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INCOME ELASTICITY OF HOUSING DEMAND

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ABSTRACT

This paper estimates a housing demand function from a four year

panel study. The findings indicate that the income elasticity of housing

demand is around .6 or .7 for owners and around .5 for renters. This

means that the percentage of income spent on housing declines as income

rises, and that the property tax falls more heavily on the poor than on

the rich. This finding differs from earlier studies which were based on

city averages rather than panel studies, and is therefore more reliable.

The study also found that, other things equal, the old demand more housing

than the young, whites more than nonwhites, and female headed households

more than male headed households.

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I. Introduction

The earliest empirical studies of the income elasticity of housing

demand supported the popular notion that this demand was inelastic.

Duesenberry and Kisten (4) estimated it to be 0.15. Winnick (9) calculated

a long-run time series income elasticity of 0.5. However, later work which

tried to use permanent income, or proxies for it, rather than measured

income, found much higher elasticities. Most recently de Leeuw (3)

adjusted cross-section estimates by Muth (10), Reid (11), and Winger (13)

and offered new estimates of his own. His range of estimates for all these

authors is 0.8 to 1.0 for renters, and 1.25 to 1.46 for owners. Among the

studies de Leeuw examined, only Lee's estimate (3) was below 1.0.

This paper offers new evidence based on better data than has been

available to earlier researchers. Using a four year panel study which followed

up movers, permanent income was calculated and defined in two ways. Then

regressions were run on house value and rent on permanant income, price, age,

race, and sex of head of household. The results obtained are robust with

respect to the definition of permanent income, and considerably lower than

results from time series analysis or from cross-section studies that relied

on grouped rather than individual data.

The next two sections of this paper set forth the model used in the

regressions and discuss the data. The fourth section presents the income

elasticities estimated for various groups and various definitions, while

the fifth section deals with the coefficients of price and demographic

terms. A concluding section briefly summarizes the results.

II. The Model

There is general agreement among economists that housing demand is

a function of permanent or normal income rather than of measured income.

Using measured income instead of normal income results in underestimates

of demand elasticities. De Leeuw, Muth, Reid, and Winger all attempt to

reduce this bias by using city medians. They argue that the transitory

components of measured income average out, leaving only the permanent

components. However, as will be discussed below, using group medians leads

to other troubles.

Far preferable to grouping the data, or restricting the sample to

households with unusually steady incomes as Reid also does, would be to use

an actual measure of normal income. In a weighted average of several years'

measured real income for individual families, the transitory or random

components can be expected to cancel out, leaving only the family's normal,

or permanent, income. However, the estimates of income elasticities should

not depend on the weights used. Therefore, two definitions of permanent

income, based on data from a four year panel study, were tried:

$$Y_e = 1/4 \sum_{i=1}^{4} Y_i \quad \text{and} \quad Y_d = \left(\frac{1}{\sum_{i=1}^{4} i}\right) \sum_{i=1}^{4} i Y_i \ .$$

The first of these, Y_e, is simply the average of the family's measured real

income for the past four years. Each year's income receives equal weight.

The second, Y_d, has weights which decline arithmetically with time. Current

year's income has a weight of .4, last year's income .3, then .2, and finally .1. Income of five years ago receives no weight.

To see whether or not estimated income elasticity was sensitive to different definitions of permanent income, regressions were run including both definitions. In addition, the current year's income was used to see whether demand elasticities with respect to measured income are lower than permanent income elasticities. Finally, following the suggestion of de Leeuw, permanent income including the imputed rent of owner occupiers was used. This rent was calculated as 6 percent of the owner's equity, which was equal to the house value minus the outstanding mortgage principle.

