On The Use and Misuse of Input-Output Based Impact Analysis in Evaluation

Grady, Patrick and Muller, R. Andrew

Global Economics Ltd., Department of Economics, McMaster University

12 May 1986

ON THE USE AND MISUSE OF INPUT-OUTPUT BASED IMPACT ANALYSIS IN EVALUATION

by

Patrick Grady

and

R. Andrew Muller

May 12, 1986

Table of Contents

1 INTRODUCTION

Estimates of the output and employment impacts are often an important part of many program and project evaluations. The analytical framework frequently used to prepare these estimates is the family of input-output models developed and maintained by Statistics Canada. The output and employment multipliers derived from input-output models are used to translate the direct impact of a program into its total impact. The total impact estimated using the "closed" version of the input-output model includes the output and employment generated by subsequent rounds of spending of the income created by the initial program expenditure. It thus reflects the traditional Keynesian multiplier taught in all the introductory economic textbooks.

Frequently, the output and employment impacts of a program are treated as though they were "benefits" of the program or project. They may be explicitly tabulated as benefits. Alternatively they may be implicitly treated as such by bearing labels like "jobs created" or by being compared to the costs of the program.

In this paper, we argue that such estimated output and employment impacts in program or project evaluation are often used inappropriately. There are two reasons why this occurs. First, many evaluators are not aware that the multipliers they use make very strong and often untenable assumptions about macroeconomic impacts. The best evidence that is currently available suggests that multipliers derived from input-output models overestimate the impact of changes in government expenditures by ignoring the critical macroeconomic feedbacks that tend to reduce the multiplier over time. This dramatizes the need to separate the analyses of the microeconomic and macroeconomic impacts of programs and projects. Second, many evaluators have an inadequate understanding of the principles of cost-benefit analysis. They thus tend to confuse the output and employment impacts of a program with its benefits. This is a tendency that has been exacerbated by the emphasis in the current guidebooks on program evaluation on procedure to the virtual exclusion of any discussion of the principles of cost-benefit analysis.[1]

Section 2 of the paper offers two examples of the misuse of output and employment impacts estimated using input-output techniques. Section 3 the paper briefly describes the methodology of input-output models and

discusses some of their limitations. It also presents estimates of the multipliers derived from them. Section 4 provides the details of our criticism of the use of input-output multipliers from a macroeconomic point of view. The main macroeconomic feedbacks that tend to dampen the reponse of the economy to government spending shocks are outlined and estimates of multipliers from the main Canadian macroeconomic models are presented. Section 5 reviews the connection between economic impact analysis and cost-benefit analysis. It emphasises a number of reasons why employment impacts cannot uncritically be considered benefits of a program or a project. Section 6 gives our conclusions.

2 EXAMPLES OF THE MISUSE OF IMPACT ANALYSIS

As recent examples of the pervasive misuse of economic impact analysis we consider a provincial position paper on housing policy and a published evaluation of benefits from irrigation expenditures in Alberta. These two provincial examples were chosen because they have been published. Federal examples can be found in some of the unpublished program and project evaluations done in federal government

departments. Most readers will thus recognize the phenomenon from their own experience.

In a position paper issued last December, the Ontario government a number of initiatives to stimulate the construction of new housing.[2] These included interest-free loans to private rental developers, changes to the rent review system, increased social housing and a strategy to stimulate the building industry. A table in the document "provides an overall picture of the estimated impact of the programs". In aggregate a provincial expenditure of $480 million was expected to induce $5.2 billion of construction expenditures and to "create" almost 200,000 job-years of employment. Footnotes indicated that a multiplier of 2.2 person years was used throughout the calculation. The table leaves the clear impression that the programs can create employment at a cost to the government of $2410 per job-year.

As a second example, Kulshreshtha et.al.[3] report on a study conducted for the Alberta Irrigation Projects Association. Here the goal was explicitly to identify the major beneficiaries of irrigation activity. Input-output calculations showed that capital expenditures of about $348 million over the period 1985-89 would generate "economic

benefits" of $415 million per year. Only 15 per cent of these benefits would be received by water users. The remainder would be distributed throughout the economies of Alberta and the rest of Canada. Taken at face value, these results imply an annual return on investment of about 119 per cent!

What is wrong with these analyses? Our contention is that they, and many like them, confuse economic impacts with economic benefits. Even when this confusion is resolved, they exaggerate the impacts of programs and projects by comparing them to the wrong benchmark and by using excessively high multipliers to compute induced effects. In the next two sections we review how the multipliers are derived and how they compare to those estimated from large macroeconomic models. We then return to the relationship between benefits and impacts.

