An Instructional Exercise in Price Controls:
Product Quality, Misallocation, and Public Policy

by

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Abstract: Price controls are a contentious topic in society and hence a good source for economics classroom engagement. The standard textbook analysis of price controls is lacking, however. This paper presents real-world examples and classroom exercises on the topic of price controls. The exercises complement the standard textbook analysis of price controls by including costs related to misallocation and quality degradation. The discussion questions and analytical exercises provide students with a broad view of price controls and their policy implications.

INTRODUCTION

One of the more interesting aspects of teaching economics is to adopt a position that almost every student in the class believes to be true and then proceed to demonstrate that there are plausible conditions under which it is false, and vice versa. In this regard, few topics in microeconomics are more rewarding to teach than that of price controls and their implications for consumer welfare and public policy.

When we introduce the idea of rent controls in our microeconomics classes—typically comprised of undergraduate and MBA students—there are almost always strong opinions. In the typical class, fully 90 percent of the students will respond in the affirmative when queried as to whether they favor rent controls. About 8 percent of the students hold back, convinced that it is a trick question, and the remaining students think more deeply about the question.

Among the approximately 2 percent of students who think more deeply about the question, one or two students will observe that rent controls would be beneficial to consumers, provided that one is still able to find housing after the policy is put in place. This line of thinking leads naturally to an inquiry as to the effects of rent controls on the supply of housing. Having identified one of the potential problems with rent controls, a few other students will discuss their concerns with housing quality upon the imposition of price controls.[1] A typical student comment goes something like the following. "I have a difficult time getting my landlord to fix anything in my apartment. I don't even want to think about what his incentives to maintain the quality of housing would be if rent controls were put in place." This discussion leads naturally to the effect that rent controls would have on the average quality of housing. And, of course, college students always have strong feelings about the rent they pay and the quality of the dwellings in which they reside. By this point in the discussion, at least half of the 90 percent of those students that initially favored rent controls begin to reevaluate their position. At long last, we have achieved what we set out to do — the students' curiosity is piqued, and we have their attention, which is more than half the battle. The fun now begins in earnest.

The literature on price controls is vast, and we will focus upon only a small segment of it (one that informs pedagogical analysis). It is well established that binding price controls lead to deadweight costs by precluding mutually beneficial transactions. In the competitive market case, for example, a price ceiling precludes mutually beneficial transactions in which the producer's marginal cost of production falls between the controlled price and the equilibrium price. It is also well-established that price ceilings (floors) transfer surplus on remaining units exchanged from producers to consumers (consumers to producers). According to the classic welfare analysis of price ceilings, therefore, consumers are made better off, on net, with a price ceiling

policy if the transfer outweighs the consumer deadweight cost burden. Kondor (1995) discusses the long run effects of a specific type of rent control policy. He shows that a discriminatory rent control could shift the demand function for apartments and actually increase consumer surplus. Similarly, Yaniv (2004) examines the long run welfare effect of an enforced minimum wage upon the labor demand curve.

Spence (1975) further informs the welfare analysis of price controls by noting that binding price caps lead firms to cut back on product/service quality. Hence, the addition of quality to the mix adds greater uncertainty to the analysis of whether consumers benefit or are harmed from the implementation of price ceilings. The quintessential example of price ceilings is that of rent controls for housing. Kruse, Ozdemir, and Thompson (2005) conduct an experiment on rent controls to present the topic of price controls in a context familiar to students. The authors find experimental evidence of quality degradation in a multi-round (or long-run) apartment allocation experiment. The authors note, "Since many students are themselves renters, they should relate to changes in quality due to lower maintenance by landlords" (73). Further decreasing the likelihood that consumers benefit from the implementation of price ceilings, Glaeser and Luttmer (2003) identify the misallocative costs of rent control (i.e., costs associated with reallocation from high to low willingness to pay consumers). Under a binding price ceiling, the price mechanism no longer restricts allocation of a good to those with a "sufficiently high" willingness to pay.

In the following sections, we provide several examples that seek to enrich student understanding of price controls. Price controls affect consumer welfare in several ways. The analytical exercises illustrate, separately, the effects of misallocation and quality degradation on

consumer welfare in markets subject to price ceilings. The attendant policy implications are also addressed.

<div align="center">EXAMPLES OF PRICE CEILINGS ABOUND</div>

There are myriad examples of price ceilings in the U.S. economy. Municipalities such as New York, Los Angeles, and San Francisco utilize price ceilings to limit the rental price of apartment housing. In the aftermath of 9/11 and the Anthrax scare, the Bush Administration considered imposing a price ceiling on Cipro, the antibiotic deemed most effective in combating the effects of Anthrax poisoning. Also following 9/11, the attorneys general in many states vowed that they would vigorously enforce anti-price gouging laws. These laws prohibit pronounced price increases on products and services following natural or man-made disasters. Similar issues arose in the aftermath of Hurricane Katrina. In a noteworthy example, CNN interviewed a Chicago resident who was stranded in New Orleans after the storm. Because the airports were closed, the man offered a taxi cab driver an amount above the standard fare if the driver would take him to Chicago. The cab driver told the man that he was prohibited from engaging in such a transaction by the anti-price gouging legislation. Hence, a voluntary exchange that would have rendered both parties better off was foreclosed at the hands of the anti-price gouging legislation.

Price cap regulation is a dominant form of economic regulation in local telephone service markets in the U.S. Under this form of economic regulation, average prices are allowed to change on an annual basis by the rate of inflation less a factor that reflects industry-wide productivity growth in the telecommunications sector relative to the general economy (Sappington 2002, Sappington and Weisman, 1996). Similar price cap rules apply to the regulated prices of electric power and natural gas. The health care reform legislation that recently moved through the U.S. Congress contemplated a number of different price caps. These

included caps on compensation for physician services, maximum-expenditure caps per individual, and even caps on various drugs and pharmaceuticals (Cogan, Hubbard, and Kessler, 2009; Pitts, 2009). Cogan, Hubbard, and Kessler write, "Ultimately, such price controls will lower the quality of health care and reduce the supply of health services, just as price controls have in every market where they've been tried" (1).

