

COMMENT ON "REGIONAL INPUT-OUTPUT ANALYSIS:
A COMPARISON OF FIVE 'READY-MADE' MODEL SYSTEMS"

William H. Miemyk*

Brucker, Hastings, and Latham have provided an excellent summary of five input-output systems available on a commercial basis. These represent efforts to derive regional models (or at least regional, sectoral multipliers) from national tables. The authors assert that "the development of a well-organized market for regional input-output models has made changes in quantity and quality of regional input-output analyses that will be undertaken (emphasis added)." They do not, however, back up this *obiter dictum* with evidence.

Leontief is quoted that: "The only way to improve (a regional model) is to go out and ask the local businesses what they buy and where they buy it." The authors imply that the availability of "ready-made" systems is somehow a step in this direction, since it might "free the regional researchers to invest more time in acquiring data that more accurately reflect the unique characteristics of their regions." They fail to indicate, however, how this might be done.

Actually, by quoting Leontief, Brucker *et al.* have moved the ancient debate about "top down" versus "bottom up" input-output tables back to square one, although the irony of this appears to have escaped them.

*Professor Emeritus and former Director, Regional Science Research Institute, West Virginia University.

Anyone who has been involved in the construction of regional tables knows the costly and time-consuming part is data-gathering. If one knows enough about input-output analysis to set up a survey framework, he or she doesn't need a "ready-made" model. The most likely customers for the purveyors of such models are non-specialists, unfamiliar with input-output analysis, looking for a "quick fix."

Analysts who argued for years that the only way to build a reliable regional input-output model was from the bottom up now concede that full-scale surveys are no longer feasible. There is, however, a reasonable alternative. This is the partial survey method developed by Jensen, and his associates, and widely used in Australia.¹ Further refinement of this approach will be far more productive than investing additional resources in methods which produce numbers that are dubious at best, and potentially misleading if used for serious analytical purposes.

FOOTNOTES

- ¹Jensen R. C., T. D. Mandeville, and N. D. Karunaratne. *Regional Economic Planning: Generation of Input-Output Analysis*. London: Croom Helm, 1979. Also Jensen, "The Concept of Accuracy in Input-Output." *International Regional Science Review* 5: 139-154.

COMMENTS ON "READY-MADE" REGIONAL INPUT-OUTPUT MODEL SYSTEMS:
MODEL ACCURACY AND THE VALUE OF LIMITED SURVEYS

Benjamin H. Stevens*

The paper by Brucker, Hastings & Latham (BHL), which appears in the current issue of the Review, is the result of an extremely useful exercise undertaken by the above authors at the University of Delaware. They have succeeded well in achieving their stated goal of reducing "...the cost of obtaining and processing relevant information about the regional input-

output modeling market." Most of what the potential user or purchaser would need or want to know about such models is laid out in a clear, comprehensive and even-handed manner. The authors are to be congratulated for their organization of two well-attended and interesting sessions at the 25th Anniversary Meetings of the Southern Regional Science Association

in March, 1986; their collection of very detailed and relevant information from the model designers; and their presentation of their findings.

The usefulness of the BHL paper to the present author is evidenced by the fact that he has already revised his model system (RSRI) to add several of the multiplier types noted as lacking in Table 3 of BHL. Finding out what the competition is doing is likely to lead to improvements in all of the model systems to the benefit of everyone.

Having said all this, the present author, who is clearly not a disinterested observer, has some reservations about what the BHL paper does not cover. The two main topics that are given only cursory discussion are the issues of nonsurvey model accuracy and the related question of how best to spend whatever funds might be available for survey data collection to improve that accuracy.

Actually, the comments that follow are directed more to the nonsurvey model constructors than to BHL's review of their work. In their questionnaire to the model builders, BHL included a request that each modeler run the same prespecified final demand changes through their models for specified states and sub-state regions. One of the states was Texas for which a "survey-based" model is available for comparison purposes. The original paper presented at the Southern Regional Science Association meetings included a comparison of the results obtained using the various nonsurvey models; and, for the Texas runs, the nonsurvey results were compared with the Texas "survey-based" model results as well.

Although these comparisons may be published in a separate paper, it is fair to say here that they were inconclusive. First, the documentation for the Texas model is so sparse that it is not really possible to determine how much survey data it really contains or how accurate it should be expected to be. Therefore, the ability of any particular nonsurvey model to reproduce the Texas results could be considered either an asset or a liability, depending on one's opinion of the Texas model.

Second, for regions other than Texas, the nonsurvey model results could only be compared with each other. This allowed for an analysis of the deviations among the models from the "consensus" impact results, but did not provide any real basis for preferring one model over another. For this reason, the

authors wisely avoided "checkrating" any of the models for accuracy. Rather they focused on the issues of cost, ease of use, model features, and other objective criteria which could be determined from their survey.

Nevertheless, the issue of model accuracy is of substantial importance to users and customers and is a significant scientific question as well. There is, perhaps, a more copious literature on this topic than on any other issue in regional input-output (I-O) modeling (cf. Stevens & Trainer [1980], Jensen & West [1980], Round [1983], Lahr & Szyrmer [1986] and references therein). The range of concerns in the input-output error literature include: how to compare a nonsurvey model with a survey-based model, which (if any) survey-models are acceptable standards of accuracy, which components of nonsurvey models are, if inaccurate, most damaging to the model's overall accuracy, how best to reduce such potential inaccuracies, and so forth?

