NOTE ON NON-SURVEY INPUT-OUTPUT MODELS FOR MULTICOUNTY REGIONS: REPLY

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Introduction

The comment by Bernat on my pragmatic solution to a problem that occurs in using the simple location quotient (SLQ) technique to estimate input-output (I-O) multipliers raises an interesting estimation issue not addressed in the comment or my paper (1980). The SLQ technique is asymmetric in the sense that "trade coefficients" estimated by location quotients (LQ) range from 0 to 1.0 whenever the LQ $\leqslant$ 1.0. However for any LQ > 1.0, the "trade coefficient" is constrained to 1.0. This constraint ignores the sector i export capacity of a single specialized county within a multicounty region to supply input i to other counties within the region with input i. Accordingly, the SLQ_i may underestimate within region interaction and underestimate regional multipliers. This possibility has been ignored in the nonsurvey I-O literature and runs counter to the usual assumption that the SLQ technique tends to overstate within region interaction because crosshauls are captured in the *intraindustry* flows (See Round, 1978).

My purposes in this reply are: 1) to assert that there still is a multicounty problem in interpretation of SLQ based I-O multipliers; and, 2) to identify potential downward bias in SLQ based multipliers associated with neglect of within region specialization.

Is There a Multicounty Problem?

The comment argues that having $SLQ_{ikr} > SLQ_{ik}$ does not lead to "inconsistent" results because a_{ij} coefficients are averages of input proportions between many firms within a given sector j. Thus, it is argued it may be that the "average" county firm in sector j may have larger a_{ij} coefficients for a given input i than those of the region in general.

Here, the comment restates the crux of the "problem" noted on page 70 (Henry). Use of the SLQ approach to estimate a multicounty model will, whenever $SLQ_{ikr} > SLQ_{ik}$ result in gross output multipliers for county r larger than region k of which r is a part. Thus, if County A's multiplier is 2.8 for wheat and the regional multiplier is 2.5 for wheat, total regional output changes by \$2.5 million in response to exports of \$1.0 million of wheat while County A (part of the region) will experience a \$2.8 million increase in output. Such inconsistencies are common using the SLQ approach, and wreak havoc with impact analyses for a multicounty planning region.

Is There Downward Bias in SLQ Based I-O Multipliers?

The SLQ approach starts with the assumption that "technical" coefficients are identical at the national and regional levels. Regional coefficients can only be *less* than corresponding national coefficients because it is assumed that regional firms import inputs to a greater extent than national firms.

Thus $a_{ij}^r = a_{ij}{}^n - m_{ij}{}^r$(imports of i by j in region r). If $SLQ_i > 1.0$, we assume $m_{ij}^r = 0$ for all j. If $SLQ_i < 1.0$ then $a_{ij}^r = SLQ_i * a_{ij}{}^n$ so that $m_{ij}^r = a_{ij}{}^n$ $(1\text{-}SLQ_i)$.

Now as SLQ_i approaches 1.0, the import (m_{ij}^r) leakages become smaller. Again following the SLQ approach, whenever $SLQ_{ikr} > SLQ_{ik}$, there must be more imports by within region producers from outside the region than by the constituent county producers from outside their county.

If we believe that the SLQ is a reasonable way to approach the estimation of import requirements for a three county region, then perhaps the SLQ is also reasonable for estimating individual county import requirements.[1] If so, we have three county bits of information on regional industry i that yield information in

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addition to the regional average. For example, we may estimate that counties B and C are less specialized in production of i than County A and therefore will likely import a larger proportion of their input i needs than A.

Assuming away the crosshauling problem,[2] is it likely that: (1) counties B and C that have larger percentage import requirements than A will import some or all of a good from County A and some from outside the region?; or, (2) all from outside the three-county region? If the counties comprise a "functional economic area demarcated on the basis of both commuting and shopping distances, and having a sufficiently full line of central place activities to be relatively self-contained" (Hoover, p. 281), then one is tempted to answer yes to assumption (1). Round (1978) introduces a similar argument to recognize that regions are not "point" economies. Essentially, he modified trade coefficients by a scaling factor (arbitrary) that gives more weight to trade between i and j sectors of subregions if the i and j sectors are located in the same or contiguous subregions relative to spatially separated subregions. He thus introduces judgment into the trading coefficients based on relative location of producing and consuming subregions. (See Round 1978, p. 184).

