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The Response of City Government Revenues to Changes in Employment Structure†

Roy W. Bahl and David Greytak*

INTRODUCTION

The changing level and composition of central city employment and the revenue performance of city tax systems are at the heart of the study of urban problems, and each of these topics has been a subject of extensive research. Study of the relationship between the two, however, has focused on how tax levels affect location decisions. The mirror issue—how employment changes affect tax levels—has not been given serious attention.

The specific objective of this paper is to identify and measure the revenue yield implications of the changing composition of city employment. In the sections following, a descriptive model is developed and then estimated with data for New York City. The policy goal of such analysis is to determine what the changing level and composition of central city employment—towards a heavier concentration in the government and service sectors—means for the revenue yield of the city tax structure. More generally, the issue is how biases in the city’s tax system translate into revenue effects as the city’s overall capital/labor ratio declines.

THE MODEL

The per employee (N) level of tax revenues accruing to a city government (R) may be defined as

$$\frac{R}{N} = \sum_{i} \frac{R_{ij}}{N_i} + \frac{R_o}{N}$$

where $R_{ij}$ refers to the total tax revenues attributable to employment in sector $i$, and to the $j$th tax—property, business income, personal income, sales and “all other” in this analysis. All direct taxes by firms in sector $i$ and all personal taxes paid by employees in sector $i$ are attributed directly to employment in that sector. The term $R_o$ refers to city government tax revenues generated by persons not employed in the central city.

†The authors are indebted to Jesse Burkhead, Bernard L. Weinstein, and anonymous referees for a number of helpful comments, and to David Bjornstad for his help in assembling and aggregating the basic data. This work is an outgrowth of a larger research project on the public finances of New York City, financed by the New York State Division of the Budget.

*The authors are, respectively, Professor of Economics and Director, Metropolitan Studies Program; and Associate Professor of Economics and Associate Director, Metropolitan Studies Program, The Maxwell School, Syracuse University.
In general, the ratio of revenues to employment is meant to describe the level of collections per unit of economic activity. There are a number of reasons for choosing the employment base, rather than the income base, as a gauge of the level of economic activity in a sector. First, employment data are collected and reported on an industry basis, and in a form which is more consistent, comprehensive and detailed than are income data. Second, the principally used measure in virtually all analyses of core city decline is employment loss [Hoover and Vernon 1959; Birch 1970]. Third, employment is the measure most commonly applied in analyses of urban structure and urban economic base changes [Tiebout 1962]. Its use here, therefore, allows a comparison with other studies of the changing composition of the urban economy. Finally, labor and capital are the primary mobile inputs in the productive process in urban areas and, of the two, at least measurement ease would dictate the choice of the employment unit. For these reasons, and given the goal of this analysis—to estimate the revenue response to a changing economic base—the employment unit seems particularly appropriate.

In the paragraphs below, the models used to establish the relationship between revenue and employment for each of the four principal forms of taxation (property, business, personal income, and sales), are presented. In these models, the revenue response to a shift of employment between industries depends on the assessment process, the rate and base structure of the various taxes, and interindustry differences in four factors: capital/labor ratios, the commuting patterns of employees, the income elasticity of employee demand for housing, and the consumption patterns of commuters and residents.

The model is developed here in a context of the New York City tax system, but this does not limit the generality of the model. The New York City tax system is one of the most complicated and inclusive in the country, and therefore requires a more refined model than would other cities.

Total property tax revenues \( PR_i \) accruing to the city government and attributable to any particular employment sector, \( i \), may be written as the sum:

\[
PR_i = PR_i^{nr} + PR_i^r (\mu_i)
\]

where:

\( PR_i^{nr} \) = nonresidential property tax payments generated in the \( i \)th employment sector;

\( PR_i^r \) = residential property tax payments generated in the \( i \)th employment sector;

\( \mu_i \) = the proportion of city employees in the \( i \)th sector who reside within the boundaries of the city.

\( PR_i^r (\mu_i) \), then, measures the residential property tax revenues accruing to the city government which are generated by employees in industry \( i \). Note that \( \mu \) may vary across the \( i \) employment sectors, \( i \).

\( 1 \)In 1970, revenues from these taxes accounted for 73 percent of local tax revenues in New York City. In the remainder of this paper, discussion of “other” taxes, and revenues not associated with employment \( (R_o) \) are omitted.

\( 2 \)A discussion of the structure and recent revenue performance of the New York City tax system is contained in Bahl, Campbell and Greytak [1974].

\( 3 \)Analysis of the employment effects of the property tax are more fully covered in Bahl and Greytak [1976].

\( 4 \)It is worth noting that we do not build the “reverse commuting” possibility into the model. We omit this because our primary concern is the revenue effect of changes in city employment structure.
but that we assume, for simplicity, that effective property tax rates are equal across jurisdictions.

Revenues from the taxation of non-residential property may be defined as:

\[ PR_{i}^{nr} = ra_{i}^{nr} \left( \frac{P}{S} \right) \left( \frac{S}{N} \right) N_{i} \]  

where:

- \( r = \) the nominal tax rate;
- \( a_{i}^{nr} = \) the ratio of assessed to market value of nonresidential property;
- \( \left( \frac{P}{S} \right)_{i} = \) market value per square foot of taxable nonresidential property used in sector \( i \);
- \( \left( \frac{S}{N} \right)_{i} = \) the average quantity (number of square feet) of taxable property per employee in sector \( i \);
- \( N_{i} = \) the level of employment in sector \( i \).

Residential property tax revenues are defined as:

\[ PR_{i}^{r} = ra_{i}^{r} \left( \frac{H}{Y} \right) \left( \frac{Y}{\mu N} \right) \mu N_{i} \]  

where:

- \( d^{r} = \) the ratio of the assessed to market value of residential property;
- \( \left( \frac{H}{Y} \right)_{i} = \) the ratio of residential property value to income for employees in sector \( i \).

