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Measuring the impact of culture using hedonic analysis[1]

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Introduction

There are many ways in which cultural organizations and arts activities might be said to have an impact on communities. There are also many reasons for wanting reliable methods for evaluating the impacts of the arts on communities. This paper provides an introduction to one possible approach for evaluating some of these impacts. The technique, referred to as *hedonic analysis*, has been widely used in economics to provide information about values ranging from the value of soil fertility to the value of good local schools. The technique is of particular importance to economists seeking to understand the value of social conditions (like crime) in neighborhoods or the value of environmental amenities (like open space) or disamenities (like a toxic waste dump).

Why should we be concerned with developing ways of measuring the impacts of the arts or cultural organizations on communities? Why not dispense with trying to measure something that is difficult (perhaps impossible) to measure and just let communities make their decisions? Those communities who understand the value of culture – those communities who *get it* – will support the creative persons within and provide an enriched cultural environment in which residents can thrive (and perhaps prosper). Those who value such an environment can relocate to the communities who *get it* and the cultural organizations themselves can be spared the necessity of attempting to develop the capacity to undertake another sort of evaluation and provide results for another metric.

It is not difficult to provide at least tentative answers to such questions. Contemporary communities face large and competing claims for the limited resources available to them. It might seem obvious to all concerned that an art museum, performing arts center, or other organization is desirable. The difficulty is that the community may face a choice between many desirable projects to support, and not have the resources to do all of them. In such circumstances, communities may want to rank potential projects and devote resources to those that are *most desirable* in some sense. In these circumstances it can be very beneficial to have a method for evaluation that can be applied in a similar way to several projects. This enables the community to make the best use of available resources. It is also helpful to have a method for evaluation that can be applied by different persons, at different times or in different communities and produce

results that can be compared. This provides a context for understanding the impacts of cultural organizations.

Even in communities that already have relatively generous support for cultural organizations, it does not follow that the current level of support is the best level. Organizations may want to explain why, even though there are already cultural organizations in the community, the community should devote additional resources in support of their programming. The arguments they present in advocating their organizations may take many forms, and hedonic analysis may provide one of these forms.

Central ideas

The central idea that motivates use of hedonic analysis of housing markets to measure the economic impact of culture and the arts is simple:

The presence of a cultural organization in a community or neighborhood provides benefits to those who live there. These benefits can be both direct and economic in nature (improved employment opportunities) or indirect and more generalized in nature (a more vibrant community, a more thoughtful and tolerant community, neighbors and fellow residents who are more creative and interesting). These benefits make the community a more attractive place to live, and as a result people who are seeking a residence to buy or to rent will have an increased *willingness-to-pay* for accommodation in the community. This increased willingness-to-pay will be directly observable through careful analysis of residential property values in the neighborhood or community where the cultural organization is located.

This central idea should not be particularly controversial. Anyone with experience in finding accommodation in a modern city will be familiar with the simple observation that houses are more expensive in better school districts, or in neighborhoods with more parks or better environmental quality. Since it is easily observed that if we improve schools the value of residential property rises, it should not surprise us if values increase when we make the community more attractive by enriching the set of cultural activities available.

Many observations by policy makers, journalists and arts advocates, for example, seem to regard the linkage between the presence of artists and the increase in property values as accepted fact and obviously true. Thus Bahrampour (2004) reporting for the New York Times notes:

> Broadway near the Williamsburg Bridge has long been seen as the border between the neighborhood's south side, a working-class Hasidic and Hispanic enclave, and the north side, which has become known for its artists, hipsters and, increasingly, affluent professionals. But as northside rents have soared, and ritzy boutiques and nightclubs have moved in, residents seeking cheaper housing have looked southward.

Across the Atlantic, Cameron and Coaffee (2005) observe that:

> The power of the arts-based regeneration of this area of Gateshead was strikingly evident in the fact that people queued overnight in order to pay what in terms of the local housing market were enormously high prices for apartments in what a few years before has been a derelict, isolated and unappealing backwater.

These images of gentrification – with artists moving in, bringing different styles, businesses and 'cultural capital' to a neighborhood, attracting affluent households and eventually causing an increase in rents and house prices – is widespread and many writers assume it has been well-established.

The most widely accepted method for establishing, measuring and testing such a relationship would be to undertake some type of hedonic analysis of housing markets (see Sheppard (1999)) to isolate the separate impact of artists and cultural activities to the value of residential property. Many seem to assume that such studies exist. McCarthy et al. (2005), writing about the techniques used to measure the economic benefits of the arts, asserts that the public benefits of the arts "are often given a dollar value … via hedonic approaches that estimate how proximity to the arts affects housing values…." No examples of such studies are mentioned in the text or identified in the extensive bibliography of the report.

Similarly, Mason (2002), Mourato and Mazzanti (2002) and Throsby (2002) all mention hedonic analysis as a core methodology for economic evaluation of the benefits of culture, and describe the analysis as detecting the impact of culture on house prices. The only references to actual application of the technique, however, concern either the impact on house prices of the architectural design of the houses themselves (rather than the cultural amenities to which the properties have access) or the analysis of the determinants of the prices of works of art (not houses).

Hedonic analysis of house prices has been widely used for valuation of goods whose consumption is facilitated by (or requires) residence in a particular location. Everything from school quality (Cheshire and Sheppard (2004) or Kane, Staiger and Samms (2003)), urban property crime (Gibbons (2004)), historic preservation districts (Leichenko, Coulson and Listokin (2001)), land use planning and open space preservation (Cheshire and Sheppard (2002)) and even the presence of neighborhood churches (Do, Wilbur and Short (1994)) have been measured and evaluated using hedonic analysis of house prices.

Given the widespread assumption that the arts and cultural vitality lead to increased house prices it is surprising how difficult it is to find actual published studies that apply the technique for evaluation of the impacts of cultural amenities. This is particularly true given the potential importance of such evaluation for arts advocacy and arts policy. Of course, there are nuances to this central idea that are important to recognize if we are to be able to conduct the analysis and to interpret the results properly. Let's review these to ensure a full appreciation of the nature of the analysis.

