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EVALUATING THE STATE BUSINESS TAX STRUCTURE: AN APPLICATION OF INPUT-OUTPUT ANALYSIS †

ROY W. BAHL ** AND KENNETH L. SHELLHAMMER ***

I.

STATE TAX studies inevitably include extensive consideration of state business taxes—their rate structure equity, adequacy of yield, incidence, and conduciveness to attracting industry and stimulating economic development.[1] Moreover, these same considerations prevail in the comparative evaluation of alternative forms of business taxation. But a common shortcoming of the typical "tax study" approach is the failure to examine the nature of the relationship between business taxation and the structural interdependence of industry within the state. For example, an evaluation of a proposed higher state tax rate on the power industry might include a statement of the ratio of taxes to net income of power companies, and some estimate of the incidence of this tax by income class. But to the extent the output of the power industry is an input of other industries, which supply still other industries, the impulses of the initial tax on electric power are felt throughout the state's economy—incidence effects being similarly diffused. The task of this paper is to describe, in non-technical terms, and to give some empirical content to, a method useful in integrating this kind of information into the state government fiscal planning process. The method is an extension of input-output analysis, the familiar techniques of which were introduced by Professor Wassily Leontief in 1936.[2]

The utility of input-output analysis in examining a wide variety of economic problems has become increasingly apparent over the 30 years since Leontief's original work, input-output tables having become almost a necessary prerequisite to serious regional analysis. Acceptance of this view is evidenced by the large and growing number of input-output tables which have been constructed for geographic regions, states and even Standard Metropolitan Statistical Areas.[3] However, the use of I-0 tables as a technique for better understanding the state-local fiscal dimension of regional analysis has been limited to a point that there exists a paucity of discuission of potential application—even at the conceptual level.[4]

† We are indebted to Professors Jesse Burkhead and William H. Miernyk for their comments on an earlier draft of this paper. The views expressed in this paper are the authors' own.

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1 Among the best of these state studies are *Report of the Governors' Minnesota Tax Study Committee,* Harvey Brazer, Director (Colwell Press, Minneapolis), and *Michigan Tax Study Staff Papers,* Harvey Brazer, Director (Lansing, 1958), University of Wisconsin Tax Study Committee, *Wisconsin's State and Local Tax Burden* (Madison, 1959).

2 Wassily Leontief, "Quantitative Input-Output Relations in the Economy System of the United States," *The Review of Economics and Statistics, XVIII* (August 1936), pp. 105-125, and *The Structure of the American Economy,* 1919-1939 (Oxford Pres, 1951).

3 For a comparative list of input-output studies through 1966, see Charlotte E. Taskier, *Input-Output Bibliography,* 1955-1960 (New York: United Nations, 1961), and *Input-Output Bibliography,* 1960-1963 (New York: United Nations, 1964), and *Input-Output Bibliography* 1963-1966 (New York: United Nations, 1967).

4 However, a general discussion of the application of *I-O* coefficients to taxation problems may be found as early as 1943 in Lloyd A.

TABLE I

Hypothetical Transactions in a State Attributable to the Delivery of One Automobile to a Final Consumer

Seller / Purchaser	1. Auto Assembly Plant	2. Fabricated Steel Mfg.	3. Auto Engine Mfg.	4. Raw Steel Forms	5. Coal	6. Iron Ore	7. Auto Retailers	8. Labor	9. State Government	10. Final Consumer	11. Total Output	#
1. Auto Assembly Plant ...	0	0	0	0	0	0	1,600 (2)	0	0	0	1,600	1
2. Fabricated Steel Mfg. ..	300 (3)	0	0	0	0	0	0	0	0	0	300	2
3. Auto Engine Mfg.	100 (3)	0	0	0	0	0	0	0	0	0	100	3
4. Raw Steel Forms	0	100 (4)	0	0	0	0	0	0	0	0	100	4
5. Coal	0	0	0	20 (5)	0	0	0	0	0	0	20	5
6. Iron Ore	0	0	0	20 (5)	0	0	0	0	0	0	20	6
7. Auto Retailer	0	0	0	0	0	0	0	0	0	2,000 (1)	2,000	7
8. Labor	300	60	0	0	10	10	20	0	0	0	400	8
9. State Government	16	3	1	1	1	1	20	8	0	60	111	9
10. Imports, Profit, Savings .	884	137	99	59	9	9	360	392	111	0	2,060	10
11. Total Outlay	1,600	300	100	100	20	20	2,000	400	111	2,060	6,711	11

The following section is devoted to defining a model capable of relating industry interdependency to the business tax structure. In Section III, the model is tested using data from a recently completed input-output table for the State of West Virginia,[5] and potential uses of these data for fiscal planning are demonstrated—specifically for the questions of tax incidence; tax exporting, and short and long term revenue forecasting. The final section of this paper is given to the question of state economic development and state business taxation, and the manner in which this extension of input-output analysis sheds new light on this relationship.

II.

Table I is a hypothetical example of production requirements of seven industries, representing transactions which necessarily precede the sale of one automobile to a final consumer.[6] These hy-

Metzler, "Taxes and Subsidies in Leontief's Input-Output Model," *Quarterly Journal of Economics,* LXV (1951), pp. 433-438. More recently, Gerhard Zeitel has made an attempt to measure the pyramiding of the West German "turnover" tax by using input-output data, in *Die Steverlastverteilung in der Bundesrepublik Deutschland* (Tubingen, 1959).