3 INPUT-OUTPUT MODELS

Input-output models are designed to trace the impact of changes in final demand such as consumer expenditures,

investment and government spending on the structure of output and employment by industry, sector or province. Statistics Canada has developed a whole family of input-output models for Canada which can be used for various types of impact analysis.[4] These include inter-provincial, price and energy models as well as the basic output determination model.

An input-output model can be used to estimate the impact on output and employment by industry of government expenditures on particular programs or projects. For example, the impact on the economy of a construction project such as building a road could be estimated. The input-output model would show the direct impact of the initial spending on the project on the final demand category government expenditures on non-residential construction. The input-output model would then transform this spending into spending on intermediate material inputs such as concrete, steel rods, gravel and fuel and into spending on the primary inputs of labour, capital and indirect taxes. Spending on inputs would in turn be transformed into industry outputs producing estimates of the indirect impact of the initial increase in spending. Employment/output coefficients are used to transform industry output impacts into employment impacts. The end result would be an

estimate of the total (direct plus indirect) impact of the initial increase in spending on output and employment by industry. If the inter-provincial model were used, a regional dimension could be added to the estimates of output and employment by industry.

There are two versions of the output determination model. One is the "open" model in which all final demand categories including consumption are treated as exogenous. In this model the income generated in the process of production is not assumed to be respent. The second version is the "closed" model in which the income generated by the production process that accrues to the household sector is assumed to be either spent on goods and services or taxes or to be saved in accordance with average past proportions. These effects are called "induced." The "closed" model exhibits a traditional textbook Keynesian multiplier when subjected to exogenous expenditure shocks. The magnitude of the multiplier varies inversely with the magnitude of the leakages from the expenditure stream for non-wage income, taxes, savings, and imports.

The impact multipliers derived from the "open" and "closed" versions of the output determination model are quite different. For instance, when subjected to a shock of

a $1 million exogenous increase in spending on residential construction, the "closed" model yields a multiplier of 1.66 (the ratio of the the impact on GDP at market prices to the initial expenditure increase), whereas the "open" version of the model only yields a multiplier of .89 (the difference from unity reflecting import leakages).

There are some features of input-output models of which those concerned with evaluation should be aware. First, input-output models are static. There is no time dimension attached to their impact estimates, which represent equilibrium results. Second, the models are linear. This entails an assumption of proportionality between inputs and outputs, between total income and its components, and between employment and output. Such an assumption can be particularly inappppropriate in making estimates of short run employment multipliers. As a rule, employment responds much less than one-for-one with output increases due to the overhead character of some labour and to the occasional prevalence of a certain degree of labour hording. Third, input-output models do not incorporate macroeconomic feedbacks which tend to reduce the impact multipliers. This tendency is examined in more detail in the next section.

4 MULTIPLIERS FROM MACROECONOMIC MODELS

The multiplier results derived from a closed input-output system yield exaggerated estimates of the impact of program expenditures on the economy. This is the case because closed input-output models do not take into account the macroeconomic feedbacks that tend to cause the multiplier to decrease over time. The principal feedbacks for government spending programs are the same as for any other type of expenditures. Higher spending raises demand and hence output and employment. Increased capacity utilization and reduced unemployment puts upward pressure on prices and wages. Greater real output and a higher price level results in increased nominal income. This in turn causes interest rates to go up provided that money growth is fixed. Higher interest rates and prices serve to erode the initial demand stimulus, thus decreasing the multiplier.

The feedback effect of interest rates and the financial sector depend very much on the financing assumption made. The usual assumption is that the increase in government spending is debt financed. Monetary policy can be assumed to be either accomodating or non-accomodating. This means

that the money supply growth is either assumed to be unchanged or allowed to increase in response to the increased spending. If it is non-accomodating, debt financed increases in government expenditure will have a larger effect on interest rates. Alternatives to the debt financing assumption are that expenditure increases are financed by tax increases or reductions in other government spending. The implications of such alternative assumptions are vastly different. The only way to take them into account is at the level of overall fiscal policy fomulation. This can not be done at the level of the individual program or project.

