Social Learning and Choice Theory

E. Somanathan
Indian Statistical Institute

5th WCERE
Istanbul

Introduction

From the Summary for Policy Makers, 5th Assessment Report of the IPCC, Working Group III, April 2014:

- "A three to five fold difference in energy use has been shown for provision of similar building related energy service levels in buildings."

Introduction

From the Summary for Policy Makers, 5th Assessment Report of the IPCC, Working Group III, April 2014:

- "A three to five fold difference in energy use has been shown for provision of similar building related energy service levels in buildings."
- "Building codes and appliance standards, if well designed and implemented, have been among the most environmentally and cost effective instruments for emission reductions (*robust evidence, high agreement*)."

Introduction

From "Energy Efficiency Policies: A retrospective examination" (Gillingham et al, Annual Reviews, 2009):

- "Ex post and ex ante analyses from Meyers et al. estimate past costs to the government of implementing 1987 to 2000 appliance standards as $200 million to $250 million and the cumulative net benefit for those years as $17.4 billion. This latter amount is added to some ex ante estimates to yield a cumulative net benefit of $154 billion and CO2 emissions reductions of 1216 MMTCE for 1987 to 2050."

Introduction

From "Energy Efficiency Policies: A retrospective examination" (Gillingham et al, Annual Reviews, 2009):

- "Ex post and ex ante analyses from Meyers et al. estimate past costs to the government of implementing 1987 to 2000 appliance standards as $200 million to $250 million and the cumulative net benefit for those years as $17.4 billion. This latter amount is added to some ex ante estimates to yield a cumulative net benefit of $154 billion and CO2 emissions reductions of 1216 MMTCE for 1987 to 2050."
- "Several authors are more skeptical of these estimates of cost-effectiveness."

Introduction

- "Although these skeptical authors contend that empirical evidence supports their theoretical findings, they typically do not provide it."

Introduction

- "Although these skeptical authors contend that empirical evidence supports their theoretical findings, they typically do not provide it."
- "In fact, most empirical studies provide evidence at the state or program level, supporting the cost-effectiveness of appliance standards. Further empirical research would be useful to examine the practical importance of the theoretical criticisms and generalize the results of the many program-level studies."

Introduction

- This is typical of controversies over the "energy efficiency gap".

Introduction

- This is typical of controversies over the "energy efficiency gap".
- Economists are often sceptical about the existence or, at least, the importance, of the energy efficiency gap because it seems to violate the axiom of revealed preference.

Introduction

- This is typical of controversies over the "energy efficiency gap".
- Economists are often sceptical about the existence or, at least, the importance, of the energy efficiency gap because it seems to violate the axiom of revealed preference.
- Today I want to discuss how the use of revealed preference in economics can go wrong. I will provide a model to suggest that it will sometimes be misleading, and when this is likely to happen. The model will make some predictions and I will look at the available evidence in this regard.

Overheard in the economics department

- "I took the best way home yesterday."

Overheard in the economics department

- "I took the best way home yesterday."
- "How do you know it was the best?"

Overheard in the economics department

- "I took the best way home yesterday."
- "How do you know it was the best?"
- "Because I took it."

- So using revealed preference makes sense when people have already learned what is best for them.

- So using revealed preference makes sense when people have already learned what is best for them.
- This suggests that if we want to understand what can go wrong with applying revealed preference and what can be done when it does go wrong, we need to understand how people learn.

- So using revealed preference makes sense when people have already learned what is best for them.
- This suggests that if we want to understand what can go wrong with applying revealed preference and what can be done when it does go wrong, we need to understand how people learn.
- In this paper, we provide a model of social learning.

A model of the Evolution of Learning Rules

One decision problem [Rogers, 1988]

- In each period, a snerdwump faces a decision problem in which it has to take one of two actions, labelled 0 and 1.

A model of the Evolution of Learning Rules

One decision problem [Rogers, 1988]

- In each period, a snerdwump faces a decision problem in which it has to take one of two actions, labelled 0 and 1.
- In each period, there is a state variable X that also takes values 0 and 1 with equal probability.

A model of the Evolution of Learning Rules

One decision problem [Rogers, 1988]

- In each period, a snerdwump faces a decision problem in which it has to take one of two actions, labelled 0 and 1.
- In each period, there is a state variable X that also takes values 0 and 1 with equal probability.
- If a snerdwump takes action j when $X = j$, then it receives a benefit of 1.

A model of the Evolution of Learning Rules

One decision problem [Rogers, 1988]

- In each period, a snerdwump faces a decision problem in which it has to take one of two actions, labelled 0 and 1.
- In each period, there is a state variable X that also takes values 0 and 1 with equal probability.
- If a snerdwump takes action j when $X = j$, then it receives a benefit of 1.
- If it takes the "wrong" action, then it gets a benefit of -1, so that the expected benefit of taking an action without conditioning on the state is 0.

- A snerdwump can find out the value of X in each period by incurring a cost of experimentation c, where $0 < c < 1$.

- A snerdwump can find out the value of X in each period by incurring a cost of experimentation c, where $0 < c < 1$.
- At the end of each period, the state X is perturbed with probability u and remains the same with probability $1 - u$.

- A snerdwump can find out the value of X in each period by incurring a cost of experimentation c, where $0 < c < 1$.
- At the end of each period, the state X is perturbed with probability u and remains the same with probability $1 - u$.
- If it is perturbed, then the two states occur with equal probability in the next period.

- Two strategies that snerdwumps may follow suggest themselves naturally.

- Two strategies that snerdwumps may follow suggest themselves naturally.
- The first is to learn the state in every period before acting. This has a payoff of $1 - c$.

- Two strategies that snerdwumps may follow suggest themselves naturally.
- The first is to learn the state in every period before acting. This has a payoff of $1 - c$.
- The second is to do what a random other snerdwump was seen to do in the last period.