First, hedonic analysis provides a measure of the value of the benefits that are realized by virtue of residing in the community where the cultural organization or activity is located. There may be some benefits to culture – perhaps the most important benefits in some cases – that accrue to humanity in general or to a national culture and do not require residence in the community or near where the activity is taking place. Thus, for example, a great artist's contribution to world culture is available as part of the common artistic heritage of the planet and provides some benefit to us all. It is not necessary to have lived near Picasso during the process of producing his

paintings to be inspired, intrigued or informed by his work. The benefits of such inspiration are more readily available to those who live near to where his work is now on display. Hedonic analysis of residential property can provide a measure of this latter benefit that is related to where the beneficiary resides, but not the former benefit that accrues globally to persons independent of where they live. In this way hedonic analysis measures *a portion* of the benefits from cultural activity.

Second, even when successfully completed, hedonic analysis measures the additional amount actually paid to reside in the culturally enhanced community, not the maximum amount a buyer would have been willing to pay. When a potential resident contemplates living in the community, after visiting the area, reading about it and drawing upon her own experiences, she might decide that she would be willing to give up $1000 per year (in spending on other goods) in order to live in the neighborhood with the cultural organization. This represents her own evaluation of what the combined benefits of the organization are worth to her, and she will be unwilling to pay more than this in extra rent or mortgage payments. When she actually begins to search for an apartment or house, however, she may find that her own valuation of the neighborhood is higher than that of the "average" buyer. While she would be willing to pay $1000 per year more, with some careful shopping and bargaining she may find that she only has to pay $500 per year additional. She only has to "out-bid" the next highest bidder for the property. In this case the price actually paid will be $500 more than the price for a similar property in a neighborhood that is similar except for the presence of the cultural organization. It is this $500 amount that will be measured by the hedonic analysis, rather than the full willingness to pay. In this sense, even under otherwise ideal circumstances, the hedonic approach provides a *lower bound estimate* of the value of culture to the resident.

Third, hedonic analysis provides no information about the equity with which the benefits from cultural organizations are distributed. It provides a lower-bound estimate of that portion of the benefits that *accrues to those who successfully obtain a house* or apartment in the community. There may be persons who would realize significant benefits if they were able to have access to the cultural assets of the community, but who do not have the resources to purchase accommodation in the area. This is analogous to the situation of the hungry person who lacks the

income to purchase food, and for whom it might be reasonably asserted that the benefit of food would be greater than for the more affluent (and well-fed) person who actually does purchase and consume the food. Hedonic analysis does not measure the value of culture distributed to most deserving persons, nor even to the persons who (in some sense) would get the greatest value from it. Hedonic analysis provides a lower-bound estimate of a portion of the value of cultural organizations that is realized by the people who actually do reside in the community.

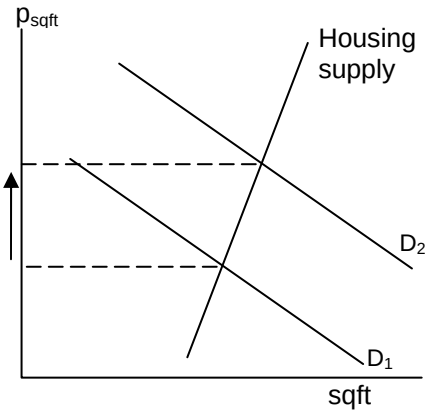
Finally, hedonic analysis measures the valuation placed upon accessibility to the cultural organization by the persons themselves. There may be some who distrust an individual's ability to determine the value of culture. Prior to exposure, individuals might not appreciate the value of the opportunity to experience a community with greater access to cultural organizations. It is surely the case that individuals might *over*-estimate as well as *under*-estimate the value of something they have not yet experienced. While lack of familiarity with culture seems likely to increase the variance of hedonic estimates of the value of cultural amenities, it is not clear that it would bias those estimates or, if bias does occur, which direction it might work. For better or for worse, hedonic analysis provides information about the willingness of a person to sacrifice consumption of other goods in order to have improved access to a culture-rich environment or cultural organization. This willingness may be for a variety of reasons, but it provides a measure of the *value* of culture in the same sense that the price of a painting at auction measures the value of the painting: it measures the amount of sacrifice that society (or someone in society) is willing to make in order to have access to the object.

Subject to these qualifications and limitations, how is it possible to measure the change in willingness to pay for residential property in a community? Consider a very simple example. Suppose that housing is available at a fixed price p_{sqft} per square foot of interior space. The value of a house is then given by:

$$House\ Value = p_{sqft} \times sqft$$

Here *sqft* represents the interior area of the home. For example, if p_{sqft}=\$225 then a 2000 square foot house has a value of \$450,000. An increase in the willingness to pay for space in a home can be represented in the familiar "supply and demand" of economics as an increase (shift upwards) in demand, indicating that the market is willing to pay more for any given quantity of interior

space. In the figure at right, the increase in willingness to pay for space causes the demand to increase from D_1 to D_2. After a period of adjustment, this can be expected to increase the price per square foot of space as indicated. Thus for example p_{sqft} might increase to \$250 and the market value of a 2000 square foot house would rise to \$500,000.



In actual applications the value of a house depends on more than the interior area. We may have:

$$House\ Value = C + p_{sqft} \times sqft + p_{lot} \times lot + \quad ... \quad + p_{baths} \times baths + p_{culture} \times culture$$

p_{sqft} , *sqft*	=	Price per square foot of interior space, amount of interior space
p_{lot} , *lot*	=	Price per square foot of lot size, size of lot where house is located
p_{baths} , *baths*	=	Price per bathroom in house, number of bathrooms in house
$p_{culture}$, *culture*	=	Price of access to cultural organization, distance to cultural organization

and the ellipsis in the equation is meant to indicate that a number of other house and neighborhood characteristics may be (and should be) included in determining the value of the house. In general we do not know in advance what the different prices such as p_{baths} or $p_{culture}$ are. The purpose of hedonic analysis is to estimate these prices (often called *hedonic prices*) using a large sample of observed sales of houses. These observations will provide information on the actual sales prices (*House Value*) and also on the location and characteristics of the house (*sqft, lot, baths, culture, etc.*).

