Market Feedback Effects

One of the most important questions that economists are asked to answer is to estimate the welfare effects of some event. Often it is the welfare effect of a tax or regulatory policy. Sometimes the event is caused by technological progress. It is important for us to understand the limits of our science.

To this end, let's analyze the problem given in Layard & Walters involving the welfare effects of a change in two prices. (See p. 147) [1]They pose the situation where the price of televisions falls due to some technological breakthrough. This causes the demand for movies to decline because movies and tv are substitutes and (presumably) movies are produced with an upward sloping supply curve. A secondary effect of this is for the price of movies to fall. The question is what is the effect on total consumer surplus from the joint change in the price of tv's and movies? L&W do an excellent job of analyzing this problem and I largely repeat their work here. However, I preface it with a couple of remarks.

The effect of a price change in one good on other goods is generally considered to be only of a second order of magnitude. That is, most economists assert that we can dismiss its impact without great concern because it is necessarily small. I think that this view is mostly an empirical generality based on the following: From our analysis of the theory of consumer behavior, recall that the gross substitution effect in the two good case is

$$\boldsymbol{e}_{21} = -\frac{\boldsymbol{k}_1}{1-\boldsymbol{k}_1}(\boldsymbol{e}_{11}+1)$$

where good one is tv's and good two is all other goods. The net effect on all other goods from a change in the price of tv's is proportional to the ratio of the budget share of tv's to everything else. Even for a necessity like tv's, this is a small number, so the total effect of all the shifts in all other goods has to be small. Also, the effect is proportional to the own-price elasticity. The more elastic is demand, the bigger the gross cross effect can be.[2] However, we expect that as demand becomes more elastic, the budget share falls.[3] Again, the expectation is that the magnitude of any ripple effects in other markets based on a change in one market will be small.

There is another aspect to the problem that L&W do not address at this point in their book but I would like to point out. The total welfare effect includes both consumer and producer surplus. In the first market where technological change occurs, it is reasonable to consider the consumer surplus effects alone. However, the only way we get feedback effects is if there is a positively sloping supply curve in the secondary market. In other words, if the supply curve for movies is flat, then there is no price change even if the demand curve shifts. Hence, to the extent that shifting demand curves in the secondary market cause price changes there, it must be because of positively sloping supply. Positively sloping supply implies producer surplus, in which case, the full welfare effect only comes from analyzing both consumer and producer

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[1] Layard & Walters (1978) p. 147
[2] And it must be elastic for the gross cross price effect to be positive.
[3]This is not a rule, just a casual empirical observation. Look at the Chinese demand system estimates. There is a loose, negative correlation between price elasticity and budget share

surplus. As we will see in a moment, any consumer gains in the secondary market from lower prices are mitigated by producer losses. Nonetheless, analysis of this problem has some value in working through the theory of consumer behavior.

The way that I like to think about producer surplus is to consider it in the context of the labor-leisure tradeoff. Figure 1 below shows the demand for leisure and supply of labor in the case where we have a positively sloping labor supply curve, which gives a positively sloping industry supply curve assuming that there are a limited number of people qualified to supply labor in the movie industry. Consider a change in the wage rate from *a* to *b*. This translates into a labor supply curve in the lower panel associated with the line segment *ab*. The compensated demand curve for leisure is *ac*. The area under this demand curve represents the loss in consumer welfare from not being able to sell labor at the higher wage rate.[4]
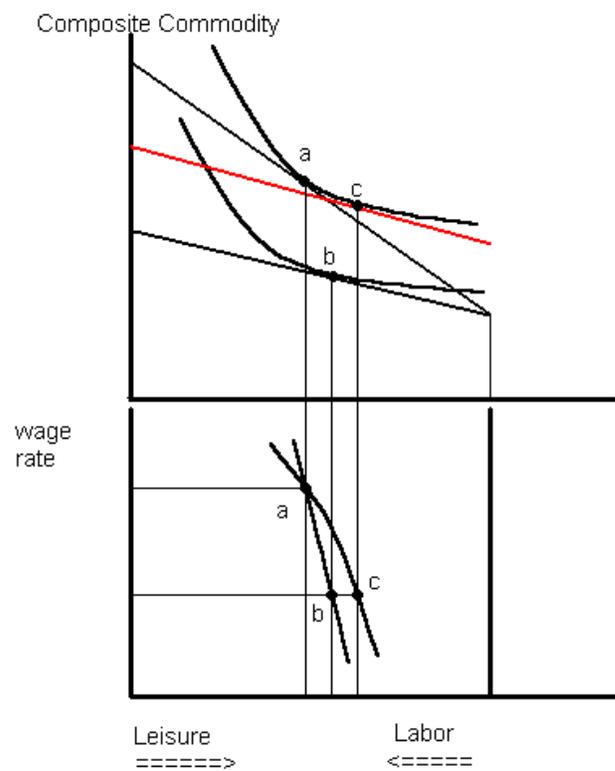

