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How good is IMPLAN?: A Comparison of Survey v. Secondary-Data Input-Output Models at the County Level

ABSTRACT

A comparison of IMPLAN and a survey based input output model of Clatsop County, Oregon, suggests that, while IMPLAN direct coefficient and total coefficient estimates are quite different from those of the survey model, the IMPLAN multipliers differ from survey multipliers by less than 5 percent on average.

INTRODUCTION

Input-output (I-O) models fall under two broad categories, survey-based (or primary data) models and derived (or secondary data) models. Primary data models are constructed by surveying a sample of businesses and households in the study area while secondary data models are derived by adjusting a national level I-O model to reflect local levels of production and purchases. It has been argued that use of the latter, while less accurate than a primary data model, can be partially justified on the basis of the tremendous cost savings associated with the secondary data model. As Boster and Martin (1972) point out, it is also unwarranted to assume the a priori superiority of a survey-based model over a non-survey model due to the numerous difficulties associated with conducting a valid field survey.

With the introduction of Micro IMPLAN, use of secondary data input-output models to predict the impact of regional economic change has proliferated. The task of determining the true substitutability of secondary data models and primary data models has only recently begun. Most such comparisons to date, however, focus on relatively large regions ranging from one to several states [see for example Radtke, Detering and Brokken (1985); Boster and Martin (1972); Brucker, Hastings and Latham (1987)] . This paper will compare the internal structures of survey-based v. IMPLAN-generated I-O models of Clatsop County, a small county on the northern Oregon coast. To our knowledge this is the first attempt to directly compare county level I-O models.

DATA

Oregon offers a unique opportunity to pursue this type of research. From 1963 to 1982 agricultural and resource economists at Oregon State University constructed 11 primary data input-output models for 9 Oregon counties [Mandelbaum, Wood and Weber (1984)]. The choice of Clatsop County for this study was primarily a function of timing. IMPLAN is based on a 1977 (price updated to 1982) Bureau of Economic Analysis (BEA) national technical coefficients matrix [Alward et al (1989)]. The more recent of two Clatsop County survey models was conducted in 1977 [Carroll and Stoevener (1978)]. The quality of the Clatsop County surveys is also generally regarded as high.

The original Clatsop survey identified 25 sectors in the local economy including local, state and federal government. Four separate commercial fishing sectors were delineated. "Households" was also included as a sector internal to the model. The IMPLAN-generated Clatsop county model identified 146 sectors, only one of which concerned commercial fishing. IMPLAN also does not close the coefficient matrix with respect to households. Consequently some aggregation and adjustment of both models was required to make the technical coefficient matrices conformable for comparison.

Aggregation of the IMPLAN model sectors to agree with those used in the survey model was done using the built-in aggregation option and following sectoral definitions listed in appendix 1 of the survey model report. Additional conformability adjustments to both models were made by merging certain sectors of the respective transactions tables. Both adjusted tables used for the comparison contained 18 sectors excluding households and including only one commercial fishing sector, a combined retail/wholesale products sector, and a combined "government" sector.

Another notable difference is the two models' treatment of sales by the retail/wholesale products sector. IMPLAN directly estimates the value of the margin earned (ie. excluding cost of the products) by the retail/wholesale products sector. However corresponding transactions in the survey-generated table appear to not have separated this margin from the value of the products. To make the two models more consistent a simple rule of thumb was applied to the survey model: Each element of the 'retail/wholesale products' row was multiplied by 0.2 under the assumption that on average only about 20% of the sale amount could be counted as value added or margin earned by the sector and that the remaining 80 percent of the sale amount is imported into the economy. While admittedly crude, this approximation falls well within a range of from 10% for certain foods to over 40% for apparel for markup pricing observed in surveys of retail outlets [Dalrymple and Thompson, (1969,p.174)].

METHODS

Internal structures of the two models were compared using the following statistics:

Mean Absolute Deviation (MAD): an unweighted estimate of the "average" difference between corresponding coefficients of the two models. MAD was calculated for both the direct (technical) and total (Leontief inverse) coefficients matrices [Miller and Blair, (1985,p.287)].

$$MAD = \frac{1}{(n^2)} * \sum_i \sum_j abs(a\sim ij - aij) ,$$

where n is the number of sectors, "abs" means absolute value, a~ij is the IMPLAN coefficient and aij is the corresponding survey table coefficient.