Hedonic analysis consists in using these observations of house sales to estimate the relationship between *House Value* and the characteristics. That is to estimate the hedonic prices. These prices then provide us information about the willingness-to-pay for the characteristics, including for access to culture.

Finally, we might want to allow that the value of the house depends in a non-linear way on some house characteristics. The structure of the equation above implies that the increase in house value caused by going from 100 to 110 square feet is the same as the increase in going from 2100 to

2110. In general we will allow the relationship between *House Value* and the amounts of characteristics to be non-linear.

In summary, hedonic analysis provides an approach for evaluation of the willingness-to-pay for access to cultural organizations and cultural resources that:

- Can be applied in a similar way to different organizations and different communities, facilitating comparisons of impact between communities or between changes in cultural resources and other changes (such as environmental)
- Can be linked conceptually to the behavior of actual households who make choices to pay extra for a residence with improved access to cultural amenities; this provides evidence that can help to support the case for the use of public resources to sustain cultural organizations and cultural activities

Data requirements

The initial reaction of some people to the ideas of hedonic analysis is one of puzzlement. How can statistical analysis be used to isolate the contribution of a single factor, like the presence of a cultural organization, to the value of residential property?

Residential properties often range in value by a factor of 1000 – from tens of thousands to tens of millions of dollars – and in some markets there are conditions unrelated to cultural organizations that are widely understand as the primary determinants of market value. The size or age of the home, its distance from the sea or lake shore, or the school district in which it is located are generally regarded as more important factors influencing the market value of the home. This understanding of relative importance of factors is (generally) completely correct. The point of using hedonic analysis to measure the impact of cultural organizations on house values is NOT to establish that the presence of these organizations is the most important factor affecting such values. The point is to isolate the contribution (if any) of the presence of cultural organizations to house values from the dozens of other factors that influence them.

To achieve this, we must adopt an approach that may be very unfamiliar to arts organizations and their advocates. The techniques required to carry out the analysis will almost certainly be beyond the capabilities of all but the very largest organizations or public arts agencies. The goal of the discussion here is to present a relatively accessible account of what goes into the analysis; to present an example that illustrates the approach; to draw conclusions from that example and thereby provide a guide to the analysis both for those who seek to undertake it and for those who simply want to be intelligent readers and consumers of the approach.

The steps involved in undertaking hedonic analysis of the impacts of a cultural organization can be summarized as follows:

1. Identify the cultural organization or change in cultural assets available to the community or neighborhood to be evaluated, and the location or locations where the organization is located or where the programming takes place.
2. Determine a reasonable date or range of dates when the cultural organization began operation or made a significant addition of programming to the community.
3. Collect data on actual house sales prices in the neighborhood over a range of dates that span the time identified in step 2 and are located within the area likely to be directly affected by the cultural organization or have access to the locations identified in step 1. Generally this means (at a minimum) several hundred property transactions covering a time period of several years over an area ranging from up to a mile from the cultural organization to up to several miles. Ideally data will be available for several thousand transactions. See discussion below on the specific house characteristics that should be included in the data.
4. Collect data on the trends in general residential property prices within the metropolitan area containing the area being analyzed. Generally this takes the form of a house price index for the metropolitan area available from public sources.
5. Identify other significant factors in the community that can affect the value of residential property. These may include proximity to lakeshores and coasts, significant local parks, school districts, industrial zones, proximity to the central business district and other major employment centers.

6. Organize the data, using a spreadsheet or alternative data base management system, with each observed transaction entered on separate rows and each variable entered in appropriate columns that include appropriate variable names.
7. Using either coordinates for each property given in the data, or coordinates obtained by geocoding the data using a GIS system, determine for each property the distance from the property to the location(s) determined in step 1, and the distance to other significant factors identified in step 5. This step is important but is the first of the steps that may be beyond the capabilities of many small or medium-size cultural organizations.
8. For variables that are qualitative or categorical in nature, create "indicator" variables taking the value 1 if the house has the quality or falls into the particular category, and 0 otherwise. Examples include style (ranch, colonial, etc.) location within a particular school catchment area, etc. Also create a variable – call it *postsale* – that takes the value 1 if the house was sold after the cultural organization or cultural asset became available to the community (the date identified in step 2).
9. Create two variables to indicate distance from the property to the cultural organization. One – call it *predist* – is equal to 0 if the property was sold after the organization opened, and is equal to the actual distance from the property to the location of the cultural organization if the sale took place prior to the increase in cultural amenity or cultural organization. The second – *postdist* – is equal to 0 if the property was sold prior to the date when the organization opened and if the property sold after the increase in cultural amenity became available is equal to the actual distance from the property to the location of the organization or amenity.
10. Using the local house price index collected in step 4, create a "real" house value variable by dividing the actual observed sales price for each transaction by the house price index (multiply by 100 if the index takes the value 100 in the base year). The resulting set of "real" house values will be adjusted for changes in the price level and also for changes in economic and demographic conditions that affect the entire metropolitan area more or less equally.

Once these data have been assembled and entered into a computer-readable format that can be used for statistical analysis, we can proceed to estimate the impact itself. Before discussing that it

is worth discussing the sources of data. This can be one of the most challenging parts of undertaking hedonic analysis.

Identification of the cultural organization or cultural resource to be studied as well as its location is relatively straightforward, although can present difficulties in some circumstances. The most straightforward situation involves an organization that maintains a physical location in a structure, and offers programming at that location more or less throughout the year. One identifies the date when programming began and the location of the structure. At the other extreme would be a cultural resource or event that happens on a single day, weekend or week of the year at locations that might vary from year to year but are within the same city. An arts festival or music festival might be organized in this way. If the event is of relatively short duration and the location varies from year to year (one park or another, the convention center, a local College or University) then it may not be clear where the cultural resource is actually to be located. If this is unclear to the researcher or arts advocate it is likely to also be unclear to a prospective house buyer, and it may not be possible to use hedonic analysis to obtain information about the willingness-to-pay for the associated cultural amenity.

