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HOUSING DEMAND AND PROPERTY TAX INCIDENCE IN A LIFE-CYCLE FRAMEWORK

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Studies of tax incidence usually present estimates based on annual data and then simply note that estimates based on lifetime information would be preferable, but are precluded by data limitations. This paper presents estimates of property tax incidence in both an annual and life-cycle framework. If full forward shifting is assumed, the property tax appears much less regressive in a lifetime sense than an annual one. If less than full forward shifting is assumed, the property tax appears to be a flat tax in lifetime terms, which is quite distinct from the annual results.

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I. INTRODUCTION

A perennial shortcoming of tax incidence studies has been the almost exclusive reliance on annual data when estimates based on lifetime earnings and consumption profiles would clearly be preferable.[1] This paper presents empirical estimates of property tax incidence in both an annual and life-cycle framework. It is found that the burden of the property tax is much lower for the lowest income groups and somewhat higher for the highest income groups in a life-cycle as opposed to annual framework. It also appears that transitory influences on measured income play a larger role than life-cycle issues in causing the annual and lifetime property tax incidence estimates to differ.

In order to obtain the property tax incidence estimates it was also necessary to estimate the income elasticity of the demand for housing. Although the literature estimating the income elasticity of the demand for housing is quite large, several contributions to our understanding of housing demand are made.[2] Among these are a consideration of the effect of unobserved characteristics on family permanent income, and an examination of permanent income in light of more recent theoretical work on the permanent income and life-cycle hypotheses.

Tax incidence estimates based on annual data and those based on lifetime earnings can be expected to differ for primarily two reasons. The first is related to the permanent-income hypothesis and the second is related to life-cycle issues.

The permanent income hypothesis states that individuals do not adjust their consumption in response to transitory windfalls or losses in income. To see how this may affect estimates of property tax incidence consider three individuals, A, B, and C, each of whom have identical permanent incomes, housing consumptions, and property tax payments. If in the year of an annual incidence study A received a bonus of $1,000, C experienced a transitory loss of $1,000, and B had neither a transitory loss nor gain, the property tax would appear regressive. Over time transitory windfalls and losses will cancel each other out, and estimates using a longer time horizon should not be susceptible to this criticism.

The second, closely related, criticism of annual studies relates to life-cycle issues. Consider two individuals, D and E, who over the course of their lifetimes can expect to have the same incomes and housing consumption. However, at the present time D is age 30 and E is age 55. Since both an expect to have the same lifetime earnings their housing consumption at time t is very similar, but because D has considerably less labor market experience he has a much lower current income. Once again, an incidence study using annual data will show the tax to be regressive, whereas from a lifetime perspective it is not.

The standard procedure in incidence studies is to form distributive series which allocate expenditures or tax payments across various income classes and then to divide those expenditures by income so that an estimate of the relative burden of various taxes can be derived. This paper also follows this basic incidence procedure. However, in addition to allocating current expenditures and dividing them by current income, I also allocate the discounted present value of lifetime property tax payments and divide it by the discounted present value of lifetime earnings.

The approach used to compare annual and lifetime incidence is as follows. First a "permanent" income equation is estimated. This income equation is used to help determine the correct income measure to use when predicting the demand for housing, as well as for obtaining estimates of lifetime earnings. Then a three equation approach is used to determine housing demand. The first of these three equations is a probit equation, which estimates the probability that a given consumer will own rather than rent in a given year. After determining individual tenure choice, separate housing demand equations are estimated for renters and owners. Having obtained these three empirical equations, I undertake a simulation to predict tenure choice and housing demand over the course of a lifetime. With appropriate assumptions about property tax rates, and our estimates of lifetime and current income, distributive series can be formed which will allow us to compare the annual and lifetime incidence of property taxes.

II. ESTIMATES OF PERMANENT INCOME

Empirical estimates of the demand for housing have long noted that it is permanent income rather than current income which is of relevance in the housing demand equation (e.g. see Carliner (1973), Lee and Kong (1977), and Vaughn (1976)). The standard approach for obtaining an estimate of permanent income has been to regress family income on the characteristics of the head of household (e.g. see Goodman and Kawai (1982, 1986)). This procedure is incomplete for several reasons. First, it neglects the contribution of spouses to family income. Secondly, it ignores the effect of non-observable characteristics on permanent income. It is quite possible for two individuals to be of the same age, education, and to be identical in all other demographic characteristics, yet still have very different permanent incomes because of special talents or the lack thereof. Finally, recent theoretical work on the life-cycle and permanent income hypotheses, combined with the rational expectations approach, suggest that consumers use a very long time horizon in modeling permanent income (e.g. see Hall (1978) and Hall and Mishkin (1982)). Earlier studies of the demand for housing have not considered the time horizon that families use when modeling permanent income for housing demand. This study considers each of these shortcomings.

The data base is the University of Michigan's Panel Study of Income Dynamics. Because of the expense of dealing with such a large, longitudinal data base, a random sample of approximately 1700 households was used for the analysis. The PSID provides family incomes, house values, rents and other pertinent information for the years 1972-1985. Variables which enter the various regressions are presented in the Appendix. The permanent income equation is of the following form:

$$Y_{it} = Y_{it}\,(\text{age, agesq, education, age*education, region, race, sex, year}) + \Delta_i + \epsilon_{it} \qquad (1)$$

The subscript i refers to individuals while the subscript t refers to time. The dependent variable is family money income, including both labor and asset income, divided by a regional price deflator.[3]

In the housing demand literature, the standard approach for obtaining a permanent income equation has been to regress family income on the characteristics of the head of household only. In my equations there are separate independent variables for both the "head of household" and his or her spouse.[4]

Δ_i in equation (1) is included to capture differences in permanent income among families that are observationally equivalent, but nonetheless may exhibit persistently different earnings profiles as a result of special talents or other unobserved characteristics. The low R^2 obtained in most permanent income regressions suggest that the importance of unobserved characteristics in determining permanent income is great. Our use of longitudinal data allows us to estimate Δ_i by following a method suggested by Lillard (1977). Δ_i is equal to the difference between a household's predicted income based on observable characteristics and the mean actual income over the corresponding time period. So, for example, if in our observations of a particular family they have made 10% more on average than is predicted by the income equation, the Δ_i for this family is 10%.[5] Any remaining difference between current income and the income predicted by the combination of observable variables and Δ_i is ϵ_{it}. ϵ_{it} can be looked upon as transitory income and is pure noise, unpredictable at time t.