Mean Absolute Percentage Error (MAPE): an unweighted average absolute percentage difference between corresponding coefficients. MAPE was calculated for the total coefficients matrices only since for certain sectors null entries in the direct coefficients matrices prevented carrying out the necessary divisions [Miller and Blair, (1985,p.287)].

$$MAPE = \frac{1}{(n^2)} * \sum_i \sum_j [abs(a\sim ij - aij)/aij] *100$$

Standard Total Percent Error (STPE): a weighted average absolute percentage difference between corresponding coefficients. Weights are determined by relative magnitude of the reference (survey) coefficient. STPE was calculated for both the direct and total coefficients matrices [Begg (1986,p.101)].

$$STPE = [\sum_i \sum_j abs(a\sim ij - aij)/\sum_i \sum_j aij] *100$$

In addition **simple output multipliers** (column sums from the total coefficients matrices) for the margined and unmargined survey-based models were compared with the corresponding multipliers from the IMPLAN generated model.

RESULTS

Results of the comparisons for the **direct coefficients** matrices are given below:

	IMPLAN V.	
	MARGINED	UNMARGINED
MAD	0.011473	0.014512
STPE	127.25%	117.10%

These results indicate that IMPLAN does a fairly poor job of replicating the individual technical coefficients obtained from the survey model.

The average IMPLAN direct coefficient is 0.0069, compared to average coefficients for the survey model of 0.009 (margined) and 0.0124 (unmargined). The mean absolute deviations of the IMPLAN coefficients from the survey coefficients are larger than the average of the survey coefficients for both margined and unmargined models. Using a measure that gives more weight to the larger coefficients does not yield a fundamentally different result. The STPE measure suggests that the sum of absolute deviations is slightly larger than the sum of the coefficients.

Results of the comparisons for the **total coefficients** matrices are given below:

	IMPLAN V.	
	MARGINED	UNMARGINED
MAD	0.01344	0.017539
STPE	20.21%	24.69%
MAPE	1514.97%	1053.76%

The results suggest that, on average, total (direct and indirect) coefficients are much closer for the survey and IMPLAN models than the direct coefficients. The average IMPLAN total coefficient is 0.063, compared to 0.067 for the margined survey model and 0.071 unmargined survey model. The mean absolute deviation is only about one fifth as large as the average coefficient for the margined model and one fourth as large for the unmargined model. The weighted measure yields essentially the same result.

A major interest of users of input-output models is in the multipliers generated by these models. Table 1 compares the simple sectoral output multipliers obtained from the column sums of the total coefficient matrices of the various models.

With the exception of three sectors, namely financial services, professional services and wood processing, the values of the survey-generated multipliers exceed those of the IMPLAN multipliers. This result leads us to believe that in general the IMPLAN model underestimates the impact of final demand changes on the county economy.

The two sectors that are most different in the two models are wood processing (the IMPLAN multiplier is 43 percent larger than the survey multiplier) and government (the IMPLAN multiplier is 25 percent smaller than the survey multiplier). These two sectors produced 13 and 5 percent, respectively, of total county output in 1977, according to the survey model. To see if we could get some insight into the reasons why these multipliers differed so greatly and perhaps some better understanding of how IMPLAN may fail to capture some important economic relationships in local economies, we examined the wood processing and government sector columns of the direct coefficient matrix. This comparison is shown in Table 2.

There are two major observations that can be made about this table. The first is that the IMPLAN wood processing sector multiplier is so much larger than the corresponding survey multiplier because the IMPLAN model estimates that Clatsop County's wood processing sector purchases 41 percent of its total inputs from the local logging sector, whereas the survey model estimates that wood processing purchases only 6 percent of its inputs from this sector.

There are potential sources of error in both IMPLAN and the survey models. The survey model might misestimate the coefficient because the survey on which the model is based may not have been administered to some important firms in the sector. For this Clatsop County model, the firms surveyed in the wood processing sector accounted for 75 percent of the sector's employment. This suggests that coverage was quite good and the survey was likely administered to a representative sample. Two potential sources of error in the IMPLAN model are (1) that the technical coefficients (production function) estimated in IMPLAN for the aggregated sector may not match the actual production function in the sector in Clatsop County or (2) that the "regional purchase coefficients" used by IMPLAN to estimate the percent of production inputs purchased locally may be misestimated.