The lack of definitive conclusions on the error question leaves the user or customer in a quandary: how should one choose among the available nonsurvey models, should one attempt a survey-based model if (as is usually the case) there are insufficient funds to collect an adequate sample of data in all sectors; what scheme of aggregation might be used to increase the sample size in the model cells; on which cells should survey collection be concentrated if funds are extremely limited, and so forth?

There are no simple answers to these questions, although there are certainly some hints in the literature. For example, Stevens & Trainer [1976] and Park, Mohtadi & Kaburski [1981] show that the most crucial estimates for the accuracy of a nonsurvey model are the "regionalization" coefficients. These, which are now commonly called regional purchase coefficients (RPCs), are measures of the extent to which a region buys any good or service from local producers as opposed to importing them from other regions. The RPCs determine the extent to which economic impacts either feed back intraregionally or leak out to other regions. High levels of leakage, associated with small RPCs, lead to small multiplier and impact effects and vice versa.

RPCs have been estimated by various methods, including the use of location quotients (RIMS II), supply/demand ratios (IMPLAN), and statistical estimating equations (RSRI); (for further information on RPC estimating techniques, see BHL and the references therein). In a recent paper, Stevens, Treyz & Lahr [1986] show that the RSRI estimating procedure reproduces a sample of "observed" RPCs better than the

*President and Research Associate, Regional Science Research Institute.

other methods currently in use; but their results suggest that none of the methods is as accurate as one might wish.

One approach to checking the accuracy and/or improving the estimates of the RPCs is the collection of survey data even if very limited funds are available for this purpose. Following the lead of Jensen & West [1980] and Szyrmer [1986], the analyst could focus on the largest coefficients in the regional matrix because they have the greatest impact on model accuracy. A regional coefficient is, generally speaking, the product of the national technological coefficient, a_{ij} , and the RPC in each cell of the regional matrix. Even if there are real variations in technology among regions for any particular sector, these are likely to be very small in comparison with the variations in the RPCs; furthermore, a large proportion of the technological variation among regions is usually in the mix among labor, energy, capital and total good and service inputs, rather than among the individual goods and services purchased.

It is clear, in any case, from the error studies previously referred to, that the survey effort should, indeed, be focused on the RPC rather than the technological coefficient in any particular cell. In other words, the survey should ask where businesses purchase their various inputs (and, for cross-checking, where they sell their outputs) and avoid the more complex (and often difficult to answer) questions about how much, in total, of each input is used per dollar of output.

There are still many unanswered questions about how best to do such survey data collection including sample size, the survey form, the analysis of the data collected and, in many cases, the uses to which the model will be put. These relate to the size of the firms in the sector, the diversity of the products, and the level of aggregation of the model being estimated. Higher levels of aggregation generally lead to greater diversity of products in each sector, thereby requiring larger samples and greater problems in the analysis and interpretation of the data.

The present author would argue that it is desirable to maintain the highest possible level of disaggregation in regional I-O model construction if any survey data are to be used. At the same time, there are compelling reasons for avoiding aggregation in nonsurvey models as well because of errors generated in the calculation of impacts from aggregated models in comparison with the disaggregated models from which they are nominally derived. Some measures of aggregation error are provided in Stevens & Trainer [1976] and in references therein.

A new set of aggregation error simulations are currently being conducted by the author and will be reported in a later paper. The new results reinforce the previous findings: error in the calculation of impacts increases systematically with the level of aggregation of the I-O matrix, at least up to the point where there are only nonzero cells in the matrix. Furthermore, sectoral aggregation predominately leads to over- rather than underestimation of impacts and multiplier effects. These problems are generally recognized by regional I-O analysts: it is no accident that all of the nonsurvey models reviewed by BHL are highly disaggregated.

In any case, it is clear that the problem of industrial mix in aggregated sectors is more serious in less-diversified economies. As a general rule, the smaller the economy of the region, the more detailed the I-O model should be. This is the exact opposite of common practice: most survey-based regional I-O models have only a few highly aggregated sectors. The 500-sector survey-based model for the Philadelphia Region (cf. Isard & Langford [1971] is a notable exception; in fact the Philadelphia economy is so diversified that having fewer sectors would probably not have had significant effects on this model's accuracy.

The question of model use is also important. For a general-purpose regional I-O model, which may be used repeatedly in a variety of impact studies of relatively small economic changes, a survey focused on the largest regional coefficients is probably sensible, as noted above. However, for special studies, such as an attempt to predict the impact of a major new industry locating in a relatively small regional economy, the accuracy of the results will depend most heavily on the extent to which the new industry will purchase its inputs within the region.

For this purpose, there is no real substitute for detailed information from the locating industry itself. One can usually not assume that the geographical purchase patterns of such a major new producer will conform to the purchase patterns of existing industries, as reflected in the "regular" RPCs. The new firm may already have established supply contracts with vendors in other regions or require materials or components that are not likely to be available in adequate quantity or quality from suppliers at its new location, at least in the short run.

The entire issue of model evaluation and improvement through limited survey data collection is one that deserves further study and discussion. Ultimately, it is a question of cost-effectiveness: how can the analyst or user make the greatest improvement in the model per dollar of survey funds? Students of

regional Input-Output have an obligation to seek answers to this and related questions about nonsurvey models. This will become increasingly important as such models become more widely used.

