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ESTIMATION OF "COST PER JOB"

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Introduction

Government assistance to and participation in industrial projects can be evaluated in a number of ways. If, for example, the goal is economic efficiency - the allocation of society's resources so as to maximize society's wealth, then the appropriate evaluation methodology is Benefit-Cost Analysis, as outlined in the Treasury Board's Benefit-Cost Analysis Guide (1976). Often, however, considerations of the distribution of wealth, by income class, region, occupational group, or other classification, may outweigh considerations of total wealth, and concern with the federal government's budgetary position may outweigh concern with economic cost. In particular, great importance usually attaches to benefits flowing to the labour force through increased employment opportunities. For this reason an estimate of the employment effects of a project usually forms an important part of project evaluation. The two measures, employment generation and government outlay, can be combined into a "cost per job" figure, which is deemed a major criterion of project acceptability.

The purpose of this paper is to initiate discussions aimed ultimately at standardizing - to whatever extent is possible - the calculation of cost-per-job estimates. Its focus is on general issues rather than specific methods, and on raising questions rather than resolving them; however, in the last section we work through a (somewhat idealized) hypothetical example in order to illustrate how the principles might be made operational. We try to use the same conceptual framework as cost-benefit analysis, but take "cost" to mean the government's outlay, and

"benefit" to mean the net incremental jobs (or alternatively, labour income) generated by the project. Neither of these measures has anything to do with economic efficiency: government outlays include both transfers and actual purchases, and jobs or labour input to a project would, from the efficiency point of view, be counted as a cost, not a benefit. We are thus dealing with non-economic criteria for project approval. Having accepted this, however, we can nevertheless use the methods of economics to try to ensure that the criteria are applied in a disciplined way.

The main thesis of this paper is that both the cost and the jobs generated by a project are only meaningful relative to the alternative to carrying out the project, and that this alternative (often called the "base case") must be specified as carefully as the project itself. Cost and jobs are then defined as the difference between the values under the project and the values under the alternative. This, we argue, is the only useful meaning of the word "incrementality".

As estimate of the net incremental employment generated by a project must take into account any jobs displaced by the project, either directly through competition or indirectly through such mechanisms as "crowding out" of investments or exports. To a certain extent this depends on the focus of the project. If the object is expansion of total national employment, then displaced jobs anywhere in the country count against jobs created. On the

other hand, if the aim is regional development or some other redistributive goal, then jobs generated in the region of interest may be considered to outweigh jobs lost outside the region. The proper procedure in this case, we would argue, is to estimate and report separately the net job figures for both the region and the rest of the country, so that the overall effect may be evaluated against the value of the regional redistribution. In this paper we generally ignore regional matters and consider only national totals, and so we must be concerned with the issue of job displacement. Usually job displacement is estimated by examining the institutional structure of the industry; who the buyers are and who they buy from and how this will change under the project. In the next section, however, we shall present a few simple microeconomic paradigms for the situations in which jobs can be displaced.

A question in need of additional thought is whether "number of jobs" is really the best measure of the effectiveness of employment programs. Jobs differ in quality along a number of dimensions, most notably in salary, but also in working conditions, full-time vs. part-time, temporary vs. permanent, matching of skill requirements with the skills available among the unemployed, and the like. As a first approximation, job numbers should be expressed as total full-time equivalent man-years expected over the life of the project. Total (or discounted present-value) labour income might be a better measure. Jenkins and Kuo (1978) and

Glenday and Jenkins (1981) have argued that the value of jobs created depends strongly on whether they are temporary or permanent, but a useful way of weighting job estimates for permanence does not seem to exist.

For other points of view on the evaluation of employment programs, the reader is urged to consult the Jenkins-Kuo and Glenday-Jenkins papers, along with Harberger (1981), Hazeldine (1981), Baldwin, Lessard, and Mason (1981), and Ashenfelter (1981).

I. Incrementality and Displacement

As emphasized in the Introduction we take "Incrementality" to be a relative term, defined only with respect to a base case. In this section we discuss incrementality in general terms, using simple demand-supply diagrams as a conceptual aid. More specific recipes are provided in later sections.

We can distinguish several separate questions which together determine incrementality:

A. What is the budgetary alternative? If the project were not carried out, would the money be spent on another project, or applied to reducing the deficit, or to some other use? If the department contemplating the project has a fixed budget, which it is reasonable to expect will be spent, than the "budgetary incrementality" will be zero. This is important for the estimation of indirect job-creation effects (see below).

If several different projects are to be compared, it is necessary to evaluate them all against a fixed base; it is probably most convenient to take as the base the alternative of no project at all, with an equivalent reduction in government expenditure.

B.   What is the <u>business</u> alternative? Would the project –
or an equivalant one – have been undertaken privately
without the government incentive?

C.   What is the likely <u>industry</u> reaction? How much
existing output will be displaced?

D.   If the product is a consumer good, what will be the
<u>consumer</u> reaction? In the short run, consumers have
fixed incomes: If sales of one item are to increase,
it will be at least partially through substitution from
other purchasers, from savings, or from imports of the
same item. Each of these alternatives has different
implications for industry production, interest rates
and exchange rates.

Questions B and C are related and will be discussed
together. We start with the following assumptions:
1) If a project is viable in the private business
sense (ie. is expected, after adjustment for risk, to
generate a return at least equal to the private
opportunity cost of the investment funds), then it will
be undertaken privately. This assumption precludes an
appeal to capital market imperfections ("gaps") or

barriers to entry to justify a conclusion of
incrementality.

2) If different plants or establishments in an
industry have different costs of production (including
both operating and capital costs), then as demand
increases, the lowest-cost facilities will be used
first.

3) The project consists of either a subsidized
addition to industry capacity or a subsidization of
existing capacity (either selective or universal).
Other types of projects (e.g. import quotas or
infrastructure not specific to an industry) may be
analysed by similar methods.

Deviations from Assumption 1 and 2 should be noted explicitly and
justified by argument and evidence. In particular an argument
from "gaps" or barriers to entry must identify the gap or barrier
specifically and present direct evidence that the market
imperfection will affect the project proposed.

The industry demand curve might be horizontal (as in
the case of a product sold in a competitive international market)
or might have a negative slope (for a domestic market, say, or an