More recently, following the downturn in the U.S. economy and the associated financial crisis, the U.S. government has pushed to limit the salaries of investment bankers (Holzer, 2009). Proponents of these salary caps have argued that investment bankers should not be rewarded unduly for what would appear to be excessive risk-taking and substandard job performance. Opponents of these salary caps contend that such rules will drive away the very talent that is necessary for the financial sector to recover (Andrews and Dash, 2009).

THE BASIC ANALYTICS OF PRICE CEILINGS

The basic welfare analysis of (binding) price ceilings focuses upon two effects of the policy: (1) the transfer of welfare from producers to consumers when exchanges occur at a lower price and (2) the so-called deadweight loss associated with a reduction in quantity supplied at the lower price. Figure 1 depicts these two basic effects of price ceilings on consumer surplus (CS). Figure 1 displays prices and quantities that obtain under a) a free market scenario, and b) a given binding price ceiling (p^{max}).

(Figure 1 here)

The above figure illustrates a binding price ceiling that decreases market price from p^o to p^{max}. The corresponding change in market quantity from Q^o to Q_{max}^S is labeled along the horizontal axis. Areas of CS before and after price regulation are labeled. The basic analysis concludes that, while price ceilings are welfare diminishing, they may benefit consumers on net if the

welfare transfer to consumers is greater than the burden of the deadweight loss borne by consumers that derives from a reduction in quantity supplied (Sowell, 2004). From Figure 1, we conclude the following:

A. Price Regulation

1. Without price controls, the market clears at $p^0 : CS_0 = A + B + C$.

2. With a price ceiling of p_{max}, a shortage develops as demand exceeds supply at this price: $CS_1 = F + A + C$

3. Are consumers better off with price controls? The change in consumer surplus (CS) is given by: $\Delta CS = CS_1 - CS_0 = F + A + C - (A + B + C) = F - B$

Interpretation: F = expenditure savings on output that remains on the market after the price control is imposed
B = CS foregone on decrement in output supplied following the price control

Within this basic framework, consumers are better off under the price control if $F > B$.

4. Notice that the analysis is biased in favor of price controls. This is necessarily the case because it is assumed that the consumers that value the good the least are the consumers that are no longer able to purchase the good after the imposition of the price ceiling. Those who place relatively high valuations on the good are still able to purchase it after the imposition of the price ceiling. If this is not the case, there is a misallocation under the price ceiling in which some consumers with a relatively low-valuation for the good are able to obtain it when other consumers with a relatively high-valuation for the good are not. Under these conditions, area B understates the CS foregone on the decrement in output supplied under the price ceiling. For example, if the true CS foregone is B + Δ, where Δ > 0, then it may well be the case that $F - B > 0,$ but $F - (B + \Delta) < 0.$

5. Price controls always benefit consumers when supply is perfectly inelastic, *ceteris paribus*. This is the case because consumers are able to purchase the same quantity that they did before the imposition of the price control but at a lower price.

We explore the extent of the consumer welfare effects for specific market parameters in the following example.

Example 1:

A. Demand Function $Q = 20 - 2p \Rightarrow p = 10 - \frac{1}{2}Q$

B. Supply Function $Q = 2p \Rightarrow p = \frac{1}{2}Q$

C. We will first explore the no-intervention outcome within the market described above. Figure 2 illustrates the free market case.

(Figure 2 here)

We impose the equilibrium condition and solve for the consumer surplus in the case of the free market outcome:

$$Q^S = Q^D$$
$$2p = 20 - 2p$$
$$p^0 = 5, Q^0 = 10$$
$$CS^0 = \frac{1}{2}(10)(10-5) = 25$$

D. We will now explore the effect of government intervention in the form of a price ceiling imposed at \$4 ($p^{max} = 4$). Figure 3 illustrates such a market intervention.

(Figure 3 here)

In the case of a price ceiling with linear supply and demand functions, CS consists of a triangle and rectangle. We can compare the levels of consumer surplus in the free market outcome and the binding price ceiling outcome.

$$\overbrace{CS(p^{max} = 4)}^{32} > \overbrace{CS(p^0 = 5)}^{25}$$

Price ceilings are in consumers' interests in this case. In the next example, consumers are harmed by the imposition of the price ceiling according to the basic analysis.

Example 2:

A. Demand Function: $Q = 20 - 2p \Leftrightarrow p = 10 - \frac{1}{2}Q$

B. Supply Function: $Q = 8p \Leftrightarrow p = \frac{1}{8}Q$

C. We first explore the equilibrium and welfare implications of the baseline case in the free market outcome. Equilibrium: $S = D \Rightarrow 8p = 20 - 2p \Rightarrow 10p = 20 \Rightarrow p^0 = 2, Q^0 = 16$.

Figure 4 illustrates the free market case within the market described above.

(Figure 4 here)

D. We now consider the case of government intervention in the form of a price ceiling imposed at \$1 ($p^{max} = 1$). Figure 5 illustrates such a policy.

(Figure 5 here)

$$\Delta CS = 56 - 64 = -8 < 0$$

Hence, consumers are rendered worse off as a result of price controls in this case. Observe the relatively large coefficient on price in the supply function. This means that small reductions in price will lead to substantial reductions in quantity supplied. This supply restriction is the source of the harm from the imposition of a price ceiling. Hence, it may have been anticipated that, in this example, the price ceiling would have harmed consumers in the aggregate.

PRICE CEILINGS WITH MISALLOCATION

Textbook analyses have consistently ignored the misallocative costs of price ceilings. However, Glaeser (1996) and Glaeser and Luttmer (2003) show these costs to be significant in the welfare analysis of rent ceilings. Glaeser (1996) states:

A major social cost of rent control is that without a fully operational price mechanism the 'wrong' consumers end up using apartments. Unless apartments are somehow allocated perfectly across consumers, rental units will be allocated to consumers who gain little utility from renting and rental units will not go to individuals who desire them greatly. The social costs of this misallocation are first order when the social costs from underprovision of housing are second order. Thus for a sufficiently marginal implementation of rent control, these costs will always be more important than the undersupply of housing (p. 2).