Assuming that the location and time when the change occurred can be determined, the next step is to obtain data on actual house sales. For communities in the US, there are three sources of information from which data on property characteristics with sales dates and transaction prices might be available. These are local property tax assessor's offices, real estate agents with access to a regional multiple listing service, and commercial data providers (such as First American CoreLogic[2]).

Because many states have public records laws that require tax assessors to make available all of the data they use for assessing property tax payments, the local tax assessor's office may be the first place to check. For the most experienced and professionally run offices, the data may be organized and either available for download online or for a reasonable fee on a DVD[3]. In other cases cooperative local assessor's offices will generally make data files available although some

[2] See http://www.facorelogic.com/products/metroscan.jsp
[3] The Lucas County, Ohio ARIES system is an excellent example. See http://www.co.lucas.oh.us/index.aspx?NID=383 .

persuasion may be required because provision of data to researchers is not the primary mission of their agencies. In almost all cases hard paper records of transactions, with property characteristics, will be available to persons at the assessor's office. If this is the only option, however, the time requirement associated with assembling the required amount of data may be excessive.

The second data source that can be considered is to find a cooperative local real estate agent. Virtually all MLS systems will be able to print out or export data on residential property sales prices and characteristics for the recent past. Sometimes these data may only be available for a limited time period such as the most recent five years, and this may not be adequate to span the time when the cultural amenity became available. There is also variation in the organization and restrictions of local real estate boards, and some may prohibit their members from making data available in this way, even for non-commercial research purposes.

If funding for the research is plentiful, commercial data providers are possibly the best possible source of information. The data they supply will generally be well-organized and checked for consistency. The documentation required for proper interpretation of the variables will be available and it is likely that estimation can proceed smoothly. The cost of the data for a single study in a large urban area, however, will typically be thousands of dollars[4]. Whatever source of data is used, the analysis requires a minimum of several hundred observations, and in larger areas with multiple forces affecting property values several thousand observations will be required, ideally with a balance of observations before and after the date when the cultural organization began operations.

Data on the general pattern of local house prices or a local house price index can generally be obtained from three different sources. These are: the shelter component of the consumer price index made available for 27 metropolitan areas in the US as well as within census regions for cities of particular size ranges[5]; the Case-Shiller-Weiss index of house prices available from

[4] Compared to $10 - $300 for the complete data from well-organized assessor's offices. Again, see http://www.co.lucas.oh.us/index.aspx?NID=383 .
[5] See http://www.bls.gov/cpi/ under the heading "Regional Resources"

Standard and Poor's[6] covering 20 metropolitan areas to at least the year 2000 and for some of the metro areas to 1987; the FHFA house price index[7] covering 384 metropolitan areas in the US and all states, extending back in time for some cities to 1978 and for all cities at least through 2000. In general the recommendation is to use the Case-Shiller-Weiss index if it is available, then the FHFA price index. While the shelter component of the CPI has the advantage of extending further back in time (to the 1960s for some urban areas) it is generally thought to provide a less accurate indicator of the local trend of house prices. A final option that is sometimes employed is to estimate a price index as part of the hedonic model by including an indicator variable for each year in the sample, excluding the last year.

The importance of having an accurate indicator of local house price trends is worth noting. The analysis of the impact of a cultural organization on house prices requires that we identify observed increases in house prices with distance from the organization and with time after the amenity became available.

It is important to distinguish between increases in house prices that take place throughout the community due to external factors (a housing bubble or change in mortgage interest rates, for example) from any impact of a cultural organization. Similarly, we don't want to declare the organization as having "zero impact" if a general pattern of decline in house values in the metropolitan area is sufficient to mask the positive impact of the cultural organization. We want to identify the change in house prices that (a) takes place after the organization begins to provide the cultural amenity, (b) generally is related to distance from the organization, and (c) consists of properties going up in value by *more* than similar properties in the community that are not close to the organization or going down in value by *less* than similar properties. Using the best house price index will help us to achieve this goal.

The process of using the street address to determine the geographic coordinates of the property is called *geocoding*. Determining location of each property is an important part of the hedonic analysis because the distance from the property to the cultural organization or venue will provide an indicator of the exposure that each property has to the impact of the increased cultural

[6] Downloadable from http://www.macromarkets.com/real-estate/data_downloads/SPCSI.xls .
[7] Downloadable from http://www.fhfa.gov/Default.aspx?Page=87

amenity. Geocoding data can be difficult because it goes beyond organization of data or calculations that can be done using a spreadsheet program. Measurement of distance to the city center, major employment centers, coastlines, and other factors is also generally employed to provide the most complete model of house price determination.

In some circumstances it may be unnecessary to geocode the properties because some assessors offices include coordinates for each property in the database that they make available to the public. Generally these coordinates are in a "state plane" coordinate system rather than the more familiar latitude and longitude. This can be an advantage if the locations of cultural organizations and other relevant factors can be determined in the same system since then the distances from individual properties to these locations can be easily calculated.

If property coordinates are not included in the data, then the street addresses must be used to determine coordinates for the property. This can be accomplished in several ways. If funding is available or access to the software can be obtained, there are several GIS (geographic information systems) programs that have specialized facilities for geocoding. ArcGIS[8] or MapInfo[9] are two widely used systems that provide this capability. These commercial programs are not inexpensive. An open source alternative that is available at no cost is QuantumGIS[10]. Making use of any of these GIS systems is more complex than using typical office software and it may be beyond the capabilities of small to medium size organizations. In some cases it may be possible to employ an intern or recent graduate who has experience using these systems. Alternatively it might be possible to establish a partnership with a local researcher or to engage a local consultant who can assist.