REFERENCES

- Brucker, Sharon M., Steven E. Hastings, and William R. Latham, III. "Regional Input-Output Analysis: A Comparison of Five 'Ready-Made' Model Systems." *Review of Regional Studies*. 17:2 (1987).
- Garhart, Robert E., and Frank Giarrantani. "Nonsurvey Input-Output Estimation Techniques: Evidence on the Structure of Errors." *Journal of Regional Science*. 27 (1987).
- Isard, Walter, and Thomas W. Langford, Jr. *Regional Input-Output Study: Recollections, Reflections, and Diverse Notes on The Philadelphia Experience*. Cambridge, Massachusetts: M.I.T. Press, 1971.
- Jensen, R. C., and G. R. West. "The Effect of Relative Coefficient Size on Input-Output Coefficients." *Environment and Planning A*. 12. (1980). 659-670.
- Lahr, Michael L., and Janusz Szyrmer. "On Measures for Comparing Input-Output Matrices." Peace Dale, Rhode Island: Regional Science Research Institute. Unpublished paper presented at the North American Meetings of the Regional Science Association, Columbus, Ohio. 1986.
- Park, Se-Hark, Malek Mohtadi, and Atif Kuburski. "Errors in Regional Nonsurvey Input-Output Models: Analytical and Simulation Results." *Journal of Regional Science*. 21 (1981). 321-339.
- Round, Jeffery I. "Nonsurvey Techniques: A Critical Review of the Theory and the Evidence." *International Regional Science Review*. 8 (1983). 189-212.
- Stevens, Benjamin H., and Glynnis A. Trainer. "The Generation of Error in Regional Input-Output Models." RSRI Working Paper A1-76. Peace Dale, Rhode Island: Regional Science Research Institute. 1976.
- _____, and _____. "Error Generation in Regional Input-Output Analysis and Its Implications for Nonsurvey Models." In Saul Pleeter (ed.), *Economic Impact Analysis: Methodology and Applications*. Boston: Martinus Nijhoff Publishing, 1980. 68-84.
- _____, George I. Treyz, and Michael L. Lahr. "A Note on the Accuracy of RPC Estimating Techniques." Peace Dale, Rhode Island: Regional Science Research Institute. Unpublished paper presented at the North American Meetings of the Regional Science Association, Columbus, Ohio. 1986.
- Szyrmer, Janusz. "Trade-off between Error and Information in the RAS Procedure." Philadelphia: University of Pennsylvania. Unpublished paper presented at the North American Meetings of the Regional Science Association, Columbus, Ohio. 1986.

ON THE CONCEPT OF READY-MADE REGIONAL INPUT-OUTPUT MODELS

R. C. Jensen*

Introduction

The dramatic changes in the practice and technology of the compilation of regional input-output tables over the last three decades have been documented often and need no further elaboration at this stage, to allow informed discussion of the question of "ready-made" models. The result of these changes, however, is that analysts appear to recognize three distinctive general methods of table compilation which are, for the

purpose of clarity of argument, defined thus: (i) *survey-based* tables, developed largely from field surveys of firms and other sources of regional data which are region-specific; this approach has largely become impractical for financial reasons; (ii) *non-survey* tables, where this term refers to methods of producing regional tables from other (normally national) tables by mechanical means such as location quotients (LQs), regional purchase coefficients (RPCs), and so on, and not incorporating region-specific survey data; and (iii) *hybrid* tables

which contain elements of both survey and non-survey methods, usually in the sense that non-survey methods provide an initial table which is then supplemented by survey data or other region-specific data to ensure that particular elements of the regional economy are accurately represented in the resulting table.

For the purposes of this paper, the five systems reviewed by Brucker *et al.* (1987) in this issue are assumed to be of the second type, namely non-survey tables as defined above. Although provision may exist in some of these systems for incorporation of region-specific survey data, particularly apparently in the IMPLAN model, it is assumed here that the essence of ready-made models is the mechanical calculation of regional tables, and that the only region-specific data incorporated into the tables is that data required for these calculations, i.e. regional employment, output levels and so on. These assumptions are based on the summary of model characteristics provided by Brucker, *et al.*

The Brucker, *et al.* paper provides a valuable service in comparing, along the lines of a carefully-prepared consumer report, five "products" in the form of ready-made tables, their costs and characteristics. The paper also presents a view of the present and future "market" for regional tables or multipliers as one in which an analyst is able to buy, for a modest fee, "ready-made or pre-fabricated input-output multipliers for his region" from producers practicing "product differentiation through the availability of options and additional features -- an important form of non-price competition", for a range of prices and time commitments. These time commitments could be as small as an hour or a phone call. Such a vision of ready-made input-output industry producing instant tables and multipliers on demand may be seen by the more expeditiously-minded as an essential and timely development in the interests of regional economic analysis, or by the purist as a degradation of the standards of economic analysis in the interests of convenience and commercial ends. This paper will not address these ethical questions in detail, nor add to the valuable work of Brucker *et al.*; the aim of this paper is the highlighting of conceptual issues and the examination of some arguments and evidence which could lead to some general evaluation of the professional value of ready-made models.

The Fundamental Questions

In the evaluation of any method of economic model compilation there can, at the bottom line, be

only two fundamental questions of concern, namely does the method produce a model which is representative of reality within professionally acceptable limits and do the results of the model have professionally acceptable levels of integrity in the real world? In the matter of ready-made input-output models, these questions are interpreted as the following: (i) do the ready-made, i.e. non survey, methods produce input-output tables which faithfully reflect the structural characteristics of regional economies, capturing both the individually unique features and the holistic nature of these economies, within error limits consistent with professional integrity and (ii) do the results in the form of multipliers and impact estimates represent reality within acceptable professional norms? We should add more generally (iii) given the need by planners, administrators and others for high-quality estimates of impact and their right to an expectation that the estimates of impact provided by regional scientists will be of this quality, do the ready-made methods satisfactorily fulfill our professional obligations and standards in producing reliable and high quality advice?