international market in which Canada is a dominant producer and possesses some degree of monopoly power.) The new or newly - subsidized capacity might have pre-subsidy marginal cost above or below the "going" price. These three alternatives provide six distinct cases, which we examine in turn. We suppose, following Hazeldine (1981), that the industry is made up of a number of plants, establishments, or firms, each of which has an approximately constant marginal cost of production including capital costs, but whose costs need not be equal. The industry marginal cost curve is obtained by ordering the units in increasing order of marginal cost, and the curve is a step function:
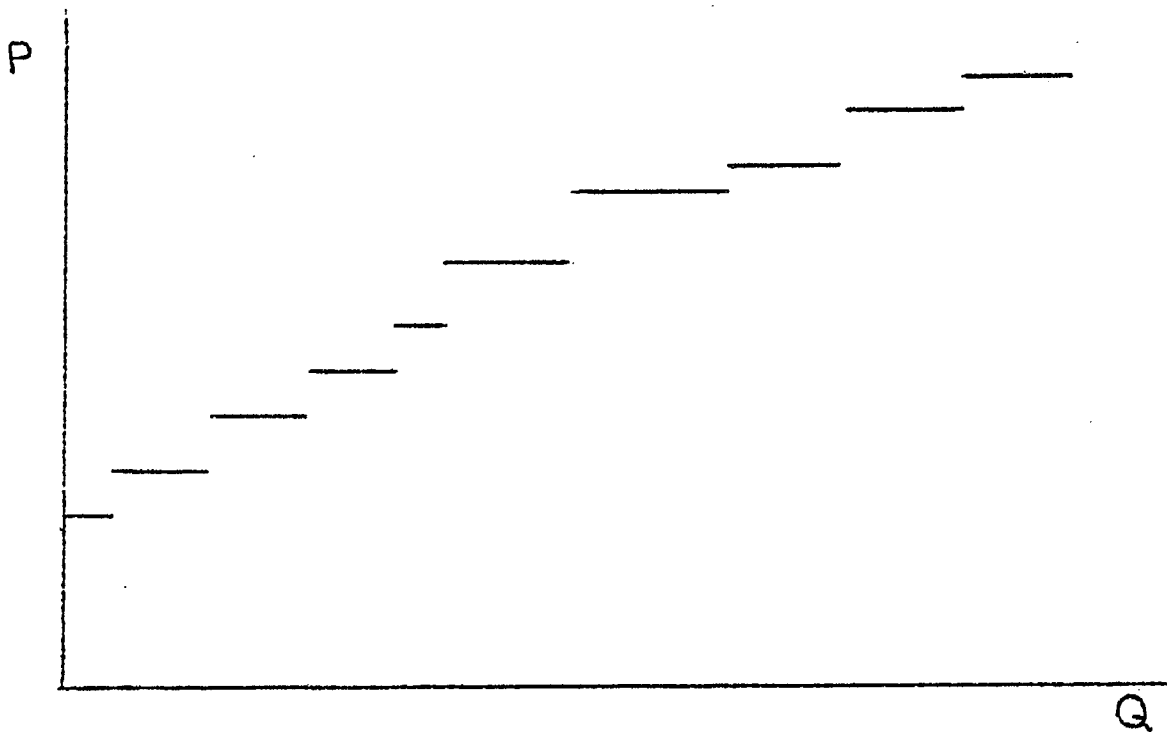
In drawing the diagrams we shall abstract from the step-function and draw a continuous curve, but we retain the notion that a particular section of the curve corresponds to a particular unit (plant or firm) of production.

Case 1: horizontal industry demand curve, firm specific subsidy, capacity added at marginal cost below the market price
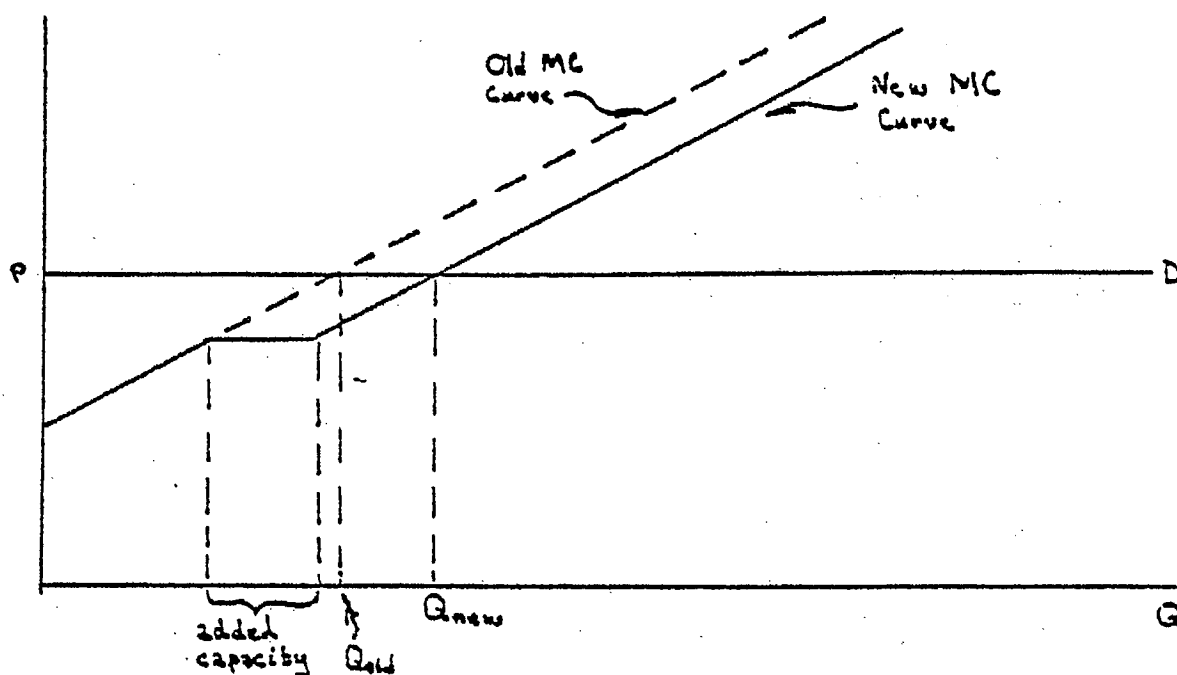
Capacity is added at marginal cost below the market price and simply shifts to the right the portion of the MC curve lying to the right of it. The added capacity is profitable without the subsidy; the subsidy is a pure rent added to the inframarginal rent the project enjoys, hence the subsidy is not needed. The project is viable privately, and displaces no existing output.

Case 2: horizontal industry demand, firm-specific subsidy, capacity added at marginal cost <u>above</u> the market price, and subsidized sufficiently to bring the net marginal cost below the market price.
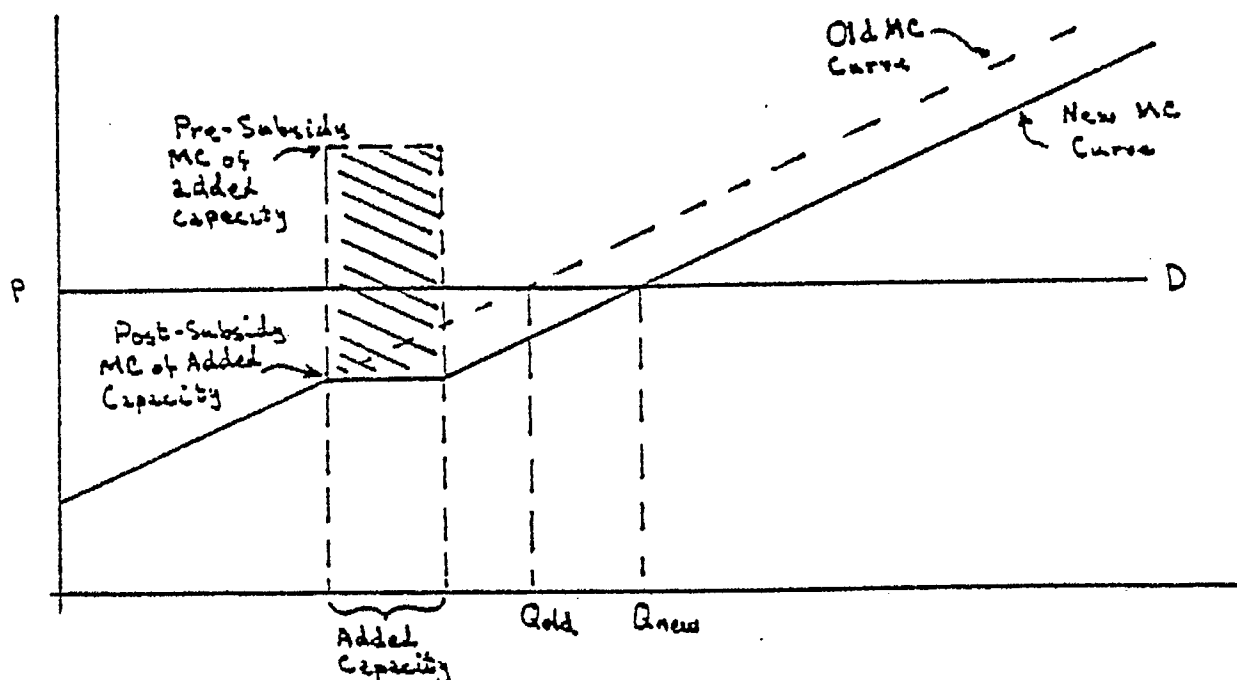
In this case the <u>net</u> marginal cost (post-subsidy) of the added capacity is below the market price, so the effect on the market is the same as in Case 1: no existing production is displaced, and output expands by the full amount of the added capacity. The total subsidy is the shaded area. The subsidy is necessary (ie. the project is "incremental") because the added capacity is not privately viable without the subsidy. Note that the subsidized

capacity need not be "new". It could be an existing plant shut down because of high costs and reopened with the subsidy. Note also that if the subsidy is insufficient to bring the cost of production below the market price, then nothing happens unless the plant is actually taken over by the government; the plant will not be operated privately. If the plant is operated by the government, then the "subsidy" can be defined as the difference between the marginal cost and the market price.

