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Abstract

This short article provides a quick summary of the hedonic pricing theory. Some new developments are also discussed.

Keywords: hedonic price, portfolio of attributes, valuation, unobservable, non-tradeable

JEL classification Number: C10, D10, R20

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Hedonic price formation

1. Definition

According to the Cambridge Dictionary, hedonic is about the feeling of pleasure (https://dictionary.cambridge.org/dictionary/english/hedonic). Following the logic, "hedonic price" is an attempt to interpret the market price of an item (e.g., a smartphone) as the sum of the value of its components (e.g., a phone, a camera, a clock, etc.), according to the "pleasure" or "utility" that each part offers to the owner. When we apply this idea to the labor market, we can interpret a worker's salary as the sum of skills, experience, social network, etc. These items can all bring value to the employer (Ekeland et al., 2004). When we apply hedonic price to the housing market, we say that the value of a house would depend on its location, size, internal features (e.g., number of bedrooms, number of restrooms), etc. Therefore, one may consider "hedonic pricing" as "component pricing" or "decomposition pricing."

2. History

While the exact origin of hedonic pricing may be controversial (https://en.wikipedia.org/wiki/Hedonic_regression), many economists learn hedonic pricing from Rosen (1974), which has accumulated almost 16,000 Google citations as this article is written. Since then, the idea has been adopted and extended in many directions. Malpezzi (2003) and Hill (2013), among others, have provided a detailed survey of the related literature.

3. Theory

The theory of hedonic pricing is straightforward. Let us consider that a consumer's "pleasure" or "utility" U is defined on a vector of attributes $(x_1, x_2, \dots, x_n)$. In the case of housing, we can consider those attributes to be housing-related. For instance, consider x_1 to be the size of the house, x_2 to be the commute distance, i.e., the distance between the housing unit and the consumer's workplace, x_3 to be the education quality of the district where the housing unit is located, etc. We consider two scenarios. In the first scenario, there is a market for each attribute, and attribute x_i's unit price is p_i. And assume that the consumer has a budget of M to purchase all these attributes. Thus, the optimization problem of the consumer is

$$max_x U(x), such\ that\ \sum_i p_i x_i \le M, \quad (1)$$

where x is a short-hand of the vector of attributes to be purchased, $x = (x_1, x_2, \dots, x_n)$. We assume an interior solution for all attributes, which means that we have the demand for every attribute to be positive. The optimality condition gives

$$U_i \equiv \frac{\partial U}{\partial x_i} = \lambda p_i. \qquad (2)$$

It means that the marginal utility of each attribute of the optimal package equates to the product of the marginal utility of an extra dollar λ and the corresponding unit price p_i. Assume that the consumer uses up all the money. We have

$M = \sum_i p_i x_i = \sum_i \left(\frac{U_i}{\lambda}\right) x_i.$ (3)

In the second scenario, imagine a housing unit with the same portfolio of attributes as the optimal package under the first scenario, with the price P. The two purchases should be equal in value as they have the same collection of attributes. It implies that

$$P = \sum_i \left(\frac{U_i}{\lambda}\right) x_i. \quad (4)$$

In other words, the value of the house P is a summation of its attributes, weighted by the ratio of the marginal utility of the corresponding attribute U_i and the marginal utility of an extra dollar λ.

4. *Conceptualisation*

Some researchers interpret equation (4) as justifying a simple linear regression of the transaction price of the house P on its attributes $x = (x_1, x_2, \dots, x_n)$. People add time-fixed and geographically fixed effects when the sample includes transactions in different periods and geographical units (e.g., cities, regions).

Other researchers provide a different interpretation. First, the marginal utility of an attribute U_i does not need to be constant but depends on the whole package of the attributes. For instance, the value of the distance from work may depend on whether there are geographical features (e.g., a river, a mountain, etc.) and transportation infrastructure (e.g., public transport, highways). Second, the marginal utility of money λ depends on the budget and the whole vector of attribute prices $(p_1, p_2, \dots, p_n)$. Thus, putting these together, equation (4) implies a *nonlinear* relationship between the transaction price P with the vector of attributes $x = (x_1, x_2, \dots, x_n)$. Among others, Ekeland et al. (2004) and Malpezzi (2003) provide a detailed discussion.

5. *New developments*

There are many developments in the hedonic pricing theory. Limited by the space, only a few are highlighted here. First, some attributes may not be observable, so some adjustments are needed in estimation (Francke and van de Minne, 2021). Second, the housing market may be spatially segmented, and the traditional ordinary least squares (OLS) may be insufficient (Liao and Wang, 2012). Third, some attributes may not be directly tradeable. For instance, the high quality of education in a local area is observable but not directly "tradeable" but reserved to the residents. Hence, people may purchase housing units in an area with complicated motives. Researchers need to adjust for such a possibility (Hanushek and Yilmaz, 2022). Fourth, when the sample involves an extended period, separately considering each subperiod may provide superior statistical performance than adding time-fixed effects (Tang and Leung, 2023). Fifth, the recent development in machine learning can be combined with the traditional hedonic pricing models (Dutra Calainho et al., 2022).

6. *Policy relevance*

The hedonic pricing model is relevant for practical policies. For instance, if a local government needs to create a new infrastructure (e.g., a bridge, a railway), how much does she need to compensate the nearby residents if specific housing units must be demolished? And how much value would the new infrastructure create after completion?

7. Application fields

The hedonic pricing model is also applied in development, health, and labor economics.

8. Prospect

With increasing available granular data, more potential applications of the hedonic pricing model would arise. Since some applications would be new, more caution would also be needed.

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