies are discussed to show how effective peer pressure is on decreasing household energy consumption.

Thaler and Sunstein (2008) discuss social nudges. According to Thaler and Sunstien a nudge is 'any aspect of the choice architecture that alters people's behaviour in a predictable manner' (P.6). Choice architecture is the responsibility for, and the organisation of, the way in which people make decisions. This definition neatly embraces and conforms to this dissertation's Social Economic Man in that the 'aspect' of choices is partly social and economic. A nudge can be a formidable tool to aid policymakers. In the context of this dissertation, policymakers can use nudges by persuading households to reduce energy consumption. Nudges work by focusing on households nudging other households to follow their behaviour through having preferences that are open to persuasion, content-manipulation, and imitation.

As Figure B in Figure 3 (p.50) illustrates, by combing economic man (ie self-interested man) and with social man (ie people's choices are influenced by other people's choices) provides a more robust explanation for how energy bill payers make choices, and the factors that affect the amount of electricity used in the household. Evidence of Thaler's and Sunstien's Social Nudges are activated by peer pressure, because a nudge is 'any aspect of the choice architecture that alters people's behaviour in a predictable manner' (P.6). The influence of peer pressure is found in a wide-body of literature, and

has been proven effective in decreasing household energy consumption.

How peer pressure affects household electricity consumption: empirical evidence to support Social-Economic Man of Figure B in Figure 3 (p.50)

Schultz *et al.* (2007) explored social nudges (or peer pressure) in the pursuit to encourage decreases in energy use in California. A study on household energy consumption involving 300,000 participants who were provided with information on their household energy use as well as their neighbours' household energy use produced some interesting results. Households who used more energy than their neighbours were encouraged to decrease household energy use. However, those that were using less than the average increased energy use: the boomerang effect describes this behaviour. The former provides evidence of peer pressure through wanting to confirm with the neighbourhood. Though there is evidence for money as a motivational factor in decreasing household energy consumption, the choice to switch off lights may also partly be explained by the fact that neighbours switch off lights. An explanation for this behaviour is that Social-Economic Man has weighed up the self-interested benefits of saving money with the social benefit of conforming to the neighbourhood, and by doing so receives a 'warm glow'. When combined, these two factors of self-interest and receiving a warm glow support each other in that the subjects of the experiment want to save money and want to conform to the neighbours' norm of saving electricity. The evidence supporting this warm glow is twofold. Firstly, those who were using more energy made quite substantial reductions when they were also provided with a picture of an unhappy face. Secondly, those that had originally increased their household energy consumption because they were below the average use (ie the boomerang effect), immediately stopped when they received a picture of a happy face.

It appears that the 'social' side of Social-Economic Man has been exposed and represented in a number of different countries. Research in January 2010 by Accenture (2011) looked at how peer pressure encourages participation in electricity management programs. The research was based on a global survey of 17 countries with a total sample size of 9,108 of people. Sixty five per cent of participations proclaimed that the choice to participate in the management programme was in part dependent on others participation. Countries like Brazil and Italy have 92 per cent and 85 per cent participation. However, for counties like Germany, United Kingdom and United States the figures were much lower, 46 per cent, 46 per cent, and 48 per cent. United Kingdom, Germany, and the USA are less enthusiastic about participating, perhaps because it was not stressed that money savings are achieved if participation is undertaken.

OPOWER also uses peer pressure that can lead to influencing Social-Economic Man and electricity consumption. The principle surrounding the philosophy of OPOWER is their belief that people want to feel that they fit in to the norm of electricity consumption in their neighbourhood. OPOWER (http://opower.com) reports data to customers for utility companies based on demographics. Since its inauguration in 2007, the company reports that it has managed to save over 90 million kilowatt hours of electricity. OPOWER uses data information on the service areas in which they operate (UK and USA) to run schemes that provide information on how much electricity communities use in their homes and then send this information to all neighbours. The type of schemes they use included, 'You used 72% more household energy than your efficient neighbours.' The information then provides a tip to help conserve energy, 'Most people in your area keep their air-conditioning at 78 degrees.' The choice of having the air-conditioning at 78 degrees, as opposed to a higher setting, is one way in which 80 per cent of the households adopted energy conservation measures.

Peer pressure was also the focus of research by Cialdini (2007). Cialdini undertook an experiment involving the residents of San Diego. The study involved placing door hangers on the doors of people staying in hotels once a week for a month. These hangers had one of four messages written on them:

1. 'You could save money by conserving energy.'
2. 'You could save the earth's resources by conserving energy.'
3. 'The majority of your neighbours tried regularly to conserve energy - information we have learnt from a prior survey.'
4. 'You could be socially responsible citizens by conserving energy.'

Of the four messages, message number 3 was the most effective. Again, it is suggested that the choices of the neighbours have influenced the choices of others in the hotel.

Pallak *et a*l. (1980) looked at how peer pressure and publicising the amount of household energy used influences energy conservation in Iowa, USA in 1973. The study lasted for 12 months. The study involved representatives visiting homes in Iowa for 20 minutes to see whether then would sign up to participate in the research. The research consisted of conservation tips and the permission to publicise participates' names along with the results of each participator's conservation success or failure as measured against the other participator's efforts in the conservation study. When the household energy choices were common knowledge, the results showed that households, who participated in the experiment, decrease their household energy use by 20 per cent less electricity. Pallak *et al.* (1980) accredited this saving as peer pressure in that participates wanting to conform and take on energy efficient behaviour.
Similar results on peer pressure were found when an experiment was undertaken in Minnesota. According to the research by OPOWER (2009) available at http://news.bbc.co.uk/1/1hi/programmes/world news america/8286152.stm, the participants involved in the experiment were provided with information on how much energy was

used by the other 100 participants involved in the social experiment. Each participant was then ranked by their energy saving performance efforts. The noticeable market drop in household energy consumption was partly to save money, but as well as this, it was partly because others had chosen to use fewer energy units in the household. From this premise, each participant wanted to be seen as 'doing their bit' and by this, each participant was influenced by knowing how much others were saving in relation to what they had saved. In this experiment, social standing and group peer pressure have influenced how much household energy can be saved as measured by the drop in household energy consumption.

Allcott (2009) also undertook research in household electricity consumption and peer pressure in Minnesota. A company called Positive Energy mailed ways in which 80,000 household energy users could conserve energy and compare this conservation with the neighbours. The findings of the experiment found that households undertaking the experiment reduced household energy consumption by 1.9 per cent. According to Allcott, this saving of 1.9 per cent was due to information about energy savings and competition between neighbours as reinforced by the social norm of wanting to compete with the neighbours. This competition between neighbours provides supplementary data that non-price nudges can considerably affect consumer behaviour and choices.

Ayers *et al.* (2009) produced similar results like Allcott when they undertook a study on peer pressure and household electricity consumption in the USA between April 2008 and April 2009. 55,000 homes received information about their electricity consumption as well as their neighbours' electricity household consumption. The average saving was 2 per cent and was attributed in part, to how the study groups believed other members in the study viewed them. The peer comparisons worked as the catalyst in reducing residential electricity consumption.

The National Grid undertook further research in America on peer comparisons. Witkin (2010), a writer for the New York Times, reported on these findings disseminated by the Northeastern States National Grid. The National Grid ran an experiment involving 100 people and their use of household energy; information of these 100 people was shared. What the National Grid found was that a 1 per cent drop in household energy use was recorded. The explanation for the drop was because each group member wanted to please the other group members and therefore made the choice of reducing and conserving energy consumption. National Grid suggested that peer pressure and monetary savings were more effective than only using monetary saving information, because, and despite the fact that monetary savings are important, by being part of the community, this community philosophy was valued as an integral part of being a good community citizen along with monetary savings.

Peer comparisons were also used as an incentive for a study in the Boston Metropolitan area of the USA ('Energy Smackdown: Driving Participation through Friendly Competition', 2010). Teams were brought together from three neighbourhoods of Arlington, Cambridge, and Medford, with a total sample size of 100 households and duration of one year. The study involved teams competing with each other to reduce carbon dioxide emissions from six different areas: electricity, heating fuel, pounds of landfill-bound waste, air travel, car travel, and servings of meat. The purpose of the experiment was for the study groups to earn points based on particular energy saving activities. These energy saving activities were then recorded on-line allowing participants in other groups to track the progress of rival teams. The results of the Energy Smackdown study found that the average annual reduction of electricity was 14 per cent. According to the researchers, the results are partly due to the nature of the experiment insofar as the groups wanted to outperform other rival groups. This competitive head-to-head mentality created peer pressure and social

norms through formed group networks to provide and help with ideas in ways in which to reduce household electricity consumption. This group network helped to maintain reductions in household electricity so that overall the group has the best possible chance of winning the competition.

Conclusion

The Chapter began by asking the research question:

Does a social preference extension strategy have an effect on household electricity consumption?

To test whether social preferences do have any influence on household energy bill payers' consumption, Figure B in Figure 3 (p.50) was constructed to show how peer pressure (a social preference) could manipulate household energy consumption. To support peer pressure in Figure B (p.50), Loomes's (1999) £10 experiment was discussed to demonstrate how individual choices are partly determined by the choices of others. Loomes's experiment was transferred to Figure B (p.50).

