

The Opportunity Costs of Residential Displacement Due to Coastal Land Use Restrictions: A Conceptual Framework

GEORGE R. PARSONS

College of Marine Studies
and
Department of Economics
University of Delaware
Newark, DE 19716

Introduction

The purpose of this article is to develop practical measures of the change in economic welfare due to coastal land use restrictions. The measures are practical because they may be derived from current market data at modest cost and may be interpreted in a manner that is useful for coastal policy.

By coastal land use restrictions I mean any zoning laws that limits the amount of undeveloped land abutting a body of water that may be used for future residential and commercial development. Such restrictions are achieved by designating areas where development is forbidden or where development is allowed at only low densities.¹ The purpose of such restrictions is to preserve the natural cover of the coastal area and thereby protect plant and wildlife habitats, maintain the aesthetic quality of the area, and to a lesser extent reduce runoff pollutants.² Examples of such restrictions include the California Coastal Commission's permitting rules and the Critical Areas Commission's (Maryland) restricted use rules for the Chesapeake Bay.

There are essentially three major efficiency effects of such restrictions. On the positive side is the preservation of amenity and environmental goods that are enjoyed by nearby residents, visitors, those with existence values, and some commercial interests. On the negative side is decreased residential and commercial proximity to the coast—fewer individuals and businesses can locate near the coastline. Last, and also on the negative side, is a potential loss of amenities and environmental quality at inland locations. With greater development in inland

¹ Coastal land use restrictions usually include guidelines for use of coastal land developed before the restrictions are in place and for use of land for which development will be permitted. For example, in residential areas these guidelines may include things such as landscaping requirements, prohibition of septic tanks, limited use of fertilizers, and setback requirements. In agricultural areas this might include limited use of fertilizers and pesticides, prohibition of certain types of tillage practices, setback requirements, and so forth. For the purposes of my analysis these guidelines are ignored.

² Whether the restrictions will achieve such goals is uncertain. Agricultural land use may contribute more to run-off pollutants than residential use. If restrictions encourage agricultural uses and discourage residential uses, there may be a net increase in run-off pollutants due to the restrictions.

areas there is potential for increased density and less preservation of inland natural sites.³

I show that market information in current housing markets is sufficient to estimate an upperbound measure for the second of these three effects—the loss in proximity to the coast. I do so for the loss in residential proximity only. In concept the analysis is the same for commercial proximity but is typically more difficult to apply due to lack of data.⁴ I use a hedonic price method to infer a price (or demand function) for proximity per residential unit. The number of displaced units is approximated using information on the number of acres placed in restricted status and the expected number of units to be developed per acre. Roughly, multiplying the price by the estimated number of displaced units gives my approximation for the aggregate loss. In this article I establish the theoretical basis for this efficiency measure using Rosen's (1974) hedonic price model and argue why it is an upperbound estimate of the true change in welfare.

The literature on measuring the efficiency effects of land use restrictions is small. Edwards and Anderson (1984) measure the welfare loss of residential displacement from land near salt ponds in Rhode Island; Batie and Mabbs-Zeno (1985) and Shabman and Bertelson (1979) measure the loss of displacement from coastal wetlands in Virginia; and Brown and Pollakowski (1977) estimate the price of residential proximity to two lakes in Seattle in a study of optimal setback restrictions. The empirical approach in all these articles is similar to that offered here. This article provides a theoretical basis for such analyses. It differs from the previous articles in that it offers upperbound, not lowerbound, approximations to the loss.⁵

Having a reliable upperbound is useful for establishing coastal policy. If the expected environmental gain from restrictions exceed an upperbound measure, decision-makers may proceed with confidence that the policy is efficient. Given the lack of information available to guide policy in most coastal land use plans, such a measure is a useful first step to rational decision-making.

In the following section I present a model of residential location choice with emphasis on location in proximity to the coast. The welfare analysis is also presented in this section. In Section 3 I present two upperbound approximations for the loss in proximity and the method for estimating these approximations.

³ The equity effects of such restrictions that are typically of concern to policymakers but which are not addressed here include windfall gains to property owners that occupy coastal land that is developed before restrictions, the loss to property owners occupying restricted land, and the potential increase in inland land prices that may impose losses to lower income residents.

