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RATE OF RETURN TO INVESTMENT IN HOUSING ATTRIBUTES

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The purpose of this study is three fold. First to explore the determinants of house rent. Second to study the factors that determine the cost of construction of dwelling units in different cities of Pakistan, and finally, to estimate the rate of return to investment in different components of a dwelling unit.In short, this paper attempts to present an empirical evidence on market parameters that describe the hedonic price structure for housing in different cities of Pakistan. The attributes that can pay back investments more rapidly were also identified. Knowledge of the household preference and the determinants of the rental and capital value respectively of the rented and constructed properties can help set targets that are attainable.

I. Introduction

While the process of urbanization took centuries in the developed countries (DCs) the process is compresses into a few decades in the less developed countries (LDCs). In trying to cope with the rapid expansion of cities,public authorities in the LDCs have devised a wide range of policy instruments to influence the rate and character of city expansion, and allocate resources in ways that redistribute both the costs and the benefits of urban growth. Ideally, such policy formulation should be based on a careful understanding of the behavior of urban markets. However, little information is available to policy makers in this regard. Some basic information is needed for improved project design, and more importantly, for improved policies.

Housing is a good where alternative choices are extremely heterogenous. The consumption decision is the choice between available dwellings based on their physical characteristics, neighborhood attributes and public services provided by each unit out of a large set of discrete alternatives.

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The purpose of this study, therefore, is three fold. First to study the determinants of house rent, second to study the factors that determine the cost of construction of dwelling units in different cities[1] of Pakistan, and finally, to estimate the rate of return to investment in different components of a dwelling unit. In short, this paper attempts to present an empirical evidence on market parameters that describe the hedonic price structure for housing in different cities of Pakistan. The knowledge of hedonic parameters for a housing market aids in both the analysis of consumer demand as well as the segmentation of the urban housing market. Information of the behavior of housing markets should provide a better base for policy makers, as housing projects can ideally be designed to be more consistent with the preferences of the tenants. Moreover, the charges of the municipal services that have been provided in different cities can be evaluated against the willingness to pay for these services as revealed by the consumers. Finally, with the help of the analysis carried out in this study the attributes that could repay the investment made in them most rapidly can also be identified.

This paper is organized into a number of sections. Section II presents a brief review of the literature, section III describes the data and the methodology or the theoretical framework, section IV analyzes the determinants of rental value as well as the determinants of the cost of construction along with the estimation of the rate of return of investment in different components of the dwelling unit. This is followed by a discussion of the policy implications emerging from the study and the conclusions arrived at.

II. Review of Literature

Housing markets are intensively studies in the DCs, especially in the US and Great Britain. On the contrary, despite the need for careful modeling of housing markets in the developing countries, only a small number of studies have been done for the LDCs. Whatever research has so far been done in this area for the developing countries was undertaken either by the World Bank or other international agencies sponsored projects (Follain and Jimene, 1985), Follain et. all (1983); Quigley, (1980); Megbolugble (1989); and Rosen, (1974); etc. Only a few studies have been conducted in this area of Pakistan e.g., Manan (1978); Akbar and Altaf (1991); and Lodhi (1990).

Housing is a composite commodity made up of diverse attributes that can not be traded individually. It is that complexity and heterogeneity of housing projects that raises the need to use hedonic technique. Applying Rosen's insight to the housing market several works have appeared in the literature. While the works differ in many

[1] We have categorized different cities into three dummies, namely, big, medium and small. Of course we have used only two dummies that is big city and small city. The excluded category was medium size cities.

ways, each employs a two step procedure for estimating demand for housing traits, wherein marginal hedonic trait prices are estimated and then used to estimate the willingness to pay or the demand for certain housing traits. For example Dewees, (1976); King and Mieszkowski, (1973); Straszheim, (1973) and (1974); and Linneman (1980); argues that housing payments for the residence site are a function of the basic site specific traits possessed by the site. Follain and Jeminez (1985); contain an interesting discussion of the theoretical foundations and the econometric procedure employed in the application of the hedonic techniques to the estimation of housing demand.

III. Data and Methodology

Theoretical Basis

The theoretical basis for recent literature in this area is Rosen's (1974) pioneering study of a market for a single commodity with many characteristics. This section outlines Rosen's model and applies it to housing.

Let $Z = (Z^1, Z^2, Z^3 \ldots\ldots\ldots\ldots Z^n)$ be a vector of housing characteristics and p(z) be a hedonic price function[2] defined by some market clearing conditions. Household take this price function as given in a competitive world.

This household decision is characterized by the utility function

$$U = U(x,z) \tag{1}$$

where x is a composite commodity whose price is unity. Households than maximize utility subject to a non-linear budget constraint

$$Y = P(z) + x \tag{2}$$

First order condition require that

$$\partial p/\partial z = p^1 U^{x1} / U^x \qquad i=1,2...n \tag{3}$$

under usual properties of U.