The following is a pedagogical analysis of the misallocative costs of price ceilings. The analysis assumes that a shortage under the price ceiling leads to a chance or random allocation of the regulated good. This assumption implies that each unit is allocated randomly and is an ideal assumption in the case of rent ceilings. In this case, individual demands are largely binary (0, 1) in nature. The assumption is less ideal in the case of, say, price-controlled gasoline. If an individual is willing to pay a relatively high price for a first gallon, he or she is probably willing to pay a relatively high price for the second gallon. At the same time, if an individual is able to procure a first gallon, he or she will probably be able to procure a second gallon. However, the

assumption of random allocation under a shortage is often plausible and provides a tractable

baseline assumption in computing the misallocative costs of a binding price ceiling. Indeed,

United States Green Cards (Permanent Residency), university campus housing, hunting permits,

harvest rights, complex medical procedures in countries like England, and campus parking

passes are all examples of goods that are sometimes subject to lottery under a binding price

ceiling. The following figure, Figure 6, illustrates the misallocative cost of a price control given

the random allocation.

(Figure 6 here)

As we will see in the analysis below, the welfare interpretation of price control is altered when
we consider the role of misallocation. Figure 6 displays the extent of the misallocation that
occurs when a good under a binding price ceiling is randomly allocated.

A. Price Regulation
1. Without price controls, the market clears at p^0: $CS_0 = A_1 + A_2 + B + C$.
2. With a price ceiling of p^{max}, a shortage develops as demand exceeds supply at this price. The
traditional interpretation assumes that the upper portion of the demand curve (those units most
valued) receive the Q_{max}^S units supplied under a price control. Under a binding price ceiling,
however, the price mechanism no longer restricts the allocation of a good to those with the
highest willingness to pay. Assuming that the shortage is addressed through random allocation
(lottery), as in Glaeser and Luttmer (2003), there is a Q_{max}^S / Q_{max}^D probability that those with
the highest willingness to pay will be served under the price control.[2] As each unit along the
demand curve in the range $[0, Q_{max}^D]$ has an equal likelihood of being served, the average
consumer surplus for a unit allocated under price control is $\frac{(p^{int}+p^{max})}{2} - p^{max}$. This is the
consumer surplus received at the point of the demand curve halfway between p^{max} and p^{int}.
Let us make the plausible assumption that this midpoint falls above p^0 but below the highest
willingness to pay for the last unit supplied under price control, $p(Q_{max}^S)$. Then, the total
consumer surplus under price control, CS_1, equals $F + A_2$ or $F + A - A_1$ (where $0 < A_1 <$
$A; 0 < A_2 < A$; $A_1 + A_2 = A$). The area $A_1 + C$ represents the misallocative cost of a price
ceiling policy.

3. Are consumers better off with price controls?
$\Delta CS = CS_1 - CS_0 = [F + A_2] - [A_1 + A_2 + B + C] = F - A_1 - C - B$
Interpretation: F = expenditure savings on new output level
                 B = CS foregone on decrement in output supplied
                 A_1 + C = CS foregone due to misallocation

Under this interpretation, consumers are better off if $F > A_1 + C + B$, rather than if $F > B$

4. Price controls always benefit consumers when supply is perfectly inelastic, *ceteris paribus*.

Example 3: Welfare under Price Ceiling with Misallocative Costs

We now explore a specific market example in which misallocative costs are considered in the welfare analysis of price ceilings.

A. Demand Function $Q = 20 - 2p \Rightarrow p = 10 - \frac{1}{2}Q$

B. Supply Function $Q = 2p \Rightarrow p = \frac{1}{2}Q$

C. We first calculate welfare by finding the market equilibrium in the free market case. Figure 7 is a diagrammatic exposition of the free market case.

(Figure 7 here)

$Q^S = Q^D$
$2p = 20 - 2p$
$p^0 = 5, Q^0 = 10$
$CS^0 = \frac{1}{2}(10)(10-5) = 25$

D. We now consider a government-imposed price ceiling at \$2 ($p^{max} = 2$). Figure 8 below displays such a policy.

(Figure 8 here)

Given the misallocation, the average unit obtained under a price control has a maximum willingness to pay of \$6. Thus, average consumer surplus per unit allocated under the price ceiling is \$4 = \$6 - \$2, and total expected consumer surplus is \$4 × 4 units equals \$16.

$$\overbrace{CS(p^{max} = 2)}^{16} < \overbrace{CS(p^0 = 5)}^{25}$$

Price ceilings are not in consumers' interest in this case. Note that $A_1 + C = 12$ represents the misallocative cost of price ceiling. If we were to ignore the misallocative costs in this case, we would form the incorrect conclusion that consumers are better off, on net, under the given price control.

PRICE CEILINGS WITH QUALITY

In a seminal article, Michael Spence (1975) recognized that capping the price that a firm is

allowed to charge would invariably give that firm an incentive to cut back on product/service

quality.[3] Hence, the addition of quality to the analysis adds greater uncertainty as to whether consumers actually benefit from the imposition of price ceilings.[4] These complexities are explored in this section. Producers of a good under a binding price ceiling (i.e., a good that is in shortage) may find that reducing expenditures on quality reduces costs more than revenues and hence increases overall profits. For example, a telecommunications firm under binding price cap regulation may not invest to maintain the quality of its network. Similarly, a landlord facing a rent control may cut back on lawn care, pest control and maintenance for her rental units. Thus, quality degradation can occur quickly in response to the imposition of a price control policy. In the following example, we explore the effects on consumer welfare when firms subject to a price ceiling allow quality to change. Note that Example 4 considers the role of quality degradation without considering the misallocative cost of rent control. This is done so as to more clearly present the marginal effect of quality degradation upon market welfare.

Example 4.

The City Council in Smallville is considering the implementation of a price ceilings on rental units based on the number of bedrooms in the unit. The demand function for rental units (on a single bedroom equivalent basis) is given by $Q^D = 80 - 2P + q$, and the supply function is given by $Q^S = 2P$, where P is price, Q is quantity and q is an index of housing quality. The Council is giving consideration to imposing a ceiling price on rental units of $p^{max} = 10$.

a) Let $q = 20$ both before and after the imposition of the ceiling price. Are consumers of rental-housing in Smallville well-served by this policy? Provide a careful economic analysis in support of your claim. Show your results graphically.

b) Suppose that the Council is concerned that landlords will allow the quality of their rental units to deteriorate following the imposition of the ceiling price. Continue to assume that $q = 20$ prior to the imposition of the ceiling price. Determine the values of q that must prevail following the imposition of the ceiling price in order for consumers to be no worse-off from this policy? Provide a careful economic analysis in support of your claim. Show your results graphically.

c) What position would suppliers of building materials likely take on the issue of ceiling prices for rental units? Provide the economic rationale for your answer.