[5] John H. Chapman and Kenneth L. Shellhammer, *The Structure of the West Virginia Economy, 1965: A Preliminary Report.* Regional Research Institute, West Virginia University (Morgantown, 1967).

[6] For a thorough, but non-technical, discussion of the input-output method and results, see William H. Miernyk, *The Elements of Input-Output Analysis* (Random House, New York, 1965), especially Chapters 1-4.

TABLE II

DIRECT AND INDIRECT REQUIREMENTS PER $1 DELIVERY TO FINAL DEMAND BY THE AUTO RETAIL SECTOR

Industry Producing		
1. Auto Assembly Plant	$1,600 / $2,000 =	$ .80
2. Fabricated Steel Mfg.	300 / 2,000 =	.15
3. Auto Engine Mfg.	100 / 2,000 =	.05
4. Raw Steel Forms	100 / 2,000 =	.05
5. Coal	20 / 2,000 =	.01
6. Iron Ore	20 / 2,000 =	.01
7. Auto Retail	2,000 / 2,000 =	1.00
Total	$4.140 / $2,000 =	$2.07

TABLE III

TAX PAYMENTS PER $1 OF OUTPUT (THE GROSS RECEIPTS TAX RATES)

Tax Paying Industry		
1. Auto Assembly Plant	$ 16 / $1,600 =	$.01
2. Fabricated Steel Mfg.	3 / 300 =	.01
3. Auto Engine Mfg.	1 / 100 =	.01
4. Raw Steel Forms	1 / 100 =	.01
5. Coal	1 / 20 =	.05
6. Iron Ore	1 / 20 =	.05
7. Auto Retail	20 / 2,000 =	.01

pothetical data show the following: (1) the final consumer purchased the auto from an auto retailer for $2,000. (2) the auto retailer purchased the auto from an auto assembly plant for $1,600. (3) in

TABLE IV

DIRECT AND INDIRECT TAXES ATTRIBUTABLE TO $1 DELIVERY TO FINAL DEMAND BY THE AUTO RETAIL SECTOR

Tax Paying Industry				
1. Auto Assembly Plant	$.01	times	$ .80 =	$.0080
2. Fabricated Steel Mfg.	.01	times	.15 =	.0015
3. Auto Engine Mfg.	.01	times	.05 =	.0005
4. Raw Steel Forms	.01	times	.05 =	.0005
5. Coal	.05	times	.01 =	.0005
6. Iron Ore	.05	times	.01 =	.0005
7. Auto Retail	.01	times	1.00 =	.0100
Total			$2.07	$.0215

order to produce the auto, the assembly plant purchased $300 of parts from fabricated steel manufacturers, and a $100 engine from an auto engine manufacturer. (4) in order to produce $300 of parts, the fabricated steel manufacturer had to purchase from steel mills $100 of raw steel forms. (5) in order to produce $100 of raw steel forms, the steel mills had to purchase $20 of coal from coal mines and $20 of iron ore from iron ore mines.

Other transactions which would take place are: (1) payments to labor of $400 —$300 by the auto assembly plant, $60 by the fabricated steel manufacturer, $10 by coal mines, $10 by iron ore mines, and $20 by the auto retailer (row 8). (2) payments to state governments of $111;[7] $8 by labor (income tax), $60 by final consumers (consumer sales tax); $16 by the auto assembly plant (gross receipts tax), $3 by the fabricated steel manufacturer (gross receipts tax), $1 each by the auto engine manufacturer, the steel plant, coal mines, and iron ore mines, and $20 by the auto retailer (gross receipts tax).

All other inputs to these industries are purchased out-of-state, and their values aggregated with profits and depreciation

[7] In our hypothetical example, only three taxes are levied: (a) a personal income tax on labor's earnings, (b) a consumer sales tax on purchases by final consumers, and (c) a gross receipts, or turnover tax on *all* sales of firms.

as shown in row 10. Labor's after-tax earnings and state government revenue are shown in the same row, savings, and the system is stopped at this point.[8]

The application of I-0 to tax structure analysis requires the derivation of a "tax" matrix. The coefficients of this matrix, shown in Table IV for our hypothetical Auto Retail Sector, are the product of payments to state government per dollar of output (Table III) and the matrix of direct and indirect output requirements per dollar of delivery to final demand (Table II). Then the last column of Table IV shows the tax payments of *each industry* directly and indirectly attributable to $1 delivery to final demand *by the auto retail sector*.[9] Alternatively, the data in Table IV (the column sum) may be interpreted as showing that $0.0215 of state tax is embodied in each dollar of final sales of automobiles. These tax coefficients, when computed for each sector in the state's economy, lend much to an analysis of the equity and adequacy of business tax structures. We now turn to the task of applying this model to a specific case and demonstrating the potential use.

III.

The State of West Virginia affords an excellent testing ground for this model for two reasons: First, the West Virginia Regional Research Institute has recently completed an I-0 table dividing the state into 48 producing sectors. Second, the major source of state government revenue in West Virginia is a gross receipts, or "turnover" tax—each industry is assessed a different rate and the tax is levied on total sales. The tax coefficients (computed on *all* state government business taxes) similar to those shown in IV were computed for each of the 48 sectors, and are presented for selected sectors in Appendix I. The total tax payments embodied in $1 of final sales of any given industry is the appropriate column sum in Appendix I, and this amount is shown in column 1 of Table V, i.e., this number for each sector is analogous to the $0.0215 for the hypothetical auto retail sector shown in Table IV.

