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THE DEMAND FOR HOUSING IN PAKISTAN

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Housing demand parameters are not known in Pakistan. This paper estimates the value of the housing stock (and flow of services) from 1960-61 to 1987-88 and sets up a model of lagged adjustment to desired demand to estimate these parameters. Long-run income and price elasticities are revealed to be low. The absolute magnitudes do not differ significantly from 0.5. However, corresponding elasticities of housing investment appear to be high, indicating the potential volatility of building activity in the country.

There is a complete paucity of research on the economics of housing in Pakistan, despite the obvious importance of shelter in influencing the quality of life and the major contribution that residential construction activity makes to the absorption of unskilled and semi-skilled labour in the economy. This has meant that the magnitude of basic parameters like the income and price elasticity of demand for housing is not known. Knowledge of these parameters is essential for proper planning of development of the sector and to derive the increase in demand for land, building materials and construction labour in line with the growth in the national economy.

The objective of this paper is to determine the nature of the demand function for housing in Pakistan on the basis of available secondary time series data. In the process, a long term consistent series of housing capital stock and a price index for building materials are derived for the first time. The former enables the determination of the trend in per capita housing consumption since 1960-61 and helps in the resolution of the controversy whether availability of housing has been increasing or declin-

ing over time in Pakistan [Zaki (1981); Ghaus and Pasha (1990)].

Section II of the paper presents the methodology used for estimating the housing capital stock series. Section III develops the specification of the housing demand function which is based on incomplete (lagged) adjustment and thereby distinguishes between short-run and long-run elasticities of demand. Section IV presents the estimated magnitude of the demand elasticities. Similar elasticities of housing investment are also computed. These highlight the potential volatility of building activity in the country. Finally, Section V develops on some of the policy implications which emerge from the study.

II. Estimation of the Housing Capital Stock

The Housing Census of 1960 and 1980 give estimates of the size and characteristics (quality, age, tenure) of the housing stock. We also have information of the nominal (and real) investment in the housing sector in the intervening period. The basic problems are of establishing a relationship between the monetary and physical magnitudes and of standardising the measure of the housing stock. We resolve the latter problem by defining a standard room unit (SRU). This corresponds to a new semi-*pucca* room.

The choice of this measure is motivated by the fact that the highest proportion of housing stock in Pakistan consists of semi-*pucca* construction.

Next, we designate the following:

C_o = value of capital stock in housing at constant prices (of 1975-76)[1] in 1960.

R_o = number of SRUs in 1960.

C_1 = value of capital stock in housing at constant prices (of 1975-76) in 1980.

R_1 = number of SRUs in 1980.

S = capital value of one SRU at constant prices (of 1975-76).

I_t = housing investment at constant prices (of 1975-76) in year t (1961-62: t=1).

We have the following equations:

[1] 1975-76 has been used as the base year because earlier this was the base year for the consumer price index and building materials price index of the Federal Bureau of Statistics. The base year has recently been changed to 1980-81.

$$\frac{C_o}{S} = R_o \quad (1)$$

$$\frac{C_1}{S} = R_1 \quad (2)$$

These equations indicate how conversion can be made from monetary to physical magnitudes. Also,

$$C_1 = C_o\,(1-\delta)^{20} + \sum_{i=1}^{20} I_i\,(1-\delta)^{20-i} \quad (3)$$

where δ is the annual depreciation rate.[2]

Therefore, we have that (1) to (3) constitute a three-equation system with three unknowns — C_o, C_1 and S — given the observed values of R_o and R_1 (see Appendix I) and the investment stream, I_i.

