CV and EV
Measuring Welfare Effects of an Economic Change

ECON 483 ST in Environmental Economics **Kevin Wainwright**

Welfare and Economic Change

Welfare is, in simple terms, the level of well-being of a group. It is sometimes thought of as the aggregate of utility (individual well-being). Whenever there is an economic change in society, there is usually and associated change in welfare.

The two most common forms of economic change are;

1. The opening or closing of a market (i.e. *A new good is invented or a current good ceases to exits*)
2. There is a change in the relative price of a good. (i.e. *it is now cheaper or more expensive relative to other goods)*

Whenever an economic change occurs an individual moves from one equilibrium point to another equilibrium point. This means that they move from one indifference curve to another indifference curve. The change in well-being is measured by the difference in utility. However utility is an unobservable number; therefore economists attempt to convert the change into some index that can be observed, such as money. The idea being that any economic change can be off-set by a lump-sum transfer of money. If the transfer amount is known, then its size can be interpreted as being proportional to the magnitude of the welfare change.

There are two measures that are used: *Compensating Variation* (CV) and *Equivalent Variation* (EV)

CV: Compensating Variation

CV, or compensating variation, is the adjustment in income that returns the consumer to the *original utility* after an economic change has occurred.

In the case of a positive economic change (such as a fall in price of a good), CV is often referred to as the *maximum* a consumer is willing to pay in order to have the economic change happen. When there is a negative economic change, CV is the *minimum* the consumer needs in order to accept the economic change.

EV: Equivalent Variation

EV, or equivalent variation is the adjustment in income that changes the consumer's utility equal to the level that would occur IF the event had happened.

In the case of a positive economic change, such as a fall in price, EV would be the increase in income that would give the consumer the same additional utility that would happen if a price did fall. In the case of a negative economic change, EV would be the amount of income that would be taken away to lower the consumer's utility to the level that would happen if the change had occurred.

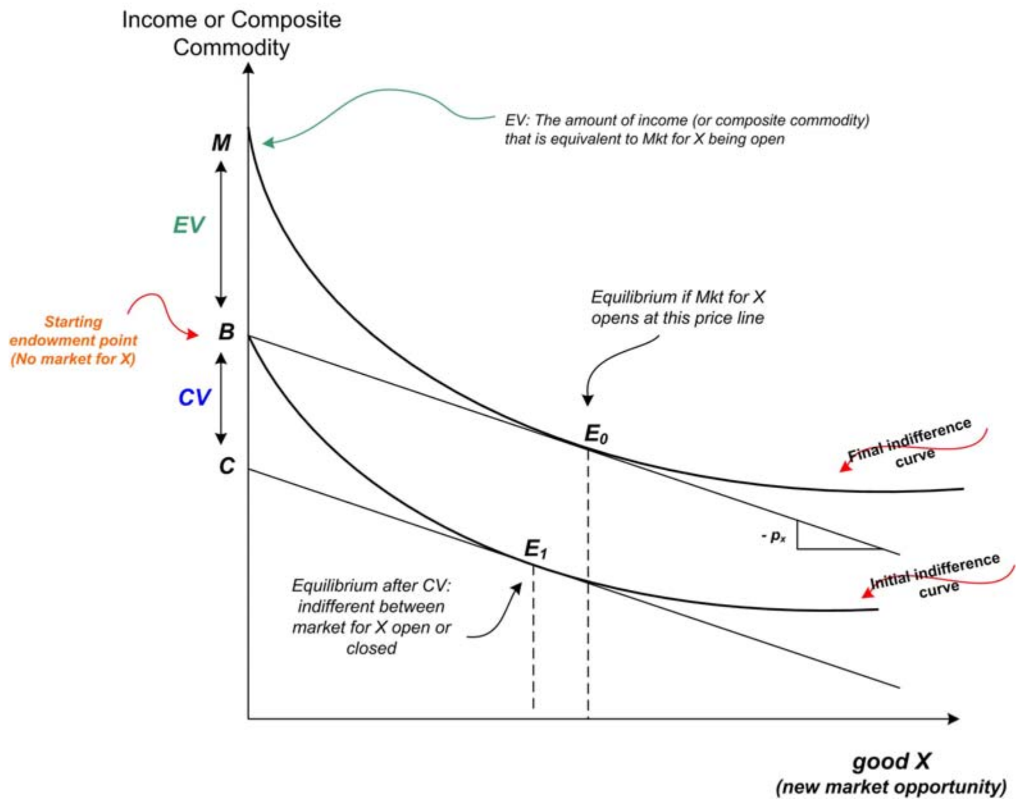

Figure 1:

Working with CV and EV

Let y be the composite commodity (all other goods) and x be the good of interest. The price of y and x are p_y and p_x, respectively, where the price of y is normalized to one ($p_y = 1$). The consumer's budget is given as B. Therefore the budget constraint is

$$B = p_y y + p_x x = y + p_x x$$

rewriting the budget constraint into standar slope/intercept format[1] yields

$$y = B - p_x x$$

Note that the slope is $(-p_x)$, the price of x. When $x = 0$ then $y = B$. Because $p_y = 1$ we can measure y and income in the same units on the vertical axis.

The consumer maximizes utility $U(y, x)$ subject to the budget constraint. Graphically this means that the consumer will choose a bundle (x and y) that allows him to reach the highest indifference curve. This implies two possible solutions:

1. Interior solution: The highest indifference curve is the one that is *Tangent* the the budget constraint (see point E_0 in figure 1)
2. Corner solution: If tangency cannot be reached, the solution will be at one of the intercepts. For example, if the consumer is prohibited from buying *ANY* of good x then only good y can be consumed (see point B in figure 1)

[1] $Y = mX + b$ is the standard format from highschool algebra m is the slope and b is the vertical intercept

Quick tip for Price Changes:

CV is *Old* utility at *New* price
EV is *New* utility at *Old* price

CV and EV for the introduction of a new good

Figure 1 illustrate the introduction of a new good. Initially the consumer is at point B, which is the vertical intercept of the initial indifference curve. When the market for x open at the price ratio $P_x/1$, the consumer trades from point B along the budget line to point E_0, where the budget line is tangent to the final indifference curve.

The welfare gain from having the market for x opened is captured by movement from the initial indifference curve to the final indifference curve. Note that it is the change in utility that is relevant, NOT the change in any quantities of goods consumed.

Finding CV

To find the maximum willingness to pay for the market to open, we shift the budget constraint parallel by the distance B to C. The new budget line is tangent to the initial indifference curve at point E_1. The consumer is indifferent between points B and E_1. the distance BC is the compensating variation.

Finding EV

Once the market is open the consumer moves to point E_0 and the change in utility is from the initial indifference curve to the final indifference curve. Point M in figure 1 is on the same indifference curve as point E_0. Rather allowing the market for X to open, an increase in the consumer's income from point B to point M, thereby moving the consumer from the initial indifference curve to the final indifference curve, thus giving the consumer the same welfare gain as if the market X had opened. The distance BM is the equivalent variation.

