Handout 4: Applications of Consumer Choice

1 Introduction

In this handout we will focus on applications of the consumer choice problem we discussed in previous handouts. First, we will focus on various true or false questions that will explore income and substitution effects, normal vs inferior goods and complementarity between goods. These questions will test your knowledge and require you to apply the consumer theory in different scenarios that could potentially appear in empirical applications. Second, we will apply the consumer theory for the Labor Supply problem. A worker dislikes work and enjoys leisure, but simultaneously enjoys consumption wages that work can buy. We will show how to solve the Labor Supply problem and discuss a channel through which technology could affect the labor supply that has been discussed in the academic literature.

2 True or False

1. All Giffen goods are inferior but not all inferior goods are Giffen.

2. If goods x and y are perfect complements, then when the price of x changes, all the change in the demand for good x must be attributed to substitution effect.

3. Suppose that when his weekly income decreases from \$1000 to \$800, Robert buys more eggs, i.e., eggs are an inferior good for Robert in this income range. Eggs are definitely a normal good for Robert in *some* other income ranges.

4. In a world with only two goods, both of these goods can be inferior.

5. When Bob went to the market to buy some T-shirts and pants, he expected the price of shirts to be \$8 and the price of pants to be \$12 and made plans accordingly. When he got there, he discovered that the actual prices were higher than he expected: \$10 for T-shirts and \$15 for pants. He adjusted his purchase accordingly. Assuming that both goods are normal goods, the income effect of the price change led Bob to buy fewer of both goods, and because pants' price went up by more than T-shirt's price, the *substitution effect* led Bob to purchase more T-shirts and fewer pants.

Solution.

1. *True.* Suppose that the price of good X increases. The substitution effect will be positive for all other goods that are not X, since they are now relatively cheaper and will be negative for good X, which is now relatively more expensive. The income effect will be negative for all normal goods and positive for all inferior goods, since there is a reduction in real income due to the increase in prices - that is, your old income cannot buy your old bundle anymore. Therefore, for good X, the substitution effect is negative and the income effect is positive (if inferior) and negative (if normal). Therefore, if good X is normal, there will be a reduction in the optimal quantity of good X, which implies X is not a Giffen good. Therefore, normal goods cannot be Giffen goods and thus all Giffen goods are inferior - which is exactly the first part of the statement.

   Moreover, if good X is inferior, then it may be the case that the income effect is larger than the substitution effect - in which case X would be a Giffen good, or it may be the case that the substitution effect is larger than the income effect, in which case X is just inferior, but not a Giffen good. Therefore, some inferior goods are Giffen goods, but some are not - which is exactly the second part of the statement.

2. *False.* If two goods are perfect complements, there is no substitution between them. An example is left foot and right foot shoes. There is no rate at which people are willing to replace one left foot shoe by right foot shoes if they have the same amount of left and right shoes to begin with. With these type of preferences, all the change must be attributed to *income effect*.

3. *True.* This is a hard/tricky question. If Robert was in some moment consuming a positive quantity of a good, it must be the case that this good was normal for some level of income. Technically, this comes from the fact that for a zero level of income, Robert can only consume zero of all goods. Therefore, if consumption is positive at any level, it must be the case that it increased from zero - which was the consumption level with zero income - and thus was normal at some income level.

4. *False.* It cannot be the case that in a world with two goods, both of these goods are inferior. When I goes up, you have to spend more money on something (assuming more is better, i.e., assuming non-satiation holds). If both were inferior goods, you would end up spending less on both. That cannot be optimal if non-satiation is satisfied. (In fact, even if non-satiation is not satisfied, you still cannot have both goods be inferior. Your original bundle is still affordable

when your income rises, so you cant switch to something else that was also originally affordable when the income goes up. That would imply a violation of transitivity.). With three goods, for instance, it could be that two are inferior - we only need one good to be normal for the logic for two goods to go through. In particular, when income increases, the consumption of at least one good must go up due to revealed preferences - if the consumption of no good went up, we would have that the new bundle would be affordable at the old income and prices.

5. *False*. The relative price of goods did not change with change in prices: before and after the relative price of shirts relative to the price of pants is $\frac{8}{12} = \frac{10}{15} = \frac{2}{3}$. This implies that there is no *substitution effect* in this example, since the substitution effect comes from changes in the relative price of goods.