The capital stock (at constant prices of 1975-76) in any year i (i > o) can then be estimated as

$$C_i = C_o\,(1-\delta)^{i} + \sum_{j=1}^{i} I_j\,(1-\delta)^{i-j} \quad (4)$$

Therefore, the above methodology yields a consistent series of capital stock in the housing sector. It is general in character and can be used between any two census periods. On the assumption of proportionality between the real capital stock in housing and the flow of housing services, this approach enables determination of the trend in housing consumption. It may also be noticed that the capital stock beyond 1980 can be estimated from the following equation:

$$C_i = C_1\,(1-\delta)^{i-20} + \sum_{j=21}^{i} I_j\,(1-\delta)^{i-j} \text{ for } i > 21 \quad (5)$$

The Federal Bureau of Statistics (FBS) has revised the housing investment series for 1980-81 to 1988-89.[3] We have, therefore, derived the capital stock estimates with the old and new investment series respectively. The resulting estimates are as follows:

[2] In view of the large component of semi-*pucca* and *kutcha* construction in Pakistan the depreciation rate has been taken as relatively high at 5 per cent per annum. This includes costs of repairs and maintenance.

[3] Gross fixed capital formation estimate in Ownership of Dwellings of the FBS covers expenditure on construction of new residential structures and major alterations and additions to old dwellings. The

	at 1975-76 prices		
	C_o	C_1	S
	(Rs. in billion)	(Rs. in billion)	(Rs.)
Old Investment Series	9.388	23.064	1771
New Investment Series	14.807	36.169	2793

Annual estimates of the capital stock (at constant prices of 1975-76) with the old and new investment series are presented in Table 1. The trend in real investment and capital stock per capita is shown in Figure 1. The presence of building cycles in Pakistan is indicated. Housing investment levels were high in the early 60s during the second plan period and attained the peak level in real per capita terms in 1964-65. This was followed by a downturn in construction activity upto 1973-74. Thereafter, the upswing has continued, more or less, unabated. Causes of the investment cycle are discussed in a subsequent section.

This cycle in building activity has also led to long-term fluctuations in the level of housing consumption per capita. Consumption levels appear to have risen, more or less, rapidly upto 1969-70, the end of the third plan period. This is followed by a period of decline in the 70s.[4] During the 80s, the relatively high levels of housing investment have implied rising consumption levels once again. By 1984-85, per capita consumption of housing crossed the peak levels attained in the late 60s.

Our estimates confirm the observation that housing standards declined during the 70s. This has led some analysts, e.g., Zaki, (1981) to conclude that the housing shortage increased repidly during this period.

investment estimates in private residential construction are made separately for rural and urban areas bifurcating into three categories, i.e., *pucca*, semi-*pucca* and *kutcha*. Annual increase of new houses is worked out on the basis of HED Survey of 1973 and Housing Census 1980. Average investment (cost) per household by type of houses is calculated on the basis of the average per square foot cost and the covered area taken from the results of the *Construction Survey 1986* conducted by the FBS. Therefore, the changed in investment series from 1980-81 to 1988-89 is primarily due to the upward revision in construction cost and covered area as a result of the 1986 Survey. However, the FBS does not give the revised estimates for housing investment prior to 1980-81. We have estimated these by applying the adjustment factor based on the average proportionate change from 1982-83 to 1987-88.

[4] The Housing, Economic and Demographic (HED) Survey of 1973, which had a sample of 255,000 households, has been criticised on the grounds of being unrepresentative, as it indicated a significant improvement in housing conditions in comparison to the Housing Census of 1960. In fact, it was off-trend because subsequently the 1980 Housing Census showed a large decline in housing consumption, as given below:

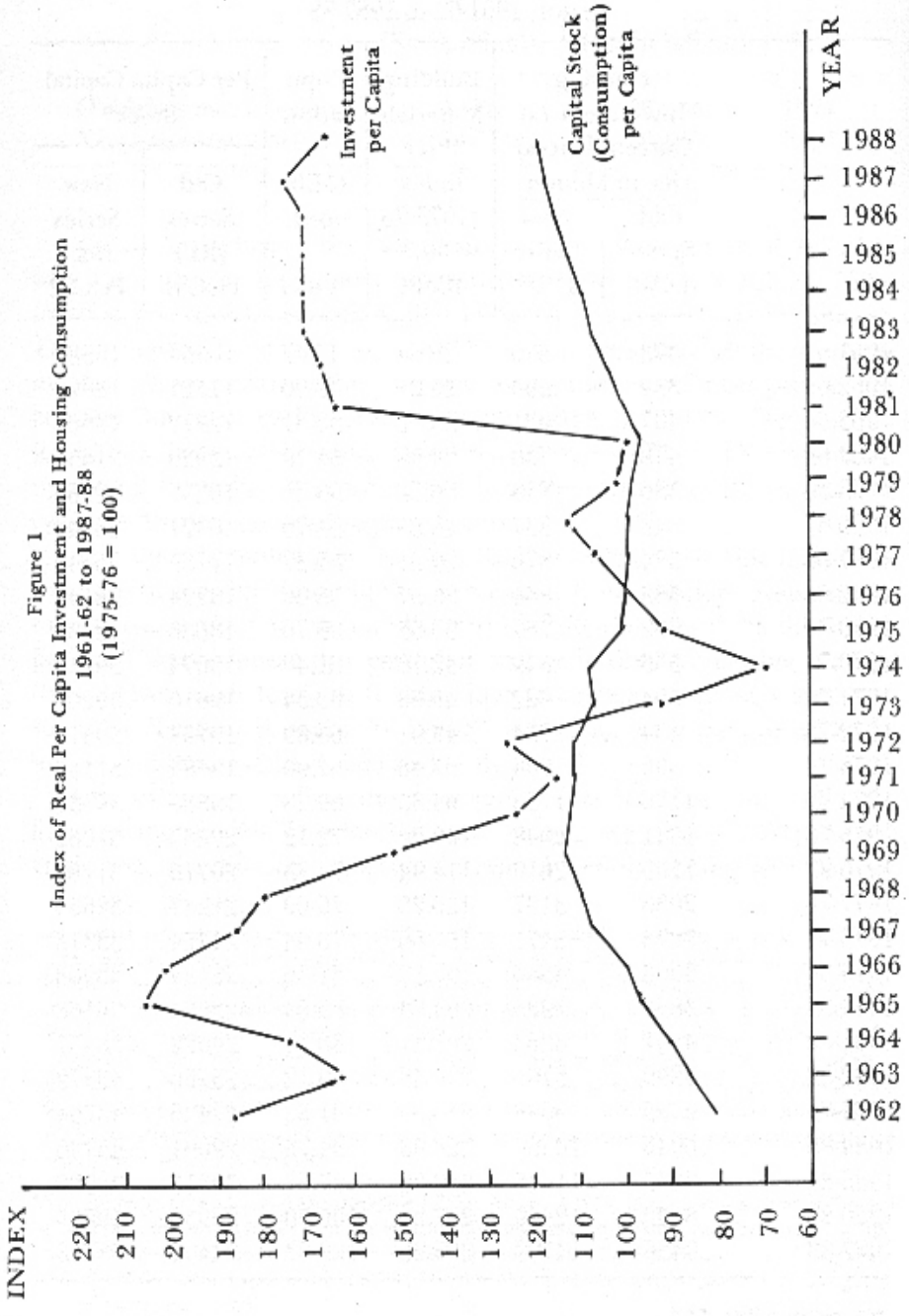
TABLE 1

Investment and Capital Stock in the Housing Sector, 1961-62 to 1987-88

	Housing Investment (at Current Prices) (Rs. in Million)		Building Materials Price Index (1975-76 =100)**	Population (Million)	Per Capita Capital Stock*	
	Old Series INV1	New Series INV2	BMPI	POPN	Old Series (Rs.) PCCS1	New Series (Rs.) PCCS2
1961-62	373	570	22.64	47.52	10564	16580
1962-63	389	594	26.21	48.90	11521	18020
1963-64	407	621	25.03	50.31	12572	19601
1964-65	478	730	24.09	51.76	13929	21651
1965-66	536	818	26.78	53.26	15232	22966
1966-67	548	837	28.85	54.79	16371	25346
1967-68	574	876	29.91	56.37	17165	26449
1968-69	563	860	34.57	58.00	18224	28147
1969-70	502	767	36.53	59.70	18686	28835
1970-71	556	849	42.16	61.49	19074	29411
1971-72	604	922	40.58	63.34	19610	30207
1972-73	494	754	43.91	65.89	19754	30415
1973-74	500	764	57.46	67.90	19684	31146
1974-75	1136	1735	94.85	69.98	19888	30539
1975-76	1341	2048	100.00	72.12	20237	31062
1976-77	1709	2610	114.94	74.33	20715	31783
1977-78	2035	3107	126.25	76.60	21287	32654
1978-79	2273	3471	151.66	78.94	21724	33313
1979-80	3003	4586	197.52	81.36	22154	33968
1980-81	3850	7983	204.73	83.84	23064	36168
1981-82	4501	8263	201.41	86.44	24022	38457
1982-83	5899	8706	200.48	89.12	25756	40879
1983-84	6395	9643	216.50	91.88	27426	43294
1984-85	6946	10566	228.98	94.73	29091	45736
1985-86	7645	11446	240.08	97.67	30815	48220
1986-87	8130	12469	247.91	100.70	32556	50843
1987-88	9436	14198	265.26	103.83	34492	53223

*Depreciation Rate of 5%.
**See Appendix II.

Figure 1
Index of Real Per Capita Investment and Housing Consumption
1961-62 to 1987-88
(1975-76 = 100)



However, what is perhaps not so well known is that the 80s have witnessed a significant period of revival. The recent buoyancy implies that the overall housing shortage has probably been reduced in comparison to that estimated for 1980 from the last Housing Census.

III. The Model

Given a time series of housing stock and investment we can now proceed to specify the model of housing demand. We use the standard lagged adjustment which postulates that investment levels are proportional to the gap between desired demand for housing and the actual availability [Muth (1960)]. This determines the level of net investment.

In particular, we define the following:

Y_t = real per capita income in year t.