From the evidence of Loomes's experiment, Figure B in Figure 3 (p.50) was created. Figure B demonstrated that peer pressure can affect household energy bill payers choices and in some cases help to decrease household energy consumption. To test the hypothesis of Figure B (p.50) and the idea of a social preference extension strategy a wide body of literature was presented based on field experiments that found peer pressure does influence the household energy bill payer into changing choices. This is because many households alter their behaviour to conform to that of groups who want to comply with others in the group or simply feel that they ought to copy what others have done in the group. Therefore, it means that household energy bill payers can no longer be taken as the immovable judges of their best interest insofar as part of the household energy bill payer's judgement is influenced by the judgements of other household energy bill payers

judgments. By emphasising context-dependent preferences, the social preference extension strategy creates options where policymakers rely on persuasion, context-manipulation and the observation and imitation of other household energy bill payers to change preference ordering, rather than only using policies they rely exclusively on the changes in electricity prices and household incomes with given preferences.

Through presenting Figure B in Figure 3 (p.50) along with the empirical evidence supporting Figure B, Chapter 3 concludes that targeting man, as a Social-Economic Man, is an effective solution to altering household environmental related behaviour.

In chapter 4, the idea of the social preference extension strategy is expanded to include negative and positive cooperation along with negative and positive endogenous preferences, all of which are set in a game of two-players to gauge how effective cooperation and endogenous preferences are in altering choices in the purchase of low carbon labelled products.

Can a Social Preference Extension Strategy help to put off Free Riders and Maintain a Pareto-improvement in the Purchase of Low Carbon Information Footprint Labelled Products?

Introduction

The research question of Chapter 4 brings the evidence from all the previous Chapters together, namely, the evidence of rational choice, transitivity, and completeness, and the evidence that the social preference extension strategy complements rational choice theory. This penultimate Chapter therefore seeks to find answers to research question 4.

Research question 4:

- Can a social preference extension strategy help to put off free riders and maintain a Pareto-improvement in the purchase of low carbon information footprint labelled products?

The research objective is to design and use a repeated cooperative game model that provides a four-grid payoff-matrix to display the decisions of customers for when they decide to free ride on other customers' actions or not to free ride on other customers' actions. The Four-Grid Repetitive Game Payoff Matrix is Figure 4 (p.73).

The research strategy is to test the hypothesis of research question 4. To do this, Figure 4 (p.73) requires breaking down into its individual grids. Each grid is scrutinised in terms of how it fits into the conventional thinking of rational choice theory and how each grid fits into the thinking of Social-Economic Man. Social-Economic Man is exposed to different situations that generate positive conditional cooperation or negative conditional cooperation as well as positive endogenous preferences or negative endogenous preferences.

The research then theoretically justifies and explains how endogenous social preferences can transform the Four Grid Repetitive Game Payoff Matrix (Figure 4, p.73) so that the cooperative solution (ie to both

agree not to free ride) becomes a Pareto-improvement. Pareto-optimality occurs when consumer A takes the best possible action for the environment as long as customer B takes the same action (ie neither free ride on the other's efforts). Actions of this nature are taken on the sole premise that this was the agreed action.

Argued next in this Chapter is that the Pareto-improvement is sustainable insofar as it calls upon each customer to respond rationally to the possible danger that other customers may impose punishment on them if they were to violate the agreement not to free ride. This voluntary understanding allows for the agreement between the different parties not defaulting to the non-cooperative action that leads to the dominant Nash equilibrium of free riding. The non-cooperative dominant Nash equilibrium is the best solution for each player irrespective of what the other player does in that each customer is unable to be made worse off by the actions of the other player if that player is already free riding. 'Worst off' refers to the effort of the player not to free ride (eg actively seeking the purchase of CO2 footprint labelled products). This non-cooperative dominant Nash equilibrium strategy does not represent the best outcome for the environment in that CO2 increases if both players were to free ride. It only provides the best outcome for the players in terms of receiving the benefits but not helping to prevent the costs. In the Pareto-improvement, this is not true, because collective agreements support the spirit of not wanting to free ride on other members of the group. This spirit of not wanting to free ride supports the objective of maximising the decrease in CO2 from all players.

Finally, the theoretical analyses within each grid are then tested against the empirical evidence. In terms of the empirical evidence, what is important is proving or disproving the 'concept' of mutual context-dependency that supports the Nash dominant equilibrium strategy and the mutual context-dependency that supports the Pareto-improvement. Since research question 4 is targeted at the individual

and not the situation in which these individuals find themselves, then if mutual context-dependency is validated, it can, therefore, be applied to situations for when free riders are, or are not, present in the purchase of carbon labelled products.

Given carbon labels are used in The Four-Grid Repetitive Game Payoff Matrix (Figure 4, p.73); I provide a brief discussion on the background of carbon footprint labelled products.

A brief background on Carbon labelled footprint products

The story behind carbon labelling has its affiliations with PAS 2050:2008. PAS stands for 'Public Available Specification'. The development of PAS was to quantify the emissions of greenhouse gases during a product's life cycle. PAS was assembled around the research carried out by an independent Steering Group by means of appointed research methodologies that measured a product's carbon emissions. The research took 16 months to complete between June 2007 and October 2009, and was funded by the Carbon Trust and the Department for Environment Food and Rural Affairs (DEFRA). The Steering Group's research methodologies were facilitated by the cooperation of the Carbon Trust, DEFRA and the British Standard Institution (BSI) along with some of the biggest household high street names: Walkers (crisps); Boots (shampoo) and Innocent Drinks (fruit smoothies) (BBC News, 2007). PAS is informing the public about a product's carbon footprint, defined as,

> The term 'product carbon footprint' refers to the greenhouse gas emissions of a product across its life cycle, from raw materials through production (or service provision), distribution, consumer use and disposal/recycling. (Guide to PAS, 2008, p.2)

The Carbon Trust and DEFRA supported the BSI to design a label that provides specific details of a product's carbon footprint. Based on the collaboration between the Carbon Trust, DEFRA, and the BSI, PAS 2050:2008 came into effect in October 2008. PAS 2050:2008 embodies a product's carbon footprint emissions. These emissions are

illustrated and disseminated through information provided on the UK Carbon Trust's Carbon Label.

With the brief history of carbon footprint labels in place, is there any empirical evidence to support consumers' willingness to purchase products that have carbon footprint information?

Pro-environmental behaviour towards purchasing low carbon labelled products: evidence in the literature of the willingness to purchase low carbon labelled products

This section provides the rationale to use carbon labelling as a method of analysing environmental related behaviour that forms the bases of the Four-Grid Repetitive Game Payoff Matrix (Figure 4, p.73). What follows is a literature review of evidence that proves consumers have an open mind and a willingness to purchase low carbon labelled products.

DEFRA found that behavioural change is evident in areas of recycling. Statistical evidenced of behavioural change in recycling and food waste is encouraging. 91 per cent of the UK population now actively seek to recycle. 88 per cent also consciously think about how much food they waste and actively participate in bringing their food waste down.

Carbon Trust (2008) did research on carbon labelling by seeking the opinions of UK consumers. Their survey found 67% of UK consumers agreed that they are 'more likely to buy a product with a low carbon footprint' (p.28). Regarding consumer preferences towards low carbon products, the research found that '44% would switch to a product with a small carbon footprint even if it were not their first preference' (p.28). 20% of consumers declared that they 'would even travel to a less convenient retailer in order to obtain such products' (p.28).

Tesco surveyed 874 shoppers in August 2008 and found that '97% of consumers would actively seek to purchase products with a low

carbon footprint if they were as cheap and convenient' (Carbon Trust, 2008, p.28). Tesco also found that '35% would buy lower-carbon products even with a cost/convenient trade-off' (Carbon Trust, 2008, P.28).

Research commissioned by the LEK (2007), based on online interviews with UK consumers and a sample size of 2,039, provided further results on public opinion of low carbon footprint labels. In support of a change in behaviour towards the purchase of more environmentally friendly products, 37% of respondents believe that they are largely responsible for their own individual carbon footprint, but the survey also found that 36% of consumers further believe that manufactures and producers are almost as equally responsible for their [consumers] carbon footprint. When the sample were asked (p.2), 'In the future, who should take the biggest role in minimising the carbon footprint of the products and services you buy?' Approximately, 38% of consumers believe that the manufactures and producers should take the lead in this responsibility. The literature on pro-environmental behaviour is clear in that customers are willing or are interested in purchasing products that have carbon labels. However, information requires the need to be clear so that customers have all the facts on carbon labelling.

Carbon labelling on products

Carbon labelling on products does appear to influence the purchasing decisions of consumers where '49% of consumers believe it makes me more likely to buy their products when the label is displayed on packs'. When consumers believe suppliers are working towards maintaining a sustainable environment, 65% are 'more likely to purchase a product'. Support for the use of the 'absolute numbers' format was also quite high with 72% believing that displaying actual number of grams of carbon per product on a carbon footprint label is important. Favourite brands are also important to consumers in that 86% of consumers want favourite brand names 'to help combat the

threat of climate change by reducing their carbon footprint' (Carbon Trust, 2010).

LEK (2007) found that product information is also important when consumers are making decisions in that 56% of the sample declared that carbon labels on packaging is an incentive in persuading customers to purchase low carbon footprint products.