- Two strategies that snerdwumps may follow suggest themselves naturally.
- The first is to learn the state in every period before acting. This has a payoff of $1 - c$.
- The second is to do what a random other snerdwump was seen to do in the last period.
- We shall suppose that such *social learning* can happen at low (for simplicity, zero) cost.

Let p denote the proportion of snerdwumps who are social learners.

Let p denote the proportion of snerdwumps who are social learners. Then the payoff to social learning is

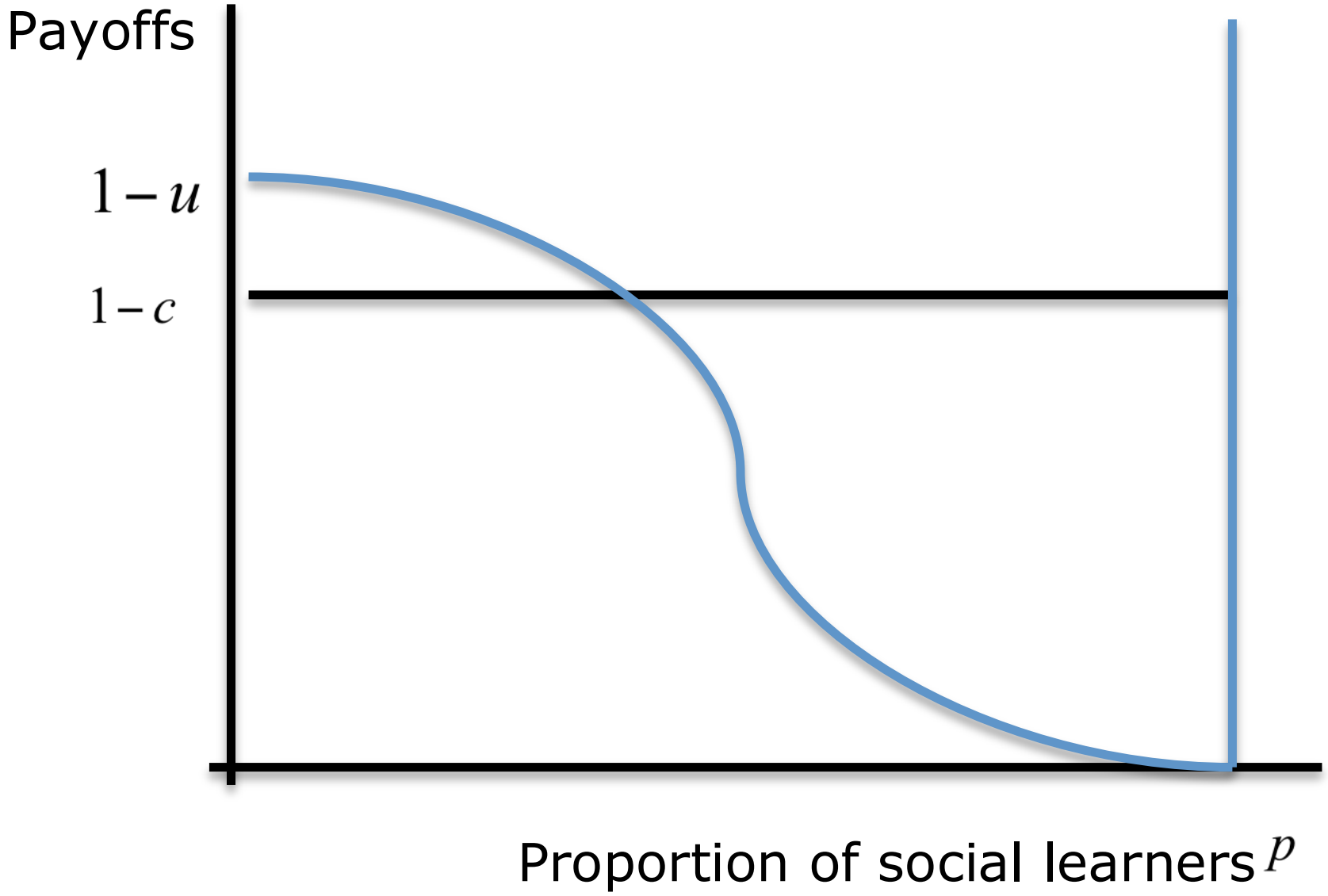
$$(1-u)[(1-p)+p(1-u)[(1-p)+....=\frac{(1-u)(1-p)}{1-p(1-u)}$$

where it is assumed that changes in p between periods are small enough to be ignored.

Let p denote the proportion of snerdwumps who are social learners. Then the payoff to social learning is

$$(1-u)[(1-p)+p(1-u)[(1-p)+....=\frac{(1-u)(1-p)}{1-p(1-u)}$$

where it is assumed that changes in p between periods are small enough to be ignored.
The payoff to social learning is decreasing in p and approaches zero as p nears one.


Payoffs
$1-u$
$1-c$
Proportion of social learners p

If u is small, this means knowledge acquired about the world does not become obsolete rapidly. We suppose that

$$1 - u > 1 - c.$$

If u is small, this means knowledge acquired about the world does not become obsolete rapidly. We suppose that

$$1 - u > 1 - c.$$

Then, if there are no social learners in the population, the payoff to social learners is $1 - u$ and exceeds the payoff to individual learners.

If u is small, this means knowledge acquired about the world does not become obsolete rapidly. We suppose that

$$1 - u > 1 - c.$$

Then, if there are no social learners in the population, the payoff to social learners is $1 - u$ and exceeds the payoff to individual learners.

A population of snerdwumps with no social learners is thus evolutionarily unstable.

- Thus, evolution by natural selection will lead to a mixed population of snerdwumps, with p settling at the level that equates payoffs to individual and social learning.

- Thus, evolution by natural selection will lead to a mixed population of snerdwumps, with p settling at the level that equates payoffs to individual and social learning.
- [Rogers, 1988] concludes from this that social learning cannot raise aggregate payoffs.