Estimating the impact

Once the data have been obtained and organized as described above, the analysis proceeds to estimating the actual impacts. This must be done using a computer program designed to estimate

[8] See http://www.esri.com/software/arcgis/arcview/index.html
[9] See http://store.pbinsight.com/store/pitneybo/DisplayCategoryProductListPage/categoryID.43348500/parentCategoryID.43227400
[10] See http://www.qgis.org/ and for a helpful video tutorial on geocoding using QuantumGIS see http://wn.com/Quantum_GIS_Geocoding_Reverse_Geocoding_plus_Google_Maps_and_OpenStreetMap_and_Yahoo_overlays

relationships using data. There are numerous programs available for this purpose ranging from the expensive and complex STATA[11] to capable, free open-source programs[12] like GRETL and R. All of these programs require some effort to learn, and there is no acceptable alternative to using one of these tools to complete the analysis. As with the GIS requirements discussed above, it may be necessary to hire a specialized staff member to complete the analysis, or to establish a relationship with a local consultant or researcher with interests in the area.

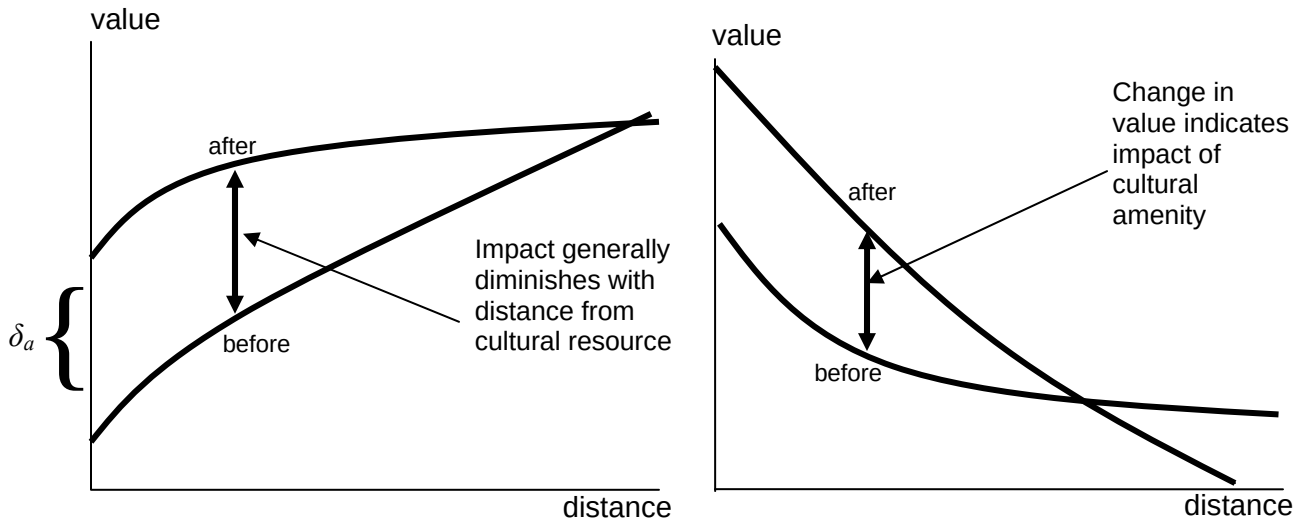
Once the data have been read into the statistical analysis system, estimation can proceed. The simplest approach is to assume a linear relationship and estimate a hedonic price function similar to:

$$\underbrace{P}_{\text{house price}} = C + \underbrace{\beta_1 SqFt + \beta_2 Lot + \ldots}_{\text{impact of characteristics that can be measured numerically}} \underbrace{+ \delta_1 x_1 + \ldots}_{\text{impact of qualitative indicators}} + \underbrace{\delta_a postsale + \delta_{pre} predist + \delta_{post} postdist}_{\text{impact of proximity to cultural amenity}}$$

In this case the actual data are the real house price *P*, along with the characteristics that can be measured numerically like *SqFt* (square footage of interior space) and *Lot* (lotsize) along with indicators of qualitative conditions discussed in step 8 above, here identified as x_1, *postsale*, *predist* and *postdist*. The values of these variables are what are observed and recorded in the data. The statistical analysis of the data provides estimates of the parameters *C*, $\beta_1, \beta_2, \ldots, \delta_1, \ldots, \delta_a, \delta_{pre}$, and δ_{post}.

The values of these three parameters δ_a, δ_{pre}, and δ_{post} are of particular interest. The estimate for δ_a provides information on the change in the value of property adjacent to the cultural organization or source of cultural amenity. The estimates for δ_{pre} and δ_{post} provide information on the change in value for identical houses located further and further from the site where cultural programming takes place (or will take place). Depending on the nature of the neighborhood where the cultural organization is located, values may generally rise or fall as we consider identical properties located further from the organization site. The impact of the organization is the *change* in value of the house that occurs when the cultural amenity becomes available. This is illustrated in the figure below:

[11] STATA was used in obtaining the estimates presented below. For more information see http://www.stata.com/ .
[12] For an extensive list of programs with links, see http://en.wikipedia.org/wiki/Category:Free_statistical_software .



Whether house values are generally increasing as we move away from the cultural organization (as on the left) or decreasing (as on the right) the basic approach is similar. The curves indicate the impact on house values of proximity to the site where the cultural amenity is or will be located. One curve shows the relationship before the amenity exists and one after. The parameter δ_a is an estimate of the change in value of a house located zero kilometers from the cultural amenity – it is the shift between the two curves along the vertical (value) axis. For any particular distance from the organization, the vertical distance between the two curves provides an estimate of the impact on the value of residential property from the cultural amenity. This is an estimate of the willingness-to-pay for the presence of the cultural amenity in the community.