Between the 12th and 21th of November 2007, a Populus (populus is Latin for 'people') study in three major UK cities Birmingham, Leeds, and London was undertaken. The focus of the research was to engage the UK's public opinion on how effective information on low carbon footprint labelled products displayed on packaging is. The research was based on 6 focus groups, all of whom shopped at main supermarkets (Upham and Bleda, 2009). The research study found strong evidence against consumers paying higher prices for products that claimed to have low carbon reduction methodologies. The research study further found that consumers want clear and simple labelling, and for the information to be stamped on the front of the packing, rather than the back. Consumers appeared to be interested in, and in the support of, the traffic lights format, that presents how carbon footprint information is displayed on packaging. Too much information displayed on the carbon label meant the majority of the information came over as confusing; this resulted in its misinterpretation leading to ignorance of the issues. Though low carbon footprint labels convey messages, these messages can lead to confusion surrounding these carbon labels.

It must be noted, therefore, that carbon labels are of limited value in the struggle against climate change unless the public appreciates why reductions in greenhouse gases are necessary in the mitigation of climate change. To help support the awareness of carbon labels, UK government campaigns include the advertisements 'Are You Doing Your Bit'? and 'Going for Green'. The aim of these advertisements is to

help change attitudes towards climate change. According to a DEFRA (2009) home face-to-face UK study of 2009 people on the people's attitudes to climate change, 61 per cent surveyed are aware of climate change. 21 per cent say it is too far in the future to spend time worrying about it now. 48 per cent of the UK residents are convinced that their lifestyles are in some way affecting climate change. Statistically, the most significant concern was about household energy use. Energy use is reputedly to be the most dominant concern in the struggle to combat climate change: the survey found that 85 per cent agreed. Energy reductions are, however, evident with 76 per cent of UK households using less electricity in their households (DEFRA, 2009).

Though the empirical evidence does suggest that customers are interested in purchasing low carbon footprint labelled products, empirical evidence suggesting pro-environmental behavioural commitment is often at conflict with actual environmental behavioural commitment. The divergence between the two may be explained by the value-action-gap. What causes this divergence is the interest of the next section.

The value-action-gap

Rational action is instrumentally important and explains choice behaviour under certain conditions of self-interest in market transactions. According to the FSA (2007), grocery shoppers are abiding to, and acting upon, the rational choice theory model by considering price and value as the main choice indicators when purchasing groceries. However, if price was the pinnacle of choice, then rational choice theory ought to remove the value-action-gap, but it fails to do this. Therefore, the rational choice model fails to understand the wider reasons for explaining why the gap is not eradicated or more plausibly decreased. To help to decrease the gap, Blake (1999) emphasised that individuals are influenced by other factors as well as price. Blake suggests that institutions and

community participation help form the conciliation of community partnerships (eg peer pressure and social norms) that help to form consumer choices and close the gap between proposed behaviour and actual behaviour.
Wider research into the causes of the value-action-gap has provided some interesting insights into the nature of proposed behaviour versus actual behaviour. Literature from the fields of social psychology suggests that the gap is partly determined through consumer basic values (Stern and Dietz, 1994 and Johnson *et al.*, 2004). Basic values are the elemental values that channel more precise values and consumer behaviour (McFarlane and Boxall, 2003). Therefore, consumer values become in violation of direct competition with consumers when wishing to purchase low carbon labelled products.

Working alongside consumer values are beliefs. Environmental pro-behaviour relies significantly on beliefs insofar as beliefs are what consumers hold to be factual (Vaske *et al.*, 2001) and allow for the prioritisation of behavioural choice. Beliefs are altered by the ways in which consumers interpret the contribution of purchasing low carbon labelled products have on the atmosphere through the dissemination of information upon which choices are made.

Information plays, therefore, an integral part in the choice process, because individuals want to know they have made the right choice. Holdsworth (2003) found a distinct lack of information increases the value-action-gap, because consumers are unsure whether their choices are benefiting the environment or simply making no distinctive difference to it. In addition, consumers often interpret environmental information in completely different ways (eg we have little impact on the environment, to we have significant impact on the environment) (Myers and Macnaghten, 1998). Interesting research to help bridge the value-action-gap or even eliminate this gap created by too confusing or too much information over available choice is the idea of 'choice editing' coined by the Sustainable Consumption Roundtable.

According to the Sustainable Consumption Roundtable (2006), choice editing is simply 'pre-selecting the particular range of products and services available to consumers' (p.63), or simply restricting consumer choice (Sigman, 2004). If suppliers were to come together and form alliances, and to agree to supply only products that are of low carbon emissions, then information about the effects of purchasing high or middle carbon emissions products would not be required. Though short-term costs would, increase, with economies of scale, these costs would decrease over time. Although according to Holdsworth (2003), income has an impact on widening the value-action-gap and any increases in the price of low carbon products would increase this gap temporally until the economics of scale redistribute the price to its former level. Any action that involves costs or exclusion of choice requires monitoring carefully, because the exclusion may create an unfair advantage.

Perhaps at the very heart of the causes that create the value-action-gap, is the theory of reasoned action (Ajzen and Fishbein, 1980) which is 'based on the assumption that humans are usually quite rational and make systematic use of the information available to them' (p.5).

Figure 4 (p.73) provides theoretical analyses using game theory for how peer pressure and social norms help to explain and support the purchase of products which have low carbon labels. By purchasing low carbon products, this helps to maintain, rather increase, CO2 levels present in the atmosphere. However, before these analyses, and to help with these analyses, the basic idea of the common pool resource is introduced to the reader.

Common pool resources

The Figure presented in this chapter, Figure 4 (p.73), uses the concept of common pool resources. The relationship between Figure 4 and common poll resource is that the atmosphere has finite benefits.

Finite benefits, because as more CO2 is present in it, changes to the climate occur such as severe weather or rising sea levels. Therefore, as one country exploits the benefits of production, but at the same time pollutes the atmosphere, this action removes benefits for other countries, as a rise in CO2 in the atmosphere may lead to an increase in severe weather. Therefore, when benefits are finite they are often labelled as common pool resources that have rival properties, but are non-excludable (Blomquist and Ostrom, 1985 and Randall, 1983). Rivalry comes from using the atmosphere as a CO2 dumping ground that results in diminishing benefits for other ecosystems. Common pool resources are also defined by their non-excludability because the atmosphere is everywhere and is available for use without restriction; however, pollution polices help to restrict the amount of pollution that is emitted into the atmosphere.

With an explanation of common pool resources in place, the fundamental characteristics of the game can be formed. Here we can create a Four-Grid Repetitive Payoff Matrix Model to answer the research question proposed at the beginning of this Chapter.

Research question 4

Can a social preference extension strategy help to put off free riders and maintain a Pareto-improvement in the purchase of low carbon information footprint labelled products?

Figure 4 (p.73) provides the theoretical reasoning underpinning and supporting how the social preference extension strategy could help to maintain a Pareto-improvement. Figure 4 (p.73) assumes some rules, and these rules are:

- The model is essentially closed. Social norms and peer pressure are affected by decisions from inside the model. For peer pressure and social norms to change over time, it requires each person to collectively agree to accept different social norms and peer pressure that are activated by external influences over which they have no control, but do have control over whether they choose to accept them or not as part of the ethos of the group.

- In small groups, customers are able to form voluntary agreements (ie not governed by acts of law).
- In large groups, customers are not able to form voluntary agreements, because these customers cannot communicate with all members of the group.
- Free riders are a possibility.
- A Pareto-improvement may lead to a better payoff for customers.
- Games are played more than once.
- Climate change is a global public good, and the effort to purchase low footprint products helps to support fewer CO2 emissions present in the atmosphere.
- Communication is allowed between customers, and can happen more than once.

The strategies open to the customers are:

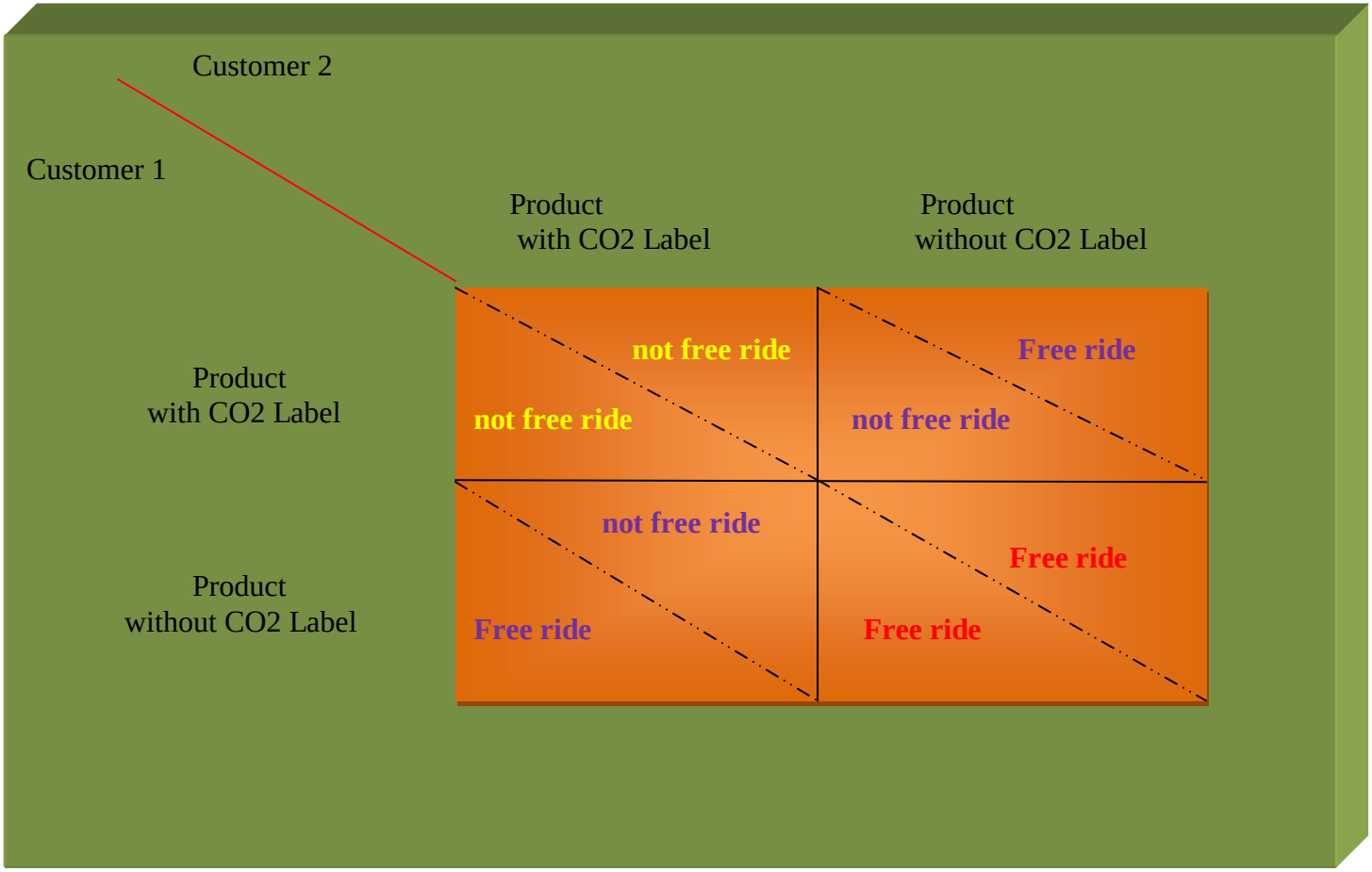
- Free ride.
- Not free ride.

The payoffs from these strategies are:

- Customer 1 purchases low carbon footprint labelled products, and customer 2 does not, then overall CO2 present in the atmosphere decreases.
- Customer 2 purchases low carbon footprint labelled products, and customer 1 does not, then overall CO2 present in the atmosphere decreases.
- Both customers do not purchase low carbon footprint labelled products, then overall CO2 present in the atmosphere increases.
- Customer 1 and 2 purchase low carbon footprint labelled products, then overall CO2 present in the atmosphere decreases.

Figure 4 is presented below on page 73.

Figure 4: Four-grid repetitive game payoff matrix



Source: adapted from Parkin, Powell, and Matthews (1997, p.232)

Figure 4 (p.73) is not a one-shot game in that interaction between customers happens more than once. Figure 4 (p.73) does not assume that customers cannot communicate information between each other. Figure 4 (p.73) uses 'to communicate cooperatively' to help to promote and create the best payoff between Customer 1 and Customer 2.

To support the use of cooperative communication in Figure 4 (p.73), research by Dawes *et al (1977)* found that in circumstances of no cooperative communication the desire to free ride was 73%, in circumstances of irrelevant communication, free riding was 65%. When communication was relevant and effective, free riding was 26%. Another empirical study by Chaudhuri *et al.* (2006) supports Dawes findings.

Chaudhuri *et al.* (2006) examined how information helps to support a better payoff. The game had 10 rounds in groups of 5, each person having 10 tokens each. The communication took place via three different mediums. Firstly, private knowledge occurs when information is passed to one other person. Secondly, public knowledge occurs when information is available to all members of the group. Thirdly, common knowledge occurs when information is available to all members of the group, but read aloud. In terms of the common knowledge scheme, contributions to the public account were around 90%. According to Chaudhuri *et al.* (2006), this high percentage of contributions to the public account was because information flow creates confident beliefs in that the majority of people contributed to the public account. Figure 4 (p.73) uses certain types of information that provides explanations for why certain payoffs take place, based on whether payoffs are self-enforcing or enforceable. To explain this information, Figure 5 (p.75) separately defines key phrases.

Figure 5: Different types of information used to convey different choice options available to Customer 1 and 2

Phrase	Meaning
Positive endogenous preferences	These occur when Person A's choice is based on Person B's choice and both choices result in a higher payoff for the group, for example, when both persons agree to reduce CO2.
Negative endogenous preferences	These occur when Person A's choice is based on Person B's choice and both choices result in a lower payoff for the group, for example, when person A finds out that person B is free riding and copies this choice.
Positive conditional cooperation	This occurs when both persons have enforceable cooperation and the outcome of this cooperation results in a higher payoff for the group, for example, when both persons agree to reduce CO2, and this agreement is enforceable within small groups.
Negative conditional cooperation	This occurs when both persons have unenforceable cooperation and the outcome of this cooperation results in a lower payoff for the group, for example, each person believes the other is free riding so they too free ride

According to Chaudhuri (2007, p.5) 'Conditional cooperation is defined as one whose contribution to the public good is positively correlated with his belief about the contributions to be made by other group members.'

Source: based on the ideas of Rabin (1993); Guth *et a*l. (1982); Fehr and Schmidt (1999) and Bolton and Ockenfels (2000)

Supporting the information in Figure 5 (p.75) are the different types of strategies that explain people's choices. A Distributional Concern Model supports the theories of negative endogenous preferences and negative conditional cooperation. A Distributional Concern Model looks at how the distribution is shared and the potential free riding on this distribution that leads to more free riding (Fehr and Schmidt 1999; Bolton and Ockenfels, 2000). A Distributional Concern Model is represented as the strategy situated in the lower right hand quadrant of Figure 4 (p.73).

The other strategy represented in Figure 4 (p.73) is based on an Intention-Based Model that focuses on the distribution that promotes cooperation and the desire to reciprocate that cooperation (Rabin, 1993; Guth *et al.*, 1982; Dufwenberg and Kirchsteiger 2004). An Intention-Based Model supports the theories of positive endogenous preferences and positive conditional cooperation and is represented as the strategy situated in the top left hand quadrant of Figure 4 (p.73). The bottom left hand side and the top right hand side quadrants of Figure 4 (p.73) are somewhere in-between the both models. What follows is a theoretical discussion explaining the different choice payoffs (or outcomes) as measured by the actions of Customer 1 and Customer 2 that are represented in each of the quadrants in Figure 4 (p.73). In Figure 4 (p.73), the payoffs shown in **Purple** are the first under discussion.

<u>Customer 1 purchases low carbon footprint labelled products, and customer 2 does not; or customer 2 purchases low carbon footprint labelled products, and customer 1 does not</u>

Customer 1 purchases whilst Customer 2 does not purchase low carbon footprint labelled products or Customer 2 purchases whilst Customer 1 does not purchase. In Figure 4 (p.73), the payoff choice to purchase is to **not free ride** and the payoff not to purchase is to **free ride**. Rational choice theory explains either of these choices. Customer 1 has self-interest, pure rationality (ie choices are based on fixed and unmoveable individual preferences) and perfect information (ie Customer 1 knows that Customer 2 shall purchase or not purchase low carbon footprint labelled products).

Customer 1 ranks all preferences and selects the one that provides the greatest utility for Customer 1. Furthermore, Customer 1 does not care about whether other customers do, or do not, purchase low carbon footprint products. Customer 1 rationalises that purchasing this product provides a net benefit for Customer 1, regardless of what Customer 2 chooses to do. Rational choice theory does not provide the best payoff for the group insofar as CO2 is increasing, in part, if Customer 2 does not purchase low carbon footprint products. Rational choice theory also makes Customer 1 worse off overall in relation to Customer 1's own self-interested agenda. Customer 1 is worse off because of all those customers not purchasing low carbon footprint products increases CO2 for the non-purchasers as well as for Customer 1. The group is worse off, and self-interest fails to provide the best outcome for the group.

When Customers 1 and 2 serve only themselves, this always provides the worst outcome for the group. A possible weakness of rational choice theory is that social preferences are not used. Social preferences provide the opportunity to do what is best for each customer and the group by making preferences context-dependent, and this context-dependency affects consumer choices that may or may not result in better payoffs for both Customer 1 and 2. This leads the discussions to the lower right hand quadrant of Figure 4 (p.73).

Theoretical analyses for mutual context-dependency supporting the Nash dominant equilibrium strategy: the case for free riding

In Figure 4 (p.73), the payoff not to purchase carbon footprint labelled products is to free ride. It is the lower right hand quadrant of Figure 4 (p.73). This is the dominant Nash equilibrium.

Characteristics of this option are:

- The choice not to purchase CO2 footprint labelled products is assumed mutually context-dependent.

- Unenforceable contracts are present in that there are too many customers to check whether all are participating in the purchase of CO2 labelled footprint products.
- Social preferences and social norms support negative conditional cooperation and negative endogenous preferences.