The analysis carried out in this paper is based on the data extracted from the socio-economic data set prepared for two different projects undertaken by the

[2] Hedonic price theory presumes that households vary in the amount of the attributes, such as number of rooms, roof or wall quality and plot size etc. that they desire to consume. Consequently, housing markets are analyzed in terms of implicit trait markets in which consumers and suppliers trade off among these various housing attributes. The hedonic techniques is used to identify that schedule of prices that clears this implicit market.

Applied Economics Research Centre, University of Karachi. The household interviews were conducted in 1988-89. The sample for rent hedonic model consists of 225 urban renters, residing in the different cities of the country. The sample for capital cost hedonic consists of 320 owner occupied constructed housing units.

The classical hedonic price model posits a relationship between expenditure on housing consumption and traits. The traits used in the present study include:

1. Size Variables (S)
2. Quality Variables (Q)
3. Utility Variables (U)
4. Neighborhood Variables (N)
5. Other Variables (O)

List of these variables is given in Appendix I. Percentage access to discrete variables and mean values of continuous variables used in the two models are given in Tables 1 and 2 respectively.

TABLE 1

Percentage Access to Housing Attributes
(Discrete Variables)

Variables	Rented Property	Constructed Property
Store Room	37.8	–
Fly Proofting	28.5	39.7
RCC Roof	43.8	52.9
Cement Plastered Wall	32.9	42.8
Block Wall	42.6	–
Paint	46.2	51.2
Wiring	46.2	62.8
Door Wood Quality	–	10.5
Floor Quality	–	50.2
Piped Gas	81.9	77.3
West Open	54.2	–
Access Pucca Road	50.6	62.0
Big City	46.6	53.1
Medium City	33.3	33.1

[3] In case of Pakistan there is no clear distinction among the two types of houses. Generally, the houses that are rented out are owned by individuals and they do it to simply supplement there income. There is no such company that built houses for rental purposes only.

TABLE 2

Mean Values of the Housing Attributes
(Contineous Variables)

Variables	Rented Property	Constructed Property
Covered Area	714 sq. ft.	1067 sq. ft.
Rooms	3.20	–
Bath Rooms	1.02	1.58
Distance*	9.28 km.	–
Period of Residence	6.03 years	–

* The names of these cities are spelled out in Appendix.
Distance is the distance from the central business district of that city. By access we mean availability of that service.

Since housing is a composite commodity made up of these diverse attributes which are not traded singly their individual prices are not observed, only market rent or total cost of construction is observed, the hedonic technique is therefore used to recover the prices in the competitive market as the implicit prices of these different attributes.

Thus house rent (reported) denoted by R and cost of construction (reported) denoted by C are generally expressed as

$$R = f\ (S, Q, U, N, O) \tag{4}$$

and

$$C = f\ (S, Q, U, N, O) \tag{5}$$

The partial derivative of hedonic function, given in equations (1) and (2), with respect to any trait can be interpreted as implicit marginal rent[4] and implicit marginal cost of construction[5] respectively. It is worth noting here that in the cost hedonic model we have included time variable as well, in order to control for historical capital cost of construction. As regards functional form, it is generally observed in the literature that this is basically an empirical issue. To arrive at an appropriate functional form a technique was developed by Box and Cox which is known as the Box-Cox transformation. We used this technique to determine the most appropriate functional form. The transformed hedonic equations for rental and capital value of

[4] Per square foot rental value of the ith attribute.

[5] Per square foot cost of construction of the ith attribute.

the dwelling units can now be expressed as follows:

$$(R^L - 1) / L = \alpha o + \alpha_i \sum Z_i + \varepsilon \quad (6)$$

and

$$(C^L - 1) / L = \beta_i \sum Z_i + b_i + {}_1T + u \quad (7)$$

where R^L and C^L are the transformed market rent and capital cost of construction respectively, Z_i is a vector of housing traits. Rents are current rental values, while the cost of construction is historical (cost at the time of construction). In order to capture the affect of time on the prices of material used in construction a time variable, T, is also included in the cost of construction hedonic model (equation 4), αs and βs are the coefficients of the rent hedonic model and the capital cost hedonic model respectively, while ε and u are vectors of the disturbance terms with standard properties in the two models respectively. The iterative ordinary least square method was used to estimate the Box-Cox equations (3) and (4). The L for which the value of likelihood function is maximized gives the best functional form. The best functional form has turned out to be semi-log for both the models in this study.

Once the appropriate functional form of the hedonic equations are identified and estimated, we are able to generate the implicit trait prices by evaluating $\partial p/\partial z$ at the mean value for each household.

