The Equity of the Real Estate Property Tax: An Empirical Examination of the City of Philadelphia

by

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I- Introduction

This study, using all the "arms-length" property transactions of 1965, 1969, and 1973 in the city of Philadelphia as a sample, examines the extent of and the potential explanations for systematic intra-city inequities of the real estate property tax. These inequities are measured as variations in the ratio of assessed value to market value across geographic sub-areas within city limits. Property tax equity, as used here, is based upon a legal statute, which requires that within the city of Philadelphia the ratio of assessed value to market value, irrespective of land use, should be uniform for all properties.[1] The analysis employs a statistical model to investigate the interrelationships between sub-area assessment-market value ratios and socio-economic variables and neighborhood property market characteristics. Also, after carefully specifying assumptions, the paper ascertains the extent of income regressivity of the property tax within the city of Philadelphia.

The major conclusion of this study is that property tax in the city of Philadelphia is regressive and inequitable. Specifically, it is found that the differences in ward and Census tract mean assessment to market value ratios in many cases do differ dramatically and systematically. In particular, relatively poor, non-white, downward unstable property sub-market areas exhibit significantly higher mean ratios. This result appears to be, at least in part, a function of the lack of systematic reassessments over time in the city of Philadlephia. Finally, under traditional assumptions about tax shifting, the recent claims that the real estate property tax on residential properties is (slightly) progressive appear to be incorrect. In Philadelphia, the error of this view of the property tax stems from not taking into account that properties with higher market values are on average assessed at sufficiently lower rates per dollar of market value to make the effective property tax regressive with respect to "permanent" income.

II- Theoretical Considerations

In recent years, there has been increased concern about the need to combine equity and efficiency in the solutions of public sector problems. Specific studies have dealt with such issues as optimal taxation, the pricing of public sector goods and services, and the evaluation of the optimal mix of public expenditures. In these studies, the distribution of goods and services presumably affects social welfare through individual utility functions. Distributional considerations enter into the analysis because of the assumed concavity of either individual utility functions or the social welfare function. Our concern in this paper with distributional equity will relate to the manner in which the property tax is administered in the city of Philadelphia. Our strategy is to define a "paradigm" for property tax equity, and, then, to verify empirically the actual fashion in which the property tax is administered.

a) Property Tax Mechanics and Market Value

The property tax liability is determined by multiplying a property's assessed value by the city-wide millage rate, m. Each property within the city of Philadelphia taxing district is supposed to be assessed at an equal proportion of its market value. In general, the tax liability (TX_k) for the kth parcel is $TX_k = m\ A_k$.

A_k is the value of the assessment for parcel k. For our purposes, the tax liability can be further subdivided such that

$$TX_k = m \cdot R \cdot V_k$$

where R is purported to be a uniform city-wide ratio of assessed value to "fair" market value applied to all properties and V_k is the "fair" market value of the <u>k</u>th parcel. Equity of the property tax, since m is nominally given, requires that R, in practice, be uniformly applied, and V_k be properly computed (i.e., appraised). Hence, in our context, if V_k were known for all properties and m is predetermined, the equity of the property tax would depend solely upon the uniformity of R across the city; and the assessment-market value ratio and the effective tax rate are virtually synonomous.

The market value for a parcel, in accordance with capital theory, is the risk adjusted discounted expected net value of services it will yield over its future life span. In this sense, the market value will depend upon the parcel's physical attributes (size, design, and quality of the physical structure and land), neighborhood-locational variables (including proximity to privately created neighborhood amenities and accessibility to employment), the level and type of local public services available, and the property tax liability. For purposes of this study, it is assumed that "arms length" bona fide market sales reflect "fair" market value <u>on average</u>. Hence, as is done in the analysis below, groups of individual property transactions, in the aggregate are assumed to provide good estimates of "fair" market value.

<u>b) Competing Explanations for Unequal Real Estate Property Tax Treatment</u>

While this study focuses on real estate property tax inequity and the implied degree of taxation regressivity, it may be useful to outline briefly several current hypotheses explaining why the property tax within a taxation jurisdiction may be administered unequally. First, Oldman and Aaron (1965) posited that observed striking and systematic variations in assessment-market value ratios in their study of Boston could be explained by de facto assessors' applications of a user-benefits principle to determine assessed values. In particular, properties that utilize (because of the type of property occupant or nature of the land use) more local public services than average should be assessed more heavily to pay their fair share of the local governmental expenditures.

A second, though related, argument has been suggested for the existence of intentional (or pure discriminatory) unequal property tax assessment practices. Under this scheme, the motivations for differential tax treatment may vary and may be multifaceted. For example, assessors may systematically under-assess expensive homes in order to avoid confrontations caused by rich homeowners, who are more likely to protest assessment changes through either court or political actions. Further, inter-community competition for relatively mobile, wealthy households, because of their relatively high tax base versus low public services usage, may lead to preferential treatment in the form of lower property taxes. Similarly, tax districts may compete for or maintain desirable industry (e.g., clean, low-demand for public services, high levels of generated jobs) within their locales by providing relatively favorable property tax treatment to such firms.

Finally, Peterson, et al (1973) develop a theory of land market dynamics, interacting with reassessment administration practices. According to this view, relative market values in various geographic sub-areas change at differential rates over time. Simultaneously, assessed values exhibit a strong inertial force, with reassessments either infrequent or inadequate to reflect fully market value changes. The resultant is that market value dynamics determine the degree of inequity by lowering the assessment to market value ratios in areas where values are increasing relatively, and vice versa. Put differently, the observed inequities in the administration of the property tax under this hypothesis are caused by market phenomenom rather than by explicit discriminatory assessment practices.[2] It is likely that this last theory for explaining the inequities of the property tax is most relevant for examining the situation that persists in the city of Philadelphia. In any case, however, it is important to realize that, no matter how differentials in property tax treatments are generated, within the city of Philadelphia it is illegal to have non-uniform assessment practices for all non-exempt properties.

A hypothetical, but suggestive, economic scenario shall provide a useful framework for studying how reassessment lags and real estate market activity interact within a taxing jurisdiction to create inequities in the property tax as observed in changes in assessment-market value ratios across sub-areas. Consider two sub-areas, area A and area B, each within the taxing district. Area A is characterized by expensive properties that are growing in value rapidly and by white, wealthy residents; Area B is characterized by relatively inexpensive properties that are declining (or growing relatively slowly) in value and by non-white, relatively low income residents. Assume, at an initial time period, that for each sub-area the land market is in economic equilibrium, and the property tax is equitably administered across sub-areas, such that the average tax burdens per dollar of market value for each area are equal. Over time, given our assumed sub-area market forces above, if property reassessments lag behind market value changes, ceteris paribus, the average assessment-market value ratio in area A will fall at least relatively to the average ratio in area B. In fact, if there were no property reassessments and if market values grew in absolute terms in sub-area A and if market values declined in absolute terms in sub-area B, then the average assessment-market value ratios will fall and rise in absolute values in sub-areas A and B, respectively. Furthermore, these changes in observed average sub-area assessment-market value ratios, will be expected to be related empirically to the property market and socio-economic features of each sub-area.

