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The Nonresidential Property Tax and the Changing Structure of City Employment: Revenue Implications †

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1 Introduction

The income elasticity of the urban property tax has been studied—and estimated—in a traditional way, that is, by linking revenue change to (automatic) changes in the tax base, and tax-base changes to changes in income(1). For residential property, the analysis (usually based on what may be an incorrect notion of full forward shifting(2)) was addressed to the question whether the product of the temporal income elasticity of housing demand and the temporal income elasticity of assessed valuation is greater than unity. With respect to the nonresidential component, little work on the income elasticity of the property tax has been done.

The analysis in this paper is based on the proposition that the traditional model is inappropriate for identifying the sources, or magnitudes, of change in urban property-tax revenues. In fact, the whole notion of the responsiveness of property-tax revenues to changes in income may not be very meaningful.

Netzer (1966) points out that in states where the level of property taxes is determined as a residual between total expenses and other revenues, the elasticity of the property tax is really a reflection of the income elasticity of demand for local government expenditures (*op. cit.* page 185). Still, property-tax revenues—residential and nonresidential—do respond to changing economic conditions in the city. Particularly with respect to nonresidential property taxation, the common belief is that changes in revenues are a function of changes in the level of economic activity. However, there has been little research on the issue of how such differences affect the 'elasticity' of nonresidential property-tax revenues.

The goal of this paper is to develop a model which explains the reaction of property-tax revenues to the changing structure of city economic activity. The model is straightforward, being based on interindustry variations in capital-labor ratios, and on biases in the assessment process. From the results given by this model, three propositions are offered:
(1) The traditional income-elasticity measure is not an accurate index of the tax responsiveness to changes in income.

† This work grows out of a larger Maxwell School research project on the public finances of New York City. See Bahl *et al.* (1974).

(1) This literature is cited in Netzer (1966).

(2) For a discussion of the recent literature on the incidence of property tax see Aaron, Musgrave (1974).

(2) The tendency for cities to gain service and lose manufacturing jobs may have substantial revenue implications for the city because of marked interindustry variation in capital-labor ratios.
(3) If tax-policy adjustments at the city level reflected these variations, revenue loss might be avoided.

The model is developed conceptually in the next section, and then is estimated with data for New York City. The final section gives the policy implications of these results, and offers suggestions for future research.

2 Model

Traditional studies have most often relied on income as the base against which to measure revenue growth. Employment is used as the basic unit of analysis in this study. There are a number of reasons why the employment base might be preferable to the income base for purposes of measuring the responsiveness of property-tax revenues to changes in economic activity. First—and most important—is that the data are reliable, that is, estimates of employment level are much firmer than estimates of income level, and more confidence can be placed on indicated interindustry variations. Second, time-series data are available for employment in the form of estimated numbers of employees by sector. Third, employment is the measure most commonly used in the analysis of economic structure. Its use here, therefore, allows a comparison of this with other studies of the urban economy. Finally, changes in employment structure may basically be a reflection of changes in the urban capital-labor ratio, and employment level compared to (taxable) capital value may be the most appropriate indicator of the revenue implications of such changes.

The empirical goal in this analysis is to compare the responsiveness of the property-tax revenue to a job gained or lost in the employment sectors. For any particular employment sector, i, the total nonresidential property-tax revenues, T_i, generated are

$$T_i = r_i M_i \ , \tag{1}$$

where
M_i is the market value in the ith sector,
r_i is the effective property-tax rate in the ith sector, that is, the product of the nominal tax rate and the assessment ratio, that is, (A_i/M_i).

Dividing by the number of employees, E_i, in each sector, we may write

$$\frac{T_i}{E_i} = \frac{r_i M_i}{E_i} \ . \tag{2}$$

If we assume that there is a given amount of property tax associated with each employee, and that the tax responds accordingly with a change in employment, then

$$\mathrm{d}T_i = \frac{r_i M_i}{E_i} \mathrm{d}E_i \ . \tag{3}$$

The assumption here, of course, is that the percentage tax change, for industry i viewed alone, is equal to the percentage employment change.

