NBER WORKING PAPER SERIES

THE SOCIAL COSTS OF RENT CONTROL REVISITED

Edward L. Glaeser

Working Paper 5441

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
January 1996

I gratefully acknowledge financial support from the National Science Foundation. Richard Arnott, David Cutler and Michael Whinston provided helpful comments. This paper is part of NBER's research program in Public Economics. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

NBER Working Paper 5441
January 1996

THE SOCIAL COSTS OF RENT CONTROL REVISITED

ABSTRACT

The textbook graphical analysis of price control (see Figure 1) is inappropriate any time there is substantial consumer heterogeneity. In cases such as rental apartments, where one unit is usually the maximum bought per customer, and the downward slope of the demand function comes exclusively from consumer heterogeneity, this analysis misses a primary source of welfare loss. A major social cost of rent control is that without a fully operational price mechanism the "wrong" consumers end up using apartments. When prices are set below market price, many consumers want to rent apartments even though they receive little utility from those 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. Figure 2 shows the losses graphically.

Edward L. Glaeser
Department of Economics
113 Littauer Center
Harvard University
Cambridge, MA 02138
and NBER

I. Introduction

Price controls have had a long history; they appear in Hammurabic and biblical records. Controlled prices have customarily been seen as a means of income redistribution.[1] Indeed, when the tax system is very costly to use, price controls may be a reasonable way of redistributing income between various groups in society.[2] While these price controls may create desired distributional effects, these controls also have social costs relative to the free market.

The welfare approach to rent control has generally focused on the social losses due to underprovision of rental apartments relative to the competitive equilibrium. Figure 1 shows the classic welfare analysis where low prices lead to underprovision and loss of both consumer and producer surplus. The gains to consumers from lower prices, which is a transfer from producers to consumers, may or may not offset the loss in consumer surplus from underprovision (for small enough price changes, consumers definitely benefit). Indeed, this framework is so well known that it has become a canonical example of the costs of government intrusion in the market place. The bulk of the policy analysis and the bulk of empirical work on rent control involves permutations of Figure 1 (e.g. Olson, 1972). Estimates of demand and cost elasticity are formed to get estimates of then welfare losses, where highly elastic supply or demand is connected to high social losses from price controls.

Economists have also known that this graphical analysis represents a tremendous oversimplification of the economics of rent control.[3] Hayek (1931) and Friedman and Stigler (1946) discussed several additional distortions created by rent control. More modern work has focused on the welfare costs of rationing by queues (Barzel, 1974), or the quality adjustments caused by rent control

[1] In some cases, price controls more closely resemble an insurance device. In particular, there seems to be a stigma against high prices in periods of natural disaster. Glaeser and Scheinkman (1994) present a model of interest rate ceilings as an insurance mechanism.

[2] Of course, it still has to be established that it is desirable to redistribute from landlords to renters. Some authors (e.g. Fraser Institute, 1975) hotly dispute this notion and indeed there is evidence suggesting that landlords, as a group, are not significantly richer than renters (Johnson, 1952).

[3] Most of the basic analysis is a partial equilibrium rather than a general equilibrium analysis, and the usual warnings apply to all such analytics that examine only one part of many interconnected markets. Gould and Henry (1967) examine the effects of price controls on interconnected markets. I will not deal with those issues here.

(Frankena, 1975) or the incentive effects of shortages on the policy makers decisions about price setting (Shleifer and Vishny, 1992).[4] A particularly large quantity of empirical work has focused on several major questions: How much does rental housing supply respond to rent controls?, Does housing quality deteriorate with rent controls?, and do rent controls really further equity goals?[5] The most recent trend (see Arnott, 1995) has been to argue that the costs of "second generation" rent control are small and that there are benefits from rent control as well, stemming from imperfections in the housing market.

I revisit rent control here and address the issue of misallocation of apartments across consumers. This concern is not new. Many writers (especially Friedman and Stigler) focused on the misallocation costs of rent control. There is a verbal tradition that acknowledges the problem that rent control creates misallocation of apartments across consumers, and, indeed, authors such as Deacon and Sonstelie (1989) and Hubert (1991) present formal analysis of such misallocation.[6] In related areas of analysis, explicit theoretical analysis has been done linking heterogeneity of consumers with the advantages of the price mechanism (see Weitzman, 1974), and in a sense this work can be seen as a special case of that more general analysis. Suen (1989) contains ideas and an explicit model that are close to those that discussed here.

Despite the fact that there is certainly verbal and even some formal treatments of the misallocation costs of rent control, and despite the fact that there is an oral tradition among certain urban theorists (e.g. Richard Arnott) of using graphical analysis to show the welfare costs of this misallocation, I have been unable to find a clear mathematical and graphical statement of the allocational welfare economics of rent control, especially when apartments are not efficiently allocated across all consumers. Despite the size and importance of the rent control literature, textbook statements of the social costs of rent control still focus exclusively on the problem of underproduction. Indeed, Mills and Hamilton (1994, p.269) write "the cost of rent control is the adverse effect on the supply of

---

[4]Smith, Rosen and Fallis (1988), and Arnott (1987) both summarize the various theoretical approaches to housing markets, and rent control.

[5]Among the many books and papers written on this topic are Downs (1988), Fraser Institute (1975), Gyourko and Linneman (1989), Olson (1988).

[6] The authors use two types of consumers, rather than a continuum of consumers that create downward sloping demand with their heterogeneity.

rental housing;" they do not mention misallocation across consumers. This paper formalizes ideas that have circulated since at least Hayek about the costs of price controls when we cannot guarantee efficient allocation across consumers. A more thorough theoretical discussion of these issues will hopefully give these costs their proper place in the popular discussion of the costs of rent control.

The basic point of this paper can be described simply. Apartments are discrete goods that are usually only consumed one per customer. For each individual demand is simply the willingness to pay for the apartment. The aggregate demand curve should be thought of as the sum of each individual's discrete demand, or each individual's willingness to pay for the apartment.[7] The overall demand curve tells us that for any given rental price, there are a certain number of consumers who value the apartment more than the rental price and thus wish to rent the apartment at that price. The downward slope of the demand curve is created only through consumer heterogeneity.[8] Anytime there is consumer heterogeneity, price controls will create social costs coming from the misallocation of products across consumers. In the case of discrete goods, where all of the demand curve comes from consumer heterogeneity, then the social costs of misallocation across consumers are extremely large and will be larger, for small impositions of rent control, than the social costs of undersupply.

The standard graphical analysis of rent control is inappropriate or extremely incomplete for the rental market. At the rent controlled price, a large number of consumers want to purchase the good; demand is not limited to those consumers who value that product most. Indeed more consumers want to purchase the apartment at the rent controlled price than at the market price. Unless there exists some mechanism that allocates apartments to those consumers with the highest willingness to pay, the introduction of rent control will mean that the average apartment renter will receive less marginal utility from his apartment than the average apartment renter without rent control. If apartments are

[7]Aumann (1966) discusses this type of demand curve.

[8]Consumer heterogeneity may be due to income differences, difference in expected mobility rates, marriage, and a wide variety of other factors that determine the choice of rental vs. owned housing. While it may seem like this decision is entirely one to due with contractual structure, the housing market seems to favor ownership for most detached housing relative to apartment buildings. While this could be true due to tax reasons, alternatively it could be the result of agency problems that are more extreme in detached housing than in apartment units.

allocated randomly across those individuals who want apartments at the rent controlled price, then the basic graph and the basic welfare analysis will be completely wrong.

The basic graph assumes the renters under rent control are those who want to consume the apartment most, i.e. those consumers with the highest willingness to pay, and under this graph (Figure 1) the average willingness to pay of renters has risen substantially with rent control. This graph seems to be inappropriate for a basic analysis of rent control, or any market where overall demand comes from combining discrete demand functions within the market. The graph is only appropriate for goods where homogeneous individuals adjust consumption along an intensive margin or if a mechanism perfectly allocates goods to those consumers who value the goods most.

An alternative graphical analysis, that may be more appropriate for rent control, is shown as Figure 2. Figure 2 has the same consumer and producer losses from underproduction of apartments, but in addition it also recognizes the substantial consumer loss from the fact that consumers who don't particularly value apartments are still trying to get apartments under rent control The point B on the graph represents the expected consumer valuation of apartments for those consumers who want apartments under rent control, assuming that apartments are randomly allocated across individuals who desire the apartment. The five-sided area labeled "lost consumer surplus due to misallocation" above represents the social losses that stem from the fact that apartments will not necessarily be allocated to those consumers who value them most. The social losses from misallocation may be much larger than the social losses from underproduction--indeed the misallocation losses are classically first order while the underproduction losses are second order. Alternatively and equivalently, the marginal damage of rent control due to underproduction losses go to zero as the rent control gets close to the free market price. However, the marginal social damage of rent control due to misallocation losses always stays positive.

The analysis in Figure 2 is more appropriate than the analysis in Figure 1 for goods where consumers make a zero-one choice to consume a particular good, and the demand curve comes from consumer heterogeneity. The analysis in Figure 1 is appropriate, when consumers are homogeneous and consumption decisions occur on the intensive margin, so that the downward sloping demand curve comes from diminishing returns at the individual level. Furthermore, Figure 1 would also be correct if the world is perfectly Coasian and apartments get costlessly allocated to the individuals who value them most (as they would be in a world where transaction costs are zero). While I certainly sympathize with this possibility, there is a legal maze enacted to maximize the difficulty of allocating apartments among consumers, and casual observation of rent controlled markets suggests that there is not an efficient market that buys and sells the rights to rent controlled markets. There are mechanisms that improve the allocation problems, such as queuing and search effort, and while these mechanisms solve the allocation problem they are themselves quite costly and represent further social losses. There are empirical means of determining how well apartments are allocated under rent control, and these are discussed at the end of the paper. Of course, the analyses in both figures avoid many other complexities of rent control and rely on what is essentially partial equilibrium analysis.

The remainder of the paper goes through the analysis formally. Section II compares rent control with perfect allocation of apartments and rent control with completely random allocation of apartments across individuals who want to rent. I give a particular parametrization and particular comparative statics about the social costs of rent control-- the more standard comparative statics become somewhat altered with random allocation of apartments. Section III complicates the matter further. I deal with the intermediate case of semi-random allocation of apartments, queues as allocation devices, quantity responses by landlords and a richer intertemporal model. Section IV describes some verbal extensions from using the model to discuss who votes for rent control, some directions for empirical work and discussion of markets other than rental housing. Section V concludes.