P_{ht} = building materials price index in year t.

P_{ct} = overall consumer price index in year t.

k_t^d = desired demand/capital stock per capita in year t.

k_t^a = actual consumption/capital stock per capita in year t.

i_t^N = per capita net investment.

i_t^R = per capita replacement investment in year t.

i_t = per capita total investment in year t.

The desired demand for housing stock (services)[5], k_t^d, is given by

$$k_t^d = \beta_o + \beta_1 Y_t - \beta_2 \left(\frac{P_{ht}}{P_{ct}} \right) \qquad (6)$$

	1960	1973	1980
Persons per housing unit	5.50	5.60	6.50
Persons per room (excluding kitchens)	3.89	2.71	3.50

Therefore, according to the persons per room indicator, housing conditions were the best in 1973. Our estimates of real per capita housing stock confirm that this was the case, although it appears that the HED Survey tends to overstate somewhat the housing consumption per capita.

[5] Muth (1960) also includes as an explanatory variable in the demand function the interest rate on mortgage credit. This is appropriate in the U.S. setting given that capital markets are, more or less, perfect. In Pakistan, however, institutional credit for the housing sector has been accorded a relatively low priority. Consequently, credit by House Building Finance Corporation (HBFC) has seldom exceeded 17 per cent of the total investment in housing. The total value of loans disbursed annually has depended on the size of credit allocation by the State Bank of Pakistan. Therefore, there has been credit rationing in the housing sector and there has generally been an excess demand for loans from HBFC as indicated by the large number of applications rejected.

where $\beta_0, \beta_1, \beta_2$, are positive parameters of the demand function. Then,

$$i_t^N = \lambda\ (k_t^d - k_{t-1}^a) \qquad (7)$$

λ is the adjustment coefficient. If $\lambda=1$, then the housing stock adjusts, more or less, instanteneously to changes in desired demand. However, since housing is a lumpy investment, the adjustment process is likely to be constrained by liquidity particularly in the presence of imperfect capital markets[6] which limit the possibility of borrowing against future income. Also, especially in developing countries, the speed of adjustment may be reduced by lack of developed land for new housing and of infrastructure. Therefore, $\lambda < 1$.