III. The Data

The data used in this paper come from "A Panel Study of Income Dynamics," conducted by the Survey Research Center (SRC) of the University of Michigan. This sample included 2,107 renting households and 2,458 owners. Unlike the SRC panel study used by Lee (8), every effort was made to follow up movers. The sample households were interviewed four times, in the spring months of 1968 to 1971. The house value term used as the dependent variable in the regressions was the owners' own estimate for 1971. The income term was total family income before taxes, and including earnings, property income and transfers. For the two permanent income definitions, income for the first three years was inflated to 1971 dollars by the CPI for all items, as published in the Economic Report of the President (5). Households that neither owned their homes nor paid rent, but received housing rent free from relatives or as part of their salary, were excluded from the sample. However, households with highly fluctuating incomes, such as farmers or

businessmen, were not excluded, as in some other studies. The demographic characteristics as of Spring 1971 were the ones used in the regressions.

The least reliable aspects of the data are the price indexes. Each household has associated with it a price for housing and a price for all goods, based on a 1967 Bureau of Labor Statistics (BLS) survey described by Brackett (1). The BLS constructed price indexes for housing in addition to a number of other items which reflect cost differences among different areas for 39 SMSAs and for nonmetropolitan urban areas in four regions. Indexes were published for three income levels. The low income housing index assumed that all poor families were renters, and that they lived in five room apartments with standard plumbing and heating. However, the low income transportation index assumed different percentages of car owners in different areas, and the food index assumed that southerners eat lower quality food.

SRC used only the low income housing index. Families living in the 39 SMSAs and in nonmetropolitan areas received the low-income price specified by the BLS survey, but households in smaller SMSA's and in rural areas were given the nonmetropolitan price of their region. Thus, these latter two groups have prices not actually theirs. A much more serious shortcoming of the prices used is that they only apply to low-income and renting families. Intercity differences are not the same for all types of housing or other items. The simple correlation coefficients between the low-income index and the moderate and high-income indexes were .77 and .75 respectively.

Finally, these indexes were constructed four years prior to the Spring 1971 survey date. During a period when national housing prices increased by 24 percent and all prices for all goods increased by 21 percent, differences

among cities could change considerably. A four year old index designed
to reflect intercity price differences in low income rental housing is
a doubtful measure of current price differences for all housing levels.
And an index for all goods, which reflects differences in market baskets
as much as it reflects differences in the cost of the same basket, is even
more doubtful.

IV. Estimates of Income Elasticities

Table 1 below presents estimates of income elasticities of housing
demand for different definitions of income for owners and for renters.
These estimates come from regressions of the form:

$$(1) \quad \log \frac{H}{P} = \alpha + \beta \log \frac{Y}{Q} + \gamma \log \frac{P}{Q} \, ,$$

where H is contract rent for renters and house value for owners, P is the
housing price index, Y is income, and Q is the price index of all goods.
This is the same form used by de Leeuw. Because all variables are in logs,
the coefficients are elasticities. Y_e and Y_d are measures of permanent
income, explained above, Y_m is the current year's measured income, and Y_r
is equal to Y_d plus imputed rent of owner occupiers. Standard errors are
in parentheses.

Table 1

Income Elasticity of Housing Demand

Income Definition	Owners	Renters
Y_e	.580 (.019)	.483 (.021)
Y_d	.564 (.019)	.480 (.020)
Y_m	.472 (.018)	.410 (.018)
Y_r	.676 (.019)	--

The relative sizes of the different elasticities for different definitions of income are similar for owners and renters. The lowest estimate comes from current year's measured income, Y_m, .472 for owners and .410 for renters. The two estimates based on the two definitions of permanent income, Y_e and Y_d, are extremely close, and somewhat larger than the measured income estimate. Finally, for owners, the estimate based on permanent income including imputed rent Y_r was the highest of all, considerably higher than the estimates based on permanent income excluding imputed rent.

The results are very encouraging. First, they support the notion that demand elasticities, especially for such durable goods as housing, are greater out of permanent income than out of current income. Second, the estimates are very robust with respect to the weighting scheme used to define permanent income. Y_e probably gives too much weight to early years' income, while Y_d may give too much weight to the income of recent years. Fortunately, the estimates based on these two quite different definitions are extremely close. It seems unlikely that any other reasonable weighting scheme would yield results much larger or smaller.