This conclusion is reinforced by the likely future behaviour for the local government's provision of public services, and the local needs for tax revenues and implied tax burden distribution across sub-areas. It is well known that cities, such as Philadelphia, have been confronted with recent and severe "fiscal crises" that are expected to have long term implications for local government operations. Two governmental responses appear especially important for the results of this study. First, the tax burdens for all properties are likely to increase, but more extensively in low-income, low value areas because the wealthy - relatively mobile constituents are, from the local government's fiscal point of view, the desirable residents, and as argued above, will be treated as favorably as possible in order to inhibit their moving out of the city. Second, and for similar reasons, local public services are likely to be reduced especially in low-income, relatively low value sub-areas.[3] These two effects in concert will tend to increase the relative assessment-market value ratios in low-income, low property value areas by simultaneously depressing market values and increasing relative tax burdens.

c) Capitalization and Property Taxation Inequity

There exist theoretical arguements, backed by substantial evidence, that indicate that local property taxes as well as local governmental expenditures for the provision of desired public services are capitalized into market values.[4] According to this approach, the purchase (or rental) of a real estate parcel includes the rights to consume a large array of publicly supplied goods and services as well as the incurence of the liability to pay local taxes, both of which should influence site values. It is important to note that in each of the hypotheses about unequal tax treatment that expected long term variations in property taxes for a particular property (holding public services constant) within the tax district in a "rational economic" world should be capitalized into value. Of course, once this capitalization has occurred and is transmitted in a market sale, the present owner will not benefit or lose from the tax treatment, if it does not (and is not expected to) change in the future. In a Tiebout (1956) world, if the property tax has been capitalized fully into the market value, it will no longer engender a locational change in the form of a pecuniary (versus an economic efficiency) incentive to prospective buyers. However, there are capital gains and losses to those who were initially subjected to changes in relatively "favorable" versus "unfavorable" tax treatment; or to those who were owners at the time that an "unanticipated" change in the tax treatment occured. The extent of capitalization is a crucial element that, along with assumptions about property tax shifting, affects the overall burden and regressivity of the property tax. Further discussion is, therefore, postponed until the section V below dealing with property tax regressivity.

III- The Basic Statistical Model for Measuring Inter-Area Property Tax Inequity

Our basic model for the empirical analysis of the equity of the property tax is a constant elasticity function:

$$R_{it} = \prod_{j=0}^{n} X_{jit}^{\beta jt} \cdot e^{u_{it}} \qquad (1)$$

where R_{it} is the aggregate sub-area ratio of the sum of assessments to the sum of the market values (as reflected by sales transactions) for properties in sub-area i in time period t. The X_{jit}'s are the relevant explanatory variables, u_{it} is the stochastic error term, and β_{jt} are the parameters to be estimated. Applying the logarthmic operator to each side of equation (1) yields the equation form that will be estimated statistically. In this form, the parametric coefficients are interpreted as the elasticity of the assessment to market value ratio with respect to the jth variable, and serve as a measure of the degree of inter-areal equity that is achieved in terms of the X_{jit}'s.

An especially important case of equation (1) is equation (2), dropping the time subscript for convenience.

$$\ln R_i = \alpha_o + \alpha_1 \ln Y_i + u_i \qquad (2)$$

where Y_i is "normal" income for the $\underline{i}^{th}$ sub-area. The parameter α_1 is the operational measure of the degree of income equity. If $\alpha_1 = 0$, the ratio, and, therefore, the tax rate, is unrelated to the sub-area income level, and is consistent with "perfectly" equitable property tax administration in a statistical sense. If, in addition, $u_i \equiv o$ for all i, then there would exist total, deterministic property tax equity.

More generally, R_i should be analyzed in a more complete system that contains additional explanatory variables, such as equation (3).

$$\log R_i = b_o + b_1 \ln Y_i + b_2 \ln V_i + b_3 \ln Z_i + \sum_{j=4}^{n} b_j \ln X_{ji} + \varepsilon_i \qquad (3)$$

where V_i is the average market value of properties in subarea i and Z_i is the racial composition of subarea i. Comparing equations (2) and (3), and using Thiel's (1965) notion of model mis-specification, one can see that the equity measure α_1 is related to the behavioral parameters of the more complete model formulation by equation (4) where γ_{gh} is the constant elasicity of g with respect to h:

$$\alpha_1 = b_1 + b_2\gamma_{VY} + b_3\gamma_{ZY} + \sum_{j=4}^{n} b_j\gamma_{X_jY} \qquad (4)$$

Note that equation (4) demonstrates that the measure of equity, R, while it is affected by Y, may be affected by other socio-economic-political variables as well, and, if the model is improperly specified, can yield misleading conclusions. Finally, it is important to state that this model has significant limitations; this model "describes" the inter-relationship between interesting socio-economic variables and property tax variables.

This is, unfortunately, an impoverished surrogate for the desired (but at this time and state of knowledge, unobtainable) complex structural system, including local political decision-making, local assessment practices, land market activities, and so forth.

IV. Empirical Findings for Inter-Area Ratios[5] in Philadelphia

The primary focus of our analysis will be upon the systematic vertical and horizontal equity of the real estate property tax as it is currently applied in various sub-areas in the city of Philadelphia.[6] We attempt to find systematic determinants of differences in property tax treatment across wards in 1965, 1969, and 1973 (political areal sub-divisions that correspond to the administrative assessment districts for the property tax in Philadelphia) and across Census tracts in 1973 (smaller non-political geographic sub-areas than the wards, which permit more refined economic data analysis). Note that the city of Philadelphia is coterminous with the county and school districts of Philadelphia, who, through the Board of Revision of Taxes, determine the assessment for each property parcel and uniform city-wide millage rate.

a) The City-Wide Aggregate Assessment- Market Value Ratio over Time

Table 1a demonstrates that the aggregate assessment-to-sales ratio (Column 5) calculated from market data for all "arms length" property sales in the city of Philadelphia has secularly declined between 1958 and 1973.[7] Since the city-wide millage rate was constant between the period 1965 and 1974, the time period considered in this study, at $44.75 per $1000 of assessed value, the effective average property tax rate per dollar of market value has declined steadily,too. The ordinary least square regression represented by Equation 1-1 illustrates that a time trend variable explains 82 percent of the observed change in the natural logarithm of the aggregate assessment-market value ratio. A plausible explanantion, consistent with the data appearing in table 1a, for this trend is that the change in aggregate assessed values in the city of Philadelphia has been small relative to changes in market values (with total number of "ratables" relatively constant). As shown in the third column of Table 1a, until 1971 aggregate assessed values in the city of Philadelphia never increased by as much as two percent, while even casual knowledge about the bulk of the land market in Philadelphia suggests that aggregate market values clearly have increased on average by more than two percent per annum during this period.[8]

Ordinary Least Squares Regression for the Aggregate Assessment-Market Value, Ratio over Time

$$\text{LAGRATIO} = \underset{(140.3^{**})}{4.20} - \underset{(-7.37^{**})}{.022}\ \text{TIME} \qquad (1\text{-}1)$$

$$\bar{R}^2 = .82 \qquad \text{SEE} = .045$$

SEE/mean (percent) = 1.14

where

LAGRATIO = the natural logarithm of the ratio of the sum of assessed values to the sum of property sales values multiplied by 100 for time period TIME

TIME = the calendar year minus 1957 (i.e., for 1958, TIME = 1, for 1959, TIME = 2, and so forth); time period used is 1958 through 1973, inclusive.

Table 1a - City of Philadelphia: The Total Value of Realty Assessments, Number of Taxable Parcels, and the Effective Assessment-Value Ratios, 1958-1974.

Year	Aggregate Value of Realty 1/ Assessments (Billions $)	Percent Change for Aggregate Value Over the Previous Year	Number of 1/ Taxable Parcels (thousands)	Aggregate Market Data 2/ Assessment-to-Sales Ratio (%)	STEB 3/ Ratio (percent)
1958				61.5	67.4
1959					67.5
1960	3.951		532		68.4
1961	4.029	1.95	534	58.8	68.7
1962	4.098	1.74	534	59.3	69.6
1963	4.180	1.99	537	59.7	69.6
1964	4.256	1.84	539	58.7	69.8
1965	4.309	1.23	539	58.2	69.8
1966	4.383	1.72	539	56.5	69.9
1967	4.439	1.27	539	56.5	69.9
1968	4.486	1.06	535	53.6	69.1
1969	4.547	1.35	532	51.4	69.1
1970	4.557	0.23	530	50.1	67.5
1971	4.787	5.03		47.8	67.2
1972	4.924	2.86	527		64.6
1973	5.089	3.36	527	42.9	64.4
1974	5.387	5.85	527	41.4	

1/ Source: Bulletin Almanac (Philadelphia: The Evening and Sunday Bulletin), several issues.