⁴ For example, Wilman (1984) applies hedonic price methods to commercial uses (hotel and cottage visits) in coastal areas in the context of estimating the cost of coastal beach pollution.

⁵ There are several other related studies. Milon (1984) estimates the value of coastal proximity on a barrier island on the Florida coast but does not use it in the context of land use restrictions. Frech and Lafferty (1976) present the first theoretical discussion of the economic effects of coastal land use restrictions, and in a later article (1984) estimate the effect of land use restrictions on land values. Similar studies analyzing the effect of land use restrictions on land values but not in the context of coastal housing markets are Rueter (1973) and Stull (1975).

Model and Welfare Analysis⁶

I consider a simple model of a coastal land market. All land is used for either residential housing or open space. All land is owned by landlords and rented to renters with housing or is held as open space. (A landowner who resides on his or her own property may be thought of as both a landlord and a renter.) A renter chooses one house to maximize utility, and a landlord provides housing to maximize profit. Implicit in a renter's choice is the selection of the locational attributes of the land—proximity to workcenters, shopping areas, parks, and coastline, quality of neighborhood and public services, and so on—and the selection of the structural attributes of the house—size, age, presence of garage, and so on.

Implicit in the land market then is a market for each of these attributes. Following this reasoning, the coastal land use restrictions are simply regulations in the implicit market for locational attributes pertaining to proximity to the coastline. The regulations alter the supply of these attributes of proximity.

I define x as a vector of housing attributes (all measured as goods, so larger x is better), U as utility for a renter, P as rental price for housing for a year, y as renter income, z as a numeraire good with price equal 1, and s as a vector of renter characteristics. A renter's choice of housing is an implicit choice of x and along with a choice of z solves the problem

$$\text{Maximize } \{U(x, z, s) | P(x; \beta) + z = y\} \quad (1)$$

$P(x; \beta)$ is a hedonic price function. The first order conditions are

$$\nabla_x U / (\partial U / \partial z) = \nabla_x P \quad (2)$$

where ∇_x is the gradient with respect to x . I define the renter's marginal rate of substitution function for attribute i in x with respect to z as $m_i(x, z, s)$. In equilibrium

$$m_i(.) = (\partial U / \partial x_i) / (\partial U / \partial z) = \partial P / \partial x_i \quad \text{for all } i \quad (3)$$

A renter maximizes utility by setting its marginal value of x_i equal to the implicit price of x_i for all i attributes.

Landlords take the hedonic price function as fixed and rent to renters so as to maximize profits. Since the landlord problem is not likely to be of relevance in measuring the efficiency effects of the land use restrictions, it is not presented. Why this is so is discussed below.

I assume that there are two types of coastline: preserved and developed. Land use density requirements define my two types of coastline. If restrictions set aside areas where density may be no greater than one housing structure per 20 acres, preserved coastline is any land with less than this density. Developed coastline is all land with greater than this density. By assumption all developed coastal areas are the same, and all preserved coastal areas are the same.

⁶ This section is developed from the work of Parsons (1986), Bartik (1987a), and Horowitz (1984).

I assume that proximity to each of these coastlines is measured by four locational attributes: distance to the coast, view of the coast, frontage on the coast, and coastal privileges.⁷ These attributes are included in the vector x . I define the set of proximity variables for the developed coast as d , the set of proximity variables for the preserved coast as p , and all other attributes as a . So my vector $x = (d, p, a)$.

Land in developed portions of the coast has large d values and low p values. The low p values here recognize that preserved coastline may affect land values in neighboring developed coastal areas. Land near preserved coastline has large p values and low d values. Inland land has low d and p values.

I assume that without restrictions the portion of coastal land that is developed increases over time. With land use restrictions the rate at which conversion from preserved to develop occurs is reduced. Indeed, this is the purpose of such restrictions. Thus, in any given year following the restrictions the supply of d is reduced and supply of p is increased relative to the case with no restrictions.

Consider a year following the restrictions. The change in supply of proximity attributes alters the equilibrium values of β in the hedonic price function—renters face higher implicit prices for d and lower implicit prices for p than without the restrictions. Define $\Delta\beta$ as the change in β due to the restrictions for the year.

