Multiplier Effects and Government Assistance to Energy Megaprojects: An Application to Hibernia

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Energy megaprojects typically require several years to construct and entail substantial costs. Those costs, in the form of employment, capital equipment and material inputs, are sometimes viewed as benefits. Moreover, the expenditures on these inputs can induce further increases in employment and income. On the basis of these project-specific and induced effects, government assistance is sometimes sought. This paper describes the very limiting circumstances under which government aid for that reason is justified. Those criteria are then applied to the Hibernia offshore oil development.

Il faut typiquement plusieurs années pour construire des mégaprojets énergétiques et les coûts en sont considérables. Les coûts encourus dans le domaine de la main d'oeuvre, des biens d'équipement et des matériaux sont quelquefois considérés comme des bénéfices. De plus, les dépenses relatives à ces facteurs de production peuvent induire une croissance ultérieure de l'emploi et des revenus. En se fondant sur ce genre d'effets relatifs à des projets spécifiques et induits, on sollicite parfois l'aide du gouvernement. Cet article explique les circonstances très particulières où l'aide du gouvernement est pour cette raison justifiée. Ces critères sont ensuite appliqués au projet Hibernia de prospection pétrolière en mer.

Introduction

Energy megaprojects are often touted as offering substantial benefits; benefits so large that governments may decide to provide financial support for them. One rationale for government support is the direct, and spin-off, employment and income effects that result from the development expenditures. And there may be other gains such as energy self-sufficiency, regional development, and technology transfer, to name a few. Economists typically argue that the resource rent that arises from the production stage is fundamental to the development decision, and that effects of the type discussed above, along with non-economic gains, ought not to be the factors that determine whether these projects proceed.[1] Nevertheless, in practice, these other considerations, especially the income and employment effects

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1/ Resource rent is the amount of revenues attributable to the resource itself. Thus, if a commodity is sold on a competitive market but the producer is earning revenues in excess of all costs, including allowance for risk and the normal rate of return on capital investment, then that surplus is the rent attributable to the resource.

of development, play a role in governments' decisions to give support. This seems especially true at times of, or in regions characterized by, high unemployment. This paper examines whether the employment and income effects deserve consideration when governments are called on to provide financial support for energy projects.

The paper deals with this issue in two ways. First, there is an extensive discussion of theoretical considerations. The key point here is whether the project-specific and the spin-off, or multiplier, effects arising from the development phase constitute benefits that should be considered by government when deciding whether to support what is ostensibly a private business endeavour. To resolve this issue requires, first, a review of the concepts of multiplier effects, and then, more substantively, a determination of when and under what circumstances these ought to count in government's benefit-cost calculus.

The second way in which this paper addresses the issue of the relevance of multiplier impacts is to consider a specific example, namely, the Hibernia development. That project involves the construction of a huge gravity-based structure and related facilities to be placed off the coast of Newfoundland to tap a large undersea oil and gas field. It was chosen as the illustrative example for several reasons. It is contemporary; the project is under way, with production expected to start in July 1997. The Government of Canada has provided substantial subsidization of the project, and has emphasized the project's huge employment benefits.[2] Finally, the development is taking place in Newfoundland where the unemployment rate is high by Canadian standards. This said, the issues raised with respect to the Hibernia project also apply to other energy-related projects, from coal mines, to tar sands projects, to nuclear plants; indeed many of the issues raised in this paper are also applicable to non-energy developments.

The remainder of the paper is organized in the following fashion. The next section deals with income and employment multipliers, deriving basic formulas for their calculation and elaborating on those concepts themselves. Following this is a discussion of the limited circumstances under which multiplier effects may justify government support of private projects. The two subsequent sections deal with Hibernia; one giving a brief background on the project, and the other applying the methodology of this paper to calculate a range of estimates for its income and employment effects. The final section is a conclusion.

Income and Employment Multipliers

The cost of putting a facility in place includes the employment of labour as well as the acquisition of materials and services. Besides these effects, those whose earnings arise from the project spend a portion of their earnings on the consumption of goods and services that are totally unrelated to the project. The income generated by this respending of earnings gives rise to what is known as the multiplier effect. Proponents of megaprojects sometimes argue that not only are the project-specific purchases of labour and materials beneficial in some sense, but that the induced, or spin-off, effects are also benefits. Consequently, the remainder of this section reviews in detail the simple analytics of multiplier effects. The next section then discusses whether these notions are in any way relevant to the argument for government involvement.