II. The Model

The supply-side of this market is characterized by a rising aggregate cost function-- C(H), where H is the total housing supplied. The marginal cost of an additional house is denoted c(H). Housing supply works along several margins. Apartments may be taken out of the rental market and transformed into owner occupied housing. Alternatively, new apartments may not be built when prices are reduced. This rising cost function can be justified by assuming a fixed supply of producers whose costs are rising in the number of units that they produce. Alternatively, there might be a continuum of producers each of whom sells a fixed number of units and the entry cost of each new producers is rising with the number of past producers, either because of competition for inputs or because the later producers have less of a comparative advantage in producing than the earlier producers.[9]

There is a continuum of potential consumers for the product; each consumer is indexed with a real positive number i. The density of consumers at each index number is one, and the number of consumers for whom i≤k, for any constant k is k. Each consumer rents at most one housing unit. These consumers have utility functions that are linear in a composite commodity (which includes non-rental housing) which has a price of 1, and there is heterogeneity in the taste for living in a rental unit. I assume that each consumer places a value, denoted V(i), on renting an apartment and that V'(i)<0. Consumer utility is therefore $U(X,Y) = X + V(i)I(Y=1)$, where I(Y=1) is an indicator function that takes on a value of 1 if the consumer rents an apartment and a value of zero otherwise. The structure of the index means that if consumer i* is indifferent towards consuming the apartment, then all consumers with i≤i* will desire to consume the apartment at the given price, and the demand for the apartment will be of measure i*.

a. Free Market Equilibrium

In the free market equilibrium, consumers will continue to purchase the product until the point that V(i*)=c(i*), where i* denotes the index number of the marginal

[9]Distinguishing between these two alternative sources of upward sloping supply is irrelevant for rent control. However, the difference would be crucial if the policy involved was a minimum rent or wage, and social costs would be much higher if there were heterogenous suppliers.

consumer and the total number of consumers that have purchased the good. Unsurprisingly, the value place by the marginal consumer on the product must equal the marginal cost of supplying that consumer with the product. The total consumer surplus is found by subtracting the price of the commodity from its value to consumers:

(II.a.1) $$\int_{i=0}^{i*} (V(i*) - c(i*))di$$

The producer surplus is found by subtracting the costs of production from the profits, or $c(i*)i* - C(i*)$. The overall social welfare will be defined by adding up the utilities of the consumers and the profits of the producers and subtracting the social cost of producing the product. In the free market equilibrium social welfare is:

(II.a.2) $$\int_{i=0}^{i*} V(i)di - C(i*)$$

Social welfare subtracts the social cost of production from the benefits to consumers. There are at this point assumed to be no gains from redistributing between the two classes of agents.

b. Price Controls with Allocational Efficiency Across Consumers

We first analyze a classic price control, where the price of the object cannot rise above $\bar{c}$. The quantity supplied will therefore equal $c^{-1}(\bar{c})$. In the case that allocational efficiency is preserved and the consumers that really value the product get to consume it at this new price, we will define $S = c^{-1}(\bar{c})$, where S denotes the total quantity supplied and the marginal consumer in this new situation and this marginal consumer is defined so that the amount demanded exactly equals the amount supplied.

The consumer surplus in this case is:

(II.b.1) $$\int_{i=0}^{S} \left(V(i) - \bar{c}\right)di.$$

Quantity (II.b.1) can be greater or less than (II.a.1), so consumers can either gain or lose with rent control. Consumers will gain if (II.b.1) is less than (II.a.1) or:

$$\text{(II.b.2)} \qquad S(c(i^*)-\bar{c}) > \int_{S}^{i^*}(V(i)-c(i^*))di$$

Equation (II.b.2) weighs the benefits for those consumers who actually receive the good (i.e. whose index numbers are less than S or $c^{-1}(\bar{c})$) under both regimes, with the losses to those consumers who used to receive the good but who now don't. If those marginal consumers are politically disenfranchised (i.e. they are transient renters or other less politically attached groups) then it is easy to understand why rent control might receive some support.[10]

However, for marginal changes from the free market equilibrium it is clear that price controls are always beneficial to consumers, since there is no distortion at the margin. If we take the derivative of (II.b.1) with respect to $\bar{c}$, we find:

$$\text{(II.b.3)} \qquad \frac{\partial S}{\partial \bar{c}}\left(V(S)-\bar{c}\right)-S=\frac{\left(V(c^{-1}(\bar{c}))-\bar{c}\right)}{c'\left(c^{-1}(\bar{c})\right)}-c^{-1}(\bar{c})$$

At $\bar{c}=c(i^*)$, V(i*)=c(i*), so this term is always negative and an imposition of rent control at the margin always helps the consumers.

The total producer surplus is $\bar{c}c^{-1}(\bar{c})-C(c^{-1}(\bar{c}))$, and this must fall as rent control is imposed. The total social welfare in this case is:

$$\text{(II.b.4)} \qquad \int_{i=0}^{S}V(i)di-C(S).$$

The derivative of social welfare with respect to the price maximum is:

---

[10]Alternatively, the marginal consumers may be more wealthy and the social planners is less disturbed about reallocating away from wealthier consumers.

(II.b.5)
$$\frac{V(S)-c(S)}{c'(S)}$$

For price controls below the market price this term will always be strictly positive, which means that a further imposition of rent control lowers welfare. However, near the free market equilibrium the price control has no effect on welfare since V(S)=c(S) at that point. The total social loss from rent control is:

(II.b.6)
$$\int_{i=c^{-1}(\bar{c})}^{i*}(V(i)-c(i))di$$

This term is classically "second order" in the sense that the loss is roughly the distance between consumer valuation minus producer cost (which is zero at the social optimum) times the difference between optimal output and regulated output (which is zero at the social optimum). These first two sections represent the benchmark analysis of rent control and are quite well known; the next section represents the first contribution of this paper.

c. Price Control without Allocational Efficiency Across Consumers

In this case, there is again a fixed upper bound on prices. Again the quantity supplied will equal $c^{-1}(\bar{c})$, which I will again denote S, and producer surplus will again equal $\bar{c}c^{-1}(\bar{c})-C(c^{-1}(\bar{c}))$. However, in this case I assume that all consumers who would like to purchase the product at this price may have an equal change of receiving the product. This assumption is the critical difference between the previous model; the relevance of much of this paper depends on which assumption holds. In a purely Coasian world where apartments could be freely traded among renters, apartments would end up being allocated efficiently. Alternatively, if apartments were allocated due to completely random factors, they could well end up in the hands of the well connected and influential who need them least. Section III.a of the paper will detail alternative allocation mechanisms. Here, I deal only with completely random distribution of apartments across prospective renters.

I will again use S to denote the supply of apartment. Now there is a new marginal consumer denoted i**, where $V(i**) = \bar{c}$. All consumers for whom i<i** would like to get the product, and total demand D=i**. I assume that there is a random allocation of products across consumes so that individuals who value the product least, yet are still willing to pay the controlled price, are just as likely to receive the product as individuals who value the product most. In this case, consumer surplus is:

(IIc.1) $$\int_{i=0}^{i**} \frac{S}{D}\left(V(i) - \bar{c}\right) di$$

The fraction S/D gives the probability that any particular individual, who wants the commodity, will receive the commodity. Now the comparison of the consumer surplus between rent control and the competitive equilibrium is:

(II.c.2) $$\int_{0}^{i*}\left(\frac{S}{D}\left(V(i) - \bar{c}\right) - \left(V(i) - c(i*)\right)\right) di + \int_{i*}^{i**} \frac{S}{D}(V(i) - \bar{c}) di$$

Equation (II.c.2) adds the potential gains from price control that accrue to the consumers who were consuming before price control to a term that captures the gains to consumers who are brought into the market through price control. Indeed the first term itself may be either positive or negative depending on whether the decline in price outweighs the possibility of not getting the product. The second term is always positive.

The total social welfare with price control and random allocation of goods is:

(II.c.3) $$\int_{i=0}^{D} \frac{S}{D} V(i) di - C(S)$$

Equation (II.c.3) is definitely less than equation (II.b.3). The added losses from price control here represent the fact that the consumers that most value the product may not necessarily receive the product. The derivative of this term with respect to $\bar{c}$ yields:

(II.c.4) $$\frac{\partial D}{\partial \bar{c}}\frac{S}{D}V(i**)+\left(\frac{1}{D}\frac{\partial S}{\partial \bar{c}}-\frac{S}{D^2}\frac{\partial D}{\partial \bar{c}}\right)\int_{i=0}^{i**}V(i)di-\frac{\partial S}{\partial \bar{c}}\bar{c} \text{ or}$$

(II.c.4') $$\left(\frac{1}{D}\frac{\partial S}{\partial \bar{c}}-\frac{S}{D^2}\frac{\partial D}{\partial \bar{c}}\right)\int_{i=0}^{i**}\left(V(i)-\bar{c}\right)di$$

Unlike the social loss from rent control when rationing is efficient, this derivative does not go to zero near the social optimum. Term (II.c.4') will alway be positive (more strict rent controls lower social welfare) because it relates to misallocation between inframarginal consumers and marginal consumers. Put another way, if we examine the social cost of rent control we can write:

(II.c.5) $$\int_{i=S}^{i*}(V(i)-c(i))di+\left[\frac{S}{D}\int_{i=0}^{D}V(i)di-\int_{i=0}^{S}V(i)di\right]$$

The first term in (II.c.5) is exactly the same as the social loss term in (II.b.6), and represents the classic loss from underprovision. The second term in (II.c.5) is the misallocation cost and it is not classically second order.[11] This term equals the loss because the expected utility of renting for renters under rent control is less than the expected utility for renters renting if perfect allocation of apartments occurred. The second term will be larger in absolute value than the first term whenever:

(II.c.6) $$\frac{D}{S}\frac{i*-S}{D-S}E(V(i)-c(i)|S\le i\le i*)>E(V(i)|S\le i\le D)-E(V(i)|i\le S)$$

(again where E(. | .) is the conditional expectations operation). This inequality should always hold when for sufficiently marginal levels of rent control. The first term on the left hand of the inequality will go to one as rent control disappears; the second term is bounded between one and zero. The expectation on the left hand size will go to zero-- the left hand side of the inequality must go to zero as rent control disappears. The right hand size of the inequality however goes to a negative constant as long as valuation of the marginal consumer is greater than the valuation of the average consumer (which will always hold if

[11] Alternatively, this term can be thought of as S[E(V(i) | i≤D)-E(V(i) | i≤S)], where E(. | .) is the conditional expectations operator.

demand curves slope down strictly). This fact that the allocational losses will always be greater than the underprovisional losses for a sufficiently marginal imposition of rent control also, and equivalently, follows from the fact that the derivative of the first term is zero at the free market equilibrium, but the derivative of the second term is strictly negative at that point.