The lower right hand quadrant in Figure 4 (p.73) shows that both Customer 1 and 2 are contributing to the increase of CO2 present in the atmosphere. This payoff shows that rational choice theory leads to both Customers receiving a worst payoff in relation to their own self-interested agendas. It is a worst payoff in that both Customers could purchase low carbon footprint products, but have chosen not to. It is a worst payoff because one of the Customers could have chosen to purchase low carbon footprint labelled products, providing an overall net social benefit that non-purchasers shall benefit. The payoff arises because both Customers believe that they are being taken advantage of by the other Customer's choice. Each Customer views the other customer as a *free rider*. Free riding is getting the benefit of a good (in this case a more sustainable climate) without paying for it, or making an effort to support a more sustainable climate by helping to decrease CO2 present in the atmosphere through purchasing low carbon footprint labelled products.

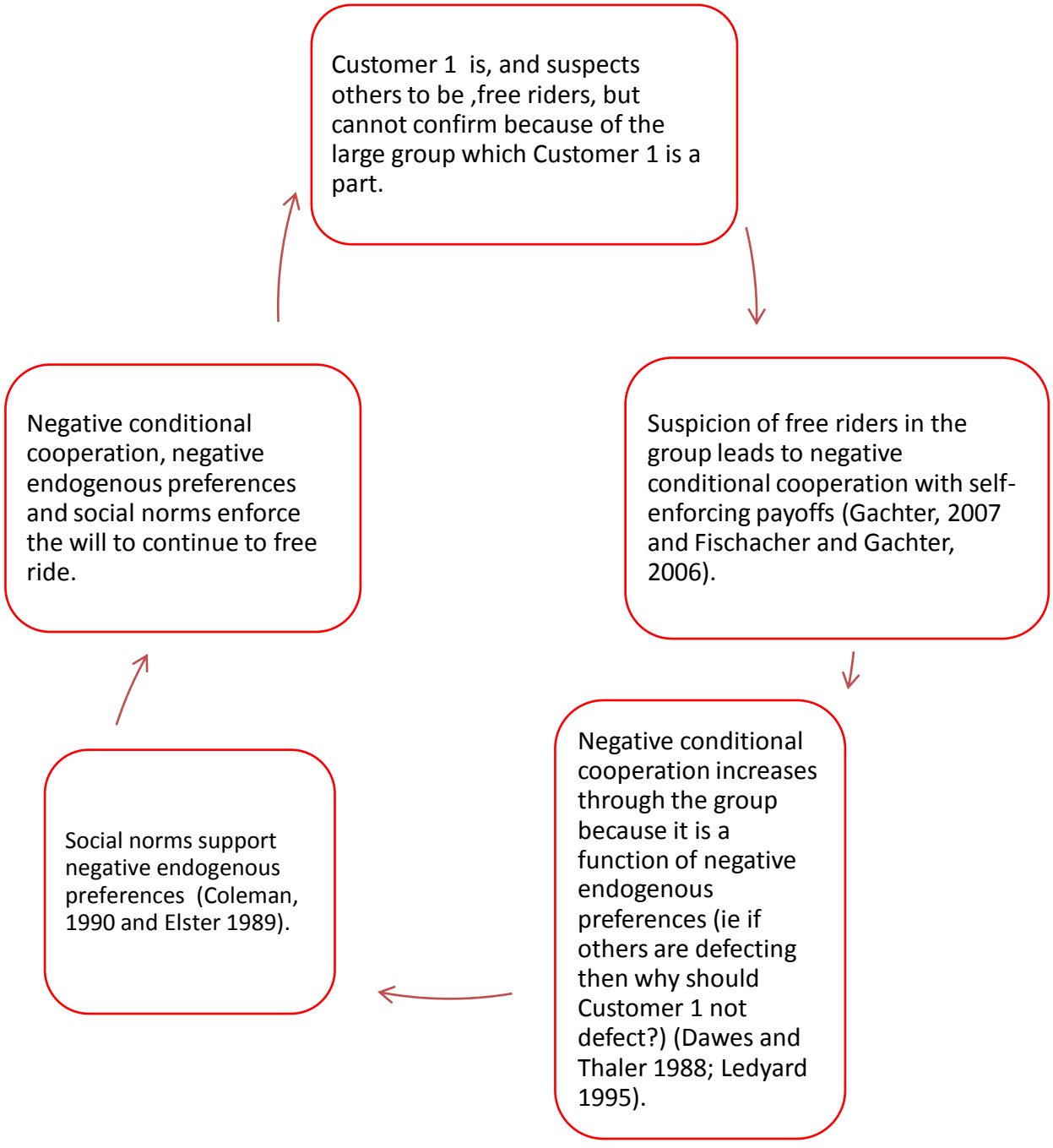
If many customers were represented in Figure 4 (p.73), then these customers would assume free riders are present, because customers cannot prove or enforce contracts to all customers that they are not one of these free riders. Customers are unable to communicate with the entire population to form agreements to the effect of not wanting to free ride. This weak communication creates inability to prove they are not free riding, therefore, creating negative conditional cooperation. Negative conditional cooperation occurs when social norms support conditional cooperation but in a negative way. According to Cialdini and Trost (1998, p.152), 'Social norms are rules and standards that are understood by members of a group, and that guide and/or constrain social behaviour without the force of laws.'

In this case, constrain is negative in that payoffs are self-enforced; customers' choices are presented as purchasing low carbon footprint labelled products. The problem with this 'presenting' is that customers proclaiming they are not free riders are not trusted, and this lack of trust, along with many customers, acts as a block in preventing conditional cooperation to get the best payoff for each customer and for the group. If taken in the context of not wanting to be a victim of a free rider, negative conditional cooperation represents the Nash dominant equilibrium strategy in that regardless of what the other customers do; Customer 1 does not purchase a low carbon footprint product. By not purchasing a low carbon footprint labelled product, Customer 1 is not a victim of free riders, for Customer 1 is a free rider himself. The social norm 'not to cooperate' drives more customers to free ride.

In Figure 4 (p.73), the inclusion of free riders is the difference between the **Purple** payoff and the **Red** payoff. With the **Purple** payoff, Customer 1 did not care about what Customer 2 chose. Nevertheless, add the thought of the possibility of free riders to the game, this addition changes choice. Before, Customer 1 thought that he was achieving a net benefit for himself, at a cost to himself in the form of the price of a low carbon footprint product and the effort to learn about climate change. But now Customer 1 thinks that the additional disadvantages of free riders, the price of the product and the effort to learn about climate change, takes too much of a liberty of Customer 1s' good nature.

Furthermore, the presence of free riding has the ability to block customers from wanting to cooperate with each other over the long-term. This negative non-conformity with others is because once free riding becomes the social norm, behaviour to free ride is circular and continuously maintained by the presence of negative conditional cooperation, supporting the worst payoff in terms of collectively, and of their own individual self-interested agendas. Figure 6 (p.80) illustrates and summarises this circular negative conditional cooperation choice pattern.

Figure 6: Free riding and continuous circular negative conditional cooperation



Source: author of dissertation

To break the negative conditional cooperation cycle shown in Figure 6 (p.80) requires reframing cooperation so that cooperation is represented as positive as opposed to negative. This leads the discussion to the final quadrant, the quadrant on the top left hand side in Figure 4 (p.73).

Theoretical analyses for mutual context-dependency supporting the Pareto-improvement strategy: the case of not wanting to free ride

The payoff to purchase carbon footprint products is to **not free ride**. It is the top left hand quadrant of Figure 4 (p.73). This option represents the Pareto-improvement.

Characteristics of this option are:

- Reciprocated or mutual context-dependency assumed.
- Enforceable contracts are present. Although the game is mutually context-dependent, this mutual context-dependency is enforceable in that an agreement is made between small local communities, and if this agreement is breached it becomes enforceable by exposing the individual to the rest of the group as a free rider.
- As previously discussed on pages 52-57, tension between social/community values and individual rationality in small local groups is dealt with by using social norms (ie wanting to conform to the group: collective rationality) and peer pressure (ie not wanting to be exposed as a nonconformists).
- Positive conditional cooperation and positive endogenous preferences are represented and are supported by social preferences and social norms.

In the last section, free riders created negative conditional cooperation and negative endogenous preferences, and that the bottom right hand quadrant of Figure 4 (p.73) is the Nash dominant equilibrium strategy in that the best option for both players was to free ride. By free riding, each player cannot be made worse off, despite what the other player decides to do. In Figure 4 (p.73), the Nash dominant strategy is the default strategy under the frame of non-cooperative behaviour. However, is it possible for the social preference

extension strategy to persuade both Customer 1 and 2 not to default to the dominant strategy? For the dominant strategy is not the best outcome for the environment in that CO2 increases in both cases given that each Customer adds more CO2 to the atmosphere.