2/ Sources: a) For 1961- 1965, City of Philadelphia, Public Information Bulletin No. 5 (prepared and Issued by the Office of Director of Finance, June 1966).

Table la sources (cont.)

b) The 1971 Ratio was calculated from a random sample of 336 property sales in Philadelphia in 1971.

c) For 1958, 1966-1970, Report on Real Property Assessments and Real Estate Tax Revenue (Prepared by the Office of the Director of Finance, January 1971).

d) For 1973, City of Philadelphia "Property Sales" computer tape.

3/ Source: County, Local and School Prpoerty Tax Rates for Selected Boroughs, Cities, and Townships (Harrisburg: Pennsylvania Department of Commerce), several issues.

Table 1b: Assessment-to-Sales Ratio Variation Across Wards

Year	Mean Ratio for 1/ All Wards (percent)	Standard Deviation	Minimum	Maximum
1965	58.64	6.54	43.50	78.74
1969	53.40	5.50	39.53	66.32
1973	48.21	9.94	31.63	72.05

1/ The mean ratio for all wards is the average of the ward average Assessment-to-Sales ratios, and, in general, is expected to differ from Assessment-to-Sales Ratios in Table 1a, which were created by dividing the sum of all assessments for all recorded "arms-length" sale properties in all wards in the city by the corresponding sum of the recorded sales prices.

In theory, the declining aggregate assessment-value ratio for the city of Philadelphia does not necessarily imply that the property tax is systematically inequitable. For example, if all properties were assessed equitably initially, and as the aggregate ratio for the city diminished, if the ratio for each of the properties in the city declined in exactly the same fashion, the property tax would satisfy the uniformity measure for equity. Table 1b provides data about the aggregate ratio by wards in the city of Philadelphia. It is clear that, while the aggregate ratio for the city and the average ratio for wards is falling, there is a great deal of variation among wards and this variation is apparently increasing over time.[9] These facts create more than a prima facie case for systematic inequity across wards.

b) Inter-ward Ratio Differences in 1965, 1969, and 1973

Tables 2,3, and 4 examine the assessment-market value ratios for wards in the city of Philadelphia for 1965, 1969 and 1973, respectively, using the constant elastcity regression model discussed above. As mentioned earlier, property taxes are likely to be capitalized into market value and property tax assessments are supposed to be determined by market value as well. Put differently, market values and property taxes are to some extent jointly and simultaneously determined. In such a case, statistical estimation of the parameters of the basic model, regressing ratios on market value variables, using ordinary least squares (OLS) may yield statistically inconsistent estimates for the coefficients. Hence, in addition to OLS, an instrumental variable technique (INVR) was employed to estimate the basic model, as reported in tables 2,3, and 4.

The statistical results appear to be consistent in each of the three years considered, though the 1973 analysis, which is our principal focus, yields the best overall results. (The variable definitions and data descriptions appear in Appendix A and Appendix B below.) In particular, in all three years, wards with more expensive average valued properties have statistically significantly lower assessment-value ratios (and lower effective tax rates), as reflected in the statistically significant negative coefficients for LMV65, LMV69, and LMV73 in tables 2, 3 and 4, respectively. The larger the percentage of non-white population, using 1970 Census data, in a ward, on average, the higher the effective property tax rate (i.e., the coefficient of LPNW70 is positive). These results appear to be similar to those obtained for Philadelphia in A.D. Little's Study for HUD (1973). In that study, using an extremely small stratified sample of properties, upper and middle income areas with high and growing average market values received favorable property tax treatment relative to poor, non-white (and declining property market) areas.

Focusing on Table 4, the 1973 ward assessment-value ratio analysis, in addition to LMV73 (the average market value of properties), the growth rate of average market value between 1973 and 1969 (LMVGR) and the assessment-value ratio in 1969 (LRATIO69) have been added to the model's analysis. LMVGR is treated as endogenous in the INVR regressions because of capitalization-assessment considerations, and has a large negative statistically significant effect on the assessment-to-value ratio, even when the negative effect of the absolute average market value (LMV73) is included. That is, there exists both an absolute property value effect

(LMV73) and a property value growth effect (LMVGR); both effects tend to lower effective ward tax rates.

To the extent that one believes that there is a lag response in the reassessment process, it is logical to use the lagged assessment-value ratio as an explanatory variable for the current ward assessment-value ratio. To avoid a positive bias in the coefficient of this variable, equation 4-2 was estimated by INVR with LRATIO69, the lagged dependent variable, treated as "endogenous." The coefficient of the lagged assessment-value ratio is positive and appears to be statistically significant,[11] implying an inertia in the relative ward assessment-value ratios over time. That is, those wards with relatively high assessment-value ratios in 1969 are likely to have relatively high assessment-value ratios in 1973, and vice versa.

In each regression equation reported in table 4, the larger the percentage of non-white population within a ward as measured by the coefficient of the logarithm of the percentage of non-whites in the ward in 1970 (LPNW70), the higher the ward assessment-value ratio. In areas that experienced the greatest change in racial population shifts, going from white to non-white (LCPNW) from 1960 to 1970, and areas with the most active property markets, measured by the proportion of sales to total properties (LMOBL), the ward assessment-value ratios tended to be lower. Subject to the discussion in the next section, these statistical results appear to be consistent with the "reassessment lag" hypothesis. In any case, however, it is clear that ward assessment-value ratios do differ systematically, and are well-related to socio-economic and land market variables. Moreover, these relationships appear to have existed for some time.

Table 2: Ward[1/] Assessment-to-Sales Ratio Behavior in the City of Philadelphia for 1965:

Dependent Variable: LRATIO65

Independent Variables[2/]					$\bar{R}^2$	Method
LMV65	LPNW70	LCPNW	LPGRPOP	Intercept	SEE	Equation Reference
-.044	.038	-.087	.169	1.72	.274	OLS
(-2.85**)	(3.98**)	(-2.39*)	(2.01*)	(4.33**)	.096	2-1
-.039	.038	-.086	.168	1.68	.322	INVR
(-1.19	(4.09**)	(-2.38*)	(2.02*)	(3.05**)	.096	(LMV65 endogenous) 2-2

1/ In 1965, there were 60 wards in the city of Philadelphia

2/ For all subsequent tables in this paper, the numbers in parentheses below the estimated coefficients are student t-statistics, with +,++,*, and ** denoting statistical significance at 15%, 10%, 5% and 1% levels, respectively.