The earnings equation is estimated in the semi-logarithmic form which is standard for permanent income regressions. The results are presented in Table 1. The R^2 is somewhat higher than that of permanent income equations done for other housing demand studies, but a large percentage of the variation in permanent income still appears to be due to unobservable characteristics.

Several different income measures, each relying on a differing concept of permanent income, were placed in the housing demand equations to determine the most appropriate one to use when estimating housing demand. Our empirical estimates of equation (1) were used to model each of these permanent income measures. These income measures are summarized in the appendix. In the standard housing demand literature, permanent income is modeled as the outcome of a permanent income regression such as equation (1), without the Δ_i to account for unobservable characteristics. This shall be referred to as Goodman-Kawai or GK permanent income. The second measure uses equation (1) without removing the Δ_i. This is referred to as Lillard or LIL permanent income.

The other permanent income measures model consumers as using time horizons longer than a single year when forming their conception of permanent income. The first income measure relying on predicted future income is equal to the discounted present value of the next four years income. This is referred to as Friedman permanent income or FRIED.[6] The other income measures rely on the rational expectations approach to modeling permanent income and are equal to the present discounted value of all future earnings, discounted at interest rates of 0%, 3%, and 8%, These income variables are referred to as RE1, RE2, and RE3 respectively. Descriptive statistics of the various income measures are presented in Table 2.

III. ESTIMATES OF PERMANENT HOUSING CONSUMPTION

The following model, which modifies the model of Lee and Trost (1978) for longitudinal data, will be used to estimate both tenure choice and quantity demand:

$$I^*_{jt} = Z_{jt}\gamma - \epsilon_{jt} \quad (2)$$

$$C_{1jt} = \beta_{1jt}X_{1jt} + \epsilon_{1jt} \quad (3)$$

$$C_{2jt} = \beta_{2jt}X_{2jt} + \epsilon_{2jt} \quad (4)$$

Equation (2) is based on the probit probability model. If the individuals I^*_{jt} is greater than some critical value, the individual owns and his housing demand is determined by equation (3), otherwise he is a renter and his housing demand is determined by equation (4). A problem results because the disturbance term in the tenure choice equation may be correlated with the disturbance term in the demand equations. It is usually easier to obtain small amounts of housing by renting and large amounts by buying. When there is correlation between the disturbance terms in the tenure choice and demand equations, least squares estimates of the demand equation will yield biased and inconsistent estimates. Lee and Trost (1978) present a method for dealing with this problem which is used in this study. By placing the inverse of Mill's ratio in the demand equations, least squares regressions yield coefficients that are consistent.[7] Furthermore, the coefficients of the inverse of Mill's ratio are an estimate of the covariance of the error term in the demand equation and the error term in the choice equation.

We first assume that the tenure choice equation can be estimated as follows:

$$I_{it} = \gamma_1 Y_{it} + \gamma_2 (P_{oit}/P_{xit}) + \gamma_3 (P_{rit}/P_{xit}) + \Sigma \gamma_j SOC_{it} + \epsilon_{it} \qquad (5)$$

Y_{it} represents permanent income for family i at time t under the several specifications described previously. P_{oit} and P_{rit} represent the price of owning or renting respectively. P_{xit} is the price of all other goods. SOC_{it} indicates various socioeconomic variables. The PSID data base does not provide sufficient variables to construct a separate estimate of price for each observation. A measure of price for renting and owning which varies by region only was used. The 1977 BLS Family Workers Budgets were used to construct these price variables.

The housing demand equation for owners is estimated as follows:

$$Q_{oit}/P_{xit} = \alpha_0 + \alpha_1(P_{hit}/P_{xit}) + \alpha_2 Y_{it} + \Sigma\alpha_j SOC_{it} + \rho\lambda_o + \epsilon_{it} \qquad (6)$$

where Q_{oit} represents the value of the dwelling owned by family i in year t and λ_o is the inverse of Mill's ratio for owners. Similarly, the equation for renters is estimated as follows:

$$Q_{rit}/P_{xit} = \beta_0 + \beta_1(P_{rit}/P_{xit}) + \beta_2 Y_{it} + \Sigma\beta_j SOC_{it} + \rho\lambda_r + \epsilon_{it} \qquad (7)$$

where Q_{rit} is rent, and λ_r is the inverse of Mill's ratio for renters.

IV. EMPIRICAL RESULTS

Tables 3 and 4 present the income elasticities and R^2 statistics for each income measure for owners and renters. The estimates were done in log linear form.[8] The ranking of income measures was remarkably similar for owners and renters. Our equations indicate the "Friedman" method of modeling permanent income is the preferable income measure to use when estimating housing demand.

Interestingly, the Goodman-Kawai concept of permanent income obtained the lowest R^2 and resulted in income elasticities that were well outside the range of the other permanent income elasticities. While most of the permanent income elasticities for owners ranged from .55 to .65, the Goodman-Kawai method yielded an elasticity of .9632. For renters the Goodman-Kawai estimates also lay well outside the range of the other estimates. Table 5 presents the R^2 statistics and income elasticities for the "Friedman" income measure when each years predicted income in not augmented by the estimates of Δ_i. Just like the difference between the Goodman-Kawai estimates and the Lillard estimates, the R^2 is substantially lowered and the income elasticities are substantially raised. Although it seems logical that the R^2 should be lowered when the Δ_i is not included, the reason for the increased income elasticity is mysterious.