Replacement investment[7] is given by

$$i_t^R = (\delta + g)\ k_{t-1}^a \qquad (8)$$

where δ is the depreciation rate and g the growth rate of population.

From (6) to (8) we have that

$$k_t^a = \lambda\beta_o + \lambda\beta_1 y_t - \lambda\beta_2 \left(\frac{P_{nt}}{P_{ct}}\right) + (1 - \lambda + \delta + g)\ k_{t-1}^a \qquad (9)$$

From (9) the short-run and long-run elasticities of demand can be estimated.[8]

The common practice in most housing demand functions is to take y_t as the permanent income and not as the current income in view of the

We have tried instead real per capita credit as an explanatory variable. However, it did not emerge as significant. Also, other variables like real per capita home remittances (largely from the Middle East) were also included in the demand equation without success.

[6] The role of HBFC in the housing sector from 1961-62 to 1972-73 when its credit disbursements accounted for only 3 to 5 per cent of the housing investment in the economy. From 1973-74 onwards, the share of HBFC credit in investment in the sector has ranged from about 11 to 17 per cent.

[7] Replacement investment includes the component of demographic investment, that is, the investment required to preserve the same level of housing stock per capita given the growth of population.

[8] An alternative approach is to derive the demand parameters by estimating the investment function as follows:

$$i_t = \lambda\beta_o + \lambda\beta_1 y_t - \lambda\beta_2 \left(\frac{P_{nt}}{P_{ct}}\right) - (\lambda - \delta - g) K_{t-1}^a$$

lumpiness of the housing investment and the fact that for households changes in housing consumption are infrequent and discontinuous in character. We have tried both current and permanent income measures to test for the responsiveness of demand to changes in income. Consumption expenditure[9] has been used as a proxy for permanent income [Friedman (1957); Hall (1978)].

IV. Results

Results of estimation of equation (9) are presented in Table 2. All variables emerge as significant in the regressions. In addition, a dummy variable has also been used for the years, 1972-73 and 1973-74, when investment levels were at their lowest, caused by the prevailing uncertainties in the aftermath of the Indo-Pakistan war and the loss of East Pakistan in 1971 and the policy of the new government to embark on large scale nationalisation of private assets in industry, banking, etc.

The overall explanatory power of the model is high, with $\bar{R}^2$ (adjusted) ranging from 0.96 to 0.98. There is also no evidence of autocorrelation.[10] A somewhat better fit is obtained with the old investment series.

The implied magnitude of λ, the adjustment coefficient, ranges from 0.276 to 0.330.[11] This indicates that the rate of adjustment of the housing stock to changes in the level of desired demand is relatively low in Pakistan. As highlighted earlier, this could reflect the lack of credit availability, land and infrastructure to cater for new construction. A consequence of the low magnitude of λ is that there is a significant divergence between short-run and long-run elasticities.

Estimated income and price elasticites are presented in Table 3. The magnitude of short-run elasticities is small, implying that housing consumption is largely invariant in the short run. The income elasticity ranges from 0.125 to 0.161 while point estimates of the price elasticity vary from –0.149 to –0.165.

[9] The proxy used for permanent income is real private consumption expenditure per capita. Lagged income variables were also tried, but did not emerge as significant.

[10] The alternative approach of estimating the investment function was not used because of the presence of significant autocorrelation.