The welfare loss is shown in Figure 2. The first term represents the two triangles that are the standard welfare loss from rent control. The difference in expectations term in (II.c.5) is the pentagon that is formed between the demand curve and the expected willingness to pay for consumers who want the apartment at the rent controlled price.

d. A Parametrization and Comparative Statics

I will now consider linear demand and supply functions. Throughout, I assume that $C(S)=cS^2/2$, or $c(S)=cS$, a classic linear supply function. I also assume that $V(i)=a-bi$ (initially, later I will show results for a piecewise linear function. In this case, the free market equilibrium sets $i^*=a/(b+c)$ and the market price is $ac/(b+c)$.

Rent controls set $\bar{c} < \frac{ac}{b+c}$. The social welfare given efficient allocation of apartments and rent controls is:

(II.d.1) $$\frac{2ac\bar{c} - (b+c)\bar{c}^2}{2c^2}$$

The effect of raising the rent control on social welfare is:

(II.d.2) $$\frac{ac - (b+c)\bar{c}}{c^2}$$

The advantage of eliminating rent control, or the cost of imposing rent control, is greater when a is higher, when b is lower and when c is higher. As demand becomes more inelastic or as supply becomes more elastic, the standard economics of rent control tells us that the social costs of rent control rise. The demand elasticity effect can be seen simply in Figure 1. As the demand curve becomes steeper the welfare loss triangle increases in size.

Alternatively, consider social welfare with rent control when there is random allocation of apartments across all individuals who want an apartment at the prevailing market rent:

$$\text{(II.d.3)} \quad \int_{i=0}^{\frac{a-\bar{c}}{b}} \frac{\frac{\bar{c}}{c}}{\frac{a-\bar{c}}{b}}(a-bi)di - \frac{\bar{c}^2}{2c} = \frac{b\bar{c}}{c(a-\bar{c})}\left(a\left(\frac{a-\bar{c}}{b}\right) - \frac{b}{2}\left(\frac{a-\bar{c}}{b}\right)^2\right) - \frac{\bar{c}^2}{2c} = \frac{a\bar{c}}{2c}$$

The social benefit of lifting price controls is a/2c. In this case, higher a increases the benefits of eliminating price controls, and indeed a lower c (or a more elastic supply) also increases the benefits of price controls. More surprisingly, b no longer enters into the equation. In this simple linear model the effect of demand elasticity completely vanishes.

The intuition behind this effect is that demand elasticity has two opposite and completely offsetting effects. Higher demand elasticity makes rent control less costly because the social cost of under production becomes more important when demand is more inelastic. However, highly elastic demand also increases the pool of perpetual candidates for the apartment. As demand elasticity goes up, the number of competitors for the apartments also rises and as a result the problems of misallocation increase.

As a further example of this phenomenon, and to further clarify the issues, I know examine a piecewise linear demand function. Consider the case where V(i)=a-bi-dMax[i-k, 0]. This piecewise linear function has two separate slopes and we can calculate the social losses for this function as well. Here we will assume that k<D. When k≥D, there is no difference between this case and the standard linear demand case. With piecewise linear demand, total social welfare can be written as:

$$\text{(II.d.4)} \int_{i=0}^{k} \frac{S}{D}(a-bi) + \int_{i=k}^{D} \frac{S}{D}(a-bi-di) - \frac{cS^2}{2} = \frac{S}{D}\left(aD - \frac{bD^2 + dD^2 - dK^2}{2}\right) - \frac{cS^2}{2}$$

Using that $S = \bar{c}/c$ and $D = (a - \bar{c})/(b + d)$, we can rewrite (II.d.4):

(II.d.4') $$\frac{a\bar{c}}{2c} + \frac{\bar{c}K^2 d(b+d)}{2c(a-\bar{c})}$$

The derivative of social welfare with respect to price controls is now:

(III.a.5) $$\frac{a}{2c} + \frac{a}{(a-\bar{c})^2}\frac{K^2 d(b+d)}{2c} = \frac{a}{2c} + \frac{a}{(a-\bar{c})^2}\frac{K^2 b_2(b_2 - b_1)}{2c}$$

For comparative statics on the slope coefficients, I have let b_1=b, the slope for i<K, and b_2=b+d, the slope for i>K. Again as always the social benefits of eliminating rent control rise with a and fall with c, or equivalently more elastic supply again raises the social costs of rent control.

Now we find that demand elasticity also determines the social costs of rent control. An increase in b_1 will definitely decrease the social costs of rent control. The intuition is that for changes in demand that are away from the margin of demand, more elastic demand means that there are fewer social costs from the misallocation of apartments across consumers-- it is less important that the high V(i) consumers may not consume apartments.

Conversely, an increase in b_2 will raise the social costs of rent control, unless $b_1 > 2b_2$. The intuition of this is that as demand becomes more elastic near the margin of demand, a small increase in price will eliminate a large number of prospective buyers who have low gains from buying but will make it harder for those consumers with high gains from buying to get the apartments. When demand on that margin is inelastic than an increase in the rent controlled price will not significantly lesson the number of potential renters who don't value the apartment very much.

Figures 3A and 3B shows this graphically. Figure 3A shows the when demand becomes more elastic near the margin of consumption, then the expected value place on apartments after rent control falls and thus the consumer welfare after rent control also falls. This change does not effect consumer welfare before rent control at all, so it acts to increase the social costs of rent control.

Figure 3B shows the effect of a decrease in elasticity for consumers who have high levels of valuation for apartments. It is true that this decreased elasticity raises the consumer surplus under rent control, but the decreased elasticity raises the consumer surplus without rent control even more. Thus the social cost of rent control itself rises with this decreased elasticity, or falls with the increased elasticity. So elastic demand can make rent control costly if the elastic demand area is near the margin of consumption. Elastic demand can make rent control less costly if it is far from the margin of consumption.

III. Extensions

These extensions treat the general case of apartments being allocated across individuals through an undescribed, but general lottery system. I deal with quality responses and queuing for apartments. Finally, I present a brief dynamic model.

a. Variable Allocation across Individuals and Variable Pareto Weights

Here we allow for the intermediate case of an allocation of apartments across consumers that is neither completely random nor completely efficient. Again I will use S to refer to the supply of apartments available and D to refer to the demand for apartments. I define a function $\theta(i)$, where $\theta(.)$ maps an individuals index number into his ability to procure an apartment. In this case agent i's probability of receiving an apartment is $\frac{\theta(i)}{\int_{i=0}^{D}\theta(i)di}S=\frac{\theta(i)S}{\Theta(D)}$, where $\int_{i=0}^{D}\theta(i)di\equiv\Theta(D)$. We denote $\phi(i,D)=\theta(i)/\Theta(D)$.

For social welfare calculations, I will use the basic welfare formula when apartments are assigned across consumers with a general allocation mechanism. I denote the pareto weight of all producers as λ_S, and use a general social weight function $\lambda(i)$ which assigns a social value to the welfare of each one of the consumers. The planners problem is now:

(III.a.1)
$$\int_{i=0}^{D} \lambda(i)\phi(i,D)S(V(i)-\bar{c})di + \lambda_S(S\bar{c} - C(S))$$

If I differentiate this with respect to the level of rent control I find that:

(III.a.2)
$$\left(\frac{\partial S}{\partial \bar{c}} - S\frac{\partial D}{\partial \bar{c}}\phi(D,D)\right)\int_{i=0}^{D}\phi(i,D)\lambda(i)(V(i)-\bar{c})di + S\left(\int_{i=0}^{D}\phi(i,D)\lambda(i)di - \lambda_S\right)$$

There are two components of the benefits of eliminating rent control. The first component represents the effects within the consumer groups. This term is always positive and represents the effect of rent control reducing supply and increasing the demand of marginal consumers on the allocation of goods and welfare across consumers. The second term represents the transfer of wealth from the producers to the consumers (when you raise the rent control). This term can have any sign depending on the relative social welfare of producers and consumers. Traditionally, renters have been thought to have been wealthy and less "deserving" of these rents; some analysis (e.g. Johnson, 1951) has documented that landlords as a class are close in average income to the average renter.

Obviously, the social costs of rent control will be higher as the social welfare of the landlord class becomes more important to the group (i.e. as λ_S rises). For further comparative statics, I assume that $\lambda(i) = \lambda_1 + \lambda_2(i - \underline{i})$. The derivative of (III.a.2) with respect to λ_1 is:

(III.a.3)
$$\left(\frac{\partial S}{\partial \bar{c}} - S\frac{\partial D}{\partial \bar{c}}\phi(D,D)\right)\int_{i=0}^{D}\phi(i,D)(V(i)-\bar{c})di - S\int_{i=0}^{D}\phi(i,D)di$$

The first term is positive, the second term is negative. The overall sign is ambiguous, which is unsurprising since this term is exactly analogous to the term in (II.c.2) where consumer welfare could either be rising or falling in the level of rent control. In this case, it is clear that if consumer welfare is rising with rent control then raising λ_1 raises the benefits of rent control. More interesting are the results on λ_2. Taking the derivative of (III.a.2) with respect to λ_2 yields:

(III.a.4) $$\left(\frac{\partial S}{\partial \bar{c}} - S\frac{\partial D}{\partial \bar{c}}\phi(D,D)\right)\int_{i=0}^{D}\phi(i,D)(i-\underline{i})(V(i)-\bar{c})di - S\int_{i=0}^{D}(i-\underline{i})\phi(i,D)di$$

The second term in (III.a.4) again refers to the effects of rent control that come from redistributing away from suppliers towards consumers. This term suggests that an increase in the connection between i and pareto weight will increase the marginal benefit of eliminating rent control if individuals for whom $i>\underline{i}$ are more likely to receive apartments than individuals for whom $i<\underline{i}$. If those quantities are roughly equal, then increasing the connection between i and the pareto weight does not effect this term. More exactly if $\phi(i,D)=\frac{1}{D}$ and $\underline{i}=D/2$, then this term equals zero.[12] In general, the first term is negative if:

(III.a.5) $$\int_{i=\underline{i}}^{D}(i-\underline{i})\phi(i,D)(V(i)-\bar{c})di > \int_{i=0}^{\underline{i}}(\underline{i}-i)\phi(i,D)(V(i)-\bar{c})di$$

When $\phi(i,D)=\frac{1}{D}$ and $\underline{i}=D/2$, then this condition always holds and an increase in the pareto weights of high i individuals always make rent control more advantageous. The correct interpretation of this finding is that rent control generally helps the marginal consumers relative to the inframarginal consumers.