We might add, to these questions, some more specific questions namely: (iv) are the various ready-made methods equally "accurate" and conceptually sound or should some be preferred on theoretical and logical grounds? (v) how would they perform if all were applied to the same situation and what would be the differences and similarities in the results due simply to methodological differences? (vi) are we producing with these ready-made methods approaches which minimize recognition of region-specific characteristics and therefore tend to produce a uniform sameness in multipliers across regions? and (viii) should we as a profession be placing a stamp of approval on ready-made methods, indicating some consensus that these methods are "recommended" by the profession?

There are important questions, most of which cannot be decided on our existing state of knowledge. We do have, however, some evidence and opinions from the literature which may be useful in forming a judgment. The following sections briefly summarize this evidence and draw some conclusions on the general concept of ready-made models. The arguments for and against these models are addressed in turn.

The Arguments For

Apart from the obvious matters of computational facility and cost advantages, it is possible to identify some strong arguments to support the general concept of ready-made models. These arguments are based on the expected structural characteristics of regional economies. The *first* argument rests on the often-

*Department of Economics, University of Queensland

expressed opinion that the structure of some industries can reasonably be expected to be quite similar at the various regional levels and at their corresponding national level, suggesting that national coefficients will be suitable proxies for regional coefficients for these industries. In these cases the ready-made methods which produce tables with regionalized mini-versions of national coefficients could be seen as producing suitable columns of coefficients for these industries. Indeed the argument could be advanced that these national coefficients, which could be seen as representing some type of national survey average, could be more reliable than those drawn from a local survey. This would occur particularly if the local survey is confronted with sampling, response, data or quality problems. Many analysts would probably nominate some of the public administration, personal and business services and wholesale/retail sectors as candidates for consideration in these categories.

The second, and probably stronger, argument rests on the recently-developed concept of fundamental economic structure (FES). The FES notion was developed by Jensen, *et al.* following a cross-section analysis of the transactions tables of the ten Queensland regions. In brief, the analysis showed a degree of commonality in regional economic structure in this particular economic system, in that about seventy-five percent of the cells of these tables were directly (mostly linearly) related to total gross regional output, i.e. were "predictable" in statistical terms. If the sectors of the table were ordered on a primary-secondary-tertiary continuum, the FES occurred in the secondary-tertiary interaction areas of the table, as shown in Figure 1. Additional analysis confirms the existence of similar patterns in the economic system of the Australian states of Victoria, New South Wales and South Australia.

The implications of the FES concept, if relevant to regional economic systems generally, are important namely: (i) that some economic activities, and groups of activities (as defined by cells of the table) appear to be "inevitably present" at measurable levels which may be unique to each regional economic system and that a given level of total gross output appears inevitably to require reasonably predictable levels of economic activity in identifiable cells and groups of cells in the economy, (ii) that this group of activities defined as the FES, is concerned largely with people-oriented activity since the household column is included in the analysis, suggesting in turn that personal-consumption-induced economic activity is a major factor in the common economic core of the table represented by the FES, and (iii) that as we move from smaller to larger regions, or possibly also as a region grows, the FES portion of the regional economies increases in a predictable and

measurable fashion, confirming to some extent the notion that there could be more which is the "same", or at least uniform in the structure of regional economies, than is "different" or non-uniform. In analytical terms, the FES studies showed that most of the analytically significant cells of the regional tables were located in the FES portion of the table.

The FES notion, if considered generally relevant, has some implications for methods of table construction and the evaluation of ready-made tables. The pertinent question is whether these methods, or some of them, will capture the essential nature of the FES of the particular economic system to which they might be applied. Clearly we have no definitive answer to this question at this stage; further research is both necessary and desirable on this issue. Since the ready-made methods effectively produce reduced-scale versions of national tables, with the size of the coefficients reflecting the size of the region, these methods certainly appear to contain the ability to capture the regularities within the FES of the economic system under analysis. This issue could be examined both on theoretical and empirical bases.

The Arguments Against

Four arguments against the ready-made non-survey models can be identified. The *first* is a rather straight-forward empirical issue, whether the non-survey methods have produced acceptably accurate regional tables and multipliers from national tables. The sum total of the large amount of research effort devoted to this question over more than fifteen years, seems to be not much different from the original conclusions by Schaffer and Chu (1969) that non-survey methods do not produce acceptable substitutes for survey-based tables. The many tests of non-survey techniques have often indicated a superior performance by the RAS but paint a generally pessimistic picture of the empirical potential of the non-survey methods (Round 1983, Richardson 1985, Blair and Miller 1985).