At this stage, the meaning of income should be clarified. The income concept used in this paper is Gross Domestic Product (GDP) at factor cost. It measures, for some specified period, the value, exclusive of indirect taxes and subsidies, of final goods and services pro-

2/ In his news release of January 15, 1993, which announced the latest agreement on the Hibernia project between the federal government and the consortium of private companies, the Honourable John Crosbie emphasized that Hibernia "will contribute to business growth and employment opportunities, not only in Newfoundland, but throughout the country." He also highlighted that Newfoundland would get 25,500 jobs spread over the construction period and 2,500 permanent jobs per year would be created during production.

duced within the geographic boundaries of a region.[3] GDP is measured in both current and constant prices. When expressed in constant prices, GDP is purged of all effects of inflation; it is calculated as if prices were the same in every year as in some chosen base year. Constant dollar GDP can rise only because of an increase in the level of economic activity. Thus, constant dollar, or real, GDP is the most widely-used indicator of economic performance. All further references to GDP will be in real terms.

The total increase in GDP arising from a project's development expenditures shall be denoted by Y. It may be represented by the following expression:

$$Y = MkI \qquad (1)$$

which is a multiplicative product of three terms. I is the total development expenditure, k denotes the yet to be defined capture rate, and M denotes the value of the GDP multiplier. The development expenditure, I, is straightforward. It is simply the constant dollar expenditure per period paid on all the services and material inputs required to construct and install the capital needed for production. The capture rate, k, and the multiplier, M, require more elaboration.

The capture rate is the fraction of the development expenditures that translates into earnings by domestic factors of production employed directly or indirectly during the development phase.[4] For example, in the first year of development there may be $1 billion of expenditures. Some of this may go directly to the purchase of imported goods and services. As a result, less than the $1 billion is actually spent within the domestic economy. In addition, not all the spending within the economy translates into earnings of domestic factors of production. Some locally purchased inputs will have been produced with some imported materials and a portion of the spending will be siphoned off by indirect taxes on the purchases. After adjusting for the direct and indirect import content of project expenditures and for indirect taxes, the residual is the share of the project expenditure that accrues to, or is captured by, domestic factors of production. The ratio of this smaller amount to total spending is the capture rate.

To determine the GDP multiplier, M, the nature of the spending effects must be made more precise. To do so, assume that one new dollar of GDP has been generated as a direct result of project expenditures. Not all this dollar of GDP will translate directly into personal incomes for domestic residents. There are two main reasons for this. First, a portion of the dollar must cover the wear and tear on physical capital used in the production process, the depreciation. Secondly, a portion of the increase in GDP will be business profit, only some of which will accrue to domestic residents.[5] In short, only a fraction of the one-dollar increase in GDP will be reflected in the personal incomes of domestic residents. Let that fraction be denoted by "r" and call it the "retention" factor.

Although personal income will rise by r per dollar of GDP increase, not all this increase will be available for spending. A fraction of it will be subject to direct taxation, largely personal income taxes.[6] Let t denote that fraction. Thus, the amount available for spending by the private sector is r(1-t). Of this amount, some will be saved and the remainder spent. Let c denote the portion that is spent. Then c(1-t)r is the increase in spending that results from a one-dollar increase in GDP. Additionally, a

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3/ Indirect taxes refer to taxes on purchases. Provincial retail sales taxes and the federal goods and services tax are examples of indirect taxes in Canada.

4/ By "domestic factors of production", it is meant that labour and capital owners reside within the relevant jurisdiction — country, state, province — as opposed to foreign-owned factors of production involved in the project.

5/ Specifically, some corporate profits will be retained by the corporation and some will be paid out as dividends to non-resident shareholders.

6/ Direct taxes are taxes on income or wealth. In Canada they include personal income tax and other levies related to income such as Unemployment Insurance premiums, Canada Pension Plan or Quebec Pension Plan premiums.

share of this spending, denoted by i, will be devoted to the acquisition of imported goods and services, leaving (1-i) for domestically produced commodities. Hence, the amount of the one-dollar increase in GDP that gets spent on domestically produced goods and services is c(1-t)r(1-i). This must be adjusted by the amount of the spending that covers indirect taxes. Letting t_1 denote the fraction going to pay these taxes, the expression for the second-round expenditure effect on GDP becomes $c(1-t)r(1-i)(1-t_1)$.