[11] If there is a one rupee change in the desired demand (at constant prices) then actual consumption increases by $[1-(1-\lambda)^t]$ after t years. Therefore, given the estimated magnitude of λ, it takes as much as six to seven years for 90 per cent of the adjustment to be completed. This indicates the slow rate of adjustment of the housing stock in Pakistan.

The absolute magnitude of long-run elasticities is over three times larger than the short-run estimates. The income elasticity ranges from 0.453 to 0.489, with little difference between permanent and current in-

TABLE 2

Results of Estimation of Demand Equations[a]

Variable	(1)[b]	(2)	(3)	(4)
Constant	114.081	120.022	68.311	70.244
	(6.375)*	(6.567)*	(8.578)*	(8.396)*
PCY	0.116	—	0.060	—
	(4.625)*		(6.125)*	
PCE	—	0.144	—	0.080
		(4.732)*		(5.847)
BPRAT	−74.749	−78.252	−45.356	−49.376
	(−5.352)*	(−5.469)*	(−5.932)*	(−7.351)*
$PCCS_{-1}$	0.762	0.750	0.804	0.796
	(16.122)*	(15.593)*	(25.552)*	(23.846)*
DUM	−15.812	−16.239	−15.007	−15.620
	(−2.611)*	(−2.715)*	(−5.314)*	(−5.384)*
R^{-2}	0.961	0.962	0.980	0.979
F	160.815	164.655	319.599	300.983
Degrees of Freedom	22	22	22	22
Durbin-Watson Statistic	1.716	1.467	1.470	1.395

a The specification is given in equation (9), with k = PCCS, k_{-1} = $PCCS_{-1}$ ' y = PCY, c = PCE, BPRAT = Ph/Pc.

b Equations (1) and (2) are with the new investment series while equations (3) and (4) are with the old investment series.

* Significant at 5% level.

come elasticities. The absolute magnitude of price elasticity is somewhat higher and there is a tendency for the old investment series to reveal a greater price responsiveness. Derived estimates of the price elasticity range from –0.494 to –0.570.

The relatively low magnitude, even of the long-run elasticities, indicates that housing demand in Pakistan is not very income or price elastic. This is consistent with the conclusions of Malpezzi and Mayo (1987) for developing countries in general. They find in a study of 16 cities in eight developing countries that the majority of point estimates of income elas-

TABLE 3

Elasticities of Housing Demand

	Income Elasticity	Price Elasticity
SHORT RUN		
With current income	0.155 (0.125)*	–0.157 (–0.149)
With permanent income	0.161 (0.139)	–0.165 (–0.162)
LONG RUN		
With current income	0.488 (0.453)	–0.494 (–0.540)
With permanent income	0.488 (0.489)	–0.500 (–0.570)
Elasticities of Housing Investment		
With current income	1.668 (1.339)	–1.691 (–1.589)
With permanent income	1.730 (1.497)	–1.770 (–1.730)

*Figures in brackets are elasticity estimates derived from the old investment series.

ticities range from 0.4 to 0.6.[12] Therefore, although their estimates are based on cross-sectional household level data, the income elasticity derived from macro time series in this study also falls within this range.

There is, however, one difference in our findings. Malpezzi and Mayo state that the price elasticities are usually below income elasticities in absolute value. This does not appear to be the case in Pakistan, where the former are somewhat larger in magnitude. Both elasticities, however, do not differ significantly from 0.5 in absolute magnitude.

One of the byproducts of the research is that elasticities of housing investment can also be quantified. These are also presented in Table 3. The absolute magnitudes are substantially larger, especially with the new investment series. The income elasticity of investment ranges from 1.339 to 1.730, with the elasticity with respect to permanent income being somewhat higher. The magnitude of price elasticity varies from −1.589 to −1.770. These elasticities clearly establish the volatility of building activity in the country with respect to changes in macro-economic parameters.

