Using wages and property values to value environmental amenities

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(note to Edward: maybe add some of the hedonic notes from Popps Ferry)

This method of valuation is driven by the basic insight that the use values associated with site-specific environmental amenities get *capitalized* into wage rates, land prices, or both

> That is, ceteris paribus (c.p.), in nice places, wages are lower and land prices are higher.
>
> Also, nice houses sell for more money than do crappy ones.

Capitalized as in *built into*

Such model predictions are based on the following sort of assumptions:

- Either everyone has similar preferences, or, to the extent preferences vary, there are a substantial number of individuals in each preference group.
- People are mobile (they are willing and able to change jobs and locations/move)
- People get utility from market goods and nonmarket commodities including environmental commodities.

Expressing utility for an individual who live in city *i* in terms of exogenous variables that describe city *i*:

$$u_i = u(p_i, w_i, r_i, A_i)$$

where i indexes the city of residence

p_i is the price index for goods and services in city *i*

w_i is the wage rate

r_i is the rental price of housing (reflects the cost of land)

A_i is a vector of the characteristics (weather, crime rate, schools, environmental amenities, etc).

Note that above restrictively assumes everyone in city *i* has the same utility, because they have the same preferences (utility function) and experience the same constraints. (This assumption can be relaxed, but this simplifying assumption makes the presentation of the hedonic technique simpler.)

Since all that is important is relative prices, we can rewrite the utility function as

$$u_i = u(w_i / p_i, r_i / p_i, A_i) = u(\tilde{w}_i, \tilde{r}_i, A_i)$$

where $\tilde{r}_i$ is the relative price of housing and $\tilde{w}_i$ is the real wage.

Imagine there are only four places to live, Boulder, Aspen, Pueblo and Denver.

i = 1 is Boulder, 2 is Aspen, 3 is Pueblo and 4 is Denver. For example, utility from living in Pueblo is

$$u_3 = u(\tilde{w}_3, \tilde{r}_3, A_3)$$

Given that we have assumed that everyone has the "same" preferences and that people are mobile, an individual will move from city *m* to city *n* if $u_n > u_m$.[1]

Therefore, everyone will be happy staying put (in equilibrium) only when

$$u_1 = u_2 = u_3 = u_4$$

What will cause equilibrium to occur? As individuals move from city *m* to city *n* the supply of labor will decrease in city *m* and increase in city *n*. This will cause $\tilde{w}_m$ to increase and $\tilde{w}_n$ to decrease. Everything else constant the individuals leaving *m* and going to *n* makes *m* more attractive in terms of wages and *n* less attractive in terms of wages.

In addition, as individuals move from city *m* to city *n* the demand for housing will decrease in city *m* and increase in city *n*. This will cause $\tilde{r}_m$ to decrease and $\tilde{r}_n$ to increase. That is, everything else constant, the individual's leaving m and going to *n* makes *m* more attractive in terms of housing prices and *n* less attractive in terms of housing prices.

In addition, as individuals move from city *m* to city *n*, A_m and A_n will change. City *n* will possibly become more congested, more polluted, etc, while city *m* will become cleaner and less congested.

In summary as individuals move from city *m* to city *n*, $u(\tilde{w}_n, \tilde{r}_n, A_n)$ likely decreases and $u(\tilde{w}_m, \tilde{r}_m, A_m)$ likely increases, making it less attractive to move and bringing the system into equilibrium.

Obviously, the real world is complicated by the fact that everyone does not have identical preferences, moving is costly, some city characteristics (e.g. family and friends) are individual specific, and some amenities increase when a city's population increases,[2] but you get the idea.

[1] Actually, the utility difference has to be enough to cover the cost of moving.
[2] Small towns won't provide a ballet, or opera, or a bunch of fancy restaurants.

When the system is in equilibrium, the values of the amenities in city *i* will be capitalized into $\tilde{r}_i$ and $\tilde{w}_i$. That is, nice places will have lower wages and higher housing prices.

Therefore, we can estimate use values for environmental amenities by seeing how $\tilde{r}$ and $\tilde{w}$ vary across cities as a function of the environmental and other components of *A*.

Studies that value amenities in this manner are called hedonic studies.

There are three types of hedonic studies: hedonic property-value studies, hedonic wage studies, and joint property value and wage studies.

A hedonic property-value study estimates changes in housing prices as a function of the characteristics of the house and its surrounding amenities.

In contrast, a hedonic wage study estimates how wage rates vary across localities as a function of the amenities in the locality.

For example, assume that within Boulder amenity values (crime rates, school quality, access to open space, traffic, etc) vary from neighborhood to neighborhood. Housing prices will differ across neighborhoods and one can use these variations to value neighborhood amenities such as distance to open space.

Imagine two neighborhoods that are identical (types of houses, crime, etc.) in every respect except for distance to open space, including the houses. The difference in the average price of a house in the two neighborhoods values the decrease in distance to open space. That is, it determines what a representative individual is willing to pay for being closer to open space.