The subscript denoting the \( i \)th industry class will be dropped from here on, with the understanding that unless otherwise stated, any equation will refer to any given industry. Substituting [3] and [4] into [2], and taking the property tax rate to be exogenously determined, the total differential of [2], upon rearrangement of terms, yields:

\[ dPR = ra_{i}^{nr} \left( \frac{P}{S} \right) \left( \frac{S}{N} \right) dN \left( \eta_{r} \eta_{sn} (1 + \eta_{nr}) \right) \]

\[ + ra_{i}^{r} \left( \frac{H}{Y} \right) \left( \frac{Y}{\mu N} \right) \mu dN \left( \eta_{hy} \eta_{ly} \eta_{on} (1 + \eta_{ln}) \right) \]

where:

- \( \eta_{sn} = \frac{dS}{dN} \) = the elasticity of space with respect to employment;
- \( \eta_{ap} = \frac{da_{i} P}{dP a} \) = the elasticity of the non-residential assessment ratio with respect to market value;
- \( \eta_{ps} = \frac{dP S}{dS P} \) = the elasticity of the price per square foot of property with respect to space used;
- \( \eta_{hy} = \frac{dH Y}{dY H} \) = the elasticity of residential property value with respect to income;
- \( \eta_{ly} = \frac{dY L}{dL Y} \) = the elasticity of resident employment income with respect to resident employment;
- \( \eta_{on} = \frac{dL N}{dN L} \) = the elasticity of resident employment with respect to total employment;

\[ ^{5} \text{Our treatment of the property tax rate as exogenous may legitimately be questioned. Our position is}\]

\[ ^{6} \text{that the primary determinants of the rate are the level of intergovernmental aid, the level of expenditures chosen and political factors; hence, it should be treated as exogenous.}\]

\[ ^{6} \text{The derivation of this equation is presented in the Appendix.}\]
\[ \eta_{rh} = \frac{d a H}{d H A} \] is the elasticity of the resident assessment ratio with respect to market value.

There are also two components of the personal income tax (IR) in New York City. The first, the tax on resident personal income, is levied on the income of city residents. The second is a commuter earnings tax levied at a flat rate on the earnings of nonresidents employed in the city. Thus:

\[ IR = IR^r + IR^c \]  

where the superscripts \( r \) and \( c \) denote resident income and commuter tax revenues, respectively. Revenues derived from the taxation of resident employee personal income in any sector are:

\[ IR^r = r^r \left( \frac{TY}{\mu N} \right) \mu N \]  

where:
\[ r^r = \text{the effective resident income tax rate;} \]
\[ \frac{TY}{\mu N} = \text{the average taxable income per resident employee.} \]

Similarly, for the commuter earnings tax,

\[ IR^c = r^c \left( \frac{W}{C} \right) (1-\mu) N \]  

where:
\[ r^c = \text{the rate of taxation on commuter earnings;} \]
\[ W = \text{the taxable earnings of commuters;} \]
\[ C = \text{number of commuters.} \]

Substituting [8] and [7] into [6], the total differential upon rearrangement of terms, yields (for any given sector \( i \)):

\[ dIR = r^r \left( \frac{TY}{\mu N} \right) \mu dN \left[ (\eta_{ry}+1)\eta_{we}r_{en} \right] \]

\[ + r^c \left( \frac{W}{C} \right) dN (1-\mu) \eta_{we} \eta_{en} \]  

where:
\[ \eta_{ry} = \text{the elasticity of the effective resident income tax rate with respect to resident income;} \]
\[ \eta_{we} = \text{the elasticity of taxable earnings of commuters with respect to the number of commuters;} \]
\[ \eta_{en} = \text{the elasticity of the number of commuters with respect to total employment.} \]

The principal forms of business taxation in New York City are the general corporation tax, the finance, the transportation, and the insurance corporation taxes, and the public utility tax. These taxes are all examined here under the heading of business taxation. Revenues derived from the taxation of business income, \( BR \), in any sector \( i \), are:

\[ BR = r^b \left( \frac{BY}{K} \right) \left( \frac{K}{N} \right) N \]  

where:
\[ r^b = \text{the effective rate of taxation on business income;} \]
\[ \frac{BY}{K} = \text{the ratio of business income to total physical capital stock;} \]
\[ \frac{K}{N} = \text{the ratio of physical taxable capital to employment in sector} \ i. \]

Taking the total differential, and rearranging terms, yields:

\[ dBR = r^b \left( \frac{BY}{K} \right) \left( \frac{K}{N} \right) dN \left[ \eta_{byk} \eta_{kn} (1 + \eta_{by}) \right] \]  

\[ + r^c \left( \frac{W}{C} \right) dN (1-\mu) \eta_{we} \eta_{en} \]
where:

\[ \eta_{by} = \text{the elasticity of the effective tax rate with respect to business income;} \]

\[ \eta_{byk} = \text{the elasticity of taxable business income with respect to physical corporate capital;} \]

\[ \eta_{kn} = \text{the elasticity of physical corporate capital with respect to employment.} \]

As with the property and personal income taxes, it is necessary to differentiate between city government sales tax revenues derived from resident employees and that derived from nonresident employees in each industry. Thus, \[ SR = SR^r + SR^c \] [12]

where the \( SR^r \) and \( SR^c \) refer to city government sales tax revenues attributable to consumption spending by the resident and commuter components of employment in sector \( i \).