The mediocre empirical performance of the non-survey methods, *secondly*, has been followed by review of the logical and theoretical bases of these approaches and tests of table accuracy. It has been suggested (Jensen 1980, Round 1983) that the empirical tests of the non-survey methods have not effectively tested the accuracy and reliability of these tables, so that, on this basis alone the quality of the non-survey tables is not fully proven. However, criticism of the concept has been strong, namely -- "in retrospect, only a real burst of professional enthusiasm could encourage researchers to hope that a simple analytical technique like the location quotient, or a mathematical technique such as

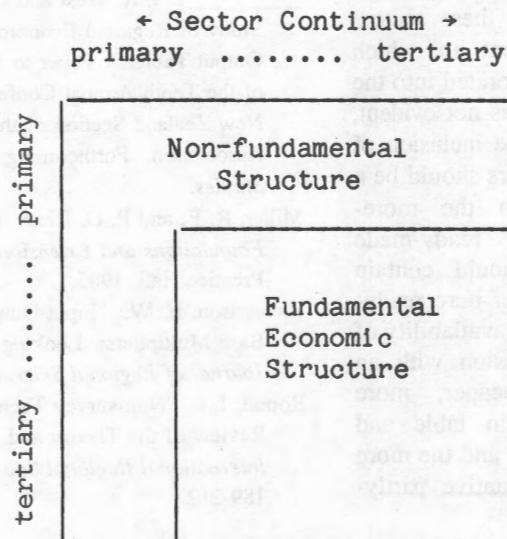
the RAS, could satisfactorily produce a regional table from a national table" (Jensen and McDonald, 1982). And Round's comment regarding "a set of naive views of which a representative one is that simple indicators such as the location quotient are likely to be sufficient to estimate the size and direction of trade flows" (Round 1983). Both Round (1983) and Hewings and Jensen (forthcoming) have been critical of the theoretical basis of the non-survey methods, in particular the latter have claimed that the way in which the (quotient-type) non-survey methods have been applied to national tables has serious theoretical and logical deficiencies. These refer specifically to the form of the coefficients in the parent table.

The third and fourth points refer to the main arguments in the previous section of this paper. The third point simply suggests that, in the same way that similarities occur between regional and national coefficient structures in some industries, clearly differences will occur in some industries between the coefficient structure of local regional industries and the regionalized versions of national coefficients produced by the ready-made models. Where these differences are significant, the ready-made models are clearly inadequate representations of local sectors. Examples of significant regional differences in industry structure are likely to be found particularly in the agricultural, mining and some manufacturing activities. Where these activities are significant in the local economy or have

significant linkages with the rest of the local economy,* the use of ready-made models could introduce large and professionally unacceptable errors into the analysis. This would be the case particularly if analysis concerned the industries with the regionally-unique structure or those industries with which they have strong economic linkages.

Fourthly, in the same way that we might expect any regional economic system to exhibit a predictable FES, evidence also suggests that substantial portions of the table (Figure 1) have a non-fundamental economic structure (NFES) i.e. tend not to be uniform or predictable (with some cells excepted) from one region to another within the same economic system. These cells tend to be primary and mining industry sales to (and purchases from) the remainder of the economy and each other. This is substantive evidence that the ready-made methods, which appear to rely on a uniformity principle, are not only unlikely to provide reasonable estimates of the NFES portion of the table but are in principle inappropriate for this purpose due to the demonstrated regional differences in structure of the NFES portions of the table. The importance of this point is underlined by the fact that, at least in the Australian context, the NFES area of the table contains a small number of the most analytically significant cells in the table, i.e. those which contribute most to multiplier values as measured by the West (1982) criteria.

Figure 1 Probable Fundamental and Non-Fundamental Areas of Regional Input-Output Tables



Concluding Remarks

As noted earlier, we are not in a position on the basis of either theoretical or empirical evidence to produce unequivocal and definitive statements of the worth of the ready-made models. In this state of incomplete evidence, which is a normal state in the social sciences, we simply produce from our observations, discussions and prejudices some conclusions on issues of this type. The discussion in preceding sections suggests the following conclusions on the value of ready-made models: (i) that it is possible, and maybe even probable, that the ready-made models have the capacity to produce acceptable estimates of those parts of regional tables where regularity or uniformity can be expected to be the norm, for example the FES portions of the table or those sectors which are in effect regionalized mini-versions of national tables, (ii) it is certainly not even probable that the ready-made and fully non-survey models will produce estimates of those parts of a regional table which are regionally unique or unique in differing substantially from the national table, such as the NFES areas of the table, with a level of accuracy which should be required by professional standards, (iii) that, with respect to those parts of the table described in (ii) above, adequate assurance of accuracy can be guaranteed with our present state of knowledge only by inserting survey or other reputable region-specific data into ready-made tables. In other words, hybrid tables are required with the minimum degree of hybridization determined by the degree of economic structural uniqueness of the particular regional economy. The need for the addition of survey or "superior" data (Jensen, et al., 1979) could be lessened only in the event that intended economic analysis does not rely heavily on regionally-unique sectors, or those industries with which these sectors have significant linkages. The extent to which additional survey data is routinely incorporated into the five models reviewed by Brucker, *et al.* is not evident, therefore conclusion (iv) suggests that the inclusion of survey data in these region-specific sectors should be a primary basis of distinction between the more-recommended and less-recommended ready-made models and that user information should contain warnings on the probable inadequacies of pure ready-made models. Lastly (v) the commercial availability of ready-made models presents the profession with an inevitable trade-off between the cheaper, more expeditious, but more suspect (both in table and analytical accuracy) ready-made methods and the more expensive but more accurately representative partly-hybridized models.

The clear obligation of those concerned with the

integrity of economic analysis using input-output tables is to maintain reasonable standards in this analysis by producing input-output analysis of the highest standards possible for each occasion or to warn the user of the consequences of the alternatives. It might well be that future generations of researchers, engaging in the time-honoured activity of critically evaluating their predecessors, will conclude that the current tide of movement to ready-made models was a slightly-too-commercial reaction to a clear market need; and in the process, some of the important intrinsic elements or essence of input-output analysis became obscured in the trade-off allowing some compromise in our professional endeavours.

