THE INTRODUCTION OF ADMINISTRATION AND RESEARCH ACTIVITIES INTO REGIONAL INPUT-OUTPUT MODELS

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ABSTRACT

Input-output analysis has been used extensively to identify the interrelationships in local, state, regional and national economies. One type of economic activity that is prevalent in several states in the Northeast has not typically been included in regional input-output models: that carried on at administrative offices and auxiliary establishments.

This paper appraises the need for a sector representing administration and auxiliary activities in regional I-O models in the Northeast and provides a method for estimating a direct requirements column for such a sector from secondary data. The method proposed is used to estimate the direct requirements column for this sector in an input-output model for Delaware. The importance of including administration and auxiliary activities in an input-output model used for impact analysis is demonstrated.

INTRODUCTION

Input-output (I-O) analysis has been used extensively to identify the interrelationships in local, state, regional and national economies. More importantly, I-O analysis can be used to assess the impacts of changes (e.g., an industry arriving or leaving) on the economy. This type of analysis is particularly relevant today, given the recent inter- and intra-regional changes in the growth of employment and population and the reductions in funding for states and communities.

In order for an input-output model to represent an economy accurately, all economic activities, especially activities important to the area, must be included. However, there is an important type of economic activity that has not typically been included in regional non-survey input-output models: that carried on at administrative offices and auxiliary establishments (warehouses, reseach laboratories and maintenance locations) (U.S. Department of Commerce). Because this activity, hereafter referred to as Administration and Research (A-R), is important to the economies of several states in the Northeast, this paper will address the problems caused by this omission and suggest a remedy.

The objectives of this paper are:

(1) to appraise the need for an administration and research sector in regional I-O models in the Northeast;

(2) to provide a method for estimating a direct requirements column for such a sector from secondary data; and

(3) to evaluate the administration and research sector and its use for impact analysis in a model of Delaware.

NEED FOR AN ADMINISTRATION AND RESEARCH SECTOR

In seven of the thirteen Northeastern states A-R activities accounted for more than 3 percent of total employment in all industries (Table 1). These activities accounted for more than 4 percent of the total payroll in seven states. In Delaware, more than 12 percent of all employees and 22 percent of total payroll were in this sector. In New Jersey, the A-R employment is 6.52 percent and the A-R payroll is 9.55 percent of the totals, respectively. These numbers indicate the importance of A-R activities.

Within manufacturing, the importance of A-R activities is even more evident (Table 1). In eight states, A-R activities accounted for more than 6 percent of total manufacturing employment and more than 8 percent of the payroll. Again, in Delaware and New Jersey, A-R activities accounted for 35.49 and 12.41 percent of manufacturing employment and 46.50 and 16.58 percent of the payroll in manufacturing industries.

Because many states in the Northeast have administration and research facilities, it is important to be able to determine the impacts on a regional or state economy of growth or decline of these industries. Many earlier input-output models classified such establishments according to the SIC code of their product industry.[1] This means that the measurement of their impact on the local economy would be based on the types of inputs that product industry is expected to use. However, administration and research facilities would not necessarily use the same inputs as their production facilities. Rather they could have a spending (input use) profile very different, both in types of inputs used and in the geographic area of input purchases. Furthermore, the total output and employment figures for an industry include both types of output and employees performing all functions associated with the industry named in the sector. This is also true of the national I-O model.

The potential problem with the disregard for

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[1] The following regional I-O models do not include an administration and Research sector: Grigalunas and Ascari; Bahn and Hardie; Bills and Barr; Boisvert and Bills; Gamble; Gamble and Raphail; Hiser; Bruck and Cole; and the Detailed Input-Output Structure of the U.S. Economy. One model does allow an option of including an Administration and Auxiliary sector--Stevens, Ehrlich, Kindahl and Treyz, 1981.

Table 1. Employment and Payroll for All Industries and Manufacturing in the Northeast.

