Chapter 7

Income and Substitution Effects

I. What Are Income and Substitution Effects?

Whenever the price of a particular good or service, say good X, changes, holding all other variables constant, there will be two effects on the quantity demanded of X. These two effects are added together to get the total effect on the quantity demanded of X for a change in the price of X. The first effect is called the substitution effect and the second effect is called the income effect.

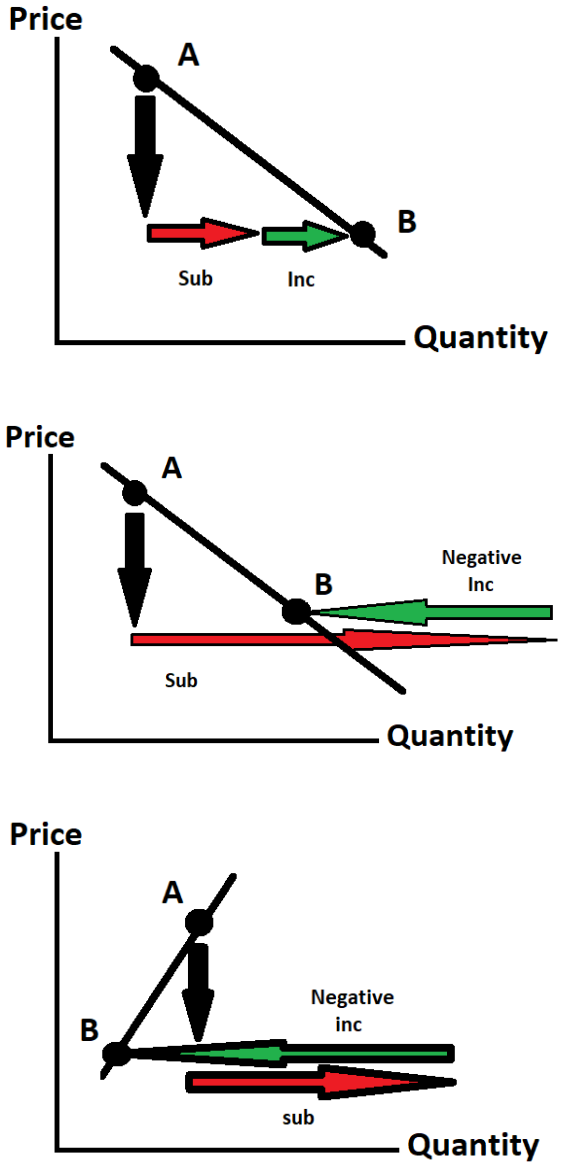
The substitution effect of a price change is exactly as the name implies. Let's say that the price of X falls. This will cause consumers to substitute increased X for less of other goods. The fall in the price of X causes consumers to want to buy more of X. The substitution effect is *always* negative. That is, a fall in the price of X causes an increase in the quantity demanded of X. They are inversely related. Cheaper X means buy more X in this case. How much more? The substitution effect can be very large or very small, but regardless of its size, it must be negative to the price change. Conversely, a rise in the price of X means buy less X. Again, the substitution effect is negative.

The income effect of a price change will depend on whether the good is a normal or an inferior good. Here is the reason. When a price falls it makes the good in question cheaper. This much we know already. But, a fall in price also means that one's money income will now be larger; its purchasing power is higher. The purchasing power of one's income has risen, even though the money value of income is being held constant by assumption. Now, if the good is a normal good, a rise in the purchasing power of income will cause the consumer to want to buy more of it. Alternatively, if the good is inferior, a rise in the purchasing power of income will make the consumer want to buy less of it.

The income and substitution effects can be conceptualized using a demand curve. The figure below shows how we can separate out these two effects, at least theoretically. There are three possible cases to consider. These three cases are shown in the figure. For each case, this is what happens. First, a fall in the price of good X means that the consumer will shift his expenditure towards more X since it is cheaper. He can in fact buy more of X and still stay on the same utility, through buying less of other goods (in total). Note that he will now have income left unspent since we keep him on the same utility level by assumption. But, this means that he can now use his additional

purchasing power left over to buy even more of good X, if it is normal, or less of good X if it is inferior. If X is a normal good, then the income effect reinforces the substitution effect. If X is an inferior good, then the income effect will offset some (or perhaps more) of the substitution effect. If it offsets more than the substitution effect, we say that good X is a Giffen good and we get an upward sloping demand curve. This is very unusual to say the least. Economists generally believe

Figure 1- Three Possible Cases of the Slutsky Decomposition



that exceptions to the law of demand are few and far between.