Figure 1

On the demand side, we know that consumer surplus is measured as the integral under the compensated demand curve. The problem in this case is that we are dealing with the demand for two goods, not one, and we are specifically interested in the results associated with demand curves that shift due to substitution effects.

Plainly enough, the correct answer to the question of how much consumer surplus changes due to two interactive price changes is given by the optimized expenditure function

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[4] See appendix.

differenced between the two price points. The only question is, how do we find this value in terms of the integrals of the compensated demand curves?

Let tv's be good one and movies, good two. We know

$$W = M*(p_1^1, p_2^1, \overline{U}) - M*(p_1^0, p_2^0, \overline{U})$$

where W is the consumer welfare effect and $M*$ is the optimized consumer expenditure function. The problem is to interpret this change in the optimized expenditure function between the two price levels in terms of the integral of the compensated demand functions.

Drawing the picture in commodity space helps:
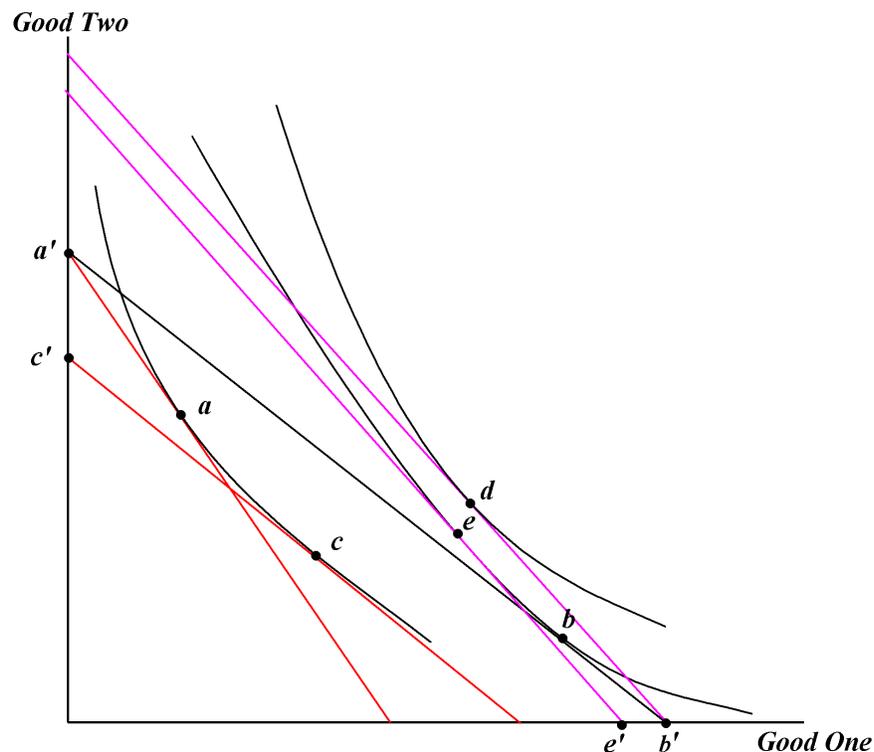
Figure 2

Figure 2 shows the effect of a change in the price of good 1 that is followed by a change in the price of good two. The change in the price of good one moves the consumer from point a to point b. Good 2 is a gross substitution for good 1. That is, when the price of good 1 goes down, the consumption of good 2 goes down. The movement from a to b shows this. As discussed above, the shift in the demand for good 2 causes the price of good 2 to change. The consequent change in the price of good 2 moves the consumer from point b to point d.