This assumption clearly oversimplifies the problem, and is strictly valid only in the case where a firm (or an activity of a firm at a particular location) ceases (or begins) operations. In the case where operations continue, but with a change in employment, then

$$\mathrm{d}T_i = g\frac{r_i M_i}{E_i}\,\mathrm{d}E_i \ , \tag{4}$$

where g represents the actual proportion of taxable value, M_i, that would be lost per employee lost. The value of g would probably be very small in the short run (in time terms) and would tend towards unity in the long run. Throughout this analysis it is assumed to be unity for all sectors. The realism of such an assumption for the problem at hand would seem defensible. The changing structure, say decline of the employment base in a central city, is more often attributable to the out-movement of jobs than to the declining scale of operations of central city employers.

Summing over all n employment sectors, the total response of property taxes to employment change is

$$\sum_{i=1}^{n} \mathrm{d}T_i = \sum_{i=1}^{n} \frac{\mathrm{d}E_i}{E_i} r_i M_i \ . \tag{5}$$

It is now possible to deduce the *net* effect of a job loss in sector i on property taxes. If the job loss results in a net migration from the city, that is, assume $\mathrm{d}E = -1$, the net revenue loss may be calculated directly from equation (5). If the job loss results in a net switch to sector j, the net revenue effects—as described in equation (5)—depend[(3)] on

$$\frac{M_i}{E_i}\bigg/\frac{M_i}{E_j} \qquad \text{and} \qquad \frac{r_i}{r_j} \ .$$

For example, if the industrial property-tax base per employee is higher in sector i than j, then the net effect of the switch of one job will be a reduction in property-tax revenues—even though total wage income may remain constant. In general, the net tax effect of replacing one job in industry i with a job in industry j is given by

$$\mathrm{d}T_j - \mathrm{d}T_i = r\left(\frac{M_j}{E_j} - \frac{M_i}{E_i}\right) \ , \tag{6}$$

if the nominal rate is assumed uniform across i employment sectors.

(3) In theory, there should be no difference between r_i and r_j since the property tax rate is levied at a uniform rate in all sectors. However, the concern here is with the effective tax rate, in which there is some slight variation across industry classes.

3 Estimation[4]

Concern with the specification of the relationship between industrial activity and the tax base requires estimation of the relationship among employment, assessed value, and market value, by employment sector. The intent here is to estimate these relationships by studying intersectoral variations in floor space requirements per employee, and in valuation (market and assessed) per square foot of floorspace.

The relation between the market value and assessed value of real property, and employment, can be expressed in terms of the following identities

$$M_i = P_i\left(\frac{S}{E}\right)_i E_i \qquad (7)$$

$$A_i = a_i P_i\left(\frac{S}{E}\right)_i E_i \qquad (8)$$

where

A_i is the assessed value of nonresidential property,

M_i is the full market value of taxable nonresidential property,

a_i is the assessment ratio, that is, assessed value divided by the market value,

P_i ($= M_i/S_i$) is the market value per square foot of the average amount of taxable property,

$(S/E)_i$ is the quantity (number of square feet) of taxable property that a worker in the industry has to work with on the average.

The component P_i in equations (7) and (8) represents the price per square foot of space in a given industrial sector, and the term $(S/E)_i E_i$, the product of the quantity of space per employee and the level of employment, can be reduced simply to S, the quantity of space. Therefore, equations (7) and (8) represent a price times quantity relationship, which determines the value of a given quantity of floorspace. When $P_i(S/E)_i E_i$ is multiplied by the assessment ratio for each employment sector, the taxable market value of property is translated into assessed value.

The tax liability of an industry can be obtained by multiplying both sides of equation (8) by the nominal tax rate r. Thus, the total amount of property-tax revenues, T_i, for which an industry is liable may be stated as

$$T_i = ra_i M_i = ra_i P_i\left(\frac{S}{E}\right)_i E_i \; . \qquad (9)$$

From equations (7) and (9), the three basic factors underlying intersectoral differences in property-tax base and liabilities among industries may be identified: the assessment ratio, the value of taxable property per space unit, and the amount of space used per employee. In general, the larger

[4] In this section we draw heavily on the work of the Maxwell Research Project on the public finances of New York City, Syracuse University, New York. See particularly Bjornstad (1973a; 1973b), Bahl *et al.* (1974), chapter 2.