In general, it should also be clear that the advantages of rent control rise if those individuals who are likely to receive apartments under rent control are individuals with a large place in the social welfare function. When changes in the allocation function favor those who are most valued socially then increasing rent control makes more sense. In particular, if the allocation system particularly favors the poor (if that group is valued in the social welfare function) then rent control becomes more advantageous.

It should be immediately obvious from (III.a.2) that the disadvantages of rent control are higher when $\theta(.)$ is higher for low levels of i, when V(i) is also high.

[12] In fact, $\underline{i}$ is a fairly arbitrary term chosen to create an increase in the connection between pareto weight and i without creating an increase in the overall social welfare put on the consumer group.

In other words, when there is a correlation between the likelihood of receiving the apartment and the social value placed on the apartment. When those individuals that value apartments most, i.e. those with low i values, are least likely to receive apartments, then the social cost of rent control is even greater than in the previous section.

To formalize the effect of changing the rationing scheme on the social cost of rent control, we will assume a linear form of $\phi(i,D)=\phi_1(D)-\phi_2(D)i$. For simplicity I also assume that $\lambda_S=\lambda(i)=1$ for all i. Taking the derivation of (III.a.2) with respect to $\phi_2(D)$ yields:

$$\text{(III.a.6)} \quad \int_{i=0}^{D}\left(S\frac{\partial D}{\partial \bar{c}}((i+D)\phi_1(D)-2iD\phi_2(D))-i\frac{\partial S}{\partial \bar{c}})\right)(V(i)-V(D))di<0$$

Equation (III.a.6) connects the social benefit of eliminating rent controls (raising $\bar{c}$) with the connection between rent valuation and probability of getting an apartment ($\phi_2(D)$ captures the extent to which valuation is linked to probability of receiving an apartment). The basic finding is that as the social costs of rent control will be higher in cases where $\phi_2(D)$ is high (i.e. close to zero) or even positive. The social costs of rent control unsurprisingly diminish as the allocation mechanism becomes highly efficient.[13] Figure 4 shows the effects of more efficient allocation mechanisms on the social costs of rent control.

b. Queuing

We now impose a price, T on entering the lottery to receive the product. This price is meant to capture the cost of waiting in line or other activities which are required to stand a chance of receiving the product.[14] When the product was allocated to those consumers who valued the product most, there was no social gain from such queues, and all of the gains to consumers could conceivable lost

[13]This point is similar to the argument of Suen (1989).
[14]As in Cheung (1974), I have in mind any number of queuing activities, many of which are socially wasterful. Following, Cheung it would be possible to endogenize this entry price for the lottery, as in Deacon and Sonstelie (1991).

by such queuing. When goods are simply allocated randomly, these queues may indeed increase social welfare.[15]

For generality we allow that only αT represents social waste and that (1-α)T is given to the producers. In this case, we will define D, so that $\frac{S}{D}\left(V(D)-\bar{c}\right)=T$, or $\frac{\partial D}{\partial T}=\frac{1}{SV'(D)-1}<0$. Total social welfare is now:

(III.b.1)
$$\int_{i=0}^{D}\frac{S}{D}V(i)di-C(S)-\alpha DT$$

Simple differentiation of (III.b.1) with respect to T yields:

(III.b.2)
$$\frac{\partial D}{\partial T}\left(-\int_{i=0}^{D}\frac{S}{D^2}(V(i)-V(D))-\alpha T\right)-\alpha D$$

which tells us that the benefits of queues in reallocating resources can be compared with the costs of queues in lost time or energy. First, this term may be negative even from the point where T=0. As long as the welfare loss from misallocation is not sufficiently large, and as long as α is not too close to zero it is entirely possible that the optimal queue is no time at all. As long as:

(III.b.3)
$$\alpha>\frac{\partial D}{\partial T}\left(-\int_{i=0}^{D}\frac{S}{D^3}(V(i)-V(D))\right)$$

then rising T from zero will lead to social losses and not social gains and it the optimal policy will be to have completely random allocation of resources.

Conversely, the optimal queue may lead to perfect allocation of apartments across consumers. Even when α=1, it is even possible that the optimal toll will set S=D, i.e. that $T=V(S)-\bar{c}$, and so create completely efficient sorting. The condition for completely efficient sorting to be optimal is:

---

[15]This section is a stylized version of a true queueing/search model., for example the model given in Arnott (1989).

(III.b.4)
$$E\left(V(i)\middle| i \le D\right) - \bar{c} \ge \frac{D}{\left(-\dfrac{\partial D}{\partial T}\right)}$$

In this case, where rent control has not lead to any distortion of who rents apartments the social costs of rent control can be seen graphically in Figure 1. The only difference between this analysis and that analysis that the box which in figure 1 is labeled transfer from producers to consumers will be lost . Not only has rent control lead to a loss from underproduction, but rent control has also lead to a loss of the entire box between V(S) and $\bar{c}$. This is exactly the case discussed in Cheung (1974). The primary difference is that in this case, social welfare with the wasteful queuing activity may still be significantly better than allocation without dissipative queues.

If $\alpha<1$, then only a fraction of that box is lost in the process of rent control. Again, the basic point is that while queuing or other mechanisms for reallocation may indeed lead to better allocation of apartments (1) they may or may not increase social welfare from the case of random allocation of apartments and (2) with queuing the familiar welfare triangle of loss is also incorrect and will seriously underestimate the social costs of rent control.

c. Quality Responses

When apartments also have a quality dimension, some of the misallocation results disappear and are replaced by more standard product underprovision costs.[16] The reason for this is that the inclusion of a quality dimension changes the consumption decision from an extensive to an intensive margin and the social costs of price controls only have misallocations across consumers when decision are on an extensive margin. To introduce quality into the analysis, assume that the valuation of an apartment for a potential consumer is now V(i,q) where q reflects the quality of the apartment. The marginal supply cost of providing an apartment is c(S)+K(q), where K(0) is normalized to zero, and the marginal cost of providing an extra unit of quality is k(q). I assume that quality is perfectly observable and that each supplier offers a price, quality pair.

To define an equilibrium, I will denote the price of a quality zero (quality has a lower bound) as $\underline{p}$ and will define a function p(q), where p(0)=0, which reflects the market price of higher quality levels. Standard equalizing difference arguments tell us that over the range of quality levels that are offered p'(q)=k(q) so that the increase in price exactly offsets the change in cost. Optimizing consumers, who are renting apartments, will choose quality to maximize V(i,q)-p(q) or

(III.c.1) $$\frac{\partial V(i,q)}{\partial q} = p'(q) = k(q).$$

This equation implicitly defines a q(i) function, which is the desired quality level for individual i and which can then be used to determine the overall market equilibrium. I will assume that q(i) is either monotonically increasing or monotonically decreasing in i and that V(i,q(i))-p(q(i)) is also strictly decreasing in i. The free market supply and demand are found so that:

(III.c.2) $$V(i^*,q(i^*)) = c(i^*) + K(q(i^*)) = \underline{p} + p(q(i^*))$$

[16]This results are highly analogous to those pioneered by Frankena (1975) in the standard analysis of rent control; Arnott (1975) provides a discussion.

Total social welfare is:

(III.c.3) $$\int_{i=0}^{i^*} V(i,q(i))di - C(i^*) - \int_{i=0}^{i^*} K(q(i))di$$

In the case of a price control of $\bar{c}$, there are several possible scenarios. In the simplest case, at that price the quantity demanded at zero quality is greater than the quantity supplied at zero quality. In that case, social welfare will be:

(III.c.4) $$\int_{i=0}^{D} \frac{S}{D} V(i,0)di - C(S)$$

which is a formula that is substantially unchanged from the prior section. This is an *equilibrium* because no supplier would ever increase quality, if the supplier will neither increase the probability of selling or increase the sales price.

Alternatively, the adjustment may take place so that we have a quality ceiling where quality does not go above $\bar{q}$. In this case, there are some apartments that are offered at this quality level and at the rent controlled price. There will also be other apartments offered with quality below this level and priced accordingly.

There are two relevant cases here: q(i) is increasing in i or q(i) is decreasing in i. If q(i) is increasing in i then, the highest level of quality will be consumed by the marginal consumer. In the new equilibrium $c(S) + K(\bar{q}) = \bar{c} = V(S,\bar{q})$. The previous expression is two equations with two unknowns and the equilibrium is uniquely determined. Consumers near the margin may also consume this quality level. For consumers some consumers away from the margin, optimal quality may be below $\bar{q}$, and price may also be below the rent controlled price. This consumer will not be effected by rent control. At some point (denoted i') $c(S) + K(q(i')) = \bar{c}$, at which point q(i')= $\bar{q}$. In this case social welfare is:

(III.c.5) $$\int_{i=0}^{i'} V(i,q(i))di + \int_{i=i'}^{S} V(i,\bar{q})di - C(S) - \int_{i=0}^{i'} K(q(i))di - (S - i')K(i')$$

These losses have no misallocations across consumer, although there are social losses both from underprovision of quality and underprovision of quantity. However, the intensive quality enables the market to clear exactly. An increase in the price control will lead to an increase in social welfare:

$$\text{(III.c.6)}\quad \begin{aligned}&\frac{\partial i'}{\partial \bar{c}}\left(V(i',q(i')) - V(i,\bar{q}) + K(\bar{q}) - K(q(i'))\right) + \frac{\partial \bar{q}}{\partial \bar{c}}\left(\int_{i=i'}^{S} \frac{\partial V(i,\bar{q})}{\partial \bar{q}} di - (S - i')k(\bar{q})\right) + \\ &\frac{\partial S}{\partial \bar{c}}\left(V(i,\bar{q}) - c(S) - K(\bar{q})\right) = \frac{\partial \bar{q}}{\partial \bar{c}} \int_{i=i'}^{S} \left(\frac{\partial V(i,\bar{q})}{\partial \bar{q}} - k(\bar{q})\right) di\end{aligned}$$

Equation (III.c.6) tells us that even though an change in level of price control will change the number of consumers who have apartments at all and the number of consumers who are satisfied in their level of quality, the social benefits of a marginal increase in rent control levels works entirely on the segment of consumers who are close to the margin of consumption who are receiving less than their desired quality level. Incidentally even if i'=0, so that all consumers are bound this comparative static is still correct. This loss is classically second order.

