Lecture: Applying Consumer Theory to Competitive Markets

David Autor

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1 Applying Consumer Theory to Competitive Markets

- When exchange takes place voluntarily, economists generally assume that it makes all participants better off. Otherwise, they would not have engaged in the exchange.
- It's useful to have a dollar metric of the gains from transacting.
- This measure is consumer surplus.
- This is critical because although we can readily measure the direct costs of a given project or policy (i.e., building a bridge, imposing a tarrif), it's less obvious how we measure the benefits.
- Demand curves allow us to measure these benefits.
- Think of market demand curve is the set of consumers arrayed in inverse ordering from the person with the highest willingness to pay (WTP) for a good to the person with the lowest WTP.
- Similarly, think of the market supply curve as the set of producers arrayed in order from firm willing to produce at lowest price to firm demanding the highest price to produce a good.
- What market ideally does is match consumers and producers:
  - If a producer is willing to produce at a price less than or equal what a consumer is willing to pay, that transaction will occur.
  - Most consumers will be buying at a price *below* than their maximal willingness to pay.
  - Most producters will be selling at a price *above* their lowest willingness to produce.
  - Marginal producer and consumer will be indifferent.
- It is easy to see that when this mechanism works correctly, it maximizes the sum of producer and consumer surplus:
  - All gains from trade are realized.
  - All transactions that benefit both parties occur.

  - No transactions occur that do not benefit both parties.

- It is noteworthy that this metric does not place any greater weight on consumer or producer surplus:
  - If supply is perfectly elastic, all of the surplus is captured by consumers.
  - If demand is perfectly elastic, all of the surplus is captured by producers.

- Why do we want to maximize surplus without any regard for who are the beneficiaries? Isn't there a tradeoff between equity and efficiency?
  - Answer: No, not in a competitive market. We'll study this issue shortly in general equilibrium theory.
  - But for the moment, take it on faith that we just want to maximize the pie, and we don't need to worry about who gets which slice.

- We often have pretty good data on producers' costs, which should reflect their willingness to pay.

- We often have less meaningful data on consumer's willingness to pay.

- But if we have an estimate of the elasticity of demand, this allows us to extrapolate a great deal of information about consumer surplus. That's because the elasticity is a measure of the slope (or curvature) of the demand curve.

- We have previously worked with compensated demand curves. For this analysis, we'll use the uncompensated demand curve for sugar. Why is that reasonable? Two explanations:
  - We don't have the compensated demand curve (not a great reason)
  - Recall the Slutsky equation: $\partial d_x/\partial p_x = \partial h_x/\partial p_x - (\partial d_x/\partial I) \cdot x$. This says that the compensated and uncompensated demand curves don't differ much if $(\partial d_x/\partial I) \cdot x$ is small. This will be true if the income effect is small *or* if sugar is a small share of consumers' budgets (so, there is very little change in consumers' real income when sugar prices change). The latter is quite likely to be true. Hence, we don't have to worry a great deal about the difference between compensated and uncompensated demand in this case.

- We're going to apply this reasoning to the system of U.S. Sugar Tariffs to perform a welfare analysis.

- This is a partial equilibrium analysis, using the tools of consumer theory that we have studied so far (plus a little producer theory from 14.01).

- We will leap into general equilibrium analysis in a couple of lectures.

- As we proceed, three points to keep in mind:

1. Distinguish carefully between *transfers* and *social gains and losses.*
   - If I pay a worker $5 to do a job, that is *not* a $5 social gain even though I have 'generated a job.'
   - Why? This transaction is a $5 *transfer* from me to the worker.
   - *If* there is a gain, it is because the value that the worker produces for $5 is worth more than $5 to me (i.e., consumer surplus) and/or the worker's alternative use of time was less than $5 (i.e., producer surplus).
2. A cost is not a benefit.
   - This is a restatement of the above. If I double the generosity of welfare programs in the United States, what is the social cost of this? To a first approximation, zero. I am simply transfering money from one group of citizens to another. The social cost, if present, would only be due to the deadweight loss of taxation or the distortions that free money had on labor supply (and other behavior) of welfare recipients.
3. All costs are opportunity costs.
   - In economic reasoning, there is no such thing as *intrinsic value.* The only cost of using a given resource is the value of its alternative to which it could have been put.
   - This is it's *opportunity cost.*
   - Why is water so cheap, even though it is the source of all human life? Because there is an abundance of water (in Cambridge), so the opportunity cost of the last gallon of water out of your tap in the morning is quite low. But if there was a shortage, the price of water could rise to extremely high levels because the value of the first gallon of water is quite prescious.
   - Similarly, diamonds are expensive because at available quantities, people appear to have very high value uses for them (i.e., wedding rings). If diamonds were as abundant as water, they would presumbaly be as cheap (and we would use as party favors). (Why are diamond quantities so limited? Probably due to cartelization of the world diamond market by De Beers rather than natural scarcity.)