Case 3: horizontal demand curve, general subsidy (note that in the case of a general subsidy the distinction between high and low cost added capacity is not significant). Assume a per-unit subsidy.
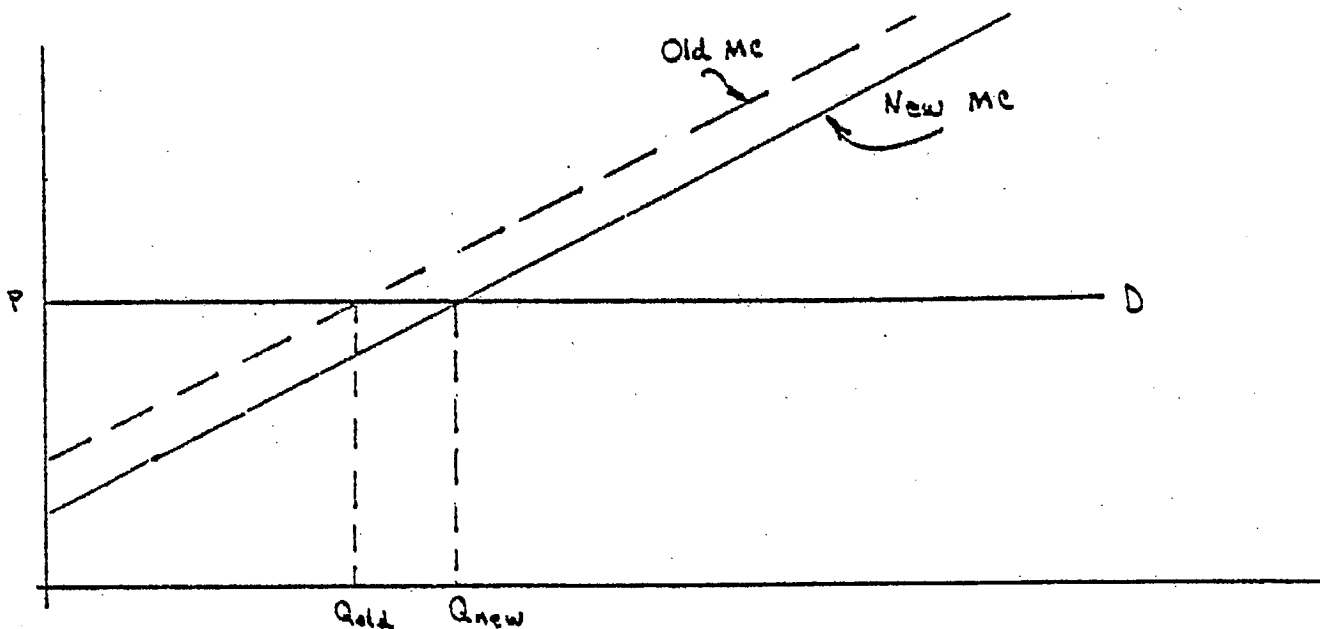
No production is displaced: the MC curve shifts down by the amount of the subsidy, adding Qnew - Qold to the industry's output.   This addition is incremental.

Case 4: Downward - sloping demand curve, firm - specific subsidy, added capacity at low marginal cost "Low" marginal cost in this context means "below the market price".
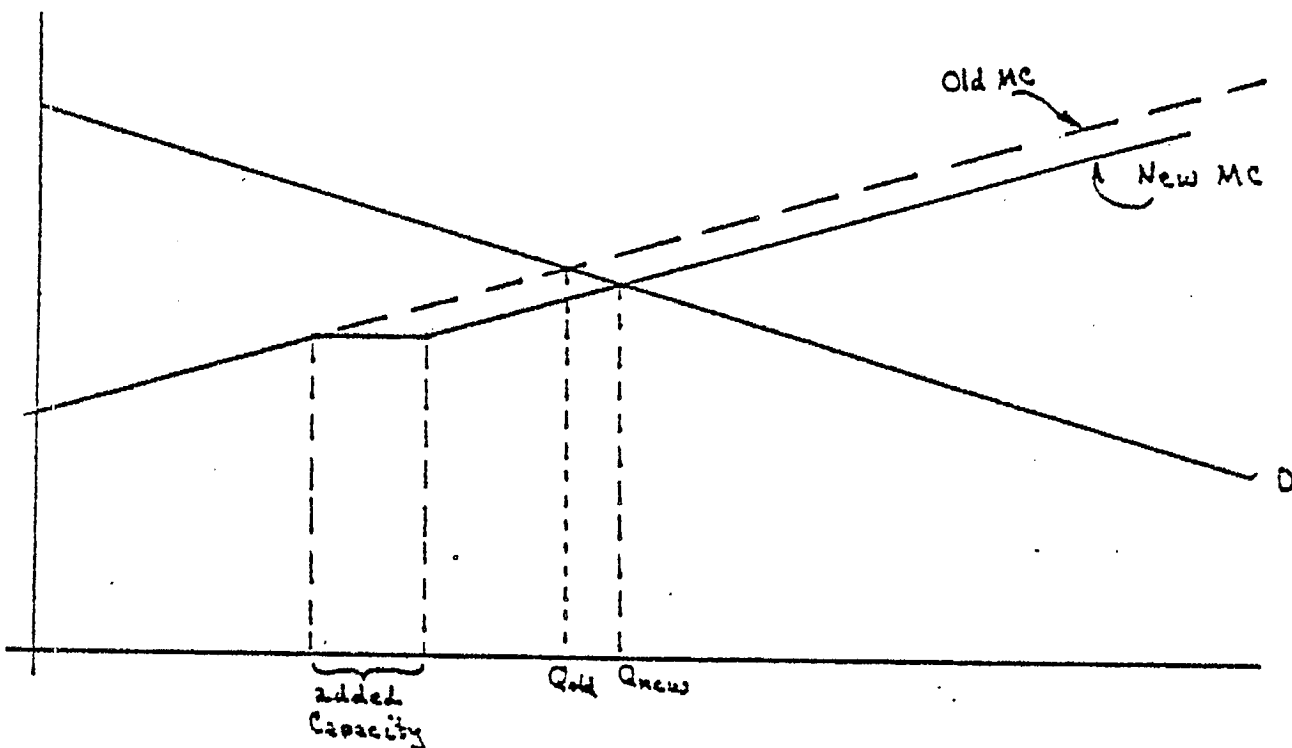
The subsidy is not needed: the project is privately viable. The new capacity displaces some existing production (that of highest cost) so that the expansion of output is less than the addition to capacity. (How much less depends on the elasticities of supply and demand: a formula will be given later.)

Case 5: Downward - sloping demand curve, firm - specific subsidy, added capacity at <u>high</u> marginal cost (above the market price).

This case is similar to Case 2: the project is "incremental" in the sense that it would not proceed without the subsidy. However not all its output is incremental because some existing output is displaced.

Case 6: Downward - sloping demand curve, general subsidy.

This case is similar to Case 3, with the modifications induced by the sloping demand curve: Some output is displaced, and the rest is incremental.