Since sales tax revenues are derived from the purchase of taxable consumption goods within the city, resident sales tax revenues \( SR^r \) can be stated as:

\[ SR^r = r^r \left( \frac{TC}{Y} \right) \left( \frac{Y}{\mu N} \right) N \] [13]

where:

\[ r^r \text{ = the nominal sales tax rate;} \]

\[ \frac{TC}{Y} \text{ = the ratio of taxable consumption to income for resident employees;} \]

\[ \frac{Y}{\mu N} \text{ = income per resident employee.} \]

Similarly, sales tax revenues attributable to commuters \( (SR^c) \), are:

\[ SR^c = r^c \left( \frac{CY}{CY} \right) \left( \frac{CY}{C} \right) (1-\mu) N \] [14]

where:

\[ \frac{CT}{CY} \text{ = the ratio of taxable consumption to income for commuter employees;} \]

\[ \frac{CY}{C} \text{ = the ratio of commuter income to the number of commuting employees.} \]

Substituting equations [13] and [14] into equation [12], taking the total differential and rearranging terms yields, for any sector \( i \):

\[ dSR = r^r \left( \frac{TC}{Y} \right) \left( \frac{Y}{\mu N} \right) \mu dN [\eta_{cy} \eta_{ey}] \]

\[ + r^c \left( \frac{CY}{CY} \right) \left( \frac{CY}{C} \right) (1-\mu) dN [\eta_{ctey} \eta_{cyc} \eta_{en}] \] [15]

where:

\[ \eta_{cy} \text{ = the elasticity of resident taxable consumption with respect to resident income;} \]

\[ \eta_{ey} \text{ = the elasticity of resident income with respect to resident employment;} \]

\[ \eta_{en} \text{ = the elasticity of resident employment with respect to total employment;} \]

\[ \eta_{ctey} \text{ = the elasticity of commuter taxable consumption with respect to commuter income;} \]

\[ \eta_{cyc} \text{ = the elasticity of commuter income with respect to commuter employment;} \]

\[ \eta_{en} \text{ = the elasticity of commuter employment with respect to total employment.} \]

The total change in tax revenues in response to any given employment change in the city may be estimated as the sum of equations [5], [9], [11], and [15], summed over all \( i \) employment classes.

ESTIMATION

The model developed above describes the response of local government tax...
yields to changing employment levels. The data required to estimate the full model in this complete form are not available. However, if a set of limiting assumptions are made about these elasticities, the model may be simplified considerably and estimated with available data. Specifically, we assume the following:

1. Firms produce outputs according to Leontief type, i.e., fixed factor, production functions ($\eta_{ln} = 1$, $\eta_{kh} = 1$).
2. The income elasticity of demand for housing ($\eta_{hy}$) is unity.
3. The property tax assessment ratio within any particular sector is a constant ($\eta_{lcn}^{ln}$, $\eta_{lah} = 0$).
4. The proportion of resident to commuter employment remains constant ($\eta_{ln} = 1$, $\eta_{cn} = 1$).
5. The income elasticity of resident and commuter taxable consumption is unity ($\eta_{lcy} = 1$, $\eta_{ctcy} = 1$).
6. The elasticity of resident employee income, commuter wages and commuter income, each with respect to total employment, is unity ($\eta_{ly} = 1$, $\eta_{wc} = 1$, $\eta_{ln} = 1$ and $\eta_{cn} = 1$).
7. The effective rates of employee and business income taxation are constant ($\eta_{ry} = 0$, $\eta_{rby} = 0$).
8. The elasticity of the effective business income tax rate with respect to business income is zero ($\eta_{bby} = 0$).
9. The elasticity of taxable business income with respect to business capital is unity ($\eta_{byk} = 1$).

With these assumptions, the response of city tax revenues to a change in employment in any given sector $i$ reduces to:

\[
\frac{dR}{dN} = [\eta^{nr} \left( \frac{TY}{\mu N} \right) \mu + \eta^{r} \left( \frac{W}{C} \right) (1-\mu)] \\
+ [\eta^{b} \left( \frac{BY}{K} \right) \left( \frac{K}{N} \right)] \\
+ [\eta^{s} \left( \frac{TC}{Y} \right) \left( \frac{Y}{\mu N} \right) \mu + \eta^{s} \left( \frac{CY}{C} \right) (1-\mu)]
\]

The assumptions applied here would seem plausible so long as total employment and total population remain constant, e.g., if a firm $i$ with $N$ employees is replaced by a firm $j$ with $N$ employees, the residential and nonresidential property tax effects are dependent on the characteristics of the industry and the income of its workers. Where there is a net loss in employment, this model would also suggest a net loss in population, increased commercial and industrial vacancy rates, and residential housing abandonments. For New York City and many other large central cities, such a scenario may not be all that farfetched.

The model described in [16] requires the estimation of each variable by major industry sector. The purpose of this section is to describe the data and procedures underlying this estimation and thereby to indicate the data prerequisites for replicating this study for other cities. These data are derived from a number of sources, including special tabulations from unpublished records of several departments of both the New York State and New York City governments.

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7 For the most part, these assumptions would seem plausible. Where the reader does not agree, at least the general direction of the estimation error may be deduced by considering the full model in light of alternative assumptions.

8 Though there is some support for this thesis, the evidence is mixed [De Leeuw 1971, pp. 1–10; Aaron 1972].
The Property Tax

Since the nominal tax rate is applied equally to the assessed value of residential and nonresidential property, the empirical problem here is one of estimating the assessed value of taxable business and residential property per employee in each industry. The nonresidential property tax base has been identified here in terms of the quantity of taxable physical capital per employee \((S/N)\), the unit value of taxable physical capital \((P/S)\) and the assessment ratio \((a)\) (see equation [16]). Estimates of these parameters and calculation of the intersectoral variation in nonresidential tax liabilities per employee are summarized in Table 1. These estimates are based on three sets of data. The amount of space per worker in each sector (column 1) is estimated from sample data provided by the New York Department of City Planning. Estimates of assessed value of space as well as the total square footage of each sample property were obtained from the assessment rolls of the New York City Department of Real Estate Assessment. The ratio of assessed to market value (column 4) and market value per space unit (column 2) were estimated using market value data drawn from records of the New York State Board of Equalization and Assessment. The results of this estimation show a considerable interindustry variation in market value per employee (column 3) which is translated into interindustry property tax liability differentials (column 6) via an interindustry variation in the assessment ratio (column 4).