The elasticity estimates based on Y_r were somewhat larger than de Leeuw's assumptions would imply. He argued that excluding imputed rent from the incomes of owner occupiers, biases estimates of income elasticities away from unity by a percentage of the difference between 1.0 and the estimate. His rough assumptions about the size of this bias imply that the estimate of Y_r should be about .58 instead of the .676 actually obtained.

Also tested was the hypothesis that households who have recently moved have higher elasticities than those who have not. De Leeuw expressed skepticism about Lee's findings because the panel study which he used did

not include movers. It seems plausible that families who have not changed

their house might have experienced changes in income, even in permanent

income, and that therefore the correlation between income and housing

consumption might be lower for nonmovers than for movers.

Therefore the total SRC sample was divided into two groups, households

who moved during the two years prior to the 1971 interview, and those that

did not. The income elasticity for moving owners was .612 (standard error

.055), for nonmoving owners .541 (standard error .020). For renters the

two coefficients were .518 (.034) and .448 (.024) respectively. Under the

assumption that intercept, price elasticity, and income elasticity all vary

between movers and nonmovers, an F test suggested by Chow (2) of the

hypothesis that the income coefficients differed was not confirmed.

Regressions were also run which included demographic characteristics

of the household head, in addition to income and price. A typical regression,

for owners using Y_d, is equation (2):

$$(2) \quad \log \frac{H}{P} = 2.396 + \underset{(.023)}{.619} \log \frac{Y_d}{Q} - \underset{(.244)}{.800} \log \frac{P}{Q}$$

$$-\underset{(.034)}{.264} \text{ Black} + \underset{(.037)}{.162} \text{ Female} - \underset{(.046)}{.338} \text{ Age}_{<35} - \underset{(.040)}{.185} \text{ Age}_{35-64}$$

$$R^2 = .32$$

The last four variables are dummies for heads who are black, female, under

35, and between 35 and 64, respectively. Their coefficients will be

discussed in the next section.

The income coefficients from these regressions are presented in Table

2. In all cases they are slightly larger than their counterparts in Table 1.

However, the conclusions are the same. Measured income elasticity is

considerably lower than permanent income elasticity. Permanent income

elasticity is not sensitive to different weighting schemes. And permanent

income elasticity including imputed rent is higher than that excluding

imputed rent by more than de Leeuw's assumptions imply.

Table 2

Income Elasticities from Regressions Including
Demographic Terms

Income definition	Owners	Renters
Y_e	.631 (.023)	.520 (.023)
Y_d	.619 (.023)	.521 (.023)
Y_m	.499 (.021)	.439 (.020)
Y_r	.746 (.023)	--

Regardless of the income definition, the sample used, the moving

characteristics, or other variables included in the regression, all the

income elasticity estimates presented in this paper are significantly above

zero and below one. This differs sharply from estimates published in several

earlier works. Specifically, these results are lower than the "consensus"

estimate of one put forward by de Leeuw.* Only Lee's estimate, also based

on a panel study rather than grouped data for only one year, was below one.

In an extensive critique of Reid's estimates, Hartman (7) suggests

several reasons why cross-sectional data grouped in different ways may lead

to overestimates of the income elasticity of housing demand. These

criticisms apply to some extent to de Leeuw, Muth, and Winger as well.

First, grouping households by occupation, education, census tracts, and

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*I only emphasize that my estimate is lower than one because of the
implication that flows from this that property taxes are regressive. Of
course this implication depends on who pays the tax, landlord or tenant,
and on whether property taxes are payments for services, or simply taxes
on a certain kind of wealth. These questions are beyond the scope of this
paper.

quality of housing are in effect grouping them by social class. If higher social classes have higher preferences for housing, then an elasticity based on differences in housing consumption among social classes is, says Hartman, "likely to overstate greatly the true income elasticity of housing."