- Thus, evolution by natural selection will lead to a mixed population of snerdwumps, with p settling at the level that equates payoffs to individual and social learning.
- [Rogers, 1988] concludes from this that social learning cannot raise aggregate payoffs.
- In economic terms, the problem is that while individual learners create a positive informational externality that can raise the payoffs of social learners, the social learners' exploitation of this information itself degrades the quality of information in the population, rendering it more and more obsolete, until the net gain from social learning is entirely dissipated.

Multiple decision problems: People

- In each period, people may face n kinds of decision problems, each of which is of the same form as that faced by a snerdwump.

Multiple decision problems: People

- In each period, people may face n kinds of decision problems, each of which is of the same form as that faced by a snerdwump.
- A fraction $1/n$ of the people are largely familiar with type-i problems, $i = 1, ..., n$, which they face with probability q.

Multiple decision problems: People

- In each period, people may face n kinds of decision problems, each of which is of the same form as that faced by a snerdwump.
- A fraction $1/n$ of the people are largely familiar with type-i problems, $i = 1, ..., n$, which they face with probability q.
- For them, these have only a few novel features while type-j problems where $j \neq i$, that they face with probability $1 - q$ are mostly unfamiliar to them.

Multiple decision problems: People

- The cost of learning the state is low (c_l) for a familiar problem and high ($c_h > c_l$) for an unfamiliar problem.

Multiple decision problems: People

- The cost of learning the state is low (c_l) for a familiar problem and high ($c_h > c_l$) for an unfamiliar problem.
- Now consider the learning rule L: Use individual learning when faced with a familiar problem, use social learning otherwise.

Multiple decision problems: People

- The cost of learning the state is low (c_l) for a familiar problem and high ($c_h > c_l$) for an unfamiliar problem.
- Now consider the learning rule L: Use individual learning when faced with a familiar problem, use social learning otherwise.
- The operational assumption here is that it is not possible to distinguish between informed and un-informed members of the population.

Multiple decision problems: People

If p now denotes the proportion of people in the population who faced a particular decision problem but did not learn the state for that problem, then the payoff to this learning rule is

$$q(1-c_I)+(1-q)\frac{(1-u)(1-p)}{1-p(1-u)}. \tag{1}$$

Multiple decision problems: People

A necessary condition for evolution by natural selection to an equilibrium in which every member of the population uses the learning rule L is

$$1 - c_l \geq \frac{(1-u)(1-p)}{1-p(1-u)} \geq 1 - c_h. \tag{2}$$

Multiple decision problems: People

A necessary condition for evolution by natural selection to an equilibrium in which every member of the population uses the learning rule L is

$$1 - c_l \geq \frac{(1-u)(1-p)}{1-p(1-u)} \geq 1 - c_h. \tag{2}$$

The left-hand inequality is necessary to ensure that those with the low cost of learning the state will not do better by using social rather than individual learning.

Multiple decision problems: People

A necessary condition for evolution by natural selection to an equilibrium in which every member of the population uses the learning rule L is

$$1 - c_l \geq \frac{(1-u)(1-p)}{1-p(1-u)} \geq 1 - c_h. \tag{2}$$

The left-hand inequality is necessary to ensure that those with the low cost of learning the state will not do better by using social rather than individual learning.
The right-hand inequality is necessary to ensure that those with the high cost of learning the state will not do better by using individual rather than social learning.

Multiple decision problems: People

If everyone uses the learning rule L, then for any of the problems, the proportion of un-informed people facing that problem will be

$$p = \frac{\frac{(1-q)(n-1)}{n}}{\frac{(1-q)(n-1)}{n} + \frac{q}{n}}. \tag{3}$$

Multiple decision problems: People

- We shall suppose that those facing unfamiliar problems will get a higher payoff from social than individual learning at the value of p given above. This will certainly be true, for example, if $c_h > 1$ so that even random choice is better than individual learning for unfamiliar problems.

Multiple decision problems: People

- We shall suppose that those facing unfamiliar problems will get a higher payoff from social than individual learning at the value of p given above. This will certainly be true, for example, if $c_h > 1$ so that even random choice is better than individual learning for unfamiliar problems.
- If the left-hand inequality also holds strictly at this value of p, so that those facing familiar problems get a strictly higher payoff from individual rather than social learning, then evolution by natural selection must lead to the entire population following L.

Multiple decision problems: People

The resulting value of the payoff is strictly higher than what would have been possible with individual learning alone. If people (unlike snerdwumps) can specialise, then not only will they evolve a social learning rule, but this social learning will raise the payoffs of the population as a whole.

Multiple decision problems: People

- It could be the case that even specialists do better to use social learning. (This will be true if unfamiliar problems are encountered rarely.)

Multiple decision problems: People

- It could be the case that even specialists do better to use social learning. (This will be true if unfamiliar problems are encountered rarely.)
- But once this happens, the proportion of uninformed people in the population will rise until the payoff to social learning is driven down to equality with $1 - c_I$.

Multiple decision problems: People

- It could be the case that even specialists do better to use social learning. (This will be true if unfamiliar problems are encountered rarely.)
- But once this happens, the proportion of uninformed people in the population will rise until the payoff to social learning is driven down to equality with $1 - c_I$.
- The evolutionarily stable outcome in this case will consist of a mixture of two strategies, L, and a strategy that calls for always using social learning, even for familiar problems.

Multiple decision problems: People

- It could be the case that even specialists do better to use social learning. (This will be true if unfamiliar problems are encountered rarely.)
- But once this happens, the proportion of uninformed people in the population will rise until the payoff to social learning is driven down to equality with $1 - c_I$.
- The evolutionarily stable outcome in this case will consist of a mixture of two strategies, L, and a strategy that calls for always using social learning, even for familiar problems.
- In this state, everyone will earn a payoff of $1 - c_I$ so that social learning leads to everyone getting the highest possible payoff at all times.