With $\beta + \Delta\beta$ instead of β in the budget constraint, renters select a different x to maximize utility. Of course there is less housing immediately abutting the coast with than without the restrictions, so for many renters d is smaller. But there is also more housing in and near coastline with more open space, so for many renters p is larger. Undoubtedly renters adjust their choice of other attributes as well. Renters consume more of attributes that substitute for d and complement p , and less of attributes that substitute for p and complement d .

For example, renters that select proximity to a developed coastline when there are no land use restrictions may select proximity to an inland amenity such as a park or river as a substitute for the coast when there are land use restrictions. Some renters may substitute private goods such as improved yardspace or a pool. On the other hand these same attributes may substitute for proximity to the preserved coast. In any case the renter's choice changes due to the land use restrictions and it is certain to include more than changes in just d and p .

I define the change in the choice attributes due to the land use restrictions for a given renter as $\Delta x = (\Delta d, \Delta p, \Delta a)$ and the change in the amount of land and other goods chosen as Δz . If there are N renters with nonzero Δx , then I can write the aggregate loss in proximity to developed coast as $\sum_j \Delta d_j = \Delta D$, where $j = 1, \dots, N$. Similarly, I can write ΔP as the total gain in proximity to preserved coast, and ΔA as the total change in other attributes.

For a given renter in a given year the change in utility due to the land use restrictions is $U(d^* + \Delta d, p^* + \Delta p, a^* + \Delta a, z^*) - U(d^*, p^*, a^*, z^*)$ or $U(x^* + \Delta x, z^*) - U(x^*, z^*)$. The $*$ denotes attribute levels chosen without the restrictions. I assume $\Delta z = 0$ for ease of presentation. Now, the renter is certain to realize a change in the rental price of land as well. But, any increase in price that reduces renter welfare increases landlord welfare by the same amount. The

⁷ Coastal privileges are rights to beach access at privately owned waterfront property. Often such rights "run with the land." That is, landowners at designated locations have the access rights, and these rights are transferred with sale of the property.

same is true for any decrease in the price. Thus, for the purposes of analyzing efficiency effects I can ignore changes in welfare that result from changes in land prices. Hereafter the change in welfare to renters that I refer to is net of transfers from or to landlords. Unless there is a change in a landlord's cost of providing structural attributes of housing there are no other welfare changes.

The renter's compensating variation is the amount of ΔZ that solves $U(x^* + \Delta x, z^* + \Delta Z) = U(x^*, z^*)$. It is the amount of change in z that holds utility constant when attribute selection changes with the land use restrictions.

Following Horowitz (1984) I know that

$$\Delta Z = Z(x^* + \Delta x, s) - Z(x^*, s) \quad (4)$$

$Z(x, s)$ is the implicit function satisfying $U(x, s, Z(x, s)) = U^*$, where $U^* = U(x^*, z^*, s)$. $Z(x, s)$ is the amount of z given the values in (x, s) that is required to keep the renter at the level of utility attained without the land use restrictions. It follows that $\nabla_x Z$ is a system of partial differential equations with the solution $Z(x, s, C)$ where C is just a constant of integration.

From the implicit function theorem $\nabla_x Z = -\nabla_x U^*/(\partial U^*/\partial z)$. From Equation (2) it follows that $-m_i(x, z, s) = \partial Z/\partial x_i$ for all i . Thus if I have estimates of the system of marginal rate of substitution functions, I can solve this system of partial differential equations (practically this may be difficult but in concept possible) for $Z(\cdot)$ which in turn may be used to calculate the welfare measure in expression (4). The annual aggregate change in welfare due to the restriction is simply $\sum_j \Delta Z_j$, where $j = 1, \dots, N$, and N is the set of all renters that change attribute selection if land use restrictions are adopted.

Measuring change in welfare using expression (4) is impractical for two reasons: (1) it is difficult to predict Δx , and (2) it is difficult to estimate the marginal rate of substitution functions.

The difficulty in predicting Δx is obvious and is the more serious of the two complications. For each renter that selects land attributes that are different from the attributes that would have been selected without the restrictions, I need to predict how their selection changes. This is not just for changes in proximity to the coast but for changes in all attributes.