Repeating this process for each subsequent expenditure round generates an infinite geometric progression. A little mathematical manipulation yields the expression for the sum of that series:[7]

$$M = \frac{1}{1-c(1-t)r(1-i)(1-t_1)} \qquad (2)$$

One could make this expression more precise by incorporating further detail.[8] Still, the formulation in equation (2) reflects the major determinants of the GDP multiplier; more complete versions would not differ significantly in terms of the implied magnitude of M.

Having expounded on the GDP multiplier and the capture rate, one can now suggest an interpretation of the multiplicative product, Mk, found in equation (1). It is the "project-specific multiplier." Its value represents the total increase in income that results from each dollar of project expenditure. The value of k varies with the capacity of the economy to provide the sorts of inputs required for the project. For different projects, capture rates will generally differ.

Before discussing the relevance of GDP multiplier effects, it is worthwhile to address the related notion of the employment multiplier. This entails determining how a change in GDP can be converted into its associated employment impact. The total employment impact of a project can be expressed as the sum of project-specific employment and resultant spin-off employment.[9] Estimates of project specific-employment are normally available and are reasonably accurate. As such, an approach is needed to derive the spin-off employment. To do this, one may use the following procedure. First, calculate the induced impact upon GDP by deducting the direct impact on GDP, kI, from the full impact, MkI. The result is (M-1)kI. Secondly, transform this induced income effect into its full-time employment equivalent. This may be estimated using a simple rule-of-thumb: namely, multiply the induced GDP impact of the project by the ratio of employment to GDP for the economy as a whole (EMP), an approach also used in Davis (1986). Thus, the total employment impact of the project may be estimated using:

$$N = E + (M-1)kI(EMP/GDP) \qquad (3)$$

where N denotes total employment resulting from the project; E is project-specific employment; and EMP/GDP denotes total full-time equivalent employment in the economy relative to the economy's GDP. The employment multiplier associated with the project is simply the ratio, N/E.

Implications for Project Evaluation

There is often confusion over the relevance of

7/ This formulation assumes none of the generated tax revenue flowing to the treasury gets respent in the economy. That is, all of the project related tax revenues flowing to the government are used for debt retirement.

8/ This could be accomplished by separating out the many different types of direct and indirect taxes rather than using a single value to represent each. Additionally, if the project were very large, other relevant variables, such as exchange rate changes, interest rates changes and domestic price effects could be affected and those effects could be incorporated into equation (2); all would tend to lower the value of M, thus reinforcing the key point of this paper.

9/ To be consistent with the project-specific expenditure multiplier, project-specific employment includes direct and indirect project employment. Often, impact analyses categorize employment effects as either direct, indirect or induced. Here, direct and indirect employment are subsumed under the category project-specific employment.

multiplier effects in assessing the appropriateness of allocating public funds. Whether multiplier effects should be included in such assessments depends on the characteristics of the project concerned. For purely "public" projects, there is overwhelming consensus in the literature that multiplier effects are largely irrelevant in determining whether to fund the project. The term "purely public projects" describes not all projects involving government funds, but a subset of those activities. Specifically, projects of this type are ones that generate insufficient profits to have them financed at socially desirable levels by private firms.[10] Examples are numerous and include: roads, police protection, the justice system, education, national defence, information collection and dissemination, environmental protection, and health services.[11]

To decide on the desirability of specific projects associated with such activities, "cost-benefit" analysis is the appropriate tool. The cost-benefit literature suggests that when projects are of the purely public type, multiplier effects ought not to be considered. In fact, many economists who write on cost-benefit analysis do not even mention multiplier effects in their discussion of what should be included as benefits and costs.[12] Others that discuss such effects, generally do so to warn against their inclusion.[13]

There are several reasons for these opinions regarding purely public projects. The most obvious case is when the economy is at or near full-employment.[14] The slightly more complicated case is when there is a substantial deviation from full-employment. It could then be argued that resources used in a public project may have been under-employed, implying that the contractionary effect due to hiring these resources may be small, relative to the multiplier effect that is generated. This line of argument may not be valid because the deviation from full-employment may not be long-lived. Therefore, for other than short-lived projects, full-employment may prevail for most of the construction period. On the other hand, structural and regional unemployment can be long-lived. Even in these cases it can be argued that, since governments have limited budgets, expenditures on one project is at the expense of another. Different projects may have different multiplier effects, but as noted by Tresch (1981, p.559):

> Unless one can argue convincingly that some particular project will have unusually strong multiplier effects, there seems little point in attaching a multiplier analysis to a cost-benefit study.