The decomposition of a price change into a substitution effect and an income effect was first shown by a Russian economist and probability theorist named Eugen Slutsky just before the Russian revolution of 1917. This decomposition, sometimes called the Slutsky equation, is now taught as standard microeconomic theory to millions of students each year. It can also be expressed in elasticity form. Given the rational utility-maximizing model of the consumer, the Slutsky decomposition is considered true for any change in the price of a good or service. You may be interested to know that this decomposition is closely related to the construction of price indexes. Price indexes help us to sort out how much price in general changes and how much quantity in general changes, whenever there is a change in two or more prices in a budget over time. It lets us know what inflation is and how big real economic growth is. Naturally, this is quite important to determining how the standard of living is changing for people.

Actually, there are two ways of considering the substitution effect. In the original Slutsky version, one has a change in the price of X and then, holding utility constant, one sees how much the quantity demanded of X changes. In the Hicks version, one has a change in the price of X and then, holding total expenditure constant, one sees how much the quantity demanded of X changes. The Hicks version is sometimes used because income can be observed, whereas utility cannot be observed. The Hicks definition of substitution approximates the true Slutsky version of the effect. For small changes in the price, the two measures are about the same.

II. Using the Income and Substitution Effects

Although the analysis of income and substitution effects that we have shown above is one of the most famous in microeconomics, it is not easy to find examples where this information is directly applied. It would appear to be a sophisticated decomposition without many obvious applications. Part of the reason for this is that it is the final effect of the price change that is important to most people, regardless of how big the decomposed income and substitution effects are. As we have said, the construction of index numbers is a process that must consider closely the income and substitution effects. There are some other reasons why that we should be aware of these income and substitution effects.

The income and substitution effects are important in helping policymakers determine whether a sales tax or an income tax should be imposed and how high the rates should be. In general, if we only consider income and sales taxes in their pure form, we tend to favor an income tax, since a

faithful comparison of taxes that raise the same revenue shows income taxes produce a higher level of utility than sales taxes. Naturally, there are other important factors to be considered, such as how such taxes are to be collected and enforced and how equity is to be ensured.

Another way that the Slutsky decomposition is used is explaining the effect of a change in interest rates on saving. Saving is merely future consumption and 1/(1+interest rate) is the price of future consumption. This means that any change in the interest rate must produce a substitution effect and income effect. A higher interest rate causes a reduce in consumption now and an increase in saving, which is consumption later. This is the substitution effect. However, a fall in the price of future consumption due to a rise in the interest rate means that the same level of income will allow one to consume more now and in the future. This is the income effect. The total impact of a rise in the interest rate is moot – it may increase or decrease saving. Generally, economists feel that the substitution effect will outweigh the income effect and saving will indeed rise with an increase in interest rates, but the effect may be small.

Yet another way to employ income and substitution effects is to consider the effect of a rise in the wage rate on the quantity of labor supplied. This is again a demand issue since the household is demanding leisure. If you are not enjoying leisure, then you are laboring. Therefore, the demand for leisure is the inverse of the supply of labor. The wage rate then becomes the price of an hour of leisure. If you do not work, then you lose earning the wage. That's the price of leisure. We say that the price of leisure is the wage rate.