Solution:

Demand: $Q^D = 80 - 2p + q$

Supply: $Q^S = 2p$

a) Given the quality level, $q = 20$, before and after the imposition of the price ceiling, we can solve for the free market equilibrium and associated level of consumer surplus.

Inverting the demand curve, and omitting superscripts, yields

(1) $2p = 80 - Q + q$

(2) $2p = \left(40 + \dfrac{1}{2}q\right) - \dfrac{1}{2}Q$

With q=20, (2) becomes

(3) $p = 50 - \dfrac{1}{2}Q$

Inverting the supply function yields

(4) $p = \dfrac{1}{2}Q$

To find the market equilibrium, set (3) equal to (4) and solve for Q.

(5) $\dfrac{1}{2}Q = 50 - \dfrac{1}{2}Q \Rightarrow Q^0 = 50, p^0 = 25$

The market equilibrium is found to be: $Q^0 = 50, p^0 = 25$

Consumers' surplus at $p^0 = 25$ is given by

(6) $CS\left(p^0 = 25\right) = \dfrac{1}{2}(50)(50 - 25) = 625$

We now impose the ceiling price of $p^{\max} = 10$ as illustrated in Figure 9.

(Figure 9 here)

At this price, $Q^s(10) = 20$. The demand price corresponding to a quantity of 20 is found by the solution to

(7) $p = 50 - \dfrac{1}{2}(20) = 40$

Consumers' surplus at $p^{\max} = 10$ is given by

(8) $CS\left(p^{\max} = 10\right) = \underbrace{\frac{1}{2}\left[20 \times (50 - 40)\right]}_{A} + \underbrace{\left[20 \times (40 - 10)\right]}_{B+C} = 700$

Hence, $CS\left(p^{\max} = 10\right) = 700 > 625 = CS\left(p^0 = 25\right)$. This implies that consumers are well served by this price ceiling policy as they realize a higher level of consumers' surplus.

b) In this part, we must determine the values of q that must prevail following the imposition of the price ceiling so that consumers are no worse off following the imposition of this policy. We proceed as in part a), except that we do not fix the level of q. Hence, the inverse demand function is given by

(7) $p = \left(40 + \frac{1}{2}q\right) - \frac{1}{2}Q$, and inverse supply is

(8) $p = \frac{1}{2}Q$

Figure 10 illustrates the potential welfare effect of quality degradation under the price control.

(Figure 10 here)

As in part a), $Q^s\left(p^{\max} = 10\right) = 20$. The demand price corresponding to a quantity of 20 is found by the solution to

(9) $p = \left(40 + \frac{1}{2}q\right) - \frac{1}{2}(20) = 30 + \frac{1}{2}q$

We now compute consumer surplus for $p^{\max} = 10$ and any arbitrary q. This is given by $D + E$ in Figure 10.

(10) $CS\left(p^{\max} = 10; q\right) = \frac{1}{2}[20]\left[\left(40 + \frac{1}{2}q\right) - \left(30 + \frac{1}{2}q\right)\right] + [20]\left[\left(30 + \frac{1}{2}q\right) - 10\right]$

This simplifies to

(11) $CS\left(p^{\max} = 10; q\right) = (10)(10) + 400 + 10q = 500 + 10q$

Note: when $q = 20, CS\left(p^{\max} = 10\right) = 700$.

In order for consumers to be no worse off following imposition of the price ceiling

(12) $CS\left(p^{\max} = 10; q\right) \geq CS\left(p^0 = 25\right)$; or

(13) $500 + 10q \geq 625 \Rightarrow 10q \geq 125$ or $q \geq 12.5$

Consumers will be no worse off under rent control if the quality level, as measured by the quality index, does not decline by more than 37.5 percent of its original value (q = 20) in this case.

d) It is quite likely that suppliers of building materials will not be in favor of price ceilings on

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rental units. Why? The supply function indicates that fewer rental units will be supplied upon the imposition of the ceiling price $\left[Q^s = 50 \text{ vs } 20 \right]$. This translates into a reduction in the demand for the building materials and a likely reduction in the income of suppliers of building materials.

In many relevant cases, the marginal cost curve shifts downward when the quality of the firm's output is allowed to degrade. It is less costly to supply the marginal apartment with unrepaired pipes and without a fresh coat of paint, for example. Example 5 discusses the implications of quality degradation under a price control when quality degradation causes a shift in both the supply and demand curve for the product. Note that Example 5 considers quality degradation without considering the misallocative cost of rent control. This is done, once again, to more clearly present the marginal effect of quality degradation upon market welfare.

Example 5.

The City Council of Smallville is giving consideration to implementing a price ceiling on rental units based on the number of bedrooms in the unit. The demand function for rental units (on a single bedroom equivalent basis) is given by $Q^D = 60 - P + 2q$ and the supply function is given by $Q^S = 2P - q$, where P is price, Q is quantity and $q > 0$ is an index of housing quality. The Council is considering the imposition of a ceiling price for rental units of $p^{max} = 20$.

a) Let $q = 10$ both before and after the imposition of the ceiling price. Are consumers of rental housing in Smallville well served by this policy? Provide a careful economic analysis in support of your claim.

b) Suppose that the Council is concerned that landlords will allow the quality of their rental units (and maintenance services) to deteriorate following the imposition of the ceiling price. Continue to assume that $q = 10$ prior to the imposition of the ceiling price. If q falls to 7 after the rent ceiling was imposed, due to decreased maintenance and upkeep, would consumers be worse off following the imposition of the ceiling price relative to the free market outcome? Provide a careful economic analysis in support of your claim.

c) In addition to the price ceiling of P^{max} = 30, suppose that the Council also imposes a quality floor on rental units. If a binding quality floor were imposed at q = 8, would consumers' surplus increase with the ceiling price?

d) Suppose now that supply is perfectly elastic at the market equilibrium and $q = 10$. How much better/worse off are consumers with the imposition of the ceiling price on rental units of P^{max} = 20? Provide the economic rationale for your answer.

Solution:

Demand: $Q^D = 60 - P + 2q$
Supply: $Q^S = 2P - q$

a) Given the quality level of $q = 10$ both before and after the imposition of the price ceiling, we can solve for the free market equilibrium and associated level of consumer surplus as in Example 4.

