DE FACTO DISCRIMINATION IN RESIDENTIAL ASSESSMENTS: BOSTON

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ABSTRACT

This paper presents empirical results on the dynamics of the residential assessment process and examines the effects of this behavior upon the distribution of the tax burden between neighborhoods of the same political jurisdiction. The principal finding is that assessments are rarely changed and therefore the tax burden is shifted toward neighborhoods with relatively slow rates of increase in property values. Failure to adjust assessments for relative price changes leads to inequities which are called de facto discrimination.

Many studies have documented striking and systematic variations in assessment sales ratios for Boston and other large cities, [3], [8], [10], and [11]. In general, these studies show that lower income or blighted neighborhoods tend to be over-assessed. It is largely because of such inequities in the implementation of a property tax that many economists believe that the tax is regressive in spite of theoretical arguments which suggest the opposite, [1], [7], [9]. The weaknesses of the assessment system have become so notable that many locations are moving toward 100 percent valuation as the legal and practical basis for assessments, [6], [12], or toward computerized assessing.

In spite of these criticisms of the existing assessment practices, there is little agreement on the causes of differing assessment-sales ratios. Oldman and Aaron [8] originally speculated that this difference could be due to an implicit benefit principle as practiced by the assessor himself. If some structures receive more public services than others, they should be taxed (assessed) more heavily. Peterson [11] (page 110), suggests instead that much of this is due to a “failure to adjust assessed valuations downward as market values decline.” The high assessment sales ratios in blighted neighborhoods are a result more of falling property values than of discriminatory assessment practices.

In order to distinguish between these two explanations, time series data are necessary on both assessments and property values. If the benefit principle is the main motivation, then assessment sales ratios should remain constant over time or at least change proportionately in different areas. On the other hand, if failure to reassess is the major cause, then assessment sales ratios should fall fastest in areas with rapid price increases.

In this paper, long time series of assessments and property values are constructed for small geographic areas within Boston’s tax jurisdiction. The principal finding is that assessments are rarely changed and therefore the tax burden is shifted toward neighborhoods with relatively slow rates of increase in property values. Failure to adjust assessments for relative price changes leads to inequities which are called de facto discrimination. Evidence is also presented that the base levels of assessment sales ratios are different in the individual communities, so that the benefit concept may be responsible for some of the differences.

I. Methodology

Constructing indices of either assessments or prices, generally requires good data on attributes of the structures in the sample. To avoid this difficulty a method described by Bailey, Muth and Nourse, [2] was used. This method is based upon the fact that when one property is sold twice, it is known that its basic attributes are the same. If the price of the ith property is determined by its attributes $A_i$, some structures receive more public services than others, they should be taxed (assessed) more heavily. Peterson [11] (page 110), suggests instead that much of this is due to a “failure to adjust assessed valuations downward as market values decline.” The high assessment sales ratios in blighted neighborhoods are a result more of falling property values than of discriminatory assessment practices.

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and by the time period in which it is sold, then we might write:

\[ P_t = f(A_t)B_t e^{ut} \]  

where \( B_t \) is an index describing the change in value of all the properties the neighborhood, \( f(A_t) \) is a function relating the attributes to prices, and \( u \) is an error term. Taking logs and subtracting the observation of the price in another period, \( t' \), when the same property is sold, yields:

\[ \log \left( \frac{p_t}{p_{t'}} \right) = b_t - b_{t'} + u_t - u_{t'} \]  

where \( b = \log(B) \). From this relation, the \( b \)'s can be estimated by ordinary least squares.1

There are several assumptions implicit in specification (1). First, all value classes and property types in the neighborhood are assumed to experience the same rate of growth of prices although of course there is no need for the price levels to be the same. This assumption is testable and in several cases Chow tests were run to determine whether the indices for different property types or value classes were significantly different. The results almost always indicated no significant differences. Second, it is assumed that the structure is unchanged between sales. This can cause a serious bias to the indices if there is substantial upgrading or deterioration of the property. No properties were included which showed a change of use or number of units between sales. Nevertheless, there is some bias in the estimates and therefore the indices are interpreted as the price change which a “typical” unit would experience. As far as the assessment sales ratios are concerned, however, there is no bias since the assessments in principle should be similarly increased. Third, a sample of properties which are sold twice is assumed to be a random sample of the population. This is only slightly more restrictive than using a sample of properties sold once, since the sample period is so long.