The rational expectations models of permanent income fared rather poorly as well. Possible explanations are that imperfections in capital markets prevent individuals from taking a longer term view, or that the uncertainty associated with predicting future income creates difficulties in making housing expenditures based upon those projections.

Table 6 presents the full results for the Friedman income measure only, but the results are fairly representative of the other income measures as well. In all the tenure choice equations, the age variables were positive while the age squared terms were negative. Black headed households were always found to be less likely to own, while having a larger family makes one more likely to own. The effects of having a female head or a head who is a veteran were more ambiguous, rarely appearing to be significant and often changing sign from equation to equation. The higher one's income, no matter what measure used, the more likely one is to own. The higher the price of renting the more likely you are to own, while the higher the price of owning the more likely you are to rent.

In the demand equations the price variables have positive signs for both owners and renters. However, the coefficient on price is one plus the price elasticity.[9] For owners the typical price elasticity is -.72 and for renters is -.28. The only consensus on demographic variables was that black headed families tend to spend less and female headed households tend to spend more. The effects of age, family size and having a family headed by a veteran were ambiguous.

V. THE SIMULATION

The empirical estimates of permanent income, tenure choice, and housing demand were then used to simulate housing consumption throughout the course of a lifetime. The main goal in performing this simulation is to compare the incidence of property taxes from an annual and a lifetime perspective. Two alternative assumptions about property tax shifting are made. The first is that the property tax is fully shifted forward to both owners and renters. The second is that the property tax is fully shifted forward to owners, but only 56% to renters. The 56% figure was chosen because this was the amount that Roche (1986) found was shifted to renters in her careful study of the issue. These shifting assumptions need not be inconsistent with the "new" view of the property tax as first expounded by Mieszkowski (1972) and later clarified by McLure (1977) in which the property tax is viewed as a tax on capital. The point Mieszkowski was trying to make was that from a national perspective the property tax depresses the return on all capital; however, local differentials from the national average have excise tax effects. On this point I quote McLure:

> "...if asked by the President of the United States, a good incidence analyst would

> probably say that the property tax is borne, on average, by owners of capital. But if asked by the mayor of Newark, St. Louis or San Diego, the same analyst might say that an increase in the local property tax would be borne, in some combination, by consumers... and by owners of geographically immobile factors".[10]

The results of this study are intended to be useful for comparison of property tax incidence estimates done from a lifetime and an annual perspective in properly done studies of local tax incidence. To obtain estimates of lifetime property tax incidence from a national perspective, a lifetime study of capital ownership would be more relevant.

The empirical equations are used to predict housing consumptions and income in 1972 and over the course of a lifetime for each family in the 1972 cross section of our data base. The first part of the analysis involved obtaining estimates of current income and lifetime income for use as the denominator in our distributive series. The prediction of equation (1) accounts for the deterministic portion of current income in any given year. However, as noted previously, part of the reason estimates of tax incidence using annual data may differ from lifetime estimates is because of transitory influences on measured income. Therefore, random shocks had to be added to the analysis. The difference between the prediction of equation (1) and current income is transitory income, or ϵ_{it}. ϵ_{it} is assumed to be normally distributed and to have a mean of zero. The entire data base was used to calculate the residual between equation (1) and current income. The standard deviation of this residual was then calculated. A normally distributed random number generator, with a mean of zero and a standard deviation equal to that of the residual, was used to model the shock for each household in the simulation for each year of its "life". For the lifetime simulation, earnings were assumed to commence at age 25 if the head of household holds a college degree or higher, and at age 20 if he or she does not. Earnings are assumed to terminate at the actuarially predicted age of death. Total lifetime earnings were discounted back to the age at which earnings were assumed to commence at alternative interest rates of 0%, 5%, and 8%.

In order to obtain estimates of current property taxes, the tenure choice equation was first used to predict if a particular family would be a renter or an owner in a given year. If the value of the cumulative density function for the predicted $\hat{I}$ from the empirical estimate of equation (5) was greater than or equal to .5, the household was assumed to be an owner, otherwise it was assumed to be a renter. If the household was assumed to be an owner, the housing demand equation was used to determine house value. Property taxes are based on assessed house values, so all that needs to be done to estimate property taxes for homeowners was to choose a reasonable effective property tax rate and multiply it by the predicted house value.[11] A rate of 1.39% was chosen since this was the mean of the effective property tax rates for the largest city in each state as reported in the

District of Columbia's publication Tax Rates and Tax Burdens: A Nationwide Comparison.

If the household was assumed to be a renter, the rental demand equation was used to predict rent. Property taxes are based on values, not rents; therefore, an estimate of the value of the dwelling had to be obtained. The value of a rental dwelling should be equal to:

$$V = (GR - OE) / (T + r) \tag{8}$$

where V=market value, GR=annual gross rent, OE=annual operating expenses, T=effective property tax rate, and r=interest rate. Reasonable assumptions about effective property tax rates, interest rates and operating expenses were made.[12] Once having estimated the value of each unit, the property tax rate of 1.39% was multiplied times the value of the dwelling to obtain the property tax on the rental.

Since the Friedman income measure worked best in the housing demand equations, the simulations were done using the outcome of those regressions.[13] Family size is a variable affecting both tenure choice and quantity demand, therefore, reasonable assumptions about changes in family size over time had to be made. Our data told us how many children were in each family in the 1972 cross section. First births are assumed to occur one year after marriage and subsequent births at three year intervals beyond that. Children are assumed to live with their parents for twenty years.