The difficulty in estimating the marginal rate of substitution functions is well documented.⁸ If data are gathered from a single housing market I observe each renter at a single point on his or her marginal rate of substitution function and hence cannot determine the shape of the functions. If data are gathered from many segmented housing markets (markets may be segmented spatially or temporally, see Schnare and Struyk (1976)) and I accept that renters with similar preferences are located in the different markets, estimation of the functions is possible.⁹ That is, it would now be possible to observe renters at different points on their marginal rate of substitution functions. This approach is often impractical because the data required are difficult if not impossible to get and more expensive to get than data from a single market. I need data on characteristics of buyers as

⁸ See Epple (1987), Bartik (1987b), Diamond and Smith (1985), Mendelsohn (1984), Parsons (1986), and McConnell et al. (1985) for analyses of this issue.

⁹ Diamond and Smith (1985) is a good presentation of the argument.

well as land attributes and data across markets that is compiled uniformly. Furthermore the assumptions pertaining to segmentation are often tenuous.

To date there are no marginal rate of substitution functions estimated for proximity to the coastline. There are, however, several recent studies that have estimated marginal rate of substitution or demand functions for a variety of housing attributes using multiple market data. These studies include Bartik (1987b), Palmquist (1984), and Parsons (1986). For some examples of attempts to estimate demand functions using single market data see Harrison and Rubinfeld (1978), Nelson (1978), and Witte, Sumka, and Erickson (1979).

Given the difficulties of measuring expression (4), I consider alternative measures that require less information to estimate. These alternatives approximate the true change in welfare.

Practical Measures Using Incomplete Information

Introduction

I consider two common situations in which information is insufficient for estimating expression (4). In the first situation I have sufficient information to estimate marginal rate of substitution functions for d , and in the second I have sufficient information to estimate only the hedonic price function including d and a in the market without the restrictions in place. In both situations I cannot predict Δx for individual renters, but I can predict the number of renters that would have located in a restricted coastal area had that area not been restricted. In both situations I cannot measure the attribute for proximity to the preserved coastline— p in x . (This is common because current residential housing is often not found near preserved coastal areas unless restrictions already exist.)

For both cases I have sufficient information for upperbound estimates of the change in welfare given by expression (4). The estimates are upperbounds essentially because I am only able to consider the loss in welfare due to ΔD . For this reason the upperbound measures may be thought of as upperbounds on the opportunity costs of the restrictions or upperbounds on the total loss of proximity to the developed coast.

Two Upperbound Measures

I consider four measures of welfare in developing the upperbound estimates. The measures, expressed by either the function $W(\cdot)$ or $V(\cdot)$, are given in Table 1. (Recall that $Z(\cdot)$ is a renter's compensating variation for a change in x measured in terms of z .) Each measure is for the aggregate change in welfare for one year due to the land use restrictions. $W(N, \Delta X)$ is the true change in welfare; it is the total change in welfare for the set of N renters for the change ΔX . Recall that N is the set of all renters with nonzero Δx . The other measures are interpreted similarly. $W(N, \Delta D)$ is the total change in welfare for the set of N renters for the change ΔD only. $W(M, \Delta D)$ and $V(M, \Delta D)$ are the proposed upperbound measures. $V(\cdot)$ is a measure of welfare that does not use the $Z(\cdot)$ function presented in the previous section. The set M used in both upperbounds is defined next.

Assume for the moment that there is no change in the number of renters in the market as a result of land use restrictions. If so, there are say M fewer renters

Table 1
Four Measures of Aggregate Welfare Change
Due to Coastal Land Use Restrictions

True change in welfare (change in welfare due to ΔX for N renters):

$$W(N, \Delta X) = \sum_j^N \{Z_j(x^* + \Delta x) - Z_j(x^*)\}$$

Change in welfare due only to ΔD for N renters:

$$W(N, \Delta D) = \sum_j^N \{Z_j(d^* + \Delta d, p^*, a^*) - Z_j(d^*, p^*, a^*)\}$$

Change in welfare due only to ΔD which is assumed to be realized entirely by the M renters displaced from the restricted area:

$$W(M, \Delta D) = \sum_k^M \{Z_k(d^* + \Delta d', p^*, a^*) - Z_k(d^*, p^*, a^*)\}$$