State	Employment[a] Total	Employment[a] Administrative and Auxiliary	Employment[a] Percent of Total	Payroll[a] Total ($1,000)	Payroll[a] Administrative and Auxiliary ($1,000)	Payroll[a] Percent of Total
ALL INDUSTRIES						
Connecticut	1,087,502	48,376	4.45	12,864,212	938,247	7.29
Delaware	193,248	25,053	12.96	2,479,929	559,737	22.57
District of Columbia	298,274	5,620	1.88	3,670,883	82,091	2.24
Maine	282,132	1,921	.68	2,639,667	26,611	1.01
Maryland	1,116,983	40,950	3.67	12,395,436	604,895	4.88
Massachusetts	1,952,938	64,610	3.31	21,379,909	1,058,436	4.95
New Hampshire	256,503	1,831	.72	2,498,566	28,244	1.13
New Jersey	2,259,537	147,271	6.52	27,606,740	2,635,802	9.55
New York	5,520,754	254,457	4.61	70,077,113	5,148,052	7.34
Pennsylvania	3,733,804	138,513	3.71	45,543,067	2,464,280	5.41
Rhode Island	309,349	4,574	1.48	3,084,767	75,579	2.45
Vermont	136,680	247	.18	1,287,329	3,176	.25
West Virginia	449,937	6,571	1.46	5,151,901	98,450	1.91
MANUFACTURING						
Connecticut	417,430	38,083	9.11	5,901,192	771,479	13.07
Delaware	66,314	23,537	35.49	1,190,337	553,589	46.51
District of Columbia	18,546	1,256	6.77	297,363	29,668	9.98
Maine	100,952	975	0.97	1,075,413	14,082	1.31
Maryland	243,557	16,746	6.88	3,476,675	300,110	8.63
Massachusetts	619,567	37,966	6.13	8,007,105	710,365	8.87
New Hampshire	95,727	1,167	1.22	1,059,647	21,566	2.04
New Jersey	780,513	96,912	12.42	11,197,815	1,856,661	16.58
New York	1,506,583	150,734	10.01	21,763,672	3,315,582	15.23
Pennsylvania	1,343,748	90,840	6.76	18,249,627	1,791,192	9.82
Rhode Island	125,725	1,539	1.22	1,333,904	29,496	2.21
Vermont	40,729	157	0.39	495,318	2,117	0.43
West Virginia	118,091	3,469	2.94	1,619,582	54,447	3.36

[a] Excludes nondisclosed data.

Source: U.S. Department of Commerce, County Business Patterns, 1977, United States, 1979.

function in the choice of sector composition is that frequently the headquarters or research facilities of a corporation may locate in a region without being accompanied by a production facility. In this case, multipliers based on expenditure profiles of combined production, administration and research activities would not accurately estimate impacts of the headquarters or research facility.

In recent years, various non-survey methods of estimating regional I-O models have been developed (Schaffer and Chu; Boisvert and Bills). In general these methods entail modifying the technical coefficients of the national I-O model to represent the region's economy. Secondary data about the region (sales, employment, etc.) are used for this modification.

With respect to administration and research activity, a twofold problem occurs when a non-survey method is used to estimate a regional I-O model. First, there is a mix of functions within the sector which requires that a constant function-mix assumption must be made (similar to the more familiar product-mix assumption) if national technical coefficients are to be used. In most regions and for most sectors, this is a reasonable assumption. However, if a corporate headquarters is located in a region or is planning to locate in a region, the national technical coefficients that reflect heavily weighted production activity can not be expected to depict accurately the impact of such an establishment.

Second, relevant secondary data sources (e.g., Census of Manufacturers) for total output, sales or shipment values include only production activities. Therefore, a total dollar output figure for the sector in the region could be grossly understated. Thus, all the transactions would be understated.

Further problems arise when employment estimates are made. Some frequently cited secondary sources for employment data by SIC code (County Business Patterns) put all central administration and auxiliary activities, regardless of two-, three- or four-digit SIC code, into a separate category for each division (i.e., central administration and auxiliary for manufacturing). In states where administration and auxiliary activities are extensive, this means that a large number of employees and dollars of output are not assigned to a specific SIC and therefore, without a sector assignment. This could lead to understatement of regional transactions, production, income and employment. From Table 1, it can be seen that manufacturing employment alone would be understated by 150,000 for New York, 96,000 for New Jersey, and 90,000 for Pennsylvania in 1977.