Table 3: Ward[1/] Assessment-to-Sales Ratio Behavior in the City of Philadelphia for 1969:

Dependent Variable: LRATIO69

Independent Variables				$\bar{R}^2$	Method
LMV69	LPNW70	LCPNW	Intercept	SEE	Equation Reference
-0.053	.038	-.076	2.42	.584	OLS
(-3.33**)	(7.04**)	(-3.68**)	(14.1**)	.067	3-1
- .060	.037	-.075	2.49	.581	INVR
(1.94++)	(6.12**)	(-3.61**)	(8.57**)	.067	(LMV69 endogenous) 3-2

1/ In 1969 and 1973, there were 66 wards in the city of Philadelphia

Table 4: Ward Assessment-to-Sales Ratio Behavior in the City of Philadelphia for 1973

Dependent Variable:LRATIO73

Independent Variables							$\bar{R}^2$	Method
LMV73	LMVGR	LRATIO69	LPNW70	LCPNW	LMOBL	Intercept	SEE	Equation Reference
- .086 (-3.63**)	- .146 (-3.78**)	.762 (5.02**)	.032 (3.54**)		- .046 (-2.33*)	2.81 (3.68**)	.826 .086	OLS 4-1
- .092 (-1.50+)	- .283 (-2.26*)	.835 (5.06**)	.021 (3.65**)		-.046 (-1.36)	3.31 (2.18*)	.802 .096	INVR (LMV73, LRATIO69 and LMVGR endogenous) 4-2
-.127 (-4.87**)	- .101 (-2.27*)		.052 (5.56**)		-.066 (-2.90**)	6.22 (15.0**)	.756 .102	OLS 4-3
- .117 (-5.99**)	- .191 (-6.49**)		.049 (3.84**)		- .069 (-1.79++)	6.53 (6.88**)	.752 .105	INVR (LMV73 and LMVGR endogenous) 4-4
- .122 (-4.70**)	- .093 (-2.12*)		.062 (5.79**)	- .623 (-1.77++)	- .462 (-1.84++)	6.31 (15.4**)	.766 .100	OLS 4-5
-.102 (-3.53**)	- .183 (-5.47**)		.060 (4.97**)	- .057 (-1.76++)	- .051 (-1.29)	6.47 (6.23**)	.755 .104	INVR (LMV73 and LMVGR endogenous 4-6

c) Tentative Evidence on Ward Assessment Practices

Tables 5 and 6 provide tentative evidence about the ward assessment practices, ostensibly supporting the "reassessment lag" hypothesis. Table 5 examines the change in ward assessment-value ratios between 1969 and 1973, using LRATIO7369ALL, the logarithm of the ratio of the 1973 ward assessment-value ratio to the 1969 ward assessment-value ratio, as the dependent variable.[12] A careful study of the results in Table 5 shows that there are statistically significant systematic relationships between the change in a ward's assessment-value ratio between 1969 and 1973 and socio-economic and land market variables, in a fashion that would be expected if the "reassessment lag" hypothesis were true.

In table 5 three variables, not surprisingly, each an important explanatory variable in the cross-sectional ward assessment-value ratio analysis above, possess strong statistical explanatory power in each of the regression equations: LMV73, the logarithm of the average market value for properties sold in each ward in 1973; LMVGR, the logarithm of the average rate of market value growth by ward between 1969 and 1973, and LPNW70, the logarithm of the percentage of non-white population within each ward, according to 1970 Census data. First, the 1973 ward assessment-value ratio relative to the 1969 ward assessment-value ratio tends to decline in areas with high average market values, *ceteris paribus*, as witnessed by the consistently and statistically significant negative coefficient for LMV73. Second, and similarly, the coefficients for LMVGR are statistically significantly negative, which suggests that wards experiencing relatively strong growth rates in average property values will tend to have relatively declining assessment-value ratios between

1969 and 1973. Third, the significant positive coefficient for LPNW70 indicates that non-white wards are likely to have relatively higher assessment-value ratios in 1973 versus 1969.

In addition, it is interesting to note that, according to the results presented in table 5, the level of market activity (LMOBL which measures the proportion of total properties that are sold within the ward in 1973) per se does tend, on balance, to reduce a ward's assessment-value ratio between 1969 and 1973. In part this might be the product of two underlying proclivities: 1) highly active property markets in Philadelphia have tended to be expensive, faster growing market value areas; and (2) reassessments do not systematically occur in general or sufficiently in the active market areas. This result is similar to and expected from our findings in table 4. Also, the absolute value of the assessment-value ratio for 1969, on balance, is not well-related to changes in the ward assessment-value ratios between 1969 and 1973. This appears to be particularly true when LMOBL, LMVGR, and LMV73 are included in the regression equation, with the latter two variables endogenous. This should not be surprising and may suggest that reassessment activity does not use, in any meaningful way, existing inter-ward assessment-value ratios as a guide for future adjustments. Overall, the results presented in table 5 are consistent with and suggest that there exists assessment inertia (i.e., lack of meaningful reassessment activity), generating the likely concommitant of ward assessment-value ratios that are market value activity determined phenomena.

Table 5: Effective Changes in Assessment-to-Sales Ratio for Wards Between 1969 and 1973 for the City of Philadelphia: All Properties

Dependent Variable: LRATIO7369ALL

Independent Variables						$\bar{R}^2$	Method
LMV73	LMVGR	LRATIO69	LMOBL	LPNW70	Intercept	SEE	Equation Reference
-.086	-.146	-.238	-.046	.032	6.87	.637	OLS
(-3.63**)	(-3.78**)	(-1.57+)	(-2.33*)	(3.54**)	(14.28**)	.086	5-1
-.073	-.160		.040	.206	6.35	.627	OLS
(-3.25**)	(-4.21**)		(2.03*)	(3.14**)	(17.94**)	.087	5-2
-.189	-.106	-.471	-.045	.025	8.55	.557	INVR (LMV73)
(-3.18**)	(-2.62*)	(-2.60*)	(-2.00*)	(2.36*)	(8.11**)	.099	endogenous) 5-3
-.069	-.260	-.133	- .046	.025	7.03	.615	INVR (LMVGR
(-2.12*)	(-2.55*)	(-.960)	(-1.26)	(2.36*)	(12.01**)	.092	endogenous) 5-4
-.043	-.232	.096	-.046	.029	6.45	.615	INVR (LMV73 & LMVGR endogenous)
(-8.76**)	(-6.36**)	(.592)	(-1.43)	(2.24*)	(11.14**)	.091	5-5

The regression outputs in table 6 provide additional insight into recent ward reassessment practices in the city of Philadelphia. In table 6, the dependent variables are LNCA7174 and LNCA7374, the logarithm of the percentage of total taxable properties with no change in assessed value within a ward between 1971 and 1974, and 1973 and 1974, respectively. (Presumably, since the city of Philadelphia has been under fiscal strains reassessments are usually "upward" changes only.) The regressions demonstrate that reassessment by ward (the obverse side of no change in assessment) is not well explained in terms of overall fit, especially over the 1971-1974 period, inclusive. The poor fit, in fact, seems to imply that the structure of the reassessment process does, to a large extent, lead to "random" or "arbitrary" adjustments in ward assessment-value ratios. However, an examination of the coefficients of the specific socio-economic and land market variables suggests that there appears to be a partial but very small underlying "corrective" adjustment pattern for reassessment, particularly for the last year considered, 1973-1974.

First, the strongest explanatory variate in table 6 is LPNW70, which has a positive coefficient in all equations and is significant in five of the six equations. These results denote that non-white areas, which are systematically over-assessed, are more likely not to experience assessment changes. Second, areas with poor housing stocks, as reflected by the positive and generally significant coefficient of the lacking plumbing variable (LPLM), are, as might be expected, less likely to be reassessed. (Of course, it might be argued that non-white and "run-down" areas need substantial reductions in assessed values in order to equalize

Table 6: Percent of Properties with <u>No</u> Change in Assessment, by Wards, between 1971 and 1974 in the City of Philadelphia