Indices were constructed for each of the 14 Boston Redevelopment Authority defined planning districts within the city. The data were taken from state tax stamps affixed to the deed at the time of sale and recorded by the Metropolitan Mortgage Bureau. In addition, the current assessment, structure type, address and date were recorded. Only properties with all of this information at two points of time in the sample period were used. In addition, in order to obtain a geographically dispersed sample, properties on each street were taken in proportion to the number of addresses on that street which lay in the district. This procedure was supplemented at random geographically in order to obtain at least ten sales per year if there were that many in the district. Thus the sample is intended to be uniform both geographically and over the time period.

II. The Dynamics of Assessment

Several of the important features of the assessment process can be seen by simple examination of the sample of sales data. Altogether, 3379 Boston properties were examined, each of which was sold twice within the sample period at intervals greater than one year, and often twenty or more years apart. By looking at the assessments at these two points of time, it is possible to make casual inferences about the process.

The most striking feature of this data is that 85 percent of these properties were not reassessed between sales. This can cause a serious bias to the indices if there is substantial upgrading or deterioration of the property. No properties were included which showed a change of use or number of units between sales. Nevertheless, there is some bias in the estimates and therefore the indices are interpreted as the price change which a “typical” unit would experience. As far as the assessment sales ratios are concerned, however, there is no bias since the assessments in principle should be similarly increased. Third, a sample of properties which are sold twice is assumed to be a random sample of the population. This is only slightly more restrictive than using a sample of properties sold once, since the sample period is so long.

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If assessments adjust fully to changing property values, the assessment indices in any year should be equal to the sales indices. In Table II the percentage change of the assessment, sales and assessment/sales indices from 1946 to 1971 are presented as well as the ranking among neighborhoods. It is immediately clear that assessments have changed very much less than sales prices. While property values went up five or six times in some communities, the assessment index nowhere increased by more than 50 percent over the entire 25 years. Even the commodities component of CPI, a measure of alternative goods, has increased by about 62 percent over the last 25 years and thus assessments have fallen in real terms in every community. If assessments were equitable in 1946, the third column indicates the magnitude of the 1971 inequity. The difference between the most and least favored district is a factor of two and a half.

There does however seem to be a systematic relation between increases in prices and assessments. Except for Charlestown, the areas with rapid price increases have above average assessment increases and those with negative or small increases in assessments have below average price increases. Thus again it appears that the assessors are somewhat responsive to changes in property values and in particular are willing to lower assessments in neighborhoods with relatively declining property values. The magnitude of the readjustments are however, much too small. The assessment sales ratio has fallen fastest in those neighborhoods with the most rapid price increases.

To estimate a response function for assessments, a simple regression model was fitted cross sectionally. Using 25 year changes in assessments and sales indices, the result is:

\[
\log\left(\frac{A_t}{A_0}\right) = - .32 + .331 \log\left(\frac{S_t}{S_0}\right)
\]

\(R^2 = .47\)

\(SE = .11\)

\(-2.34\) (3.26) (4)

The value .331 is an estimate of the elasticity of assessments with respect to sales prices. Equation (4) was also estimated for the first fifteen years and the last ten years in order to see if the process
### TABLE II