REFERENCES

- Brucker, S. M., S. E. Hastings and W. R. Latham.
"Regional Input-Output Analysis: A Comparison of Five 'Ready-Made' Model Systems." *Review of Regional Studies*. 17:2 (1987).
- Hewings, G. J. D. and R. C. Jensen. (forthcoming)
"Regional and Multiregional Input-Output Models."
In Nijkamp, P. and Mills, E.S. (eds.). *Handbook in Regional and Urban Economics: Volume 1 Regional Economics*. Amsterdam: North Holland Publishing Company.
- Jensen, R. C. "The Concept of Accuracy in Regional Input-Output Models." *International Regional Science Review*. 5 (1980). 139-154.
- _____, T. D. Mandeville and N. D. Karunaratne.
Regional Economic Planning. London: Croom Helm, 1979.
- _____, and S. McDonald. "Technique and Technology in Regional Input-Output" *Annals of Regional Science*. 16 (1982). 27-45.
- _____, G. R. West and G. J. D. Hewings. "On the Study of Regional Economic Structure Using Input-Output Tables." Paper to the Input-Output Workshop of the Tenth Annual Conference of the Australian and New Zealand Section of the Regional Science Association. Forthcoming in *Review of Regional Studies*.
- Miller, R. E. and P. D. Blair. *Input-Output Analysis: Foundations and Extensions*. Englewood Cliffs: Prentice-Hall, 1985.
- Richardson, H. W. "Input-Output and Economic Base Multipliers: Looking Backward and Forward." *Journal of Regional Science*. 25 (1985). 607-662.
- Round, J. I. "Non-survey Techniques: A Critical Review of the Theory and the Evidence." *International Regional Science Review*. 8 (1983). 189-212.

Schaffer, W. A. and K. Chu. "Non-survey Techniques for Constructing Regional Interindustry Models." *Papers and Proceedings of the Regional Science Association*. 23 (1969). 83-101.

West, G. R. "Sensitivity and Key Sector Analysis in Input-Output Models." *Australian Economic Papers*. 21:39 (1982). 365-378.

I-O TO GO: A COMMENT ON READY-MADE MULTIPLIERS

Hugh W. Knox*

Comparisons of "ready-made" regional input-output multipliers are overdue. The paper by Brucker, Hastings, and Latham in this issue of the *Review of Regional Studies*, along with their promised follow-up article comparing multipliers calculated for identical scenarios, should be of great value to those practicing regional scientists, economic development planners and consultants, and policy analysts who regularly conduct impact analyses. Those users have long sought comparisons of the relative design and performance characteristics of many of the leading ready-made modeling systems even in the face of the major methodological problems in making such comparisons (Richardson, 1985). What are still missing, of course, are comparisons with the real thing--carefully crafted survey based models of recent vintage for states and metropolitan areas.

The lack of current benchmark tables for comparison purposes is particularly unfortunate because the recent availability of detailed four-digit industry data at the county level, has reduced the sting of some of the theoretical criticisms of using supply-demand pool methods or location quotient based techniques to derive regional direct coefficients from national ones. For example, as geographic and industry disaggregation increase, the likelihood of crosshauling is smaller; potential problems of industry mix are reduced as well. Consequently, ready-made input-output multipliers

derived from four-digit data should be closer to survey-based input-output multipliers, *ceteris paribus*, whether they are based on supply-demand pool methods, simple location quotients, or on one of a wide variety of adjusted location quotient techniques up to and including the most-adjusted (so far) location quotient--the regional purchase coefficient.

How "close" survey and nonsurvey multipliers are has been evaluated for the RIMS II system against survey-based tables for Texas, West Virginia, and Washington, (Cartwright, et al., 1981), for the RSRI system for the West Virginia and Washington tables (Stevens, et al., 1983) and for location quotient and supply-demand pool techniques for a Delaware county (Brucker and Hastings, 1983). The results were much more encouraging than those reported in recent journal articles on nonsurvey techniques applied to two-digit data (Richardson, 1985 and Round, 1983). Disaggregation to the four-digit level appears to be a significant advance. The difference between survey and nonsurvey multipliers on average tends to be less than 10 percent, although differences in individual sector multipliers can be much higher.

Beyond the purely ready-made techniques lies developing interest in partially ready-made techniques, the so-called "hybrid" or "mongrel" models (Richardson, 1985). It remains to be seen if the application of modest survey resources to a few key industries can overcome the lack of the major resources necessary to do regional survey based tables properly in the first place. Post-mortem simulations of already constructed survey tables may help to identify historically significant sectors, but they cannot bring fresh solutions to the problems of separating multi-establishment firms, of estimating regional capital stocks, of measuring interregional and international

*Chief, Regional Economic Analysis Division, Bureau of Economic Analysis, U.S. Department of Commerce. The author is indebted to his BEA colleagues Dan Garnick, Dick Beemiller, Zoe Ambargis, and John Kort for their continuing insightful comments on issues of nonsurvey input-output analysis. The author's views are not necessarily those of the Bureau of Economic Analysis or the Department of Commerce.

flows of goods (and now, exported services), of measuring output, or of estimating regional final demand components in real terms. And it is the cost of overcoming these problems that drives the search for alternatives to the survey based table.

Without the resources to construct survey based tables, research like that underlying the Brucker, et al., article should help us to remain humble but hopeful. The availability and careful use of ready-made regional multipliers improves our ability to conduct impact analyses. Further research into hybrid techniques may bring us to similar levels of confidence about partial-survey regional tables as well.