A second observation about this comparison is that IMPLAN tends to greatly underestimate the local purchases in the service sectors. This is most noticeable in the government column where IMPLAN direct coefficients are one or more orders of magnitude smalller than the survey coefficients in eight of the 11 service sectors.

CONCLUSION

While IMPLAN does a relatively poor job of estimating direct coefficients for the case of Clatsop County, Oregon, examined here, it provides somewhat better estimates of total coefficients and estimates of multipliers that are within 5 percent, on average, of the estimates generated by a comparable (margined) survey model. Still, the IMPLAN multipliers were more than 10 percent different (mostly smaller) than the margined survey model in 8 of the 18 sectors (including 5 of the 7 "basic" sectors). This suggests that IMPLAN users need to examine critically the correspondence between the technical and local purchase relations built into the IMPLAN model and the actual relationships in the local economy when using IMPLAN at the county level.

TABLE 1. COMPARISONS OF MULTIPLIERS: SURVEY V. IMPLAN MODELS CLATSOP COUNTY, OREGON

SECTOR	IMPLAN	SURVEY UNMARG.	%ERROR*	SURVEY MARGINED	%ERROR*
LOGGING	1.150473	1.332503	-13.66	1.310559	-12.2151
WOOD PROCESSING	1.610307	1.131764	42.28	1.124089	43.25443
FISHING	1.049006	1.286638	-18.47	1.166179	-10.0476
FISH PROCESSING	1.106530	1.374234	-19.48	1.318437	-16.0726
AGRICULTURE	1.125743	1.519194	-25.9	1.242204	-9.37537
MANUFACTURING	1.077766	1.171150	-7.97	1.126999	-4.36849
LODGING	1.085972	1.404097	-22.66	1.286700	-15.6002
RESTAURANTS	1.053558	1.332583	-20.94	1.183292	-10.9638
AUTOMOTIVE	1.045523	1.155098	-9.49	1.100479	-4.99383
TRANSPORTATION	1.194490	1.387362	-13.9	1.208602	-1.16765
COMMUNICATION	1.129015	1.192019	-5.29	1.168747	-3.3995
PROF.SERVICES	1.143149	1.116803	2.36	1.088941	4.978026
FINANCIAL	1.105094	1.076239	2.68	1.066649	3.604293
CONSTRUCTION	1.137517	1.399197	-18.7	1.302379	-12.6585
RETAIL/WHOLESALE	1.114799	1.148514	-2.94	1.075689	3.635836
RETAIL SERVICES	1.119024	1.254531	-10.8	1.184249	-5.50769
EDUCATION	1.142858	1.311422	-12.85	1.253995	-8.86266
GOVERNMENT	1.011111	1.423155	-28.95	1.345705	-24.8639
MEAN	1.133441	1.278695	-10.26	1.197439	-4.70135

* Overall percent error = {[IMPLAN - Survey)/Survey]*100}

TABLE 2. COMPARISONS OF DIRECT COEFFICIENTS: SURVEY V. IMPLAN MODELS WOOD PROCESSING AND GOVERNMENT SECTORS, CLATSOP COUNTY, OREGON

	Woodprocessing Sector		Government Sector	
	IMPLAN	Survey	IMPLAN	Survey
LOGGING	.41281	.056290	0	0
WOOD PROCESSING	.06662	.001604	0	.000027
FISHING	0	0	0	0
FISH PROCESSING	0	0	0	0
AGRICULTURE	.00001	0	.00001	0
MANUFACTURING	.00050	0	.00028	.000381
LODGING	.00012	.000018	.00009	.000790
RESTAURANTS	.00198	.000172	.00049	.001389
AUTOMOTIVE	.00098	.000266	.00019	.008961
TRANSPORTATION	.01205	.001462	.00074	.006265
COMMUNICATION	.00031	.000249	.00013	.009888
PROF.SERVICES	.00001	.000231	.00001	.015853
FINANCIAL	.00213	.001214	.00005	.017596
CONSTRUCTION	.00046	.000397	.00217	.022989
RETAIL/WHOLESALE	.00508	.000802	.00427	.012797
RETAIL SERVICES	.00187	.000693	.00086	.027565
EDUCATION	.00005	.010632	.00001	.052979
GOVERNMENT	.00124	.021447	.00065	.100155

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