The SLQ procedure may introduce a downward bias to regional "average" multipliers if the $LQ_i > 1.0$ for a given county within a region. Here the county (if not the region average) specializes in the i^{th} sector relative to the nation so that exports to other counties in the region is certainly reasonable. Not using the MAXLQ procedure in this case probably understates regional interaction. For example, a county with an industrial chemical complex may have an LQ for this sector much larger than 1.0. Counties surrounding this "individual chemical" county may have LQ's of zero with a regional average LQ of 0.5. Using the SLQ approach we would assume that only 50% of the regional needs are supplied locally when all local needs in the region are being met by the single county.

More explicitly, consider a three county, three sector multicounty region. First, let the balance equations in this system be denoted as:

$$\begin{aligned} X^1 - A^{11}X^1 - A^{12}X^2 - A^{13}X^3 &= F^1 \\ X^2 - A^{21}X^1 - A^{22}X^2 - A^{23}X^3 &= F^2 \\ X^3 - A^{31}X^1 - A^{32}X^2 - A^{33}X^3 &= F^3 \end{aligned}$$

where

X^1 = Gross output vector, 3 × 1 for region 1

X^2 = Gross output vector, 3 × 1 for region 2

X^3 = Gross output vector, 3 × 1 for region 3

A^{11} = Direct input coefficients in region 1

A^{22} = Direct input coefficients in region 2

A^{33} = Direct input coefficients in region 3

A^{rs} = Matrix of imports of good i from region r to sector j in region s (or exports from r of i to sector j in region s.)

F^r = Regional r sales to final users in each subregion s and outside the region.

For a subregion 1 model the SLQ technique yields:

$$A^{11} = A^{U.S.} - \lambda A^{U.S.}$$

where λ = Diagonal matrix, with diagonal elements:

$\lambda_i = 0$ if $LQ_i' > 1.0$ or,

$\lambda_i = (1 - LQ_i)$ if $LQ_i < 1.0$

$A^{U.S.}$ = National Technical Coefficients

This operation takes place across all columns of A^{11} so that the LQ_i represents the import behavior of all j sectors in the subregion.

Most importantly, from the SLQ perspective, the location of input suppliers is irrelevant; thus the A^{21} and A^{31} flows can be assumed to be zero. Similar arguments could be made for subregion 2 and 3, resulting in zero matrices for A^{12}, A^{32}, A^{13}, and A^{23}. If the multicounty planning region resembles at all a functional area, this is unlikely. Furthermore, if we have any sectors in any region with "large" LQ's (e.g., $\geqslant$ 1.50) it is reasonable to assume that they will be involved in exports. Leontief has suggested on the grounds of transport costs and influence of distance that imports will come from the nearest surplus area (Richardson, p. 63). Thus, if Leontief's hunch is correct, exports from county sectors with "large" LQ's will likely be imports to counties in the same planning region. Accordingly, we might expect nonzero matrices for A^{12}, A^{13}, A^{23}, and A^{32}.

So far, the argument is that, not surprisingly, multicounty models will exhibit more regional interaction (nonzero A^{12}, A^{13}, A^{23} and A^{32} matrices) than would be the case if one merely measured the interindustry effects of any of three district subregions (the A^{11}, A^{22} or A^{33} matrices) within the region while ignoring subregion interaction.

Using the SLQ technique, as we move from the A^{11}, A^{22} and A^{33} matrices to a regional "average" matrix, A^r, one should expect that there will be fewer zero elements in A^r than any of the county matrices since there will be fewer zero location quotients resulting in fewer zero rows in the A^r matrix. For example, if two counties (2 and 3) have 0 employment in a sector "k" while a third county (1) has 6% of its employment in that sector (with a LQ = 1.50), the region average (for three counties with equal employment totals) would be 2% of its employment in sector "k" (with a LQ of say .75).

Now, the SLQ technique will result in *regional* input coefficient = .75 of the k^{th} row in the $A.^{U.S.}$

This averaging over all three counties will, however, imply that all sectors in the region will import from outside the region 25% of their inputs of "k" (per $ of output). This is assumed even though a county in the region specializes in the production of "k."

If instead of the SLQ technique, we assume that Counties 2 and 3 receive input k from county 1, then for County 1, the k^{th} row of A^{11} will equal the k^{th} row in A^{US}; for County 2, the k^{th} row of A^{12} will equal the k^{th} row of A^{US}; and for County 3, the k^{th} row of A^{13} will equal the k^{th} row of A^{US}. For County 2, we would add the k^{th} row of A^{12} to the zero k^{th} rows of A^{22} and A^{32} to arrive at the average input coefficients along row k in County 2.