1.1 Sugar case

1.1.1 Analytics

Using basic competitive theory, we will analyze the efficiency consequences of the U.S. sugar program.

To do this, we need to model the consumer demand curve (to assess consumer surplus) and model the supply curve to assess producer surplus.

With these, we can consider the consequences of the quota system relative to a counterfactual case in which the market was unrestricted.

The deviations from the competitive baseline case can be divided into three components:

1. Transfers. In general, quantity or price distortions will yield some transfers from consumers to producers (or vice versa). These are *not* efficiency losses (though we may still feel negatively about them).

2. Deadweight losses from inefficienct resource allocation. As we'll see in the sugar case, price or quantity quotas may also cause production distortions whereby low cost producers are thwarted from producing and high cost producers take their place. In these cases, there is of course the usual loss in consumer surplus and gain in producer surplus. But there is also a deadweight loss incurred; real resources are consumed by high-cost producers to make goods that low-cost producers could have made using fewer resources.

3. Deadweight losses from foregone consumption. A price or quantity quota will generally reduce equilbrium consumption below its competitive level. This implies that there are some units of the good that consumers would have been willing to pay for at a price that producers would have been willing to produce at. These thwarted trades are a form of deadweight loss.

1.1.2 Sources of sugar supply:

1. World sugar supply:
   - Price: perfectly elastic at price \$0.068 per pound
   - Quantity: capped at 3.8 billions pounds
2. U.S. sugar producers:
   - upward sloping from \$0.068 per pound at 1 pound to \$0.22 at 14 billion pounds.
   - So $P_{domestic} = 0.068 + 1.09 \cdot Q$, where Q is billion pounds produced.
3. High fructose corn syrup (HFCS) producers:
   - Supply: \$0.15 per pound for 12 billion pounds, infinite cost thereafter (until new plants built).

1.1.3 Demand:

We are given that: elasticity of demand is -0.30 and that domestic demand is 29 billion pounds at \$0.22 per pound.

- Use the functional form
$$Q(P) = KP^{-.30}$$
- Why this functional form?
$$\eta = \frac{\partial Q}{\partial P} \cdot \frac{P}{Q} = -.30KP^{-1.30} \cdot \frac{P}{KP^{-.30}} = -.30,$$
so, this functional form has a constant elasticity.

- Another way to see this:

$$\begin{aligned} \ln Q(P) &= \ln K - .30 \ln P, \\ \frac{\partial \ln Q}{\partial \ln P} &= -0.30 \end{aligned}$$

- Applying in this example:

$$\begin{aligned} 29 &= K(22)^{-0.30} \\ K &= 29(22)^{0.30} = 73.3 \\ Q &= 73.3(22)^{-0.30} \end{aligned}$$

  - What would quantity demanded be at the world price:

$$Q(0.068) = 73.3 \times \left(6.8\right)^{-0.30}) = 41.2 \text{ billion pounds}$$

1.1.4 Accounting

Gains in producer surplus?

- *Why won't gains to producers be identical to corresponding losses for consumers?*

  - Foreign producers (Do you want to count these gains? What are the politics that makes this large transfer feasible?)

$$3.8(22 - 6.8)/100 = 0.58 \text{ billion}$$

    This amount is a pure *pure transfer*. Why? There is no distortion involved in taking a chunk of consumer surplus and handing it over to producers. Deadweight losses accrue when consumption is foregone (as it will be) or production decisions are distorted.

  - U.S. sugar producers

$$\begin{aligned} \text{Production Costs } 13.2 \times (6.8 + 0.5(22 - 6.8))/100 &= 1.9 \text{ billion} \\ \text{Revenue } 13.2(22)/100 &= 2.9 \text{ billion} \\ \text{Gain in Producer surplus} &= 1.0 \text{ billion} \\ \text{Loss in Consumer surplus } 13.2(22 - 6.8)/100 &= 2.0 \text{ billion} \\ \text{DWL } 1.0 - 2.0 &= -1.0 \text{ billion} \end{aligned}$$

– HFCS producers

$$\begin{aligned} \text{Production costs } 12(15)/100 &= 1.8 \text{ billion} \\ \text{Revenue } 12(22)/100 &= 2.64 \text{ billion} \\ \text{Gain in producer surplus} &= 0.84 \text{ billion} \\ \text{Loss in consumer surplus } 12(22-6.8)/100 &= 1.82 \text{ billion} \\ \text{DWL } 0.84-1.82 &= -0.98 \text{ billion} \end{aligned}$$