These variations in market value per space unit conform in some ways to a priori expectations. The lower price of space in the real estate sector as compared to the rest of the office-oriented sector may be partially explained by the fact that this activity is spread throughout the city, while mining, finance and insurance activities are primarily located in Manhattan where land values are highest. The relatively low market value of manufacturing, wholesale, and transportation space is also expected because of the shell-type building structures often used in these sectors and the tax-exempt status of movable machinery and equipment. Not expected, however, is the finding of a substantial variation in the assessment ratio among sectors—the range is about 4 percent of assessed value. This result suggests a bias in the assessment process, with preferential treatment of the lower-valued transportation and service sectors.13

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9 A New York City Planning Commission survey [1971] had as its base all firms within industrial zones in the five boroughs, and included 948,000 workers, 63 percent of those reported by the Department of Commerce [1968]. See also New York Department of City Planning [1970] and Vollmer Associates [1969].
10 For a discussion of these estimates see Greytak and Bjornstad [1973].
11 Property values in each industry were estimated from disaggregated data on the use of space by type, i.e., office, production, and storage. For each of these space use classifications the assessed value of space per unit was obtained from a sampling of the New York City assessment records. For each industry, the assessed and market value of space was then estimated as the weighted average of assessed value and equalized assessed values, respectively, of space by type of use. The weight employed in this procedure was the proportion of total floor space in each use. The equalization ratio corresponding to the sample properties (drawn from the New York City Assessors' roll) was obtained from the New York State Board of Equalization and Assessment. For a detailed discussion of the sample characteristics and estimating procedures see Bjornstad [1973, p. 32].
12 The mining employment in Manhattan is central employment office.
13 We do not test the hypothesis that these differences are due simply to sampling variations, and this possibility remains. Because we were not able to obtain a truly random sample in every case, and because our data is taken from many sources, we have chosen to treat the results as population estimates. This limitation, though unavoidable, should be viewed as a major caveat in inferring the revenue implications of these results.
## TABLE 1
PER EMPLOYEE NONRESIDENTIAL PROPERTY TAX REVENUE AND BASE VARIATIONS:
BY EMPLOYMENT SECTOR

<table>
<thead>
<tr>
<th>Employment Sector</th>
<th>(1) Floorspace per Employee (square feet)</th>
<th>(2) Market Value per Square Foot of Floorspace (dollars)</th>
<th>(3) Market Value of Taxable Property Per Employee (dollars)*</th>
<th>(4) Assessment Ratio (percent)</th>
<th>(5) Effective Tax Rate** (percent)</th>
<th>(6) Property Tax Liability (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>227</td>
<td>18</td>
<td>4,103</td>
<td>67.49</td>
<td>3.52</td>
<td>144</td>
</tr>
<tr>
<td>Mining</td>
<td>227</td>
<td>30</td>
<td>6,910</td>
<td>64.98</td>
<td>3.39</td>
<td>234</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>310</td>
<td>10</td>
<td>3,141</td>
<td>65.39</td>
<td>3.41</td>
<td>107</td>
</tr>
<tr>
<td>Transportation</td>
<td>1,257</td>
<td>9</td>
<td>11,377</td>
<td>62.13</td>
<td>3.24</td>
<td>369</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>705</td>
<td>14</td>
<td>7,192</td>
<td>64.84</td>
<td>3.38</td>
<td>243</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>239</td>
<td>19</td>
<td>4,657</td>
<td>67.73</td>
<td>3.54</td>
<td>165</td>
</tr>
<tr>
<td>Finance</td>
<td>173</td>
<td>29</td>
<td>4,952</td>
<td>65.21</td>
<td>3.40</td>
<td>168</td>
</tr>
<tr>
<td>Insurance</td>
<td>145</td>
<td>28</td>
<td>3,997</td>
<td>65.37</td>
<td>3.41</td>
<td>136</td>
</tr>
<tr>
<td>Real Estate</td>
<td>1,041</td>
<td>24</td>
<td>24,926</td>
<td>66.06</td>
<td>3.45</td>
<td>860</td>
</tr>
<tr>
<td>Services***</td>
<td>429</td>
<td>11</td>
<td>4,592</td>
<td>63.40</td>
<td>3.31</td>
<td>152</td>
</tr>
</tbody>
</table>

Sources: Calculated from unpublished data, Department of City Planning and Department of Real Property Assessment, City of New York, and New York State Department of Equalization and Assessment, and from employment data reported in Employment Review [New York State Department of Labor 1971 and 1972].

*This column is the product of columns (1) and (2), but the latter have been rounded for presentation here.

**The effective tax rate (i.e., the rate levied on market value) was calculated by applying the assessment ratio in column (2) to the 1969 citywide tax rate (0.0522).

***Includes only business services.
An estimate of the level of *residential property taxes* generated by employees in each of the city's industries requires estimates, by industry class, of employee income (\(Y\)), housing value (\(H\)), nonresident employees as a percent of total employment (\(\mu\)) and the assessment ratio (\(a\)). Estimates of these parameters and the calculation of intersectoral variations in residential property taxes per employee are summarized in Table 2. First, we estimate average income per sector (the product of average employees earnings, as reported by the Department of Commerce, and the ratio of gross income to earnings, as reported in a special tabulation of New York City income tax returns)\(^{14}\) and assume that this estimate maps directly into family income classes as given in the *Census of Population*. This allows the imputation of an average housing value (column 3) to each sector from census cross-classifications of median values of owner-occupied dwelling units and average income. The average assessment ratio for noncommercial property in 1969 was 36 percent, and assumed equal across employment sectors. The product of the assessment ratio and the estimated housing value yields an estimate of assessed value (see column 4). Applying the nominal 1969 tax rate of 0.0522 to the assessed values in column 4 yields the average tax liability per employee in each sector. The proportion of commuter employees in each sector (column 5) was estimated from data provided by the New York Regional Plan Association on the occupation distribution of employees by industry, and from census data on commuting patterns by occupation. These commuting percentages were used to adjust total yield per employee to that received by the city government. The results show a lower revenue generation per employee in the low paying trade and service sectors.

**Personal Income Tax**

Resident personal income tax revenues per employee in each sector has been identified above as the product of taxable income per employee (\(TY/\mu N\)) and the effective income tax rates. Estimates of the intersectoral variation in these parameters are given in Table 3. Taxable income, the tax base, is estimated as the product of wage and salary income per employee, obtained from unpublished reports provided by the U.S. Department of Commerce [1972] and the ratio of taxable income to employee earnings, as calculated from unpublished data provided by the New York State Department of Taxation and Finance. The resulting intersectoral variations in tax base per employee are shown in column 1. Tax liabilities and the effective tax rate were then estimated by applying the appropriate nominal tax rate to the tax base adjusted for deductions and exemptions.