The above cases, though somewhat over-simplified, give an idea of the situations that must prevail in order to conclude that all or part of a project is "incremental". They suggest the following conclusions:

1) The additional output generated by a project will <u>all</u> be incremental only in one case: that of a horizontal industry demand curve (infinitely elastic). This will occur if the industry's output is sold in a competitive international

market in which Canada is too small a player to affect the price. (Actually, the market need not be competitive so long as there is a standard price (perhaps even set by a cartel) which the level of Canadian output is too small to change). In all other cases (e.g. a domestic market, or an international market in which Canada is a major player), the demand curve will have some slope, and this means that an expansion of capacity in one firm will displace some of the existing production.

Let e_H, e_M, and e_D denote, respectively, the elasticities of domestic supply, import supply, and total demand, with respect to price. Let S be the current share of imports in the domestic market, expressed as a proportion, so that 1-S is the share held by domestic production. Then, adding capacity to the domestic industry capable of producing Q units per year will expand domestic output by approximately

$$Q \, (Se_M + e_D)/((1-S)e_H + Se_M + e_D)$$

units per year. This formula assumes that the shock Q is small enough that it can be considered not to affect the import share S. If this assumption is not justified, the formula still holds provided S is taken to be the new import

share. If good estimates of elasticities are unavailable,
then consideration of the institutional structure of the
industry, together with what data is available, should
provide at least plausible ranges for the elasticities.

It might be argued that if the market is expanding
rapidly enough (ie. the demand curve is moving to the right)
to absorb the new capacity, then no output is displaced,
even if demand has finite elasticity. The problem in that
case (after evidence is presented that it _is_ the case) is to
justify putting subsidized high-cost capacity into a market
in which the private sector would be ready to add low-cost
unsubsidized capacity. It might be justified on regional or
distributional grounds (the value of such intangibles must
exceed the cost differential), but   not normally on
employment grounds unless evidence is presented that the
private sector, for some reason, is reluctant to add
capacity in an expanding market.

The _net_ increase in domestic output in the industry (added
capacity minus displaced domestic output) can be converted
into employment using input-output tables, as described in
a later section.

If there is no existing domestic industry then the
new capacity will presumably displace only imports (provided
the output can be sold, i.e. is perceived by buyers as a

substitute for imports.) and so the full output can be counted as incremental.

2) A <u>project</u> will be incremental (to what the industry would have done without the intervention) only if it can be shown that it is not viable privately on its own. In order to qualify as a good use of public funds, however, it must carry some significant economic or social benefit not captured by the private market. To justify a project, then, one must show both that it is a good proposition in a public sense and that it is unviable in a private sense. The magnitude of the subsidy necessary to render the project a workable business proposition can be taken as the minimum level at which the "public" benefits must be valued in order to justify the project.

In Cases 1-6 above, the "viability" of a project was taken implicitly to mean that the marginal cost of output (considering both capital and operating costs) is less than the market price, and the "subsidy" was left unspecified as to type, but was merely assumed to be sufficient to bring the marginal cost below the market price. These ideas are correct as summaries, but skip over many of the complexities of the firm's actual investment decision and the way in which subsidies of various types affect it.

Normally the firm bases its decision to invest or not to invest on the net present value of the cash flows expected to be generated by the project, with a suitable adjustment for risk. If the net present value is positive, the investment is accepted. This requires laying out a full schedule of the after-tax revenues, operating costs, and capital costs expected over the life of the project, and discounting by an appropriate interest rate. The connection with the setup in Cases 1-6 is that it was there tacitly assumed that all the flows are constant from year to year. The Present Value is a device for dealing with non-constant flows.

The capital cost must include not only cost of debt but also the risk-adjusted opportunity cost of the equity portion of the project's financing. This opportunity cost depends on the risk-free rate of return prevailing at the time in financial markets, and on the project's risk premium, which depends on the project's correlation with the rest of the market (usually called its "beta"). Techniques for estimating the risk-adjusted opportunity cost of capital by means of the Capital Asset Pricing Model are well-established in the financial literature (e.g. Quirin and Wiginton (1981), chapter 11), and the reader is referred there for details.

Having the net present value (N.P.V.) of the project, we can now determine the minimum subsidy necessary to make the net present value positive. Note that the subsidy will itself generally be spread over time, so must be reduced to a present value. This present value need not be the same as the Cash Grant Equivalent cost discussed in a later section, because the latter is evaluated from the government's point of view, and the former from the firm's point of view: in particular, the discount rates used will generally differ, and the two values may include different items. The present value of subsidy just sufficient to make the N.P.V. of the project positive will be the minimum required if the project is to go ahead.

It is important to note that different types of subsidy will have different effects on firm behaviour, even if the Cash Grant Equivalent is the same. For example, subsidizing the cost of replacing obsolete equipment will obviously induce different action than subsidizing operating losses. A tax concession will only be of value to the firm (or cost to the government) if the firm expects to be in a taxable position; the value of a temporary tax concession (say, for the first two years of a five-year project) depends strongly on the expected time-profile of the project's cash flows. It follows that, in analyzing the firm's investment decision, one must not only determine the

minimum amount of subsidy necessary to make the project viable, but also the best type of subsidy to accomplish the purpose.

When a project has been determined to be incremental in a budgetary sense and incremental in a business sense (ie. not viable privately), and in addition has sufficient public benefits to justify government support, and its net incremental output is determined, and converted to (full-time-equivalent) jobs, then the indirect effects can be assessed. One job in a project will not, in general, reduce unemployment by one person because of several factors:

A. Factors reducing the impact on measured unemployment:

   1) Availability of the project's jobs may induce entry
       into the labour force: such entrants may, of course,
       be involuntarily unemployed, even though not counted in
       the labour force for a variety of reasons.

   2) If the job is part-time, seasonal, or temporary, the
       impact is reduced in proportion. Employment effects
       should be stated in full-time-equivalent person-years.

3)   Jobs requiring skills in short supply and not readily
     acquired will not be filled, directly or indirectly,
     from the unemployed.

4)   Jobs will not, in general, be filled 100 per cent from
     the unemployed (estimates run 20-30 per cent: better
     estimates are needed). The already-employed workers
     who quit to take the new jobs may or may not be
     replaced; they are _less_ likely to be replaced in a
     recession, especially if their firms are practicing
     "labour-hoarding", or if they were employed in a
     declining industry which is reducing employment by
     attrition. If all quits are eventually replaced, then
     any increase in employment must ultimately reduce
     unemployment by the same amount, but it may take a long
     time (Treasury Board Benefit-Cost Guide, p. 20).

5)   As discussed above, some existing output in the
     industry or elsewhere in the economy may be displaced
     by the subsidized capacity. If elasticities of demand
     and supply are available, one can estimate the
     displaced output and arrive at a net new employment
     figure using the formulas of the previous section.
     Alternatively, in doing a retrospective study, one can

compare output (or employment) figures before and after
the project (allowing sufficient time for the market to
adjust).

6) If there is "crowding out", then private projects - and
the jobs thereof - are displaced by government
projects. As argued recently recently by Wirick
(1983), since Canada can draw on a well-integrated
international capital market, the crowding out may
occur not in investment but in the export market,
because of exchange rate appreciation. This would be
in addition to any appreciation that would result if
the project increased exports or reduced imports.

B. Factors increasing the impact on unemployment.

1) Multiplier effects due to expansion of the economy:
this depends primarily on the project's contribution to
the government's net budgetary stance, given the method
of financing and the monetary policy followed. It is
for these effects that a careful specification of the
budgetary alternative to the project is crucial. If
the realistic alternatives involve spending the same
amount of money on other uses, then little or no
additional multiplier effect can be claimed for the

project. In these notes we shall generally ignore
multiplier effects, on the grounds that they attach
properly to the overall economic policy of the
government and not to individual projects; in
comparison of projects of equivalent size, any
attributable multiplier effects net out.