Multiple decision problems: People

- The benefit to social learning in this case is even higher than in the case when natural selection leads to the entire population following the learning rule L.

Multiple decision problems: People

- The benefit to social learning in this case is even higher than in the case when natural selection leads to the entire population following the learning rule L.
- This is because the fraction of uninformed people is not large, so that information does not get obsolete through too much imitation.

If there was some degree of specialisation of tasks in our evolutionary past – hunting different kinds of game in different places, gathering different kinds of plant foods in different places, etc. – but this specialisation was incomplete, so that individuals still had to occasionally perform tasks that they were not used to, then the model suggests that this would have led to evolutionary selection pressure to adopt a learning rule like L.

- This kind of imitation is far from being a complete account of social learning.

- This kind of imitation is far from being a complete account of social learning.
- But it is ubiquitous because it costs nothing for both teachers and learners.

Implications for Choice Theory

- The model suggests that evolution would have predisposed people to invest in finding the optimal choice when the cost of doing so is low, and to imitate others when this is not the case.

Implications for Choice Theory

- The model suggests that evolution would have predisposed people to invest in finding the optimal choice when the cost of doing so is low, and to imitate others when this is not the case.
- When will the cost of finding the optimal choice be low?

Repeated choices

- For repeated choices, a little experimentation pays off, for one can then enjoy the benefits of making the best choice many times.

Repeated choices

- For repeated choices, a little experimentation pays off, for one can then enjoy the benefits of making the best choice many times.
- The purchase of frequently consumed goods is an important example.

Repeated choices

- For repeated choices, a little experimentation pays off, for one can then enjoy the benefits of making the best choice many times.
- The purchase of frequently consumed goods is an important example.
- So standard welfare economics that presumes that consumers reveal what is best for them via the choices they make may also be appropriate and reliable.

Repeated choices

- For repeated choices, a little experimentation pays off, for one can then enjoy the benefits of making the best choice many times.
- The purchase of frequently consumed goods is an important example.
- So standard welfare economics that presumes that consumers reveal what is best for them via the choices they make may also be appropriate and reliable.
- Caveat. Ariely, Drazen, and Prelec (2003). Coherent Arbitrariness.

Easily observable attributes

- Even if a decision has to be made that is encountered only occasionally, if it is the case that people can easily observe the payoffs that others got from having made such choices, rather than only the choices themselves, then the cost of learning which is the best choice will be low.

Easily observable attributes

- Even if a decision has to be made that is encountered only occasionally, if it is the case that people can easily observe the payoffs that others got from having made such choices, rather than only the choices themselves, then the cost of learning which is the best choice will be low.
- An example is the purchase of consumer durables such as smartphones.

Easily observable attributes

- Even if a decision has to be made that is encountered only occasionally, if it is the case that people can easily observe the payoffs that others got from having made such choices, rather than only the choices themselves, then the cost of learning which is the best choice will be low.
- An example is the purchase of consumer durables such as smartphones.
- The relevant characteristics of such phones may be discerned from those possessed by one's friends fairly easily, so that it may not be difficult to make a good choice.

Easily observable attributes

- Even if a decision has to be made that is encountered only occasionally, if it is the case that people can easily observe the payoffs that others got from having made such choices, rather than only the choices themselves, then the cost of learning which is the best choice will be low.
- An example is the purchase of consumer durables such as smartphones.
- The relevant characteristics of such phones may be discerned from those possessed by one's friends fairly easily, so that it may not be difficult to make a good choice.
- Once again, standard welfare economics using revealed preference may be appropriate.

It is when we depart from both these cases that standard theory will no longer be reliable, whether for prediction or for making welfare judgements.

- A well-known phenomenon in energy economics, and energy studies more generally, is the observation that there appear to be opportunities for large savings to be made by investing in energy efficient equipment of various sorts, and yet these do not appear to be taken up.

- A well-known phenomenon in energy economics, and energy studies more generally, is the observation that there appear to be opportunities for large savings to be made by investing in energy efficient equipment of various sorts, and yet these do not appear to be taken up.
- A common reaction of economists to this observation has been that, since this violates the central postulate of choice theory that people maximise their utility or profits subject to feasibility constraints, the observation itself must be false or greatly exaggerated, except possibly for special cases such as owner-renter split incentives.

- Our theory, by contrast, suggests that an energy efficiency gap is exactly what we would expect to see.

- Our theory, by contrast, suggests that an energy efficiency gap is exactly what we would expect to see.
- This is because it is difficult to evaluate the energy consumption of any specific appliance even after using it (Jessoe and Rapson, 2013).

- Our theory, by contrast, suggests that an energy efficiency gap is exactly what we would expect to see.
- This is because it is difficult to evaluate the energy consumption of any specific appliance even after using it (Jessoe and Rapson, 2013).
- Therefore, while it is possible to observe which models of any given appliance others are buying, their payoffs from such purchases are largely unobservable.

- Our theory, by contrast, suggests that an energy efficiency gap is exactly what we would expect to see.
- This is because it is difficult to evaluate the energy consumption of any specific appliance even after using it (Jessoe and Rapson, 2013).
- Therefore, while it is possible to observe which models of any given appliance others are buying, their payoffs from such purchases are largely unobservable.
- Furthermore, since the goods are durable, one makes such purchases infrequently. Personal experience, therefore, tends to be obsolete in the presence of technical change. It is, therefore, difficult to determine the best choice. These are exactly the conditions under which imitation is predicted by our theory.

- Consider the choice of buying a piece of energy-using equipment from some finite number of models available.

- Consider the choice of buying a piece of energy-using equipment from some finite number of models available.
- Suppose that in Year 1, a new model that is, in fact, superior to previous models, becomes available.

- Consider the choice of buying a piece of energy-using equipment from some finite number of models available.
- Suppose that in Year 1, a new model that is, in fact, superior to previous models, becomes available.
- Suppose the fraction of persons with a low cost of making the optimal choice is f.