The *commuter earnings tax* is applied only to the wages and salaries earned in the city by noncity residents. Data on wage and salary earnings were obtained from unpublished estimates provided by the U.S. Department of Commerce, and tax liabilities are calculated as above—as the product of the tax rate (0.45 percent) and the tax base. The estimates of these parameters are given in columns 3–6 in Table 3.

Overall, personal income tax liability per employee, by sector, is obtained as

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\(^{14}\)These data are obtained from New York State Department of Taxation and Finance [1972]. For a detailed discussion of these data see Bahl, Campbell and Greytak [1974].
the weighted average of the commuter and resident components with the commuter and resident employment percentages in each sector as the weights (see column 7).

**The Business Income Tax**

Estimation of interindustry variation in business income tax revenues per employee requires estimation of the income earned per unit of capital \((BY/K)\) and the capital/labor ratio \((K/N)\). Since the data necessary to measure these parameters separately are not available, we estimate only their product, the ratio of business income to employment. Intersectoral variations in this ratio and in effective tax rates are reported in Table 4.

Estimation of the tax yield and effective rate for the general corporation income tax of the city is not possible from published reports. For purposes of this study, the distribution of general corporation tax liabilities and taxable income by industrial class was estimated for 1969 from a special tabulation of general corporation income tax returns made by the New York City Department of Finance and Administration.\(^{15}\) For the public utilities, transportation, finance and insurance corporation taxes, tax revenues per employee for these sectors can be estimated from revenue data reported in the New York City Comptroller’s Report.

**Sales Tax**

Interindustry variation in sales tax revenues per employee have been identi-
TABLE 3
PER EMPLOYEE PERSONAL INCOME AND COMMUTER EARNINGS TAX REVENUES AND BASE:
BY EMPLOYMENT SECTOR

<table>
<thead>
<tr>
<th>Employment Sector</th>
<th>(1) Tax Base per Resident Employee</th>
<th>(2) Effective Rate on Residents</th>
<th>(3) Tax Liability per Employee</th>
<th>(4) Tax Base per Commuter Employee</th>
<th>(5) Effective Tax Rate per Commuter Employee</th>
<th>(6) Tax Liability per Commuter Employee</th>
<th>(7) Total Personal Income Tax Liability per Employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm</td>
<td>$10,062</td>
<td>$.86</td>
<td>$87</td>
<td>($) na*</td>
<td>($) na</td>
<td>($) na</td>
<td>($) na</td>
</tr>
<tr>
<td>Government</td>
<td>11,537</td>
<td>.92</td>
<td>107</td>
<td>10,456</td>
<td>.45</td>
<td>47</td>
<td>98</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>10,649</td>
<td>.89</td>
<td>95</td>
<td>9,698</td>
<td>.45</td>
<td>44</td>
<td>88</td>
</tr>
<tr>
<td>Mining</td>
<td>32,015</td>
<td>1.70</td>
<td>544</td>
<td>18,671</td>
<td>.45</td>
<td>84</td>
<td>488</td>
</tr>
<tr>
<td>Construction</td>
<td>15,230</td>
<td>1.10</td>
<td>169</td>
<td>13,232</td>
<td>.45</td>
<td>60</td>
<td>154</td>
</tr>
<tr>
<td>Transportation and Communication and Public Utilities</td>
<td>13,535</td>
<td>1.03</td>
<td>140</td>
<td>12,143</td>
<td>.45</td>
<td>55</td>
<td>131</td>
</tr>
<tr>
<td>Wholesale and Retail Trade</td>
<td>10,230</td>
<td>.87</td>
<td>89</td>
<td>9,337</td>
<td>.45</td>
<td>42</td>
<td>80</td>
</tr>
<tr>
<td>Finance, Insurance and Real Estate</td>
<td>11,265</td>
<td>.91</td>
<td>103</td>
<td>10,220</td>
<td>.45</td>
<td>46</td>
<td>83</td>
</tr>
<tr>
<td>Services</td>
<td>9,529</td>
<td>.84</td>
<td>80</td>
<td>8,729</td>
<td>.45</td>
<td>39</td>
<td>72</td>
</tr>
<tr>
<td>Other</td>
<td>11,317</td>
<td>.92</td>
<td>104</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>


*Data would not permit estimation of the proportion of commuters in the farm (central offices) and “other” categories, and since these are relatively small, and since our focus is on interindustry variations, we report them here as “not available.”
TABLE 4

PER EMPLOYEE BUSINESS INCOME TAX REVENUES AND BASE: BY EMPLOYMENT SECTOR

<table>
<thead>
<tr>
<th>Employment Sector</th>
<th>(1) Tax Base</th>
<th>(2) Effective Tax Rate</th>
<th>(3) Tax Liability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>$1,379</td>
<td>5.76%</td>
<td>$79</td>
</tr>
<tr>
<td>Transportation</td>
<td>na</td>
<td>na</td>
<td>17</td>
</tr>
<tr>
<td>and Communication</td>
<td>na</td>
<td>na</td>
<td>1,687</td>
</tr>
<tr>
<td>Public Utilities</td>
<td>na</td>
<td>na</td>
<td>77</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>1,324</td>
<td>5.85</td>
<td>33</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>551</td>
<td>5.92</td>
<td>255</td>
</tr>
<tr>
<td>Finance</td>
<td>na</td>
<td>na</td>
<td>116</td>
</tr>
<tr>
<td>Insurance</td>
<td>na</td>
<td>na</td>
<td>202</td>
</tr>
<tr>
<td>Real Estate</td>
<td>3,071</td>
<td>6.79</td>
<td>36</td>
</tr>
<tr>
<td>Services</td>
<td>589</td>
<td>6.10</td>
<td></td>
</tr>
</tbody>
</table>

Sources: Finance, transportation and insurance corporation tax revenues taken from Comptroller of the City of New York [1970]; general corporation income tax liabilities taken from Special Tabulation, City of New York, Department of Finance Administration; and Employment Review [New York State Department of Labor 1971 and 1972].

fied in terms of resident and commuter income per employee, the ratios of resident and commuter taxable consumption to income and the sales tax rate. Specifically, we estimate sales tax revenues as the product of the per employee tax base—earned personal income—and the citywide ratio of sales tax revenues to earned personal income. Intersectoral variations in the sales tax base and in sales tax liabilities are given in Table 5.