Now if we have exports out of the region from firms in County 2, the impact on the *region* will be identical, for k^{th} sector direct effects, to exports originating in County 1 using the SLQ technique on County 1 alone (i.e., use of A^{11}). This is the essence of the MAXLQ approach. Use of SLQ would take the "average" ability of the region to be able to supply only 75% of input k locally. However, averages are likely to be misleading under these circumstances and will produce downward bias on regional interaction and can result in "inconsistent" multiplier effects between a region and its constituent subregions.

Richardson (1972) provides a summary of attempts to model trade coefficients to reflect the spatial distribution of supply and consumption areas. The MAXLQ technique is merely a pragmatic or "quick-fix" to the multiplier inconsistency issue. In the gravity model framework, MAXLQ is similar to an estimated "friction of distance" parameter that is very large.[3] The MAXLQ approach probably overstates regional interaction when LQ_i 's are small for all counties in the region although it avoids the "inconsistent" multiplier estimates between a region and a member county. A possible compromise is to use the MAXLQ approach only for sectors where the $LQ_i \geq k$ where k = 1.50; this would involve assigning a regional LQ_i of 1.0 whenever a county in the region had a sectoral $LQ_i \geq 1.50$. For $LQ_i < 1.0$ for all counties, use the regional LQ_i.

The value for k could be increased or decreased as comparisons are made between a survey based regional I-O model (with county components) and the various modified MAXLQ models. Given the emphasis on the need for accuracy of "regional purchase coefficients" in nonsurvey regional models, such experiments seem warranted.

On page 3, the comment purports to demonstrate "the fact that MAXLQ is unnecessary by noting that the regional technical coefficients a_{ij} are weighted averages of the county coefficients $a^{rr}{}_{ij}$ and the intercounty trade coefficients $a^{sr}{}_{ij}$, s = r, the weights being each county's share of regional sectoral output."

In response, two points can be offered. First, the MAXLQ in no way purports to yield an "ideal" interregional model where all $a^{sr}{}_{ij}$ flows are estimated. It merely asks: If we are to use a nonsurvey technique to reduce the national a_{ij} coefficients for import leakages at the regional level, does the SLQ technique yield reasonable results in a multicounty framework? Surely, to reduce all national a_{ij} coefficients by .60 across the i^{th} row to reflect imports because the SLQ_i = .60, is something the regional analyst would like to avoid if time and money were not important research constraints. Lacking data on trade flows, the regional analyst could choose between a $MAXLQ_i$ = .8 for a single county within the region or the regional SLQ_i = .6 as the most reasonable coefficient by which to reduce the national a_{ij} across row i. The MAXLQ approach yields "consistent" results in the sense mentioned previously, and it has some conceptual basis given the functional economic area argument presented above.

Second, in equation (4) the comment provides a disaggregation of a regional a_{ij} coefficient into its weighted county and intercounty trade flow components for an ideal interregional model. However, this exercise sheds no light on the relative merits of the SLQ and the MAXLQ procedures. The MAXLQ problem is to find the appropriate way to reduce the national technical a_{ij}^n coefficient to arrive at a regional coefficient if one is to avoid "inconsistent" regional and subregional multipliers. The research issue is how to estimate import flows into a multicounty region using nonsurvey techniques. The MAXLQ procedure may indeed be inferior to the SLQ technique in estimating these flows. However, empirical tests of this proposition are needed before one can conclude that "the use of MAXLQ will introduce additional error into the SLQ estimation procedure . . ." (Bernat, p. 5).

FOOTNOTES

[1]It should be emphasized that use of the SLQ to estimate "trade" coefficients is done with little justification other than empirical expediency. In an exhaustive and recent survey of "nonsurvey" I-O techniques, Jeffrey Round (1982) concludes, "No writer has attempted to justify equating the trade coefficient (ppt_{ij}) to the α-values, [e.g., SLQ_i]. Clearly, it would be futile to do so since it is obviously no more than a matter of practical expediency. Their success has to be judged on empirical grounds alone."

[2]In an interregional framework, Round (1979) finds that feedback effects in a balanced two region model will mostly offset any assumption about crosshauling from zero intraindustry transaction to all crosshauls being included in the intraindustry cells. (p. 152).

[3]See Richardson, (1972) p. 70 for a summary of how gravity models have been used to estimate trade coefficients.

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