Change in welfare due only to ΔD for M renters using implicit prices for proximity near the coast:

$$V(M, \Delta D) = \sum_k^M \{(\nabla_d P(X_k^*)) \cdot \Delta d'_k\}$$

N = Number of renters that change attribute selection with restrictions ($j = 1, \dots, N$)

M = Number of renters displaced from restricted zone ($k = 1, \dots, M$)

$x = (d, p, a)$

$\Delta X = \sum_j^N (\Delta d_j, \Delta p_j, \Delta a_j)$

$\Delta D = \sum_j^N \Delta d_j = \sum_k^M \Delta d'_k$

in the restricted area than would have been developed without the restrictions and M more in the nonrestricted area than would have been the case without the restrictions. The set M is that set of renters that locate in the restricted area if there are no restrictions but locate outside the area if there are restrictions. Denote these renters by their characteristics as s_k , where $k = 1, \dots, M$. Let Δd_k be the k^{th} renter's change in proximity to the developed coastline as a result of the restrictions.

Recall that $\sum_j \Delta d_j = \Delta D$, the aggregate loss in proximity to developed coastline. It follows that $\sum_k \Delta d_k \leq \Delta D$, because there is some nonzero Δd for renters that are not in the set M . This implies that it is possible to divide ΔD into M units such that each of the units, $\Delta d'_k$, satisfies $\Delta d'_k \geq \Delta d_k$ and $\sum_k \Delta d'_k = \Delta D$.

Now consider the upperbound measure presented in the following proposition.

Proposition 1: $W(M, \Delta D) \leq W(N, \Delta X)$

$W(N, \Delta X)$ is the true change in welfare. $W(M, \Delta D)$ is the change in welfare due only to the total loss in proximity to the developed coast (ΔD) and assumes the loss is born entirely by the M renters displaced from the restricted area. This

upperbound is estimable if I have estimates of the marginal rate of substitution functions for d and a .

Notice that $W(N, \Delta X)$ and $W(M, \Delta D)$ differ in three ways. First, $W(N, \Delta X)$ measures the change in welfare for the change in all attributes ΔX . $W(M, \Delta D)$ measures the change for only loss in proximity to the developed coast ΔD . Second, $W(N, \Delta X)$ measures the change for all renters, N , that change attribute selection with restrictions. $W(M, \Delta D)$ measures the change for only the set of renters, M , that would have located in the restricted area without the restrictions. Third, in $W(N, \Delta X)$ the actual change in d , Δd , is used in each of the N renter's utility functions. In $W(M, \Delta D)$, $\Delta d'$ is used in each of the M renter's utility functions.

Intuitively, $W(M, \Delta D)$ is an upperbound measure of $W(N, \Delta X)$ because it only considers the negative effects on welfare (the first difference mentioned above) and because it assumes all the negative effects are borne by a set of renters that would suffer most from such effects (the second and third differences).

To see the effect of the first difference consider the measure $W(N, \Delta D)$. $W(N, \Delta D)$ is the change in welfare for *all* relocating renters due only to the loss of proximity to the developed coastline. It follows that $W(N, \Delta D) \geq W(N, \Delta X)$. That is, if I only let ΔD in the vector ΔX change, the loss in total renter welfare is greater than if I let all the elements in ΔX change. I know that $\Delta P > 0$, so excluding Δp from each renter's welfare measure must reduce aggregate welfare. ΔA are welfare-increasing market adjustment to the restrictions so excluding Δa from each renter's measure of welfare change must increase the measured loss further, even though some individual renters may have lower $U(\cdot)$ as a result of Δd .¹⁰ Hence, $W(N, \Delta D) \geq W(N, \Delta X)$.

Next, notice that $W(N, \Delta D)$ distributes the lost proximity, ΔD , according to intensity of preferences in the implicit market for proximity while $W(M, \Delta D)$ arbitrarily takes it from a small set of renters with the most intense preferences.¹¹ Thus $W(M, \Delta D) \geq W(N, \Delta D) \geq W(N, \Delta X)$. Proposition 1 holds.