A better appreciation of how these macroeconomic factors tend to decrease the value of the multiplier in the longer-run can be gained by considering the results of simulations with macroeconomic models. Table 1 presents the results of a $1 billion government expenditure shock for the main Canadian macroeconomic models that participated in a Bank of Canada - Department of Finance sponsored seminar held in Ottawa in July, 1982.[5] The models included are: QFS - the Quarterly Forecasting and Simulation Model of the Department of Finance; RDXF - the Research Department Experimental Forecasting Model of the Bank of Canada; the CHASE Econometric Model of Chase Econometrics; the DRI Model

of the Canadian Economy of Data Resources Canada; FOCUS - the Forecasting and User Simulation Model of the Institute for Policy Analysis, University of Toronto; TIM - the Informetrica Model of Informetrica Ltd.; CANDIDE 2.0 of the Economic Council of Canada; SAM - the Small Annual Model of the Research Department of the Bank of Canada; and MACE - the Macroeconomic and Energy Model of Professor John Helliwell of the University of British Columbia.

The noteworthy feature of these results is the extent to which the multiplier declines over time for almost all the models - the DRI model being the only exception. On average, by the fifth year, the multiplier was less than one and by the tenth year it was not very much greater than zero. Some of the models such as FOCUS, SAM and MACE even had negative multipliers. This suggests that in the medium term the indirect effects of government spending are negative and growing.

The conclusions to be drawn are that there is much uncertainty about the medium-to-long-run value of multipliers and that any estimate of the impact of government spending programs based on input-output multipliers which ignore macroeconomic feedbacks are likely to be greatly exaggerated. The indirect effects of

government spending programs are more likely to be negative than positive.

While not perhaps as much as might be expected, the model estimates of the multiplier depend on the degree of capacity utilization assumed for the economy. Consequently, it is necessary to consider the overall economic situation and total government expenditures and revenues in order to accurately gauge the impact of government spending on the economy. There is also the issue of the financing of the expenditure increase that can only be taken into account in the context of the overall formulation of fiscal policy.

Given the great uncertainty concerning the indirect effect of government spending programs and the importance of determining the setting of fiscal policy centrally, the most prudent course for those responsible for evaluating programs and projects would be to confine their estimates of the output and employment impacts to the direct impacts and to leave the question of the indirect impact to those responsible for stabilization policy.

5 ECONOMIC IMPACTS AND COST BENEFIT ANALYSIS

In this section we comment on the relationship between cost-benefit analysis and economic impact analysis and restate some long known but insufficiently heeded objections to the exaggeration of the employment and output gains through the use of multipliers and to the uncritical treatment of impacts as benefits. We do not attempt to replicate the excellent introductions to the theory and practice of cost-benefit analysis which can be found, for example, in the Treasury Board's Benefit-Cost Analysis Guide.[6]

The economic impact of a progam or activity is the change it induces in an economic indicator, such as GNP or employment. To calculate a change, one must compare the results of the program or project to what might reasonably be expected to occur in its absence. This is the benchmark or basis of comparison. In many evaluations, these impacts are implicitly or explicitly treated as "benefits" of the program. For example, the employment impacts of the Ontario

housing policies in the study mentioned above were reported under the heading "Jobs Created" and the Kulshreshtha study used the terms "impact" and "benefit" interchangeably.

One difference between cost-benefit analysis and economic impact analysis is that cost-benefit analysis places a much stricter interpretation on the term "benefit". The benefit of the program or project is the gain realized by undertaking it. In cost-benefit analysis, benefits are measured by what people are willing to pay for them. Similarly the negative impacts (costs) of a program or project are valued at what people are prepared to pay to avoid them. These definitions are consistent with the common sense proposition that a project is worth undertaking only if its benefits exceed its costs.

A second difference lies in the choice of benchmarks. Like economic impact analysis, cost-benefit analysis employs a benchmark for purposes of comparison. When using input-output analysis to assess impacts, the usual benchmark is a world in which the program or project does not exist and nothing takes its place. It is implicitly assumed that all the labour, capital and other resources used in activities affected by the program would have otherwise been idle. But the cost-benefit analyst must always explicitly

consider the alternative uses of the resources in question. Normally it is assumed that they could have found other employment at the same wage, but techniques exist to adjust for the presence of unemployment in special cases. The correct treatment of employment gains is considered in the literature on the social opportunity cost of labour.[7] Briefly, the net gain from the creation of a permanent job is estimated to range from zero to 25 per cent of the wage bill (depending on the rate of growth of the region), while the creation of temporary jobs may actually impose a cost of up to 30 to 50 per cent of the wage bill by increasing the pool of workers who experience regular bouts of temporary unemployment.