- Consider the choice of buying a piece of energy-using equipment from some finite number of models available.
- Suppose that in Year 1, a new model that is, in fact, superior to previous models, becomes available.
- Suppose the fraction of persons with a low cost of making the optimal choice is f.
- Suppose, in accordance with the evolved behaviour modelled above, that these buyers make the optimal choice while the other buyers imitate the choice of a random member of the population from the previous period.

Then the fraction of buyers making the optimal choice in Year 2 will be

$$F_2 = f + (1 - f)f, \tag{4}$$

Then the fraction of buyers making the optimal choice in Year 2 will be

$$F_2 = f + (1 - f)f, \tag{4}$$

so that, by induction, the fraction of buyers making the optimal choice in Year t will be

$$F_t = 1 - (1 - f)^t. \tag{5}$$

- What fraction of buyers will actually be capable of making the optimal choice in real situations?

- What fraction of buyers will actually be capable of making the optimal choice in real situations?
- 40% of US car buyers in a survey said they did not take operating costs into account when choosing which car to buy (Allcott, 2011).

- What fraction of buyers will actually be capable of making the optimal choice in real situations?
- 40% of US car buyers in a survey said they did not take operating costs into account when choosing which car to buy (Allcott, 2011).
- Let us generously assume that $f = 0.1$

- What fraction of buyers will actually be capable of making the optimal choice in real situations?
- 40% of US car buyers in a survey said they did not take operating costs into account when choosing which car to buy (Allcott, 2011).
- Let us generously assume that $f = 0.1$
- Then it will be 22 years before 90% of buyers are buying the right model, even assuming that there is no further technical progress in this time, rather than zero years as would be the case with correctly optimising buyers.

- For example, if we consider a product like an air-conditioner with a 10-year lifespan, then it will take 27 years after the introduction of a superior model before 90% of the air-conditioners in use are the best model, rather than the 9 years it would take if everyone made the optimal choice.

- For example, if we consider a product like an air-conditioner with a 10-year lifespan, then it will take 27 years after the introduction of a superior model before 90% of the air-conditioners in use are the best model, rather than the 9 years it would take if everyone made the optimal choice.
- In actuality, matters will be worse because of further technical progress.

- For example, if we consider a product like an air-conditioner with a 10-year lifespan, then it will take 27 years after the introduction of a superior model before 90% of the air-conditioners in use are the best model, rather than the 9 years it would take if everyone made the optimal choice.
- In actuality, matters will be worse because of further technical progress.
- Standard welfare economics would suggest that once any pollution externalities have been priced, further government intervention would only raise costs.

- Note that there is no pollution externality above, yet we get a hugely inefficient outcome because of the cost to individuals of making the optimal choice.

- Note that there is no pollution externality above, yet we get a hugely inefficient outcome because of the cost to individuals of making the optimal choice.
- The cost to society of making the optimal choice is much lower because it can be incurred only once and then transmitted to everybody via information or regulation.

Information or Regulation?

- Economists generally look upon labelling policies and nudges with less disapproval than regulations because they preserve consumer choice.

Information or Regulation?

- Economists generally look upon labelling policies and nudges with less disapproval than regulations because they preserve consumer choice.
- From the perspective of costly decision-making, however, this neglects the costs consumers have to still undergo to make choices, mostly because many people will continue to make the wrong choices.

Information or Regulation?

- Economists generally look upon labelling policies and nudges with less disapproval than regulations because they preserve consumer choice.
- From the perspective of costly decision-making, however, this neglects the costs consumers have to still undergo to make choices, mostly because many people will continue to make the wrong choices.
- Regulation is a better policy when the other attributes of a good that consumers care about (other than their energy bill) are unimportant or unaffected by the performance standard. This is likely to be the case with devices such as air-conditioners, but may be less the case with, for example, cars.

Health-related behaviours

- Important environmental issues in developing countries include the adoption of behaviours and technologies that would protect individuals from environmental health risks.

Health-related behaviours

- Important environmental issues in developing countries include the adoption of behaviours and technologies that would protect individuals from environmental health risks.
- Switching from modern to traditional fuels, protecting water sources, paying for improved sanitation, etc.

Water quality and information

- Households can undertake averting expenditures to improve their own water quality if they feel the need to do so. These actions are easily observed and act as a measure of demand, using revealed preference.

Water quality and information

- Households can undertake averting expenditures to improve their own water quality if they feel the need to do so. These actions are easily observed and act as a measure of demand, using revealed preference.
- How does demand vary with the information available to households?

Water quality and information

- Awareness and the Demand for Environmental Quality: Survey Evidence on Drinking Water Quality in India. Environment and Development Economics (2009) – J. Jalan, E. Somanathan and S. Chaudhuri

Water quality and information

- Awareness and the Demand for Environmental Quality: Survey Evidence on Drinking Water Quality in India. Environment and Development Economics (2009) – J. Jalan, E. Somanathan and S. Chaudhuri
- If awareness does have a significant effect on willingness to pay for better water quality, then we would expect more educated people, who are presumably more aware of the importance of water quality for health, to be spending more on home purification.

Water quality and information

- Awareness and the Demand for Environmental Quality: Survey Evidence on Drinking Water Quality in India. Environment and Development Economics (2009) – J. Jalan, E. Somanathan and S. Chaudhuri
- If awareness does have a significant effect on willingness to pay for better water quality, then we would expect more educated people, who are presumably more aware of the importance of water quality for health, to be spending more on home purification.
- We used the urban subsample of the 1998-99 National Family Health Survey in India to see if this is the case.

Water quality and information

- Sample size 20,000+ households

Water quality and information

- Sample size 20,000+ households
- Sampled households highly exposed to waterborne diseases: 16.5 percent of households with children in the 0-3 age group had at least one case of diarrhea in the two weeks preceding the survey.