The objective in the following section is to make use of these tax coefficients to demonstrate the utility of data describing inter-industry relations for analysis of business tax structures. More specifically, the discussion below focuses on: (a) a method of estimating the incidence of business taxes; (b) a method for estimating the exporting of business taxes; and (c) the potential for using this model for short or long-term revenue forecasting. These specific uses of inter-industry analysis for fiscal planning purposes would seem necessary to properly consider the more general question of business taxation and economic development, and the alleged trade-off between the size of state and local government revenues extracted directly from industry and the climate within the state for economic growth.

Differential Impact and Incidence Analysis

A useful and currently popular method of evaluating alternative busines tax structures is that of differential impact analysis accomplished by comparing the distributional pattern of tax payments, by industry, which are asociated with

[8] Though it is possible to show with *I-O* analysis the *complete* continuum of transactions which could be attributed a final consumers purchases of, for example, one auto (if the analyst could predict how labor would spend net earnings of $392, and how the state would dispose of its revenues of [$111] for purposes of this paper, the state revenue which can be logically and predictably attributed to the sale of one auto to a final consumer is assumed here to be $111).

[9] Note that when the coefficients in Table IV are multiplied by $2,000, the resulting values are the same as in Table I, i.e., sector 1 pays $16 in taxes, sector 2 pays $3, etc., and total tax payments by all of the seven industries of $.0215 x $2,000 = $43.

TABLE V

Sector Description	Tax Per $1 of Total Final Demand	Taxes Embodied in Total Final Demand	Taxes Attributable to Exports	Exports as a Per Cent of Final Demand
	$ Amounts in Thousands			
1. Agriculture	.012335	$ 1,039	$ 665	0.64
2. Coal mining (underground)	.017878	11,311	11,198	0.99
3. Coal mining (strip & auger)	.032024	773	727	0.94
4. Petroleum & natural gas	.055762	47	47	1.00
5. All other mining	.022649	590	177	0.30
6. General contractors (building)	.034561	5,041	302	0.06
7. General contractors (non-building)	.033548	5,030	453	0.09
8. Special trades contractors	.037062	2,198	198	0.09
9. Food & kindred products (meats, n.e.c.)	.015346	551	77	0.14
10. Food & kindred products (dairies)	.012448	889	107	0.12
11. Food & kindred products (bakeries)	.013691	600	246	0.14
12. Food & kindred products (beverages)	.160800	4,581	870	0.19
13. Apparel & accessories	.007511	169	127	0.75
14. Logging & sawmills	.018194	737	619	0.84
15. Furniture & other wood fabrications	.013121	259	117	0.45
16. Printing & publishing	.009571	167	57	0.34
17. Chemicals	.009868	10,691	10,477	0.98
18. Petroleum	.015712	447	246	0.55
19. Glass	.012435	3,195	3,099	0.97
20. Stone & clay products	.019820	1,868	1,588	0.85
21. Primary metal products	.007528	6,798	6,730	0.99
22. Fabricated metal products	.008759	747	695	0.93
23. Machinery (except electrical)	.008096	857	394	0.46
24. Electrical machinery & apparatus	.010743	1,234	1,111	0.90
25. Transportation equipment	.009215	1,620	907	0.56
26. Instrument & related products	.010871	53	43	0.81
27. All other manufacturing	.008181	699	545	0.78
28. Eating & drinking establishments	.047709	5,333	960	0.18
29. Wholesale trade	.124076	26,514	9,015	0.34
30. Retail food stores	.038682	4,579	229	0.05
31. Retail gasoline service stations	.125934	3,760	263	0.07
32. All other retail	.023986	8,778	1,404	0.16
33. Banking	.010195	749	120	0.16
34. Other finance	.018950	963	77	0.08
35. Insurance agents & brokerage	.030126	6,254	125	0.02
36. Real estate	.034439	1,083	162	0.15
37. All other Finance, Insurance, Real Estate	.018169	304	119	0.39
38. Hotels & other lodging places	.023205	781	391	0.50
39. Medical & legal services	.010815	1,476	253	0.17
40. Educational services	.008523	1,838	18	0.01
41. All other services	.033946	11,356	681	0.06
42. Railroads	.034492	5,533	4,758	0.86
43. Trucking & warehousing	.026140	3,283	2,101	0.64
44. All other transportation	.020525	301	42	0.14
45. Communications	.032068	2,407	602	0.25
46. Electric companies & systems	.053031	3,709	556	0.15
47. Gas companies & systems	.019796	6,331	5,698	0.90
48. Water & sanitary services	.034580	494	15	0.03

alternative forms of equal-yield taxes.[10] It focuses on the question of "given the amount of tax to be extracted from industry, what tax base or combination of bases secures a distributional pattern consistent with policy objectives?" Operationally, differential impact analysis requires computing (a) the per cent of total taxes paid by each industry, and (b) the effective tax rate for each industry, based on alternative equal-yield taxes, e.g., gross receipts, value added, and net income. The decision as to the "best" tax is based ultimately on the state legislators' decisions about which industries should pay higher effective rates, which taxes discourage which industries from locating or expanding in the state, and on comparisons of effort and ease of administration and compliance, etc.

