APPENDIX E

UNDERSTANDING MULTIPLIERS AND HOW TO INTERPRET THEM
INTRODUCTION

Multipliers are used to estimate the regional economic impacts resulting from a change in "final demand". In the case of recreation or tourism, "final demand" means the change in expenditures associated with recreation trips to a site or destination region. The size of the multiplier reflects the impact of the various rounds of respending of recreationist dollars before those dollars leak entirely from the region. Size and complexity of the local region affect the size of the multiplier. In general, the more interdependent the sectors in a region, the larger the multiplier effect of a given investment. This implies that multiplier effects are greater in larger regions with more diversified economies than in smaller regions or in communities where economic diversity is low. As community self-sufficiency in providing recreation goods and services rises, there will be a decrease in the need to import and an increase in the dollars remaining in the community to be re-circulated among households and firms within the region before disappearing to nonlocal purchases and savings.

The Function of Multipliers in an EIA

As noted elsewhere (Miernyk 1965, Propst and Gavrilis 1987), traditional economic impact assessments or EIA's make explicit the economic structure of a region. Not only are the specific sectors that form the economic base of a region identified, but also the degree of interdependence among those sectors is specified. The calculation of multipliers was added in the late 1960's to such analytical tools as input-output (I/O) analysis in order to estimate the effects of the economic changes brought about by existing or proposed industrial and natural resource developments. Multipliers are indices of the effects of such changes. Their role in an EIA is to represent the degree to which various sectors of an economy are linked to each other as well as the proportion of consumer spending that escapes from a region (i.e., leakage) as the amount spent recirculates among various sectors.

In Chapter 3 of this manual, the MI-REC model for estimating economic impacts of recreation is presented using three equations. These equations express the relationships between visitor use and spending by segment, "bridge" table proportions, final demand vectors, multipliers and total impacts. The third equation demonstrates the relationship among final demand, multipliers, and total impacts as:

\[ I = R \cdot FD_k \]  

where

- \( FD_k \) = a final demand vector of recreation spending changes
- \( R \) = a set of sector specific multipliers
- \( I \) = total impacts, expressed as changes in output, income, or employment resulting from the change in final demand.

In recreation or tourism economic impact analysis, multipliers are multiplied by final demand vectors to derive estimates of the changes in regional economic parameters (output, jobs, income, value added).

The challenge to interpreting the results of an EIA is that there are many different types of multipliers and they are often incorrectly applied. Furthermore, there is no such thing as one generic multiplier which will apply to all situations in all regions. Appendix E of the Micro-Implan Users’ Guide defines the types of multipliers generated by MI. Richardson (1985) discusses at least 14 different types of multipliers and their mathematical formulae and interpretations. Following is a summary of the major multiplier types and their appropriate uses in EIA.

RATIO vs. KEYNESIAN MULTIPLIERS

Multipliers vary according to the economic variables to which they apply (i.e., sales, income, employment, value added) and how they are defined (i.e., Type I, Type II, Type III, Keynesian-type). Type I, II, and III multipliers are called "ratio" multipliers since they are a ratio of either direct plus indirect divided by direct impacts (Type I) or direct plus indirect plus induced divided by direct effects (Types II and III). The reader is referred to Chapter 3 for definitions of direct, indirect, and induced impacts. Type III multipliers are similar to Type II multipliers but differ in the manner in which induced impacts are calculated. Types I, II and III multipliers have the same units in both the denominator and the numerator. Keynesian-type multipliers, however, may have different units in the numerator and denominator.
Various combinations of multipliers and types are possible. For example, it is possible to derive a Type I income multiplier, a Type III employment multiplier, a Type II value-added multiplier, or a Keynesian income multiplier.

Micro-Implan generates the direct, indirect, and induced amounts required to calculate Type I and Type III multipliers. Keynesian-type multipliers (also called "response coefficients" in previous IMPLAN publications) can be derived from the Micro-Implan output and an independent estimate of the total amount of new dollars spent in a region as a result of some action. When deciding how to interpret the results of an EIA, one must always decide what type of multiplier(s) to use and how to use it (them) correctly. If the wrong multiplier is used, the resulting economic impacts can be in error by millions of dollars in income and hundreds of jobs even for a relatively small region.

MICRO-IMPLAN MULTIPLIER REPORTS

MI generates a number of reports which contain various multipliers and their components as described above. Before a change in final demand is input into an MI analysis (i.e., before an "IMPACT" analysis in MI jargon), base year employment, income, and output multipliers are provided in Invert Reports # 602 through 606. Direct, indirect, induced, and total effects by sector and their resulting Type I and Type III multipliers are given for the region’s economy. The information in these reports yields a snapshot of the existing economy and the degree of intersectoral linkage among the various sectors before any policy or development changes occur. Invert Report # 601 is the complete Leontief inverse matrix (Type I multipliers) which indicates all the intersectoral transactions that take place in a region. For example, for each dollar of increase in final demand by industry A, the matrix shows how much additional output is created for industry A (itself) as well as for industries B, C, and so on that are related to the products produced by industry A.

After a change in final demand (FD_k in Equation 3, Chapter 3) is applied to a regional model, MI generates a set of impact reports from which a variety of ratio type multipliers may be calculated. Specifically, direct, indirect, and induced effects are provided on a sector-by-sector basis in Impact Reports # 903 through 906. Type I and Type III multipliers are not provided in these reports but may readily be calculated from the information given (e.g., divide direct + indirect + induced effects by direct effects to derive the Type III multiplier). Once the basic regional model is built, numerous policy alternatives can be subjected to multiplier analysis and different 903 through 906 reports generated for each alternative.