Water quality and information

- Households used various home water purification methods ranging from costless filtration with a cloth to costly electronic water purifiers. We estimated the probabilities of these methods as functions of wealth, education and other variables and calculated expected expenditure as a function of the variables.

Water quality and information

- Households used various home water purification methods ranging from costless filtration with a cloth to costly electronic water purifiers. We estimated the probabilities of these methods as functions of wealth, education and other variables and calculated expected expenditure as a function of the variables.
- Female (and to a lesser degree male) education, exposure to media, and occupations all have strong effects on the willingness to pay for better water quality.

Water quality and information

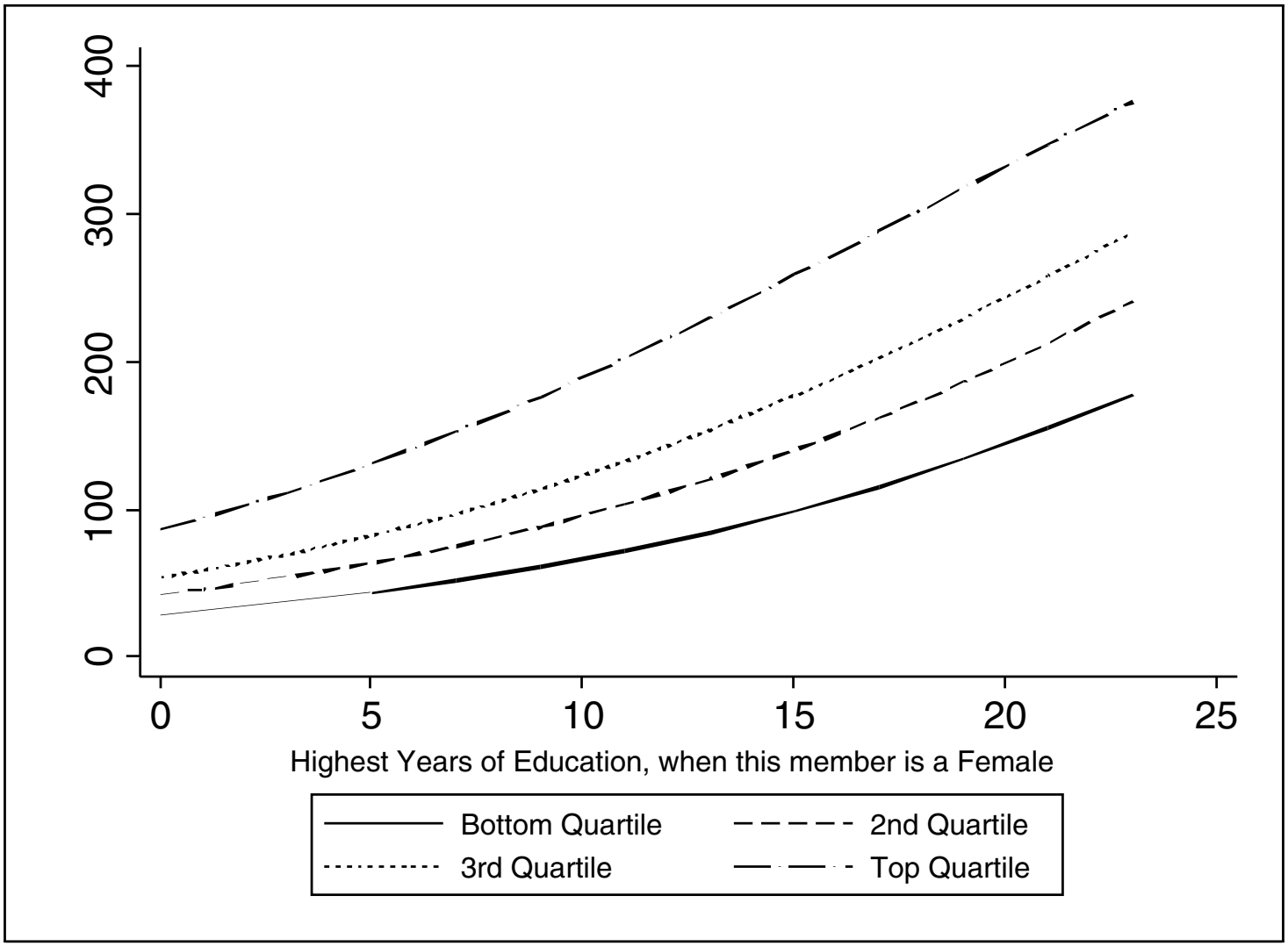


Figure 5. *Averting expenditure: highest years of education (when the member is female) across different wealth quartiles*

Water quality and information

- The Importance of Being Informed: Experimental Evidence on the Demand for Environmental Quality. Journal of Development Economics (2008) – J. Jalan and E. Somanathan

Water quality and information

- The Importance of Being Informed: Experimental Evidence on the Demand for Environmental Quality. Journal of Development Economics (2008) – J. Jalan and E. Somanathan
- A randomised trial in Gurgaon, suburb of Delhi.

Water quality and information

- The Importance of Being Informed: Experimental Evidence on the Demand for Environmental Quality. Journal of Development Economics (2008) – J. Jalan and E. Somanathan
- A randomised trial in Gurgaon, suburb of Delhi.
- Our survey found that awareness about the causes of waterborne diseases was surprisingly low.

Water quality and information

- 1st round: 1000 randomly chosen Gurgaon households surveyed in the winter of 2003. Water samples were taken of unpurified drinking water and purified drinking water if any.

Water quality and information

- 1st round: 1000 randomly chosen Gurgaon households surveyed in the winter of 2003. Water samples were taken of unpurified drinking water and purified drinking water if any.
- Half of them randomised into treatment. Treatment group given results soon after - either dirty water, or clean water, and a handout explaining purification methods and their cost and effectiveness.