Second, income elasticity estimated from city averages, which de Leeuw, Muth, and Reid all do, will overstate the true elasticity if income is positively correlated with negative temporary income, severe climates, or highly stratified societies. If Northeast and North Central cities have higher incomes and colder climates than the rest of the country, the income elasticity will be overestimated. What looks like the effect of income may actually be simply a need for well built houses.

Finally, estimates based on changes in city averages between two years is highly dependent on the choice of years. Hartman presents data showing much lower estimates of the relation between housing and income when Reid's years are changed only slightly. Since housing consumption is a function of normal income, the measured housing/income ratio will be higher than normal in a recession year and lower than normal during a boom year. Thus, comparing city averages from an early boom year with later averages from a recession year will yield artificially high estimates of income elasticities.

It may be that these shortcomings in cross-section studies based on grouped data do not explain the differences between their findings and those of Lee and my own from panel studies. However, panel-study data seem superior to grouped data. De Leeuw wondered whether the differences might be the result of Lee's exclusion of movers, but chose the estimates based on grouped data as the "consensus" values until the matter could be resolved.

Since the results presented above do not indicate that movers and nonmovers have different income elasticities, it seems more reasonable to give credence to the estimates based on the better data until the causes of the differences can be resolved.

V. Other Results

The estimates of price elasticities from these regressions vary considerably for owners and renters, and for regressions including or excluding demographic terms. For owners, there was little variation for different definitions of the income term. The lowest estimates of price elasticities were around -.8, significant at the one percent level, for owners in regressions including demographic variables. The estimates for owners in regressions including only price and income terms were around -.5, also significant at the one percent level. For renters, the results were more disappointing. In all cases, the standard error was at least twice the size of the estimated coefficient. These estimates ranged from -.101 from a regression including only price and measured income to +.022 from a regression including Y_e and demographic terms in addition to price.

Dummy variables for race, age, and sex of head were also included in the housing regressions. Equation (2) above presents the coefficients for owners. The coefficients in regressions using other income definitions were only slightly different. Equation (3) presents a comparable regression for renters, using Y_d. Standard errors are shown in parentheses.

$$(3) \quad \log \frac{H}{P} = -.045 + \underset{(.023)}{.521} \log \frac{Y_d}{Q} - \underset{(.241)}{.034} \log \frac{P}{Q}$$

$$-\underset{(.028)}{.094} \text{ Black} + \underset{(.029)}{.231} \text{ Female} + \underset{(.056)}{.096} \text{ Age}_{<35} + \underset{(.054)}{.001} \text{ Age}_{35-64}$$

$$R^2 = .30$$

Because the dependent variable is the log of house value or rent, these coefficients should not be interpreted directly. Rather, the antilogs of the coefficients indicate the percentage difference between the dummy group and the excluded group. For instance, the -.094 coefficient on the black dummy has an antilog of .91. Thus a black household exactly the same as a white household in all respects but color can be expected to rent an apartment worth 91 percent of the white household's unit.* Table 3 presents the antilogs of the coefficients from equations (2) and (3).

Table 3

Percentage Differences in Housing Demand,
by Color, Sex, and Age of Head

	Owners	Renters
Nonwhites (as % of whites)	76	91
Female heads (as % of male heads)	117	125
Heads under 35 (as % of heads 65+)	71	110
Heads 35 to 64 (as % of heads 65+)	83	100

*The comparison is actually between blacks and nonblacks, but only 0.5% of the sample was "other."

In both the owner and renter regressions, the coefficients for
female heads are significantly positive, and the coefficients for blacks
are significantly negative. Moreover, the difference between blacks and
whites in the owner regression is considerably larger than in the renter
regression.* This may reflect greater discrimination in suburban single
family housing markets than in central city apartments. It may also indicate
discrimination by banks in offering blacks worse mortgage terms than whites.
Alternatively, it may be that blacks with the same income, age, and sex of
head as whites have less wealth. All these factors would affect owners
more than renters.