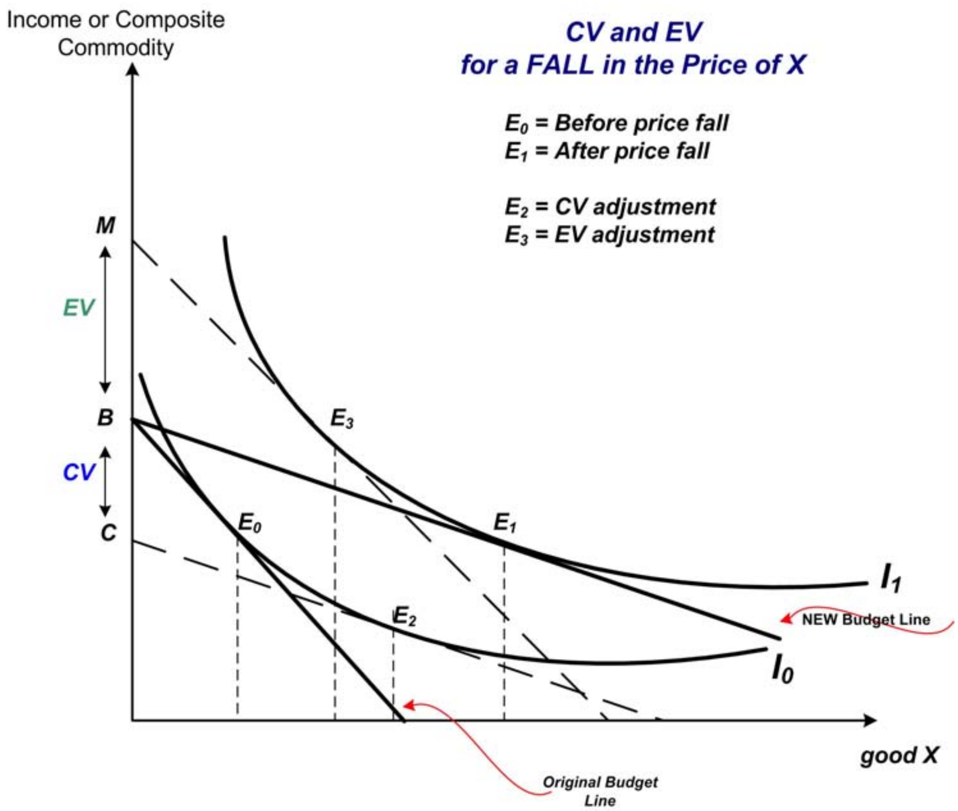

Figure 2:

Finding CV and EV when the price of a good falls

In figure 2 the consumer is initially at point E_0 on the original budget line and has a utility denoted by I_0. Then the price of x falls and the budget line rotates out (*NEW Budget Line*) and the consumer's new equilibrium is now E_1. The consumer's new utility is I_1.

CV is "old indifference curve, but new price ratio". Therefore we shift the new budget line parallel until it is tangent to the original indifference curve. At point E_2 the dashed budget line is tangent to the original indifference curve, I_0. The vertical intercept of the dashed budget line is at point C. The parallel shift of the new budget line is distance BC which is the compensating variation of a price fall.

EV is "new indifference curve at the old price ratio". Therefore we shift the original budget line parallel until it is tangent to the new indifference curve. This occurs at point E_3. The shifted budget line has a vertical intercept is point M. The distance BM is the equivalent variation.

Problems

1. Myrtle has \$200 per month to spend on Transit (X) and all other goods (Y). She currently buys a bus pass for \$50 and rides 40 times per month.If she didn't buy the pass, bus rides would cost \$2/ride. Myrtle is offered to join a Transit program that would allow her to pay a membership fee and then could ride the bus for \$1 per trip. The most Myrtle would pay for the membership is \$20. and then she would ride 15 times a month. If she were given the membership for free, she would ride the bus 18 times per month. Myrtle also reveals that she would be indifferent between a free membership (and \$1 per ride) versus simply having the traditional bus pass reduced to \$25 per month (flat rate), where she would again choose to ride the bus 40 times a month.

   (a) Using all the information provided, draw all the relevant budget constraints and indifference curves. Be sure to label all equilibrium points and have a legend that explains each point (in one or two sentences).

   (b) Calculate her CV (compensating variation)

   (c) Calculate her EV (equivalent variation)

2. Skippy has the following utility function: $u = xy$ and faces the budget constraint: $M = p_x x + p_y y$. Her associated marginal rate of substitution is $MRS = \dfrac{y}{x}$

   (a) Use the $MRS = p_x/p_y$ and the budget constraint to find Skippy's demand functions.

   (b) Suppose $M = 120$, $P_y = 1$ and $P_x = 4$. What is Skippy's optimal x, y and utility number? If the price of x was lowered to 2 what would be her x, y and utility number

   (c) What is the most Skippy would pay to have P_x lowered to 2?

   (d) Suppose $M = 120$, $P_y = 1$ and $P_x = 4$. How much additional income would Skippy need to be as well off as if the price of x had fallen to 2?