Water quality and information

- 1st round: 1000 randomly chosen Gurgaon households surveyed in the winter of 2003. Water samples were taken of unpurified drinking water and purified drinking water if any.
- Half of them randomised into treatment. Treatment group given results soon after - either dirty water, or clean water, and a handout explaining purification methods and their cost and effectiveness.
- A few weeks later, all households were re-surveyed to see if they had changed their purification behaviour.

Water quality and information

- 1st round: 1000 randomly chosen Gurgaon households surveyed in the winter of 2003. Water samples were taken of unpurified drinking water and purified drinking water if any.
- Half of them randomised into treatment. Treatment group given results soon after - either dirty water, or clean water, and a handout explaining purification methods and their cost and effectiveness.
- A few weeks later, all households were re-surveyed to see if they had changed their purification behaviour.
- The treatment group with a dirty result was 11 percentage points more likely to start purifying their water than the control, if they were initially not doing so. The clean result had no effect. The effect was present only above median wealth and education.

Water quality and information

- Revealed preference methods casually used for policy are dangerous!

Water quality and information

- Revealed preference methods casually used for policy are dangerous!
- They will under-estimate the demand for environmental protection because of missing information.

Water quality and information

- Revealed preference methods casually used for policy are dangerous!
- They will under-estimate the demand for environmental protection because of missing information.
- There is less work on social learning and long-run effects. How important is it that information campaigns be sustained? This is likely context-dependent.

Water quality and information

- Revealed preference methods casually used for policy are dangerous!
- They will under-estimate the demand for environmental protection because of missing information.
- There is less work on social learning and long-run effects. How important is it that information campaigns be sustained? This is likely context-dependent.
- Dickinson and Pattanayak

Water quality and information

- Revealed preference methods casually used for policy are dangerous!
- They will under-estimate the demand for environmental protection because of missing information.
- There is less work on social learning and long-run effects. How important is it that information campaigns be sustained? This is likely context-dependent.
- Dickinson and Pattanayak
- Balasubramanya et al, (EDE, forthcoming) in this conference, examines longer-run effects.

Savings behaviour

- How do we know how much saving is appropriate?

Savings behaviour

- How do we know how much saving is appropriate?
- Personal experience is not available. Others' realised experience is out-of-date. One has to do calculations about quantities saved and rates of return to make any judgements.

Savings behaviour

- How do we know how much saving is appropriate?
- Personal experience is not available. Others' realised experience is out-of-date. One has to do calculations about quantities saved and rates of return to make any judgements.
- It's not surprising then, that people may fail to optimise their savings. Madrian and Shea (2001) found that changing the default option in employee savings plans in a company dramatically changed savings behaviour.

Savings behaviour

- How do we know how much saving is appropriate?
- Personal experience is not available. Others' realised experience is out-of-date. One has to do calculations about quantities saved and rates of return to make any judgements.
- It's not surprising then, that people may fail to optimise their savings. Madrian and Shea (2001) found that changing the default option in employee savings plans in a company dramatically changed savings behaviour.
- This research has subsequently been confirmed experimentally and has been used for policy-making.

- From our perspective, the main point is that this is strong evidence that people find it difficult to decide how much and how to save.

- From our perspective, the main point is that this is strong evidence that people find it difficult to decide how much and how to save.
- Other people's savings are largely unobservable, so we should not expect social learning to operate on savings.

- From our perspective, the main point is that this is strong evidence that people find it difficult to decide how much and how to save.
- Other people's savings are largely unobservable, so we should not expect social learning to operate on savings.
- Other people's consumption, however, is observable, and so social learning may matter for savings via imitation of consumption decisions.

- From our perspective, the main point is that this is strong evidence that people find it difficult to decide how much and how to save.
- Other people's savings are largely unobservable, so we should not expect social learning to operate on savings.
- Other people's consumption, however, is observable, and so social learning may matter for savings via imitation of consumption decisions.
- This provides an alternative, perhaps more benign, interpretation of the findings Robert Frank talked about three days ago, that the consumption of the rich "cascades" down the income ladder.

Social effects on savings: Prediction

- To test the prediction of our model, that consumption (and, therefore, savings) should display social learning, we need to show that other people's consumption should affect an individual's consumption.

Social effects on savings: Prediction

- To test the prediction of our model, that consumption (and, therefore, savings) should display social learning, we need to show that other people's consumption should affect an individual's consumption.
- One way to do this is to look for the effect of neighbours' income on an individual's income, after controlling for own income.

Social effects on savings: Prediction

- To test the prediction of our model, that consumption (and, therefore, savings) should display social learning, we need to show that other people's consumption should affect an individual's consumption.
- One way to do this is to look for the effect of neighbours' income on an individual's income, after controlling for own income.
- Since higher income people consume more, if one compares two identical people with the same income living in rich and poor neighbourhoods respectively, then the one in the richer neighbourhood will tend to consume more due to social learning and thus will save less. (Note that this effect will tend to make the rich save more than the poor.)

Social effects on savings: Prediction

- To test the prediction of our model, that consumption (and, therefore, savings) should display social learning, we need to show that other people's consumption should affect an individual's consumption.
- One way to do this is to look for the effect of neighbours' income on an individual's income, after controlling for own income.
- Since higher income people consume more, if one compares two identical people with the same income living in rich and poor neighbourhoods respectively, then the one in the richer neighbourhood will tend to consume more due to social learning and thus will save less. (Note that this effect will tend to make the rich save more than the poor.)
- Is this prediction borne out?

Social effects on savings: Evidence

- Richard Tooth (2005) combined data from the NLSY with the US Census to look at this question.

Social effects on savings: Evidence

- Richard Tooth (2005) combined data from the NLSY with the US Census to look at this question.
- He found that a $1 increase in income in a household's zip code is associated with a 9 cent reduction in family saving. Since the mean savings rate in the data was 10-15%, this is a large effect.