Dependent Variable	Independent Variables							$\bar{R}^2$	Method
	LMV69	LMVGR	LRATI069	LMOBL	LPLM	LNWP70	Intercept	SEE	Equation Reference
LNCA 7174	-.044		.809		.106	.094	4.99	.110	OLS
	(-.247)		(.666)		(.885)	(1.35)	(1.34)	.700	6-1
LNCA 7174	-.091				.115	.117	6.90	.116	OLS
	(-.554)				(.975)	(1.96*)	(2.91**)	.697	6-2
LNCA 7174	-.117	-.074		.388	.225	.158	6.04	.175	OLS
	(-.635)	(-.223)		(2.45*)	(1.56+)	(2.55*)	(1.52+)	.674	6-3
LNCA 7374	-.136		2.43		.263	.149	2.52	.306	OLS
	(-.582)		(1.53+)		(1.68++)	(1.63+)	(.514)	.917	6-4
LNCA 7374	-.276				.291	.219	8.27	.290	OLS
	(-1.27)				(1.85++)	(2.76**)	(2.62**)	.927	6-5
LNCA 7374	-.395	-.385		.522	.380	.262	9.80	.349	OLS
	(-1.62+)	(-.884)		(2.50*)	(2.00*)	(3.22**)	(1.88++)	.889	6-6

inter-area assessment-value ratios; no change in assessed values may not be sufficient to correct existing inequities.) Third, the negative coefficient (only significant in equation 6-6, however) for LMV69 indicates that higher market value areas, which as explained before are under-assessed systematically, are more likely to have changes in assessment. Similarly, the coefficient of LMVGR is negative, though not significant in any regression equation in table 6. Fourth, the magnitude and semi-randomness of this "corrective" reassessment practices effect is further illustrated by the barely significant positive coefficient of LRATIO69 in equation 6-4. That is, ward areas with higher assessment-value ratios are slightly less likely to be reassessed. Finally there seems to be a "counter-corrective" effect in the reassessment practices in the city of Philadelphia reported in the regressions in table 6. As one might expect because of the results obtained in table 5, the coefficient of LMOBL (equations 6-3 and 6-6) are positive and statistically significant. This might be interpreted to mean that more active land market areas in the city of Philadelphia, which generally are higher value areas, are less likely to be reassessed. Hence, the regression equations in table 6, taken as a whole, seem to indicate that the current reassessment practices in the city of Philadlephia are unlikely to lead in any substantial way to inter-ward assessment-value ratio equalization over time.

V - The Income Regressivity of the Property Tax

Two standard but important metrics of property tax equity are the income elasticity of the effective property tax rate (or, in this study, equivalently, the income elasticity of the effective assessment-value ratio) and the income elasticity for the property tax liability. In order to examine empirically the degree of property tax regressivity, using these two suggested income elasticity measures, three underlying issues must be understood: a) the nature of property tax shifting assumptions; b) the use of proper income variates, and c) the appropriate statistical specifications for the property tax regressivity model. Therefore, before presenting the empirical findings for the property tax regressivity model, these three issues will be discussed briefly.

a) Tax Shifting Assumptions

There are several alternative hypotheses about the shifting of taxes, which necessarily affect the eventual outcomes for the bearing of the ultimate tax burden. In a general equilibrium framework, in order to determine tax progressivity, one would need to know the distribution of capital ownership and consumption patterns economy wide, across all sectors and across all geographic districts. Moreover, one must assume to know the responsiveness and mobility of capital in all sectors in all geographic areas to changes in economic variables. Obviously, such an analysis requires an extensive understanding of the economy, and probably at some stage heroic assumptions.

Consider a simpler general equilibrium model. Assume a one commodity (housing services) economy in order to avoid any tax effects upon the composition of demand. Further, assume that the revenues from the property tax within a locale are used for government expenditures such that societal utility does not change (vis-a-vis the no tax situation). Given these assumptions, in a general equilibrium theory of tax incidence, the property tax can be shifted only by reducing the taxed activity, say, by reducing the quantity of housing supplied in the taxed district. If the taxed activity does not change, the original set of gross prices continues to clear the economy. With the original set of gross prices, only the net price of housing in the taxed district will change. Since the prices for housing in all other areas remain unchanged, the owners or consumers of the taxed area's housing must bear the entire burden. On the other hand, if the supply of the taxed activity changes, for example, by the movement of housing stock capital out of the taxed district to non-taxed districts, the burden of the tax will be shifted to other districts as well. Hence, even in this "simplified" general equilibrium model, one must know the mobility-response of capital across all areas to calculate tax burdens. An example of this type of analysis is discussed in Musgrave (1974) in the context of what he calls the Harberger-Mieszkowski model of tax incidence. It is clear that the general equilibrium approach, in theory, is correct; but requires substantive assumptions for operationalizing the analysis.

Our approach is more modest because of data and statistical modeling limitations. This paper utilizes assumptions characterized by Aaron (1974 and 1975) as the "traditional" assumptions for property tax shifting. Under this scheme, the property tax is fully shifted forward to renters and homeowners (in their role as consumers of housing services). Put differently, the property tax under these assumptions is a pure excise tax borne by the consumer of the product (i.e., housing services). Therefore, the real property tax is treated as a tax on land and structures that causes increases in the price of housing services; the burden of the property tax is borne in proportion to <u>consumption</u> of such commodities.[13]

b) <u>Proper Income Variables</u>

As has been noted by Aaron (1975) and Reid (1963), among others, normal or permanent income is the appropriate income concept for equity analysis. Normal income can be thought of as the flow of income per year that a household generates and expects to continue to generate from its human and non-human wealth. Observed income in any year contains normal and transitory income components; the latter tends to average zero over time and over groups of similar households in each time period. That is, the expected value of income (and the observed mean income for sufficiently large groups) equals the mean value of normal income for the group.

In the case that is studied here, that of owner-occupied housing, it is reasonable to believe that a significant portion of normal income for the household is created by the "implicit" rental income from the dwelling. This contribution to normal income should be added to the household's "earned" normal income (as reported in U.S. Census) to form an estimate of total normal income for the household. Further, it is reasonable to expect that housing consumption in small geographic sub-areas, such as Census tracts, tend to contain relatively homogenous housing consumption patterns. Using the ratio of mean annual rental income to mean market value of housing as reported in the Census, the rate of "normal" implicit housing services income per dollar of market value in each Census tract was calculated. This housing services rental income rate per dollar of market value multiplied by the average market value of residential properties for each tract, as reflected in the property sales transaction data, was utilized to estimate the "normal" average rental income component for households.

It should be noted that this is a rudimentary measure of rental income contributions to normal income, and, in principle, should be adjusted to take into account that housing expenditures and rentals probably are a declining share of normal income as income increases (i.e., the "normal" income elasticity is slightly less than unity). Also, the use of the gross normal income rather than a net estimate was necessitated by data limitations, though the net "normal" income would clearly be preferred for this analysis.

To understand the statistical estimation effect of not using the appropriate measure of income, consider the following example for TX, the dollar tax bill:

$$\ln TX = \alpha_o + \alpha_1 \ln (Y-H)$$

where Y is true income, and H is the omitted implicit income derived from housing services of owner-occupied dwellings. This can be written such that

$$\ln (R \cdot m \cdot \frac{H}{\lambda}) = \alpha_o + \alpha_1 \ln (Y - H) \qquad (5)$$

where it is assumed that $\lambda V = H$ and $R = \frac{A}{V} = \frac{A}{\lambda H}$. The "true" property tax-income expenditure elasticity is defined to be $e = (\delta H/\delta Y) \cdot \frac{Y}{H}$. Differentiating equation (5), and solving for e will yield

$$e = \frac{\alpha_1}{1 - \frac{H}{Y}(1 - \alpha_1)}$$

But α_1 is the estimate of e in the model above. Hence, if $\alpha_1 = 1$, then $e = \alpha_1 = 1$, and α_1 is an unbiased estimate of property tax equity. However, if $\alpha_1 < 1$ ($\alpha_1 > 1$) α_1 will be an underestimate (overestimate) of e. Therefore, in many cases, one would expect that the uncorrected normal income variable will engender statistically biased equity elasticity measures.

c) Appropriate Specification of the Model and Systematic Assessment Ratio Mal-Practice.