Doing so, we find the following:

The market equilibrium is found to be: $Q^0 = 50$, $p^0 = 30$. Consumers' surplus at $p^0 = 30$ is given by $CS(p^0 = 30) = 1250$.

We now impose the ceiling price of $p^{max} = 20$ as shown in Figure 11 below.

(Figure 11 here)

At this price, $Q^S(pmax = 20; q = 10) = 30$. The demand price corresponding to a quantity of 20 is found to be $p = 80 - 30 = 50$.

Consumers' surplus at $p^{max} = 20$, absent quality degradation, is given by

$CS(p^{max} = 20; q = 10) = \frac{1}{2}[30 \times (80 - 50)] + [30 \times (50 - 20)] = 1350$.

Hence, $CS(p^{max} = 20; q = 10) > CS(p^0 = 30)$.

This analysis implies that consumers are well served by this price ceiling policy if quality degradation does not occur.

b) In this part, we must determine whether consumers are worse off should q fall from 10 to 7 after the imposition of the price ceiling. The supply and demand functions after quality degradation are as follows:

Demand: $Q^D = 74 - P$
Supply: $Q^S = 2P - 7$

and

$CS(p^{max} = 20; q = 7) = \frac{1}{2}[33 \times (74 - 41)] + [33 \times (41 - 20)] = 1237.5$

Hence, $CS(p^{max} = 20; q = 7) = 1237.5 < 1350 = CS(p^0 = 30)$.

Given the degree of quality degradation, consumers are worse off after the price ceiling is imposed at $p^{max} = 20$.

c) In this part, we must determine whether consumers are worse off, as compared to the free market case, should a price ceiling be imposed at $p^{max} = 20$ along with a binding quality floor at $q^{min} = 8$. The supply and demand functions after quality degradation are as follows

Demand: $Q^D = 76 - P$
Supply: $Q^S = 2P - 8$

and

$$CS(p^{max} = 20; q = 8) = \frac{1}{2}[32 \times (76 - 44)] + [32 \times (44 - 20)] = 1280.$$

Hence, $CS(p^{max} = 20; q = 8) = 1280 > 1250 = CS(p^0 = 30)$.

Given the binding quality floor, consumers are better off after the price ceiling is imposed at $p^{max} = 20$.

d) Consumer's surplus goes to zero if the supply curve is perfectly elastic at the equilibrium price and a binding price ceiling is imposed. A perfectly elastic supply curve at the equilibrium price implies that the marginal cost of producing housing is constant at the equilibrium rental price. It further implies that quantity supplied will fall to zero if a binding price ceiling is imposed. The binding price ceiling will not allow the minimum willingness to sell price for firms to be met at any positive quantity.

SUMMARY AND CONCLUSIONS

Price ceilings are common in the U.S. economy; the recent financial meltdown and the debate over healthcare legislation have further served to place this issue in the forefront. This paper discusses the myriad applications of pricing ceilings and complements the standard textbook treatment by introducing misallocations and quality to the analysis. Hence, in addition to supply shortages, which are the familiar source of harm to consumers under price ceilings, we introduce the prospect of misallocations and quality degradation and its effects on consumer welfare. This more rigorous approach to the topic demonstrates that any comprehensive analysis of the merits of price ceilings must address the combined effects of supply shortages, misallocations and

quality degradation. The numerous discussion questions and analytical exercises provided are designed to further develop the students' facility with these important concepts.

QUESTIONS FOR CLASS DISCUSSION

1.The Congress recently enacted healthcare reform legislation. From time to time, the Congress has considered capping the fees for medical services and for pharmaceuticals. How would you advise the Congress on the merits of such policy reforms? How would the pharmaceutical companies likely respond to the imposition of price controls on the drugs they bring to market, in both the short-run and the long-run.

2. Suppose that the housing authority in Cambridge Massachusetts has found that the supply of housing is perfectly (in)elastic. How would you advise the City Council as far as the merits of price ceiling for rental units if the objective is for consumers to be no worse-off?

3. In the aftermath of 9/11 and various natural disasters, such as Hurricane Katrina, the attorneys general in several states announced that in order to protect the public interest they would strictly enforce anti-price gouging legislation. Whereas the specific details of such legislation vary across the states, in most cases it prohibits price increases of more than x% following the disaster in question. Discuss the pros and cons of "anti-price-gouging" legislation in terms of its effect on the consumer welfare. Specifically, are the attorneys general unequivocally protecting the public interest in their enforcement of anti-price gouging legislation?

4. The Department of Justice (DOJ) and the Federal Trade Commission (FTC) evaluate the merits of particular mergers between firms in various industries, including airlines, banking telecommunications, retailing and other industries. The DOJ/FTC face the difficulty of determining whether the underlying motive for the proposed merger is to realize efficiency gains

and hence reduce costs, consolidate market power and raise prices, or some combination of these motives. Evaluate the following proposed merger policy in terms of its effectiveness in enabling the government to discern the true motive for the merger, and the likelihood that any industry consolidation that takes place is welfare-enhancing.

> The merger policy of the U.S. Department of Justice shall be the following. Any two or more firms are free to merge provided that the average price for the product/service sold by the consolidated firm post-merger not exceed the average price for the product/service that prevailed in the market for a two-year period prior to the merger. This particular policy is known as a *price-cap* merger policy because the price for the product/service is capped at the average market price that prevailed pre-merger.[5] [Assume that there are no supply constraints. In other words, assume that supply accommodates demand at the prevailing price.]

ANALYTICAL EXERCISES

1. The FDA (Food and Drug Administration) has recently given consideration to placing price controls on drug companies to prevent price gouging. Suppose that the demand function for prescription drugs is given by $Q^D = 60 - 4P + 2e$ and the supply function for prescription drugs is given by $Q^S = 1P$, where P is price, Q is quantity and e is an index of drug effectiveness. The FDA is giving consideration to imposing a ceiling price on prescription drugs of $P^{max} = 16$.

a) Let $e = 20$ both before and after the imposition of the ceiling price. Are consumers of prescription drugs better off under this policy? Provide a careful economic analysis in support of your claim.

b) Suppose that $e = 10$ following the FDA's imposition of the price ceiling. Determine the value(s) of P^{max} that must prevail if consumers are worse-off relative to the free-market (no government intervention) outcome you derived in part a). Provide a careful economic analysis in support of your claim.

c) What effect, if any, would the imposition of a price ceiling have on the incentives for drug companies to consolidate (merge)?