2) Intermediate - goods demand induced by the project:
this can be estimated from the input-output tables, and
determines, given an increment in activity in a certain
industry, how much increase in output of "upstream"
industry is required to support it. This can be turned
into jobs using valued-added tables. As will be argued
in more detail further on, if the project's output
consists of marketed goods or services, there is no
need to consider upstream production explicitly, unless
a breakdown of activity by industry is desired. The
value of gross output (sales) attributable to the
project includes all intermediate productive activity,
and this can be converted into an estimate of jobs
using standard coefficients derived from the
input-output tables, and from average salary figures
(some formulas and tables will be given in a later
section.) If the project's output is not marketed,
then the total expenditure on the project can be broken
up into

a)   wages and salaries of those directly employed by the project.

b)   Interest payments and other financing charges.

c)   Purchase of materials, equipment, and services (other than direct employment of labour.)

d)   Indirect taxes if any.

It is the third category in which the upstream inputs reside, and the total expenditure in this category contains all intermediate activity; so applying standard coefficients yields an estimate the employment generated by the upstream demand. There is no reason to use the input-output tables explicitly unless a breakdown by industry is desired of the upstream activity generated by the project.

The upstream employment figures thus generated should be considered an upper bound; factors causing the actual value to fall short of the estimate include:

a)   Any economic activity displaced by the project carries its own "upstream" demand which is also displaced.

b)   Demand may not be slack in all the "upstream"

industries: more generally, the <u>marginal</u> supplier in a particular industry may be imports, a situation not apparent from <u>average</u> import shares as used in the input-output tables, and which may not be changed by "Canadian content" rules.

3) If the project produces an efficiency improvement in a plant producing for a world market, the resulting competitive advantage may increase exports. This should show up in industry production figures. If the efficiency is gained through increased productivity, then the incremental production must be converted to jobs using the now (higher) productivity level. Again, as argued above, in order to claim that output is incremental, it is necessary to establish that the increased efficiency is privately unviable.

When the basic microeconomic analysis of the project has been completed, including budgetary impact and alternatives, production levels, cost of production and size of subsidy, demand and supply (including imports) elasticities for the industry, and perhaps capital market conditions, the effects outlined under A and B above can best be estimated using a large-scale macroeconomic model such as CANDIDE or TIM. Such a model will have built into it equations to account for most of the effects

mentioned under A and B (if special information is available one can use it to override any particular equation). The principal advantages to using a model are:

a)   all estimates are consistent, with each other and with the National Accounts.

b)   The discipline of preparing detailed descriptions of the "base case" (ie. the alternative to the project) and the "impact case" (the project itself) tends to enforce clarity of thought about policy alternatives.

c)   If a model is not used, but the considerations outlined under A and B above are treated seriously, then one must redo much of the work that has gone into construction of a model. It is often more productive to start from a model and put the effort into determining the suitability of the assumptions underlying the model and overriding those parts considered unsuitable.

II. Cost to the Government

As stated above, the cost of a program is taken simply as the amount of money the government must pay: this is complicated only in that the payments are spread over time and subject to uncertainty in amount (for example a loan guarantee may require no outlay ever or, at an uncertain future date, a payment up to the size of the loan). To account for these complications we need to form a Cash-Grant Equivalent (CGE) for the project cost stream. This is almost the same as a discounted present value, but takes into account the uncertainties in future outlays. Among the issues that need to be decided are the choice of a discount (interest) rate for discounting, the method of pricing risk, and the treatment of "implied" costs such as shutdown costs.

In the formulation of the Cash-Grant Equivalent of a cost stream, it is important to emphasize that "equivalence" means equivalence from the government's point of view. This is in accordance with the cost-benefit principle that "cost" is determined at the valuation of the payer of the costs and benefits at the valuation of the recipient. Two government programs with the same CGE cost may have very different value (and incentive effect) to the beneficiary firms, but the difference is irrelevant on the cost side: it shows up on the benefits side.

Given a (certain) stream of future costs C_1, C_2, C_3 .... C_n extending n years into the future, and given a discount rate d

(which is $1/(1+r)$, where r is the corresponding interest rate), the CGE (or present value) of the cost stream is $dC_1 + d^2C_2 + \ldots + d^n C_n$, or

$$CGE = \quad d^i C_i$$

This is straightforward, but two questions suggest themselves: first, what discount rate should be used? Second, what if the cost stream C_i is not certain?

a)   We argue that the appropriate interest rate to use in forming the discount rate is the government's cost of funds. The rationale for considering CGE or present value is as follows: if an agent can borrow or lend at the same rate r, then any certain future stream of costs (or revenues) can, by appropriate borrowing and lending, be temporally rearranged into any other stream with the same CGE. Since we are considering only the government's cash outlay, its borrowing rate is the appropriate rate to use. It might be argued that the government can lend at the market rate, which is normally higher than its borrowing rate, and hence a theory of CGE must be worked out in which borrowing and lending costs differ. However, the reason the government borrows at a lower rate than others is that its borrowing is virtually free of the chance of default, and thus its rate is a "certainty-equivalent" rate. When the government lends, it must accept the default losses that accompany lending in the market, and its net return will be essentially the

certainty-equivalent rate, which is the same as its borrowing rate (this argument assumes that the government makes the same valuation of risk as does the private market, but any error introduced by this assumption is likely to be small.) So, as long as only government budgetary outlays are of interest and no consideration of efficient allocation of resources intrudes, the appropriate rate is the government's cost of funds.

b) The treatment of uncertainty of future outlays, such as is implicit in loan guarantees and similar initiatives, is in its full generality a matter of some complexity. We will propose here a somewhat simplified treatment which should be adequate in most cases.

Consider first a situation in which there are only two future periods, and the cost stream C_1, C_2, consists of random variables. These random variables C_1 and C_2 need not be independent, nor need they have the same distribution. As an example, suppose the government guarantees a two-year loan in which all accrued interest, plus one-half the principal, is paid at the end of each of the two years. If L is the principal and i is the interest rate, then a default in the first year requires a government outlay of $L + iL/2$, and a default in the

second year requires $L(1+i)/2$. To account for the time lag we must discount these by $1/(1+r)$ in the first year and $1/(1+r)^2$ in the second. Note that for simplicity we are assuming that the default is total: the borrower cannot make a partial payment. Suppose that from the record of similar projects it is estimated that the probability of a first-year default is 10%, and the probability of a second-year default is 8%. Then the _expected_ or _mean_ default loss in present-value terms, is

$$(.10)L(1+i/2)/(1+r) + (.08)L(1+i)/(2(1+r)^2)$$

If, for example, L is $1 million, i is 15%, and r is 14%, then this works out to $129,694. This is a weighted average of the three possible values, corresponding to no default, first-year default, and second-year default. An individual loan guarantee may have any of these three values in the event, and will not necessarily be close to the expected value. If, however, the government has a large, diversified portfolio of loan guarantees, and if defaults on individual accounts are independent, then one would expect that the government's total future outlays (in present-value terms) to be very close, in the actual event, to the total expected present value, provided the probabilities are accurately estimated. This is the value of diversification: fluctuations in the total are much less than fluctuations of the individual accounts.

These considerations would suggest using the expected value (or a suitable estimate of it), as the appropriate measure of CGE in the case in which future costs are uncertain. The trouble with this is that the two key assumptions may be violated: the individual guarantees may not be independent, and in fact the government may not be well-diversified, in that a substantial proportion of its portfolio may be in a few large accounts, such as the Massey-Ferguson and Chrysler guarantees. The consequences of non-independence are that there is a limit to the reduction of uncertainty which diversification can accomplish. Hence both of these deviations from ideal conditions imply that there is an irreducible level of uncertainty about the level of total future outlays: they may be less than the expectation or greater, but the actual value is unpredictable. It is this irreducible component of uncertainty which is termed "risk".

In the cost-benefit literature it has been extensively debated whether the government should make any explicit allowance for risk. It has been argued (see, e.g. Arrow and Lind (1970)) that the government should ignore the uncertainty of returns and costs and, in effect, base its decisions on the expected value. Others (see, e.g.