The combination of income and substitution effects also shows how that the income elasticity is related to the point price elasticity. The elasticity version of the Slutsky equation is as follows

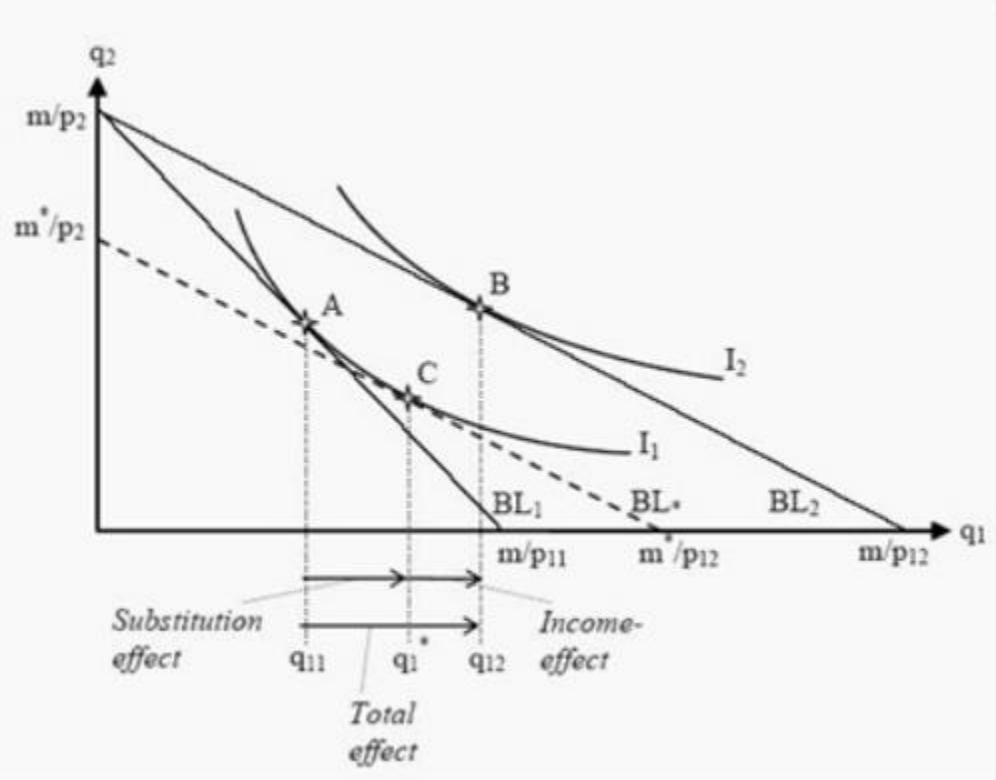
$$\varepsilon_x = e_x + k_x \eta_x$$

where $\varepsilon_x =$ the price elasticity of the Marshallian demand, $e_x =$ utility constant price elasticity of the constant utility demand, $k_x =$ proportion of income spent on good X, and $\eta_x =$ income elasticity of demand for good X. One innovative way of looking at the matter is to treat the point price elasticity of the Marshallian demand, ε_x, as a proxy measure of sales risk, with zero elasticity representing zero risk and infinite elasticity representing unbounded risk. This risk is something a firm facing a downward sloping demand must confront. The decomposition above shows that the

firm faces two kinds of risk – the risk of substitutes and competition on the market (e_x) and the risk of an economic recession pushing down consumer incomes, (η_x). Finding ways to compensate or hedge these two types of risk is something the firm will naturally try.

III. Indifference Curve Analysis of Income and Substitution Effects

We finish this lecture about income and substitution effects by showing how one can relate these to indifference curves and budget constraints. This is shown in the figure below. We will discuss this figure in class, along with some interesting modifications.



Questions:

#1. Suppose the money price of good X is P_X and the money price of good Y is P_Y. How would we define the relative price of X in terms of Y. What is the relative price of Y in terms of X?

#2. Why is the substitution effect always negative?

#3. What is the real income measured in terms of good X? What is the real income measures in terms of good Y? Is it possible to measure real income in terms of a composite good X and good Y? Explain.

#4. Suppose that the price of good X rise. How much do we need to "compensate" the consumer to make him stay at the same original utility level? Draw a graph. Compensate means give him enough income to stay on the same utility level as before.

#5. Is it possible that the income effect for an inferior good exactly offsets the substitution effect so that there is no change in quantity demanded, even though the price has risen? Draw a graph.

#6. Why is it reasonable to say that a low price elasticity of demand indicates low sales risk to the firm? A ***necessity*** is a good with a low income elasticity (say $\eta < 1$). Will a necessity have a low price elasticity? Explain.

#7. How can the price elasticity for good X be split between (i) the number of substitutes and (ii) the state of the economy?