2. The City Council of Smallville is giving consideration to implementing a price ceiling on rental units based on the number of bedrooms in the unit. The demand function for rental units (on a single bedroom equivalent basis) is given by $Q^D = 80 - 3P + 2q$ and the supply function is given by $Q^S = 2P - q$, where P is price, Q is quantity and $q > 0$ is an index of housing quality. The Council is giving consideration to imposing a ceiling price for rental units of $P^{max} = 16$. **[Advanced]**

a) Let $q = 20$ both before and after the imposition of the ceiling price. Are consumers of rental housing in Smallville well served by this policy? Provide a careful economic analysis in support of your claim.

b) Suppose that the Council is concerned that landlords will allow the quality of their rental units to deteriorate following the imposition of the ceiling price. Continue to assume that $q = 20$ prior to the imposition of the ceiling price. What can you infer about the level of housing quality that landlords provision if consumers are worse off following the imposition of the ceiling price? Provide a careful economic analysis in support of your claim.

c) In addition to the price ceiling of $P^{max} = 16$, suppose that the Council also imposes a quality standard on rental units. What value of q would the Council impose if its policy objective is to maximize consumers' surplus at the ceiling price? What is the corresponding maximized value of consumers' surplus?

d) Suppose now that supply is perfectly elastic at the market equilibrium and $q = 20$. How much better/worse off are consumers with the imposition of the ceiling price on rental units of $P^{max} = 16$? Provide the economic rationale for your answer.

3. Government regulators in California have capped the retail price of electric power. Suppose that the demand function for electric power is given by $Q^D = 40 - 2P + r$, and the supply function for electric power is given by $Q^S = 1P$, where P is the price per kilowatt hour, Q is quantity of kilowatts and r is an aggregate index of power reliability. Suppose that regulators set the price cap at $P^{max} = 12$.

   a) Let $r = 20$ both before and after the imposition of the price cap. Are consumers of electric power better off with the price cap or the free market price? Provide a careful economic analysis in support of your claim.

   b) Suppose that California regulators believe that they must impose minimum reliability standards (i.e., reliability floors) on the electric power companies along with the price cap. Continue to assume that $r = 20$ prior to the imposition of the price cap. At what level would regulators have to set the reliability floor, $\underline{r}$, in order for consumers to be no worse-off from the price cap policy? Provide a careful economic analysis in support of your claim.

   c) Is there excess demand for electric power at the price cap of $P^{max} = 12$ and the reliability floor you derived in part b)? If so, determine the amount of this excess demand.

4. The market demand function is given by $Q^D = 40 - 2P$. Supply is perfectly elastic at a price of 10. How much better or worse off would consumers be in this market if the government imposed a ceiling price of $P^{max} = 8$? How would you answer change if supply were perfectly inelastic?

5. Demand is given by $Q^D = 20 - P$. Supply is given by $Q^S = 10$. What price ceiling does the

government set in this market if consumers are better off by $50 under the price ceiling relative to the free-market outcome?

ENDNOTES

[1] See discussion in Kruse et al. (2005).

[2] There are, of course, other possibilities for the allocation of the good. For example, it might be assumed that those who value the good the most would devote the greatest amount of time and effort in securing it. In this case, the misallocative costs may be lower, but the opportunity cost of time and effort must be accounted for in computing consumer surplus. Alternatively, valuations for the good may be highly correlated with the opportunity cost of time. This could result in the good being allocated disproportionately to relatively low-valuation consumers, and this necessarily implies higher misallocative costs.

[3] See Sappington (2002) and Lynch et. al. (1994) for a discussion of service quality in the context of telecommunications markets. Bannergee (2003) investigates whether incentive regulation (e.g., price cap regulation) has led to degradation in service quality in telecommunications markets.

[4] Weisman (2005) shows that commonly used penalty schemes intended to provide firms with incentives to increase quality can actually have the opposite effect.

[5] It is noteworthy that Mel Karmazin, the CEO of Sirius Satellite Radio, proposed a price-cap approach in order to increase the likelihood of the government approving his merger with XM Satellite Radio, the only other competing satellite radio provider. See Siklos (2007).