Quirin and Wiginton (1981, chapter 8) for a general discussion and references) argue that the government should include a correction for uncertainty, so that an uncertain cost is assigned a higher CGE than what results from considering only the expectation.

As pointed out in Baldwin, Lessard and Mason (1983), use of the expectation alone (without any risk adjustment) would already considerably improve federal budget-making practice, which currently costs a loan at full face value in the year it is made (i.e., exactly the same as a grant) and costs a loan guarantee at zero in all years up to the time (if any) of default. These authors favour an adjustment for risk based on contingent claims analysis (Black and Scholes (1973), Jones and Mason (1980)) which provides, under certain idealizing assumptions, a market price for assets containing undiversifiable risk (Jones and Mason (1980) give tables for valuing loan guarantees).

For the problem at hand, given the relatively low precision of available information, we would suggest that any adjustment for risk used for the CGE calculations be based on a rule which is simple to understand, simple to use, and not too dependent either on idealizing

assumptions or on accurate estimates of market and other
parameters. One possibility might be a fixed percentage increase
over the expected value: if the expected present value, for
example, is estimated at $1 million, then we might simply add ten
per cent to get a CGE of $1.1 million. A related rule would be to
have two or three categories of projects, each with its own risk
adjustment: for example, a low-risk category consisting of small,
well-diversified projects of moderate risk, such as the loan
guarantees made under the Small Business Loans Act, carrying a risk
adjustment of perhaps three or four per cent; and a high-risk
category consisting of large, undiversified, very uncertain
ventures such as the Massey-Ferguson guarantee, which would carry a
large risk-adjustment, perhaps thirty or forty per cent over the
expected value. One can propose other such schemes; the point we
wish to emphasize is the requirement for something simple, that
involves listing explicitly any assumptions made. In addition to
the obvious expenditures in a project, there are certain hidden
costs and savings that should be accounted for. For example, any
net jobs contributed by a project will mean extra income tax
revenue collected, and unemployment insurance payments saved.
Formulas can be developed for estimating amounts. A potentially
more important source of hidden costs is what might be called
"implied" costs. These would include the costs, for example, of
shutting down a project if at some time in the future the decision
is made to discontinue. Even if the shutdown costs are not part of

the initial agreement, a realistic assessment will often suggest that the government will incur an implied obligation which should be accounted for in cost estimates at the beginning of the project.

Let us consider a hypothetical example. Suppose the government gives a research grant to a new small firm and simultaneously provides a loan guarantee, both for the purpose of developing a new product. This is the "project", at the beginning. The estimation of future cost, however, should take into account the likelihood that after the product is developed, further government support will be needed to begin production and marketing. If this likelihood is ignored, then the CGE will be estimated by adding the value of the grant to an estimate of the costs of the loan guarantee, using a standard estimate of default probability based on past experience: suppose this is 10%. If the grant is $100,000 and the loan is $500,000, then (assuming no risk-adjustment), the estimated CGE will be $150,000 (the grant plus 10% of the loan value, ignoring for simplicity the interest cost in default). When the product is developed, the government will face a choice of putting in more assistance, or of withholding it, and in many cases the consequences of withholding will be default on the loan. The government thus will be forced to choose to make good on the guarantee (not with 10% probability but with certainty) or to enter into another round of assistance. This choice can be foreseen from the beginning of the project, and it is clear that estimating the CGE at $150,000 seriously understates the government's ultimate liability.

It is difficult to provide firm rules for dealing with implied costs, since they can take a large variety of forms. At a minimum, there should be an explicit statement of all assumptions made with respect to implied costs (including, if applicable, the assumption that there will be none), and their contribution to the final estimate of CGE should be indicated separately. If the implied costs can be foreseen with reasonable accuracy, they should be included in the total CGE of the project, even if the initial project does not formally bind the government to them.

III.   Indirect Effects

Multipliers: It is customary, when assessing the employment and
other effects of a project, to include an allowance for the
possibility that a project may induce an enlargement of the economy
beyond the immediate size of the project.   Such "keynesian"
analysis may consist simply of applying a standard rule-of-thumb
"multiplier", or it may range up to simulation on a large-scale
macroeconomic model.   Either way, the logic underlying the
procedure is the same: that the level of economic activity in
aggregate (the national income) is determined by a multi-market
equilibrium in goods, capital, money, and labour markets (See
Sargent (1979)).   The value of the equilibrium depends on
underlying economic parameters and on certain policy instruments
which the government controls.   One of these is the level of
autonomous government expenditure, together with the choice of
method of financing this expenditure.   In general, a permanent
increase in real government expenditure by an amount g requires an
increase in private expenditure to restore equilibrium. Since both
public and private spending are components of national income, this
will produce an increase in real national income of mg, where m is
the "multiplier". The value of m depends on the method of
financing, the action of the monetary authorities, the state of the
economy at the time, and many other things.   As mentioned above,
multipliers are a feature of economic policy as a whole, and it is
doubtful that any sensible way can be found to assign multipliers

to individual projects. Since in any case multipliers cancel out
of comparisons of projects of equal size, we recommend that project
evaluation be carried out ignoring multiplier effects. Such
effects tend to be relatively small in any case, averaging perhaps
1.1 times the incremental portion of government expenditures.
Further information on the magnitude of multipliers for different
policy alternatives can be found in a recent Bank of Canada Study
"Seminar on Responses of Various Models to Selected Policy Shocks"
(1982).

Input-Output: The use of the Input-Output tables for determining
impacts seems to be attended by some confusion: in some cases the
"input-output multiplier" seems to have been applied as if it were
similar to a Keynesian multiplier. The Input-Output tables consist
of a system of accounting that allows one to determine the
industrial distribution of the economic activity which is generated
by a given distribution of final demand among final demand
categories. The best source of information about the Canadian
Input-Output tables is the introductory chapters of the two
Statistics Canada publications "The Input-Output Structure of the
Canadian Economy 1971-77", Cat. 15-201E and "The Input-Output
Structure of the Canadian Economy in Constant Prices 1971-79" Cat.
15-202E.

The input-output system is based on a distinction between purchases for end use, or "final demand" purchases, and purchases of materials for further processing, or "intermediate input" purchases. When a consumer buys a car, an addition is made to final demand. The car manufacturer, to produce the car, must purchase steel, glass, and many other materials as intermediate input; the steelmaker in turn purchases iron ore, coal, paper clips, and cars, as intermediate inputs. And so on. In addition to material (intermediate) inputs, businesses also use "primary" inputs: labour, capital, and government services: these show up in the input-output tables as wages and other labour income (purchase of labour), profit ("purchase" of capital) and indirect taxes ("purchase" of government services). Subsidies are entered simply as negative taxes. Labour income and profit are defined as "value-added" inputs. The production process is thus conceived as purchasing commodity inputs and transforming them by the application of labor and capital into higher-valued outputs. The "gross output" is the value of the final product, and is the sum of all the inputs - commodity , tax, and value-added, which go into the production. The actual production that takes place in this stage is represented by the value-added. The distinction between gross output and value added is crucial if we are to avoid multiple counting of economic activity.

Starting with a vector of final demand values (consumption, investment, government purchases, exports, and

imports entered as negative) we can solve the input-output system
to obtain a vector of gross outputs, by either commodity or
industry. Having gross output by industry, we convert it to
value-added by the application of a special Value Added matrix.
The usefulness of the value-added concept is that it can be
totalled with adding anything twice (as gross output can not be).
The total of value added is called Gross Domestic Product at Factor
Cost. Adding in the total of net indirect taxes gives GDP at
Market Prices.

The accounting framework of the Input-Output system
implies a number of identities, of which the most important for our
purposes here is

Total primary inputs = total final demand,
or, in more familiar terminology

GDP at market prices = Expenditure on GDP at market
prices.