Assessment and Sales Indices 1971  (1946 = 100)*

| District             | Assessment | Rank | Sales  | Rank | Assessment/Sales | Rank |
|----------------------|------------|------|--------|------|------------------|------|
| East Boston          | 108.4      | 8    | 382.5  | 6    | 28.4             | 5    |
| Charlestown          | 99.2       | 13   | 618.0  | 1    | 16.1             | 1    |
| South Boston         | 107.5      | 9    | 347.0  | 8    | 31.0             | 7    |
| Central/North End    | 142.7      | 2    | 554.5  | 2    | 25.7             | 4    |
| Back Bay/Beacon Hill | 148.9      | 1    | 498.3  | 4    | 29.9             | 6    |
| South End            | 121.0      | 4    | 490.9  | 5    | 24.7             | 2    |
| Fenway Kenmore       | 135.6      | 3    | 532.2  | 3    | 25.5             | 3    |
| Allston/Brighton     | 111.4      | 5    | 350.7  | 7    | 31.8             | 9    |
| Jamaica Plain        | 99.7       | 12   | 296.6  | 12   | 33.6             | 10   |
| Washington Park      | 86.0       | 14   | 217.4  | 14   | 39.6             | 13   |
| Roslinadle           | 102.6      | 11   | 328.5  | 9    | 31.2             | 8    |
| West Roxbury         | 111.4      | 5    | 317.5  | 10   | 35.1             | 11   |
| Hyde Park            | 111.3      | 7    | 299.6  | 11   | 37.1             | 12   |
| Dorchester           | 102.7      | 10   | 257.1  | 13   | 40.0             | 14   |
| All Boston           | 110.3      | 10   | 357.1  | 13   | 32.4             |      |

*Geometric average of indices for 1970, 1971, 1972 minimizes local fluctuations due to multicollinearity in estimation, and will not produce bias if the growth rate is approximately constant over the period.

was stable over time. The elasticities were .331 and .155 with standard errors of .123 and .075 respectively, and therefore the responsiveness of assessments is, if anything, less now than in the past.

Two simple hypotheses can be tested from this result. If there is no shift of the tax burden resulting from changes in property values, then the coefficient of the price term should be unity. The burdens may differ such as under the benefit principle, but the distribution will not change with changing property values. The constant term will allow all assessment sales ratios to fall together, as long as the elasticity of assessments with respect to property values is one. If this elasticity is less than one, there will be a shift in the tax burden toward the communities with relatively low rates of increase in property values.

The most extreme version of assessment failure would be a complete lack of response of assessments to prices. This hypothesis is formulated as a zero elasticity of assessments with respect to prices.

The empirical results strongly reject the pure benefit principle, and indicate that assessments increase only about a third as much as prices. The complete failure to adjust assessments is also rejected at the 95 percent level for all periods but not at the 99 percent level for sub-periods. So, in conclusion, the data suggest that assessments do respond to property value changes but
not nearly enough to maintain a constant distribution of the tax burden. Communities with relatively slow increases in property values will suffer from de facto discrimination in their residential assessments.

III. The Levels of Assessments

The preceding analysis has shown the dramatic changes in assessment sales ratios over the last twenty-six years. The ratios have fallen to a mere 16 percent to 40 percent of the initial levels over this period. The different rates of decline have led to substantial shifts in the tax burden toward areas with slowly increasing property values.

On the basis of this analysis, it is not possible to tell which communities bear the highest tax burden. This depends on the initial levels of assessment sales ratios as well as their subsequent evolution. In this section, the same data on property sales and assessments will be reexamined, without using the special indices, in order to compare the tax rates faced by different areas of Boston. In particular, these relative tax rates may provide evidence of the benefit principle, at least in the early portions of the sample period.

Raw assessment sales ratios were calculated for each neighborhood in each year, ignoring the mix of properties in each sample. These assessment sales ratios are available from the author and, for the early sixties, are in close agreement with the residential figures of Oldman and Aaron. The sampling error is, however, rather large, since there are few observations per cell.