REFERENCES

- Brucker, Sharon M. and Steven H. Hastings. "An Evaluation of Non-Survey Estimation Techniques for Regional Input-Output Models." *The Review of Regional Studies*. 13:1 (1983). 14-27.
- Cartwright, Joseph V., Richard M. Beemiller and Richard D. Gustely. *RIMS II, Regional Input-Output Modeling System*. Washington, D.C.: U.S. Department of Commerce, Bureau of Economic Analysis, 1981.
- Richardson, Harry W. "Input-Output and Economic Base Multipliers: Looking Backward and Forward." *Journal of Regional Science*. 25:4 (1985). 607-661.
- Round, Jeffrey I. "Non-survey Techniques: A Critical Review of the Theory and the Evidence." *International Regional Science Review*. 8:3 (1983). 189-212.
- Stevens, Benjamin H., George I. Treyz, David J. Ehrlich and James R. Bower. "A New Technique for the Construction of Non-Survey Regional Input-Output Models and Comparisons with Two Survey-Based Models." *International Regional Science Review*. 8:3 (1983). 271-286.

A NOTE ON 'READY-MADE' REGIONAL INPUT-OUTPUT MODELS

Jeffery I. Round*

Many regional economists on the academic/commercial interface would readily attest to the apparent thriving market for usable input-output models at all levels of the spatial hierarchy. This is not only true in the United States; it is also revealed in the U.K. and many other countries of the world. Practitioners, therefore, face a long-standing and continuing dilemma: the costs of carrying out anything remotely like a comprehensive survey of production establishments, households and other institutions are prohibitively high, and yet the existing battery of nonsurvey methods have been generally regarded in academic debate with considerable scepticism. What tends to happen in the overwhelming majority of instances is that nonsurvey methods win the day as the 'best available methods' to perform the task, given the budget (or time) available. However, the problems do not end at this point. Even a nonsurvey-based model is

relatively time-consuming (and expensive) to assemble. Hence, it is not at all surprising to see a genre of 'ready-made' models being developed which enable practitioners to cut the cost of I-O construction and considerably reduce the time it takes to implement them.

In one important respect this development should be welcomed. There are many instances where purely mechanical aspects of model construction can be efficiently built into a suite of software. Moreover, these procedures are likely to be replicated whatever region is studied, so there is little virtue in developing this software from scratch on each occasion. Good examples of such computations are the use of the national I-O tables to determine regional technical structure, possibly with some adjustment according to regional weights, and the derivation of regional household income and expenditure patterns (again on the basis of the national tables). The same would be true of the standard computations such as multipliers,

*Senior Lecturer, Department of Economics, University of Warwick.

aggregations, matrix inversion, and the various calculations of output and employment effects.

However, in other respects one ought to be much more cautious about advocating their use. The review by Brucker, Hastings and Latham, (1987) (BHL) provides a valuable comparison of the general features of five ready-made model systems for the U.S. As well as describing their principal features BHL focus on their relative cost and supposed flexibility. In my view, it is these aspects which open up important areas of debate about the efficacy of these systems for real world policy analysis. Although, as is demonstrated, there is some variation in costs and some differences in their products, what we do not get is any sense of the *cost-effectiveness* of the respective systems. What is missing is any assessment of the effectiveness, or measure of performance of the systems. This question is not answerable in a simple way. We cannot, for instance, just compare one system with another; nor can we easily measure error in respect of some absolute target. A naive and virtually costless alternative may perform just as well in some experiments. Input-output analysts have typically been rather bad at error assessment in spite of the early studies by Ghosh (1964) and Tilanus (1966) where the basic problems involved were clearly highlighted. The whole question of system effectiveness needs to be researched with great care. Only then can the costings be compared in a truly economic sense.

All five systems rely heavily on nonsurvey methods. The case for and against such methods has been discussed in some detail by Richardson (1985), by myself in Round (1983), as well as by many others. The general consensus seems to be that there is little evidence in support of the existing set of methods. It therefore is worrying that four of the five systems are so dependent on the location quotient and supply-demand pool methods which have been so discredited in the past. Even the RSRI's regional purchase coefficients

have not been subjected to the full panoply of tests, and many would remain skeptical about their general validity and applicability.

A further concern with the systems, as described in BHL, has to do with their flexibility. None of the systems appear to be flexible enough to accommodate coefficient "fix-ups" or source data whenever they exist. One simply buys a package and opts for all the short cut techniques already built into it. There are exceptions, of course, and these are clearly indicated in Tables 1 and 2, but in none of the systems is there a way of by-passing the particular specification of the trade coefficients which ultimately will so crucially affect the size of all the multipliers generated.

In summary, therefore, I worry about the performance and flexibility of these "ready-made" models and whether their continued popularity will actually deter not only serious scholarship to improve the methodology applicable to particular regions but also the collection of data and information in the way convincingly suggested to be so necessary by Leontief.

REFERENCES

- Brucker, S. M., S. E. Hastings and W. R. Latham.
"Regional Input-Output Analysis: A Comparison of Five 'Ready-Made' Model Systems." *Review of Regional Studies*. 17:2 (1987).
- Ghosh, A. *Experiments with Input Output Models*.
Cambridge: Cambridge University Press, 1964.
- Richardson, H. W. "Input-Output and Economic Base Multipliers: Looking Backward and Forward." *Journal of Regional Science*. 25:4 (1985). 607-661.
- Round, J. I. "Nonsurvey Techniques: A Critical Review of the Theory and the Evidence." *International Regional Science Review*. 8:3 (1983). 189-212.
- Tilanus, C. B. *Input-Output Experiments: The Netherlands, 1948-1961*. Rotterdam: Rotterdam University Press, 1966.