It follows from this that an addition to final demand
produces the same addition to total income (GDP). The input-output
system has no "multiplier" in the sense of producing an increase in
national income greater than the increase in final demand caused by
a project. The occasionally encountered belief that it does
apparently derives from a confusion between gross output and
value-added. A project that results in a net increase (after
allowing for displaced sales of other producers) of export sales

of, say, a pulp mill, of $10 million, and requires an investment of
$50 million which is incremental to the alternative case, will
produce a one-time increment to final demand of $50 million, plus a
yearly increment of $10 million, and the project therefore
increases national income by $50 million once and $10 million
yearly. There is no separate "input-output multiplier" as such;
final demand at market prices contains all information about
intermediate production. It is possible, using the input-output
matrices, to work back through the stages of production,
accumulating value-added and indirect taxes at each stage: the
result will be the same as the project value at market prices. If
the output of the project is a "public good" which is   not
marketed, such as improved air-sea rescue capability or landscape
beautification, then it is difficult to establish a market value
directly, and the "work back through the inputs" procedure is the
only one available. Some specifics of the method will be presented
further on.

All of this is sorted out automatically if the project is
simulated by a model. If a project is too small to justify the
cost of simulation, then the procedure outlined below can be used.

Use of the Input-Output Tables; Specifics: In this section we
describe the use of the Input-Output tables in a mechanical way.
More precise information for those familiar with the input-output
system is given in the appendix. The reader is again referred to
the Statistics Canada publications 15-201 and 15-202.

Given a vector of (increments to) final demand, one applies the normalized "Final Demand" matrix to obtain a vector of commodity requirements needed to supply the final demand. One then applies the normalized "Make" matrix to translate the commodity list into requirements for industry production. Intermediate inputs required for industry production are obtained by applying the normalized "Make" and "Use" matrices to industry gross output. Gross output is the sum of intermediate requirements and final requirements, and this relation provides a system of simultaneous linear equations which are solved to obtain the actual vector of gross outputs by industry. To this is applied the normalized "Primary Inputs to Industry" matrix to obtain the industry primary inputs required to satisfy the final demand. Adding the "Primary Inputs to Final Demand" gives total primary inputs required to satisfy the given final demand.

This rather complicated procedure can be collapsed to give directly the correspondence between final demand increments and primary inputs required to satisfy them. The correspondence is summarized in Table 1. The rows represent various categories of final demand and the columns the primary inputs required. This table is computed from the 1977 current-dollar matrices at the "Small" aggregation level, publication 15-201. Those wishing more disaggregation or other refinements are referred to the Appendix. The normalized matrices change only gradually, so the use of 1977 relations will be a reasonable approximation to current values.

The table omits two small primary inputs: Non-Competing Imports and Unallocated Imports and Exports, neither of which is of interest here. "Labour Income" consists of Wages and Salaries, Supplementary Labour Income, and Net Income of Unincorporated Business. It must be emphasized that this table represents final dispositions: all intermediate production and distribution is accounted for in the table, along with certain "leakages" such as imports of intermediate inputs. For example, for every $100 spent on consumer durables, $48.55 ultimately goes to labour income, $14.28 to indirect taxes, and $20.26 to other Operating surplus (primarily interest payments and profits).

Table 1

Primary Inputs Required to Supply $1
of Final Demand in Various Categories

Final Demand Category	Primary Inputs		
	Net Indirect Tax	Labour Income	Other Operating Surplus
Consumer Expenditure:			
Durables	.1428	.4855	.2026
Semi-Durables	.0999	.5116	.2117
Non-Durables	.1773	.4310	.2265
Services	.1055	.5035	.3087
Construction Investment:			
Business	.0680	.5503	.2160
Government	.0593	.5687	.1966
Machinery and Equipment			
Business	.0820	.4714	.2249
Government	.0768	.4652	.2259
Value of Physical Change in Inventories	-.0151	.6386	.0220
Exports	.0349	.4350	.2678
Re-Exports	.0185	.4694	.2439
Imports	+.0199	-.4297	-.2568
Current Government Purchase of Goods and Services	.0197	.7909	.1413
Sale of Goods & Services	-.0529	-.5560	-.3080

Source: Computed from 1977 Input-Output Matrices, aggregation "S",
          Statistics Canada 15-201.

When the net increments to final demand in the various categories have been determined it is a simple matter to convert to Labour income, using the second column of Table 1. Dividing by the average wage gives an approximation to the number of jobs. Note that Imports and Government Sale of Goods and Services, being categories of supply rather than demand, carry negative entries in the table.

IV. <u>An Example</u>

In this section we treat a hypothetical example; many simplifying assumptions are made to improve the clarity of presentation, which in an actual case should be subject to searching scrutiny. Most of these assumptions are listed below.

Suppose, then, that, an automobile manufacturer has a Canadian plant producing for the Canadian market, which requires a major refitting in order to remain competitive against imports and other domestic manufacturers. After the upgrading, it is expected that the volume of production in the plant will remain about the same as at present. The alternative to upgrading the plant is shutting it down and upgrading a plant outside Canada, importing its production to meet Canadian demand.

<u>Assume</u>

1) The planning period is from 1985 to 1996.

2) All amounts are expressed in constant 1985 Canadian dollars.

3) The investment planned for the Canadian plant is
1985	$80 million
1986	100
1987	40
1988	20

4) The gross output attributed to the investment is expected to be $100 million in 1987 and $150 million per year for the remainder of the planning period. As noted above the total output of the plant is expected to remain at current levels in real terms.

5) The net after-tax revenue attributable to the investment is expected to be $25 million in 1987 and $30 million thereafter.

6) The real private interest rate is 6%. The real
    government borrowing rate is 5%.

7) The investment expected for the foreign plant, if that
    alternative is chosen, is

1985	$85 million
1986	110
1987	40
1988	35

8) The net revenue expected from the foreign investment is
    $37 million each year starting in 1987.

9) The federal government has offered a package of
    inducements for the "Canadian" option consisting of
    a) Grants of $25 million in 1985, $45 million in 1986,
        $25 million in 1987, and $10 million in 1988.

    b) A loan guarantee of $80 million.
        Assume, in real terms, the loan is paid back in
        straight-line installments over the planning period,
        the real interest rate is 6%, and the probability of
        default in any one year is judged to be 5%. Assume
        also a risk-adjustment of 10% over the expectation
        is to be made in costing the guarantee. It is
        assumed that the guarantee allows the firm to borrow
        at 1.0% less than otherwise.

10) From the "M-aggregation" input-output tables (15-201) we
    learn that 40% of the total input of the transportation
    equipment industry consists of purchases of motor vehicle
    parts. Therefore we would expect that the project would
    result in a substantial amount of business for Canadian
    parts manufacturers if normal input-output relations hold
    for this project. It is learned, however, that Canadian
    parts makers will require substantial re-tooling to
    supply the upgraded plant, and failing this, most of the
    parts for the new production will be imported. The
    federal government has accordingly offered the parts
    manufacturers an assistance package of grants totalling:

1985	$10 million
1986	12
1987	8

    The parts manufacturers will invest a total of

1985	$20 million
1986	25
1987	15

11) All government expenditures are considered incremental
    in a budgetary sense: if the money were not spent on the

given project, then total government expenditure would be reduced by a like amount.

12) If the "foreign" option is taken, the federal government will offer the other Canadian manufacturers some inducements to increase Canadian production. These will be grants totalling

1985	$3 million
1987	5
1988	5
1989	8
1990	3

These incentives are expected to induce investments of

1986	$10 million
1987	20
1988	20
1989	20
1990	10

13) In the event of the "foreign" option, the combined effect of the extra investment, changes in consumer habits, and interest and exchange adjustments is expected to reduce the net loss in Canadian production by 40%, so that imports will increase by 60% of the gross output cost, i.e. 60% of $150 million, or $90 million, will be the loss of Canadian production and corresponding increase of imports.

14) There is no "crowding out": specifically, the government incentives are assumed to be financed by the sale of bonds, and arguments have been offered establishing that there will be no adverse effects on either investment or exports.