One possible criticism of the methodology is that it implicitly assumes the quantity of housing owned or rented by individuals can adjust in a continuous fashion. They are able to make constant adjustments to housing consumption in response to family size and other changes. Homeowners and renters are seen as always being in equilibrium. This criticism is not as devastating as it appears at first blush. All we are really doing is fitting a smooth curve to what ideally should be a step function.

One other issue to mention before presenting the results is that the time and time-squared variables did not behave very well when projected into the past or the future. Since they were not well behaved their values were held constant at 1978, the median year for the data.[14] This is equivalent to holding interest rates constant throughout the simulation.

Table 7 presents comparisons of the distribution of income, house values, and rents across income classes in the annual and lifetime cases. The annual case is the predictions for the 1972 cross section of the data base. The distribution of income is more equally spread among income classes in the lifetime case than in the annual case. Annual rents are concentrated more heavily in the lower income deciles in the lifetime case. Note that the highest income decile does not even pay rent in the annual case. Higher income deciles pay a larger share of rent in the lifetime case because those with high lifetime income may nonetheless have been renters earlier in their lives when their current income was low.

The distribution of house values is more concentrated in the upper income deciles in the lifetime case relative to the annual case. This results from both transitory influences on income and life-cycle factors. In the annual case transitory shocks place those with large housing expenditures in lower income deciles and those with low housing expenditures in higher income deciles. Furthermore, those with high lifetime income and housing expenditures may have low current income because they are retired or lack labor market experience, but nonetheless consume housing more in line with longer term earnings.

Table 8 and Figure 1 present the baseline results using several interest rates to discount future income and property tax payments when full forward shifting to tenants and owners is assumed. The property tax is found to be regressive in the annual and lifetime cases, but in the lifetime case, especially for the lowest income deciles, the regressivity is substantially reduced. For the top income deciles, the tax burden is greater no matter what discount rate is assumed. Note that the higher the interest rate, the lower the lifetime burden. This result obtains because earnings tend to peak at middle age and then decline, whereas housing expenditures plateau at middle age. A higher interest rate reduces the value of future property taxes more than future income.

Table 9 and Figure 2 show the results when 56% forward shifting to renters is assumed. Under this assumption the difference between the annual and lifetime cases is dramatic. In the lifetime case the property tax appears to be virtually a flat tax and even exhibits progressivity over certain income ranges.

Table 10 and Figure 3 show the results when the simulation was run without any random shocks to income. The most dramatic changes between running the simulation without shocks and all the other simulations occurs, as to be expected, in the annual case. This is particularly true for the lowest and highest income deciles. By eliminating the random shock, we are removing those who are temporarily in a bad situation from the lower income deciles, and those temporarily in a good situation from the upper income deciles. Essentially, the annual figures in this particular simulation are not comparable to the annual figures used in the other simulations in this study, as well as those in other annual incidence studies. Since income is free of transitory shocks, what we really have as the denominator is not current income, but what was previously referred to as the Lillard concept of permanent income.

The lifetime figures for this simulation are little different from the lifetime figures for the other simulations. This is because over time shocks balance themselves out and do not impact the longer term figures. Finally, note that in Figure 3 the lifetime figures all lie completely below the annual figures, with no point of intersection as in the other cases.

This would indicate that life-cycle issues have their strongest impact on the magnitude of the tax burden, not on the shape of its distribution. If transitory influences on income could be accounted for, an annual incidence study may still be useful in looking at the relative distribution of property taxes across income classes.

One way to characterize whether a tax is regressive, proportional, or progressive, is to look at the elasticity of tax payments with respect to income. If the elasticity is greater than one (less than one) the tax is progressive (regressive). Property tax elasticities are presented in Table 11. When full forward shifting is assumed the tax may be characterized as regressive in both the annual and lifetime cases, but the regressivity is substantially lower from a lifetime perspective. When less than full forward shifting to renters is assumed, the difference between the lifetime and annual cases is dramatic, with the tax appearing regressive in the annual case, but proportional in the lifetime case. Finally, when random shocks are removed from the analysis, there is little difference in this progressivity measure between the annual and lifetime cases.

VI. CONCLUSIONS

The simulations confirm the widely held belief that the results for the lowest income categories in annual studies of tax incidence are the most unreliable. The difference in the property tax burden for the lowest income deciles between the annual and lifetime cases was substantial in all of the cases considered, and indicate the tax burden is much lower for these deciles than annual studies would suggest. Furthermore, except for the case where transitory shocks to income were removed from the analysis, there also appeared to be a slight increase in tax burden for the highest income deciles with little change for the middle income deciles. In the full forward shifting case, the regressivity of the property tax was much lower in the lifetime case than in the annual case. Under the assumption of only partial forward shifting to renters, the burden of that portion of the property tax which is shifted forward appears to be borne proportionally across income classes in the lifetime case.

Our results indicate that transitory shocks to income may be more important than life-cycle issues in causing annual and lifetime incidence to differ. Future research into how transitory shocks vary across income classes and their distribution is called for.

Overall, the property tax does not appear nearly as regressive from a lifetime perspective as it does from an annual perspective. This would imply that the property tax may not be as inequitable a source of revenue as many economists and policy makers have heretofore argued. This study represents an early attempt to empirically measure tax incidence in a life-cycle framework. My hope is that it will encourage much needed future research on the lifetime incidence of the property tax as well as that of other taxes.

1.For the only two exceptions I know of see Davies et al (1984) and Fitzgerald and Maloney (1990).

2.For a comprehensive survey of the housing demand literature see Mayo (1981).

3.A measure of permanent income should include both human and non-human wealth. Including asset income in the dependent variable helps to capture the non-human wealth aspects of permanent income.

4.The PSID data set allows each family to define for itself the "head of household", which almost invariably refers to the husband in a two adult household. When the household has only a single female parent, the PSID refers to this person as the head of household. Our age and education variables for the head of household refer to both males and females, so we are implicitly assuming the returns to education are the same for all heads of household regardless of sex. An alternative approach would be to categorize the age and education variables by sex only. Such an approach should not greatly alter the overall results.