The input-output method described above may be used to accomplish a differential business tax analysis of a slightly different order. Although the coefficients in Appendix I—state payments per dollar of final demand—are computed on the basis of West Virginia's existing state tax system, it would be possible to recompute the fiscal coefficients under the alternate assumptions, for example, of: (a) an equal-yield value added tax; or (b) an equal-yield net income tax.[11] But the difference between the differential impact method and the input-output method described here is that the fiscal coefficients of the latter show *the amount of tax which is embodied in a dollar's worth of delivery to final demand,*[12] and how this proportion varies across industries. The figures shown in column 1 of Table V are such estimates, e.g., $0.015 per one dollar of final demand for meat, $0.161 for beverages, $0.010 for chemicals, $0.126 for retail gasoline stations, and $0.050 for electric power.[13] Calculating these coefficients for alternative tax bases and/or rate structures will provide policy makers with estimates of different amounts of tax embodied in the final sales of different sectors. The value of these data is that they enable a judgment of the degree to which alternative tax bases and rate structures are more or less regressive in their distribution of burden among state residents. This is obviously a valuable piece of additional information for public decision makers if equity considerations are a part of the public policy objective function.

Specific estimates of incidence would, of course, require information on the per cent of total income spent on different product lines in relation to the size of total family income.[14] This information is available and may be incorporated into a comprehensive burden-distribution analysis of business taxes. For example, estimates, by income class, of the incidence of business taxes on apparel goods are shown in Table VI. First, the amount of business tax embodied in one dollar of final sales of apparel (Table V, row 13, column 1) is

[10] See John B. Legler and James A. Papke, "Optimizing State Business Taxation: An Application of Diffierential Impact Analysis," *National Tax Journal, Volume* XVIII, Number 3, pp. 240-246.

[11] However, this method requires that the tax be linear with respect to output (though not necessarily homogeneous) in order to have a general solution. If the tax base varies with output in a non-linear manner, a general solution is impossible . . . though one could be approximated with a number of tax matrices, each approximating the relationship at alternative levels of output.

[12] To reiterate, the tacit assumption here is that each industry passes 100 per cent of its taxes forward at each stage of production. Again it would be possible to assume some smaller fraction is passed forward, but recomputation of the fiscal coefficients would be required.

[13] It should be noted that differentials among some sectors are attributable to direct excises, e.g., direct excises are imposed on retail gasoline but not on chemicals.

[14] Such estimates are available, by region, in *Consumer Expenditures and Income,* Supplement 3—part A to BLS Report 237-91 (USDA Report CES—13, April 1966), pp. 30-42.

TABLE VI

EFFECTIVE TAX RATES OF WEST VIRGINIA FAMILIES BY INCOME CLASS: FOR APPAREL GOODS

Income Class	(1) Per Family Clothing Expenditures [a]	(2) Per Family Tax Payments [b]	(3) Average Family Income [a]	(4) Effective Tax Rates [c]
Under $1,000	$ 104.39	$ 0.78	$ 610	$.001279
1,000-1,999	151.39	1.14	1,553	.000734
2,000-2,999	239.36	1.80	2,529	.000712
3,000-3,999	365.31	2.74	3,574	.000767
4,000-4,999	445.47	3.35	4,612	.000726
5,000-5,999	560.15	4.21	5,552	.000758
6,000-7,499	659.73	4.96	6,717	.000738
7,500-9,999	847.34	6.36	8,648	.000735
10,000-14,999	1,149.64	8.63	11,794	.000732
15,000 and over	1,815.78	13.64	24.638	.000554

[a] Source: *Consumer Expenditures and Income*, Supplement 3—part A to BLS Report 237-91 (USDA Report CES—13) April 1966, pp. 30-42.
[b] Column (1) times $0.007511.
[c] Column (2) divided by column (3).

multiplied by average family clothing expenditures in any given income class. This product is then divided by family income to obtain an estimate of the effective tax rate. Similar calculations may be carried out for other sectors in the state's economy.

But again, these estimates are based on the assumption that 100 per cent of business taxes is shifted forward at every level of production—possibly an unrealistic assumption. The more complicated question of deriving actual measures of intersectoral tax shifting cannot be answered via the I-0 technique, but must await more detailed industry studies. However, there does exist some evidence that, at least in some cases, the assumption of 100 per cent forward shifting may be a reasonable approximation of reality.[15]

A second limitation of this approach to measuring the distribution of burden is that studies of consumer behavior have not been disaggregated by type of product to an extent great enough to enable intensive incidence analysis, e.g., food expenditures are available, but dairy product expenditures are not. In general, consumer survey expenditure sectors do not match the input-output sectors.

In sum, the differential impact analysis compares the variance in inter-industry tax impact (under the assumption of alternative tax bases), while the input-output fiscal coefficients describe inter-industry differences in the amount of taxes embodied in each dollar of final sales (under the assumption of alternative tax bases). Then the joint use of these techniques may answer the questions most relevant in any consideration of tax revision: (a) how will the "impact" of the proposed revision be distributed among the state's industries? and (b) how will the revision affect the distribution of tax payments among different income level families?

Tax Exporting

Another use of the input-output table is to derive estimates of the degree to which different industries are able to export state taxes. This becomes an important element of the typical state tax

[15] For example, see Karl Roskamp's discussion of the literature on the West German Turnover tax in "The Distribution of Tax Burden in a Rapidly Growing Economy: West Germany in 1950," *National Tax Journal*, XVI (March 1963), No. 1, pp. 24-25.

study, since a perennial question is the degree to which the burden of state taxpayers is increased by any given rate or base adjustment. The coefficients shown in Table I give the sales of each of the seven hypothetical sectors to all other sectors within the state, and to final demand—but the final demand sector includes exports (out-of-state sales to both final consumers and to other firms). Hence, Table I can be envisioned as showing sales of each sector to all other sectors *in the state* (including final consumers), and to other states. Then if the 48 x 48 matrix showing state tax payments per dollar of final demand (a matrix comparable to Appendix I) is multiplied by the vector showing exports for each of the 48 industries, the result is an estimate of the amount of tax exported by each industry (a 48-row column vector). The assumption required is that for each industry the proportion of tax exported is equal to the proportion of output exported, which is tantamount to assuming that each industry shifts its entire state tax payment forward.