In 1946, the average assessment sales ratio for Boston as a whole was 96 percent, while in 1972 it was only 29 percent. In the last 26 years Boston has passed from a 100 percent valuation procedure to a very small fractional valuation method. As expected, this change has not fallen equally on all neighborhoods. Table III shows the decline of assessment sales ratios for four representative areas.

The broad pattern of these results indicates that at the beginning of the sample period, the central city districts had the highest assessments, frequently over 100 percent, while the more suburban areas such as West Roxbury, Hyde Park and Roslindale, had low ratios. The intermediate, dense, ethnic neighborhoods of South Boston, East Boston, Dorchester and Jamaica Plain originally had assessment ratios between these extremes. One could argue that this distribution of tax burden corresponds to an implicit benefit principle practiced by the assessment office. The central city areas receive more public services and therefore are taxed more heavily.

However, over time, the growth of prices in the central districts was so rapid that in the early sixties, they passed the intermediate neighborhoods which were growing more slowly. By 1970, these districts had almost reached the levels of the suburban districts and had far outstripped the intermediate neighborhoods. If the benefit principle were originally appropriate, the new tax rates are not. As a result of assessor inertia, the gap between central city assessments and suburban assessments narrowed. Of course, if history is any guide, the central areas will soon be assessed even lower than the suburbs.

The neighborhoods which are hurt by these developments are the intermediate areas and Washington Park (Roxbury). Many of the intermediate neighborhoods are now substantially above the all city averages. The most important inequity is in Washington Park. This section of the city was originally assessed at a rate comparable with the central city districts. Over time, it has become a blighted neighborhood and has had very slow growth of prices, and thus its assessment sales ratios have fallen slowly relative to the other central zones. By 1970 the tax rate in Washington Park was 35 percent higher than in any other neighborhood, and 50 percent higher than the Boston average. In 1969 the estimated tax rate was more than double the rate in 10 of the other 13 neighborhoods. This very substantial inequity between neighborhoods illustrates the need to improve assessment practices to minimize the effects of this type of de facto discrimination.
### TABLE III
ASSESSMENT-SALES RATIOS
FOR SELECTED BOSTON NEIGHBORHOODS, 1946-72

| Year | Washington Park | Central/ North End | East Boston | Hyde Park |
|------|-----------------|--------------------|-------------|-----------|
| 1946 | 1.193           | 1.096              | 0.797       | 0.620     |
| 1947 | 1.041           | 1.098              | 0.659       | 0.489     |
| 1948 | 1.036           | 0.674              | 0.562       | 0.642     |
| 1949 | 0.810           | 1.040              | 0.620       | 0.432     |
| 1950 | 0.701           | 0.820              | 0.632       | 0.451     |
| 1951 | 0.800           | 0.776              | 0.478       | 0.492     |
| 1952 | 0.717           | 0.886              | 0.442       | 0.393     |
| 1953 | 0.619           | 0.757              | 0.627       | 0.466     |
| 1954 | 0.571           | 0.833              | 0.426       | 0.401     |
| 1955 | 0.664           | 0.754              | 0.464       | 0.384     |
| 1956 | 0.580           | 0.845              | 0.475       | 0.364     |
| 1957 | 0.711           | 0.446              | 0.464       | 0.304     |
| 1958 | 0.595           | 0.622              | 0.449       | 0.322     |
| 1959 | 0.653           | 0.581              | 0.537       | 0.348     |
| 1960 | 0.569           | 0.449              | 0.423       | 0.318     |
| 1961 | 0.669           | 0.514              | 0.421       | 0.299     |
| 1962 | 0.578           | 0.388              | 0.466       | 0.311     |
| 1963 | 0.753           | 0.451              | 0.408       | 0.303     |
| 1964 | 0.606           | 0.850              | 0.378       | 0.276     |
| 1965 | 0.593           | 0.373              | 0.434       | 0.262     |
| 1966 | 0.718           | 0.314              | 0.387       | 0.263     |
| 1967 | 0.556           | 0.357              | 0.498       | 0.254     |
| 1968 | 0.557           | 0.403              | 0.305       | 0.231     |
| 1969 | 0.644           | 0.309              | 0.347       | 0.242     |
| 1970 | 0.491           | 0.234              | 0.365       | 0.206     |
| 1971 | 0.355           | 0.245              | 0.283       | 0.218     |
| 1972 | 0.464           | 0.266              | 0.261       | 0.206     |
REFERENCES