STATISTICAL RESULTS

The data in column 1 of Table 6 show the interindustry variance in total tax revenues per employee, as summed from Tables 1–5, and provide an estimate of equation [16] for each sector. These results indicate a potentially substantial response of New York City tax revenues to changes in the city’s employment structure. Particularly important is the finding that per employee total tax revenues are lowest in the government and service sectors, which have been the major sectors of employment growth since 1960 (see column 2). The relatively low value of tax revenues per government employee is directly attributable to the fact that government activities are not liable for property or business income taxation. The relatively low tax contribution per employee in the service industry, the other major sector of employment growth, can be traced to its relatively low level of average wages and to the relatively large proportion of nonprofit enterprises in this sector.

These results may be used to describe the response of the city tax system to employment change by exploring the revenue implications of the changes in the employment composition which actually occurred in New York City between 1960 and 1970. Such an estimate requires us to assume that the structure of the property tax, the business income tax, the resident personal income and

---

16 It should be noted that some government activities, e.g., the Port Authority, make payments in lieu of the property tax. These payments are relatively small and are not further considered in this analysis.
TABLE 5
PER EMPLOYEE SALES TAX BASE AND
REVENUE: BY EMPLOYMENT SECTOR

<table>
<thead>
<tr>
<th>Employment Sector</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tax Base</td>
<td>Tax Liability</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>$12,633</td>
<td>$128</td>
</tr>
<tr>
<td>Construction</td>
<td>17,102</td>
<td>173</td>
</tr>
<tr>
<td>Transportation and Communication</td>
<td>15,853</td>
<td>160</td>
</tr>
<tr>
<td>Wholesale and Retail Trade</td>
<td>12,179</td>
<td>123</td>
</tr>
<tr>
<td>Finance, Insurance and Real Estate</td>
<td>13,319</td>
<td>135</td>
</tr>
<tr>
<td>Services</td>
<td>11,366</td>
<td>115</td>
</tr>
<tr>
<td>Government</td>
<td>13,489</td>
<td>136</td>
</tr>
</tbody>
</table>

Sources: Calculated from “Earnings by Broad Industrial Sector” and “Earnings as a Percent of Personal Income” (unpublished tables) [U.S. Department of Commerce, Bureau of Economic Analysis 1972], and Comptroller of the City of New York [1971].

commuter earnings taxes and the sales tax did not change during the 1960–1970 period, that the underlying assumptions of our model hold, and in general that a large and finite change is predictable from [16]. While these are questionable assumptions, they do provide a means of tentatively identifying the implications of changing employment patterns for tax revenue levels. Two related questions may be addressed: (a) What was the revenue response to the combined change in the level and structure of employment? (b) What was the revenue response solely attributable to the changing composition of employment?

During the 1960s, New York City employment increased by over two hundred thousand and, by our model, the revenue growth attributable to this employment increase was $165 million (see Table 6).\(^\text{17}\) The net negative effects of employment decline in the manufacturing and trade sectors were more than offset by the revenue growth contributed by the growing employment sectors—government, finance and services. To measure this compositional effect, we abstract from the effects of changes in the level of total employment by comparing the revenue yield of each tax from each industry in 1970 with that which would have been forthcoming if the structure of employment in 1970 had been the same as it was in 1960.\(^\text{18}\) The results (see Table 7) show that total tax revenues are slightly larger in 1970 than they would have been had the structure of employment not changed, i.e., had the 1960 composition of employment still existed in 1970. Specifically, changes in employment structure have accounted for a positive revenue differential of about $14 million, i.e., the shift out of the manufacturing and trade sectors resulted in a loss of about $240 million while the employment shift into the services, government, and FIRE sectors resulted in a gain of $254 million. What these results would appear to indicate is that the changing role of the core city—to a service orientation and away from a manufacturing orientation—in and of itself does not have an unfavorable effect on city revenues. At least this is the case for New York City.

A more general statement of the revenue response to changes in the structure of employment may be developed in terms of intersectoral job trade-offs allowable if revenues are to be held

\(^\text{17}\)Actually, this is the revenue growth attributable to the four major taxes. If the remainder of the revenue system maintained a constant share of total receipts over that period, the total estimated increment would be $213 million, or about $26 per capita.

\(^\text{18}\)This comparison still allows for aggregate revenue increase due to the growth in aggregate employment; however, it also allows estimation of structural effects by holding constant the percentage of employment in each sector.
TABLE 6
ESTIMATED REVENUE RESPONSE TO CHANGES IN TOTAL EMPLOYMENT IN NEW YORK CITY: 1960–1970

<table>
<thead>
<tr>
<th></th>
<th>(1) Total Revenue Change per Employee Change</th>
<th>(2) Total Employment Change</th>
<th>(3) Property Tax</th>
<th>(4) Business Income Tax*</th>
<th>(5) Personal Income and Commuter Earnings Tax</th>
<th>(6) Sales Tax</th>
<th>(7) Total Tax Revenues (in $ 000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>$ 815</td>
<td>- 180.6</td>
<td>$ - 93,912</td>
<td>$ - 14,267</td>
<td>$ - 15,893</td>
<td>$ - 23,117</td>
<td>$ - 147,189</td>
</tr>
<tr>
<td>Wholesale and Retail Trade</td>
<td>855</td>
<td>- 9.3</td>
<td>- 5,571</td>
<td>- 492</td>
<td>- 744</td>
<td>- 1,144</td>
<td>- 7,951</td>
</tr>
<tr>
<td>FIRE**</td>
<td>1,109</td>
<td>74.7</td>
<td>54,382</td>
<td>12,176</td>
<td>6,200</td>
<td>10,084</td>
<td>82,842</td>
</tr>
<tr>
<td>Services***</td>
<td>778</td>
<td>176.0</td>
<td>97,680</td>
<td>6,336</td>
<td>12,672</td>
<td>20,240</td>
<td>136,938</td>
</tr>
<tr>
<td>Government</td>
<td>651</td>
<td>154.6</td>
<td>64,468</td>
<td>0</td>
<td>15,151</td>
<td>21,026</td>
<td>100,645</td>
</tr>
<tr>
<td>Estimated Revenue</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss Due to Employment Loss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated Revenue</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain Due to Employment Increase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated Total Change in Tax Revenues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: Calculated from Tables 1, 2, 3, 4 and 5; New York State Department of Labor [1970]; and Employment Review [New York State Department of Labor 1971 and 1972].