(or smaller) the amount of physical capital associated with the typical worker in an industrial sector, that is, $(S/E)_i$, the larger (or smaller) will the industry's tax liability. Similarly, the larger (or smaller) the value placed on floorspace in any industry, that is, P_i, the larger (or smaller) will be the industry's tax liability. Finally, the larger (or smaller) the assessment ratio, the larger (or smaller) will be the industry's tax liability. It is clear, however, that various combinations of differences in the size of these variables may cause substantial differences in the interindustry tax base, for example, a smaller number of workers working with large quantities of high-priced real property may contribute more to the tax base than a large number of workers utilizing smaller amounts of low-priced real property.

Since the nominal rate, r, is constant across industry classes, the estimation of tax liabilities in equation (9) requires estimation of the assessment ratio and the components of taxable full market value. Three sets of unpublished sample data underlie these estimates. The first set, provided by the New York City Department of City Planning, comprises the total amount of space per employee, the distribution of space per employee, and the distribution of space among different categories of use, for example, offices, warehouses, factories, etc. The second is the value per square foot of space by type of use and was obtained from the New York City Real Property Assessment Department. As the assessment records give assessed values, a third set of data, equalization rates by property class, was required for the estimation of the market value per square foot of space. These data were provided by the New York State Department of Equalization and Assessment[5].

The estimated value of the P and S/E components, described[6] in equation (7), are presented in table 1. Underlying these interindustry variations in taxable market value, and in tax liability per employee, are significant differences in the intensity of space, and in the price of the space used. With respect to the latter, the variations should be a function of differential land values—to the extent that the operations of a particular sector are concentrated in higher or lower land value areas—and in differential structure costs. Such sectors as mining, finance, and insurance, all of which are primarily office functions in New York City, show similar prices. Real estate is also an office activity, and its somewhat lower price

(5) For a discussion of these data sets, and the procedures underlying the estimates presented in tables 1 and 2, see Bjornstad (1973b).

(6) Both the square footage and the property values (prices) are calculated from disaggregated data sets; hence, 'manufacturing', as shown here, is the weighted average of the two-digit level SIC (Standard Industrial Classification) manufacturing industries. The values calculated for the floorspace prices are also composite in a vertical sense, that is, they represent a summary from a broader data set, but have also been aggregated horizontally in order to consider the various uses of space in each industry.

means that this activity is spread throughout the city, while the others (mining, finance, and insurance) are primarily based in Manhattan. Outside Manhattan, the value of office space is less than that in the central borough. The variations in market value per square foot of floorspace as shown in table 1 are also consistent with the explanation that certain activities require less costly structures; for example, the building associated with wholesale trade or with manufacturing would be expected to be less expensive than that associated with finance, insurance, or real estate.

Conversely, manufacturing, transportation, and services all possess relatively low values per square foot of floorspace. This is probably because such space is generally used for production or warehousing and is subject to much less intense use (per employee) than would be true in, for example, the finance sector. Because, ultimately, the use to which it is put determines the value of floorspace, those industries which use space less intensively carry on activities in lower-priced facilities. This is evident from the inverse relationship between floorspace per worker and price of floorspace. Using the quantity of floorspace per worker to serve as a measure of intensity in use, the data in table 1 reveal that office-oriented industries tend to use rather small amounts of high-priced space, while production- and warehouse-oriented industries use larger amounts of lower-priced space—an expected consequence of the 'normal' demand for land in a particular use.

The data in table 2 show the variation in assessment ratios (the proportion of market value at which real property is assessed) among industries and the resulting effective tax rate differentials (that is, variations in the rate at which market value is taxed). As indicated there,

Table 1. Floorspace per worker and market value per square foot of floorspace for industry in New York City for 1969.

Industry	Floorspace per worker (ft^2)	Market value of floorspace ($\$ ft^{-2}$)
Agriculture	227	18·07
Mining	227	30·44
Manufacturing	310	10·13
Transportation	1257	9·05
Wholesale trade	705	14·24
Retail trade	239	19·49
Finance	173	28·62
Insurance	145	27·57
Real estate	1041	23·66
Services	429	10·70

Source: Calculated from unpublished data, Department of City Planning, and Department of Real Property Assessment, City of New York.

transportation is assessed at the smallest proportion of market value (62·13%). Therefore, the real tax rate for this sector is correspondingly the lowest of all sectors. This is because an equal nominal tax rate is levied on all sectors, that is, assessed value in all sectors is taxed at the same rate. All variations in the rate at which market value is taxed may, therefore, be attributed to variations in the assessment ratio.