DERIVING KEYNESIAN MULTIPLIERS

To estimate the total economic effects of the injection of recreationist spending into a region, Keynesian-type multipliers (response coefficients in Micro-IMPLAN) are the appropriate types of multipliers to use for R in Equation (3). In general, Keynes' original formulation of the income multiplier was:

\[ K = \frac{\Delta Y}{\Delta J} \]

(4)

where, K is the multiplier;
\( \Delta Y \) is the change in income that arises from an additional economic stimulus, like tourism; and
\( \Delta J \) is the injection, or change in tourist spending that brought about the additional income.

Economists calculate Keynesian-type multipliers "by hand" or through the use of "input-output" models. The general formula for calculating multipliers by hand is:

\[ K = \frac{1}{A \times \frac{1}{1 - BC}} \]

(5)

where A = percentage of tourist spending remaining in the region after subtracting leakages; B = percentage of income spent by residents on locally produced goods and services; C = percentage of resident spending remaining as local income after subtracting leakages.

Thus, if 50 per cent of tourist spending (A) remains after leakages, and 60 per cent of resident income is spent locally (B), and 40 per cent remains as local income (C), the income multiplier is:
\[
K = \frac{1}{1 - 0.6 \times 0.4} = 0.65
\]

This means that for every dollar of tourist spending, 65 cents in local income is generated. In tourism, the amount of income generated is typically less than the amount tourists spend because of leakages. Thus, \( K \) is usually less than 1 for tourism unless the study region is very large and diverse.

This "hand calculation" formula for the income multiplier is algebraically equivalent to the equation for the income multiplier developed by Keynes in his 1936 "General Theory of Employment, Interest, and Money." Equation (5) for the income multiplier may look slightly different from \( \Delta Y / \Delta J \), but it is a Keynesian-type multiplier because it expresses the change in household income (or employment) as a proportion of the additional amount of tourist spending. The reader is referred to Baumol and Blinders (1985) and Pearce (1981) for the algebraic proof of this equivalency.

The multipliers derived from input-output models carry an added bonus: an examination of how different business sectors interact with one another in a given economy. To satisfy the demand for hotel lodging, for example, hotels must buy from other business sectors (e.g., laundry, food, beverage) in order to produce their product. Multipliers developed from input-output models show the degree of linkage between various sectors, like hotels, and the sectors upon which they rely (see MI Aggregation/ Lister Reports # 401 and 402). Multipliers also measure leakage (see MI Impact Reports 903 to 906). If a given economy lacks the sectors that supply laundry, food, and beverage to the hotel sector, then there is more leakage than from a region that contains hotel-related sectors. The size of the multipliers that can be derived from Reports 903 to 906 reflect leakage, or the proportion of new dollars injected into a region than remains in terms of direct, indirect, and induced effects.

MI does not generate Keynesian-type multipliers (response coefficients) directly, but they can be derived from MI reports by dividing direct plus indirect plus induced impacts (columns 3 through 7 in MI Impact Report # 906) by the total change in new dollars spent in a given region. These figures will be based upon 1990 dollars, the year upon which the current version of MI is built.

**MULTIPLIER INTERPRETATION ERRORS**

A common mistake is to confuse sales and income multipliers. Sales multipliers are also called "output" multipliers in Micro-Implan documentation. Whatever they are called, the essential principle is that output multipliers alone are virtually useless as recreation planning tools unless they are translated into income and employment effects (Archer 1984).

Output multipliers tend to be quite large (range of 1.5 to 3.0 for counties in the U.S.) as compared to income multipliers (range of 0.20 to 0.80), so they tend to be attractive as political weapons used to justify additional development. However, high sales multipliers give false impressions of the true impacts of recreation spending because sectors showing the greatest increases in recreation sales are not necessarily those where the highest income and employment effects are generated. To determine impacts, it is more informative to estimate how much of those sales leak away from the community at each round of spending and which sectors generate the most income and jobs per dollar of recreation spending. It is misleading to multiply total recreation expenditures \( S_j \) in Equation 1) by an output multiplier and refer to the product as a positive economic impact of recreation.

Another common mistake is to use a ratio multiplier for \( R \) in Equation (3). A Type II or III ratio multiplier is the sum of direct plus indirect plus induced effects divided by direct effects:

\[
M = \frac{\text{direct} + \text{indirect} + \text{induced}}{\text{direct}}
\]  

(6)

Ratio multipliers therefore divide sales by sales, income by income, or employment by employment. The units in the numerator and denominator are the same. In contrast, the Keynesian-type multiplier divides income (or other economic parameters) by sales. It is essential to understand the difference because MI generates only the information necessary for computing ratio multipliers.
Ratio multipliers should be used as indicators of a region's economic self-sufficiency. To illustrate, assume that community A has a ratio output multiplier for tourism of 2.5, whereas the equivalent multiplier for community B is 1.5. This means that one tourist dollar spent in community A generates an additional 2.5 dollars in sales in various rounds of respending. The same dollar would generate an additional 1.5 dollars in sales in community B. Thus, in terms of tourism, community A is more self-sufficient than community B. That is, community A likely has more of the businesses closely linked to the production of tourism goods and services than community B. The same principle applies at the sectoral level. For example, given Region A with a Type I output multiplier of 2.0 in the "boat building and repair" sector and region B with a Type I output multiplier of 3.0 in the same sector, it is appropriate to conclude that the boat sector in Region A is not as economically intertwined with supporting sectors as it is in Region B. Thus, leakage of the initial dollars spent by tourists on boats and boat repair will occur at a faster rate in Region A than in Region B. In both examples, the output multiplier does not tell how much of revenue escapes from each economic sector during each round of respending. Furthermore, it is mathematically and theoretically incorrect to multiply tourist expenditures by a ratio multiplier as a measure of total economic impact.

REFERENCES