5.Since not all families are in the data base for the same number of years, different numbers of observations are used to calculate the Δ_i's for different households. Those families which experience a change in the head of household during the years for which we have data are modeled as being one distinct household before the change took place and as another after the change.

6.Friedman devoted Chapter Seven of his A Theory of the Consumption Function to estimating the length of this horizon and concluded the typical horizon is from three to five years.

7.Although the augmented OLS estimates of the demand regressions are consistent, they are not efficient. To obtain estimates that are efficient, a simultaneous equations method is needed. In this literature, Lee (1978), Rosen (1979), and King (1980) use only the two stage method used in this study. Lee and Trost (1978) develop a two stage method that provides estimators which are both consistent and efficient, but their method is not attempted in this study. The small standard errors obtained for most of the estimated coefficients in our regressions indicate that ignoring this problem is not terribly important in this study.

8.Results in the linear form are available upon request from the author.

9.Let Q represent the quantity of housing services, P indicate the price of housing services, and V be the value of housing equal to P times Q. Then:

$$Q = V/P = e^{a_0} P^{a_1} Y^{a_2}$$

Taking logs of both sides we have:

$$\ln V - \ln P = a_0 + a_1 \ln P + a_2 \ln Y$$

Adding ln P to both sides yields:

$$\ln V = a_0 + (1+a_1) \ln P + a_2 \ln Y$$

10.Charles Mclure, 1977, "The New View of the Property Tax: A Caveat," National Tax Journal 1, 69-75

11.Effective property tax rates already take into account the possible divergence between assessed value and market value. For a fuller exposition of this issue see Oates (1969).

12.The tax rate was assumed equal to 1.39%. The interest rate was assumed equal to 5%. A mean figure for operating expenses was calculated using the Institute of Real Estate Management of the National Association of Realtors publication Income-Expense Analysis. The figure arrived at was that operating expenses are on average equal to 36% of rent.

13.Estimates using the "Lillard" income measure are available upon request.

14.Results using the years 1972 and 1985 are available upon request. The general observations were not altered by using these values for the time variable.

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TABLE 1
PERMANENT INCOME EQUATION

INDEPENDENT VARIABLE	ESTIMATED COEFFICIENT	t-STATISTIC
INTERCEPT	871.3206	0.6376
HAGE	0.0334	7.5751
WAGE	0.0298	4.8819
HAGESQ	-0.0005	-14.0481
WAGESQ	-0.0004	-8.9143
HEDUC1	0.2879	0.9866
HEDUC3	-0.0536	-0.2904
HEDUC4	-0.3451	-1.9248
HEDUC5	-0.1491	-0.8304
HEDUC6	-0.2490	-1.3718
HEDUC7	-0.2101	-1.1604
HEDUC8	-0.1185	-0.6454
HEDUC9	-0.2425	-1.1787
WEDUC1	0.1645	0.6564
WEDUC3	-0.2614	-1.0152
WEDUC4	0.0572	0.2310
WEDUC5	0.2940	1.1918
WEDUC6	0.5427	2.1877
WEDUC7	0.4919	1.9645
WEDUC8	0.3479	1.3709
WEDUC9	0.3276	1.1853
HINTER1	-0.0048	-0.9854
HINTER3	0.0055	1.7509
HINTER4	0.0138	4.5221
HINTER5	0.0120	3.9032
HINTER6	0.0172	5.5063
HINTER7	0.0166	5.3275
HINTER8	0.0182	5.7162
HINTER9	0.0260	6.8903
WINTER1	0.0031	0.5125
WINTER3	0.0111	2.2411
WINTER4	0.0062	1.2826
WINTER5	0.0033	0.6982
WINTER6	-0.0025	-0.5237
WINTER7	-0.0011	-0.2229
WINTER8	0.0046	0.9110
WINTER9	0.0050	0.8746
SINGLE	0.2870	2.5196
BLACK	-0.1557	-12.1895
FEMHD	-0.2919	-13.7058
OVR65	-0.0811	-2.7714
NE	0.0642	3.5212
MID	-0.0322	-1.9537
SOUTH	-0.0475	-2.9442
TIME	-0.8646	-0.6259
TIMESQ	0.0002	0.6200
Number of Obervations		16902
R-Squared		0.4351

TABLE 2
DESCRIPTIVE STATISTICS OF INCOME MEASURES

	RENTERS		OWNERS	
	MEAN	STANDARD ERROR	MEAN	STANDARD ERROR
CURRENT	10,790	8,308	20,475	18,836
GK	9,082	5,744	16,882	8,694
LIL	10,497	7,396	19,454	12,515
FRIED	41,487	29,141	75,461	48,254
RE1	331,220	257,856	440,948	309,724
RE2	188,318	138,077	278,336	182,991
RE3	109,075	77,098	176,909	112,404

TABLE 3
INCOME ELASTICITY ESTIMATES FOR VARIOUS INCOME MEASURES
RANKED BY R-SQUARED

OWNERS

INCOME MEASURE	INCOME ELASTICITY	R-SQUARED
FRIED	0.6342	0.3386
LIL	0.6317	0.3383
RE3	0.6455	0.3376
RE1	0.6472	0.3372
RE2	0.6472	0.3370
CURRENT	0.4097	0.2865
GK	0.9632	0.2720

TABLE 4
INCOME ELASTICITY ESTIMATES FOR VARIOUS INCOME MEASURES
RANKED BY R-SQUARED

RENTERS

INCOME MEASURE	INCOME ELASTICITY	R-SQUARED
FRIED	0.4823	0.3216
LIL	0.4817	0.3216
RE1	0.4910	0.3202
RE3	0.4875	0.3201
RE2	0.4902	0.3200
CURRENT	0.3150	0.2748
GK	0.6866	0.1884