The point to be made here is that while a 6·2% difference in rate of assessment seems perfectly defensible, and indeed, perhaps unavoidable, the resulting differential tax rates (again a 6·2% differential) clearly reflect an assessment differential(7).

From these estimates of P, S/E, and a, by employment sector, it is possible to identify the relative importance of various sources of tax-liability differentials. Finally, it should be noted that the government sector has been omitted so far because of its tax-exempt status.

Table 2. Effective property tax rates and assessment ratios for industry in New York City for 1969.

Industry	Effective tax rate (%) [a]	Assessment ratio (%)
Agriculture	3·52	67·49
Mining	3·39	64·98
Manufacturing	3·41	65·39
Transportation	3·24	62·13
Wholesale trade	3·38	64·84
Retail trade	3·54	67·73
Finance	3·40	65·21
Insurance	3·41	65·37
Real estate	3·45	66·06
Services	3·31	63·40

Source: Bjornstad (1973b).

[a] The effective tax rate (that is, the rate levied on market value) was calculated by applying the assessment ratio to the 1969 city-wide tax rate (0·0522).

4 Statistical results

Tax liabilities and taxable market value per employee are given in table 3 for the ten employment-sectors studied. As indicated in column (2), the real-estate sector contributes the largest amount of tax liability per employee ($860), while manufacturing contributes the least ($107). Even though assessment ratios vary among sectors, a similar pattern is evident in the case of taxable market value per employee, that is, real estate registers the largest values ($24926) and manufacturing the smallest ($3141).

(7) While there is no evidence that these differences in assessment ratios are the result of explicit policy, the pattern of these differentials are in conformity with certain principles of taxation, see Greytak and Bjornstad (1973).

Having identified the contributions of each industry to taxable property and tax liability, the analysis may now be turned to the question of the effect of the changing composition of economic activities on the base and revenues of the property tax. Table 4 allows an estimation of the revenue effect. The coefficients in the table indicate the number of jobs in the column industry which would be necessary to replace a job in the corresponding row industry and still maintain constant property-tax liabilities. Explained in terms of manufacturing (the third row), they indicate that the replacement of a manufacturing job requires the addition of 0·74 agricultural jobs, 0·46 mining jobs, 0·29 transportation jobs, 0·65 retailing jobs, 0·12 real-estate jobs, and 0·71 service-sector jobs.

The variation in replacement requirements is quite large among industries. The easiest jobs to replace are those in manufacturing, while the most difficult are those in real estate. In terms of the employment trend out of manufacturing and wholesaling and into services, the results are quite interesting. Specifically, the replacement of a manufacturing job requires 0·71 service-sector jobs, while wholesaling requires 1·60 service-sector jobs in order to maintain constant property-tax liabilities.

Table 4 allows a similar analysis in terms of property-tax base (the full market value of taxable property) per employee. It should be noted that, since it is the tax base that determined the tax limit and the amount of revenues which can be raised, the coefficients in panel (b) of table 4 refer to both the tax base and tax limit and, when the tax is levied at or close to its limit, to tax revenues. The interpretation of the coefficients follows as before. For manufacturing, the replacement of one job requires the addition of 0·45 mining jobs, 0·67 retailing jobs, 0·13 real-estate jobs, and 0·68 service-sector jobs to maintain a constant property-tax base.

Table 3. Property-tax liability and market value of taxable property per employee for industry in New York City for 1969.

Industry	Property-tax liability ($)	Market value of taxable property ($)
Agriculture	144	4103
Mining	234	6910
Manufacturing	107	3141
Transportation	369	11377
Wholesale trade	243	7192
Retail trade	165	4657
Finance	168	4952
Insurance	136	3997
Real estate	860	24926
Services [a]	152	4592

Source: Bjornstad (1973b).

[a] Includes only business services.

Table 4. Employment replacement requirements for industry in New York City for 1969 (a) for constant property-tax liabilities (b) for constant property-tax base[a].