The failure to take into account variations in assessment practices across different socio-economic and geographic sub-areas can yield deceptive results in terms of measuring property tax equity. To illustrate this point, assume that equation (6) is to be estimated.

$$\ln TX = \ln (R \cdot m \cdot \frac{H}{\lambda}) = b_o + b_1 \ln Y \qquad (6)$$

If we assume that $m > 0$, $0 < R < 1$, $\lambda V = H$, $0 < \lambda < 1$, and now R is no longer considered to be a constant, then it can be shown that

$$b_1 = e_{HY} + e_{RY} \qquad (7)$$

where $e_{HY} = \frac{\delta H}{\delta Y} \cdot \frac{Y}{H}$ and $e_{RY} = \frac{\delta R}{\delta Y} \cdot \frac{Y}{R}$. Therefore, fixing e_{RY} as zero (i.e., no administrative variation in the ratio across socio-economic groups), when in fact, e_{RY} is negative (because $\frac{\delta R}{\delta Y} = \frac{\delta R}{\delta H} \cdot \frac{\delta H}{\delta Y} < 0$) will yield an over estimate of the property tax-permanent income elasticity, b_1. Put differently, the property tax will appear to be more income progressive than it really is.[14]

In addition to the assumed income responsiveness in the H and R variables, de Leeuw (1971) claims that it is appropriate to assume that λ, the proportion of housing value expended on housing services per period, varies with income. In such a case, an analysis similar to that for equations (6) and (7) would yield instead equation (8) or (8').

$$b_1 = e_{RY} + e_{HY} - e_{\lambda Y} \quad (8)$$

$$b_1 = e_{RY} + e_{HY} (1-e_{\lambda H}) \quad (8')$$

If $\lambda(H) \cdot V = H$, it is assumed that $\lambda(H) > 0$ and $\lambda'(H) \leq 0$. In either equation (8) or (8'), the observed income elasticity (b_1) would be the composite effect of the ratio-income elasticity, the housing expenditure-income elasticity, and the property value-income elasticity. However, treating e_{RY} and $-e_{\lambda Y}$ as zero, when they are negative and positive, respectively, is likely to lead to biased and understated values for the income elasticity, e_{HY}, using b_1 as the estimator.

d) Measuring the Income Regressivity of the Property Tax

Tables 7a, 7b, and 7c present the empirical results for our basic statistical model, equation 3 above, for the property tax-income elasticity on a Census tract basis for residential properties for the city of Philadelphis in 1973. The discussion of equation (8) and (8') explains that the property tax-income elasticity is a composite outcome, generated by the interaction of market value, housing expenditures, normal income, and assessment practices variables. In the case of Philadelphia, the residential real estate property tax appears to be (at least slightly) regressive because of assessment practices, despite the recent theoretical arguments to the contrary, such as Aaron (1975) or Musgrave (1974).

Table 7a explores the income-equity relationship for the assessment-value ratio and effective tax rate in Philadelphia. Equations 7-1 and 7-2 are Census tract analyses for 1973 data that most closely correspond to the results for the 1973 ward data in Table 4. It is interesting to note that the overall fit for the ward assessment-value ratios regressions is superior to the Census tract assessment-value ratios regressions. This, in part, may reflect that assessment administration is conducted on a ward basis. However, the statistical significance of the coefficients of the independent variable shows a remarkable similarity in both the Census tract and ward regressions. In particular, land market variables increases assessment-value ratios. Also, for the Census tract regressions, areas that have more rental housing (versus owner-occupied housing) experience higher assessment-value ratios as reflected by the positive coefficients of LRENTOWN, the proportion of renter to owner-occupied dwellings. This may reflect assessors' perceptions of home owners' political power.

In Table 4, income variables were not used because it was felt that for relatively large geographic sub-areas, such as wards, an "averaged" income variable would not be a meaningful economic measure. In contrast, Census tracts are relatively small geographic sub-areas with somewhat homogenous socio-economic characteristics, and an average income variable might be useful in this analysis. In Table 7a, equations 7-3 and 7-4, the Census tract assessment-value ratio, omitting LMV73, is negatively and statistically significantly related to measures of normal income (either LMINC or LMINCR). Re-running the analysis, but including LMV73 (equations 7-5 and 7-6) renders the income variable small, positive and statistically insignificant. That is, the assessment practices effect and income responses incorproated in the market value variable overwhelm the "pure" income elasticity. Overall, this might be interpreted to mean that the effective tax rate is regressive in terms of normal income, ostensibly because of assessment practices.

This last conclusion is the crux of our argument, and bears additional comment: The property tax assessment-value ratio-income elasticity is the resultant of two opposite forces; one is progressive and one is regressive. Obviously, if the property tax is regressive overall, the regressivity effect dominates. On the regressive side, the assessment-value ratio declines with market value, as demonstrated by equations 7-21 and 7-22 in Table 7c. This is the assessment practices effect, and is decidedly regressive. On the progressive side, the value-income elasticity is greater than unity, as illustrated by equations 7-19 and 7-20 in Table 7c. (Note that the value-income elasticity is the composite of the value-housing expenditure elasticity--which is thought to be greater than unity--and the housing expenditure-income elasticity--which is considered by many experts to be less than unity.) Hence, de facto assessment practices are sufficiently regressive to overcome progressive elements in the economics of the property tax.

Table 7b examines the relationship between the average tax dollar liability, income and other socio-economic variables. The elasticity coefficient of the income variable, with the exception of one case (equation 7-10) is never statistically significantly different from a value less than one (i.e., it is regressive). Comparing regressions in Tables 7a and 7b with the relevant equations in Table 7c illustrates that the use of an income variable itself, without controlling for specification bias (equation 4 in the basic statistical model above) will overstate the implied elasticity of the property tax-income function.

Therefore, on balance, under our tax shifting assumptions, it is plausible to conclude that the property tax, in practice is likely to be systematically inequitable and slightly regressive, adversely affecting poor, non-whites the most. The regressivity is caused ostensibly by inappropriate assessment practices. In fact, if property tax administration followed the letter of the law, the property tax would probably be progressive.

Table 7a: Measurement of Regressivity for the Real Estate Property Tax in 1973 for the City of Philadelphia: Residential Property Only, Census Tract Data

Dependent Variable: LRATIO73RES

Independent Variables							$\bar{R}^2$	Method
LMV73	LMINC	LPNW70	LCROWD	LRENTOWN	LMINCR	Intercept	SEE	Equation Reference
- .223		.026	-.035	.020		5.97	.677	OLS
(-13.14**)		(7.10**)	(-.635)	(1.69+)		(21.16**)	.123	7-1
-.214		.027	-.032	.021		5.88	.663	INVR (LMV73 Endogenous)
(-5.50**)		(10.72**)	(-.564)	(1.49+)		(22.00**)	.123	7-2
	-.205	.037	-.099	.010		5.96	.486	OLS
	(-4.73**)	(8.29**)	(-1.33)	(.606)		(10.24**)	.155	7-3
		.035	-.101	.009	- .264	6.55	.519	OLS
		(7.98**)	(1.46+)	(.579)	(-6.29*)	(11.94*)	.150	7-4
- .229	.023	.026	-.021	.022		5.76	.677	OLS
(-11.71**)	(.577)	(7.11**)	(-.359)	(1.79++)		(12.46*)	.123	7-5
- .244	.038	.025	-.016	.023		5.75	.661	INVR (LMV73 Endogenous)
(-1.96*)	(.237)	(12.94**)	(-.301)	(1.22)		(4.63*)	.123	7-6

Table 7b: Measurement of Regressivity for the Real Estate Property Tax in 1973 for the City of Philadelphia: Residential Property Only, Census Tract Data