A PROCEDURE TO ESTIMATE THE EXPENDITURES AND SALES FOR ADMINISTRATION AND RESEARCH

If an I-O model is estimated using a survey, then creation of an A-R sector is relatively easy. Corporate headquarters and research facilities would be adequately represented in the sample, and the response from these establishments grouped together rather than with the sector for their product.

However, if the model is being estimated using a non-survey method, then a more complex procedure is necessary. Most non-survey methods are based on regionalizing a national I-O table or updating an earlier regional table. Since neither of these tables would have an A-R sector, the first step is to estimate a row of sales and a column of expenditures that represent the administrative and research facilities in the region. This was done for the model of Delaware (discussed below) using data from the Census Bureau's Enterprise Statistics for Central Administrative Offices and Auxiliaries.

The Enterprise Statistics report provides data for many types of expenditures made by administrative offices and auxiliaries. Unfortunately, there is no measure of overall output or total costs reported, nor is there much detail by state. Therefore, a regional expenditure profile has to be estimated from national expenditures. These are given in detail at the division (SIC) level, some at the industry level. To estimate a column of technical coefficients or direct requirements, two sets of information are needed: the expenditure requirements per dollar of output and the relative size of various divisions (or industries) as components of total regional administration and research operations.

To make the expenditures most accurately represent the expenditure by A-R establishments in the region, profiles for each national industry division are estimated in coefficient form, weighted according to that division's importance in the region, and then aggregated. When industry level expenditures are given, they may be substituted for the division figure, also aggregated to reflect importance in the region. The procedure used is discussed below.

Technical Coefficients: To estimate the A-R expenditures for goods from various sectors per dollar of total expenditure (known as technical coefficients or direct requirements), two pieces of information are needed. It is necessary to know the expenditure made and the total expenditures made by A-R. Each expenditure is assigned to a sector, then all expenditures summed and a total expenditure estimate made. Finally, each sector expenditure is divided by the total expenditure to provide a column of technical coefficients for each division, a_{ik}. Judgment is required of the researcher in allocating some expenditures to sectors, such as supplies.

For example, if A-R manufacturing establishments spent $100,000 on electricity, $200,000 on communication, $2,000,000 on payroll, $50,000 on supplies, and other expenses of $900,000, the total expenditures would be $3,250,000. Therefore, the technical coefficient for electricity purchased by manufacturing A-R would be .0307, for communication .0615, for payroll .6153.

Weighting: The relative importance of the divisions as components of the total administrative and research sector by state can be determined from the Enterprise Statistics report. In the report, the number of employees in each division is given and can be expressed as a fraction or percent of A-R employees in the state. For example, in New York, mineral industry represents 1.5 percent of the total, construction .9 percent, wholesale trade 16.1 percent, retail trade 15.7 percent, services 5.1 percent and manufacturing a major portion, 60.1 percent. Therefore, in New York the technical coefficients for manufacturing, wholesale, and retail trade A-R would be weighted heavily and the others relatively lightly. However, the distribution of A-R expenditures would be considerably different in West Virginia, where mining A-R employment represents 21.3 percent, zero in construction, 54.5 percent in manufacturing, 6.8 percent wholesale trade, 16.6 percent retail trade and .8 percent in services. The regional technical coefficient for an A-R sector's purchase from an industry i is:

$$a_{ij} = \sum_{k=1}^{n} a_{ik} \frac{E_k}{E}$$

where:

- E = total A-R employment in the region.
- E_k = A-R employment in division k.
- j = administrative and research sector
- i = sector from which purchase is made
- k = six divisions for which A-R data is collected (minerals, construction, manufacturing, retail trade, wholesale trade and services).

Each a_{ij} for New York would be different from West Virginia's due to heavier weights for manufacturing, wholesale trade and services and much less weight on mining A-R expenditure profile (assuming the expenditures by manufacturing A-R establishments on specific type products are different from expenditures by mining or trade A-R establishments).

