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The British Columbia Input Output Model

What is an Input Output Model?

An input output (IO) model is a way of understanding and estimating how economic changes in one industry can affect other industries. For example, changes in lumber sales will have immediate (direct) effects on the sawmill industry, but also less immediate (indirect) effects on the logging industry, the transportation industry, and any other industries which provide inputs to the sawmill industry. British Columbia has had an IO model since the mid-seventies – the current model is based on 1996 industrial data collected by Statistics Canada and provided to BC Stats under formal data sharing agreements.

The model database is comprised of information for 243 industries and 679 commodities and consists of three arrays. The USE array specifies the inputs to each industry (what it buys) expressed in dollar values for the 679 commodities. For example, various grains, hay and straw are inputs to the Livestock Farms industry, but so also are electric power and accounting services. Wages and salaries paid directly to labour is a significant input to virtually every industry. The MAKE array specifies the outputs of each industry (what it makes), also expressed in dollar values for the 679 commodities. Examples here would include the coal made by coal mines, the fish products made by the fish products industry, and the meals made by the food and beverage services industry. The FINAL DEMAND array specifies the values of the 679 commodities taken out of the economy by "final users". Final users include export

markets, BC residents, and capital expenditures by business and government. The FINAL DEMAND array also has information on the total value of imports for each of the 679 commodities.

An IO model is called that because it looks at the economy in terms of inputs and outputs and, in fact, requires that for each industry

Inputs = Outputs

(or, in more familiar terms,

Expenditures = Revenues

where the former includes profits, or return on investment). Moreover, for each of the 679 commodities,

BC Production + Imports = Total Use + Final Demand

What's it Good For?

The simplest application of the provincial IO model is to estimate the economic impacts of a change in the final demand for some commodity produced by the economy. For example, suppose that there is an increase in exports of paint. Each of the industries that make paint will increase production accordingly. To do this, they will each purchase more of the inputs they require. Industries which make those inputs will increase production accordingly. To do so they will need to buy more of their inputs. And so on. The model does all of these calculations in the blink of an eye and provides estimates of the increased outputs

for each industry affected by the change. What's more, it is able to provide estimates of the changes in GDP, employment, and taxes paid for each affected industry.

In the same way, the model can estimate the impacts on the economy of entire sets of commodity demand changes. An example of this might occur with an increase in tourist spending. Tourists typically spend money on accommodation, food services, transportation, recreation and souvenirs. The start-up of a new industry might also require analysis of the changes in demand for a variety of goods and services simultaneously.

The BC IO model has been used to estimate impacts associated with research facilities, industrial operations, convention centres and land use planning discussions. Access to the services of the BC IO model is available to the public, the consulting community and other government departments on a cost-recovery basis. Typical charges can be anywhere from $1,000 to $15,000 depending on the number of model runs and the amount of supporting analysis required. Anyone wishing further information about this service should contact Garry Horne at 387-0364.

Open and Closed Models

The type of model described previously is an "open" model in the sense that there is no feedback from any of the end users to generate new demand. (As noted earlier, the final users are export markets, capital expenditures by business and government, and BC residents.) But when there is increased demand (say, from increased export sales), the resulting increased production means that BC residents will earn more and be able to spend more, and domestically produced goods and services will also experience increased demands. The simplest closed version of the IO model

takes this feedback into account and estimates what we call "induced impacts" resulting from the increased spending by BC residents.

What produces the induced impacts is the change in personal incomes which result from the project in question. But that change clearly depends on what the situation was before. It may be that the new income flows entirely to individuals who had no previous income; alternatively, the income changes may just mean that individuals who previously were living on employment insurance or other forms of income assistance will now be paid because of the new jobs. We refer to these two cases as the no-safety-net (NSN) and safety-net (SN) cases respectively, and typically estimate the induced impacts under both extreme assumptions. The actual situation will always be somewhere between these two extremes.

But all I really Want is a Multiplier…

Standard economic multipliers are defined as the ratio of the total economic impacts associated with a given project or policy to the direct expenditure. The IO model is not full of multipliers. What generally happens is that we run the model to answer a particular impact question. If you then take the answer and divide it by the question, the result will be a "multiplier" appropriate for that particular situation. When the same question gets asked for a similar situation, a simpler (and therefore, cheaper) alternative may be to apply the multiplier rather than rerun the model

To allow for these simpler, cheaper, do-it-yourself analyses BC Stats is preparing an update to the publication *Provincial Economic Multipliers and How to Use Them*. While not appropriate for use in all situations, the multipliers in this publication should permit the accurate estimation of

provincial impacts in many common situations. This publication should be available by the end of April.

The table below provides a few employment multipliers extracted from the publication. The figures in the table are the number of person-years of employment resulting from $1 Million of revenue in the specified industry. As noted earlier, the induced impacts depend on the change in personal incomes which result from the direct effects. SN stands for Safety Net, and means that the alternative against which these impacts are measured is that provided by employment insurance payments or other income assistance.

Selected BC Employment Multipliers			
	Direct	Indirect	Induced SN
Mining	3.2	2.6	1.3
Construction	9.4	4.3	1.6
Manufacturing	5.3	4.0	1.2
Retail Trade	20.3	3.4	2.0
Business Services	13.8	3.8	2.1

The estimates for Retail Trade should be treated with caution. If the retail trade margin is 10% then it takes $10 Million in retail sales to produce $1 Million of revenue for the Retail Trade industry.

IO and Contributions to the Economy

There are many ways to look at the economy and at the contributions that various industries make to it. The most straight-forward of these is based on some standard industry classification scheme ("SIC" or "NAICS"[*]) and assigns GDP or employment or some other measure of activity to each identified industry. (See the February 2001 issue of Business Indicators for an excellent introduction to BC's economy from this perspective.)

The IO model provides an alternative way to look at and understand those contributions. From this perspective the final demands are what drives the economy. Intermediate demands depend on the final demands and the input output allocation procedure assigns the activities that meet intermediate demands to the industry which satisfies the final demand. Thus, for example, the export of lumber leads to an intermediate demand for raw logs so the part of the logging industry that meets that demand is assigned to the sawmill industry. In the context of this example, the sawmill activity that exports its products is called a "final demand impact" and the logging activity which provides raw materials to the sawmill is an "indirect impact".

This way of looking at the economy is not necessarily better than the simpler alternative, but it may be more useful from a policy perspective because it takes into account the linkages between industries that exist in the economy and does not regard each industry as a separate completely independent entity.

A forthcoming BCBI article will look at the BC economy from an input output perspective.

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[*] For many years Statistics Canada has promoted the use of SIC (Standard Industrial Classification), but there is now a transition underway to a more modern classification scheme called NAICS (North American Industrial Classification System).