The combination of the changes moves the consumer out from the indifference curve on which point a lies to the indifference curve containing point d. This is the total welfare change on the demand side that is associated with the combined price changes. To value this welfare

change, we look at the implied income compensations. The budget line tangent at point *c* is parallel to the budget line tangent at *b*. Hence the budget line tangent at *c* reflects the income associated with the price change from *a* to *b*. The vertical distance given by *b'-c'* times the price of good 2, which is held constant in the move from *a* to *b* is the compensating income variation. This is the value of the welfare change from the decline in the price of good one.

Similarly for the second price change, the change in the price of good 2, we look at the income equivalent of this price change. It can be seen by the parallel to the budget tangent to point *d* drawn tangent at point *e*. In other words, how much income would the consumer pay to get the lower price of good 2 that induces the consumer to move from point *b* to *d*? This is shown by the shift in the budget constraint from points *d* to *e*. The value of this shift is the horizontal distance *d'-e'* times the second (or lower) price of good 1, which was held constant during the analysis of the change in the price of good 2.

It is instructive to plot the ordinary and compensated demand curves that are associated with these shifts in budget constraints in commodity space.
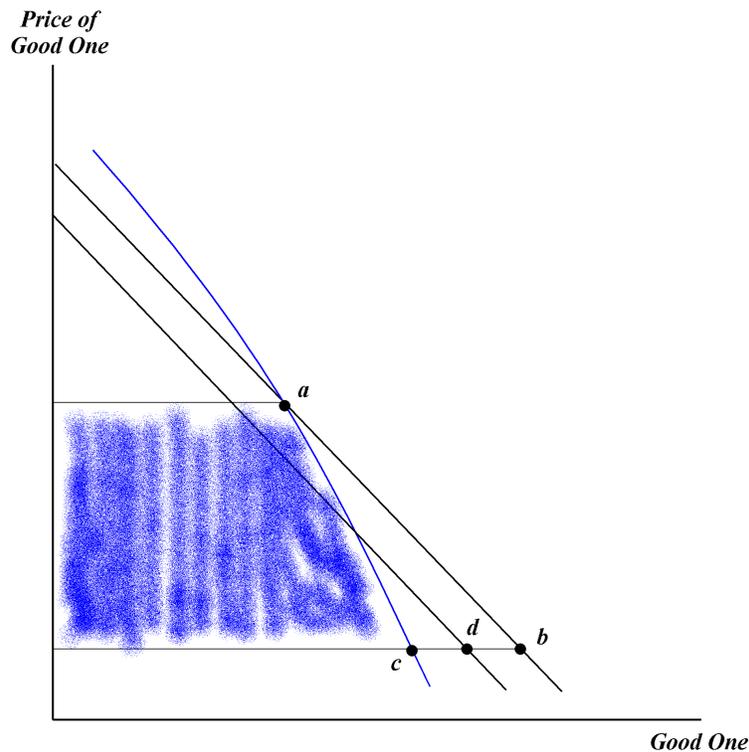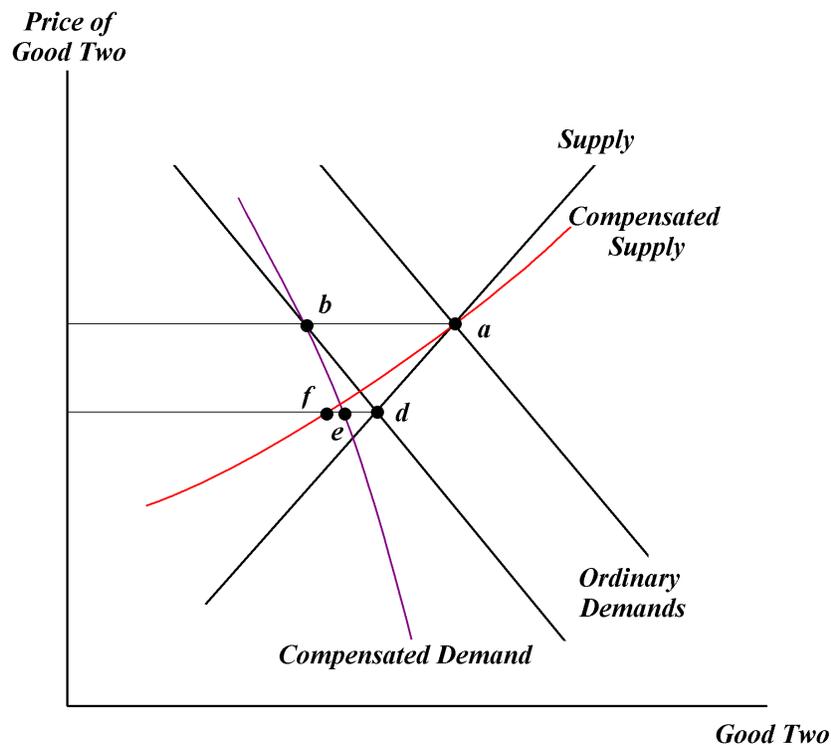

