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# APPENDIX C: ECONOMIC IMPACTS

## ECONOMIC IMPACT MODEL METHODOLOGY

### HISTORY

The theory behind input-output modeling stretches as far back as the mid 17th century, when Sir William Petty described the interconnectedness of “production, distribution, and wealth disposal.” While Petty can be credited with noticing links between economies, input-output modeling did not begin to take true form until the mid 18th century, when French physician François Quesnay created the *Tableau Économique*. His work detailed how a landowner spends his earnings on goods from farms and merchants, who in turn spend their money on a host of goods and services. Over the course of the century, an algebraic framework was added by Achille-Nicholas Isnard. Robert Torrens and Léon Walras refined the model by establishing the connections between profits and production.

The modern input-output system can be attributed to Wassily Leontief. In his thesis, “The Economy as a Circular Flow” (1928), he outlined the economy as an integrated system of linear equations relating inputs and outputs. This framework soon gained popularity, and became a widely accepted analytical tool. In 1936, Leontief produced the first input-output analysis of the US. Leontief’s work became the US Department of Commerce’s Bureau of Economic Analysis’s (BEA) standard benchmark for US production in the 1950s. Leontief received a Nobel Prize for his work in 1973.

By the 1970’s, the BEA had developed regional multipliers that could benchmark regional production throughout the US. Through extensive surveying, the impacts of each industry could be determined at the individual county level. These multipliers later became known as the Regional Input-Output Modeling System, RIMS. These multipliers would later be improved in the 1980s and reclassified as RIMS II multipliers. This new system soon became a trusted standard in economic impact studies. The updated RIMS

II multipliers show the effect on the local economy that localized expenditures have in terms of employment, output, and earnings.

#### APPLICATION

The use and application of multipliers are fairly basic and intuitive. Multipliers, in their most basic form, are the result of an algebraic analysis expressing how two inputs are interconnected in the production of an output. The result of the equation generates a multiplier that is broken down into direct, indirect, and induced effects. In a generalized example: if the multiplier for good "X" to good "Y" is 3, then the direct of good "X" on "Y" is 1, with indirect and induced effects of 2. Essentially, every unit of good "X" supports 2 units of good "Y".

When implemented on a large complex scale, such as that of the US economy or any subsection of it, multiplier effects across industries can be complicated. However, the same general concept comes into play. Each industry has largely different and varied inputs into other industries. The quantity of the output is largely decided by the scale and efficiency of the industries involved. As a result, the sum of those inputs equates to an output product plus a value added/ component. By arranging these inputs and outputs by industry in a matrix, and performing some algebra to find the Leontief inverse matrix, each industry's effect on final demand can be estimated. Additionally, the

direct, indirect, and induced effects can also be determined. Direct effects include direct purchases for production, indirect effects include expenses during production, and induced effects concern the expenditures of employees directly involved with production. Using building construction as an example, the direct effects would include materials, brick, steel, and mortar, the indirect effects would involve the steel fabrication, concrete mixing, and the induced effects would consider the construction workers purchases from their wages. While impacts vary in size, each industry has rippling effects throughout the economy. By using an input-output model, these effects can be more accurately quantified and explained.

RIMS II is one of several popular choices for regional input-output modeling. Each system has its own nuances in establishing proper location coefficients. RIMS II uses a location quotient to determine its regional purchase coefficient (RPC). This represents the proportion of demand for a good that is filled locally; this assessment helps determine the multiplier for the localized region. RIMS II takes the multipliers and divides them into over 500 industry categories in accordance to the North American Industrial Classification System (NAICS) codes. A comprehensive breakdown of a region's multipliers by industry can be shown.

Despite the usefulness of input-output modeling, there are some shortcomings to the system. Notably, input-output models ignore economies of scale. Input-output models assume that costs and inputs remain proportionate through different levels of production. Further, multipliers are not generally updated on a timely basis; most multipliers are prone to be outdated with the current economy. If the multipliers are sourced from a year of a recession economy, the multipliers may not accurately represent the flows from an economic boom period. Additionally, the multipliers may not capture sudden legal or technological changes which may improve or decrease efficiency in the production process. Regardless, I-O models still serve as the standard in the estimation of local and regional impacts.

#### ECONOMIC IMPACT MODEL

The methodology and input-output model used in this economic impact analysis are considered standard for estimating such expenditure impacts, and the results are typically recognized as reasonable and plausible effects, based on the assumptions (including data) used to generate the impacts. In general, one can say that any economic activity can be described in terms of the total output generated from every dollar of direct expenditures. If an industry in a given region sells \$1 million of its goods, there is a direct infusion of \$1 million into the region. These are referred to as direct expenditures.