Given the magnitude of the investment elasticities, we can also now offer an explanation for the building cycles in Pakistan, referred to earlier. During the Second Plan period, per capita income grew repidly and there was relative price stability. This, combined with the low level of housing stock, had the effect of providing a strong stimulus to housing investment. The growth momentum faltered somewhat after the war of 1965 and the cessation of foreign aid flows. This was followed by the break up of Pakistan in 1971. The devaluation of 1972 and the oil price shock in 1973 led to extremely rapid inflation in building material prices, which more than doubled between 1972-73 and 1975-76. Since then, especially after 1977-78, the growth performance has improved significantly and per capita incomes have increased rapidly due to this and the phenomenal rise in home remittances. In addition, inflationary pressures have moderated substantially. Consequently, there has been an upswing in housing investment from mid-70s onwards.

V. Conclusions

This paper uses Housing Census data and the investment series for ownership of dwellings to estimate the value of the housing stock (and flow of services) from 1960-61 to 1987-88. The estimates reveal that housing consumption per capita increased rapidly upto 1969-70, followed by a period of decline in the 70s. During the 80s, the relatively high levels of

[12] A recent study by Lodhi (1990) of 6261 households in Karachi yields estimates of the income elasticity of demand for housing for owner-occupiers of 0.6 and for renters of 0.4.

housing investment have implied rising consumption levels once again. By 1984–85, per capita consumption of housing crossed the peak levels attained in the late 60s.

Given the time series for housing consumption, we use a standard stock adjustment model to estimate housing demand parameters. Both short-run and long-run income and price elasticities of demand are revealed to be relatively low in Pakistan. The absolute magnitudes of the long-run elasticities do not differ significantly from 0.5. The results indicate, however, that the income and price elasticities of housing investment are high. This highlights the potential volatility of building activity in the country.

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References

Friedman, M., 1957, A theory of the consumption function, Princeton Princeton University Press.

Ghaus, A., and H.A. Pasha, 1990, Magnitude of the housing shortage in Pakistan, Pakistan Development Review, 29(2).

Hall, R.E., 1978, Stochastic implications of the life cycle – permanent income hypothesis: Theory and evidence, Journal of Political Economy, 86(6).

Lodhi, A., 1990, Income elasticity of housing demand in Karachi, Unpublished MAS thesis, Applied Economics Research Centre, Karachi.

Malpezzi, S., and S.K. Mayo, 1987, User cost and housing tenure in developing countries, Journal of Development Economics, 25.

Mayo, S.K., S. Malpezzi and Sungyong Kang, 1983, Housing demand in developing countries, Mimeo, The World Bank, Washington, D.C.

Mayo, S.K., 1981, Theory and estimation in the economics of housing demand, Journal of Urban Economics, 10 (1).

Muth, R., 1960, The demand for non-farm housing, in: A.C. Harberger, ed., The demand for durable goods, Chicago: University of Chicago Press.

Zaki, M.J.A., 1981, Housing conditions in Pakistan: 1960-80, Pakistan Development Review, 20(2).

Appendix I

Determination of the Magnitude of R_0 and R_1

R_0 and R_1 represent the number of standard room units (SRUs) as reported in the Housing Censuses of 1960 and 1980 respectively. A SRU is taken as corresponding to a new semi-*pucca* room.

The 1980 Housing Census gives the distribution of rooms by quality (*kutcha*, semi-*pucca*) and by age intervals (0–4, 5–10, 11–33, 34 years and above). This information can be used to generate the number of SRUs, by application of the following methodology.

R_1 = number of SRUs.
N_{ij} = number of rooms of quality i and age j.