*Includes general corporation, financial corporation, and insurance corporation taxes.

**Finance, insurance and real estate.

***Includes only business services for the property tax.
constant. The coefficients in Table 8 indicate, for example, that the replacement of a manufacturing job requires the addition of 0.95 wholesale or retail trade jobs, 0.73 finance, insurance and real estate jobs, 1.04 service jobs, and 1.25 government jobs. The hardest jobs to replace are in the finance, insurance, real estate and trade sectors. The most easily replaced are those in government. From these data it may be seen that the gain of a government or a service sector job is more than offset by the loss of one job in any of the other sectors.19

With the New York City employment structure changing toward government and services, these coefficients imply that for the tax revenue response to be positive, the government and service sector employment gains must be substantial. While such gains were the case in New York City during the decade of the sixties, this pattern appears unlikely for the future. Indeed, during the period 1970–74 the historic job decline in manufacturing (−123,300) and wholesale and retail trade (−55,500) continued, while the growth in finance, insurance, and real estate was reversed (−24,000). Only the services (+11,000) and government (+16,500) sectors made substantial employment gains. With the recent expenditure pressures brought on by inflation and the wage rate increment success of public employee unions, there have of necessity been discretionary reductions in local government employment. What is clear from this recent pattern is that the growth in service employment will have to be unthinkably large to compensate for the revenue loss resulting from the declining employment sectors.

These estimates can also be used to describe the very great contribution of economic decline to the New York City fiscal problem. The analysis here permits an estimate of the maximum effect on New York City government revenues of this 1970–1974 employment pattern, i.e., the revenue loss implied if each job loss was because a firm had ceased operations within the city20 and the net job loss reflected a proportionate decline in residential housing occupancy. Using these per employee tax estimates (see Table 6), the combination of this net job loss of 175,000 and the replacement effects suggest a revenue loss of about $160 million. A similar computation applied to the 1965–1975 period shows that the failure of the New York City economy to grow at the national rate cost the city government approximately $800 million in revenues in 1975, i.e., an amount roughly equivalent to the city’s now famous deficit [Puryear and Bahl 1976].

POLICY IMPLICATIONS

Two uses derive from such a model. The first involves forecasting the revenue implications of changing city employment structures and commuting patterns. With continuing decline in the core city economy and increasing concentrations of government and service employment, significant interindustry

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19 It should be noted that since local government jobs must be funded primarily out of local government revenues, the shift of employment out of the private sector into local government is accompanied by an expenditure increase as well as a decrease in revenues. Given that government salaries are 10 to 15 times greater than per employee tax revenues in the private sectors, the shift to local government employment implies both a decline in revenues and an expenditure increase and, therefore, a substantial reduction in the amount of revenues available for other expenditure purposes.

20 This may not be too farfetched an assumption. In the manufacturing sector alone, firms of more than 20 employees left the city over the 1969–1974 period at an average rate of one per day.
### TABLE 7
**ESTIMATED REVENUE RESPONSE TO THE CHANGING COMPOSITION OF EMPLOYMENT IN NEW YORK CITY: 1970**

<table>
<thead>
<tr>
<th>(1) Nonresidential Property Tax</th>
<th>(2) Personal Income and Commuter Earnings Tax</th>
<th>(3) Residential Property Tax</th>
<th>(4) Business Income Tax</th>
<th>(5) Sales Tax</th>
<th>(6) Total Tax Revenues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>$ - 25,381</td>
<td>$ - 20,857</td>
<td>$ - 98,007</td>
<td>$ - 18,747</td>
<td>$ - 30,375</td>
</tr>
<tr>
<td>Wholesale and Retail Trade</td>
<td>- 10,618</td>
<td>- 4,312</td>
<td>- 21,668</td>
<td>- 2,856</td>
<td>- 6,629</td>
</tr>
<tr>
<td>FIRE</td>
<td>15,901</td>
<td>4,190</td>
<td>20,848</td>
<td>8,228</td>
<td>6,815</td>
</tr>
<tr>
<td>Services</td>
<td>22,086</td>
<td>10,461</td>
<td>58,558</td>
<td>5,231</td>
<td>16,709</td>
</tr>
<tr>
<td>Government</td>
<td>0</td>
<td>12,749</td>
<td>54,251</td>
<td>0</td>
<td>17,694</td>
</tr>
<tr>
<td>Estimated Gross Revenue Loss Due to Employment Change</td>
<td>- 36,010</td>
<td>- 25,169</td>
<td>- 119,676</td>
<td>- 21,603</td>
<td>- 137,004</td>
</tr>
<tr>
<td>Estimated Gross Revenue Gain Due to Employment Change</td>
<td>37,987</td>
<td>27,400</td>
<td>133,657</td>
<td>13,459</td>
<td>41,218</td>
</tr>
</tbody>
</table>

Sources: See Table 6.