In the equation to be estimated provided above, the variable on the left hand side is the real house price. In this equation the relationships are all linear and (unlike shown in the figure) the curves indicating impact of proximity to the organization site should all be straight lines. In almost all applications, allowing some non-linearity in these relationships will provide an improved fit to the data and better estimates of the impact. For example analysts often estimate a relationship that specifies the logarithm of house value *ln(P)* as a linear function of the logarithm of the variables that can be measured numerically (for example *ln(SqFt)* and *ln(Lot)*) plus the qualitative indicator variables as given above. A more general approach is to consider a

mathematical transformation[13] of the variables that uses $\frac{y^{\lambda}-1}{\lambda}$ instead of y for the price and for numerically measurable characteristics, and estimates the value of the parameter λ at the same time as estimates are obtained for other parameters. This transformation encompasses the linear form presented above (which holds if $\lambda=1$) the logarithmic form (which holds as λ gets closer to *0)* as well as many intermediate forms. This is a recommended approach if using one of the more capable statistical analysis software packages[14]. The form used in estimating the models illustrated in the examples of the next section takes this general form:

$$\underbrace{\frac{P^{\theta}-1}{\theta}}_{\text{transformed house price}} = C + \underbrace{\beta_1 \frac{SqFt^{\lambda}-1}{\lambda} + \beta_2 \frac{Lot^{\lambda}-1}{\lambda} + \ldots}_{\text{impact of characteristics that can be measured numerically}} \underbrace{+ \delta_2 x_2 + \ldots}_{\text{impact of qualitative indicators}} \underbrace{+ \delta_a postsale + \delta_{pre} predist + \delta_{post} postdist}_{\text{impact of proximity to cultural amenity}}$$

Note that the transformation parameter used for the real house price (θ) is different from that used for the measurable characteristics (λ). This permits a more general form as well as captures a non-linear effect of the distance from the cultural amenity source. The use of this form makes calculation of impacts somewhat more complicated. For example, the parameter δ_a is now the change in *transformed* house price for a property adjacent to the source of the cultural amenity, and we have to take account of the estimated parameter θ to calculate the predicted change in actual house price. This complexity is justified by the improvement in the estimates obtained.

Example

As an example to illustrate the use of hedonic analysis for evaluation of the impacts of a cultural organization, consider the case of the Kenosha Public Museum in Kenosha, Wisconsin.

The city of Kenosha is located on the shores of Lake Michigan 32 miles south of Milwaukee. The lakefront near the city center was dominated for most of the 20th century by industrial sites

[13] Called the Box-Cox transformation after the names of the two statisticians who introduced the approach
[14] STATA has a special procedure designed specifically for estimating these types of models

and automobile factories. With the collapse of American Motors in 1987 and the purchase of most of its assets by Chrysler, the assembly facilities in Kenosha fell on hard times and while the newer factories remained in use until the Chrysler bankruptcy of 2010, the lakefront plants closed shortly after Chrysler's acquisition of the property. This left Kenosha's lakefront as a blighted brownfield site in need of reclamation, a process that began in the early 1990s.

A central component of this revitalization plan was construction of a new home for the Kenosha Public Museum where its collection of art and historical artifacts could be displayed and where

cultural and educational programming could be made available to the city. Plans were also made for a museum with collections related to the Civil War to be located next to the new Kenosha Public Museum, and parklands, walkways, and new housing were planned for the area around the new museums. Construction began in the late 1990s and the new Kenosha Public Museum opened in 2001. The Civil War museum in turn opened in 2008. The old location of the Kenosha Public Museum in the central city area remained open as the Dinosaur Discovery Museum space for display of fossils and paleontological collections.

In order to better understand the impacts of this cultural investment for the city, a hedonic analysis was undertaken in the manner described above. The year when the new cultural amenity became available was known (2001) and the exact location was determined. The Kenosha assessor's office maintains a database of all properties in the city. Individual properties can be examined on the office web site as seen in the illustration.

In order to facilitate the hedonic analysis the assessor's office was contacted directly and a computer-readable file was obtained that contained all residential properties within the city, along with addresses, sales prices and sales dates of transactions, and a large number of structure and lot characteristics. The properties were geo-coded using ArcGIS and distances from the Central Business District, the museum, and the lakefront were measured. The locations were matched with US Census block group boundaries so that each property could be assigned values for census variables such as ethnic composition of households in the neighborhood, educational attainment of persons living in the neighborhood, and housing tenure (rental or owner-occupied) in the neighborhood.

FHFA house price index data were obtained and used to convert all house prices to a 2007 base. Indicator variables were constructed for proximity bands to the lakefront, presence of air conditioning in the home, local zoning ordinance conditions, style of the structure, and material used on the house exterior. All properties considered are located within the city of Kenosha and served by the Kenosha public school district. The result was 17053 observations of residential property sales.

Hedonic Model for Kenosha Public Museum

Variable	Coefficient	Test of significance
λ	-0.41***	0.0211
θ	0.27***	0.0089
Postsale - δ_a	7.47***	891.14
Postdist - δ_{post}	0.20***	7.29
Predist - δ_{pre}	1.46***	344.71
SqFt	215.58***	1129.12
SqFt on ground floor	1.92***	16.35
Bedrooms	0.46	1.35
Baths	2.72***	109.06
Stories	-0.26	0.16
Lotsize (acres)	1.21***	187.64
Age at time of sale	-32.96***	939.77
Age^2	33.22***	1550.50
Pct White	3.34***	115.19
Pct College Graduate	0.27***	32.96
Pct Owner Occupied	0.66***	24.38
Distance to CBD	-0.09	0.06
Constant	-423.68***	
Air Conditioning		
Distance to Lake	See	
Building Type	Appendix	
Zoning Type	Table	
Exterior Wall Type		
Number of observations	17053	
LR χ^2 (67)	15733.63***	
σ	6.37	

The STATA statistical package was used to estimate a hedonic price function with transformed price and transformed characteristics values. The model parameter estimates are presented in the

table above. The first column provides the name of the characteristic or variable in the hedonic price function. The second column provides the parameter estimate, along with asterisks that reflect the level of statistical significance (confidence that the true parameter value is not zero). Three asterisks imply that we can be 99% confident that the true parameter value is not zero. Two asterisks indicate a 95% level of confidence and one asterisk indicates a 90% level of confidence. The third column presents the statistic upon which the test of statistical significance is based[15]. The table does not include parameter estimates for detailed qualitative characteristics. These are provided below in a separate table in the appendix.