The second upperbound measure only requires an estimate of the hedonic price function that includes d and a . That upperbound is stated in the following proposition

Proposition 2: $V(M, \Delta D) \geq W(N, \Delta X)$ provided $\nabla_d Z(d^*, a_s) \geq \nabla_d Z(d, a_s)$ for all $d \leq d^*$ and for all x and s .

The intuition of proposition 2 is that if renters' marginal value of proximity increases with proximity to the coast, the implicit price on the last increment of proximity chosen without the restrictions must be an upperbound estimate of each lost unit of proximity due to the restrictions. This measure uses the implicit price in just this manner.

¹⁰ To see that ΔA is a welfare-increasing adjustment, consider the following exercise. Imagine that I can change ΔD and ΔA in discrete steps and after each step can evaluate the aggregate change in welfare. (This method of analysis is borrowed from Bartik (1987b)). First, let ΔD change. Each renter has less d and hence a drop in welfare. Next, let ΔA change. Since ΔA is chosen by renters in response to a change in the supply of d and p (and since the supply of a is perfectly inelastic and unchanged with the restrictions), this adjustment must increase aggregate welfare.

¹¹ ΔD may be spread across all N renters as expected will occur in the market or it may be foisted upon the set of renters (in estimating the loss) that have the highest willingness to pay for d . The latter measure is surely an upperbound measure of the former. I accept that my set M represents the latter group.

To see that Proposition 2 holds recall that $\nabla_d Z(x^*, s) = \nabla_d P(x^*)$ for each renter. From the proviso in Proposition 2 it follows that $Z_k(d^* + \Delta d', p^*, a^*, s) - Z_k(d^*, p^*, a^*, s) \leq \nabla_d Z_k(x^*, s) \cdot \Delta d' = \nabla_d P(x^*) \cdot \Delta d'$ for all k in the set M .¹² In terms of total welfare change this implies that $W(M, \Delta D) \leq V(M, \Delta D)$. I know that $W(N, \Delta X) \leq W(M, \Delta D)$ from Proposition 1, so $W(N, \Delta X) \leq V(M, \Delta D)$. Proposition 2 holds.

Estimation

To estimate the upperbound in Proposition 1 I need estimates of the marginal rate of substitution functions for d , a prediction of M , and predictions for s_k , d^* , and $\Delta d'$ for each renter in the set M .

The marginal rate of substitution functions may be estimated using temporal or spatial segmentation as discussed above. The system $-m_i(x, s)$ for only the attributes in the vector d need be estimated. This, in turn, may be integrated back to $Z(\cdot)$ for the welfare analysis.

M may be predicted using time-series data on the rate of coastal housing development and acreage data for the amount of restricted land. For example if an increase of 20% in new housing units in the coastal area is projected and there is enough space to accommodate 5% after the restrictions, use 15% of the stock as an estimate of the number of displaced units. Projections are made by year for the years after the restrictions are in place, so I have M_t for $t = 1, \dots, T$, where 1 is the year the restrictions begin and T is the final period of the analysis. Shortly, I show that each M_t must be divided into zones according to distance from the waterfront. This gives M_{tr} , for $r = 1, \dots, R$ where r denotes one of R zones.

Values for s_k , d^* , and $\Delta d'$ must be predicted for each renter in each set M_{tr} . For s_k use the average characteristics of current renters that choose large values of d , that is, the average characteristics of renters that are located in coastal areas that are developed today.

The vectors d^* and $\Delta d'$ include four elements: view (d_1), privileges (d_2), frontage (d_3), and distance (d_4). Divide the coastal area into zones of some arbitrary size according to distance from the water as shown in Table 2. The entries to the left of the curved line pertain to the zones; moving right to left a renter is located further from the coast. The entries for each zone are the values assumed for the vector d for a renter in the set M without restrictions. All of these renters are displaced from proximity to a developed coast by the restrictions. The entries to the right of the curved line pertain to the predicted location of a displaced renter with restrictions, and assume the entire adjustment in ΔD is borne by renters in the set M .