If further disaggregation is desired, it is possible to substitute a weighted sum of specific industry (two-, three- or four-digit SIC) technical coefficients. The weights for the specific industries however, may be more difficult to ascertain. In some instances, the researchers knowledge of the region may be adequate to determine a dominant industry. Otherwise, a comparison of County Business Pattens employment figures (which are net of administration and research employment) to Department of Labor employees (which do not net out A-R) by SIC code or by sector, will provide the number of administration and research employees in each SIC industry as the difference between the two data sets.[2]

For example, in Delaware, knowledge of the region would lead a researcher to conclude that most of the manufacturing A-R activity in the state would be associated with the chemical industry. Using the difference between Department of Labor employment data and the County Business Pattern's numbers, the chemical industry employees account for 94.87 percent of the manufacturing A-R employment. Therefore, when detailed expenditures for the chemical industry were available in the Enterprise Statistics report, the chemical technical coefficient was used rather than the general manufacturing coefficient.

The above procedure produces an administration and research sector column for the regional table of technical coefficients. Before further adjustment or analysis can be performed, an A-R row is also needed. Since most corporate headquarters by their nature serve establishments throughout the country, well beyond the region, it would be unlikely that many of their services are implicitly "sold" to firms in the region. Therefore, almost all of their output will be exported. The appropriate row entry would be zero. However, if there are large facilities in the region for production of a product that is administered or researched in the region, then some nominal sales would be indicated in the appropriate cell of the administration and research row.

THE ADMINISTRATION AND RESEARCH SECTOR IN THE DELAWARE MODEL

The procedures discussed above, with some modifications, were used to include A-R activities into an input-output model of Delaware. In this section, the transactions, expenditures and multipliers associated with this sector are discussed to illustrate the importance of it.

Several modifications were necessary to deal with disclosure problems in the data and with table of different levels of detail in the Enterprise Statistics report. Because the exact numbers of A-R employees in three of the five divisions were undisclosed for Delaware and because the A-R sector in Delaware is dominated by one industry, chemicals, only one column of technical coefficients was estimated. This eliminated the weighting step.

On the basis of the importance of the chemical industry in manufacturing A-R activity, it was assumed that the expenditure profile of Delaware's A-R sector would be more accurately represented by the national chemical A-R expenditures. Thus, whenever expenditure data were presented in sufficient detail to provide A-R chemical industry expenditures, these were used. However, since not all data were adequately detailed, some expenditures represented national A-R manufacturing expenditures.[3]

Table 2 shows the transactions estimated for the A-R sector for the state of Delaware. If the Delaware I-O model had been presented without an A-R sector, approximately 11 percent of the total processing sectors' output would be omitted. In terms of a transactions table, which portrays the interindustry flows in the state, approximately \$183 million of interindustry transactions would not be included.

It is interesting to compare the type of expenditure an A-R establishment is likely to make with the expenditure of various production establishments in Delaware. In Table 2, the Chemicals, Other Foods and Paper sectors' expenditure-profile (expenditure per dollar of output) are also shown. By comparing the columns for A-R and Chemicals, it can be seen that if the impact of a new chemical research facility were estimated using the chemical production expenditures, the nature of the impact would be quite different from that using an administration and research expenditure profile.

For example, if new production of chemicals for final demand are undertaken, the transportation industries are heavily impacted; however, a research or corporate headquarters increase in activity would not have much impact there. Conversely, chemical production uses considerably less communication services (about one tenth) than do administrative and reseach activities. The sum of requirements from other industries in the state (sum of 1 to 55, Table 2) indicates that chemical production establishments purchase more in the state than A-R establishments. This is also true for paper production and to a lesser extent for other food production.

Because input-output models are most frequently used to predict impacts of various changes in a region's economy, it is valuable to see how the lack of an administration research sector affects the nature and magnitude of the predicted impacts. Impacts are estimated by multipliers--production, employment and income.