Alternatively, if q(i) is decreasing in i-- the price control will start to bind on quality levels away from the margin far before it binds for the marginal consumer. In that case, total demand and supply of units will still be the equilibrium outcome. However, the quality level for low levels of i will decline so that $c(S) + K(\bar{q}) = \bar{c}$. We can again define a switching point i' at which consumers start receiving their desired quality level (q(i)) and social welfare under price controls will be now:

$$\text{(III.c.5')}\qquad \int_{i=0}^{i'} V(i,\bar{q})di + \int_{i=i'}^{S} V(i,q(i))di - C(S) - \int_{i=i'}^{S} K(q(i))di - i'K(\bar{q})$$

The effect of increasing the price control on social welfare will now be:

$$\text{(III. c.6')}\qquad \frac{\partial \bar{q}}{\partial \bar{c}} \int_{i=0}^{i'} \left(\frac{\partial V(i,\bar{q})}{\partial \bar{q}} - k(\bar{q})\right) di$$

Again, when all consumers are bound by the quality control then (III.c.6') still captures the benefits of raising the price ceiling. Only when the minimum quality level has been reached do the allocational issues become important. When there is a enough discretion over quality level in the provision of apartments, independent of whether or not quality is complement or substitute to i, the primary losses are measured in underprovision of quality and not misallocation of apartments across consumers. As such these results again confirm the basic argument of Frankena (1975) that quality adjustments mitigate the social costs of rent control. The extent to which this critique is appropriate depends on empirical estimates of the flexibility of housing quality (see Olsen, 1988).

d Dynamic Supply Responses

This section imbeds housing supply in a dynamic settings This model abstracts from quality, and focuses simply on a dynamic version of the basic model.[17] Consider for example a world in which rent control is exogenously and unexpectedly imposed on a world which previously had an efficient number and allocation of apartments. If apartment suppliers are allowed to evict tenants (perhaps gradually); the supply will contract and a random sample of tenants will be evicted.

In this long run equilibrium of this case, the social losses are not as great as those in the previous section, because the average valuation of tenants still living will be the expected value of V(i) conditional upon i being sufficient low that the tenant wanted an apartment an the old free market price. In this scenario consumer surplus under rent control will be $SE(V(i)|i \leq i^*)$ which is greater than $SE(V(i)|i \leq D)$, consumer surplus when there was completely random allocation across tenants. The social costs of rent control, in this scenario, are lower than in the analysis above because renters are chosen among those who decided to rent at the pre-rent control price, not among those who tried to rent at the post-rent control price.

---

[17]Sweeney (1974) is the ancestor of dynamic supply models in the housing literature; Arnott (1987) gives a more extensive bibliography and discussion.

To better formalize dynamic issues consider a model where supply cannot contract until old tenants voluntarily leave there apartments. I assume that is a decay process where δ percent of the tenants voluntarily leave their apartments each period, and I assume that these tenants leave the system completely (they either die or leave the urban labor market). This model should be seen as an overlapping generations model, where tenants make a choice of renting (or seeking other housing) at the beginning of their lifetime. The tenants that leave are chosen randomly from the distribution of tenant valuations. When a tenant leaves the apartment, the rentor has the option of either rerenting the apartment or taking the apartment off the market. There is a supply of new potential renters with a uniform distribution of renters.

The supply response again is dictated by the supply function which is envisioned as the a number of apartments where the cost of bringing an apartment on the market is c(j). If an apartment is vacated where c(j)<c, then the apartment will be rerented. Alternatively, if the vacated apartment has c(j)>c then the apartment will be taken off the market.

The market can be usefully segmented into two groups. This first group contains those apartments where c(j)>c. The owners of these apartments want to remove these apartments from circulation, but socially it is optimal for these apartments to remain in existence. The social welfare generated by this section of the market is:

(III.d.1) $$\delta^{t}\left[\frac{i^{*}-S}{i^{*}}\int_{i=0}^{i^{*}}V(i)di-\int_{j=S}^{i^{*}}c(j)\right]$$

While this set of apartments generates positive social welfare, its contribution is getting smaller over time, and in the limit none of these apartments will be rented. The second section of the market includes those apartments that have a production cost that is less than the rent controlled price. This section includes apartments that are still rented to their original tenants and apartments that are rented to tenants drawn from a random sample where V(i)≥c. The total quantity of social welfare generated by this section of the market is:

(III.d.2) $$\delta^t \frac{S}{i^*}\int_{i=0}^{i^*} V(i)di + \left(1-\delta^t\right)\frac{S}{D}\int_{i=0}^{D} V(i)di - C(S)$$

Again in this section of apartments, overall social welfare is declining over time. Here the decline is because tenants who were previously selected for having i≤i*, or being willing to pay the free market price, are now being selected for having i≤D, or being willing to pay the rent controlled price. Over time, social welfare converges to (II.c.4), and social welfare is declining over time. Producer profits are:

(III.d.3) $$\bar{c}(S+\delta^t(i^*-S)) - C(S) - \delta^t \int_{j=S}^{i^*} c(j)dj,$$

which are transparently rising over time, because unprofitable apartments are being removed from the market. Consumer welfare is:

(III.d.4) $$\delta^t \frac{S}{i^*}\int_{i=0}^{i^*} V(i)di + \left(1-\delta^t\right)\frac{S}{D}\int_{i=0}^{D} V(i)di + \delta^t \frac{i^*-S}{i^*}\int_{i=0}^{i^*} V(i)di - \bar{c}(S+\delta^t(i^*-S))$$

which is shrinking over time for two reasons. The first reason is that the degree of underprovision is rising over time. The second reason is the degree of misallocation of apartments across consumers is also rising over time. Figures 5 through 8 shows the time paths of producer profits, consumer surplus and overall social welfare relative to the free market optimum. In these figures I assume linear demand, i.e. V(i)=a-bi=1-.5i, c(S)=s, so the free market price and quantity is .5. I assume that the rent control sets price and thus long term quantity at .4 and the depreciation rate is .9.

V. Further Implications

These implications extend the analysis verbally. The first subsection uses the previous results to discuss the political economy of rent control, and who this model predicts those supporters will be. The second subsection presents directions for empirical work, and in particular, suggestions about how to differentiate random, or quasi-random, allocation of apartments from efficient allocation of apartments empirically. The third subsection addresses the possible implications of this analysis for other areas of analysis that have price controls.

a. Who Supports Rent Control

The political economy of rent control in this context means asking who has the greatest incentives to support rent control. In a sense, this question is the dual problem of the pareto analysis where we asked how changing pareto weights led to different socially optimal levels of rent control, i.e. as certain groups become more important should rent control rise or fall. Under both random and efficient allocation of apartments, suppliers and landlords dislike rent control, and rent control will be less likely when those groups are not empowered. The interesting differences between the two models come from which types of consumers like rent control in the different scenarios.

Under the efficient allocation of apartments, consumers that benefit most are those who are far from the margin of consumption at the free market price. Essentially all consumers who will continue to consume apartments at the rent controlled quantity will gain from rent control. All consumers who used to consume apartments at the free market price, but now don't consume apartments, lose from rent control. Under efficient allocation, rent control is in part a transfer from consumers with relatively low desire for apartment to individuals with high levels of desire for apartments. The key supporters of rent control will be individuals who are extremely intense in their desire for apartments.

Under random allocation of apartments, the consumers that benefit most are those that are close to the margin of consumption at the free market price. Put algebraically, the gains for individual $i \geq i^*$ (consumers who bought in the free market) of going to rent control are:

(IV.a.1)
$$\frac{D}{S}\left(c(i^*)-\bar{c}\right)+\frac{S-D}{S}\left(V(i)-c(i^*)\right)$$

This quantity rises as V(i) declines (since D>S), so those consumers who have low levels of V(i) benefit most from rent control, since they enjoy the lower prices but are less worried about the probability of not having an apartment. Among consumers that don't consume apartments before rent control the benefits of rent control are:

(IV.a.2) $$\frac{D}{S}\left(V(i)-\bar{c}\right)$$

Now benefits are declining with V(i). Thus benefits reach there peak at V(i*). In principal these political economy implications are testable.

This analysis also helps explain why rent control would have such widespread support. Under efficient allocation a small group of renters earn large rents from rent control. Under inefficient allocation a potentially much larger group of renters, and people who never rented before, all gain benefits from rent control, although the sum of those benefits are much smaller than under efficient allocation.

A further analysis of the political economy of rent control should do a better job of separating between older and younger residents. The timing model suggested that old tenants should desire the reform, but new tenants or migrants to the community from elsewhere will end up paying the price for rent control. Naturally, this helps us to explain the exceptional history of rent control in college communities (e.g. Berkeley, Cambridge) where the benefits of rent control are received by a politically empowered group of long term residents and the costs are born by short term non-voting residents.

b. Directions for Empirical Work

The bulk of empirical work suggested by this exercise requires an working empirical definition of i. In the model i was meant to be an index capturing the degree to which an individual wants to consume a rental apartment. Obviously no such index exists exactly, but it would be possible to construct one using properly estimated probits from non-rent controlled markets. A vector of individual characteristics should help predict whether an individual is a renter or owner. Using estimated probits from non-rent controlled markets, given any set of observables we can produce an "index" of desire for rental housing which is non-other than the predicted probability that an individual with those given observables will live in a rental apartment in a non-controlled market.

For example, if we find that rental housing declines with family size and with income, and we estimate an equation for several pooled real estate markets estimating the propensity to live in a rental based on those two individual characteristics then this estimated propensity will serve as our index an and proxy for i. If there is only one observable, then it is not necessary not run the probability models, but instead all we need is the raw correlation between ownership and that characteristic and then the characteristic itself is either a positive or negative (depending on the sign of the correlation) index of propensity to rental living.

Given this index, the most natural test of the theory is to see whether the index rises or falls when rent control is imposed on an area. The standard model predicts that the index will rise as rent control is imposed. The random allocation models that I have presented here suggest that the index will fall eventually. This test presents a stark comparison of predictions that can readily differentiate between the extreme forms of the two models.

Since, assuredly, the truth lies between these two extremes, it will make sense to calibrate a precise model (along the lines of the model in section III.a) and use the observed change in the index values for renters to calibrate the model. However, this more complicated exercise requires a fuller set of estimates of rental demand and supply elasticities. If before/after evidence is not available, it is possible to use cross-sectional differences across towns as long as there are not omitted town levels characteristics that would bias the results and as long as mobility between the towns is limited.

A second path for empirical work is to use the index and evidence on who either votes for rent control or supports rent control in opinion polls. The standard model predicts that the supporters of rent control will have the highest indices. The model of random allocation suggests that the supporters of rent control will have intermediate levels of the propensity estimate.

c. Other Markets

This paper has focused primarily on rental markets and housing, but there is little in this paper that is specific to that market. In principle, the arguments that I have presented should apply equally well to any commodity that is consumed along the extensive margin and where we don't believe that perfect allocation will easily follow price controls. In general the results provide a warning that it is not enough to simply look at supply responses to gauge the social costs of price control-- misallocation costs across consumers may be far greater.

