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

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Abstract — Estimates of economic activity generated and jobs created that are derived using input-output analysis are often presented in program evaluations and confused with the benefits resulting from die program. Two such cases are presented as examples. We argue that for two main reasons this type of analysis constitutes a misuse of input-output analysis. First, input-output estimates generated using the Keynesian closed versions of input-output models are biased upwards because they ignore the price and financial feedbacks that tend to reduce multipliers in macro-economic models. Second, and more important, it is inappropriate to consider induced effects resulting from a particular program in isolation, because such effects can only be properly considered in the aggregate at the level of overall stabilization policy. In this paper we contend that cost-benefit analysis, with its assumption of full employment, is the most appropriate tool for analyzing the benefits resulting from particular programs. Input-output analysis should be confined to providing estimates of die industrial or regional breakdown of the direct impact of a program or of the employment impacts of program spending. It should not be used to generate Keynesian multipliers.

Resumé — Les estimations de 1'impact sur 1'activité éconononuque et 1'emplois faites avec 1'analyse intrant-extrant se présentent souvent dans les évaluation des programmes et sont confuses avec les bénéfices du programme. Deux examples sont examinés içi. On prétends que ce genre d'analyse fasse un mauvais usage del'analyse intrant-extrant pour deux raisons principales. Premier, les estimations géncrée utilisant les modeles intrant-extrant de version kéynésienne et fermée sont predisposées a la hausse parce-qu'elles ignorent les rétroaction des prix et du secteur financier qui sont dans les modèles macroeconomiques. Deuxieme, et avec plus d'importance, il n'est pas propre a considérer les effect induits qui resultent d'un programme sauf dans le contexte de la polidque de stabilization. On soutien que 1' analyse des couts ct bénéfices est le meilleur outil pour analyser les bénéfices d'un programme particulier. L'analyse intrant-extrant ne doit être utilisee que pour faire des estimation de 1'impact régional ou industiel et elle ne doit pas être utilisée pour le calcul des multiplicateur kéynésien.

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 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, or they may implicitly be treated as such by bearing labels like "jobs created" or by being compared to the costs of the program.

In this article, we argue that such estimated output and employment impacts in program or project evaluation are often used inappropriately. There are two reasons for this. 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 the 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 tendency has been exacerbated by the emphasis in current program evaluation guidebooks on procedure, to the virtual exclusion of discussion of the principles of cost-benefit analysis (e.g., Office of the Comptroller General, 1981 a and b).

Section 2 of this article offers two examples of the misuse of output and employment impacts estimated using input-output techniques. Section 3 briefly describes the methodology of input-output models, discusses some of their limitations, and presents estimates of the multipliers derived from.them. Section 4 provides the details, from a macroeconomic point of view, of our criticism of the use of input-output multipliers. The main macroeconomic feedbacks that tend to dampen the response 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 emphasizes a number of reasons that employment impacts cannot uncritically be considered benefits of a program or a project Section 6 gives our conclusions.

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 in Ontario 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 in December 1985, the Ontario government introduced a number of initiatives to stimulate the construction of new housing (Ontario Ministry of Housing, 1985). 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" (Ontario Ministry of Housing, 1985, pp. 29-30). fa 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 $2,410 per job-year.

As a second example. Kulshreshtha. Russell, Aycrs. and Palmer (1985) report on a study conducted for the Alberta Irrigation Projects Association. Here the goal was explicitly to identify the major beneficiaries of irrigation activity. mput-output calculations showed that capital expenditures of about $348 million over the period 1985-89 would generate "benefits" of$415 million per year (Kulshreshthn et al.. 1985, pp. 7-8). Only 15% 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%!

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.

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, orprovince, Statistics Canada has developed an entire family of input-output models for Canada that can be used for various types of impact analysis (Statistics Canada.1986). 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 initial spending on the project on the final demand category of 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 labor, 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-provindal 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, income generated in the process of production is not assumed to be re-spent. The second version is the closed model, in which 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 me leakages from me expenditure stream for non-wage income, taxes, savings, and imports.

The impact multipliers derived from me 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 impact on GDP at market prices to the initial expenditure increase), whereas the open version of the model yields only 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 arc 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 inappropriate 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 labor and to the occasional prevalence of a certain degree of labor hoarding. Third, input-output models do not incorporate macroeconomic feedbacks, which tend to reduce the impact of multipliers. This tendency is examined in more detail in the next section.

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 increases output and employment. Increased capacity utilization and reduced unemployment put upward pressure on prices and wages. Greater real output and a higherprice level result 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 accommodating ornon-accommodating. This means that the money supply growth is either assumed to be unchanged or allowed to increase in response to the increased spending. If monetary policy is non-accommodating, debt-financed increases in government expenditure will have a greater effect on interest rates. Alternatives to the debt financing assumption are that expenditure increases are financed by tax increases or by 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 formulation. This cannot be done at the level of the individual program or project.

We can better appreciate how these macroeconomic factors tend to decrease the value ofthe multiplier in the longer run 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 macro-economic models that were considered in a Bank of Canada-Department of Finance-sponsored seminar held in Ottawa in July 1982 (0'Reilly, 1983), The models were: the quarterly forecasting and simulation (QFS) model of the Department of Finance; the research department experimental forecasting model (RDXF) of the Bank of Canada; the CHASE econometric model of Chase Econometrics; the DRI model of the Canadian Economy of Data Resources Canada; the forecasting and user simulation (FOCUS) model of the Institute for Policy Analysis, University of Toronto; the Informetrica model of Informetrica Ltd. (TIM); the CANDIDE 2.0 model of the Economic Council of Canada; and the small annual model (SAM) of the Research Department of the Bank of Canada; and the macroeconomic and energy model (MACE) of Professor John Helliwell, 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 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.