For example, a renter in a house that would have been built in zone 1 without the restrictions would have view, privileges, the average frontage of houses currently in such areas, and the average distance to the water of houses currently in such areas. With the restriction the renter has no view, no privileges, no frontage, and is located at the distance $d_4^* + \Delta d_4$. $d_4^* + \Delta d_4$ is the value of d_4 at which $\partial P(x^*, \beta) / \partial d_4 = 0$ —the distance at which nearness to the coast no longer affects property values. Indeed, this defines my choice of $\Delta d'$. The reasoning is simply that land must be sufficiently abundant in this area vis-a-vis the coast that Δd_4 is

¹² For elements in d that are discrete, let $\partial P / \partial d$ be the coefficient on the discrete attribute.

Table 2
With and Without Values for Coastal Proximity Attributes

Values Assumed for d^* for the Set of M Renters Without Restrictions				Values Assumed for $d^* + \Delta d'$ for the Set of M Renters With Restrictions
Zone #4	Zone #3	Zone #2	Zone #1	
$d_1^* = 0$	$d_1^* = 0$	$d_1^* = 0$	$d_1^* = 1$	$d_1^* + \Delta d'_1 = 0$
$d_2^* = 1$	$d_2^* = 1$	$d_2^* = 1$	$d_2^* = 1$	$d_2^* + \Delta d'_2 = 0$
$d_3^* = 0$	$d_3^* = 0$	$d_3^* = 0$	$d_3^* = \bar{d}_3$	$d_3^* + \Delta d'_3 = 0$
$d_4^* = \bar{d}_4(4)$	$d_4^* = \bar{d}_4(3)$	$d_4^* = \bar{d}_4(2)$	$d_4^* = \bar{d}_4(1)$	$d_4^* + \Delta d'_4 = d_4^{*}$ (d_4^{*} is the value of d_4 at $\partial P/\partial d_4 = 0$)

Area of Restricted Coastal Zone

←————→
 waterfront

$\begin{cases} d_1 = 1 \text{ if view} \\ d_1 = 0 \text{ if no view} \end{cases}$

$\begin{cases} d_3 = \text{frontage (feet of land abutting water)} \\ \bar{d}_3 = \text{average frontage for current properties in coastal zone} \end{cases}$

$\begin{cases} d_2 = 1 \text{ if privileges} \\ d_2 = 0 \text{ if no privileges} \end{cases}$

$\begin{cases} d_4 = \text{distance to waterfront} \\ \bar{d}_4(i) = \text{average distance to waterfront for current properties in zone } i \end{cases}$

not likely to take on values that place displaced housing any further inland. Similar assumptions for the other zones are shown.

The final welfare measure where δ_t is a discount rate is

$$W(M, \Delta D) = \sum_t \sum_r M_{tr} \cdot \delta_t \{Z(d_{rt}^* + \Delta d'_{rt}, p^*, a^*, s) - Z(d_{rt}^*, p^*, a^*, s)\}.$$

Less information is needed to estimate the welfare measure in Proposition 2: an estimate of the hedonic price function without restrictions and predictions for M_{tr} and $d^* + \Delta d'$.

An estimate of the hedonic price function in the coastal housing market where the restrictions are being considered but before they are proposed may be used for the estimate of the hedonic price function without restrictions. M_{tr} , d^* , and $\Delta d'$ predictions are the same as presented in Table 2.

The welfare measure is

$$V(M, \Delta D) = \sum_t \sum_r \{M_{tr} \cdot \delta_t \{(\nabla_d P(x_{tr}^*; \beta)) \cdot \Delta d'_t\}\}$$

Summary

I present two upperbound measures of welfare loss of residential displacement due to coastal land use restrictions. One measure requires data from a single

coastal housing market with characteristics similar to that of the market for which the restrictions are proposed. For this measure only the hedonic price function is estimated. The other measure requires either cross-sectional or time-series data on coastal housing markets that are segmented. For this measure a willingness to pay function is estimated for proximity to the coast. Both measures require prediction of the number of units displaced from the restricted coastal area.

If the expected value of environmental improvements exceed these measures and the expected loss of displaced commercial uses and displaced environmental stress is slight, decision-makers should favor a set of proposed land use restrictions with confidence that the decision is efficient. If the restrictions fail such a test, the decision-maker may consider a similar test with Edwards and Anderson's lowerbound measure. Failure here should lead to rejection of the restrictions with confidence of an efficient decision.