Recently, the location in Delaware of a new banking headquarters and large new chemical research facility have been announced. In Table 3, the multipliers estimated for Delaware are given by sector. The A-R sector is included as the last sector (55). If there were no sector 55, then the impacts of the new research facility and new banking headquarters would be estimated using

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[2] This assumes no other differences in the data sets, which is unlikely. However, it should provide an estimate of the relative importance of the sectors as components of the administration and research sector.

[3] In order for the national chemical A-R expenditures and national manufacturing A-R expenditures to be comparable for summing to estimate total sectoral expenditures, they were each expressed as a percent of total payroll. Because all expenditures were expressed as a percent of payroll, Delaware A-R expenditures were then determined by multiplying each percent by total A-R payroll in Delaware. This yielded an A-R transactions column for Delaware. The division of each transaction by the column sum provided an A-R technical coefficients column for Delaware.

Table 2. Representative Columns From Delaware I-O Model.[a]

Sector	A-R Transactions ($1,000)	A-R 55	Technical Coefficients[b] Other Foods 11	Paper 16	Chemicals 18
1 Poultry	0	0.0000000	0.0034450	0.0000004	0.0000007
2 Livestock	0	0.0000000	0.0238384	0.0000039	0.0000108
3 Crops	0	0.0000000	0.0315108	0.0001389	0.0000621
4 Frt Veg	0	0.0000000	0.0125298	0.0000024	0.0000158
5 Nursery	0	0.0000000	0.0000001	0.0000035	0.0000099
6 Ag Ser	0	0.0000000	0.0000000	0.0000819	0.0001478
7 Cons New	0	0.0000000	0.0000000	0.0000000	0.0000000
8 Cons Mnt	3598	0.0038000	0.0026953	0.0041592	0.0100259
9 P Proc	0	0.0000000	0.0015296	0.0000033	0.0000277
10 V Proc	0	0.0000000	0.0027847	0.0000015	0.0000398
11 Oth Food	0	0.0000000	0.0454081	0.0000692	0.0009154
12 Tex Mill	284	0.0003000	0.0001198	0.0123842	0.0013252
13 Apparel	0	0.0000000	0.0000933	0.0001579	0.0000777
14 Wood Prd	330	0.0003490	0.0000441	0.0026350	0.0000795
15 Furn	11	0.0000118	0.0000277	0.0000201	0.0000148
16 Paper	3073	0.0032459	0.0318926	0.3814283	0.0131238
17 Printing	5625	0.0059409	0.0185203	0.0064720	0.0044915
18 Chem	18937	0.0200000	0.0112691	0.0167771	0.2696028
19 Petrol	1608	0.0016990	0.0010074	0.0010566	0.0082363
20 Rubber	4592	0.0048500	0.0204384	0.0138100	0.0125321
21 Leather	142	0.0001500	0.0000111	0.0000134	0.0001137
22 Glass	2504	0.0026450	0.0001541	0.0001012	0.0004391
23 Steel	0	0.0000010	0.0002823	0.0008201	0.0036960
24 Fab Metl	2941	0.0031068	0.0005688	0.0003346	0.0015617
25 Machinery	11630	0.0122828	0.0010858	0.0008966	0.0056565
26 Elec Eq	1591	0.0016809	0.0000441	0.0000295	0.0001167
27 Trans Eq	1514	0.0015994	0.0002518	0.0001067	0.0001515
28 Instrum	9468	0.0100000	0.0001170	0.0001188	0.0008334
29 Misc Man	0	0.0000000	0.0009324	0.0006452	0.0006305
30 Tr Rail	9	0.0000099	0.0083549	0.0170180	0.0095640
31 Tr Passn	0	0.0000000	0.0013815	0.0020527	0.0011749
32 Tr Truck	214	0.0002266	0.0149371	0.0109834	0.0064031
33 Tr Water	0	0.0000010	0.0020482	0.0007163	0.0029806
34 Tr Other	0	0.0000000	0.0053392	0.0052519	0.0047493
35 Commun	32843	0.0346872	0.0069667	0.0038811	0.0039877
36 Utility	9184	0.0097000	0.0066844	0.0066904	0.0271390
37 Whsl Trd	29163	0.0308000	0.0594354	0.0508037	0.0236152
38 Retl Trd	66	0.0000700	0.0005621	0.0001863	0.0003897
39 Banking	3999	0.0042240	0.0041579	0.0022992	0.0050128
40 Insurance	2560	0.0027040	0.0017946	0.0008128	0.0014018
41 Real Est	15888	0.0167803	0.0085473	0.0071981	0.0117930
42 Lodging	1389	0.0014673	0.0002474	0.0009882	0.0014673
43 Pers Ser	1168	0.0012338	0.0038301	0.0045685	0.0012338
44 Eat Drnk	5851	0.0061797	0.0029949	0.0019755	0.0061797
45 Bus Ser	6612	0.0069840	0.0160152	0.0095222	0.0138672
46 Prof Ser	2984	0.0031524	0.0020978	0.0009538	0.0044844
47 Auto Rep	504	0.005332	0.0033846	0.0012515	0.0007688
48 Amusement	0	0.0000000	0.0004011	0.0002102	0.0002264
49 Doctors	0	0.0000000	0.0000000	0.0000000	0.0000000
50 Oth Heal	0	0.0000000	0.0000000	0.0000000	0.0000000
51 Educ Ser	378	0.0004000	0.0000501	0.0001029	0.0004506
52 Oth Ser	10	0.0000110	0.0009495	0.0005699	0.0008521
53 Fed Gov	600	0.0006339	0.0011652	0.0005353	0.0006339
54 S&L Gov	1	0.0000017	0.0000262	0.0000252	0.0000887
55 Adm Res	1893	0.0020000	0.0000000	0.0000000	0.0010000
Sum of 1-55	183164	0.1934625	0.3619734	0.5708786	0.4634027
Households	576738	0.6091591	0.2307091	0.2994441	0.3817208

