Input-Output Models and Economic Impact Analysis:

What they can and cannot tell us

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What economic impacts does a new business have in a region when it first opens its doors?

What happens to business creation, or job growth, when income taxes are increased or tax credits are provided to businesses?

How much does traffic decline on highways and roads when the price of gasoline increases?

These questions have at least one thing in common, they can each be examined in detail through a process known as economic impact analysis.

At a basic level, economic impact analysis examines the economic effects that a business, project, governmental policy, or economic event has on the economy of a geographic area. At a more detailed level, economic impact models work by modeling two economies; one economy where the economic event being examined occurred and a separate economy where the economic event did not occur. By comparing the two modeled economies, it is possible to generate estimates of the total impact the project, businesses, or policy had on an area's economic output, earnings, and employment. At the center of most regional and state level economic impact analysis is an estimation method known as an input-output model. This article examines input-output modeling in more detail to provide a general description of economic impact concepts, to provide an example of an economic impact model and to discuss some of the limits of these types of models.

Input-output models are designed to examine all of the industries in a local economy and estimate all of the ways that spending in one sector influences each of the other sectors in the area's economy. For example, what happens when an automobile manufacturer increases the number of cars it produces each month? To increase production, the car manufacturer will need to hire more workers, which directly increases total employment in the area. However, the car manufacturer will also need to purchase more aluminum, steel, and other goods that are used in the manufacturing process. As the automobile manufacturer purchases more steel and other inputs, the manufacturers of the goods, such as steel producers, respond to the increase in demand by hiring more workers and purchasing more of their own inputs. Overall, the increase in automobile production results in a direct increase in total employment caused by the car manufacturer, as well as indirect increases in total employment caused by the steel producers.

Input-output models generate their estimates by examining three types of economic effects. The first effect is the direct impact of the spending or economic event. When a new business enters a city, it may employ 100 workers and sell $1

million in goods and services each year, which is the direct effect the business has on the local community. The business also has another effect on the community, called the indirect effect. In input-output modeling the indirect effect is the impact the new business has on other local industries when it purchases goods and services for the operations of the business. In addition to the indirect effect, the new business or project also creates an induced effect within the regional economy. The induced effect is the result of the new employees and business proprietors spending the new income they are now receiving from the new business within the community. In the end, input-output models estimate the total economic impact new spending has on a local economy by combining the direct, indirect and induced economic effects. To get a better understanding of how each of these effects interact, and how input-output model results are represented, it is useful to examine the results of an actual input-output analysis.

Input-Output Model Example

In 2009, the U.S. federal government passed, and began implementing, the American Recovery and Reinvestment Act (ARRA). For Montana, approximately $7.5 million dollars was allocated to forest restoration projects that were designed to accelerate the recovery of Montana's forest ecosystems to their original health, integrity, and sustainability. In total, the $7.5 million dollars were allocated to seven separate forest restoration projects within the state. According to the organizations that received the ARRA forest restoration funding, the $7.5 million dollars resulted in slightly more than 75 full-time equivalent positions[1] in Montana over the entire course of the seven projects.

While the employment estimates given by the ARRA funded organizations provide estimates of the direct economic impact of each forest restoration program, they do not provide any information on the indirect and induced effects of each program. In order to estimate the total employment and economic impact of the forest restoration funds, an economic impact analysis is needed. To estimate the indirect and induced effects of Montana's forest restoration programs, an input-output model was created by the Montana Department of Labor and Industry using the IMpacts for PLANning (IMPLAN) software.

As the IMPLAN program does not have pre-developed models prepared for forest restoration projects, a forest restoration input-output model was developed using one of the ARRA funded forest restoration projects as a template. For the model, each business involved with the forest restoration project was examined to determine their North American Industry Classification System (NAICS) code, the amount of funding they received, and the location of the business. In addition, custom employment estimates were provided by the businesses and were included in the model to provide more accurate employment estimates. An industry spending breakdown of the forest restoration project can be seen in Figure 1.

Based on the forest restoration model developed by the Montana Department of Labor and Industry, approximately 9.2 full-time equivalent positions are created by the businesses directly providing forest restoration services for each $1 million dollars that are spent for forest restoration projects (Figure 2). The businesses that sold the tools and equipment to the forest restoration businesses also hired new workers to meet the new demand for their products, resulting in an increase in indirect employment. At the same time, some of the additional income earned by the forest restoration and indirect workers were spent within the forest restoration area, resulting in induced employment increases. When combined, the increased forest restoration spending resulted in an estimated 10.4 indirect and induced full-time equivalent positions. In total, an increase of $1 million in forest restoration spending will increase employment by approximately 19.5 full-time equivalent positions. Based on the $7.5 million dollars that were allocated, Montana's input-output model estimates that approximately 146 full-time equivalent positions were created in Montana from ARRA's forest restoration grants.

[1]Full-time equivalent employment is defined as the total hours worked divided by the average annual hours worked in full-time jobs.