TABLE 5
ELASTICITY ESTIMATES AND R-SQUARED
FRIEDMAN EQUATIONS WITHOUT DELTA

	R-SQUARED	ELASTICITY
OWNER	0.272	0.9648
RENTER	0.188	0.6875

TABLE 6
REGRESSION RESULTS
FRIEDMAN INCOME MEASURE

A)TENURE CHOICE EQUATION

INDEPENDENT VARIABLE	ESTIMATED COEFFICIENT	t-STATISTIC	
INTERCEPT	0.09351	0.10853	
HAGE	0.07502	14.70990	
WAGE	0.03952	14.79077	
HAGESQ	-0.00427	-80.49245	
WAGESQ	-0.00044	-10.81244	
BLACK	-0.79494	-27.71839	
FEMHD	0.06863	1.42438	
HDVET	-0.02322	-0.76569	
FAMSIZ	0.01108	1.57613	
LPRENT	0.42354	2.04243	
LPOWN	-0.61668	-4.06515	
LFRIED	0.55012	24.13521	
Number of Obs.	16902	L.L.F.	-7497

B)RENTER DEMAND EQUATION

INTERCEPT	6919.14	3.8366	
HAGE	-0.0149	-5.1033	
WAGE	0.0013	0.9032	
HAGESQ	1.48E-04	4.6042	
WAGESQ	2.48E-05	0.0973	
BLACK	-0.0791	-4.7237	
FEMHD	0.1658	7.2553	
HDVET	0.0018	0.0899	
FAMSIZ	-0.0095	-2.4748	
TIME	-6.9940	-3.8365	
TIMESQ	0.0018	3.8348	
MILLS	-0.0014	-1.0611	
LPRENT	0.7178	11.1758	
LFRIED	0.4823	38.9836	
Number of Obs.	5978	R-squared	0.3223

C)OWNER DEMAND EQUATION

INTERCEPT	-6041.77	-3.7966	
HAGE	0.0022	0.7331	
WAGE	-2.65E-03	-1.6275	
HAGESQ	7.76E-06	0.2654	
WAGESQ	5.55E-05	2.3718	
BLACK	-0.2922	-17.7742	
FEMHD	0.2544	7.7706	
HDVET	-0.0642	-4.6543	
FAMSIZ	-0.0066	-1.7545	
TIME	6.0979	3.7907	
TIMESQ	-0.0015	-3.7842	
MILLS	-0.0191	-4.0505	
LPOWN	0.2768	58.7806	
LFRIED	0.6342	14.9762	
Number of Obs.	5978	R-squared	0.3384

TABLE 7
DISTRIBUTION OF INCOME, RENTS AND HOUSE VALUES

	INCOME		RENTS		HOUSE VALUES	
DECILE	ANNUAL	LIFETIME	ANNUAL	LIFETIME	ANNUAL	LIFETIME
BOTTOM	0.0023	0.0224	0.2608	0.2421	0.02196	0.0099
2ND	0.0041	0.0381	0.2808	0.2569	0.03787	0.0289
3RD	0.0057	0.0543	0.1342	0.1815	0.06789	0.0495
4TH	0.0074	0.0677	0.1038	0.1118	0.08376	0.0764
5TH	0.0095	0.0777	0.0886	0.0775	0.09218	0.0870
6TH	0.0114	0.0904	0.0477	0.0493	0.11616	0.1057
7TH	0.0140	0.1070	0.0448	0.0471	0.11785	0.1203
8TH	0.0168	0.1263	0.0165	0.0130	0.12748	0.1429
9TH	0.3757	0.1510	0.0199	0.0147	0.14633	0.1593
TOP	0.5531	0.2652	0.0000	0.0060	0.18853	0.2203

CUMULATIVE DISTRIBUTION OF INCOME, RENTS AND HOUSE VALUES

	INCOME		RENTS		HOUSE VALUES	
DECILE	ANNUAL	LIFETIME	ANNUAL	LIFETIME	ANNUAL	LIFETIME
BOTTOM	0.0023	0.0224	0.2608	0.2421	0.0220	0.0099
2ND	0.0063	0.0604	0.5416	0.4990	0.0598	0.0388
3RD	0.0121	0.1147	0.6758	0.6805	0.1277	0.0882
4TH	0.0195	0.1824	0.7796	0.7923	0.2115	0.1646
5TH	0.0290	0.2602	0.8681	0.8698	0.3037	0.2516
6TH	0.0404	0.3506	0.9158	0.9191	0.4198	0.3573
7TH	0.0544	0.4575	0.9606	0.9662	0.5377	0.4775
8TH	0.0712	0.5838	0.9771	0.9793	0.6652	0.6204
9TH	0.4469	0.7348	1.0000	0.9940	0.8115	0.7797
TOP	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

TABLE 8
DISTRIBUTIVE SERIES
PROPERTY TAX PAYMENTS
FULL FORWARD SHIFTING

DECILE	ANNUAL	INTEREST 5%	INTEREST 8%	INTEREST 0%
BOTTOM	0.0531	0.0306	0.0304	0.0328
2ND	0.0414	0.0251	0.0249	0.0280
3RD	0.0348	0.0249	0.0242	0.0282
4TH	0.0330	0.0244	0.0234	0.0279
5TH	0.0317	0.0242	0.0234	0.0271
6TH	0.0287	0.0242	0.0227	0.0268
7TH	0.0254	0.0232	0.0224	0.0263
8TH	0.0214	0.0233	0.0224	0.0251
9TH	0.0191	0.0213	0.0206	0.0238
TOP	0.0150	0.0184	0.0178	0.0208