[a] From Brucker and Hastings.

[b] Expenditure in sector named at left per dollar of output in sector named at top.

Table 3. I-O Multipliers for Delaware, by Sector.[a]

Sector	Multipliers Type I Output	Type II Output	Type II Income	Type II Employment
1 Poultry	2.15	3.28	7.01	3.42
2 Livestck	1.75	2.96	2.91	1.87
3 Crops	1.46	2.96	1.92	1.61
4 Frt Veg	1.43	3.02	1.83	1.88
5 Nursery	1.33	2.97	1.71	1.61
6 Ag Serv	1.65	3.08	2.25	2.07
7 Cons New	1.44	2.69	2.00	3.05
8 Cons Mnt	1.36	2.80	1.76	3.12
9 P Proc	2.58	3.80	5.21	3.12
10 V Proc	1.58	2.53	3.09	4.17
11 Oth Food	1.56	2.54	2.70	6.85
12 Tex Mill	1.83	3.13	2.88	4.29
13 Apparel	1.62	2.74	2.42	1.21
14 Wood Prd	1.51	2.62	2.25	2.24
15 Furn	1.58	2.96	2.15	1.73
16 Paper	2.06	3.52	3.10	3.61
17 Printing	1.66	3.20	2.15	2.14
18 Chem	1.75	3.23	2.45	4.64
19 Petrol	1.24	1.67	2.68	1.39
20 Rubber	1.75	3.19	2.47	3.03
21 Leather	1.52	2.58	2.37	1.24
22 Glass	1.41	2.62	1.99	2.92
23 Steel	1.51	2.64	2.25	2.51
24 Fab Metl	1.56	2.86	2.12	2.21
25 Machinery	1.45	2.75	1.97	2.07
26 Elec Eq	1.54	2.88	2.11	2.49
27 Trans Eq	1.73	2.78	2.74	2.27
28 Instrum	1.41	2.79	1.87	1.45
29 Misc Man	1.60	3.01	2.19	5.28
30 Tr Rail	1.42	2.93	1.88	6.97
31 Tr Passn	1.31	2.76	1.69	1.63
32 Tr Truck	1.36	2.85	1.78	1.86
33 Tr Water	1.83	3.12	2.72	2.75
34 Tr Other	1.38	2.75	1.82	2.02
35 Commun	1.22	2.69	1.59	1.83
36 Utility	1.39	2.63	1.92	2.81
37 Whsl Trd	1.27	2.63	1.68	2.14
38 Retl Trd	1.22	2.60	1.61	1.30
39 Banking	1.44	2.91	1.98	1.61
40 Insurance	1.63	3.12	2.27	2.42
41 Real Est	1.23	2.64	1.64	4.67
42 Lodging	1.47	2.95	1.99	1.76
43 Pers Ser	1.35	2.77	1.78	1.64
44 Eat Drnk	1.51	2.61	2.19	1.42
45 Bus Ser	1.35	2.85	1.77	2.37
46 Prof Ser	1.26	2.86	1.63	1.62
47 Auto Rep	1.64	2.97	2.15	2.40
48 Amusemnt	1.52	2.99	2.09	1.96
49 Doctors	1.27	3.00	1.62	1.90
50 Oth Heal	1.41	3.00	1.79	1.25
51 Educ Ser	1.34	2.89	1.75	1.18
52 Oth Serv	1.37	2.91	1.79	1.48
53 Fed Gov	1.18	3.01	1.51	9.79
54 S&L Gov	1.55	2.84	2.12	4.27
55 Adm Res	1.27	2.14	1.63	2.54