Table 1
The Impact of a $1 Billion Increase In Federal Current Non-Wage Expenditures Estimated Using Canadian Macro-Econom etric Models (Difference between Shocked and Control Simulations)

	QFS	RDXF	CHA SE(a)	DRI	MODEL FOCUS	TIM(b)	CANDIDE 2.0	SAM	MACE	AVG.(c)
REAL GNE (%)										
YEAR1	0.32	0.28	0.80	0.33	0.22	0.46	0.55	0.09	0.18	0.28
YEAR 3	0.38	0.14	0.40	0.27	0.24	0.43	0.60	0.07	0.05	0.25
YEARS	0.31	0.07	0.20	0.26	0.01	0.36	0.46	0.06	0.00	0.17
YEAR 10	0.14	0.01	0.00	0.24	-0.06	0.28	0.17	-0.10	-0.18	0.03
EMPLOYMENT (%)										
YEAR1	0.18	na	0.60	0.16	0.15	0.19	0.28	0.00	0.06	0.14
YEAR 3	0.55	na	0.40	0.23	0.35	0.34	0.42	0.03	0.09	0.28
YEARS	0.29	na	0.10	0.18	0.00	0.40	0.37	0.04	0.09	0.16
YEAR 10	-0.03	na	-0.40	0.17	0.12	0.28	0.25	0.02	0.07	0.10
REAL MULTIPLIER										
YEAR1	1.04	1.09	1.10	1.44	1.05	1.67	1.98	0.42	0.75	1.11
YEAR 3	1.31	0.58	0.50	1.23	1.24	1.72	2.25	0.14	0.22	1.00
YEARS	1.11	0.34	0.20	1.25	0.07	1.52	1.85	-0.27	0.00	0.62
YEAR 10	0.64	0.06	0.00	1.48	-0.44	1.41	0.77	-0.23	-1.00	0.18

a Total federal government expenditures.
b Nominal interest rates fixed.
c On ly includes s trictly comp arable model resu lts. Exclud es Ch ase and T IM and variables that are not available.

Note: From Joint Bank of Canad a - Departm ent of Financ e Comp arative Models Sem inar. Ottawa. J uly 1982. S ee B. O'R ellly, G. Paulin. and P. Smith (1983, p. 48) and papers presented by individual model-builders.

The conclusions to be drawn arc 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 that ignore macroeconomic feedbacks is likely to be greatly exaggerated. The indirect effects of government spending programs are more likely to be negative than positive.

The model estimates of the multiplier depend on the degree of capacity utilization assumed for the economy (although not perhaps as much as one might expect). 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, which 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.

ECONOMIC IMPACTS AND COST-BENEFIT ANALYSIS

This section comments on the relationship between cost-benefit analysis and economic impact analysis, and restates 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 that can be found, for example, in the Treasury Board's Benefit-Cost Analysis Guide (1976) or in Mishan (1976).

The economic impact of a program 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 Ontario housing policies in the study mentioned earlier were reported under the heading "Jobs Created" and the Kulshrcshtha et al. (1985) study used the terms "impact" and "benefit" interchangeably.

One difference between cost-benefit analysis and economic impact analysis is that the former 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 mem. Similarly the negative impacts (costs) of a program or project are valued at what people are prepared to pay to avoid them. Those 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 worid in which me program or project does not exist and nothing takes its place. It is implicitly assumed that all the labor, 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 labor (Harberger. 1981). Briefly, the net gain from the creation of permanent jobs is estimated to range from zero to 25% of the wage bill (depending on the rate of growth of the region), and the creation of temporary jobs may actually impose a cost of up to 30-50% 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 in which no other activity takes their place. But this is an unacceptable basis for comparison from the viewpoint of cost-benefit analysis 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 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, property speaking, should be measured by how much we are willing to pay to achieve these differential impacts. Similarly, the Kulshreshtha ct al. (1985) 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 as 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 forgone elsewhere can be approximated by the payments formerly made to the labor and other resources now used in irrigation. The benefits of the irrigation project could then be measured by the increased earnings of land, labor, 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 labor will cause the labor 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. Doing so requires an explicit judgement on how public fimds would be expended in its absence and on 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 (Musgrave. 1959). The Department of Finance and the Bank of Canada are responsible for advising the government on stabilization policy, including attempts to influence the levels of output and employment and the rate of inflation. The Treasury Board and the program departments arc responsible for advice on resource allocation and program delivery. Given this division of labor, 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 labor force value their leisure. In this context, leisure means much more than idle time. For example, consider a policy which enables mothers to enter the labor force by providing subsidized day care. The mother incurs a cost both in lost time available for housework, shopping, 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 with an income transfer sufficient 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? One 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 that is appropriate in this case. The induced effects measured by the closed model will be similar regardless of the program analyzed. 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 forgoing 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 to cost-benefit analysis. The difference is that cost-benefit analysis attempts to place a value on the economic impacts of a project as pan 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 that basic cost-benefit analysis helps to avoid.

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 on 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 are 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 appropriate, including 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. In these cases, estimates derived from the input-output model may be either the most reliable or the most cost-effective estimates possible.

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