CUMULATIVE DISTRIBUTION
PROPERTY TAX PAYMENTS
FULL FORWARD SHIFTING

DECILE	ANNUAL	INTEREST 5%	INTEREST 8%	INTEREST 0%
BOTTOM	0.0428	0.0378	0.0384	0.0354
2ND	0.1017	0.0879	0.0905	0.0849
3RD	0.1699	0.1545	0.1571	0.1532
4TH	0.2518	0.2321	0.2334	0.2344
5TH	0.3505	0.3205	0.3214	0.3255
6TH	0.4595	0.4226	0.4201	0.4287
7TH	0.5770	0.5360	0.5335	0.5450
8TH	0.7020	0.6680	0.6658	0.6742
9TH	0.8437	0.8159	0.8125	0.8197
TOP	1.0000	1.0000	1.0000	1.0000

TABLE 9
DISTRIBUTIVE SERIES
PROPERTY TAX PAYMENTS
56% FORWARD SHIFTING TO TENANTS

DECILE	ANNUAL	LIFETIME
BOTTOM	0.0419	0.0204
2ND	0.0357	0.0183
3RD	0.0325	0.0206
4TH	0.0306	0.0216
5TH	0.0290	0.0217
6TH	0.0300	0.0210
7TH	0.0246	0.0227
8TH	0.0225	0.0221
9TH	0.0195	0.0207
TOP	0.0155	0.0183

CUMULATIVE DISTRIBUTION
PROPERTY TAX PAYMENTS
56% FORWARD SHIFTING TO TENANTS

DECILE	ANNUAL	LIFETIME
BOTTOM	0.0337	0.0270
2ND	0.0875	0.0668
3RD	0.1560	0.1266
4TH	0.2378	0.2025
5TH	0.3314	0.2889
6TH	0.4456	0.3856
7TH	0.5587	0.5074
8TH	0.6863	0.6449
9TH	0.8298	0.7999
TOP	1.0000	1.0000

TABLE 10
DISTRIBUTIVE SERIES
PROPERTY TAX PAYMENTS
NO SHOCK

DECILE	ANNUAL	LIFETIME
BOTTOM	0.0365	0.0334
2ND	0.0333	0.0272
3RD	0.0295	0.0272
4TH	0.0286	0.0267
5TH	0.0277	0.0264
6TH	0.0266	0.0262
7TH	0.0268	0.0257
8TH	0.0272	0.0261
9TH	0.0254	0.0237
TOP	0.0242	0.0204

CUMULATIVE DISTRIBUTION
PROPERTY TAX PAYMENTS
NO SHOCK

DECILE	ANNUAL	LIFETIME
BOTTOM	0.0343	0.0373
2ND	0.0864	0.0873
3RD	0.1507	0.1537
4TH	0.2289	0.2315
5TH	0.3150	0.3188
6TH	0.4118	0.4196
7TH	0.5277	0.5335
8TH	0.6631	0.6681
9TH	0.8126	0.8147
TOP	1.0000	1.0000

TABLE 11
ELASITICITY OF TAX PAYMENTS
WITH RESPECT TO INCOME

ASSUMPTION	ANNUAL	R-SQUARED	LIFETIME	R-SQUARED
FULL FORWARD SHIFTING INTEREST-5%	0.5447	0.9874	0.8021	0.9933
FULL FORWARD SHIFTING INTEREST-8%	0.5447	0.9874	0.7881	0.9947
FULL FORWARD SHIFTING INTEREST-0%	0.5447	0.9874	0.8151	0.9946
56% FORWARD SHIFTING TO RENTERS	0.6296	0.9787	1.0035	0.9864
NO SHOCK	0.8126	0.9971	0.8148	0.992

TABLE A-1

DEFINITION OF VARIABLES USED IN REGRESSIONS

Variable	Definition
HAGE	Age of head of household
WAGE	Age of wife or co-habitator
HAGESQ	HAGE*HAGE
WAGESQ	WAGE*WAGE
HEDUC1	1 if head illiterate, 0 otherwise
HEDUC3	1 if head had 6-8 grades education, 0 otherwise
HEDUC4	1 if head had 9-11 grades education, 0 otherwise
HEDUC5	1 if head has high school education, 0 otherwise
HEDUC6	1 if head has high school education and nonacademic training, 0 otherwise
HEDUC7	1 if head has some college, 0 otherwise
HEDUC8	1 if head has completed college, no advanced degree, 0 otherwise
HEDUC9	1 if head has some graduate work or advanced degree, 0 otherwise
WEDUC1	1 if wife illiterate, 0 otherwise
WEDUC3	1 if wife had 6-8 grades education, 0 otherwise
WEDUC4	1 if wife had 9-11 grades education, 0 otherwise
WEDUC5	1 if wife has high school education 0 otherwise
WEDUC6	1 if wife has high school education and nonacademic training, 0 otherwise
WEDUC7	1 if wife has some college, 0 otherwise
WEDUC8	1 if wife has completed college, no advanced degree, 0 otherwise
WEDUC9	1 if wife has some graduate work or advanced degree, 0 otherwise

TABLE A-1 (CONT'D)

HINTER1	HEDUC1*HAGE
HINTER3	HEDUC3*HAGE
HINTER4	HEDUC4*HAGE
HINTER5	HEDUC5*HAGE
HINTER6	HEDUC6*HAGE
HINTER7	HEDUC7*HAGE
HINTER8	HEDUC8*HAGE
HINTER9	HEDUC9*HAGE
WINTER1	WEDUC1*WAGE
WINTER3	WEDUC3*WAGE
WINTER4	WEDUC4*WAGE
WINTER5	WEDUC5*WAGE
WINTER6	WEDUC6*WAGE
WINTER7	WEDUC7*WAGE
WINTER8	WEDUC8*WAGE
WINTER9	WEDUC9*WAGE
SINGLE	1 if head of household has no spouse, 0 otherwise
BLACK	1 if Black head of household, 0 otherwise
FMHD	1 if female head of household, 0 otherwise
OVR65	1 if head of household over age 65, 0 otherwise
NE	1 if household resides in the northeast, 0 otherwise
SOUTH	1 if household resides in the south, 0 otherwise
TIME	time trend variable, 1972...1985
TIMESQ	TIME*TIME
HDVET	1 if head of household is a veteran, 0 otherwise
FAMSIZ	number of persons in family
MILLS	inverse of Mill's ratio
LPRENT	log of price of renting
LPOWN	log of price of renting