Social effects on savings: Evidence

- Richard Tooth (2005) combined data from the NLSY with the US Census to look at this question.
- He found that a $1 increase in income in a household's zip code is associated with a 9 cent reduction in family saving. Since the mean savings rate in the data was 10-15%, this is a large effect.
- The use of longitudinal data allowed quite fine control for permanent, as opposed to only current, income. It also allowed a check for selection bias by looking at a subsample of households that moved from zip codes with a significantly different median income. The results were robust to this.

Social effects on savings: Evidence

- Kosicki (1987) did a very similar study with similar findings.

Social effects on savings: Evidence

- Kosicki (1987) did a very similar study with similar findings.
- Kapteyn (2000) asked people about their acquaintances' incomes and found that those who reported friends with higher incomes saved less.

Savings and discounting climate change

- There are two views on the appropriate discount rate to use for evaluating the damages from climate change.

Savings and discounting climate change

- There are two views on the appropriate discount rate to use for evaluating the damages from climate change.
- One school of thought favours using a discount rate derived from observed interest rates, while the other prefers a normative approach in which the appropriate discount rate for future consumption is derived from "ethical" parameters of the social welfare function.

Savings and discounting climate change

- There are two views on the appropriate discount rate to use for evaluating the damages from climate change.
- One school of thought favours using a discount rate derived from observed interest rates, while the other prefers a normative approach in which the appropriate discount rate for future consumption is derived from "ethical" parameters of the social welfare function.
- The former approach relies on revealed preference since market interest rates are presumed to revealing individuals' optimal choices between current and future consumption.

Savings and discounting climate change

- There are two views on the appropriate discount rate to use for evaluating the damages from climate change.
- One school of thought favours using a discount rate derived from observed interest rates, while the other prefers a normative approach in which the appropriate discount rate for future consumption is derived from "ethical" parameters of the social welfare function.
- The former approach relies on revealed preference since market interest rates are presumed to revealing individuals' optimal choices between current and future consumption.

Savings and discounting climate change

- Since we now have strong evidence that many individuals are driven by social learning and fail to optimise in their savings behaviour, this assumption is dubious. So policy implications from it should be treated with great caution.

Savings and discounting climate change

- Since we now have strong evidence that many individuals are driven by social learning and fail to optimise in their savings behaviour, this assumption is dubious. So policy implications from it should be treated with great caution.
- The other approach is free of this problem. But it does incorporate strong assumptions about how society's choices should be evaluated, for example, that consumption is all that matters.

Savings and discounting climate change

- Since we now have strong evidence that many individuals are driven by social learning and fail to optimise in their savings behaviour, this assumption is dubious. So policy implications from it should be treated with great caution.
- The other approach is free of this problem. But it does incorporate strong assumptions about how society's choices should be evaluated, for example, that consumption is all that matters.
- It's not clear whether this can be improved upon. Stated preference methods are one possibility.

The rhetoric of preferences

- Valuation of non-marketed goods is, of course, a very important sub-field of economics.

The rhetoric of preferences

- Valuation of non-marketed goods is, of course, a very important sub-field of economics.
- Sometimes the claim is made, that these methods "uncover" preferences, as if such preferences actually existed in the way that Fermat's Last Theorem exists.

The rhetoric of preferences

- Valuation of non-marketed goods is, of course, a very important sub-field of economics.
- Sometimes the claim is made, that these methods "uncover" preferences, as if such preferences actually existed in the way that Fermat's Last Theorem exists.
- It should be clear by now that I believe that people discover what they like and the best choice to make in a process of discovery. Consequently, I prefer to treat non-market valuation methods as "best guesses" about what people would choose if they were in a position to actually do so.

Fertility behaviour

- Clearly this is likely to be heavily influenced by social learning for the same reasons as savings behaviour.

Fertility behaviour

- Clearly this is likely to be heavily influenced by social learning for the same reasons as savings behaviour.
- Becker and Duesenberry.

Technology adoption in agriculture

- New varieties of seeds are often adopted with extreme rapidity.

Technology adoption in agriculture

- New varieties of seeds are often adopted with extreme rapidity.
- This is because it is easy to observe the payoffs that other farmers get from the new variety.

Technology adoption in agriculture

- New varieties of seeds are often adopted with extreme rapidity.
- This is because it is easy to observe the payoffs that other farmers get from the new variety.
- Technologies that affect soil fertility and long-run yields, may however, be much more dependent on neighbourhood effects, because the payoffs are harder to observe.

Conclusions

- We need to be discriminating about the reliability of the standard model of choice theory, depending on the context. Otherwise, as a profession, we lose credibility.

Conclusions

- We need to be discriminating about the reliability of the standard model of choice theory, depending on the context. Otherwise, as a profession, we lose credibility.
- The nature of learning is crucial to further understanding, and a very exciting avenue for research is more on individual and social learning that determines how choices are made and how close to optimal they can be expected to be.

Conclusions

- We need to be discriminating about the reliability of the standard model of choice theory, depending on the context. Otherwise, as a profession, we lose credibility.
- The nature of learning is crucial to further understanding, and a very exciting avenue for research is more on individual and social learning that determines how choices are made and how close to optimal they can be expected to be.
- Behavioral economics now consists largely of a disjointed bunch of findings that contradict mainstream theory. A theoretical integration of behavioural economics with mainstream theory is a goal we should aim towards, which means testing theory more rigorously as it is developed.

Conclusions

- We need to be discriminating about the reliability of the standard model of choice theory, depending on the context. Otherwise, as a profession, we lose credibility.
- The nature of learning is crucial to further understanding, and a very exciting avenue for research is more on individual and social learning that determines how choices are made and how close to optimal they can be expected to be.
- Behavioral economics now consists largely of a disjointed bunch of findings that contradict mainstream theory. A theoretical integration of behavioural economics with mainstream theory is a goal we should aim towards, which means testing theory more rigorously as it is developed.
- The model given here is one attempt in this direction.