Replaced industry	Replacing industry									
	agriculture	mining	manufacturing	transportation	wholesale trade	retail trade	finance	insurance	real estate	services
(a)										
Agriculture	1·00	0·62	1·35	0·39	0·59	0·88	0·86	1·06	0·17	0·95
Mining	1·62	1·00	2·19	0·64	0·96	1·42	1·39	1·72	0·27	1·54
Manufacturing	0·74	0·46	1·00	0·29	0·44	0·65	0·64	0·79	0·12	0·71
Transportation	2·55	1·57	3·44	1·00	1·52	2·24	2·19	2·71	0·43	2·43
Wholesale trade	1·68	1·04	2·27	0·66	1·00	1·48	1·44	1·78	0·28	1·60
Retail trade	1·14	0·70	1·54	0·45	0·68	1·00	0·98	1·21	0·19	1·08
Finance	1·17	0·72	1·57	0·46	0·69	1·02	1·00	1·24	0·20	1·11
Insurance	0·94	0·58	1·27	0·37	0·56	0·83	0·81	1·00	0·16	0·90
Real estate	5·95	3·67	8·02	2·33	0·53	5·22	5·10	6·30	1·00	5·65
Services	1·05	0·67	1·42	0·41	0·62	0·92	0·90	1·11	0·18	1·00
(b)										
Agriculture	1·00	0·59	1·31	0·36	0·57	0·88	0·83	1·03	0·16	0·89
Mining	1·68	1·00	2·20	0·61	0·96	1·48	1·40	1·73	0·28	1·50
Manufacturing	0·77	0·45	1·00	0·28	0·44	0·67	0·63	0·79	0·13	0·68
Transportation	2·77	1·65	3·62	1·00	1·58	2·44	2·30	2·85	0·46	2·48
Wholesale trade	1·75	1·04	2·29	0·63	1·00	1·54	1·45	1·80	0·29	1·57
Retail trade	1·14	0·67	1·48	0·41	0·65	1·00	0·94	1·17	0·19	1·01
Finance	1·21	0·72	1·58	0·44	0·69	1·06	1·00	1·24	0·20	1·08
Insurance	0·97	0·58	1·27	0·35	0·56	0·86	0·81	1·00	0·16	0·87
Real estate	6·08	3·61	7·94	2·19	3·46	5·35	5·03	6·24	1·00	5·43
Services	1·12	0·66	1·46	0·40	0·64	0·99	0·93	1·15	0·18	1·00

[a] Figures in the columns indicate the number of jobs in the respective sectors necessary to replace a job in the row sectors and still maintain (a) constant property-tax revenues (b) constant property-tax base.

In terms of industrial variation in the pattern of coefficients, manufacturing again is the easiest industry to replace, while real estate is the most difficult. Further, the present trend of a shift in employment from manufacturing and wholesaling into services appears a mixed blessing. While these coefficients suggest that the replacement of a manufacturing job requires 0·68 service employees, they also suggest that the replacement of a wholesaling job requires the addition of 1·57 service-sector jobs.

In fact, it is the government sector which is most easily 'replaced'. Any switch of one job to the government sector from any other sector results in a nonresidential property-tax revenue loss, as shown in table 4.

Table 5. Hypothetical nonresidential property-tax revenue response to changes in the composition of second level employment in New York City for the period 1960-1970[a].

Sector	Property-tax revenue response ($ thousands)	Allowing for compositional changes only ($ thousands)
Manufacturing	-13027	-18642
Wholesale and retail trade	-2121	-14769
Fire, insurance, and real estate	4168	12166
Services	6636	5244
Government	0	0
Estimated revenue loss	-4344	-16101

[a] The figures in the second column were derived by assuming actual 1960-1970 employment changes, while those in column three were derived by allowing for compositional changes only.

5 Revenue implications of changing economic structure

The object in analyzing the base and revenue of the tax on nonresidential property, as related to employment change, is to assess the revenue implications of a changing economic structure. To this end, the difference between the revenue loss, which can be attributed to changes in the level, and structure of employment between 1960 and 1970 can be calculated. The importance of this question is underlined by the great changes which the composition of New York City's employment base has undergone over the past decade, and the more acute job losses of the past two years. Particularly important is the low property-tax liability per employee in the services and government sector and the fact that over the past decade three out of every four new employees were in the government sector.