There are also only minor differences is we alter the analysis from a maximum price charged to a minimum price offered. In the case that the regulation is a minimum price, there will generally be oversupply. The allocational inefficiencies come from the fact that high cost suppliers will be selling even though low cost suppliers are available and would be more efficient producers. Similarly to the rent control case, these efficiency losses will be first order when the underproduction of goods are second order.

A particular example of minimum price legislation is the minimum wage. This analysis suggests that one problem of the minimum wage is that the wrong individuals end up working and that looking at the quantity response of labor gives you only part of the social costs of minimum wages. While this type of problem may be relatively small in the United States, where the minimum wage is only rarely binding, it may represent considerable social damage in European countries with higher minimum wages.

An implication of this analysis is that the minimum wage will be much more damaging when there is considerable heterogeneity of individuals and when the adjustment to the minimum wage occurs on the extensive margin. When workers are relatively homogeneous and firms adjust to a minimum wage by cutting back hours, then the social costs of the regulation will be much less than in those cases where firms adjust on the extensive margin by eliminating workers. Markets with high levels of heterogeneity and adjustment on the extensive margin are particularly likely to suffer large costs from the imposition of a minimum wage.

V. Conclusion

The standard welfare analysis of rent control includes only the social costs of underproduction. Rent control stops the price mechanism from communicating the optimal level of rental housing supply to potential suppliers. Unfortunately, rent control also stops the price mechanisms from allocating goods optimally across consumers. A major cost of rent control may be that without the correct cost being charged, individuals who gain little utility from rental apartments will be just as likely to apply for apartments and receive them as individuals who gain high utility from apartments. The results suggest that this social cost will always be higher than the social cost of underproducing housing if rent control sets prices sufficiently close to the free market price.

These results are mitigated if allocation mechanisms distribute apartments towards consumers with a particular desire for rental housing. The existence of queues, or other socially wasteful means of allocating apartments, will lessen the costs of misallocation across consumers, but will create social losses of their own. The ability of suppliers to respond by providing lower quality also lessons the misallocation levels across consumers, but again the social costs of rent control are still high. A intertemporal model suggests that these misallocation costs, like the underprovision costs, are not instantaneously felt by consumers but are born by new entrants to the market.

These results cast doubt on the revisionist view of both rent control and price and wage setting in general. Arnott (1995), in the rent control literature, and Card and Krueger (1992) in the minimum wage literature, have suggested that these price controls may have relatively small social costs and achieve truly desired redistributional gains. Neither literature particularly focuses on misallocation costs, and they should be seen as one of the possibly even larger set of social problems that come about when governments set prices.

References

Arnott, R. (1995) "Time for Revisionism on Rent Control," *Journal of Economic Perspectives* 9, 1: 99-120.

Arnott, R. (1989) "Housing Vacancies, Thin Markets and Idiosyncratic Tastes," *Journal of Real Estate Finance and Economics* 2: 5-20.

Arnott, R. (1987) "Economic Theory and Housing," in E. Mills Ed. Handbook of Regional and Urban Economics, Vol. 2. *Handbook of Regional and Urban Economics*, Volume 2. Amsterdam: North-Holland: 959-988.

Aumann (1966) "The Existence of Competitive Equilibria in Markets with a Continuum of Traders," *Econometrica* 34 (1).

Barzel, Y. (1974) "A Theory of Rationing by Waiting," *Journal of Law and Economics* XVII (1): 73-95.

Card, D. and A. Krueger (1995) *Myth and Measurement: The New Economics of the Minimum Wage.* Princeton: Princeton University Press.

Cheung, S. (1974) "A Theory of Price Control," *Journal of Law and Economics* XVII (1): 53-71.

Deacon, R. and J. Sonstelie (1991) "Price Controls and Rent Dissipation with Endogenous Transaction Costs," *American Economic Review* 81 (5): 1361-1373.

Deacon, R. and J. Sonstelie (1989) " The Welfare Costs of Rationing by Waiting," *Economic Inquiry* 27: 179-196.

Downs, A. (1988) *Residential Rent Controls: An Evaluation.* Washington: D.C.: Urban Land Institute, 1988.

Frankena, M. (1975) "Alternative Models of Rent Control," *Urban Studies* 12: 303-308.

Fraser Institute. (1975) *Rent Control: A Popular Paradox.* Vancouver: The Fraser Institute.

Friedman, M. and G. Stigler (1946) "Roofs or Ceilings? The Current Housing Problem." in Block and Olson Eds. *Rent Control: Myth or Realities.*

Gould, J. and S. Heny (1967) "The Effects of Price Control on a Related Market," *Economica* XXXIV: 42-49.

Gyourko, J., and P. Linneman (1989) "Equity and Efficiency Aspects of Rent Control: An Empirical Study of New York City," *Journal of Urban Economics* 26: 54-74.

Hayek, F. (1931) "Wirkungen der Mietzinsbeschränkun, *Schriften des Vereins für Socialpolitik* 182: 253-270.

Hubert, F. (1991) *The Regulation of Rental Contracts in the Housing Market.* Frankfut: Peter Lang.

Johnson, D. (1951) "Rent Control and the Distribution of Income," *American Economic Review* XLI (2): 569-585.

Mills, E. and B. Hamilton (1994) *Urban Economics.* New York: Harper-Collins.

Olsen, E. (1988) "What do economists know about the effect of rent control on housing maintenance?" *Journal of Real Estate Finance and Economics* 1: 295-307.

Olson, E. (1972) "An Econometric Analysis of Rent Control," *Journal of Political Economy* 80: 1081-1100.

References Continued

Smith, L., K. Rosen, and G. Fallis (1988) "Recent Developments in Economic Models of Housing Markets," *Journal of Economic Literature* 26: 29-64.

Shleifer, A. and R. Vishny (1992) "Pervasive Shortages Under Socialism," *Rand Journal of Economics* IX: 237-246.

Suen, W. "Rationing and Rent Dissipation in the Presence of Heterogeneous Individuals," Journal of Political Economy 97(6): 1384-1394.

Sweeney, J. (1974) "A Commodity Hierarchy Model of the Rental Housing Market," *Journal of Urban Economics* 1: 288-323.

Weitzman, M (1974) "Prices vs. Quantities," *Review of Economic Studies* 41.