TABLE A-2

DEFINITION OF INCOME TERMS

Measure	Definition
CURRENT	current income
GK	income as predicted by equation (1) with no delta to account for difference among observationally equivalent families
LIL	income predicted by equation (1)
FRIED	present discounted value, next four years predicted income
PDV1	present discounted value, total predicted future income, interest rate 0%
PDV2	present discounted value, total predicted future income, interest rate 3%
PDV3	present discounted value, total predicted future income, interest rate 8%

FIGURE 1

SIMULATION RESULTS

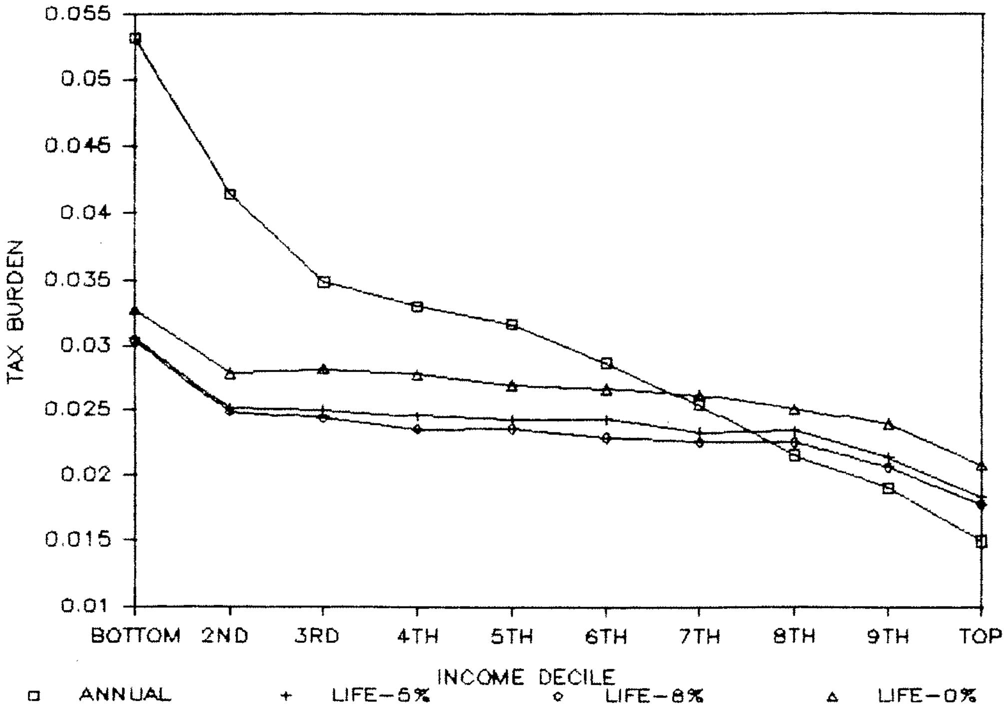

FIGURE 2

56% FORWARD SHIFTING

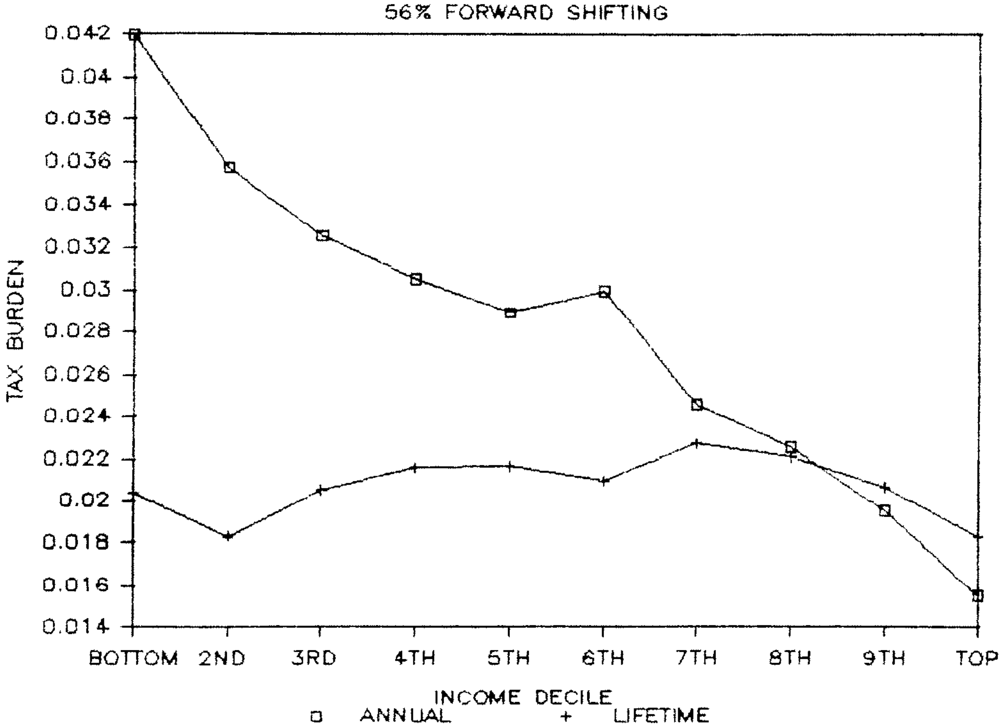

FIGURE 3

NO SHOCK