However, the economic impact on the region does not stop with that initial direct expenditure. Regional suppliers to that industry have also been called upon to increase their production to meet the needs of the industry to produce the \$1 million in goods sold. Further, suppliers of these same suppliers must also increase production to meet their increased needs as well. These are referred to as indirect expenditures. In addition, these direct and indirect expenditures require workers, and these workers must be paid for their labor. These wages and salaries will, in turn, be spent in part on goods and services produced locally, engendering another round of impacts. These are referred to as induced expenditures.

Direct expenditures are fed into a model constructed by Econsult Corporation and based on RIMS II data. The model then produces a calculation of the total expenditure effect on the regional economy. This total effect includes the initial direct expenditure effect, as well as the ripple effects described, the indirect and induced expenditure effects.

Part of the total expenditure effect is actually the increase in total wages and salaries (usually referred to as earnings), which the model can separate from the expenditure estimates. Direct payroll estimates are fed into the “household” industry of the input-output model. Impacts of this industry are estimated using the personal consumption

expenditure breakdown of the national input-output table and are adjusted to account for regional consumption spending and leakages from personal taxes and savings. The direct, indirect, and induced earnings represent a component of the total economic impact attributable to wages and salaries. Finally, the model calculates the total expenditures affecting the various industries and translates this estimate into an estimate of the total labor (or jobs) required to produce this output.

In short, the input-output model estimates the total economic activity in a region that can be attributed to the direct demand for the goods or services of various industries. This type of approach is used to estimate the total economic activity attributable to the expenditures associated with various types of spending in the region (see Table C.1 and Figure C.1).



## FISCAL IMPACT MODEL THEORY

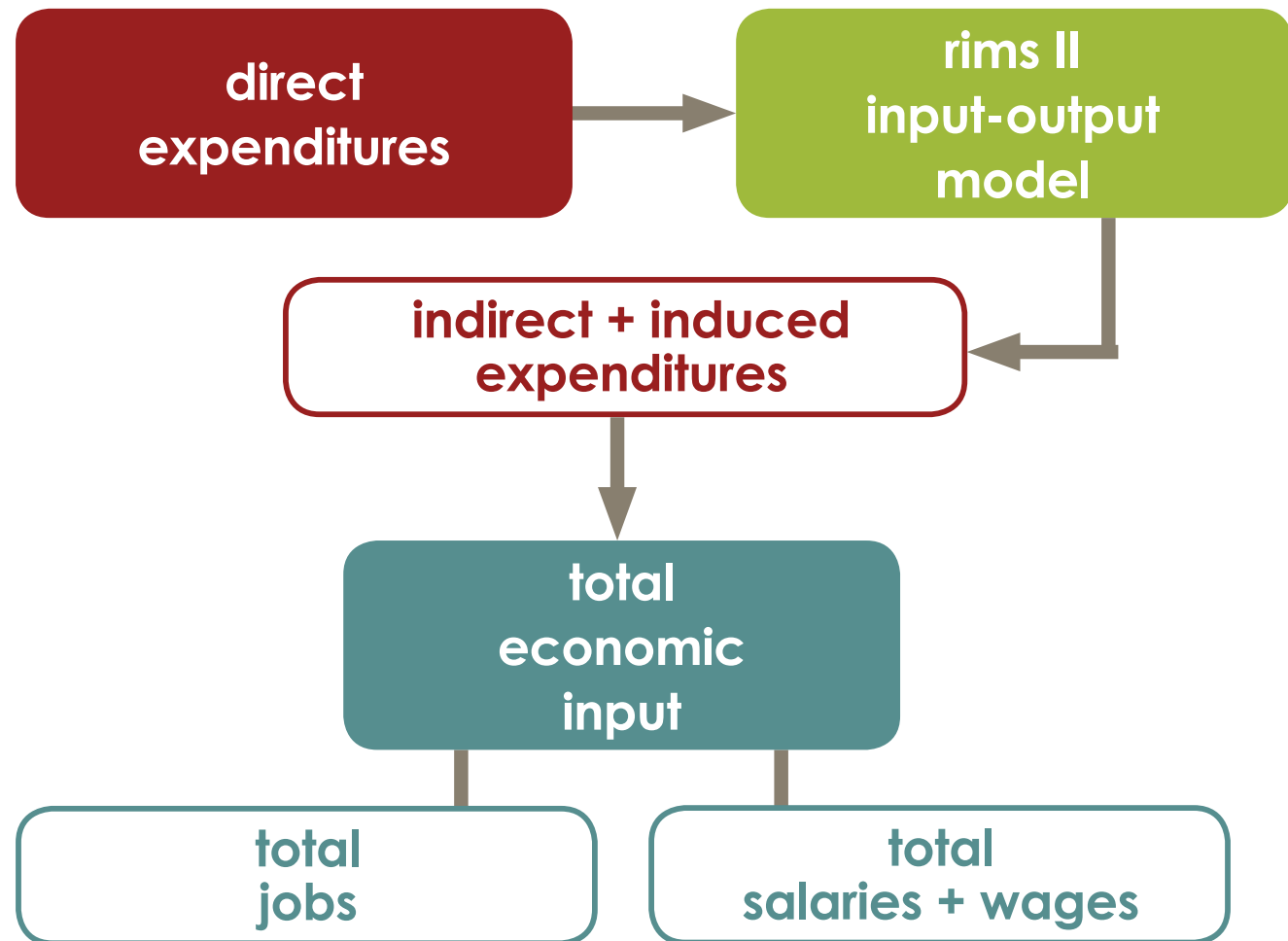
The RIMS II model provides estimates of the economic impact of a new project or program on the regional economy. It does not, however, estimate the fiscal impact of the increased economic activity on state and local governments. Econsult has constructed a model that takes the output from the RIMS II model and generates detailed estimates of the increases in state and local tax collections that arise from the new project. Those revenues are in fact a part of the total economic impact of a new project that is often ignored in conventional economic impact analyses.