Unlike race and sex, the effect of age on housing demand is completely
different for owners and for renters. Among renters, old and young families
spend about the same. The coefficient for families with heads under 35
indicates that they spend 10 percent more than families with heads over 65,
but the difference is not statistically significant. For families between
35 and 64, there is no difference. However, among owners, the young
demand considerably less housing. Owners under 35 own houses worth 71
percent of houses of similar owners over 65, while owners 35 to 64 own
houses worth 83 percent of those of owners over 65.

If the level of spending differs for different age groups, then it is
possible that the income elasticity will differ as well. To test this
hypothesis, dummy variables were included in the regression to allow both
the intercept and the income elasticity to vary by age group. In equation

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*While no strict hypothesis was tested, the difference between the Black
coefficient in the owner regression and the Black coefficient in the renter
regression was 2.7 times the sum of their standard errors.

(4), Y_d is permanent income for all ages; Y_y is income if the household head is under 35, zero otherwise; Y_z is family income if the head is between 35 and 64, zero otherwise. Thus the income elasticity for heads 65 and over is the coefficient of Y_d. The elasticities for the other age groups are their coefficients added to the Y_d coefficient. These results are for owners.

$$(4) \quad \log \frac{H}{P} = 2.830 + \underset{(.041)}{.501} \log \frac{Y_d}{Q} + \underset{(.076)}{.401} \log \frac{Y_y}{Q} + \underset{(.048)}{.120} \log \frac{Y_z}{Q}$$

$$\underset{(.244)}{-.830} \log \frac{P}{Q} \underset{(.034)}{-.246} \text{ Black} + \underset{(.037)}{.162} \text{ Female} \underset{(.339)}{-2.091} \text{ Age}_{<35} \underset{(.198)}{-.651} \text{ Age}_{35-64}$$

$$R^2 = .32$$

The demographic coefficients are all significantly different from zero at the 1 percent level. In fact, the income elasticities and the dummy intercept coefficients for young and middle-aged household heads are significantly different from each other as well as from the oldest group. This pattern of coefficients indicates that at given income levels, old people demand more housing than young people. However, young people are more responsive to income changes than old people.

Three explanations for this result seem plausible. First, it could be that older households move less often than young ones, and therefore their housing consumption is less closely correlated with their incomes. However, as mentioned above, a regression of households who had moved within the previous two years did not yield significantly different income elasticity from a regression of nonmoving households. The second explanation is that given other characteristics, including income, old owning households tend to be wealthier than young owning households. Unfortunately, the data do not permit a direct test of this hypothesis. Finally, old households often have paid off their mortgages and have only property taxes

and maintenance to pay. These older families may be more influenced by out-of-pocket expenses than by the opportunity cost of their imputed rent. In a regression which included imputed rent in the income term the coefficients of Y_y and Y_z were unchanged.

When dummies for both intercept and income elasticity for age groups were included in regressions of renters, none of the coefficients were significant. Perhaps old renters do not have more wealth than young ones. In any event, all age groups must generally pay the same rents for the same apartments.

Using similar techniques, the hypothesis was also tested that income elasticities were different for blacks and whites. However, when dummy variables for both intercept and income elasticity were included for blacks, neither one was significant.

VI. Conclusion

The results of this paper indicate quite strongly that the income elasticity of housing demand is inelastic. Using various definitions of income, the estimates are around 0.6 to 0.7 for owners and 0.5 for renters. This supports the findings of the only other estimates of income elasticities based on a panel study, and contradicts the results of studies based on grouped cross sectional data. If certain assumptions about incidence are accepted, this finding implies that property taxes in general are regressive.

Estimates of price elasticities varied from close to zero to -0.8. However, as emphasized above, the price data were not very reliable. Other results are that, other things equal, blacks demand less housing than whites, and female-headed households demand more than male-headed ones.

However, the hypothesis that income elasticities differ for whites and blacks could not be confirmed. On the other hand, income elasticities for households with young owners are significantly higher than for older owners. This difference is not true for renters.

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