Estimates of the amounts and percentages of total tax exported, for individual industries in West Virginia are shown in columns (3) and (4) respectively, in Table V. These data indicate (given our assumptions) that 45.8 per cent of all state business taxes are exported, i.e., 45.8 cents on every business tax dollar. Among industries, the coal mining, petroleum and natural gas, chemical, glass, primary metal products, fabricated metal products and electrical machinery sectors each export more than 90 per cent of total output to other states. On the other hand, contractors, retail food stores, retail gasoline service stations and the insurance and finance sectors export less than one-tenth of total output. An industry-by-industry comparison of state tax payments per dollar of delivery to final demand with the per cent of total output exported (columns (1) and (4) of Table V) shows the amount of tax per dollar of final demand to be generally smaller for the high export industries. For example, these rates are .99 cents per dollar of final demand for chemicals and .75 cents for fabricated metal products (both of which export over 90 per cent of total output), as compared with 3.87 cents for retail food stores and 3.46 cents for general building contractors (both of which export less than 10 per cent).

There are two general implications of high rates of tax exporting. First, since a portion of the state tax load is shifted to another state, the relative prices of the public and private goods are distorted, leading local governments to make non-optimal decisions.[16] Second, there necessarily are changes in real income which result from tax exporting, a consideration which will be dealt with below.

Sensitivity Analysis

A more general use of input-output for purposes of fiscal planning is provided by a sensitivity analysis. The objectives of a sensitivity analysis may be: (a) to determine the impact and incidence effects for each sector of alternative tax bases and/or rate structures; (b) to generate revenue forecasts on the basis of projected levels of economic activity or hypothetical rate change; and (c) to examine the potential fiscal effects of changes in the nature of inter-industry relations within the state, and to evaluate alternative courses of remedial action.

The technical meaning of sensitivity analysis as used here involves varying the relevant coefficients by some specified amount and observing the reaction

[16] McLure points out that the effects of "tax importing" do not lessen this distortion, but rather have only an income effect upon the choice between public and private goods. See Charles McLure, "*The Interstate Exporting of State and Local Taxes: Estimates for 1962,*" *National Tax Journal*, XX (March 1967), p. 49.

of the entire system. With reference to objective (b) above, one could create a new final demand vector based on the projected level of final demand for each of the 48 industries in, say, 1975 and generate appropriate estimates of revenue for that year. Alternative estimated levels of sector activity (e.g., high, medium, low) also might be projected so that a possible range of state tax receipts in 1975 could be generated. A comparison of these estimates with projected expenditure requirements should indicate to the public decision-maker whether a revision of the state tax structure would be required or, viewed in another way, what level of services could be supported. Then, as suggested above, alternative revisions of the rate structure, or possible changes in the base, might be evaluated in terms of equity and adequacy by deriving the appropriate set of coefficients (similar to those shown in Table IV).

The question raised in objective (c) above—that of changes in technical interdependence among industries—is uniquely amenable to an input-output approach. Recalling that data such as that in Table I is a "recipe" for the production and sale of one automobile, assume for technical reasons that a change in the input mix is expected to occur in the auto assembly plant. More specifically, assume that the auto assembly plant finds it economical to manufacture internally the fabricated steel parts it formerly purchased from in-state producers. This would eliminate a $300 transaction from the system and reduce taxes per automobile by $3.00.[17]

The relationship of state business taxation to the level and rate of state economic development are central to the study of tax structures. Two general approaches to identifying this relationship have been taken. First, on a macro level, Campbell and Sacks have attempted to show the cross-state relationship between the level and rate of growth of per capita income.[18] As other indicators of economic growth they used total employment, non-agricultural employment and population growth rates, and the state manufacturing employment location quotient. Their findings do not lend support to the thesis that either higher per capita business taxes or a higher business tax component in the state structure dampen state economic development. The micro approach to the tax-development relationship is the industry location study. The special concern of such a study is the question of whether a particular rate or base structure might either discourage new industry seeking a home, or deter existing firms from expanding within the state. The conclusions are usually drawn from questionnaries, and/or from a differential impact analysis as described in III above.

The extension of input-output described in this paper provides another way of examining the business tax-economic development question, i.e., it might help provide an answer to the question: "Given some *level* of business taxation, what effect does the existing *structure* have on the propensity for state economic growth?" The answer must be cast in terms of two considerations: (1) Does the existing rate or base structure adversely affect the industry in the product market, and (2) does the existing rate or base structure adversely affect the factors of production in the industry's input market?

[17] Other, less dramatic, changes can also be examined. If, for example, a technological change enabled steel producers to produce the same amount of steel with half the coal input, this would reduce by 50 cents tax payments per automobile.

[18] Alan K. Campbell, "State and Local Taxes, Expenditures, and Economic Development," pp. 195-208, and Seymour Sacks, "State and Local Finances and Economic Development," pp. 209-224, both in *State and Local Taxes on Business* (Tax Institute of America, Princeton, New Jersey, 1963).