Figure 1: Industry Breakdown of Forest Restoration Project

Industry	NAICS	Industry Sales	Direct Employment Estimate
Services to buildings and dwellings	561730	$115,098	0.1
Commercial logging	113310	$93,499	0.1
Commercial logging	113310	$271,896	1.5
Commercial logging	113310	$359,143	6.7
Forestry, forest products, and timber tract production	113210	$31,500	0
Forestry, forest products, and timber tract production	113210	$55,000	0

Source: Montana Department of Labor and Industry

In addition to employment increases, Montana's forest restoration input-output model estimates that each $1 million in forest restoration funding will generate approximately $2.33 million in total economic activity. The initial $1 million of direct spending generates $200,000 in direct income increases for forest restoration workers and slightly more than $370,000 in indirect and induced labor income. The $1 million in funding for forest restoration programs was also expected to generate nearly $100,000 in federal tax revenue and nearly $70,000 in state and local tax revenue. With a total of $7.5 million allocated, the total change in economic activity caused by Montana's ARRA funded forest restoration projects was an estimated $17.5 million dollars.

Finally, while the input-output results generated within IMPLAN indicates that the ARRA forest restoration spending may have had some measureable economic impacts; the estimates do not include any of the additional non-economic benefits that the forest restoration projects provide. Many forest restoration projects are designed to provide improved forest health and improvements in biodiversity. Not only do the improvements in forest health and biodiversity provide direct benefits, but they will also provide additional indirect benefits, including increased tourism, recreational opportunities and potential improvements in animal health that are not measured in the input-output model.

Limitations of Input-Output Models and their Results

Input-output models, and economic impact analysis in general, are useful tools to estimate the effects new policy proposals, or changes in spending, will have within an area. However, input-output models are based on a strict set of assumptions

Figure 2: Economic Impacts of $1 Million in Forest Restoration Spending in Montana

Full-Time Equivalent Positions	
Direct Employment	9.2
Indirect and Induced Employment	10.4
Total Employment	19.5
Economic Activity (Thousands of Dollars)	
Total Economic Activity	$2,330
Direct Labor Income	$201
Indirect and Induced Labor Income	$374
Federal Tax Revenue	$99.2
State and Local Tax Revenue	$68.3

Source: Montana Department of Labor and Industry

that need to hold for the results to be valid. One key assumption in input-output models is that the new spending patterns are the same as the spending patterns made in the past. For example, if current automobile manufacturers needed one ton of steel to produce one new car, the input-output model assumes that a new automobile manufacturer will also require one ton of steel to produce each new car. For most industries, the past relationship assumption is reasonable, as production methods generally do not change significantly from one year to the next. However, the past relationship assumption also means that input-output models will not perform well in sectors of the economy that are experiencing rapid and significant changes, such as new and emerging industries, or for businesses that implement new production methods.

Another weakness of many input-output models is their assumption that there are an infinite amount of inputs that are available without prices having to increase. For example, if current automobile manufacturers in a city are employing 100 workers at $15 an hour, input-output models assume that a new automobile manufacturing plant could be opened in the town and could employ as many workers as the new plant requires at the same $15 dollars an hour. As large increases in demand for goods and services are likely to lead to measurable price increases, input-output model estimates are not suited for estimating the impacts of large changes in an area's economy. In addition, input-output model estimates will also provide less accurate estimates in sectors of the economy where businesses will be unable to hire a small number of new workers, or other inputs, without having an impact on prices, such as workers in Montana's health care sector.

Finally, a lot of economic impact analyses that use input-output models assume that the increased spending being modeled comes from outside the area the impact analysis examines, resulting in an increase in total spending. For example, an input-output model may estimate that the construction of a sports stadium would create 100 jobs in the economy of the city during the construction process. However, if the money used to construct the sports stadium also came from within the city, either by a new tax, donations, or other funding methods, the total spending and employment in the city may not change at all, as spending in other parts of the city's economy will decrease to pay for the stadium. For the ARRA-funded forest restoration projects, the outside funding assumption was appropriate, as most of the funding for the project came from sources outside of Montana. However, if the funding for the forest restoration projects came from within Montana, the economic impact estimates provided by an input-output model would overestimate the economic effects of the projects if the model only examined the increased restoration spending, but none of the other spending that did not occur because of the projects.

Conclusion

Many people would like to know how a new project or business will impact their local economy. Economic impact analyses are one way of estimating the effects various economic events and changes will have on an area's economy, and are used for this purpose by many people, and organizations, all across the world. The most common economic impact analysis method that is used at the regional and state level is input-output models. When used correctly, input-output models allow local communities, businesses, and governments to estimate the effect various economic changes will have on an area or community. Like all tools, input-output models can be misused and can create meaningless estimates when the assumptions underlying the input-output process do not hold. This article has provided the information necessary to have a general understanding of where input-output models come from, what their results mean, as well as the basic tools necessary to determine if the results are valid and meaningful.