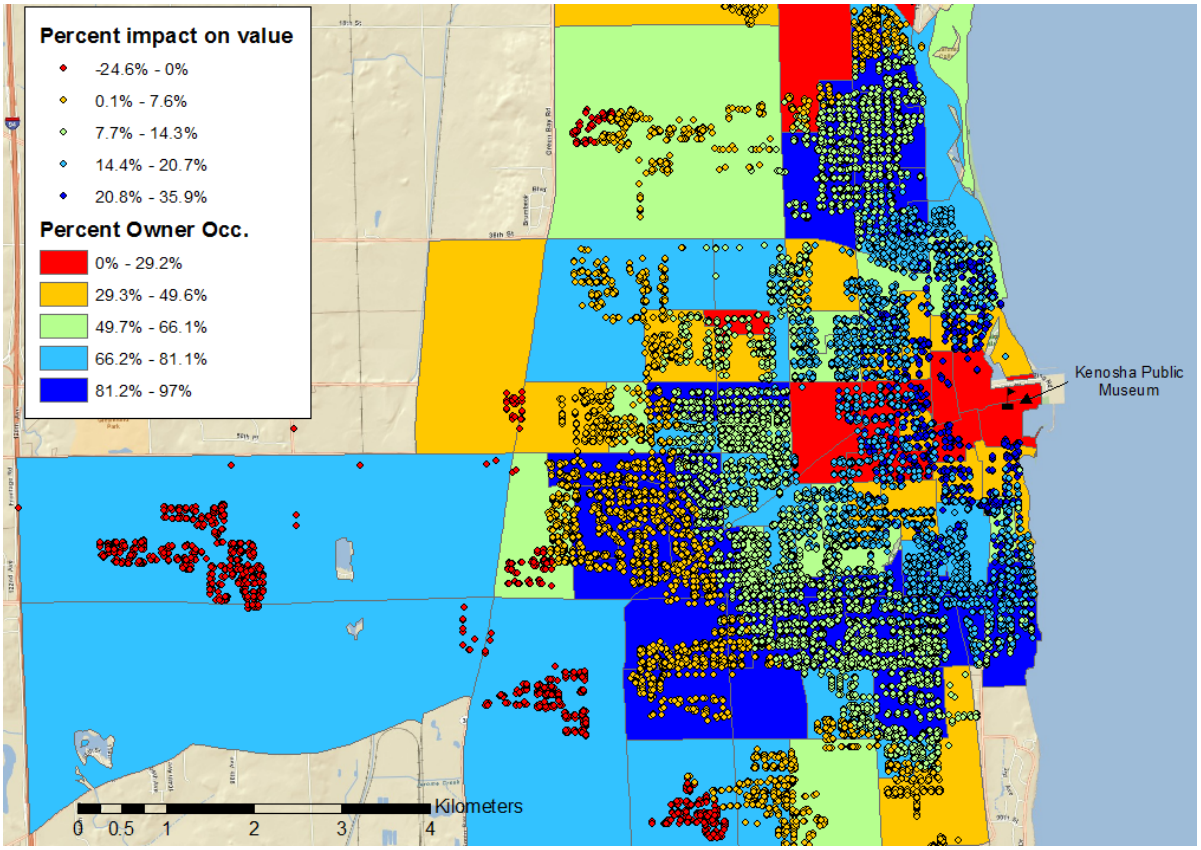
The parameter estimates are all of sign and magnitude that corresponds to what might be expected. The parameters that are most important for measuring the impact of the new museum(s) are all estimated with good precision and are statistically significant. The positive sign of the estimated parameters associated with *postdist* and *predist* indicate that the Kenosha housing market conforms to the situation illustrated in the left panel of the figure at the top of page 15. The positive and significant estimate for δ_a is also consistent with this figure and indicates that the museum and lakefront restoration has generated significant increased willingness to pay for properties nearby.

Just how large are the impacts? Since the estimated hedonic model involves transformed prices, the impacts were calculated using the STATA program. The map below illustrates, providing a dot for each residential property in the sample. Dots are shaded according to the percentage increase in house value. The properties indicated by a dark blue dot experienced the largest increase – between 21% and 36% increase in value.

As we move away from the museum site, the impact diminishes down through the yellow dots at the urban periphery representing 0 to 7.6% increase in value, and at the far edge of the city red dots show actual decreases in value associated with the arrival of the new museum and lakefront restoration. These diminutions in value can arise – particularly in communities like Kenosha where city population has been relatively static – because the museum changes the relative

[15] In most cases this is the likelihood ratio statistic obtained by constraining the parameter estimate to equal 0. That statistic is distributed χ^2 with 1 degree of freedom.

attractiveness of the urban core versus the ex-urban periphery. Keep in mind that the actual values – the sales prices – of these properties may still have gone up. We are adjusting for overall trends in the local housing market. When the model tells us that a home experiences a 20% increase in value, it means that it is selling for 20% more than would be expected if the house value had followed the same track as the overall metropolitan area average. In the case of Kenosha we see that after the museum opened homes far away from the museum appreciated by less than the metro average. Homes close to the museum, by contrast, increased in value relative to the metro area average.



The dots indicating individual residential properties are plotted against shaded areas that indicate the share of the local housing stock that is owner-occupied. If the occupant of the house is also the owner, an increase in the value of the home is generally unambiguously good news. It represents an increase in their wealth along with an increase in the attractiveness of the neighborhood. For an occupant who is a renter, however, the situation may not be so clear.

Properties that are represented by blue dots[16] (greater than 20.8% increase in value) located in block groups shaded red (less than 29.2% owner occupied) may identify potential problems that require public policies to ensure affordable housing so that renters in the neighborhood can continue to enjoy the neighborhood that has been improved because of the new cultural amenity. This underscores an additional important use for hedonic analysis: to enable local housing policy makers to be proactive to ensure equitable access to cultural amenities in the community.