Consider the possible effects on product and factor markets, assuming that we can estimate the amount of tax embodied in each dollar of final demand (Table V, column 1). If the industry is selling in a local market, all firms pay the tax; hence it is likely to be shifted forward to state consumers entirely. In this situation the tax is not likely to discourage either the attraction of new industry or the expansion of old. However, in the case of a gross receipts tax, such as exists for West Virginia, this may not be true for all firms. If there exists one vertically integrated firm, it avoids the tax at n-1 stages of the production process and therefore may sell at a lower price than non-vertically integrated firms seeking the same return. But the latter will soon cut the price, shifting the tax on n-1 production processes backward to the factor inputs; initially to the least mobile of inputs—land and labor.

On the other hand if the industry is selling in a national market, the question of business taxes on that industry in other states becomes a relevant consideration. For example, if West Virginia firms in the i^{th} industry pay higher taxes than firms in that industry located in other states, the expected amounts of the tax shifted forward is less than if the reverse were true. To the extent it is shifted backwards to capital it may be a negative consideration for firms considering a West Virginia location. If it is shifted backwards to labor it may induce both a short and long-run dampening effect on the rate of economic growth. In the short run, wages and salaries are lower than would have been the case in the absence of the unfavorable tax, thereby resulting in lower income and consumption levels. In the long run the geographic mobility of factors could have a similar effect on income and consumption levels. The reverse of this argument is true if West Virginia firms in this industry face a lower tax than competitors located in other states.

It is important to note here that a differential impact analysis does not give the information necesary to evaluate the relative advantages or disadvantages provided by interstate variance in rate or base structure, i.e., interstate comparisons, by industry, of

$$\frac{\textit{State Tax Payments}}{\text{Net Income}}$$

or

$$\frac{\textit{State Tax Payments}}{\text{Gross Product Originating}}$$

do not reflect the amount of *tax embodied in the inputs to any given industry.* The difference is analogous to comparing, for our simple example in Tables I-IV, \$0.0100 which is the amount of states taxes paid by auto retailers per \$1 of output, with \$0.0215 which is the *total* amount of tax embodied in \$1 of final demand in the auto retailing sector. Clearly the latter is more relevant for the location decision of the firm.

Then, in general, the business tax would appear to be the least important locational consideration for new firms anticipating a largely local market, and the most important for firms selling in a national market. Accordingly, to the extent taxes are a relevant locational consideration, the kind of analysis sketched out above may be particularly important for a state such as West Virginia. McLure's estimates, for example, place West Virginia third from the bottom in the per cent of state value added in manufacturing for local markets.[19]

Obviously, the kind of analysis suggested here is important only to the extent that taxes are an important locational factor, and indeed there is much

[19] He estimates West Virginia (and New Hampshire) at 9.1 per cent with only Rhode Island and South Carolina lower. Charles E. McLure, Jr., "The Interstate Exporting of State and Local Taxes: Estimates for 1962," *National Tax Journal*, XX (March 1967), pp. 57-59, esp. Table III.

evidence that they are not. Numerous studies have shown taxes to be a marginal consideration at best, and in many cases less important than the public infrastructure.[20] But the cost of inputs to the industry are a relevant concern, and to the extent these costs are affected by the state tax structure, as described above, business taxes are in fact of some importance. The questionnaire approach would probably miss this factor.

If taxes are mildly important in interstate location decisions, they are vitally important in intrastate decisions. The input-output coefficients of Table V could be amended to show the effects of local gross receipts and business property levies. The analysis of shifting as described above still applies, except that firms dealing with a local but multicounty market must take into account, *cet. par.*, the tax structure of other counties in their factor and product pricing decisions.

The discussion in this section, and the taxes-per-dollar-of-final-demand concept in general, would seem to suggest a game-like approach to deriving an optimal business tax structure. For firms competing in a local (e.g., statewide) market, the state need be guided only by distributional and yield objectives. Since the tax will be shifted forward to consumers, a state may desire to lessen the overall regressivity by rate adjustments which could, for example, make tax payments per dollar of soft drink consumption less than tax payments per dollar of apparel consumption. Local governments, on the other hand, are constrained by the actions of other local governments. Their optimal strategy would seem to be the granting of tax concessions only to firms selling in nonlocal markets. These data suggest that the behavior of state and local governments in West Virginia is just opposite to that described above. The coefficients in Table V, column 1, suggest that if state fiscal planners do have some objective function it would seem to call for greater rather than less regressivity in effective rate. (As evidence, note the taxes per dollar of sales of soft drinks, row 12, retail food stores, row 30, and retail gasoline service stations, row 31). It should be noted, however, that the retail sectors have been "margined," i.e., resale merchandise purchases taken out. The tax coefficients in these sectors are therefore taxes per dollar of *markup* on sales. Markup is about 25 to 30 per cent of sales.

In conclusion, the extension of input-output analysis suggested in this paper can be a valuable aid in state and local fiscal planning in that it sheds new light on many of the old questions which are considered in the typical state fiscal analysis.[21] It forces the analyst to focus away from a single stage consideration of taxes and to take account of multistage production processes. (Is not the impact of any governmental decision about state taxes as roundabout as the production process itself?)

Finally, the kind of analysis suggested here is not impractical in terms of effort or expense, once a table of direct and indirect coefficients is completed. And with the large number of states already having, or in the process of completing, input-output tables, the derivation and use of fiscal coefficients would seem to be a true necessity for serious fiscal planning.