The RIMS II model provides estimates of direct, indirect, and induced expenditures, earnings, and employment within the defined region. The Econsult fiscal impact model combines the RIMS II output with the relevant tax types and tax bases associated with the jurisdiction or jurisdictions for which fiscal impact is being modeled. Specifically, the estimated earnings supported by the direct, indirect, and induced expenditures generated by the model are used to apportion the net increase in the relevant tax bases and therefore in those tax revenue categories. The resulting estimates represent the projected tax revenue gains to the jurisdiction or jurisdictions as a result of the increased business activity and its attendant indirect and induced effects.

## SOURCES

- Miller, Ronald E., and Peter D. Blair. *Input-output Analysis Foundations and Extensions*. Cambridge, UK: Cambridge UP, 2009. Print.
- Bess, Rebecca & Ambargis Zoë. "Input-Output models for Impact Analysis: Suggestions for Practitioners Using RIMS II Multipliers" Conference Proceeding, Southern Regional Science Association Conference March 2011
- Lahr, Michael. "Input-Output Analysis: Technical Description and Application." Rutgers University Edward J. Bloustein School of Planning and Public Policy, 2010.

FIGURE C.1 – FLOWCHART OF INPUT-OUTPUT METHODOLOGY FOR ESTIMATING ECONOMIC IMPACT



Source: Econsult Corporation (2012)

TABLE C.1 – GLOSSARY OF TERMS FOR INPUT-OUTPUT MODELS

- **Multiplier Effect** – the notion that initial outlays have a ripple effect on a local economy, to the extent that direct expenditures lead to indirect and induced expenditures.
- **Economic Impacts** – total expenditures, employment, and earnings generated.
- **Fiscal Impacts** – local and/or state tax revenues generated.
- **Direct Expenditures** – initial outlays usually associated with the project or activity being modeled; examples: one-time upfront construction and related expenditures associated with a new or renovated facility, annual expenditures associated with ongoing facility maintenance and/or operating activity.
- **Direct Employment** – the full time equivalent jobs associated with the direct expenditures.
- **Direct Earnings** – the salaries and wages earned by employees and contractors as part of the direct expenditures.
- **Indirect Expenditures** – indirect and induced outlays resulting from the direct expenditures; examples: vendors increasing production to meet new demand associated with the direct expenditures, workers spending direct earnings on various purchases within the local economy.
- **Indirect Employment** – the full time equivalent jobs associated with the indirect expenditures.
- **Indirect Earnings** – the salaries and wages earned by employees and contractors as part of the indirect expenditures.
- **Total Expenditures** – the sum total of direct expenditures and indirect expenditures.
- **Total Employment** – the sum total of direct employment and indirect employment.
- **Total Earnings** – the sum total of direct earnings and indirect earnings.