[a] From Brucker and Hastings.

the multipliers for sectors 18 (Chemicals) and 39 (Banking), respectively.

The impacts predicted with the I-O model are quite different when made from an A-R sector, every additional dollar's worth of chemical research would be expected to lead to $1.75 worth of total economic activity in the state (or $3.23 worth of total new production in the state if induced effects were also included). This would be ranked as the seventh largest multiplier in the state (or fourth largest if Type II, accounting for induced effects also). However, if the more appropriate A-R multiplier is used, the impact is a smaller $1.27 per dollar of research activity, which is the forty-eighth largest --one of the smallest-- multipliers estimated for the state ($2.14 if Type II used, the second smallest multiplier).

Thus, without the A-R sector the impact of the new research facility would be overstated. If the additional activity were two million dollars, the total impact on other state economic activity would be $6.460 million rather than $4.280 million an overstatement of over two million dollars.

Although the magnitude of the overstatement is less if the impact of the banking headquarters are predicted, similar problems could occur. Using the banking multiplier, administrative activities valued at $1,500,000 is expected to lead to $4,365,000 worth of total economic activity in the state, while a more likely impact of $3,210,000 is expected if the A-R multiplier is used.

Similar misleading estimates can be expected if production sector employment and income multipliers are used to estimate statewide increases or decreases in employment and income resulting from growth or decline or administrative and/or research activities in the state. If new employment in chemical research is expected to be 100 people, the estimated change in total employment using the A-R multiplier is 254, whereas using the chemicals multiplier, the change is 464 employees. If a $100,000 change in income is expected to be generated by chemical research activity, an A-R income multiplier leads to an estimate change of $163,000 in total income. However, using the chemical sector income multiplier the impact on income is $245,000. Similar comparisons could be made for banking and other industries. Data from Table 3 indicate that these will not be consistently under- or overstated.

CONCLUSIONS AND IMPLICATIONS

Given the existence of many administration and research establishments in the Northeast, it is prudent to be able to estimate accurately the overall economic impact of the growth or decline of such an industry. This paper has proposed a method of introducing administrative and research activities into regional I-O models based on nonsurvey methods. This method is of course limited by the availability of relevant secondary data. Survey information would strengthen the procedure.

The analysis for Delaware indicates the importance of including this type of industry. The expenditure profile of Delaware's administration and research establishments is greatly different from the expenditure profiles of the related production industries. Therefore, the distribution of statewide impacts will be different for administration and research establishments than for their production counterparts. Furthermore, in Delaware the magnitude of production, income and employment impacts will be incorrect if production industry expenditure profiles and multipliers are used to estimate the impacts of A-R activity.

These findings imply that I-O models for states or local areas should include an administration and research sector. This is particularly important if this is a prominent industry in the economy. Without such a sector, the magnitude and distribution of impacts on the economy can be inaccurate, probably overstated.

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