[20] This latter finding could almost lead one to the conclusion that industry has been lost to some states not because taxes are too high, but because they are too low. See, for example, James H. Thompson and Thomas S. Issack, *Factors Influencing Plant Location In West Virginia* (Bureau of Business Research, West Virginia University, Morgantown, 1961), or Leonard Yaseen, *Plant Location*, (American Research Council, Inc., New York, 1956), p. 164.

[21] For a fairly comprehensive bibliography and content summary of recent tax studies, see *State Tax Studies: 1959-1967*, Tax Foundation, Research Publication 13, 1967.

APPENDIX I

Selected Columns from the West Virginia Business Tax Matrix[a]

↓ Tax Paying Industry / Industry Selling to Final Demand →	Extractive: Underground Coal Mining (2)	Manufacturing: Chemicals (17)	Manufacturing: Food & Kindred Bakeries (11)	Trade: Retail Food Stores (30)	Utilities: Electric Companies (46)
1. Agriculture	.000002	.000001	.000016	—	—
2. Coal mining (underground)	.013826	.000186	.000056	.000073	.002165
3. Coal mining (strip & auger)	.000277	.000018	.000034	.000046	.001322
4. Petroleum & natural gas	.000012	.000559	.000189	.000094	.000035
5. All other mining	.000024	.000102	.000005	.000006	.000021
6. General contractors (building)	.000001	.000017	.000003	.000062	.000003
7. General contractors (non-building)	.000001	.000053	.000007	.000013	.000009
8. Special trades contractors	.000140	.000266	.000009	.000122	.000040
9. Food & kindred products (meats, n.e.c.)	.000007	.000007	.000004	.000001	.000002
10. Food & kindred products (dairies)	—	—	—	—	—
11. Food & kindred products (bakeries)	—	—	.005656	—	—
12. Food & kindred products (beverages)	—	.000001	—	.000001	.000001
13. Apparel & accessories	—	.000001	—	—	—
14. Logging & sawmills	.000078	.000003	.000001	.000001	.000013
15. Furniture & other wood fabrications	.000028	.000003	—	—	.000005
16. Printing & publishing	.000006	.000011	.000013	.000263	.000021
17. Chemicals	.000003	.004775	.000001	.000001	.000002
18. Petroleum	.000013	.000016	.000004	.000009	.000039
19. Glass	—	.000006	.000001	.000002	—
20. Stone & clay products	.000026	.000012	.000002	.000004	.000023
21. Primary metal products	.000002	.000007	.000001	.000002	.000007
22. Fabricated metal products	.000008	.000018	.000002	.000010	.000037
23. Machinery (except electrical)	.000003	.000002	—	.000001	.000002
24. Electrical machinery & apparatus	—	.000007	—	.000001	.000003
25. Transportation equipment	—	.000001	—	—	.000001
26. Instrument & related products	—	.000026	—	—	—
27. All other manufacturing	.000006	.000050	.000006	.000027	.000002
28. Eating & drinking establishments	.000003	.000017	.000006	.000010	.000031
29. Wholesale trade	.001679	.001370	.003101	.000883	.001212
30. Retail food stores	—	.000005	—	.032000	—
31. Retail gasoline service stations	.000034	.000041	.000625	.000199	.000042
32. All other retail	.000058	.000078	.000198	.000033	.000029
33. Banking	.000004	.000009	.000036	.000014	.000009
34. Other finance	.000002	.000002	.000044	.000029	.000004
35. Insurance agents & brokerage	.000220	.000150	.000443	.000519	.000133
36. Real estate	.000013	.000009	.000017	.001357	.000070
37. All other Finance, Insurance, Real Estate	.000039	.000024	.000022	.000024	.000035
38. Hotels & other lodging places	.000001	.000009	.000002	.000003	.000007
39. Medical & legal services	.000014	.000019	.000012	.000017	.000017
40. Educational services	—	—	—	—	—
41. All other services	.000144	.000312	.001321	.000647	.000244
42. Railroads	.000038	.000460	.000040	.000045	.000912
43. Trucking & warehousing	.000041	.000227	.000047	.000120	.000282
44. All other transportation	.000006	.000044	.000007	.000017	.000017
45. Communications	.000045	.000212	.000204	.000392	.000103
46. Electric companies & systems	.001067	.000457	.001082	.001364	.043383
47. Gas companies & systems	.000007	.000222	.000400	.000191	.000024
48. Water & sanitary services	.000001	.000056	.000072	.000078	.000005
49. Total	.017878	.009868	.013691	.038682	.050314

[a] Each column shows the taxes paid by the industries named at the left attributable to one dollar of delivery to final demand by the industry named at the head of the column.

APPENDIX I (continued)

SELECTED ROWS FROM THE WEST VIRGINIA BUSINESS TAX MATRIX [b]