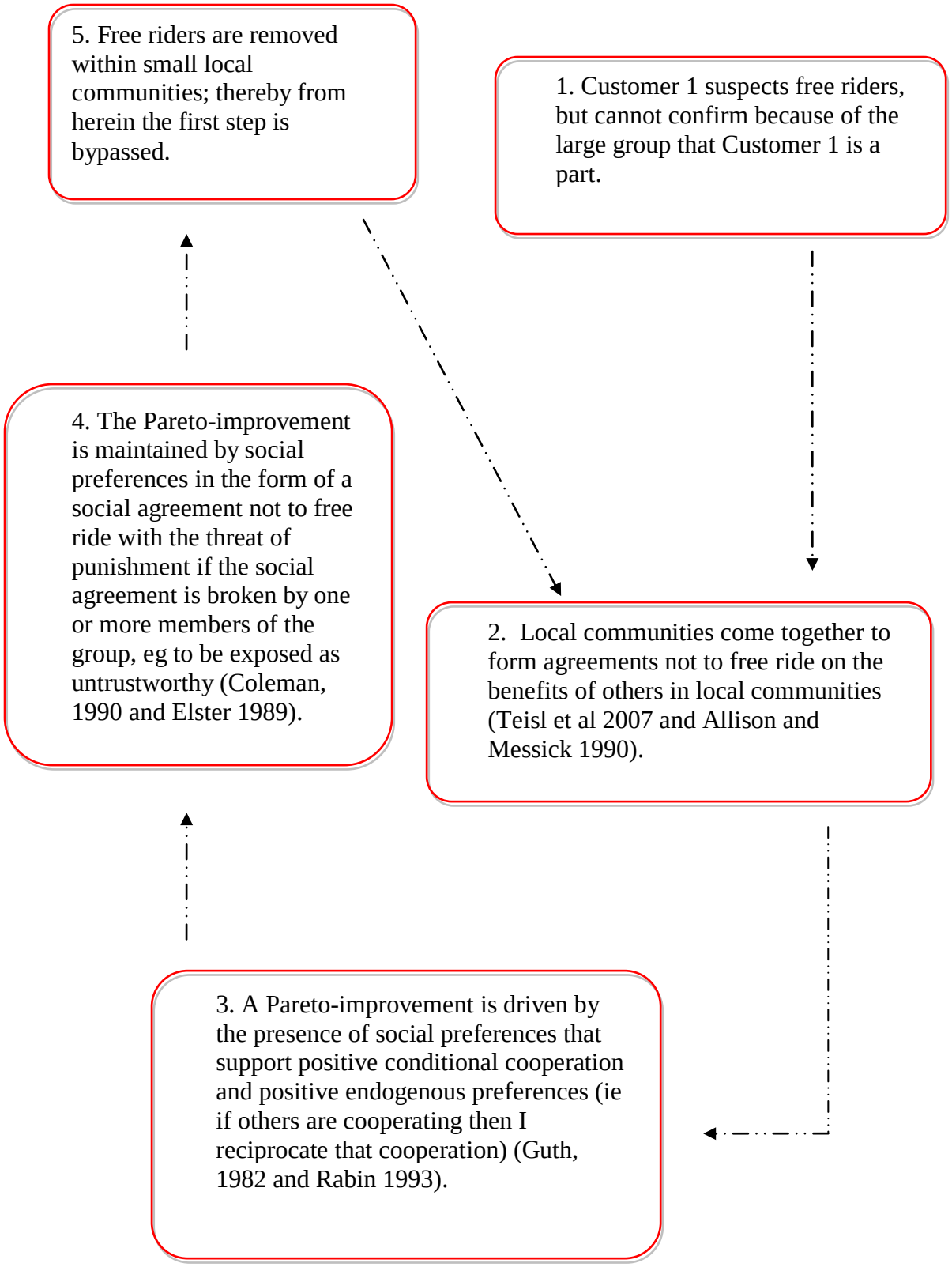
To persuade customers to purchase carbon footprint labelled products, it requires both Customer1 and Customer 2 to view collective action in a positive way in the hope to create a Pareto-improvement. A Pareto-improvement occurs when one person in a community is better off without anyone else becoming worse off. The Pareto-improvement considers only the CO2 emissions in the atmosphere. The Pareto-improvement happens when Customer 1 takes the best possible action for the environment as long as Customer 2 takes the same action (ie neither free ride on the other's efforts). Therefore, the action of each customer benefits themselves, but at the same time, makes no other person worse off. Given that only CO2 emissions are considered, Pareto-optimality is not applicable. For the outcome to be Pareto-optimum, one person is made better off whilst another is made worse off. However, if only CO2 emissions are considered, then purchasing carbon labelled products does not make any other person worse off, because CO2 has decreased for the purchaser as well as the community. Actions of this nature are taken on the sole premise that this was the agreed action. The reasoning behind this type of equilibrium is that this Pareto-improvement calls upon each customer to respond rationally to the believable danger of the other customer's willingness to impose punishment if the agreement is breached. From this premise, of not wanting to run the risk of being exposed, as a free rider, it requires 'significance' placed on each player in terms of their actions either to purchase, or not to purchase, CO2 labelled products.

This placement of significance falls under the headings of positive conditional cooperation and positive endogenous preferences, and are effective if used with social norms. The social norm 'to cooperate' acts as a social preference and forms part of the social preference extension strategy, because both Customer 1 and 2 know that the other customer shall expose

them as untrustworthy if they were to default on the agreement between them and free ride. Therefore, both Customer 1 and 2 shall not run the risk of being exposed as free riding. The social preference extension strategy is in effect, because social preferences are being used such as reciprocity of trust. Positive endogenous preferences are also at work in that the choice not to free ride is context-dependent on the other customer's choice not to free ride. The outcome is that CO2 is decreased by the actions of both customers, and this decrease in CO2 supports positive conditional cooperation in that the overall benefit for both customers is at its highest. It is at its highest because both customers benefit from what the other is doing either individually or collectively in terms of personal satisfaction (ie being trustworthy), and for the environment (ie both decreasing CO2 present in the atmosphere).

Figure 7 (p.84) summarises how the Pareto-improvement works, and how it is maintained in the pursuit of helping to persuade both customers not to default to the dominant strategy and both become free riders.

Figure 7: Pareto-improvement:
the removal of free riders from small groups



Source: author of dissertation

Figure 4 (p.73) paints a picture of either Customer 1 and 2 defaulting and free riding or forming a collective agreement with the help of social norms and social preferences in an effort to work together to reduce CO2 present in the atmosphere. To test the hypothesis of Figure 4 (p.73), what follows are empirical findings that provide evidence for both cases: either to free ride (and therefore support the Nash dominant equilibrium strategy) or not to free ride (and therefore support the Pareto-improvement strategy).

Empirical evidence

Empirical evidence for mutual context-dependency supporting the Nash dominant equilibrium strategy: the case-supporting no in that individuals want to free ride

Gachter (2006) explains that free riding on public goods is because of the fragility of conditional cooperation. According to Gachter (2006, p.2), 'Conditional co-operators, who experience free riding, will stop cooperating themselves.' Furthermore, Gachter (2006, p.3) explains that, 'There exist social interaction effects in voluntary cooperation.' Therefore, my interpretation of Gachter's argument is that if the voluntary social norm is against cooperating, then the individual shall 'adapt their behaviour to the respective group they are in' (p.3).

Fischbacher and Gachter (2006) and Fischbacher *et al.* (2001) developed two similar experiments that validate Gachter's (2006) free rider claim. For the 2001 experiment, 44 players were involved, and were divided into groups of 4. The game was played only once, ie a one-shot game. Throughout the game, the players could not communicate with each other. Each player had 20 tokens, which were redeemable at the end of the game as money. The players had to make two choices: an unconditional choice and a conditional choice. The unconditional choice asked each player to state how many tokens he or she is willing to put in the public account, based on not knowing what the other players' contributions might be. The second choice was conditional. Each player had to state how many tokens he or she would give to the public account based on the average group tokens given. Communication for this choice was also not permitted. The payoff for each

player is the money each player put into his or her private account plus a share of the public account. The average contribution could be 20 tokens for the group, and from this assumption, each player places a figure on how many tokens he or she would give to the public account if this assumption were to be true. When a person is randomly selected, it is this amount that goes into the public account, eg if a person puts 0 tokens against the average of 20 tokens, then 0 tokens would go into the public account. The results found that 50% of players are conditional co-operators. This is because for some players the temptation to free ride is more attractive when each player can make a judgement on what the other player might prefer to do. Based on this assumption, this partially free riding player can achieve higher contributions, netting a higher payoff than the other players do, by giving less rather than more to the public account.

The second experiment is Fischbacher and Gachter 2006 experiment. This experiment is similar to the circumstances represented in Figure 4 (p.73) in that this experiment was not a one-shot game, because the game was played 10 times. The players have to state what they would pay into the public account based on their belief of what they believed the other players would contribute to the public account. The results found that actual contributions fell in correlation to the derived belief contributions, because the games are played more than once. Therefore, time becomes an important influence in this game insofar as social norms over time allow the players to believe that the other players shall try to free ride the more times the game is played. The social norm states that the norm is to free ride as time progresses. This is a negative choice, for it is the choice to free ride on other's generosity. Furthermore, negative endogenous preferences are at work here, because the belief preference to free ride is context-dependent on the belief preference that other players are also free riding and shall contribute less to the public account. Negative endogenous preferences have (supported by social norms) led to a peer effect (Manski, 2000). Choice has changed as a function of context-dependent preferences (ie choice is based on the choice of others), making preferences endogenous.