To illustrate these points, consider the impact of the Ontario housing policies. The estimate that 200,000 jobs would be created was made by multiplying by 2.2 the estimated number of housing starts associated with each policy. The multiplier of 2.2 jobs per housing start can be derived from input-output models by adding up all direct, indirect and induced effects. The benchmark being used, therefore, is an economy in which none of the housing starts occur and no other activity takes their place. But from the viewpoint of cost-benefit analysis, this is an unacceptable basis for comparison, because we know that in the absence of

the program other activities would have occurred. For example, the $480 million might have been spent on highway construction or returned to taxpayers by cutting taxes. Either alternative would create jobs and income and either alternative would have induced effects that could be estimated using a multiplier. The true impact of the housing program is the difference between the jobs and income created under it and those created under a reasonable alternative. (These "differential" impacts may be positive or negative). The benefits of the program, properly speaking, should be measured by how much we are willing to pay to achieve these differential impacts. Similarly, the Kulshreshtha study calculates the impact of continued irrigation by computing the direct, indirect and induced impact of the construction expenditures and the associated increase in crops. All of the increase in GDP is counted a benefit of the project. But a better benchmark would be the pattern of economic activity in Alberta and Canada if the resources used by the irrigation project were used elsewhere in the economy to generate higher outputs in other industries. The value of the output foregone elsewhere can be approximated by the payments formerly made to the labour and other resources now used in irrigation. The benefits of the irrigation project could then be measured by the

increased earnings of land, labour and capital employed in irrigation rather than in their best alternative uses.

These examples illustrate why the employment changes estimated using input-output analysis or multipliers should never be treated as benefits. More formally, employment changes ("impacts") cannot be treated as benefits for at least three reasons.

First, the employment created by a project or program will almost never increase net employment in the region by a corresponding amount, since the employees attracted to the project need not be replaced. Even less will the project reduce unemployment, because the increased demand for labour will cause the labour force to grow through migration and new entry. The creation of temporary jobs may even increase the pool of workers experiencing temporary unemployment.

Second, it is both difficult and unwise to use impact analysis to calculate the net increase in employment attributable to a program. To do so requires an explicit judgement on how public funds would be expended in its absence and how macroeconomic feedbacks would affect the final outcome. Even in the best of circumstances, this requires the knowledge and expertise of specialists in macroeconomics, taxation and fiscal policy. The Canadian

government, like most western governments, has been organized to reflect three goals of government expenditure and taxation: stabilization, allocative efficiency and income redistribution. [8] The Department of Finance and the Bank of Canada are responsible for advising the government on stabilization policy, including attempts to influence the level of output and employment and the rate of inflation. The Treasury Board and the program departments are responsible for advice on resource allocation and program delivery. Given this division of labour, it is inappropriate for program departments to evaluate their programs and projects from the point of view of stabilization policy. This is best left to the Department of Finance, where the expertise and information required to carry out the task is concentrated.

Finally, it is not always true that increased employment is an unambiguous good. This point is often expressed by saying that the unemployed and those not in the labour force value their leisure. By leisure is meant much more than idle time. For example, consider a policy which enables mothers to enter the labour force by providing subsidized day care. The mother incurs a cost both in lost time available for housework and shopping as well as for recreation and relaxation and in lost satisfaction from

caring for her children. This cost, together with the total cost of day care subsidy, may easily outweigh her earnings. Under these circumstances everyone would be better off if she were provided an income transfer sufficent to allow her to stay at home. In this case, increased employment is not synonymous with increased welfare.

If impact analysis cannot be used to estimate the benefits of a program, what can it be used for? An appropriate role is to identify regions and industries that will be particularly affected by a project or program. Input-output analysis is well suited to this purpose. Note, however, that it is the open model which is appropriate in this case. The induced effects measured by the closed model will be similar regardless of the program analysed. And even when the open model is used the analyst must be careful to note that the impacts are not net of offsetting changes induced by foregoing alternative programs. For that reason it should be unacceptable to use employment impacts to measure "job creation".

The preceding discussion indicates that economic impact analysis has many similarities with cost-benefit analysis. The difference is that cost-benefit analysis attempts to place a value on the economic impacts of a project as part

of a systematic evaluation of the benefits and costs of alternative actions. While many reservations have been expressed about the details of cost-benefit analysis and the practicality of reducing all costs and benefits to a common scale of dollars and cents, this should not excuse other analysts from committing fallacies which basic cost-benefit analysis helps to avoid.

6 CONCLUSIONS

Estimates of the output and employment impacts of government programs and projects prepared using the closed input-output model should not be used in evaluations. It is more important that the evaluators concentrate their efforts on producing the most reliable direct impact estimates and in applying the microeconomic allocative tool of cost-benefit analysis. The measurement of the indirect (macroeconomic) impacts of government spending can with a few exceptions be best carried out at a higher level of aggregation and can be best left to those specializing in stabilization policy.