As regards the rate of return of investment in different housing attributes the marginal rent and the marginal capital value of construction of the ith attribute was estimated at the mean rental and capital cost of construction of the dwelling units. The ratio of the former to the later gives the annual rate of return to investment in the ith attribute of the dwelling unit.

$$ARRI_i = R_i/C_i \quad (8)$$

where $ARRI_i$ is the annual rate of return to investment in the ith attribute of the dwelling unit; R_i is the share of the ith characteristic in the reported rent of the rented property and C_i is the share of the ith attribute in the total capital cost of construction of the owner occupied constructed dwelling unit.

IV. Empirical Findings

Determinants of Rent and Capital Cost of Construction of a Housing Unit

The rental value of a property depends, first, upon its characteristics including plot size, number of rooms, quality of construction etc., second, on neighborhood characteristics like proximity to type of access road and also on the availability of services like, water supply and piped gas etc. The impact of these characteristics on rent can

be studied in the context of rented properties where rents are observed.[6] The first part of the analysis of the return to investment in housing, therefore, consists of estimation of rent hedonic equation (3). The equation quantifies the relationship between per square foot rental values and the above mentioned characteristics.

Similarly, capital cost of construction also depends on both the quality variables and the quantity variables. Equation (4) quantifies the relationship between per square foot capital value of construction of owner occupied housing units, with these quality and quantity variables. The results of these hedonic equations are presented in Table 3.

TABLE 3

Regression Results of the Two Hedonic Models

Variables	Coefficient (Rent Hedonic)	T-Stat (Rent Hedonic)	Coefficient (Cost Hedonic)	T-Stat (Cost Hedonic)
Constant	4.9247	26.4	4.7087	12.1
Covered Area	0.0006	1.94	-0.0004	-5.26
Number of Rooms	0.0737	1.74	–	–
Number of Bath Rooms	0.1588	3.05	0.0536	1.67
Number of Store Rooms	0.2504	2.60	–	–
Fly Proofing	0.2693	2.37	0.0316	0.31
RCC Roof	0.1047	0.99	0.2876	2.94
Cement Plastered Wall	0.3220	2.64	–	–
Block Wall	0.3075	2.29	0.3836	3.68
Quality of Paint	0.1963	1.73	0.0586	0.49
Quality of Wiring	0.2055	1.63	0.1677	1.27
Quality of Door Wood	–	–	0.3059	1.47
Floor Quality	–	–	0.1562	0.55
Piped Water	0.2744	2.14	–	–
Piped Gas	0.4123	3.38	0.2231	1.80
Location (West Open)	0.1624	1.62	–	–
Access Pucca Road	0.0808	0.77	-0.1758	-1.76
Period of Residence	-0.0171	-3.84	–	–
Distance	-0.0118	-1.82	–	–
Time	–	–	-0.0208	-2.23
Big City	0.1247	0.81	0.2880	2.39
Small City	0.2938	2.03	0.1777	1.24
Adjusted R-Square	0.673		0.222	

[6] By observed rent, we mean the reported rent that is the actual rent that the dweller is paying at the time of interview.

Determinants of Rent

As shown in Table 3 almost all the size and quality variables used in the rent hedonic model have the expected signs and are highly significant except for the roof quality variable. The insignificance may be due to the fact that the quality of roof is effected by the wall quality and the number of bathrooms, or it may indicate that the strength and durability of the housing unit is a function of the wall quality more than that of the roof. We have used two separate dummies to capture the variation in the quality of wall. Both the dummies[7] are highly significant.

Of the service variables, both piped water and piped gas are highly significant. However, neighborhood variables do not have any significant impact on the rental value of the house. As expected, both period of residence and distance from the Central Business District (CBD) are inversely related to the rental values of the dwelling unit, i.e., the longer you stay in one house the lesser of rent you pay as compared to any new occupant in similar housing unit. Similarly, the farther the property is from the CBD the lesser its rental value.

It is surprising to note that the rental value of the property in smaller cities is higher as compared with the rental value of a similar housing unit in medium or larger cities. This may due to fact that the rental market is not that developed in the former. In big cities, on the other hand, like all other markets, the housing market, is also relatively developed and competitive due to which rents are low.

Determinants of Capital Value of Construction

The results of capital value hedonic given in Table 3, are quite interesting. The per square foot capital cost of construction falls as covered area of the dwelling unit increase, the concept of economics of scale seems to be working here. Contrary to the rent hedonic results the variable for roof quality has a significant impact on the capital value of construction. The other quality variable, wall, is also highly significant.

We have used year of construction as a controlling variable for the effect of time on the prices of construction material. The sign of the variables is, as expected, negative, which means that the cost of construction of the similar dwelling unit would be higher now then what it would have been two or four years ago. The coefficient of access to pucca road variable is nearly significant, and has the expected sign. The farther the dwelling unit is located from the pucca road, the higher the cost of construction, due to factors like inconvenience in transporting the building material etc.