Furthermore, Dawes and Thaler (1988) and Ledyard (1995) give support for the breakdown of conditional cooperation. They argue that conditional cooperation is hardly ever achievable in finitely recurring public games with self-enforced anonymous interactions. Gardner and Stern, 2002 and Stern (1992) found that when more effort is required along with rising costs cooperation decreases.

On balance, so far, the discussion has focused on the outcomes that provide negative conditional cooperation, being that if Customer 1 free rides, then so shall Customer 2 free ride (Figure 4, p.73). The explanations for this were because of negative endogenous preferences that support the social norm not to cooperate. Because Customer 1 and 2 thought, it was unfair for either to free ride so they too decided to free ride. Whereas Fischbacher *et al.* (2001) explained the reasons why negative conditional cooperation occurs, the fact remains that 50% (of the 2001 research findings) were categorized as positive conditional co-operators. In other words, these positive conditional co-operators are willing not to free ride as long as others in the group do not free ride either. This willingness to cooperate supports the Pareto-improvement strategy and the use of the social preference extension strategy. Empirical evidence to support the social preference extension strategy is discussed below.

Empirical evidence for mutual context-dependency supporting the Pareto-improvement strategy: the case supporting yes in that individuals do not want to free ride on other individuals

To encourage customers not to free ride when in small groups, I suggest using positive endogenous preferences, positive conditional cooperation, and social norms to show the willingness to cooperate as a group, group loyalty, and group reciprocity of choices. The idea that choices might be described as 'positive' is from the idea of the ultimatum bargaining game. The ultimatum bargaining game is the idea of Guth *et al.* (1982). In addition to Guth, Rabin (1993) helped to pioneer the idea that the best Pareto-improvement strategy is achieved by including a kindness function

incorporated from within the conditional cooperation transaction. What Rabin shows is once we allow for reciprocal motivators (eg the social norms of willingness to cooperate and choice reciprocity in that A buys if B buys) then free riding becomes an unstable equilibrium. According to Rabin and Guth's models, prolonged conditional cooperation depends on fairness and group benefits.

Group benefits could come from experiencing group loyalty, instead of groups experiencing and acting upon negative endogenous preferences through the information that free riding is the best option because others are, or shall, free ride. Small groups could focus on group benefits via better communication and exchanges of information. The social norm willingness to cooperate as a group then supports positive endogenous preferences.

Positive endogenous preferences are reciprocity choices that have been based on other people's choices not to free ride. Therefore, utility increases for the whole group. Reciprocity of choice depends on the belief that other group members maintain the purchase of low carbon footprint labelled products; trust in the group that all group members shall reciprocate that trust, and purchase low carbon labelled products (Bicchieri, 2006). In addition to the social norm of willingness to cooperate as a group, reciprocity of choice is further reinforced by the social norm of loyalty to the group in that members would not want their loyalty challenged by other group members leading to devaluation of reputation and status in the eyes of their peer group. Loyalty would be challenged if some group members did not pay back the group in kind (ie I will, if you will). Reciprocity choices are imposed through sanctions on non-group conformity; these sanctions help to prevent free riding (Teisl, *et al.*, 2007; Allison and Messick, 1990; Fehr and Fischbacher, 2004).

According to further research, there is significant evidence signifying that social norms in groups encourage and support cooperation (Bicchieri, 2006 and Biel, 2000). By keeping groups small, Communications are easier, because of the credibility of information and its purpose. Those who do not

obey this small group information circle meet with punishment. Kerr (1995) found that communication in groups activates a commitment norm. Cialdini (2001) revealed that once commitment norms are in place group members are more probable to obey and follow them. Orbell *et al.* (1988) tested the claim that commitment norms encourage higher cooperation and found it to be true.

Chaudhuri and Paichayontvijit (2006) examined how commitment norms of the players in the game influence the players' decisions to cooperate. The sample consisted of 84 university students at the University of Auckland. Based on ten rounds, each group had students that were randomly selected. Each student had 10 tokens. 62% of the university students are conditional co-operators. When the level of information was increased to provide information on the presence of conditional co-operators, the number of students conditionally cooperating increased.

Further evidence of conditional cooperation reciprocity is from Hermann and Thoni (2008) who conducted a study involving 160 Russian university students. The results found that overall 55.6% were conditional co-operators. Kocher *et al.* (2008) tested for conditional cooperation in three different countries using university students and found similar results. The universities were in the USA, Austria, and Tokyo. 36 university students participated in each location, and were divided into groups of 3. 20 tokens were given to each student. These students had to make two decisions: one unconditional and the other conditional. The study found significant evidence for conditional cooperation in all universities. For the USA, 81% were categorised as conditional co-operators. In Austria, the figure was 44%. In Japan 42% were conditional co-operators.

Field experiments on conditional cooperation reciprocity include Cialdini (2008). Cialdini undertook a field conditional cooperation experiment in a subway station in New York City. They watched as people left the train and made their way out of the Subway. Whilst making their way out of the subway, they passed a street musician. The test was to see if they could

influence whether a passerby would elect to make a donation. To do this, they had an individual make a donation in front of the passersby. The experiment found that by seeing this individual make a donation increased the probability of making a donation by 8 times, when compared to those who did not see this individual make a donation. Donations were also the focus of an experiment by Frey and Meier (2004a). The study consisted of students choices concerning contributions to two social funds. The results found that students were more likely to contribute when other students contributed. Information is imperative to the amount contributed to the two social funds in that students were more uncertain when the information was ambiguous (Frey and Meier, 2004b). Fundraising was the focus of an experiment by Shang and Croson (2005). Shang and Croson investigated how information on a fundraising campaign broadcasted over public radio influenced the amount of the money contributed. The study found that social information did increase the size of contributions given to the fundraising campaign. Given that donations were broadcast on the radio, each choice to contribute is enforceable and is due partly because others have chosen to contribute. Vesterlund (2003) found similar results for the benefit payoffs of social information. According to research by Vesterlund, donations to charitable organisations increase when donators are aware of the amount others have donated. Conditional cooperation based on verifiable evidence improves contributions. Martin and Randal (2005) found that the level of conditional contributions increased in an art gallery when the donation box is transparent. Though the admission to the gallery was free, one could make a donation into a transparent box. When visitors went to view the artwork, they passed the donation box. If the box had donations in it, then visitors donated significantly more. Potters *et al.* (2001) had similar results. When the size of the donation was announced, this information was used for the next donator. Potters *et al.* found that successive donors maintained the size of the first donor. Heldt (2005) also undertook an experiment that required contributions to a cause. The study looked at the choice of cross-country skiers in Sweden. The choice was to pay, or not, towards a ski track. The results found that cross-country skiers

made higher payments when they knew other cross-country skiers were also contributing.

Burlando and Guala (2005) focused on how the heterogeneity of preferences (ie endogenous preferences in terms of choice reciprocity) supports conditional cooperation reciprocity. Based on 4 different games, the highest result was for the game that used conditional cooperation. From a sample of 92 participants, 35% were classified as conditional co-operators. Furthermore, Keser and van Winden (2000) also found reciprocity is important when contributing to a public account. With a sample size of 160 participants, the study found that 80% of the sample increased or decreased their contribution based on the information of the average group contribution.

Conclusion

Chapter 4 has showed a detailed analysis of free riding on others in the purchase of low carbon footprint labelled products. To do this, a Four-Grid Repetitive Payoff Game Matrix (Figure 4, p.73) was constructed. From within this theoretical model, the concepts of positive conditional cooperation, positive endogenous preferences, negative conditional cooperation and negative endogenous preferences were applied to each quadrant framed within the research question: 'Can a social preference extension strategy help to put off free riders and maintain a Pareto-improvement in the Purchase of Low Carbon Information Footprint Labelled Products?'

The central core result from the investigation of the research question is that for the removal of free riders from the population, small groups must form so that the Pareto-improvement is nurtured from within these small groups. To bring about, and to maintain, a Pareto-improvement, the research theoretically reasoned that for the Pareto-improvement to be a success, this success hinged around focusing on social preferences activated from within these small groups. This allows these groups to become more open to persuasion and context-dependent in an effort to change preference ordering, including the imitation and observation of others within each of

these small groups. From this premise, to cooperate is partly determined by the reciprocators' authority to punish defectors by exposing them as non-conformists in their close local community groups.
The significance of this outcome is that to defect to the Nash dominant equilibrium strategy does not necessarily automatically activate if social preferences can guide the customers to conform to the Pareto-improvement strategy, assuming communication is permitted within these small groups, and these groups are of few persons. The empirical evidence on conditional cooperation (Chaudhuri and Paichayontvijit, 2006; Hermann and Thoni, 2008; Kocher et al., 2008; Cialdini, 2008; Frey and Meier, 2004a; Frey and Meier, 2004b; Shang and Croson, 2005; Martin and Randal, 2005; Potters et al., 2001; Heldt, 2005; and Burlando and Guala, 2005) suggests that individuals do have a willingness to cooperate. The empirical evidence on positive conditional cooperation reciprocity in support of the Pareto-improvement (Figure 4, p.73) does provide grounded evidence that it is reasonable to postulate that there would be some communities willing to cooperate under a Pareto-improvement and by doing so, maintain the Pareto-improvement status, and refrain from free riding on other's efforts.