SYNTHETIC I-O MODELS: A COMMENT

Philip J. Bourque*

Introduction

How good are synthetic regional I-O models in characterizing the input-output structures of regional economies? This is the central question to which the scientific community ought to respond. By synthetic regional models is meant the genre of non-survey methods which utilize national technical coefficients to estimate regional flows or multipliers.

The assumption that national coefficients of production are transmittable to regions and that trade patterns are governed by LQ's and pools characterize these algorithms. Should anyone believe that an input-output table for France, if based on U.S. national coefficients and French employment, would yield a descriptively useful matrix? Why should we regard that as a more frivolous exercise than doing the same for California or El Paso? Regional economics is concerned with the uniqueness of places in terms of resources, technology, output, costs, and markets. Undue reliance upon indirect estimating techniques surely invites skepticism, at least until synthetic models are subject to much more rigorous testing.

Problems of Testing

Since all synthetic models play off the national I-O tables, it is important to note several features which make testing of their regional offspring difficult.

The most obvious testing approach would be to compare the dollar flows tables of the national reduction techniques with those of survey-based tables. Assuming a matching classification of industries and time period, one could proceed methodically: are the gross outputs, intermediate inputs and outputs, value-added and imports similar? A reaction to such a proposal might be that the principles of measurement between the data sets are so different that close similarities should not be expected . . . at least not with respect to the Washington tables, and probably not for other survey-based tables.

Reasons for some of the differences are obvious. The measures of industry output are not the same: total industry output (TIO) of the synthetic tables reflects transfers and redefinitions for secondary products not

typically undertaken or ascertainable in survey approaches. The regionalized national table is industry x commodity, not industry x industry. In survey-based tables, foreign imports are specifically directed into acquiring industries rather than dictated by the fiction that their use pattern corresponds to the flow of domestically-produced counterparts. Synthetic tables are unrevealing about the importance of foreign vs. domestic regional imports or specific external markets for outputs, variables which are of great interest to regional planners. For these and other reasons, Round's (1983) conclusion that ". . . the empirical tests performed to date have revealed little about the absolute performance of non-survey methods for constructing regional input-output tables" is still applicable.

In recognition of the difficulties confronting such a direct approach, testing has proceeded indirectly, with emphasis upon the size of multipliers. This shifts concern from absolute levels to implicit relationships and from regional I-O as a descriptive tool to a exclusively impact analytic one. For this purpose some modified LQ approaches are somewhat encouraging as Cartwright-Beemiller-Gustely (1981) have shown. However, broad similarity with survey-based multipliers is not surprising since localized activities are pretty much lookalikes (the drug store in Peoria vs. Tacoma). The important multipliers for impact analysis are for those sectors where inter-regionally traded products are significant, and for these the RIMS II results appear to have mixed effectiveness.

Given the desirable properties of synthetic models as noted by Brucker, *et al.* (speed of implementation, low cost, disaggregation, portability), survey-type models are bound for extinction. The tables for Washington (1982), Texas (1979), and West Virginia (1975) may be the last of their kind. If so, the testing and calibration of synthetic models will become increasingly difficult.

The Wave of the Future

The days of survey-based models are coming to an end, it appears. I use the term survey-based loosely to mean those regional models which use questionnaires and interviews as an element and maximize the use of available regional information, including census data, reports of regulatory agencies, trade reports, and the panoply of other arcane sources which empirical

*Professor of Business Economics, University of Washington at Seattle.

research uncovers. Unfortunately, there never has been much discussion in the journals about how to mine these resources successfully, or how to cope with the distribution of trade and transportation margins and other practical problems. Even conceptual terms such as "regional" output and resources are ill-defined. Those who have labored in the trenches of observational science have good reason to be impatient with abstract X's and Y's.

If the days of survey-based models are over, the development of fact-based I-O models should receive increasing emphasis within the context of PC and other ready-made procedures. Computer-driven PC models easily have the capacity and flexibility to absorb more region-specific data into their calculations. Rich mines of flow data, available across the board for many states, can and ought to be incorporated directly or as constraints in the estimation of regional tables. A realistic expectation is that a linkage of BEA's estimates of gross state product (Garnick, 1985) and regional I-O models should take place just as national I-O and national income and product accounts became conjoined in 1958.

What should be avoided is the proliferation of PC models driven by untested assumptions and little region-specific data content. So far, that approach has made

little contribution of scientific value in advancing conceptual inquiry or establishing reliable empirical foundations for further regional research. There is nothing wrong with getting the most information content possible out of a set of observations, but there appears to have been undue reliance upon indirect statistical inference as the principal method of regional I-O modeling and a dearth of direct observation by which to monitor the results.

REFERENCES

- Brucker, S. M., S. E. Hastings, W. R. Latham III.
"Regional Input-Output Analysis: A Comparison of Five 'Ready-made' Model Systems." *Review of Regional Studies*. 17:2 (1987).
- Cartwright, J. V., R. M. Beemiller, R. D. Gustely.
RIMS II: Regional Input-Output Modeling System: Estimation, Evaluation, and Application of a Disaggregated Regional Impact Model. Washington, D.C.: U.S. Department of Commerce, 1981.
- Round, J. I.. "Nonsurvey Techniques: A Critical Review of the Theory and the Evidence." *International Regional Science Review*. 8 (1983). 203.