For the case of Kenosha it might be noted that the estimated impact should properly be associated with all the changes that took place at the same time in the location around the new Kenosha Public Museum. This includes the environmental cleanup, the parks and the two new museums. The museums were absolutely central to this project.

The map above presents percentage impacts. How large is the actual dollar figure associated with these new cultural amenities? If we sum the estimated increase in values across all homes in the sample, the total is over $241.8 million in 2007[17].

Conclusion

Hedonic analysis provides a methodology for obtaining estimates of the willingness-to-pay for increased access to cultural amenities associated with new cultural organizations and new cultural programming. The technique has been widely applied to estimate the benefits of public goods and environmental benefits, and could be more widely applied to evaluate and understand the impact of cultural amenities. Although somewhat complex to undertake, the technique makes use of widely available data that should permit comparison between different projects and different communities.

An example evaluation of the Kenosha Public Museum in Kenosha, Wisconsin was presented. There are surprisingly few published studies that provide results of hedonic analysis, but

[16] A pdf version of this report can be obtained from http://www.c-3-d.org/
[17] Nearly $255 million in 2010 prices.

additional examples of evaluations can be found for several other museums at the web site for the Center for Creative Community Development[18].

In the discussion above, we noted that there are surprisingly few published studies that apply hedonic analysis to cultural organizations, despite several assertions that such analysis is routinely undertaken. Why is hedonic analysis infrequently done (or if done, infrequently published)? There are at least two possible answers that might be provided. One is that it is more difficult to undertake than surveys and collections of anecdotal evidence. As noted above the skills required are somewhat specialized and the limited resources of both public agencies and cultural organizations themselves makes it difficult to keep on staff persons with the skills to undertake the analysis. This could be changed with greater support from funding agencies or by forging more extensive partnerships with consultants and academic researchers.

A second possible reason for not doing or publishing hedonic analysis is embarrassment about or concern over the impact on residential property values. Many cultural organizations are concerned about the impacts of gentrification and possible displacement of low-income residents who might live near the cultural organization. The organization may be very interested in helping these neighborhoods and embarrassed about the impact they might generate that would make housing more expensive.

In response to this second expressed concern, it seems appropriate to note that *any* improvement in neighborhood quality is capable of increasing house values and rents. Reducing environmental pollution or crime will also increase house values and no person concerned with good public policies would propose increasing pollution or crime in a neighborhood in order to make housing more affordable. It is similarly inappropriate to deny provision of cultural amenities to a neighborhood out of concern for impacts on house prices. The increase in house values is an indication of the benefit that is being produced. The true public policy challenge is to not only produce that benefit, but see that it is made available equitably to the community. Here again hedonic analysis can be of great value. As seen in the Kenosha example above, hedonic analysis

[18] See http://www.c-3-d.org/ and choose the link for Case Studies. Property value maps are available for MASS MoCA, the Dia gallery in Beacon, NY, the Bailey Matthews Shell Museum, the Philbrook Museum, the Polk Museum of Art, the Gulf Coast Museum (now closed), the Toledo Museum of Art and the Vero Beach Museum of Art.

can help to identify neighborhoods where attention is required to ensure an adequate supply of affordable housing so that all members of the community are provided an opportunity to enjoy this important new benefit. In this way hedonic analysis can be an important tool for design of good public policy as well as for arts advocacy and scholarship.

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Appendix

Hedonic Model for Kenosha Public Museum Qualitative Characteristics		
Variable	**Coefficient**	**Test of signicance**
Central Air	1.64***	156.23
Within 100 meters of lake	8.52***	204.575
Within 200 meters of lake	7.14***	209.931
Within 300 meters of lake	2.43***	19.333
Within 400 meters of lake	3.34***	61.969
Within 500 meters of lake	2.33***	21.007
Bldg Type 1	-5.62***	9.023
Bldg Type 3	-2.85	2.468
Bldg Type 6	-4.18**	4.975
Bldg Type 7	-4.70**	6.598
Bldg Type 8	27.28***	81.85
Bldg Type 9	-0.56	0.094
Bldg Type 10	-1.65	0.808
Bldg Type 11	-3.00*	2.731
Bldg Type 13	-3.26*	3.285
Bldg Type 14	-3.63*	3.778
Bldg Type 15	-5.98***	8.305
Bldg Type 16	-3.73**	4.02
Bldg Type 17	-4.23**	5.056
Bldg Type 18	-5.25***	7.484
Zone Type 2	0.02	0
Zone Type 3	0.12	0
Zone Type 4	0.26	0.002
Zone Type 5	1.89	0.083
Zone Type 6	0.34	0.002
Zone Type 7	12.32*	3.455
Zone Type 8	1.68	0.068
Zone Type 9	-0.74	0.013
Zone Type 10	0.92	0.021
Zone Type 11	2.42	0.145
Zone Type 12	0.99	0.024
Zone Type 14	-0.65	0.009
Zone Type 15	1.37	0.034
Zone Type 16	1.74	0.037
Zone Type 17	-11.54*	2.907
Zone Type 18	-5.95	0.864
Zone Type 19	0.46	0.005
Zone Type 20	2.39	0.14
Zone Type 21	3.38	0.281
Ext Wall ALUM	0.97	0.092
Ext Wall ASBT	0.09	0.001
Ext Wall ASPH	-0.84	0.068
Ext Wall BLCK	0.96	0.083
Ext Wall BRCK	3.38	1.12

Hedonic Model for Kenosha Public Museum Qualitative Characteristics		
Variable	**Coefficient**	**Test of signicance**
Ext Wall CEDR	2.25	0.49
Ext Wall FRME	1.25	0.152
Ext Wall MASN	3.90	1.473
Ext Wall METL	-3.12	0.41
Ext Wall STNE	2.24	0.45
Ext Wall STCO	0.81	0.063
Ext Wall VINL	0.86	0.072