15) The average real wage, in thousands of 1985 dollars per man-year, is expected to be (these figures are taken from the latest Informetrica forecast)

1985	26.3	1991	29.1
1986	26.5	1992	29.6
1987	27.1	1993	30.0
1988	27.6	1994	30.4
1989	28.1	1995	30.9
1990	28.6	1996	31.4

16) One-third of the investment expenditure is for construction, and two-thirds for machinery and equipment.

17) All jobs are permanent.

Let us first consider the firm's decision in the absence of government inducements, and then with them.

Canadian Option (millions of 1985 Canadian dollars)

Present Value of Investment Outlays	226.73
Present Value of Net Revenue Stream	208.84
Difference (Net Present Value of Project)	-22.88
Present value of government incentives	
Grants	98.09
Loan Guarantee	4.27
Total	102.36
Net Present Value with incentives	79.48

Foreign Option

Present Value of Investment Outlays	253.76
Present Value of Net Revenue Stream	256.91
Net Present Value of Project	3.15

The present value of the foreign option is positive, and that of the Canadian option, in the absence of government incentives, is negative. Hence if the government does nothing, the firm will probably choose the foreign option. The Canadian option with incentives, however, has a much higher net present value than the foreign option, and so will probably be chosen. The difference between the two values is large enough to suggest doubts about whether the incentives offered are the minimum necessary to induce the desired decision.

Let us now consider the question of cost of the project per job generated. As emphasized before, cost and employment are to be estimated relative to the alternative to the project, and in the present case this means that we take the difference in cost and

jobs between the Canadian and foreign options. For convenience we lay out the relevant flows here, in millions of 1985 Canadian dollars. The cost of the loan guarantee, including risk-adjustment, is 1.1 times the expected loss, which is found by multiplying the probability of default (.05) by the amount of default in the given year. This declines over time as the loan is repaid.

Table 2

Canadian Option

	Government Costs			Investment	
	Grants to Car Makers	Grants to Parts Makers	Loan Guarantee	By Car Makers	By Parts Makers
1985	25	10	4.66	80	20
1986	45	12	4.28	100	25
1987	25	8	3.89	40	15
1988	10	0	3.50	20	0
1989	0	0	3.10	0	0
1990	0	0	2.72	0	0
1991	0	0	2.33	0	0
1992	0	0	1.94	0	0
1993	0	0	1.55	0	0
1994	0	0	1.17	0	0
1995	0	0	.78	0	0
1996	0	0	.39	0	0

Table 3

Foreign Option

	Government Grants	Investment	Net Imports
1985	0	0	0
1986	3	10	0
1987	5	20	60
1988	5	20	90
1989	8	20	90
1990	3	10	90
1991	0	0	90
1992	0	0	90
1993	0	0	90
1994	0	0	90
1995	0	0	90

Table 4

Increments: Canadian Option Minus Foreign Option

	Government Cost	Investment	Domestic Production
1985	39.66	100	0
1986	58.28	115	0
1987	31.89	35	60
1988	8.50	0	90
1989	-4.89	-20	90
1990	-0.28	-10	90
1991	2.33	0	90
1992	1.94	0	90
1993	1.55	0	90
1994	1.17	0	90
1995	.78	0	90
1996	.39	0	90

The second, third and fourth columns represent the increment to final demand of the Canadian option over the foreign option. We want to determine the labor-income component of this increment, so we use the input-output matrix Table 1 of the previous section, specifically the Labor Income column. Since we have assumed that investment is one-third construction and two-thirds machinery and equipment, we multiply one-third of the investment figure above by the Business Construction entry (.5503) and two thirds by the Business Machinery and Equipment entry (.4714). If the project involved significant infrastructure investment by the government, we would use the appropriate government construction rows. Since the Domestic production figures above in fact represent imports prevented, we use the Import entry in Table 1, which is .4297. The results are given in Table 5.

Table 5

Incremental Labour Income due to Project

From:	Investment	Domestic Production	Total	Jobs
1985	50.0	0	50.0	1893
1986	57.5	0	57.5	2158
1987	17.5	25.8	43.3	1592
1988	0	38.7	38.7	1399
1989	-10.0	38.7	28.7	1021
1990	-5.0	38.7	33.7	1179
1991	0	38.7	38.7	1328
1992	0	38.7	38.7	1306
1993	0	38.7	38.7	1288
1994	0	38.7	38.7	1270
1995	0	38.7	38.7	1250
1996	0	38.7	38.7	1233

The last column is the number of incremental full-time-equivalent jobs attributable to the project and is obtained by dividing the total incremental labor income by the real wage values given in assumption 16. These average 1410 over the planning period.

Now we work out the government's incremental cost. Incremental government outlays are given in the first column of Table 4. These outlays have a present value of $132.8 million, which corresponds to a constant annual stream (equivalent annuity) of $14.3 million per year. The present value of labour income (from Table 5) is $364.7 million, which means, in present value terms, that the government spends just over 36 cents for every dollar of labour income generated. This is perhaps a better measure of program effectiveness than cost per job, since labour income, after all, is the purpose of employment. We can obtain a measure of cost per job by dividing average outlay, ($14.3 million) by average jobs (1413), giving $10120 as a cost per job figure. The trouble with this is that it is arithmetically meaningless because the numerator is a different type of average (discounted) than the denominator (simple average). To get comparable quantities we need to form a discounted average of jobs, discounting by the same rate as for cost. This gives 1454 jobs, and dividing yields a cost of $9812 per job.

If detailed information on wage rates is available, then better job estimates can be made: instead of totalling the first three columns of Table 5 and dividing the total by the average

wage, we can divide the "Domestic Production" column by the average auto worker wage, the "Investment" column by one-third the average construction wage plus two-thirds the average manufacturing wage, and the "Income Effect" column by the economy - wide average wage. More generally, each source of labour demand attributed to a project should be divided by the wage appropriate to that source.

It must be emphasized that such a calculation is dependent on the assumptions that underlie it and it is essential that these assumptions be stated and justified. In particular the assumption of "no crowding out" of investments or exports requires careful argument, as does any assumption about the displacement of existing output by new output. Wirick (1983) discusses the issue of "crowding out" in a specifically Canadian context. Displacement questions must be addressed by an industry specific analysis of the product, its substitutes, and its market.

Appendix: The Input-Output Model

This appendix provides a precise description of the Input-Output matrix given in Table 1. Familiarity with the Statistics Canada input-output system, and with basic matrix algebra is assumed. The starting point is the "Impact" matrix provided in 15-201, which is defined as

$$Q = [I - D(I-M)B]^{-1}D$$

where   D   is the "Make" matrix normalized by column (i.e. each column is divided by the gross output of the corresponding commodity)

         B   is the "Use" matrix, excluding the primary input rows, normalized by column (each column is divided by the gross output of the corresponding industry)

         M   is a matrix of corrections for the effects of imports, government production, and inventory changes.

Now let E be the final demand matrix (excluding the rows corresponding to primary inputs) normalized by dividing each column by the corresponding total of the commodity rows and the primary input rows. The primary input rows themselves divided by the same total form the matrix Z, so that the column totals of E, plus those of Z, are equal to 1.

Finally, let P denote the matrix formed from the primary input rows of the "Use" matrix (these rows are denoted by YI in the Statistics Canada literature), by dividing each column by the corresponding industry gross output.

Given a vector f of final demand, the vector Ef represents commodity demand implied by f, and Zf the primary input demand. We convert Ef to industry demand by multiplying by D, and

the total implied industry gross output, including intermediate
inputs, necessary to satisfy f is given by QEf. The primary inputs
required for this gross output are obtained by multiplying by P,
and so the total primary input requirements implied by the demand f
are given by

$$PQEf + Zf = (PQE+Z)f.$$

The matrix PQE+Z at the "S" aggregation level is the one given in
Table 11. Note that for convenience of display Table 1 shows the
matrix transposed, that is with primary inputs corresponding to
columns and final demand categories to rows.

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