SUGGESTIONS FOR FURTHER READING

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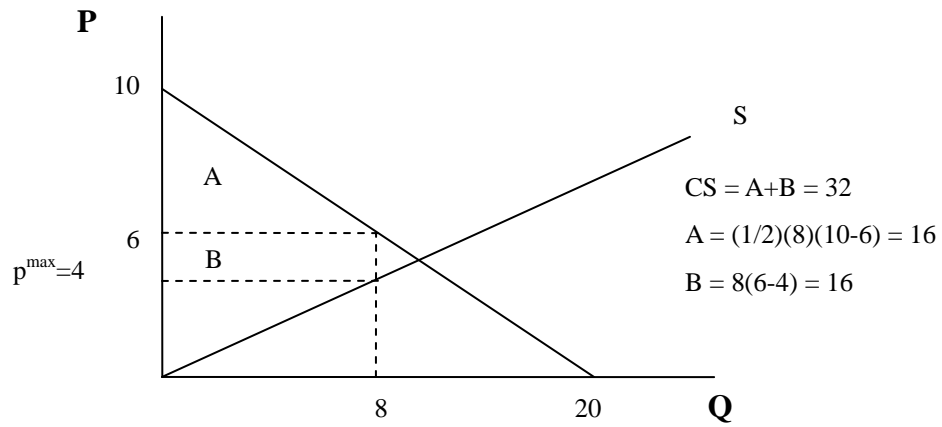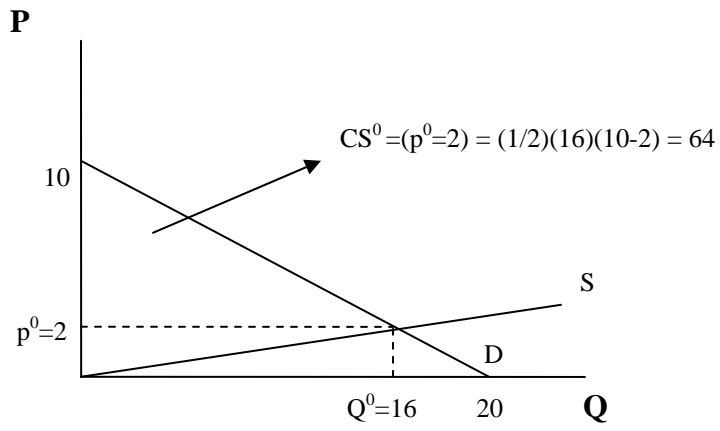**FIGURE 1: THE ECONOMICS OF PRICE CEILINGS**
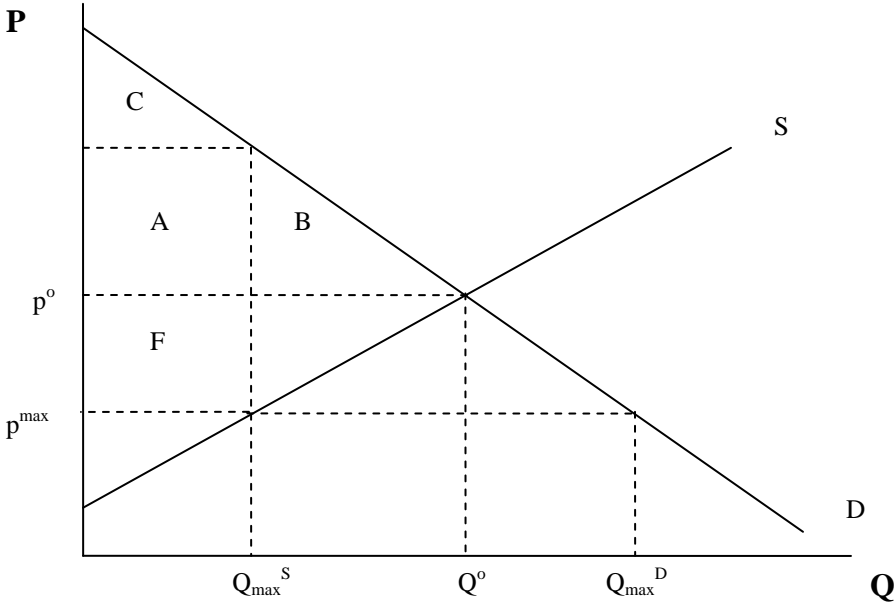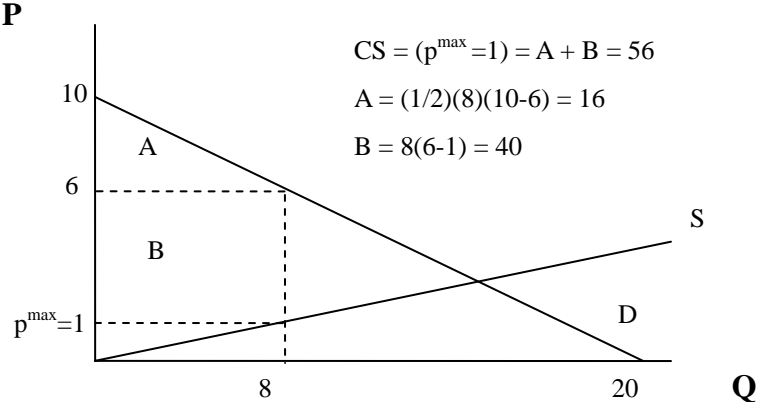
FIGURE 2: FREE MARKET CASE
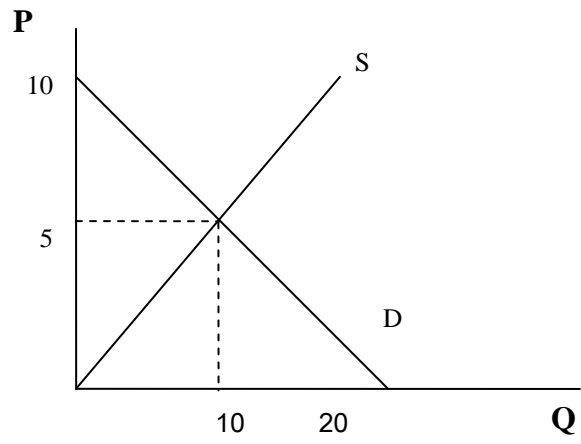
FIGURE 3: BASIC ANALYSIS OF A BINDING PRICE CEILING