Dependent Variable: LTXRES

Independent Variables							$\bar{R}^2$	Method
LMV73	LMINC	LPNW70	LCROWD	LRENTOWN	LMINCR	Intercept	SEE	Equation Reference
.843		.027	- .031	.002		2.23	.912	OLS
(46.92**)		(7.01**)	(- .535)	(.153)		(7.45**)	.133	7-7
.878		.030	- .019	.005		1.83	.903	INVR (LMV73 Endogenous)
(21.15**)		(11.28**)	(- .318)	(.303)		(6.40**)	.135	7-8
	.880	- .012	.280	.054		1.05	.298	OLS
	(8.56**)	(-1.15)	(1.60+)	(1.46+)		(.758)	.367	7-9
		.002	.367	.073	1.27	-3.19	.543	OLS
		(.231)	(2.67**)	(2.48*)	(15.39**)	(-2.95**)	.296	7-10
		- .0004	.279	.075	1.01	- .941	.527	INVR (LMINCR Endogenous)
		(- .056)	(2.69**)	(2.83**)	(9.00**)	(-1.38)	.275	7-11
.830	.051	.028	- .001	.008		1.76	.913	OLS
(40.28**)	(1.22)	(7.11**)	(- .188)	(.567)		(3.59**)	.130	7-12
.871	.011	.030	- .015	.005		1.79	.901	INVR (LMV73 Endogenous)
(6.58**)	(.063)	(14.15**)	(- .261)	(.258)		(1.35)	.131	7-13

Table 7c: Measurement of the Sources of Overall Income Regressivity for the Real Estate Property Tax in 1973 for the City of Philadelphia: Residential Properties, Census Tract Data

Dependent Variable	Independent Variables			$\bar{R}^2$	Method
	LMINC	LMINCR	Intercept	SEE	Equation Reference
LXTRES	.850		2.44	.297	OLS
	(10.03**)		(3.11**)	.367	7-14
LXTRES		1.16	-.641	.532	OLS
		(16.4**)	(-.961)	.300	7-15
LXTRES		1.08	.158	.521	INVR (LMINCR Endogenous)
		(11.17**)	(.174)	.301	7-16
LTYRES		1.05	.525	.513	OLS
		(15.79**)	(.842)	.280	7-17
LTYRES		.918	1.73	.497	INVR (LMINCR Endogenous)
		(10.13**)	(2.03*)	.283	7-18
LMV73	1.38		-3.15	.325	INVR (LMINC Endogenous)
	(10.52**)		(-2.59**)	.189	7-19
LMV73		1.47	-4.17	.571	INVR (LMINCR Endogenous)
		(13.30**)	(-4.02**)	.118	7-20
LRATIO73RES	-.519		4.02	.207	INVR (LMINC Endogenous)
	(-8.90**)		(7.40**)	.193	7-21
LRATIO73RES		-.550	4.40	.221	INVR (LMINCR Endogenous)
		(-9.34**)	(7.94**)	.173	7-22

VI- Summary-Commentary

This paper has examined the relationship between property tax assessments and the market value of real estate in Philadelphia. The legal statutes of that city require that the ratio of assessment to market value should be independent of land use and should be uniform for all properties. Information presented in this paper indicates that this objective of equity and neutrality is not satisfied for individual properties and that there is considerable variation in the assessment-value ratio across the sixty or so different wards of the city. The standard deviation of this statistic is as much as 20% of the mean for the city as a whole.

The most important conclusions of the paper are that the assessment-value ratio is lower in wealthier neighborhoods (wards) and that the assessment ratio is somewhat higher in non-white neighborhoods than in white neighborhoods. A representative result is that a doubling of income is associated with a 10% to 12% decline in the assessment to value ratio and that the assessment to value ratio is about 4% to 5% higher in an all-black neighborhood than in an all-white neighborhood. Taking an annual tax bill of $600 a year, these percentages translate into $60-$80 and $25-$30 a year, respectively. These are not large amounts but they are certainly not trivial either.

The paper clearly demonstrates a systematic relationship between socio-economic characteristics of neighborhoods and the assessment-value ratio. Whatever the reasons for the assessment differences, the results bring out the deviations from the neutrality principle and represent a serious shortcoming of assessment practices in Philadelphia that should be rectified.[15] Although it is difficult to say whether these results "generalize"to other jurisdictions, it would not be surprising to find that assessment practices do in fact favor more expensive residential properties in wealthier neighborhoods. Finally, the research presented in this paper is not intended to be definitive; rather is is intended to be highly suggestive for further work in variations in assessment practices, and for empirical work on the distributive effects of the property tax system.

LRATIO65 = Natural logarithm of the ratio of the sum of the assessed values to the sum of the recorded sales prices in 1965 (60 wards) for all properties sold in 1965, multiplied by 100.

LRATIO69 = Natural logarithm of the ratio of the sum of the assessed values to the sum of recorded sales prices in 1969 (66 wards) for all properties sold in 1969, multiplied by 100.

LRATIO73 = Natural logarithm of the ratio of the sum of the assessed values to the sum of recorded sales prices in 1973 (66 wards) for all properties sold in 1973, multiplied by 100.

LRATIO7369ALL = Natural logarithm of the ratio of the 1973 assessment to sales ratio over the 1969 assessment to sales ratio, multiplied by 100, for all "arms" length sales (66 wards).

LRATIO73RES = Natural logarithm of the ratio of assessment to sales for 1973 "arms length" transactions for all residential property (Census tracts).

LTXRES = Natural logarithm of the average property tax liability (4.475 x Ratio x average market value) for residential properties in 1973 (Census tracts); [Note: 4.475 was the millage rate in 1973].

LTYRES = Natural logarithm of the average property tax liability for residential properties in 1973 (Census tract), reduced by marginal Federal tax bracket (IRS) to generate effective net tax liability.

LMV65 = Natural logarithm of average market value of properties, by ward, in 1965, multiplied by 100, for all properties.

LMV69 = Natural logarithm of average market value of properties by ward, in 1969, multiplied by 100, for all properties.

LMV73 = Natural logarithm of average market value of properties, by ward, in 1969, multiplied by 100, for all properties.

LMVGR = Natural logarithm of ratio of average market value in 1973 to average market value in 1969, by ward, for all properties, multiplied by 100.

LPNW70 = Natural logarithm of percentage non-white population in 1970 (by ward and Census tract).

LPNW60 = Natural logarithm of percentage non-white population in 1960 (by ward and Census tract).

LCPNW = Natural logarithm of ratio of percentage non-white population in 1970 over the percentage non-white in 1960, multiplied by 100 (by ward and Census tract).

LNCA7174 = Natural logarithm of the percentage of properties in each ward that were not reassessed between 1971 and 1974, multiplied by 10.

LNCA7374 = Natural logarithm of the percentage of properties in each ward that were not reassessed between 1973 and 1974, multiplied by 10.

LMOBL = Natural logarithm of the ratio of the number of units sold in 1973 over the total number of units in the area in 1970 (ward and Census data), multiplied by 1000.

LPRENT = Natural logarithm of the ratio of rental units to owner-occupied units in 1970, by ward.

LPGRPOP = Natural logarithm of the ratio of the total population in 1970 to the total population in 1970, multiplied by 100, by ward.

LPLM = Natural logarithm of the ratio of units lacking planning to the total units in 1970, multiplied by 1000 (ward and Census tract).

LMINC = Natural logarithm of the mean family income, by Census tract, 1970 U. S. Census data.

LMINCR = Natural logarithm of the mean family income plus implicit average gross rental income from owner-occupied dwellings (1970 Census data), by Census tract. Rental income is gross rate of return on rental properties times 1973 average market.

LCROWD = Natural logarithm of the percentage, multiplied by 100, of units that are over-crowded (more than one person per room), by Census tract in 1970.

LRENTOWN = Natural logarithm of the ratio of Rental units to owner units in 1970 multiplied by 100 (Census tract).

Note: "L" as the first letter of a variable name denotes that the variable values are calculated in the natural logarithm.