1. Aaron, Henry, “A New View of Property Tax Incidence,” The American Economic Review, 64 (May 1974), pp. 212–220.

2. Bailey, Martin J., Richard F. Muth, and Hugh O. Nourse, “A Regression Method for Real Estate Price Index Construction,” Journal of American Statistical Association, 58 (1963), pp. 933–942.

3. Black, David E., “The Nature and Extent of Effective Property Tax Rate Variation Within the City of Boston,” National Tax Journal, 25 (June 1972), pp. 203–210.

4. Bradbury, Katharine, Robert Engle, Owen Irvine and Jerome Rothenberg, “Simultaneous Estimation of the Supply and Demand for Household Location in a Multizoned Metropolitan Area,” in NBER Studies in Income and Wealth, Gregory K. Ingram, ed., “Conference on Economics of Residential Location and Urban Housing Market,” Cambridge, Mass., May 15–16, 1975.

5. Engle, Robert F., F. M. Fisher, J. R. Harris, and J. Rothenberg, “An Econometric Simulation Model of Intra-Metropolitan Housing Location: Housing, Business, Transportation and Local Government,” The American Economic Review, 62 (May 1972), pp. 87–97.

6. Holland, D. and O. Oldman, Estimating the Impact of 100 Percent of Market Value Property Tax Assessments of Boston Real Estate, Boston Urban Observatory.

7. Musgrave, Richard A., “Is a Property Tax on Housing Regressive?” The American Economic Review, 64 (May 1974), pp. 222–229.

8. Oldman, Oliver and Henry Aaron, “Assessment—Sales Ratios Under the Boston Property Tax,” National Tax Journal, 18 (March 1965), pp. 36–49.

9. Peterson, George E., “The Issues of Property Tax Reform,” in Property Tax Reform, Peterson, ed., The Urban Institute (1973), p. 5.

10. __________, “The Property Tax and Low-Income Housing Markets,” in Property Tax Reform, Peterson, ed., p. 111.

11. __________, Arthur Solomon, Hadd Madjid, William C. Apgar, Jr., Property Taxes, Housing and the Cities, (Lexington, Mass: D. C. Heath and Co.), 1973.

12. Wheaton, William C., “The Statewide Impact of Full Property Revaluation in Massachusetts,” unpublished manuscript, 1975.

FOOTNOTES

1 In econometric matrix notation, observations on (2) can be combined to give
\[ y = Xb + \epsilon \] (3)
where the observations on \( y \) are \( \log (p_t/p_{t-1}) \) and each row of \( X \) is a set of zeros and ones such as:
\[ X_i = (0, 0, 0, 1, 0, 0, -1, 0) \]
where the one and minus one correspond to the \( t \) and \( t-1 \) period. Assuming that errors between properties are uncorrelated and that all have equal variance, equation (3) should be estimated by least squares. Clearly there must be no constant term and one column of \( X \) must be eliminated (the base year) in order to avoid exact multicollinearity. Equation (3) can be fitted for assessments, sales, or their ratio. However, since the \( X \) matrix is the same for each, the index of the ratio of assessments to sales will be numerically equal to the ratio of the indices for assessments and sales calculated separately.

2 This is not exactly the \( F \) statistic printed from the regression output since there is no constant. Letting \( I^2 = 1 - e'e'y \) where \( e' \) is the vector of residuals from (3) and \( y \) is the dependent variable, the statistic
\[ F = (I^2 / I) (N - K)/K \]
is distributed as \( F_{K,K-N} \) under the null hypothesis.