This is not to suggest that the input-output model should be banned entirely from the evaluator's toolbox. There will still be many instances in which it will be an appropriate. These include the use of the open input-output model to provide estimates of the industrial or regional breakdown of the direct impact of a program or of the employment impacts of program spending. For these particular uses, estimates derived from the input-output model may be either the most reliable or most cost-effective estimates it is possible to obtain.

FOOTNOTES

---

1. Treasury Board of Canada, Comptroller General, Principles for the Evaluation of Programs by Federal Departments and Agencies, (Ottawa: Supply and Services Canada, 1981) and Guide on the Program Evaluation Function, (Ottawa: Supply and Services Canada, 1981).

2. Government of Ontario, Ministry of Housing, Assured Housing for Ontario: A Position Paper, December 1985.

3. Surendra N. Kulshreshtha, K. Dale Russell, Gordon Ayers, and Byron C. Palmer, "Economic Impacts of Irrigation Development in Alberta Upon the Provincial and Canadian Economy," Canadian Water Resources Journal, vol. 10, no.2 (1985), pp.1-10.

4. See Statistics Canada, Structural Analysis Division, Users' Guide to Statistics Canada's Structural Economic Models, February 1986.

5. Brian O'Reilly, Graydon Paulin and Philip Smith, "Responses of Various Econometric Models to Selected Policy Shocks," Technical Report 38, Bank of Canada, July 1983.

6. Treasury Board of Canada, Benefit Cost Analysis Guide (Ottawa: Department of Supply and Services, 1976).

7. See Employment and Immigration Canada, Task Force on Labour Market Development, Labour Market Developments in the 1980s, July 1981, Appendix A, pp. 211-219 and A.C. Harberger, "The Social Opportunity Cost of Labour: Problems of Concept and Measurement as Seen from a Canadian Perspective," a paper prepared for the Task Force on Labour Market Development.

8. See R.A. Musgrave, The Theory of Public Finance (New York: McGraw Hill, 1959).

TABLE 1

THE IMPACT OF A $1 BILLION INCREASE IN FEDERAL CURRENT NON-WAGE EXPENDITURES ESTIMATED USING CANADIAN MACRO-ECONOMETRIC MODELS

(Difference between shocked and control simulations)

	MODEL									
	QFS	RDXF	CHASE(1)	DRI	FOCUS	TIM(2)	CANDIDE 2.0	SAM	MACE	AVG.(3)
REAL GNE (%)										
YEAR 1	0.32	0.28	0.8	0.33	0.22	0.46	0.55	0.09	0.18	0.28
YEAR 3	0.38	0.14	0.4	0.27	0.24	0.43	0.60	0.07	0.05	0.25
YEAR 5	0.31	0.07	0.2	0.26	0.01	0.36	0.46	0.06	0.00	0.17
YEAR 10	0.14	0.01	0.0	0.24	-0.06	0.28	0.17	-0.10	-0.18	0.03
EMPLOYMENT (%)										
YEAR 1	0.18	na	0.6	0.16	0.15	0.19	0.28	0.00	0.06	0.14
YEAR 3	0.55	na	0.4	0.23	0.35	0.34	0.42	0.03	0.09	0.28
YEAR 5	0.29	na	0.1	0.18	0.00	0.40	0.37	0.04	0.09	0.16
YEAR 10	-0.03	na	-0.4	0.17	0.12	0.28	0.25	0.02	0.07	0.10
REAL MULTIPLIER										
YEAR 1	1.04	1.09	1.1	1.44	1.05	1.67	1.98	0.42	0.75	1.11
YEAR 3	1.31	0.58	0.5	1.23	1.24	1.72	2.25	0.14	0.22	1.00
YEAR 5	1.11	0.34	0.2	1.25	0.07	1.52	1.85	-0.27	0.00	0.62
YEAR 10	0.64	0.06	0.0	1.48	-0.44	1.41	0.77	-0.23	-1.00	0.18

(1) Total federal government expenditures.

(2) Nominal interest rate fixed.

(3) Only includes strictly comparable model results. Excludes Chase and TIM and variables that are not available.

SOURCE: Simulation results reported at joint Bank of Canada - Department of Finance Comparative Models Seminar in Ottawa in July 1982. See B. O'Reilly, G. Paulin and P. Smith (1983, p.48) and papers presented by individual model-builders.