[7] We have tried to overcome the problem of pooling the data by using dummy variables for different size of cities. Separate analysis for each size of city was not possible because of the loss of degree of freedom.

The cost of construction is significantly higher in big cities as compared with medium or small size cities. The reason for this is that the wages etc., are relatively higher in big cities. The variables that turned out to be insignificant in this model include quality of doors, quality of floor, paint and fly proofing. This may be due to the fact that their share in total cost of construction is very small.

Rate of Return to Investment in Housing Components

In order to estimate the annual per square foot rate of return to investment in different components of a housing unit, we first, estimate the marginal rent of significant attributes of the rented properties and marginal capital cost of different significant attributes of the constructed housing units at the mean per square foot value of rent and capital cost of construction respectively. Table 4 reveals these marginal rents and marginal capital values of different significant or nearly significant attributes of the two models. The interpretation of these marginal values is quite straight forward.

The annual per square foot rate of return to investment in the ith component is nothing but the ratio of the marginal rent of the ith attribute of the rented property to the marginal capital value of the ith component of the owner occupied constructed dwellings.

TABLE 4

Annual Rate of Return to Investment in Housing Componants

	MARGINAL		Rate of Return to Investment (%)
	Annual Rental Value	Capital Cost of Construction	
Covered Area	0.0156	0.1192	13.1
Number of Bath Rooms	4.1288	15.97	25.8
RCC Roof	2.7221	85.70	3.2
Cement Plastered Wall	5.1038	17.46	29.2
Quality of Wiring	5.3430	49.90	10.7
Piped Gas	10.7198	66.48	16.1
Access To Pucca Road	2.1004	52.38	4.0

The analysis shows that if investment is made in improving the quality of the wall[8] then such an investment can be recovered very rapidly. The investment made in cement plastering of the wall can be recovered at the rate of 29 per cent per annum, thus making recovery possible in less then four years.

V. Policy Implications and Conclusions

The study will shed some light on the preferences of people in the selection of houses. This information will be invaluable to those interested in the development of specific housing projects, particularly the international agencies, i.e., the World Bank and the Asian Development Bank. With the help of the information provided in this study housing projects can ideally be designed to be more consistent with the preferences of the tenants and those interested in purchasing these housing units. In addition, the rates of the municipal services that are being provided in these houses can be evaluated against the marginal prices revealed by the analysis. Knowledge of the household preferences and the determinants of the rental and capital value respectively of the rented and constructed properties can help set targets that are feasibly attainable.

In the first four sections of this paper we discussed the hedonic approach to the study of housing market, and empirically examined the approach to the study of the housing market, and empirically examined the approach in an urban housing market in a developing country. The vector of the attributes that characterize the various housing stock segments in Pakistan were identified, and statistical tests were conducted to determine an appropriate functional form for the housing hedonic equations analyzed in this paper.

We were able to obtain estimates of the marginal rents and marginal capital value of various housing attributes. Results of the rent hedonic model indicate that the size, quality and the utility variables add significantly to the rent of a housing unit. Similarly in the capital value hedonic covered area and some quality variables along with piped gas and access to pucca road have a significant impact on the capital cost of construction of a housing unit.

The attributes that can pay back investment made in them more rapidly were also identified. The quality of material used in the wall, number of bathrooms, piped gas, covered area and the quality of wiring were among the variables that were identified as the most rapidly repaying attributes.

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[8] By improving quality of wall we don't mean improvement of wall quality in the same unit. In fact by that we mean that if instead of an ordinary wall we have cement plastered wall then investment made in the wall can be recovered four years faster than the investment made in ordinary unplastered wall. It is a kind of comparison between the recovery of investment made in two different types of walls in two separate housing units.

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Appendix

List Of Variables

Variables	Description	
Covered Area	Square Feet	
Rooms	Number of Rooms	
Bath Rooms	Number of Bath Rooms	
Distance	Kilo Metres	
Period of Residence	Number of Years	
Store Room	If Access	= 1
	Otherwise	= 0
Fly Proofing	If Access	= 1
	Otherwise	= 0
Roof	If RCC	= 1
	Otherwise	= 0
Cement Plastered Wall	If Access	= 1
	Otherwise	= 0
Block Wall	If Access	= 1
	Otherwise	= 0
Paint	If Distampered	= 1
	Otherwise	= 0
Wiring	If Concelled	= 1
	Otherwise	= 0
Door Quality	If Wooden	= 1
	Otherwise	= 0
Floor Quality	If Cemented	= 1
	Otherwise	= 0
Piped Gas	If Access	= 1
	Otherwise	= 0
Wst Open	If Access	= 1
	Otherwise	= 0
Pucca Road	If Access	= 1
	Otherwise	= 0
Big City	If Property is in KHI or LHR	= 1
	Otherwise	= 0
Medium City	If in PSH, QTA, SUK or HYD	= 1
	Otherwise	= 0