CHAPTER 5

Conclusion

The research aim of this dissertation was to investigate the effectiveness of rational choice theory and to attach a social preference extension strategy to rational choice theory in the context of household energy consumption of electricity and the purchase of products that have a carbon footprint label. It was suggested that using rational choice theory to explain consumer choice was a good place to start, for it represents the basic model of consumer choice, but falls short in that rational choice theory does not consider preferences as context-dependent on the choices of others. This shortfall was addressed by using a social preference extension strategy. To build up a model that represents the social preference extension strategy, four-research questions were proposed. The four-research questions (RQ) proposed were:

RQ1: Do household energy bill payers make rational choices when faced with an increase in the price of household electricity?

RQ2: Do household energy bill payers make rational choices when exposed to information on energy consumption in the household?

RQ3: Does a social preference extension strategy have an effect on household energy bill payers' electricity consumption?

RQ4: Can a social preference extension strategy help to put off free riders and maintain a Pareto-improvement in the purchase of low carbon information footprint labelled products?

The results from RQ1 suggest that household energy bill payers do make rational choices when faced with increases in the prices of household electricity, however:

On what premise was it justifiable to state that the household energy bill payer does make rational choices?

The premise by which it has proved this lies in the characteristics of economic man that represents the household energy bill payer. It was discussed that the household energy bill payer has some important, if questionably, characteristics. These characteristics include the pursuit to satisfy self-interest, having fixed preferences and the desire and want to

always utility maximise when presented with a set of choices around which complete and perfect information is assumed. For the household energy bill payer to utility maximise and follow rational choices, it only requires justification that the household energy bill payer seeks to have more over less when exposed to the dissemination of the correct and relevant electricity price signals. The empirical evidence supports the postulation that the household energy bill payer seeks to have more over less (Taylor, 1975; Bohi and Zimmerman, 1985; Maddala, *et al.*, 1977; Garcia-Cerratti, 2000 and Espey and Espey, 20004). This outcome leads to the first conclusion and the first building block to attach the social preference extension strategy to rational choice theory.

Conclusion to research question 1

RQ1: Do household energy bill payers make rational choices when faced with an increase in the price of household electricity? Yes, in that, the theoretical evidence postulated and the empirical evidence showed that household energy bill payers were transitive in choice by preferring more savings to fewer saving on electricity consumption.

In addition to electricity price signals, it was further found that information could have the ability to alter household electricity consumption by informing the household on ways in which to become more household energy efficient in the use of electricity in the home. Figure 2 (Chapter 2, p.29) demonstrated this with a hypothetical diagram that supports the empirical material that depicts the shift from Usage Rate (UR) to Usage Rate$_1$ (UR$_1$) (Seligman and Darley, 1977; Winett et al., 1982; Herbrelein and Baumgartner, 1985; Haakana et al., 1997; Wilhite, 1997; Brandon and Lewis, 1999; McCalley and Midden, 2002 and Mountain, 2006). It was suggested that when price signals and energy efficient information are combined, these attributes lead to the household energy bill payer reducing energy consumption in the home whilst at all times choices exclusively remain, and are explained by, the premise under which the rational actor calculates choices. Therefore, Conclusion 1 expands to include information in the choice process to the order of Conclusion 2 that represents the actions of the household energy bill payer:

Conclusion to research question 2

RQ2: Do household energy bill payers make rational choices when exposed to information on energy consumption in the household? Yes, in that, the theoretical evidence postulated and the empirical evidence showed that household energy bill payers do respond to information on electricity savings in the home by preferring more savings to fewer saving on electricity consumption.

Conclusion 2 is different from Conclusion 1 in that to maximise participation in household energy related behaviour requires the combining of information along with electricity price signals. Conclusion 2 is supported by the empirical studies both on the sensitivity of the supply of electricity (Chapter 2, pp. 24-26) and information regarding ways in which households can become more household energy efficient (Chapter 2, pp. 28-35). However, although the result of Conclusion 2 is important in that rational behaviour is able to influence environmental household related behaviour, the research further found that this conclusion is only part of the complete story. Conclusion 2 sits on the premise that preferences are exogenous and do not change. Figure 1 (Chapter 2, p.21) took the stance of unchanging preferences by showing that individualistic choices view all other social phenomena as 'not relevant' to the explanation of choice, and focus only on the ways in which to get the price right by using electricity price signals and environmental efficiency information. However, this assumption of non-relevance is a significant limitation and completely dismisses the idea that preferences are often endogenous and that preferences are affected by social phenomena such peer pressure and social norms (Chapter 3, Figure B in Figure 3, p.50).

Furthermore, Conclusion 2 provides no explanation for experiments that suggest that the participation in environmental related behaviour is further enhanced by the influence from social preferences (Duesenberry, 1949; Leibenstein, 1950; Lichtenstein and Slovic, 1971; Loomes and Sudgen, 1982; Davis and Holt, 1993; Bereby-Meyer and Erev, 1998; Loomes, 1998, 1999; Benabou and Tirole, 2002; Bowles, 2004 and Akerlof and Kranton, 2005). The research at this point introduced Social Man. The characteristics

of social man were explained in Loomes's (1999) experiment (Chapter 3, Table 1, p.41) where we found support for expanding even further Conclusion 2. Loomes's choice experiment adds to the evidences that household energy bill payers are willing to accept behaviour and change choices to achieve or sacrifice possible gains depending on whether household energy bill payers feel they have been dealt an unfair hand. Loomes's experiment is instrumental in helping to manipulate Conclusion 2 in that the research proved that social preferences are used to make preferences malleable and depend on persuasion and context-manipulation including the observation and imitation of other's choices in relation to environmental related behaviour. Therefore, Conclusion 2 expands to include social preferences as an extension strategy in the choice process to the order of Conclusion 3 that represents the combination of economic man and social man to explain the decisions of Social-Economic Man that represents the household energy bill payer:

Conclusion to research question 3

RQ3: Does a social preference extension strategy have an effect on household energy bill payers' electricity consumption? Yes, in that, the logical conditions of rationality (ie transitivity and completeness) also apply to social preferences in that Social-Economic Man divides this rationality into more money savings are preferred to less money savings and wanting to conform to others is preferred to not wanting to conform to others. When these characteristics were combined, household energy consumption did decrease.

Social-Economic Man represents Conclusion 3. It is the evidence that for the best approach for manipulating environmental related behaviour, policymakers must appeal to the characteristics of economic man and the characteristics of social man to maximise the chance of influencing environmental related behaviour. The importance of this conclusion is that it incorporates the social preference extension strategy. The social preference extension strategy represents the times when choices become context-dependent on the choices of other household energy bill payers. The empirical research provided the evidence that environmental related behaviour from individuals provides cooperation between these individuals when they become exposed to social norms and peer pressure (Thaler and

Sunstein, 2008; Schultz, *et al.*, 2007; Cialdini, 2007; Pallak, *et al.*, 1980; Allcott, 2009 and Ayers, *et al.*, 2009).

Finally, the presents of the social preference extension strategy attached to rational choice theory proved how social preferences manipulate choices when framed in a hypothetical Four-Grid Repetitive Game Payoff Matrix (Chapter 4, Figure 4, p.73). The results from this game provided two important findings in the context of research question 4.

Conclusion to research question 4

Can a social preference extension strategy help to put off free riders and maintain a Pareto-improvement in the purchase of low carbon information footprint labelled products?

1. No, if in large groups, in that, the thought of free riders triggers defection in the purchase of carbon footprint labelled products. This is because strong negative conditional cooperation and strong influences from negative endogenous preferences leads both customers to free ride in that Customer 1 anticipates Customer 2 shall defect, thereby triggering Customer 2 to defect in the purchase of products that have carbon footprint information.
2. Yes, if in small groups, in that to remove the free rider problem it was suggested that peer pressure and social norms are used and targeted at small local community groups. By targeting small local community groups, it allows for the creation of strong positive conditional cooperation and strong influences from positive endogenous preferences. Because, by having small local community groups, it provides the opportunity to punish those in the group who violate the social norm of wanting to cooperate with the group and not to free ride on the expensive of the groups' efforts. This risk of punishment from other members of the small group helps to maintain a Pareto-improvement and encourages free riders not to defect to the dominant Nash equilibrium option.

Final thoughts

Overall, taking the wider picture, the conclusion of this dissertation is that rational choice theory remains a strong theory to explain consumer choices, but requires modernising. This modernisation comes in the form of a social preference extension strategy that attaches itself to rational choice theory. By attaching the social preference extension strategy to rational choice theory, it has added another dimension to rational choice theory.

This dimension has major implications for policymakers, because it means that household energy bill payers and consumers purchasing low carbon footprint labelled products can no longer be taken as the immovable judges of their best interest. The social preference extension strategy creates options where policymakers rely on persuasion and context-manipulation to change preference orderings, rather than using policies that rely exclusively on sticks and carrots with given preferences. This particular social preference extension strategy explored in this dissertation takes into account the possibility that preferences are malleable and depend on the observation and imitation of others when in small groups.

Though the research has focused on environmental related behaviour, the social preference extension strategy is applicable to any type of consumer choice decision that allows group dynamics to create context-dependent consumer choices, instead of relying on individualistic choices with given preferences.

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