ARE261 Blog: Sense and Sensibility of Consumers

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Professors, researchers, journalists, legislators: What do you mean when you use the word *"consumer"*?

I am not asking for a definition like "one that utilizes economic goods" from Merriam-Webster; Nor am I satisfied with explanation from my mum, who pays visit to farmers' market almost everyday and claims that she knows everything about consumption, "A consumer is whoever has money and use that to get whatever makes her life better, foods, cloths, cars, etc.". After studying her for seven years as a economic students, I still know her much less about a friend I just met two weeks ago.

I treat the term *consumer* with such caution, because I know that they are not as simple as they sounds. Consumers, in academic papers, business school cases or newspapers, are surprisingly changeable: they are sometimes assumed to be walking calculators and masters of discounting practices, but now and then they are just human beings living a Yolo lifestyle and rule of thumb users; their demands are the source of vitality of the entire economy, while their welfares are the ultimate goal of social planners; they speak occasionally in one voice, enjoy bananas and apples in the same way, but more often they have different tastes; they can make decision in one second and buy stuffs with one click, or they can engage in prolonged searching, learning, evaluating, bargaining activities. Now will you tell me what exactly is the subject I am dealing with?

This is not an easy question (and I personally think giving a simple response will lose the value of asking it). In this blog I just want to show how some energy economists studying car purchase behavior try to answer it and why it matters for their analysis, or for energy policy designs in general. The two papers mentioned are Grigolon et.al. (2017) *Consumer valuation of fuel costs and tax policy: Evidence from the European car market* and Jim Sallee (2014) *Rational Inattention and Energy Efficiency*

How do economists turn a 3-D flesh into a 1-D component in their models?

Mankind is so complex that the most elongated novel cannot precisely grasp the complete picture of human nature, let alone even more parsimonious depictions. Nevertheless, for economists, precision is not the focus, as human beings themselves are not the goal of the studies. Consumers, however complicated, are only one component of the entire market, whose performance is what economists ultimately care about. Descriptions of human behaviors in economic models need to be simplified to (mathematically) tractable level, but meanwhile without loss of generality, i.e., preserving the characteristics that drive consumers to make decisions in a "reasonable" way.

A common method is to treat them as mathematicians. Following a utility function and optimization rule, they take a set of inputs and output a number, which determines the choice they eventually made (sometimes a level; sometimes simplified as a to-be-or-not-to-be situation). This approach is powerful: easy to manipulate (all we need to do is solving math problems) and to extend (most of decisions can be represented in this way).

The most important innovations are baked in the process of determining how this one number is calculated. The machinery are essentially functional forms and parameters, or

the multipliers, of different inputs of the utility function. Economists, playing the role of gods, "construct" the hypothetic universes, "design" game rules for consumers living in that universe and "observe" the outcomes. Take paper of Grigolon et.al. for example. In their world, consumers' only task is to choose cars using numbers outputted by the following rule:

$$u_{ijk} = x_{jk}\beta_i^x - \alpha_i(p_{jk} + \gamma G_{ijk}) + \xi_{jk} + \varepsilon_{ijk}$$

Every notation in this single equation contains important information about the consumers: x_{jk} are observed car and engine characteristics, and to what extent that they are valuable for the consumer is different for individual i (β_i), but this individual cannot use different criterion to select different models; α_i is the marginal utility of income, again varies across individuals; p_{jk} represents prices, which are reasonably vary across cars, not individuals; γ is the attention weight or future valuation parameter, no variation across the whole population and different cars; G_{ijk}, on the other hand, are the present discounted value of future fuel costs and vary both in the dimension of individual consumer and specific type of cars; ξ_{jk}, unobserved product characteristics, do not vary across individuals; finally ϵ_{ijk}, random "taste parameter", captures everything else and is assumed to have particular distribution.

What is special about this world? Take closer look at the equation again. Consumers, when thinking about whether to buy a car, not only look at one-time price of the car, but also consider future expenses needed to be made on it. They are allowed to be distinct from each other, just because α_i and β_i have a subscript. They are also allowed to be "myopic",i.e. mistakenly estimating future fuel costs, with the presence of γ.

In comparison, Jim's paper uses the following decision rule to model "rational inattention".

$$U_{ij} = \beta' \boldsymbol{X}_j - p_j - (\bar{c}_j + c_j) + \boldsymbol{\varepsilon}_{ij}$$

$$\equiv W_{ij} - c_j,$$

If you are a detail-oriented reader, you will quickly discover that the β in this universe is different - it's constant over all consumers, i.e., everyone is the same in terms of valuating car characteristics. They are not short-sighted about future fuel costs in a systematically way, but they make "guess", and the best guesses c_j for different cars j are different. The key design is there are two random error terms here: c_j is from inattention (lack of information) and ϵ_{ij} is from taste. Combination of the two helps Jim Sallee to characterize how consumers value additional product information.

What should policy makers care?

Painful efforts have been exerted and myriads of policies are proposed by the governments around the world to reduce emissions from passenger cars, including Carbon Dioxide and other toxic pollutants. They could take effects via various channels: on consumers' part, they can change the amount they drive, become a better driver (e.g. learn tricks to save gas), purchase a "cleaner" car, replace the type of fuel they use, etc.; on producers' part, they can spend money in R&D and advertisement for greener cars, change their product lines, manipulate prices, use engineering tricks to alter model performance, etc.

In regulators' arsenal there are lots of policy instruments: fuel taxes, vehicle taxes, standards, Cap-and-Trade programs, media, etc. Just like weapons, they are suitable for different targets, can bring different side-effects, and have different requirements for implementation.

To understand consumers is to recognize the targets, to predict their responses and to customize the battle plan, so that the policy maker with limited knowledge can achieve the goal with minimized costs and maximized benefits, and balance distribution of costs and benefits across groups.

For instance, using their setup, Grigolon et.al. find that fuel taxes are more effective in reducing fuel usage than product taxes based on fuel economy. Moreover, fuel taxes also perform better in terms of total welfare even when usage demand is held completely fixed because fuel taxes better target the right consumers, those with a high mileage, to purchase more fuel efficient cars. Jim Sallee, on the other hand, conclude from his model that due to rational inattention, consumers may correctly recognize and properly value fuel cost differences across broad product categories, but they may not value small differences correctly. It is possible for consumers to correctly value the energy efficiency of products that are available in the market, but there can simultaneously be an inefficient provision of energy efficiency.

This is just a very brief presentation of consumers in worlds created by economists. The key message is that sometimes less is more - even one single equation are enough to capture a lot of interesting characters of the logics, emotions, actions, relations of the most complicated creatures.