Appendix B: Data Set Information

Ward Data

Variable	Mean	Standard Deviation	Minimum Value	Maximum Value
Number of "arms length" sales, 1969	369.9	224.6	33.0	1114.0
Average market value, 1969	$15,321	$21,370	$4,786	$177,250
Number of "arms length " sales, 1973	279.8	180.6	20.0	884.0
Average market value, 1973	$17,871	$12,050	$5,313	$ 76,603
Ratio of 1973 average market value to 1969 average market value (multiplied by 100)	131.3	34.6	43.2	235.9
Percentage of Properties with No Change in Assessment 1971 thru 1974--	46.3	26.0	1.0	91.0
1973 thru 1974 --	61.8	24.2	3.0	99.0
Percentage of Non-white population in 1960 --	33.0	34.9	1.0	97.0
in 1970 --	36.1	35.8	1.0	98.2

Census Tract Data: Residential Properties Analysis

Variable	Mean	Standard Deviation	Minimum Value	Maximum Value
Mean Family Income, 1970	$10,795	$3,302	$4,332	$29,137
Mean Family Income plus imputed Rental of Housing Services	$12,659	$3,730	$5,805	$32,385
Ratio of assessed value to sales value, 1973 (percentage)	43.8	8.4	30.1	78.7
Single-family residential sale value, 1973	$15,337	$9,701	$3,282	$119,970
Property tax liability, 1973	$328	$191	$92	$2,320

Footnotes

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1. According to Pennsylvania law, a first class county (such as the city of Philadelphia) is required to assess all non-exempt real estate parcels, irrespective of land use, at one-hundred percent of current "fair" market value. As a practical matter, no one believes this to be the situation; the courts, in fact, interpret that the legal obligation of a taxing jurisdiction is fulfilled satifactorily, when the ratios of assessed values to "fair" market values for all properties are ostensibly uniform (for some value of this ratio, perhaps different from one-hundred percent) throughout the county. Also, note that for the purposes of this discussion, "fair" market value is assumed to be determined by "arms length" bona fide sales values; this is not necessarily the exclusive method accepted by the courts in Pennsylvania.

2. In conjunction with this explanantion for inequitable property tax treatment,it is sometimes argued that many assessor errors are caused

by the relative paucity of recent comparable property sales for certain types of industrial, commercial and high-valued residential properties. If this were true, there is no reason to expect *a priori* that there should be persistent and systematically different over- or under-assessment of these types of properties relative to other types of properties. Second, it is argued that the reassessment of a property is more likely to occur after a sales transaction, and, of course, new properties are assessed in relation to their initial market value. Hence, if property values are rising, as they have been historically, recently sold and new properties will be relatively over-assessed, thereby, exacerbating both vertical and horizontal inequity of the property tax because of assessment lags.

3. There is evidence suggesting that there are substantial local neighborhood and sub-district differences in the quality and quantity of public services (and private amenities) received by people within the city (and school district) of Philadelphia. Moreover, these differences appear to be consistent with our neighborhoods A and B scenarios. An excellent discussion about the differences in the quality of local schools in Philadelphia is contained in B. Wolfe and A. Summers (1974).

4. For example, see Oates (1969) for a heralded major work on the capitalization of property taxes and public services. Though the precision and universality of Oates' empirical results have been under attack, for example, by Edel and Sclar (1974) and Hamilton (1976), the existence of a capitalization effect for appropriate and *relevant* local public expenditures on public services appears to be ostensibly correct.

5. In the subsequent analyses, a "weighted"ratio is used. The weighted ratio for subarea i in time period t is defined to be the sum of the assessed values for all properties in subarea i in period t that experienced "arms length" sales divided by the sum of the market values,as reflected in "arms length" sales prices, for the corresponding properties. It is a weighted ratio because it takes into account the individual assessment-to-market value ratios for each property, and simultaneously the market value for each parcel relative to the market values for all parcels used in the calculation. This is to be contrasted with the simple or unweighted average ratio, which is calculated by taking the average of the individual parcel ratios, without accounting for differences in relative parcel market values.

6. It is well-known that effective tax rates for individual properties within a taxing jursidiction, or across taxing jurisdictions, are highly variable. Therefore, on a micro-level, the property tax is considered to be vertically and horizontally inequitable. See, for examples, U.S. Bureau of the Census, Census of Government (1962, 1967, or 1972), Edelstein (1974), or Engle (1975).

7. The Census of Government data for aggregate average assessment-to-sales ratio (calculated by use of sampling property sales) essentially corroborates our absolute values and trend in market value ratio calculations; the Census of Government reports ratios of 57.7, 58.5, and 43.2 percent for 1961, 1966 and 1971, respectively. U.S. Bureau of the Census, Census of Government 1962, 1967, and 1972.

8. As a side note, but one that is important in terms of its public finance implications for schools and tax payers in the city of Philadelphia, the State Tax Equalization Board (STEB) allegedly calculates the assessment-to-sales ratio for the city in each year (the last right hand column in Table 1a). This ratio is used to determine the aggregate market value of taxable property in the city (and similarly for each school district within the Commonwealth of Pennsylvania). The market value, certified by STEB, is then utilized to allocate state subsidy funds for education by school district. The implied exaggerated STEB ratio for the city of Philadelphia, ceteris paribus, will decrease the city's apparent aggregate market value, and, thereby increase the city's share of state educational funds. Therefore, it is likely that the city of Philadelphia receives, according to existing laws and legislative regulations, too large a state subsidy for education.

9. Table F-1 shows that for 1965 and 1973 that all property types are not treated the same; residential land uses on average receive the most favored assessment-to-sales ratio treatments. Incidentally, in the subsequent empirical analyses, the regression results for all properties usually yield better statistical results than for similar regressions (not shown in this paper) for sub-aggregated property land uses, except for residential land uses.

Table F-1

Aggregate Assessment-to-Sales Ratios, By Property Land Use, in Philadelphia 1965 and 1973.

Property Type	Aggregate Mean Assessment to Sales Ratio (Per Cent) 1965	1973
All Properties	58.2	42.9
Private Residential	57.1	40.5
Apartments and Hotels	62.1	43.7
Store and Dwelling	62.8	51.6
Commercial	57.5	50.5
Industrial	64.8	48.5
Vacant Ground	47.5	44.6

10. See J. Johnston (1972), pp. 278-281 for a description of the instrumental variables estimation procedure.

11. A positive bias would be expected to occur if the disturbance term were correlated with the lagged dependent variable. In this model of ward assessment-to-sales ratios, this could reflect a common ward-specific component in each year's disturbance. See P. Balestra and M. Nerlove (1966) and M. Nerlove (1971) for a more complete discussion of such models.

12. In 1973 and 1969, there were 66 distinct and identical geographic wards within the city of Philadelphia. Unfortunately, for 1965, there were 60

wards, most of which are not geographically comparable to the 66 ward configuration. Hence, an analysis of ward assessment-value ratio changes back through 1965 was not possible.

13. In a perfectly adjusted Tiebout world, anticipated property tax differentials and local public services will be fully capitalized into market values. In such circumstances, under our incidence assumptions, once market value adjustments have been completed, no one gains or loses (in a utility sense) from property taxes. However, for many reasons it is unlikely that the world is not perfectly Tiebout, especially in terms of the mobility and capital market access for poor, non-whites in the housing market . To the extent poor, non-whites do not have appropriate alternative market options, property taxes will be borne by them, without full capitalization possibly because of a relative inelastic demand for housing in the "ghetto." Therefore, the likely existence of market imperfections, under our assumptions of shifting, will create relative property tax burdens across different socio-economic groups.

14. Aaron (1975), p. 37 is aware of this possibility, though his data can not be used to perform adequate analysis on this point.

15. From an economist's point of view, of course, it may be optimal to have some degree of property tax inequity; the "optimal" degree of inequity of the property tax will obtain when the social marginal benefits will be equal to the social marginal costs for correcting further the inequity.

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