Figure 1: The Basic Welfare Losses from Rent Control

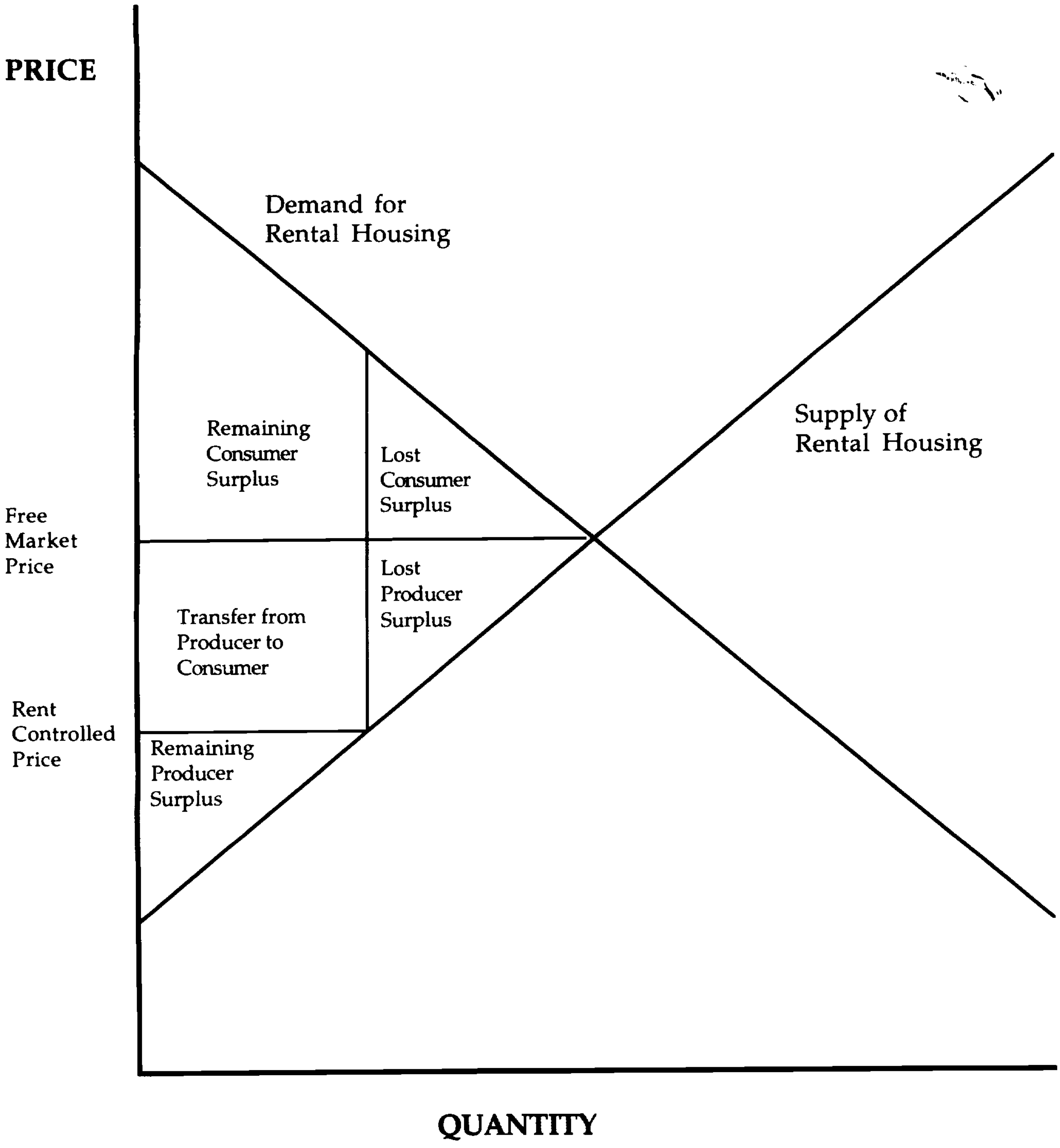
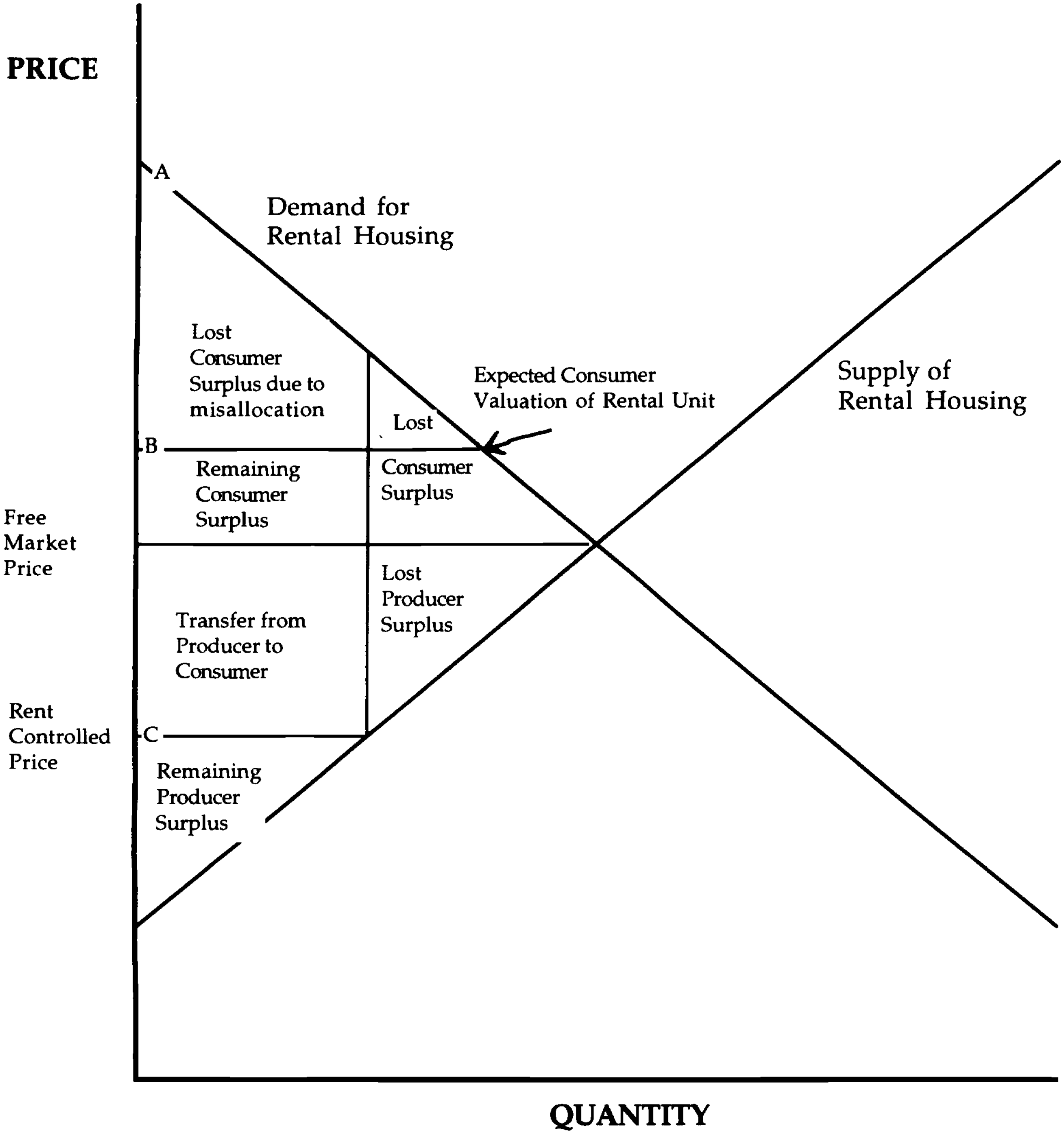
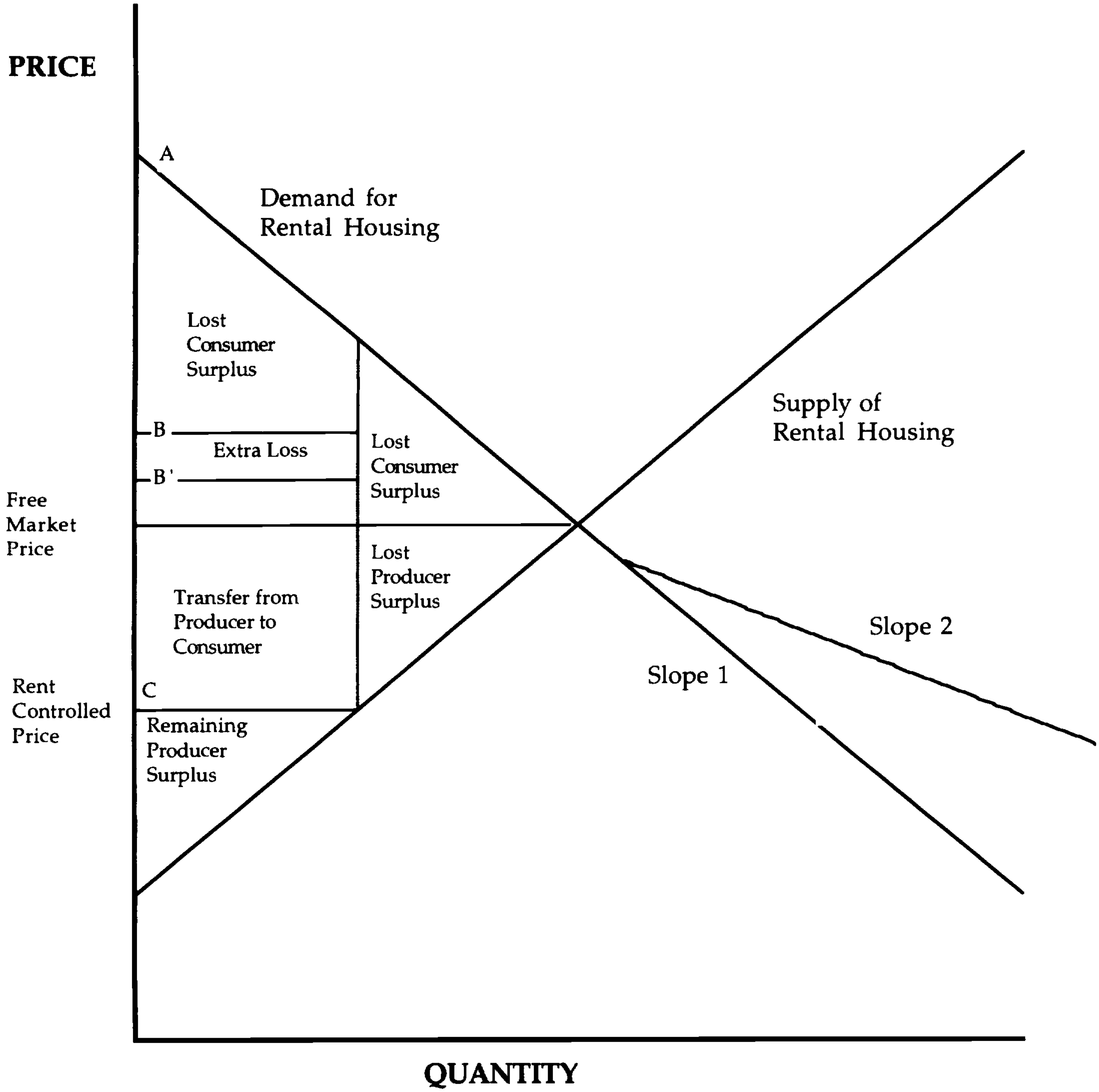


Figure 2: The Welfare Losses from Rent Control when Apartments are Randomly Allocated across Consumers



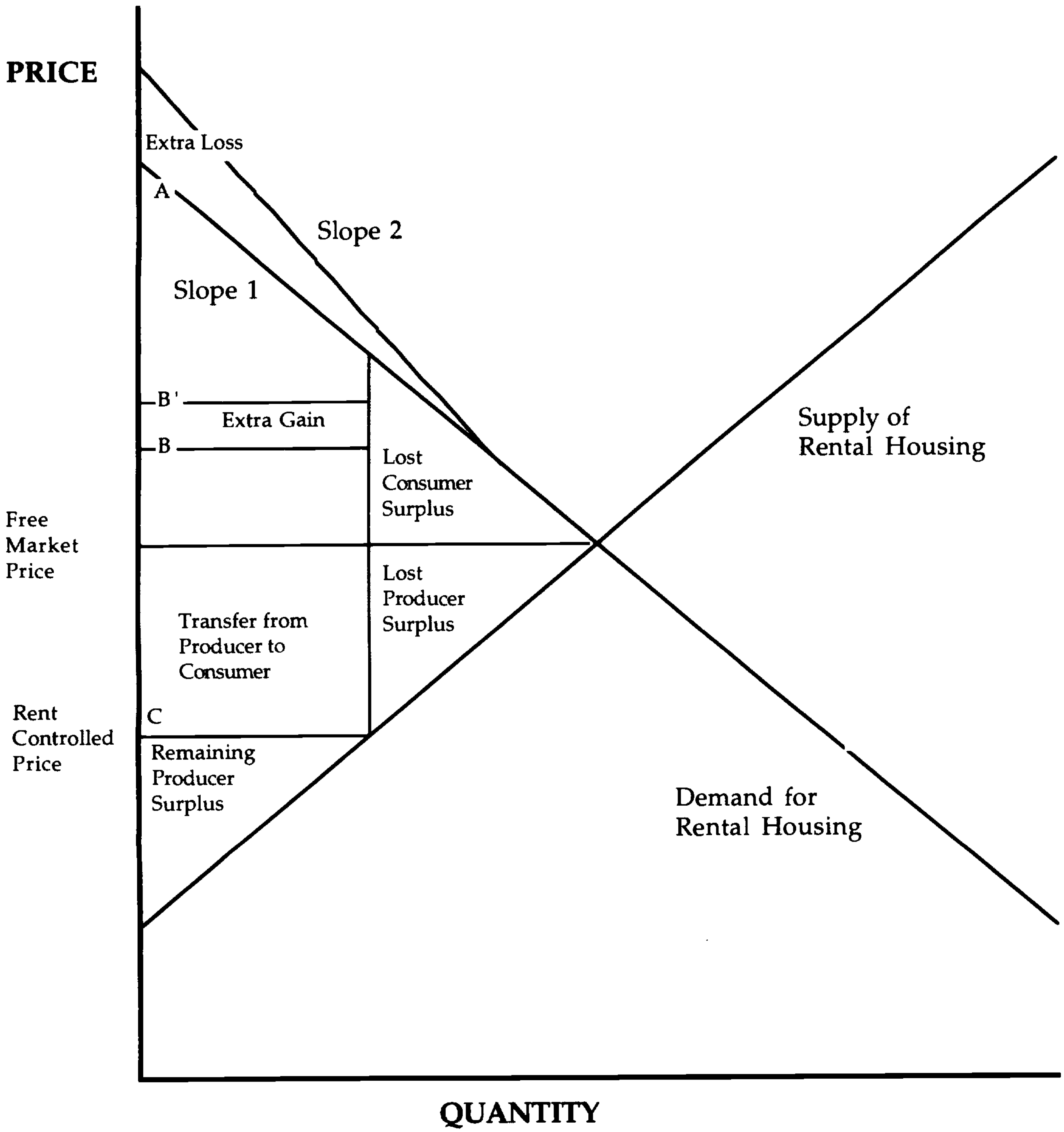
Point B lies half way between point A and point C on the Y-axis and this point represents the value that the average consumer, who wants an apartment at the rent controlled price, places on getting an apartment.

