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A METHODOLOGY TO CALCULATE REGIONAL CAPITAL INVESTMENT MULTIPLIERS

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Many states record the dollar amount of capital expansion announcements made in the state. These capital expansion amounts may take the form of new plants or the expansion of existing plants. Regional input-output models, such as RIMS, often are used to estimate the total economic impacts of changes in final demands within a state's economy. These models provide the multipliers necessary to determine the sum of the direct, indirect, and induced impacts of changes in final demand on total economic activity (output), earnings, and jobs. There is, however, no direct means of determining the multiplier for capital expansion. For example, from a model such as RIMS, we may determine the impact on the state's economy of increased textile sales. The expansion of a textile plant is not directly determined from RIMS. The availability of capital expansion or investment multipliers would be of interest to policy makers, particularly state economic development boards. In South Carolina, the S.C. State Development Board tracks capital investment (i.e., putting new plant and equipment into place) by manufacturing concerns. The purpose of this note is to suggest a relatively straightforward and inexpensive method for determining capital expansion multipliers for a regional economy. The method proposed was used in a study recently completed at the Division of Research at the University of South Carolina College of Business Administration for South Carolina.

We start with the basic material balance equation in the regional input-output framework:

$$AX + F = X,$$

where:

- A = A matrix of regional input-output coefficients;
- X = A column of regional commodity output; and
- F = A column of regional final demands.

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From this equation the well-known Leontief inverse is derived:

$$X = (I - A)^{-1}F.$$

Final demand may be decomposed into personal consumption expenditures, gross private domestic investment, net exports, and government purchases; or

$$X = (I - A)^{-1}(C + I + G + NX).$$

An increase in investment demand generated by capital expansion produces a change in output given by:

$$\Delta X = (I - A)^{-1} \Delta I.$$

This increase in investment demand, however, is the demand for a particular commodity used as an investment good. To say that a textile plant is expanding by \$10 million does not translate into the commodity demands needed to operationalize an I-O model. What is needed first is a method to distribute the \$10 million capital investment across commodity categories. The problem addressed here is how to convert an announced capital expansion into the appropriate commodity demands.

The Bureau of Economic Analysis (BEA) provides a capital flow table (CFT) for the national I-O accounts. The CFT distributes the investment demand of commodities by the using industry. Thus, each element, C_{ij} , is the amount of good i flowing to industry j for investment purposes. The row totals of the CFT are the total investment demands for each commodity.

$$\sum_{j=1}^N C_{ij} = I_j$$

The column totals given by

$$\sum_{i=1}^N C_{ij} = J_j$$

are the total amounts invested by each industry.

We define

$$B = C \hat{J}^{-1}$$

where:

- \hat{C} = CFT;
 \hat{J} = The matrix formed by diagonalizing the column vector J; and
 B = An investment coefficients matrix where each element b_{ij} is the amount of good i demanded as capital investment by industry j for one dollar of investment expenditures by industry j .

Assuming that there are no regional technological differences in the capital structure of firms, then we may apply the B matrix derived from the national I-O tables to determine the demand for investment goods by a new firm in a particular state. Although it may be valid, albeit arguably so, that the capital structures of firms in different regions are the same, it certainly is not valid to assume that the capital needs of each firm are purchased within its own region. A location quotient may be applied to the investment demands to determine the amount purchased within the region. For the purposes of this note a simplified LQ may be used.

Define

$$LQ_i^R = \left[\frac{E_i^R / E^R}{E_i^N / E^N} \right]$$

where:

- E_i^R = Employment in sector i in the region;
 E^R = Total employment in the region;
 E_i^N = Employment in sector i in the nation; and
 E^N = Total employment in the nation.

The regionalized b_{ij} , or b_{ij}^R , are determined as follows:

$$b_{ij}^R = b_{ij}(LQ_i^R) \text{ if } LQ_i^R < 1; b_{ij} \text{ if } LQ_i^R \geq 1$$

BR , composed of the b_{ij}^R , then represents a regional specific capital demand matrix.

To determine the total economic impact of the regional demand for each b_{ij}^R , multiply each b_{ij}^R by M_i^R , where M_i^R is the regional multiplier for changes in demand for commodity i . (For example, the M_i^R may be found

from RIMS, or from the Leontief inverse using any other regionalized A matrix). Then the regionalized capital expansion multiplier, IM_j^R , of a one dollar investment in industry j is given by

$$IM_j^R = \sum_{i=1}^N M_i^R b_{ij}^R$$

The resulting multipliers for manufacturing in South Carolina at the two digit SIC code level are presented in Table 1. There are several options in determining LQs, and the choice often depends on the data available and the researcher's preferences. The above method applies to any choice of LQs. This note refers to RIMS for regionalized impact multipliers of final demand changes. The method presented also would apply for other regional models available to the researcher.

Conclusion

A number of problems exist with the proposed method detailed in this note. But applied research is fraught with problems. These difficulties do not obviate the need for research; rather they point to possible improvements. One objection to this method is that it relies on two crucial assumptions—namely that the CFT adequately captures the capital structure of the regional firm and that the distribution of capital expenditures is industry driven rather than project driven. For those researchers who have adequate survey data on the types of goods purchased in the capital expansion, the obvious recommendation is that the survey results be used rather than the CFT. Most states do not have survey-based I-O tables and rely on some variant of a top-down model, such as RIMS. Thus, the researcher is already dependent on the appropriateness of location quotients. Again, for those researchers who have sufficient data to determine the purchase site of the goods used in the capital expansion, the recommendation is that these data be used.

The purpose of this note is to provide a solution for those researchers who are called upon to develop a multiplier for their state for capital expansion investments and who do not have the luxury of complete information on the nature and location of the purchases. For those in such a state, this method provides an approximation of the total economic impact. Further, jobs and employment multipliers may be developed in a similar fashion.

We suggest that refinements should be made over time as more data became available. Survey information would be preferable to the use of location quotients. Survey information also would be preferable to the use of a CFT. In the meantime, we suggest that this method be

applied as a start to an interesting problem: the measurement of the economic impact of capital expansion.

References

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Table 1
Capital Investment Multipliers
by SIC Code for South Carolina

| SIC Code | Multiplier |
|--|------------|
| 20 Food and Kindred Products | 1.733 |
| 21 Tobacco Manufacturers | 1.715 |
| 22 Textile Mill Products | 1.763 |
| 23 Apparel and Other Textile Products | 1.778 |
| 24 Lumber and Wood Products | 1.712 |
| 25 Furniture and Fixtures | 1.770 |
| 26 Paper and Allied Products | 1.671 |
| 27 Printing and Publishing | 1.852 |
| 28 Chemical and Allied Products | 1.644 |
| 29 Petroleum and Coal Products | 1.719 |
| 30 Rubber and Miscellaneous Plastic Products | 1.840 |
| 31 Leather and Leather Products | 1.863 |
| 32 Stone, Clay, and Glass Products | 1.663 |
| 33 Primary Metal Industries | 1.743 |
| 34 Fabricated Metal Products | 1.799 |
| 35 Machinery, Except Electrical | 1.802 |
| 36 Electric and Electronic Equipment | 1.765 |
| 37 Transportation Equipment | 1.836 |
| 38 Instruments and Related Products | 1.753 |
| 39 Miscellaneous Manufacturing Industries | 1.749 |