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3 Labor Supply

Objective. *In this example we will apply the consumer choice framework to an applied problem. We will focus on how labor supply of young men changes when technology changes. The idea is that online gaming and technological advances has made staying at home playing video-games much more pleasurable, which changes the trade-off in terms of how many hours individuals are willing to work. Remember that the two key concepts in the consumer choice framework are the budget constraint and the indifference curves. The budget constraint in a labor choice problem is in terms of labor and leisure. A person has 24 hours in a day - and must choose how much time is spent working and not working (which we will call leisure). When working, the person receives a wage w per hour. In terms of indifference curves, we will assume workers dislike working, but enjoy leisure and consumption coming from wages. Technology will shift workers preferences such that they derive more utility from leisure relative to consumption.*

Consider an agent that must solve the problem below to determine his leisure N and consumption c given wages w. When technology T evolves (cheaper and better video-games, streaming etc.), the agent values more his leisure time, as in the following utility function

$$\max_{c,N} \; c^{1/2} + TN^{1/2} \quad \text{subject to} \quad \frac{c}{w} + N = 24$$

1. Explain the economic meaning of each term in the budget constraint.
2. Solve the consumer problem as a function of T.
3. How does labor supply react when T increases? Explain.

Solution.

1. The worker has 24 hours to allocate in the day. He can choose to work L and have N hours of leisure. It must be the case that:

$$L + N = 24$$

If the agent works L hours, it makes $L \times w$ in income, which he uses for consumption. Therefore:

$$c = L \times w \Rightarrow L = \frac{c}{w}$$

It must then be the case that:

$$\frac{c}{w} + N = 24$$

2. We can see the labor choice as a utility maximization subject to a budget constraint. The utility function is

$$U(c, N) = c^{1/2} + TN^{1/2}$$

We can re-write the budget constraint as:

$$\frac{1}{w}c + N = 24$$

In our consumer choice framework, this corresponds to having an income of 24, and choosing between the consumption of two goods N and c. The price of good N is 1, while the price of good c is $1/w$. If wages are high, the price of consumption is relatively small to leisure or, equivalently, the price of leisure is relatively high with respect to consumption. The idea is that a worker that makes \$500 per hour is giving up more consumption by choosing 1 extra hour of leisure than the worker that makes \$20 per hour.

The tangency condition can thus be written as:

$$\frac{MU_c}{MU_N} = -\frac{p_c}{p_N}$$

where from the previous paragraph we have that $p_c = 1/w$ and $p_N = 1$. In our example:

$$MRS_{c,N} = -\frac{\frac{1}{2\sqrt{c}}}{\frac{T}{2\sqrt{N}}} = -\frac{1}{T}\sqrt{\frac{N}{c}} = -\frac{1}{w}$$

Therefore:

$$\frac{N}{c} = \left(\frac{T}{w}\right)^2 \Rightarrow N = \left(\frac{T}{w}\right)^2 c$$

By solving the tangency condition, we can get what is the optimal consumption and leisure as a function of each other. To solve for c, N, we replace the equation above in the constraint:

$$\frac{1}{w}c + N = 24 \Rightarrow \frac{1}{w}c + \left(\frac{T}{w}\right)^2 c = 24$$

Therefore:

$$c = \frac{24w}{1 + \frac{T^2}{w}}$$

and:

$$N = \left(\frac{T}{w}\right)^2 c = \left(\frac{T}{w}\right)^2 \frac{24w}{1 + \frac{T^2}{w}} \Rightarrow N = \frac{24}{\frac{w}{T^2} + 1}$$

3. Leisure time increases with technological advancements in this model. To see that, note that when $T \uparrow$, the ratio $\frac{w}{T^2} \downarrow$, so the denominator is decreasing in T. As a consequence the fraction must be increasing in T. Some researchers argue that this channel could be behind a decline in labor hours for younger men when compared to older men or women:

> "*Younger men, ages 21 to 30, exhibited a larger decline in work hours over the last fifteen years than older men or women. Since 2004, time-use data show that younger men distinctly shifted their leisure to video gaming and other recreational computer activities. We propose a framework to answer whether improved leisure technology played a role in reducing younger mens labor supply.Since 2004, time-use data show that younger men distinctly shifted their leisure to video gaming and other recreational computer activities.*"(Aguiar et. al. (2017): 'Leisure Luxuries and the Labor Supply of Young Men'.)

There is still some debate over the evidence if this is an important channel on labor supply.

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