*Each entry in the table is the difference between actual 1970 tax revenues attributable to a sector and that which would have resulted had each sector's employment share remained constant at its 1960 level.*
TABLE 8
HYPOTHETICAL EMPLOYMENT REPLACEMENT REQUIREMENTS NECESSARY TO MAINTAIN A CONSTANT LEVEL OF TAX REVENUES

<table>
<thead>
<tr>
<th>Replaced Industry</th>
<th>(1) Manufacturing</th>
<th>(2) Wholesale and Retail Trade</th>
<th>(3) FIRE</th>
<th>(4) Services</th>
<th>(5) Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>1.00</td>
<td>0.95</td>
<td>0.73</td>
<td>1.04</td>
<td>1.25</td>
</tr>
<tr>
<td>Wholesale and Retail Trade</td>
<td>1.05</td>
<td>1.00</td>
<td>0.77</td>
<td>1.09</td>
<td>1.31</td>
</tr>
<tr>
<td>FIRE</td>
<td>1.36</td>
<td>1.30</td>
<td>1.00</td>
<td>1.43</td>
<td>1.70</td>
</tr>
<tr>
<td>Services</td>
<td>1.95</td>
<td>0.91</td>
<td>0.70</td>
<td>1.00</td>
<td>1.19</td>
</tr>
<tr>
<td>Government</td>
<td>0.80</td>
<td>0.76</td>
<td>0.58</td>
<td>0.84</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Source: Calculated from Tables 1, 2, 3, 4 and 5.

Differences in revenues per employee could have marked intermediate and long-term effects on the city fisc. Second, this kind of analysis indicates biases in the tax system which may have unfavorable revenue implications for the city government, e.g., differentially lower property tax assessment ratios/effective tax rates in sectors of employment increase. It is conceivable that city governments may be able to reform tax structures so as to maximize revenue return in the context of a given employment structure change. It should be noted, however, that such fiscal adjustments would take account of only partial revenue effects and may well be inconsistent with equity and location-incentive goals. For example, it seems clear that greater reliance on direct personal taxes would be the most effective means of capturing the resources generated by increased government and nonprofit service sector employment, but increased city/suburban tax rate disparities and interpersonal tax burden differences would also result from such tax adjustments. The latter, it is frequently argued, are factors which lead to migration and hence to a further deterioration of the core city economy.

While the general model developed here is applicable in most cases, these statistical results are applicable only to New York City. Indeed, the replacement coefficients may vary widely across cities depending, among other things, on the structure of the local tax system. For example, Ganz and O'Brien [1972] have speculated that for Boston, the shift out of manufacturing and into the services and government sectors has a substantially greater revenue impact that we have estimated for New York City. Such differences, where they exist, can most likely be traced to the nature of the tax system. For example, a definition of taxable property which includes personal property (i.e., movable capital equipment, as is the case in Boston) would greatly alter the interindustry variation in per employee tax revenues.

Though this research develops the conceptual and empirical model necessary for such analysis in other cities, it also suggests the very great estimation problems and the need to rely heavily on unpublished data. Still, the problem has
important enough policy implications, and city tax systems are diverse enough, to warrant future research. Indeed, the uncertain fiscal future and changing economic structure of American cities demands it.

References


APPENDIX
DERIVATION OF PROPERTY TAX EQUATION

Nonresidential Property:
Taking the total differential of equation [3] \(^1\) and factoring, we obtain

\[ dPR = ra \left( \frac{P}{S} \right) \left( \frac{S}{N} \right) dN \left[ 1 + \frac{d}{dN} \left( \frac{S}{N} \right) \right] \]

Differentiating, rearranging terms and simplifying,

\[ dPR = ra \left( \frac{P}{S} \right) \left( \frac{S}{N} \right) dN \left[ \frac{dS}{dN} + \frac{dP}{dN} \right] \]

Substituting

\[ (dP)N = \frac{dP \cdot S}{(dN)P} \]

and rearranging terms,

\[ dPR = ra \left( \frac{P}{S} \right) \left( \frac{S}{N} \right) dN \left[ \frac{dS}{dN} + \frac{dP}{dN} \right] \]

substituting

\[ \frac{dS}{dN} = \frac{da}{dN} \]

and rearranging terms,

\[ dPR = ra \left( \frac{P}{S} \right) \left( \frac{S}{N} \right) dN \left[ \frac{dS}{dN} + \frac{dN}{dP} \right] \]

Defining

\[ \frac{dS}{dN} = \eta_{sn} \]

\[ \frac{dP}{dS} = \eta_{ps} \]

\[ \frac{dP}{dP_a} = \eta_{ap} \]

\[ dPR = ra \left( \frac{P}{S} \right) \left( \frac{S}{N} \right) dN \eta_{ps} \eta_{sn} (1 + \eta_{ap}) \]

Residential Property:
Taking the differential of [4] and factoring,

\[ dPR = ra \left( \frac{H}{Y} \right) \left( \frac{Y}{\mu N} \right) dN \left[ 1 + \frac{d\mu}{dN} \right] \]

Note that \( \mu = \) the percentage that work and live in the city, i.e., \( \mu = L/N; \)
differentiate, and simplify to:

\[ dPR = ra \left( \frac{H}{Y} \right) \left( \frac{Y}{\mu N} \right) dN \left[ 1 + \frac{dL}{dN} \left( \frac{N}{L} - 1 \right) \right] \]

which sums to:

\[ dPR = ra \left( \frac{H}{Y} \right) \left( \frac{Y}{\mu N} \right) dN \left[ \frac{dH}{dN} \left( \frac{N}{H} \right) + \frac{dN}{dN} \right] \]

Let

\[ \frac{dH}{dN} = \left( \frac{dH}{dY} \right) \left( \frac{dY}{dN} \right) \left( \frac{dN}{dL} \right) \left( \frac{dL}{dN} \right) \]

\[ = \eta_{hy} \eta_{y} \eta_{yn} \]

\(^1\) In both the nonresidential and residential cases, the assumptions here will give a zero value to the interaction terms (see assumptions presented earlier). So as not to further complicate this presentation, these terms are not presented in their general form.
Substituting and rearranging terms,

$$dPR = ra \left( \frac{H}{Y} \right) \left( \frac{Y}{\mu N} \right) \mu dN \eta_{hy} \eta_{y} \eta_{on} (1 + \eta_{ah})$$

The residential and nonresidential terms may be combined for any sector $i$ to yield equation [5].