It is possible to use the estimated *per capita* property-tax liability variations, in conjunction with actual changes in employment by industrial sector, to explore the revenue implications of the changes in the composition of employment which occurred between 1960 and 1970. It must be emphasized that such an explanation should be considered hypothetical in that it does not pretend to estimate the actual changes in tax revenues which occurred between 1960 and 1970. In fact, due to the omission of residential property, estimation of the actual changes in total property-tax revenues is not possible within the present context.

However, it is possible to estimate what the effects of the changes in the level and composition of employment would have been, if
(1) the structure of the nonresidential property tax had remained constant throughout the 1960–1970 period; and
(2) the amount of tax revenues per employee in each employment sector from these taxes had remained constant at the levels given in table 5.

Applying the 1960–1970 employment changes to these revenue response coefficients reveals that, in total, the revenue response is negative, that is, the implication is for a \$4·3 million decline in nonresidential property-tax revenues (see table 5). The results show that the net negative effects of declines in the manufacturing and trade sectors exceeded the revenue growth contributed by the service and finance, insurance, and real estate sectors. Clearly, however, this net negative effect for the nonresidential property tax may be traced to the fact that the second largest sector of employment growth, the government, is not generally liable for property taxes. Again, it should be emphasized that these estimates allow for changes in the total level of employment, as well as for changes in the structure of employment.

In addition to the overall response of tax revenue to growth and change in the composition of employment, it is also possible, and of interest, to isolate the effects of changes in the *composition* of employment on tax revenues. To do this, it is only necessary to compare the revenue yield of nonresidential property tax in 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. The revenue responses to changes in the composition of employment are given in the last column in table 5. The results show that the property tax is affected negatively by such structural change. Specifically, we estimate here that revenues from the taxation of nonresidential property would have been over \$16 million more had employment structure not changed. Again, this result is attributable to the shift out of manufacturing and trade and into services and government.

6 Summary and evaluation

The purpose of this analysis is to develop a model capable of estimating the implications of the changing structure of central city employment for nonresidential property taxation. This model, tested on data for New York City, identifies the assessment ratio, the price per square foot of space, and the quantity of space per employee as the principal factors underlying interindustry difference in the amount of tax base and tax revenues per employee. Estimates of these components for New York City reveal large interindustry differences, particularly in the quantity of floorspace per worker and the value of space. Generally, it is found that office-oriented industries (at least in New York City) tend to use rather small amounts of high-price space, while production and warehouse-oriented industries use larger amounts of lower-price space. Conversely, interindustry variations in effective tax rates and in the assessment ratios are slight.

Estimated taxable market value and tax liabilities per employee vary widely among industries (see section 4). In terms of replacement requirements—the number of new employees in any given sector required to replace a lost employee in any given sector while maintaining a constant level of nonresidential property-tax liabilities—the easiest jobs to replace are those in manufacturing and services, while the most difficult are those in finance, insurance, and real estate.

Turning to the question of the sensitivity to the change in the composition of employment, it is estimated that revenues from the taxation of nonresidential property would have been $16 million higher if the structure of employment in 1970 had not changed during the decade. It should be noted that, in large part, this overall decline can be attributed to the fact that government property is the major sector of employment growth.

A number of limitations in this analysis should be emphasized. First, the measurement here is strictly concerned with employment changes which result from either the termination of an existing firm or the opening of a new firm. Second, these conclusions may not apply in many other cities, that is, the definition of taxable property varies from state to state. Therefore, a similar analysis performed in cities of other states may yield drastically different results. Finally, while the findings of this analysis imply that the changing structure of employment in New York City has had a negative effect on nonresidential property-tax revenues, it should be noted that, in total, local tax revenues are derived from taxation of many other bases. Clearly, a comprehensive evaluation of the revenue implications of the changing structure of central city activities awaits the incorporation of these other forms of taxation in a more general analysis.

Nonetheless, the findings of this study, limited as it is, do have important implications. As central city employment structures shift towards those activities which are characterized by relatively small amounts of taxable capital per employee, reliance on the property tax as a major source of local tax revenues portends fiscal difficulties unless total employment growth is quite large. Since it is unlikely that central cities will in the future experience rapid employment growth, it would seem imperative that local fiscal policymakers consider the redesign of local tax systems.

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