Acknowledgments

Special thanks are due to Glen Anderson for detailed comments on two earlier drafts of this paper. This work is a result, in part, of research sponsored by NOAA Office of Sea Grant, Department of Commerce, under Grant No. NA86AA-D-56040 (Project No. SG87 R/CB-2. The U.S. Government is authorized to produce and distribute reprints for governmental purposes, notwithstanding any copyright notation that may appear hereon.

References

- Bartik, T. J. 1987a. Measuring the benefits of amenity improvements in hedonic price models. Working paper, Department of Economics, Vanderbilt University.
- Bartik, T. J. 1987b. The estimation of demand parameters in hedonic price models. *Journal of Political Economy* 95(1):81-88.
- Batie, S. S. and C. C. Mabbs-Zeno. 1985. Opportunity cost of preserving coastal wetlands: a case study of recreational housing development. *Land Economics* 61(1):1-9.
- Brown, G. and H. O. Pollakowski. 1977. Economic valuation of shoreline. *Review of Economics and Statistics*:272-278.
- Diamond, D. and B. Smith. 1985. Simultaneity in the market for housing characteristics. *Journal of Urban Economics* 17:280-292.
- Edwards, S. and G. Anderson. 1984. Land use conflicts in the coastal zone: an approach for the analysis of the opportunity costs of protecting coastal resources. *Journal of Northeastern Agricultural Economics*:73-81.
- Epple, D. 1987. Hedonic prices and implicit markets: estimating demand and supply functions for differentiated products. *Journal of Political Economy* 95(1):59-80.
- Frech, H. E., III, and R. N. Lafferty. 1976. The economic impact of the California coastal commission: land use and land values. In *The California coastal plan: a critique*, Johnson, M. B., ed. San Francisco: Institute for Contemporary Studies.
- Frech, H. E., III, and R. N. Lafferty. 1984. The effect of the California coastal commission on housing prices. *Journal of Urban Economics* 16:105-123.
- Harrison, D., and D. L. Rubinfeld. 1978. Hedonic housing prices and the demand for clean air. *Journal of Environmental Economics and Management* 5:81-102.
- Horowitz, J. 1984. Estimating compensating and equivalent income variations from hedonic price models. *Economic Letters*:303-338.
- McConnell, K. E., et al. 1985. Identification of preferences in hedonic models. Volume I of *Benefit analysis using indirect or imputed market methods*. College Park, MD: University of Maryland.

- Mendelsohn, R. 1984. Estimating the structural equations of implicit markets and household production functions. *Review of Economics and Statistics* 66:673-677.
- Milon, W., et al. 1984. Hedonic amenity valuation and functional form specification. *Land Economics* 60:378-387.
- Nelson, J. 1978. Residential choice, hedonic prices, and the demand for urban air quality. *Journal of Urban Economics* 5:357-369.
- Palmquist, R. B. 1984. Estimating the demand for the characteristics of housing. *Review of Economics and Statistics* 66:394-404.
- Parsons, G. 1986. An almost ideal demand system for housing attributes. *Southern Economic Journal* 53(2):347-363.
- Rosen, S. 1974. Hedonic prices and implicit markets: product differentiation in pure competition. *Journal of Political Economy* 82(1):34-55.
- Rueter, F. H. 1973. Externalities in urban property markets: an empirical test of the zoning ordinance of Pittsburgh. *Journal of Law and Economics* 26:313-349.
- Schnare, A. B., and J. Struyk. 1976. Segmentation in urban housing markets. *Journal of Urban Economics* 3(2):146-166.
- Shabman, L., and M. K. Bertelson. 1979. The use of development value estimates for coastal wetland permit decisions. *Land Economics* 55(2):213-222.
- Stull, W. J. 1975. Community environment, zoning, and the market value of single-family homes. *Journal of Law and Economics* 28:535-557.
- Wilman, E. A. 1984. *External costs of coastal beach pollution: an hedonic approach*. Washington, DC: Resources for the Future.
- Witte, A. D., H. J. Sumka and H. Erickson. 1979. An estimate of a structural hedonic price model of the housing market: an application of Rosen's theory of implicit markets. *Econometrica*:1151-1173.

Copyright of Marine Resource Economics is the property of Marine Resources Foundation. The copyright in an individual article may be maintained by the author in certain cases. Content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.