Figure 3

The points from commodity space are shown in Figure 3 which shows the ordinary and compensated demand curves for good 1. The line going through points *ac* is the compensated demand curve reflecting the consumer surplus effect of the price change along the ordinary demand curve from *a* to *b*. The shaded area to the right of *ac* is the value of this consumer surplus. The secondary effect of the price change in good 2 is shown by the shift in the ordinary

demand curve from *b* to *d* because, as drawn, good 1 is also a gross substitute for good 2. (Notice that this graph is not exactly the same as the one used by L&W, not because theirs is wrong. Just different emphasis. I think that the shift in the ordinary demand curve, which is pictured in Figure 3, is more important.)

Figure 4 shows the demand curves and the supply curve for good 2. The initial change in the price of good 1 causes the ordinary demand curve for good two to shift to the left from *a* to *b*. Because the supply curve for good 2 is positively sloping, the market price of good 2 falls as a consequence. This causes the price change from *b* to *d* that is depicted in Figure 2. Shown in Figure 4 is the compensated demand curve for good 2 which passes through points *d* and *e*. This curve tells us how much the consumer will pay not to have to face the higher price of good 2 at *b*. The area to the left of *de* along this curve is the consumer surplus associated with the lower price.

Figure 4

The total welfare effect can be seen in Figures 3 and 4. The total welfare effect cannot be seen in Figure 2 because it only shows the welfare effect on the demand side. From both the demand and supply side, the welfare effect of the secondary price change is virtually zero. This is because the increase in consumer surplus associated with the price decline in good two is more than offset by the loss in producer surplus. The net effect in the market for good 2 is the difference between the increase in consumer surplus and the decline in producer surplus. This all depends on the relative shapes of the compensated demand curve for good 2 and the compensated supply curve that embodies the income effects in the labor market. We cannot say

for sure that the lost producer surplus will outweigh the gain in consumer surplus, but it will clearly reduce the magnitude of the net welfare gains.[5]

In spite of the fact that there are small spillover effects, the analysis shown in Figure 2 emphasizes the correct way to think about the problem. It is a two step process and it does not matter which price change is examined first. Also, recognize that the producer surplus effects will show up in measured income so there is reason just to concentrate on the consumer surplus separate from producer surplus.

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[5] As it is drawn in Figure 4, the loss in producer surplus is greater than the gain in consumer surplus.

Appendix on Labor Surplus:

Consider the simply model of labor-leisure in which the consumer maximizes utility that is a function of the composite commodity good and leisure. The budget is made up of non-labor income and labor income earned at the wage rate. That is,

$$\max_{\{C,l\}} U = U(C,l) + \lambda(E + (T-l)w - C)$$

The problem as a dual:

$$\min_{\{C,l\}} E = C - (T-l)w + \mu(\overline{U} - U(C,l))$$

At the optimum:

$$E^* = C^* - (T - l^*(\overline{U}))w$$

By the envelope theorem:

$$\frac{\partial E^*}{\partial w} = -(T - l^*(\overline{U}))$$

Thus, for a change in the wage rate, the consumer surplus (or in this case more property defined as producer surplus) can be defined by the integral of optimized E^* over the wage change. This is the same thing as the integral of the optimized labor supply, i.e.,

$$\int_a^b \frac{\partial E^*}{\partial w} dw = \int_a^b -(T - l^*(\overline{U})) dw$$

This says that the area to the left of the income compensated labor supply (labor supply holding utility constant) is the surplus associated with a change in the wage rate.