To do a hedonic property-value study of the value of open space in Boulder, one would want to estimate something like the beta in the following function (obviously one would have to include all the determinants of the price of a house and maybe your function will need to have a bunch of nonlinear terms and interaction terms

$$\tilde{r}_{ji} = \alpha_0 + \beta_1(squareft_{ji}) + \beta_2(\#ofbathrooms_{ji}) + \beta_3(dist_{ji}) + \varepsilon_{ji}$$

where $\tilde{r}_{ji}$ is the price of house *j* in neighborhood *i*.

One collects a bunch of data on house prices and the characteristics of the house and its neighborhood, and then finds those values of the betas that best explain the prices.

The estimate of β_3 is an estimate of the marginal value of being closer to open space.

If, for example the estimate house prices are expressed in thousands of dollars, *dist* in measured in one mile units, and the best estimate of β_3 is -5, then wtp for each mile closer is $5,000.

A former student estimated such a regression for her class paper: she did a hedonic property-value study of Grape Street in Boulder. Grape Street runs east/west for a few blocks. It is on the west side of Broadway in north Boulder. The houses on Grape are very similar to the other houses in this neighborhood, but those on Grape sell for thousands less. Why???

A hedonic wage example:

Imagine two areas that are identical in every respect except for weather. In one place it is nice and the other place the weather is lousy. Both places are featureless plains. (In this case, the weather difference will likely be completely capitalized into $\tilde{w}$.)

If so, we could value the nicer weather by looking at the difference in the wage rates. People give up a certain amount of income per year to live in the place with better weather.

Some complications:

- Amenities are often capitalized into both wage rates and housing prices, not just one of these prices, which is why a joint wage and property value study than one that only considers wages or one that only considers property values.
- For example, in Boulder real wages are low relative to other places, and housing prices are high.

  My salary at C.U. and the value of my house.

- In general, very local amenities get capitalized more into housing prices and more regional amenities, such as weather, get capitalized more into wage rates.[3]

- The hedonic technique only estimates **use** values because nonuse values are not capitalized into prices.[4]

  E.g. a hedonic property value study to value a park would not pick up any nonuse values associated with the existence of the park.

Ideally one want to do a joint wage and property-value study.

[3] So are the mountains a local amenity or a regional amenity?
[4] Why aren't non-use values capitalized into prices.

Does the above theory explain why some types of individuals are more likely to move to certain places?

- Consider retired people. Unlike most of us, they don't worry about wage rates.
- Where should they move?
- They should move to places where positive amenities are more capitalized into wages than into housing prices. If they move to such places they can make themselves better off than the rest of us (as long as there aren't too many old people with the same idea).
- Arizona is—used to be—the place. Old farts moved to Arizona because the weather is nice, which is capitalized into wage rate because it is a regional amenity, and old farts do not participate in the labor market, so do not suffer the low wages. That said, the advantage of moving to Arizona has decreased as old people become a larger proportion of the population.

Calculating WTP for open-space using property values: a very a simple, too simple, example

Consider the following scenario:

Assume everyone has identical preferences and that there are only two non-housing commodities: beer and access to open-space.

More beer is always preferred and closer to open-space is better if one lives within a mile of it. If one lives more than a mile from open-space one does not care whether one moves closer or farther as long as one does not move within a mile.

Further assume that everyone has a fixed income per-year of $100,000 and that all money spent on beer and rent goes to the French (who live elsewhere, own all of our land and sell us the beer). We don't need to worry about wages—no one works.

Assume that all houses are identical.

Consider two parallel universes: one with no open-space (no one cares where they live) and one with open-space at the end of society's only road (everyone lives on the road). In the second universe, individuals prefer, at the same rent, to live closer to the open-space if they live within one mile.

Maybe the open space at the end of the road is a beach or a rain forest.

In the world with no open-space, all of the properties will rent for the same price (no reason they would not). Assume its $20,000/year, so everyone drinks $80,000 of beer per year. This is the equilibrium because no one has an incentive to change their behavior.

In the universe with open-space, housing prices will differ. They will be the same for all houses more than a mile from the open-space ($20,000),

But, assume, the 10 houses within a mile sell , in terms of distance from the beach, for $100,000, $90,000, $80,000, $70,000, $60,000, $50,000 $40,000 $30,000, $25,000, and $21,000. Assume this is the equilibrium distribution of prices in that with this price vector no one will want to move. That is, no one can make herself better off by moving.

The open space gives added value to each property within a mile of the openspace. $80,000 is the value added to the closest property. We know that among the population the household with the highest wtp to live near the beach will live in this house: if someone other than the current resident had a higher wtp for the location they would outbid the current resident. The location is going to the highest bidder, the household that has the highest wtp for each lot.

What is this society's willingness to pay for the creation of the open-space?

$80,000 + $70,000 + $60,000 + $50,000 +$40,000 + $30,000 + $20,000 + $10,000 + $5,000 + $1,000 = $366,000, which is a lot.

We just valued the openspace using the hedonic property-value method.

Note that in the second universe, society is not better off because of the open-space: the entire surplus has been paid to the French in terms of higher rents. So, the creation of the open space did not make the locals any better off.[5]

One can calculate WTP in more complicated worlds; it is only a more complicated endeavor.

[5] Did the creation of Boulder openspace make the residents of Boulder better off?