Figure 3A: Changes in the Slope of the Demand Curve



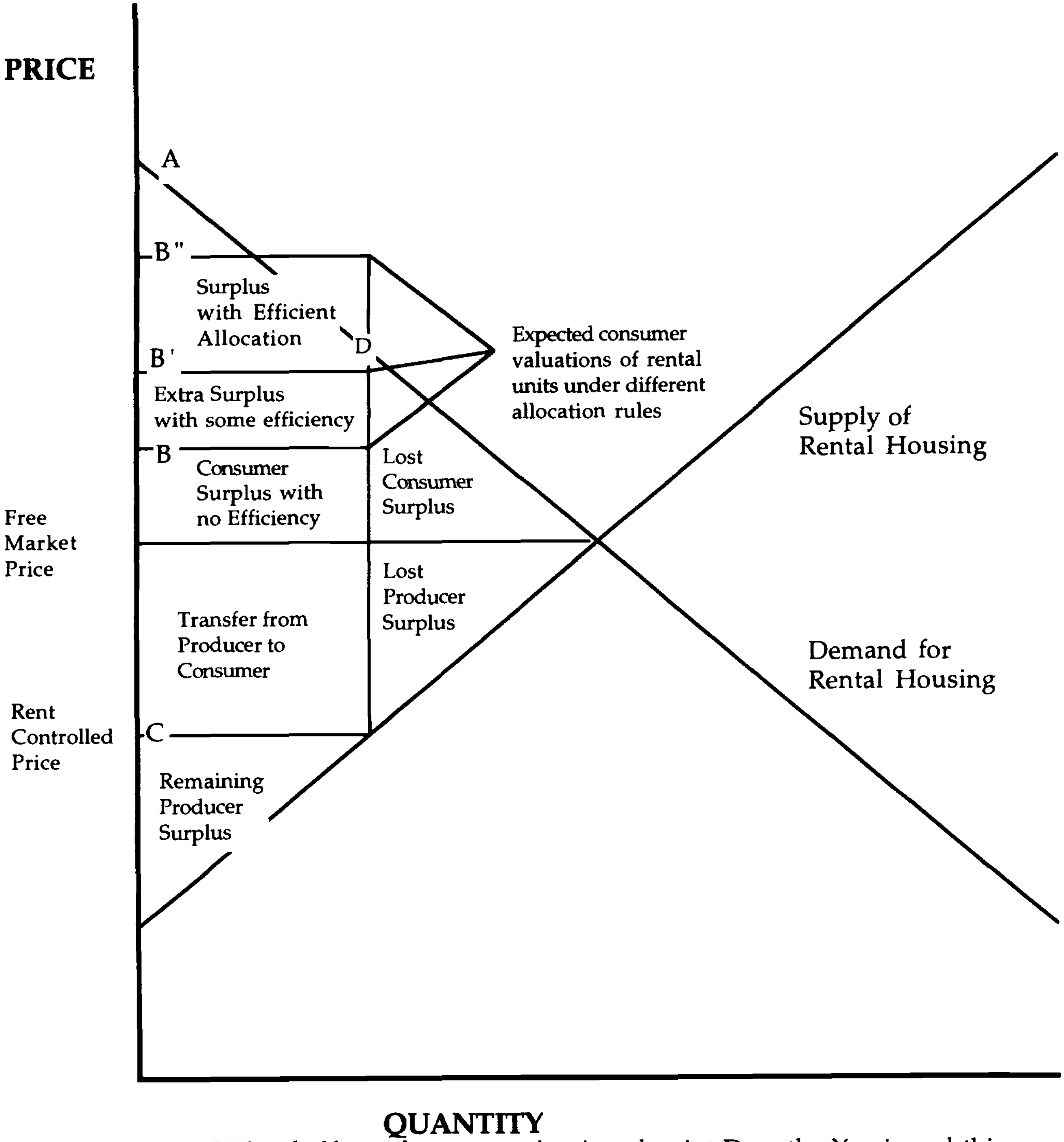
Point B represents the expected consumer utility from rental housing when the demand curve has slope 1.
Point B' represents the expected consumer utility from rental housing when the demand curve has slope 2. The flattening of the demand curve increases the social costs of rent control.

Figure 3B: Changes in the Slope of the Demand Curve



Point B represents the expected consumer utility from rental housing when the demand curve has slope 1.
Point B' represents the expected consumer utility from rental housing when the demand curve has slope 2. While there is more consumer surplus with the steeper curve, the consumer surplus lost due to rent control has increased, i.e. the triangle of extra loss is bigger than the rectangle of extra gain under rent control.

Figure 4: The Welfare Losses from Rent Control when Apartments are Allocated across Consumers



Point B" lies half way between point A and point D on the Y-axis and this point represents the value that the average consumer, whose value is greater than D places on getting an apartment.

Point B' represents the average consumer value for a random allocation of apartments across consumers who want apartments at the controlled price.

Point B is as in Figure 2, the point between A and C.

Figure 5: Producer Surplus over Time

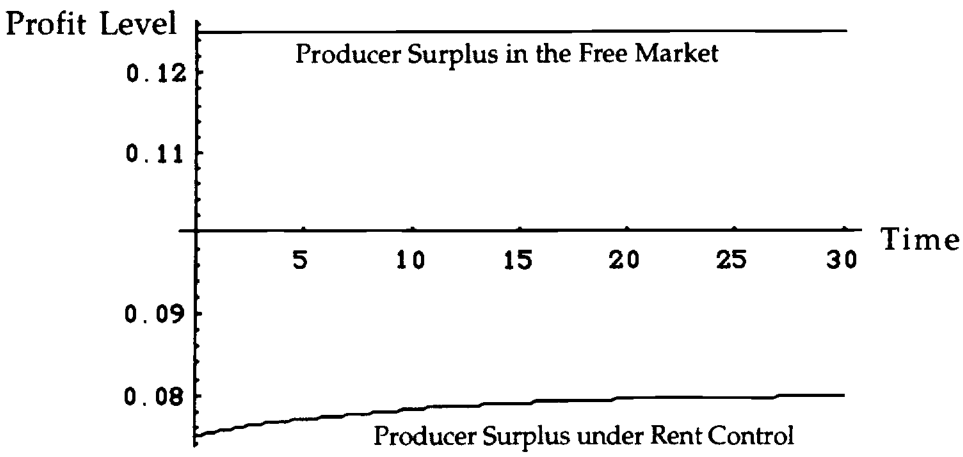
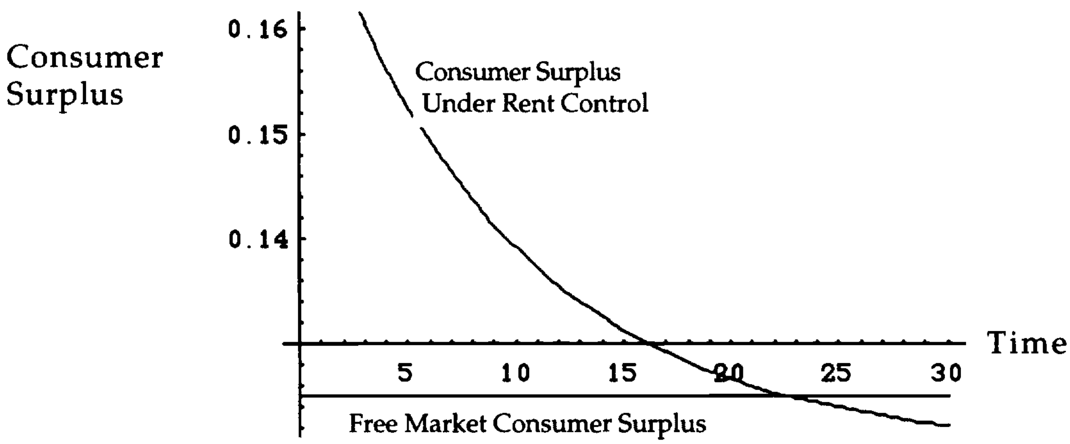
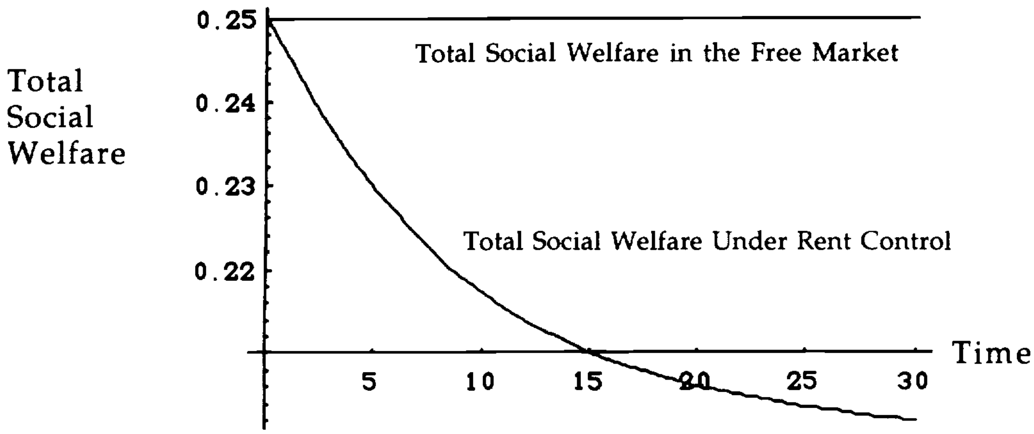


Figure 6: Consumer Surplus over Time



These plots, and figure 6, represent the results of simulations described in the text.

Figure 7: Total Social Welfare over Time under Rent Control



The simulations used to produce figures 4-6 assumed that V(i)=1-i, c(S)=S, and that the rent control set rents at .4 (where .5 is the free market rent). The parameter delta equals .9.