Tax Paying Industry → / ↓ Industry Selling to Final Demand	Extractive	Manufacturing		Trade	Utilities
	Underground Coal Mining (2)	Chemicals (17)	Food & Kindred Bakeries (11)	Retail Food Stores (30)	Electric Companies (46)
1. Agriculture	.000026	.000003	—	—	.000354
2. Coal mining (underground)	.013826	.000004	—	—	.001103
3. Coal mining (strip & auger)	.002771	.000003	—	.000001	.000378
4. Petroleum & natural gas	.000037	.000026	—	.000001	.000315
5. All other mining	.000014	.000038	—	—	.000186
6. General contractors (building)	.000045	.000023	—	.000001	.000323
7. General contractors (non-building)	.000071	.000255	—	.000001	.000207
8. Special trades contractors	.000020	.000011	—	.000001	.000173
9. Food & kindred products (meats, n.e.c.)	.000037	.000003	—	.000001	.000704
10. Food & kindred products (dairies)	.000018	.000002	—	—	.000323
11. Food & kindred products (bakeries)	.000056	.000002	.005656	—	.001118
12. Food & kindred products (beverages)	.000020	.000019	—	—	.000149
13. Apparel & accessories	.000021	—	—	—	.000302
14. Logging & sawmills	.000039	.000002	—	.000001	.000586
15. Furniture & other wood fabrications	.000120	.000065	—	—	.000356
16. Printing & publishing	.000026	.000003	—	.000001	.000231
17. Chemicals	.000186	.008268	—	.000005	.000473
18. Petroleum	.000361	.000391	—	.000001	.000434
19. Glass	.000035	.000039	—	—	.000569
20. Stone & clay products	.000127	.000028	—	—	.000567
21. Primary metal products	.000285	.000043	—	—	.000351
22. Fabricated metal products	.000056	.000014	—	.000001	.000465
23. Machinery (except electrical)	.000030	.000004	—	—	.000317
24. Electrical machinery & apparatus	.000111	.000165	—	—	.001185
25. Transportation equipment	.000038	.000004	—	—	.000391
26. Instrument & related products	.000012	.000356	—	—	.000098
27. All other manufacturing	.000024	.000009	—	—	.000312
28. Eating & drinking establishments	.000038	.000001	.000168	.000148	.000604
29. Wholesale trade	.000050	.000010	—	.000006	.000903
30. Retail food stores	.000073	.000002	—	.032000	.001410
31. Retail gasoline service stations	.000041	.000012	—	—	.000551
32. All other retail	.000043	.000003	.000003	—	.000636
33. Banking	.000010	.000001	—	—	.000110
34. Other finance	.000005	.000001	—	—	.000074
35. Insurance agents & brokerage	.000006	.000002	—	.000002	.000062
36. Real estate	.000020	.000004	—	.000001	.000335
37. All other Finance, Insurance, Real Estate	.000043	.000015	.000002	.000016	.000237
38. Hotels & other lodging places	.000192	.000006	—	—	.002371
39. Medical & legal services	.000016	.000035	.000004	.000038	.000221
40. Educational services	.000057	.000013	.000004	.000001	.000472
41. All other services	.000012	.000022	—	—	.000200
42. Railroads	.000019	.000007	—	—	.000204
43. Trucking & warehousing	.000017	.000002	—	.000001	.000256
44. All other transportation	.000015	.000004	—	—	.000204
45. Communications	.000014	.000005	—	—	.000170
46. Electric companies & systems	.002165	.000004	—	—	.044864
47. Gas companies & systems	.000049	.000003	—	—	.000094
48. Water & sanitary services	.000133	.000135	—	—	.002219

[b] Each column entry is the tax payment by the industry named at the head of the column attributable to one dollar of delivery to final demand by the industry named at the left.

APPENDIX (II)

Mathematical derivation of the tax matrix:

(1) $X_i = X_{ij} + X_{ia}$

(where $j = 1, 2, \ldots n$, for $i = 1, 2, \ldots n$)

(2) $X_i = \Sigma_{j=1}^{n} a_{ij} X_j + X_{ia}$ $(i = 1, 2, \ldots n)$

(3) $X_{ia} = X_i - (\Sigma_{j=1}^{n} a_{ij} X_j)$ $(i = 1, 2, \ldots n)$

Expression (1) is the general balance equation of *I-O* analysis. Total sales of industry i, X_i, equals intermediate sales, X_{ij}, plus sales to final demand, X_{ia}. Expression (2) shows X_{ij} equal to $\Sigma_{j=1}^{n} a_{ij} X_j$, which introduces the assumption that sales from industry i to j are a direct proportion, a_{ij}, of the output of industry j . . . or, $a_{ij} = \frac{X_{ij}}{X_2}$. Expression (3) states that final sales of industry i are equal to i's total sales less i's total intermediate sales. The equations of expression (2) can be expressed in matrix notation as

(4) $X = AX + F$

where X is the column vector of outputs, F is the column vector of final sales, and A is the matrix of a_{ij}'s. The equations in expression (3) above can be expressed as

(5) $F = (I\text{-}A)X$

where I is an identity matrix of the same order as A.

(6) $X = (I\text{-}A)^{-1}F$

is the final solution to this system. The matrix $(I\text{-}A)^{-1}$ shows the direct and indirect requirements per dollar of delivery to final demand.[1]

(7) $\frac{T}{X}X = \frac{T}{X} \cdot (I\text{-}A)^{-1} F = T$

Multiplying both sides of equation (6) by $\frac{T}{X}$, an $n \times n$ matrix with $\frac{T_i}{X_i}$ along the main diagonal and zeros as the other elements, yields a column vector T which contains the elements T_i, tax payments by industry i. The sum of column j of the matrix obtained by the operation $\frac{T}{X}(I\text{-}A)^{-1}$ is the amount of tax payments per dollar of delivery to final demand by industry j. And the i^{th} entry of column j is the tax payment by industry i attributable to one dollar of delivery to final demand by industry j. This assumes that tax payments are proportionate to output in each industry. The selected rows and columns shown in appendix (i) are taken from the $\frac{T}{X}(I\text{-}A)^{-1}$ relationships in West Virginia.

[1] For a thorough and understandable treatment of these mathematical concepts, see Miernyk, *The Elements of Input-Output Analysis*, op. cit., Chapter 7.