- **Loss of consumer surplus from foregone consumption?**
  - The DWLs calculated above are from inefficient resource allocation – expensive producers producing what cheap producers could have produced were it not for the sugar program.
  - There is also a second DWL that should look more familiar. A considerable quantity of sugar is not consumed at 22 cents per pound that would have been consumed at 6.8 cents per pound.
  - Quantify this DWL: Willingness to pay − production costs in the competitive case.
  - What were consumers willing to pay for this sugar? Invert the demand curve and integrate:

$$\begin{aligned} Q(P) &= 73.3P^{-0.3} \\ P(Q) &= \left(\frac{Q}{73.3}\right)^{-\frac{1}{0.3}} \end{aligned}$$

$$\int_{29}^{41.2} \left(\frac{Q}{73.3}\right)^{-\frac{1}{0.3}} \partial Q = 2.03$$

  - We calculated above that at 6.8 cents, they would have consumed 41.2 billion pounds, instead of the 29 billion pounds consumed under the quota system. So, that's 12.2 billion pounds of consumption foregone
  - 12.2 billion pounds would have had a real cost of 0.83 billion dollars.
  - So, the DWL of the foregone consumption if $0.83 - 2.03 = 1.2$ billion in DWL.

1.2 Accounting

Accounting for costs and benefits

	Quantity Produced	Production Cost	Revenue	Producer Surplus	Consumer Surplus	DWL
Foreign	3.8 bil	$3.8(.068) =$ 0.260 bil	$3.8(.22) =$ 0.84 bil	0.58 bil	$3.8\times$ $(.22 - .068)$ $= -0.58$ bil	0.0 bil
HFCS	12 bil	$12(.15) =$ 1.8 bil	$12(.22) =$ 2.64 bil	0.84 bil	$12\times$ $(.22 - .068)$ $= -1.82$ bil	-0.98 bil
Domestic Prod'n	13.2 bil	13.2 $\times \frac{1}{2}(.22 - .068)$ $+13.2 \times .068$ $= 1.90$ bil	$13.2(.22) =$ 2.9 bil	1.00 bil	$13.2\times$ $(.22 - .068)$ $= -2.00$ bil	-1.00 bil
Reduced Consump	12.2 bil	0.83 billion (*if produced*)	$12.2(.068) =$ 0.83 bil (*if prod*)	0 (*if prod*)	$.83 - 2.03$ $= -1.2$ bil (*if consumed*)	-1.20 bil
Total				$+2.42$ **bil**	$-$ 5.60 **bil**	-3.18 **bil**

Notice the following identities:

- Change in Producer surplus = Change in revenue minus change in production costs
- Change in Consumer surplus = Quantity consumed times price change [This only applies to the units consumed – not the thwarted consumption]
- DWL for units consumed = Gains to producers - Loss to consumers
- DWL from thwarted consumption = Willingness to pay for foregone consumption minus cost of producing those goods

Amazingly, the deadweight loss of the program is 2.5 times as large as the transfer to producers: 6.3 versus 2.4 billion. For every $1 in surplus that producers gain from the sugar quotas, consumers lose $2.5.

Notice that about 25 percent of the gains (0.58 of 2.42 billion) is a pure transfer to foreign producers. The gain to U.S. producers is $1.84 billion.

Moreover, about $0.98 is a transfer *not* to sugar producers but to HFCS producers.

The transfer to domestic sugar producers is only $0.86 billion, less than 15 percent of the loss to consumers.

1.3 Consider

- At the time the case was written, there were $8,360$ sugar farms in the U.S. So this is implicitly a subsidy of

$$(0.86 \text{ billion})/8,360 = \$102,000 \text{ per farm.}$$

- Also consider that $1,400$ farms account for about 50% of all production.

$$(0.86 \text{ billion } x \ 0.5)/1400 = \$307,000 \text{ subsidy per farm for these farms.}$$

- And these are the *gains* per farm. If we counted the loss to consumers per farm, it would be more than twice as large.

- What would be the reaction of farmers if we proposed to open the U.S. to world sugar prices and gave a cash payment of $\$102,000$ per (former) sugar farm per year?

- How would the High Fructose Corn Syrup producers (e.g., Archer Daniels Midland) feel about this?

1.4 What about Michael Warner of the American Sugarbeet Growers Association?

- He points out the \$300 per pound loss in domestic sugar production in North Dakota over $\frac{1}{4}$ million acres? Is this loss $\$300 \cdot 250,000$?

- What about the $30,000$ sugar beet farming jobs in North Dakota that Warner stresses? What are the economic losses if these workers are not needed for sugar production? Are they $30,000 \cdot AnnualEarnings$?

- Is it significant that Mr. Warner counts *both* the loss in crop production of $\$300/acre$ and the loss of jobs of $30,000$ workers as costs of eliminating the program?

  - This is clearly double-counting.
  - The workers should be viewed as costs to sugar producers and their wages should be subtracted from the crop production per acre – along with all other variable costs and the opportunity cost of the land – to get a measure of the potential surplus generated by using this land for sugar production.
  - Stated differently, farmers would be delighted to fire all of their workers if they could still get \$300 per acre in direct subsidies. So clearly you can't count both the sugar income and the expense of employing the workers as social benefits.