Then we have that

$$R_1 = \sum_{i=1}^{3} \sum_{j=1}^{50} \gamma_i N_{ij} (1-\delta)_j \qquad (1)$$

where γ_i = ratio of rent of room of quality i with respect to the rent of a semi-*pucca* room. The rent differentials have been obtained from HED Survey of 1973 which gives information on rents. We have that for *kutcha* rooms, $\gamma_1 = 0.8$; for *pucca* rooms, $\gamma_3 = 1.624$, while $\gamma_2 = 1$.

Separate information is not given in the 1980 Housing Census on age distribution of room by quality. We, therefore, assume the same age distribution for *kutcha*, semi-*pucca* and *pucca* rooms as the overall age distribution. This is given below.

Age Distribution of Rooms in the 1980 Census

Age Intervals (years)	Rooms (Million)	Percentage	Average Annual Number (Million)
0–4	4.674	19.5	0.935
5–10	5.491	23.0	0.915
11–33	8.831	36.9	0.384
34 and above	4.919	20.6	n
Total	23.915	100.0	n

n = not known

It may be noticed that the number of rooms declines with age. This is expected if the real level of housing investment in the economy has a rising trend. Given the shape of the age distribution, we assume that this distribution can be approximated by a negative exponential function. That is, the share, S_j, of rooms of age j can be represented as

$$S_j = \theta e^{\theta j} \quad (\theta > 0) \tag{2}$$

θ can be determined by finding the value at which the sum of squares of residuals, SSR, is minimised, where

$$SSR = \sum_{k=1}^{4} (e^{\theta t_k} - e^{\theta t_{k+1}} - P_k)^2 \tag{3}$$

where the limits of the kth age interval are given by t_k and t_{k+1} and the proportion of the rooms in this interval is P_k.

$$\frac{\partial SSR}{\partial \theta} = \sum_{k=1}^{4} (e^{\theta t_k} - e^{\theta t_k} - e^{\theta t_{k+1}} - P_k) \bullet (t_k e^{\theta t_k} - t_{k+1} e^{\theta t_{k+1}}) = 0 \tag{4}$$

From (4), θ can be determined. Solution of (4) yields $\theta = 0.049$. The predicted shares, P_k, in the different age intervals do not diverge significantly from the actual shares.

Following the determination of the age distribution of rooms we are in a position to determine R_1 from (1) with $\delta = 0.05$. The resulting estimate is 12.947 million SRUs. Therefore, adjustment for quality and age effectively reduces the number of rooms by 46 per cent.

The magnitude of R_0 can also be determined by application of the same methodology. Also, for 1960, there is need to adjust for the underenumeration of population in the Census and for the fact that kitchens were included in rooms in 1960 and not in 1980. Following all these adjustments, the estimated magnitude of R_0 is 5.302 million SRUs.

Appendix II

Construction of Building Materials Price Index

Data is available on three materials which enter the price index, viz, timber, cement and steel. As such, we designate the following:

P = building materials price index.
P_1 = timber price index.
P_2 = cement price index.
P_3 = steel price index.

$\alpha_1, \alpha_2, \alpha_3$ = weights of the three materials in the price index.

$$\alpha_1, \alpha_2, \alpha_3 = 1$$
$$P = \alpha_1 P_1 + \alpha_2 P_2 + (1 - \alpha_1 - \alpha_2) P_3$$

$$\Rightarrow (P-P_3) = \alpha_1 (P_1 - P_3) + \alpha_2 (P_2 - P_3)$$

Therefore, we can find the magnitude of α_1, and α_3 by running a constrained regression (zero intercept).

The results for the period, 1975-76 to 1987-88, are as follows:

$$(P-P3) = 0.304\ (P_1 - P_3) + 0.303\ (P_2 - P_3)$$
$$(1.978) \qquad (6.743)$$

$\bar{R}^2 = 0.990$, F = 492.189, D-W Statistic = 1.754

The above equation implies that $\alpha_3 = 0.393$.

Given the magnitude of the weights and the price indices for the individual materials for the period, 1961-62 to 1974-75, the building material price index can be determined for this period. The estimates are presented in Table 1.