$CS = A+B = 32$

$A = (1/2)(8)(10-6) = 16$

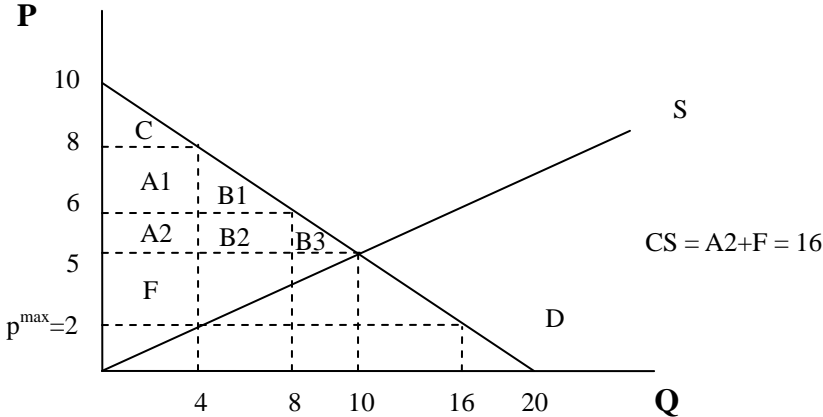$B = 8(6-4) = 16$

FIGURE 4: FREE MARKET CASE

P

10

$CS^0 = (p^0=2) = (1/2)(16)(10-2) = 64$

S

$p^0=2$

D

$Q^0=16$ 20   Q

FIGURE 5: BASIC ANALYSIS OF A BINDING PRICE CEILING

$CS = (p^{max} = 1) = A + B = 56$

$A = (1/2)(8)(10-6) = 16$

$B = 8(6-1) = 40$

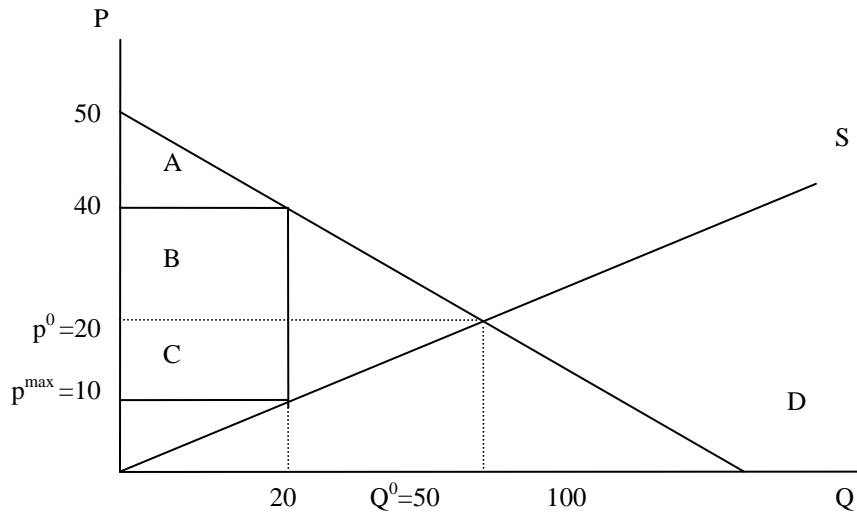**FIGURE 6: PRICE CEILINGS WITH MISALLOCATIVE COSTS**
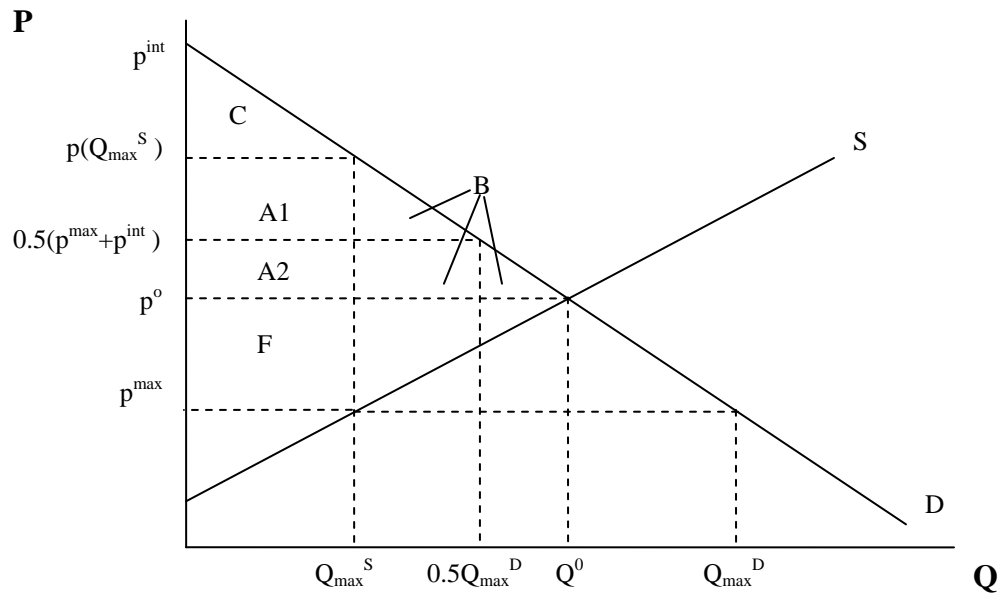
FIGURE 7: FREE MARKET CASE
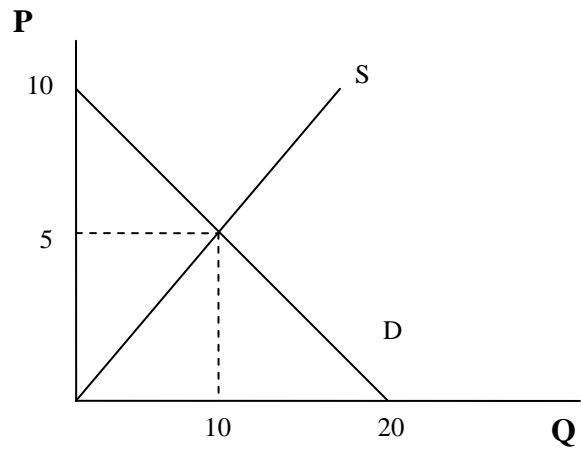
FIGURE 8: A BINDING PRICE CEILING ANALYSIS WITH MISALLOCATIVE COSTS
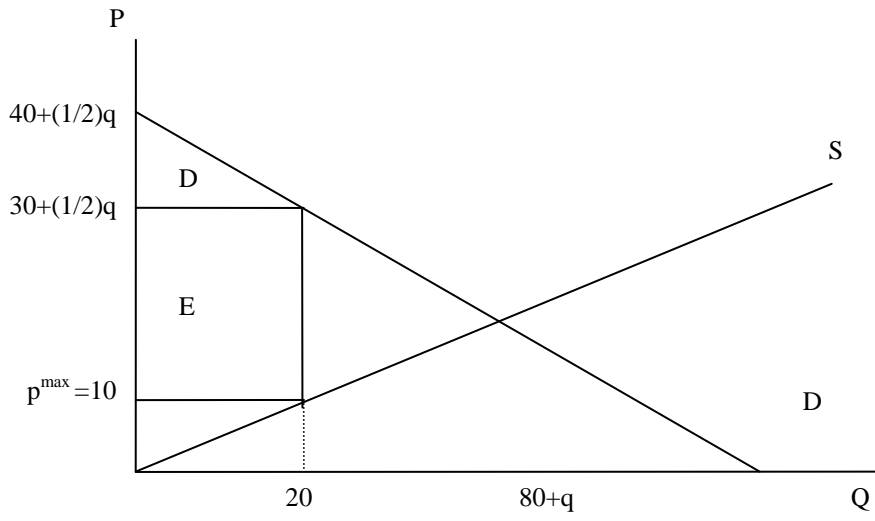

$CS = A2+F = 16$

FIGURE 9: PRICE CEILING WITHOUT QUALITY DEGRADATION

FIGURE 10: PRICE CEILING WITH POTENTIAL QUALITY DEGRADATION

FIGURE 11: PRICE CEILING WITHOUT QUALITY DEGRADATION