This differential among multipliers offers a basis for government assistance to private projects as well. Private projects are those that put in place or maintain facilities that produce goods and services to be sold for private profit. Despite the lack of collective or social benefit and the private nature of such projects, governments sometimes assist them with grants, loan guarantees, equity positions, or favourable tax treatment. One rationale for giving such help is the belief that project-specific and induced GDP effects will be large. If that belief were correct, then government would recoup much of the assistance through the taxation of the economic activity generated. Even without full recovery, additional disposable income

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10/ Such underprovision, despite the fact that people value the commodity, typically arises because the nature of the commodity makes it difficult or impossible to charge those who benefit.

11/ These types of commodities are called "public goods." For a detailed description of the characteristics that distinguish pure public goods from other goods, see Boadway and Wildasin (1984).

12/ Examples include Boadway and Wildasin (1984), Mishan (1976), Gramlich (1981), and Ray (1984).

13/ See, for example, Tresch (1981), Treasury Board (1976), and Dasgupta and Pearce (1972).

14/ In that situation, resources used in the public project must be bid away from the activities in which they would have otherwise been engaged. The expansionary multiplier effect from the public project would be offset by the contractionary multiplier process associated with foregoing the alternate activities. Inclusion of multiplier effects in determining whether the public project should proceed is, in these circumstances, incorrect.

accrues to residents of the economy that could offset the cost of government assistance.

For these private projects, caution is still in order. Multiplier effects become relevant only in special cases. It would have to be that the private expenditure would not otherwise have occurred in some form in the economy. That is, it must be a new injection of spending that does not simply substitute for another investment expenditure that becomes deferred. If it is truly new spending in a situation of prolonged unemployment, then the total of this spending, net of government assistance, causes a multiplier effect. Again, it must be stressed that if the government finances the project entirely or if the expenditure would have occurred in another form anyway, there would be no net employment or income improvements.[15] This point is of fundamental importance.

Whether government-assisted projects fall into the private or public categories there are other considerations that ought to enter the decision-making process. Another argument against the inclusion of multiplier analysis is that government spending has to be financed by either current or future taxation.[16] As there is a multiplier effect for project expenditures so, too, is there a contractionary multiplier effect associated with the imposition of taxes to finance the project. Consequently, the net multiplier effect can be expected to be small, as the two opposing forces may be largely offsetting.

In short, government assistance to private energy developments based on the employment and income impacts of the development phase can be justified only in very limited circumstances. There must be unemployment and, as Tresch (1981) suggests, the multiplier effects must be relatively large. Moreover, government must consider the adverse impact on the economy of the imposition of taxation required to finance their contribution to the project. On top of all this, the expenditure must be new in the sense that it would not otherwise have occurred elsewhere in the economy in a similar or different form. These are extreme limitations. The Hibernia project is perhaps one that might satisfy these criteria.

Background on Hibernia

The Hibernia project involves the development of an offshore oil field 315 kilometres east of St. John's, Newfoundland. Estimated recoverable reserves are between 525 and 700 million barrels, and the project will achieve a plateau production rate of approximately 110,000 barrels of oil per day. Its estimated as-spent development costs, based on 525 million barrels of recoverable reserves, consist of $5.2 billion in preproduction cost and $3.3 billion that occurs after production. As well, the operating phase entails an additional expenditure of $10 billion.[17] The corresponding constant 1990 dollar costs are: $4.3 billion for preproduction capital, $1.9 billion for other capital, and $4.7 billion for the operations phase of the project.[18]

Development is being undertaken with generous financial support from the Canadian government. Under a prior agreement with the private developers, the federal government will contribute 25% of the pre-production capital expenditures up to a limit of $1.04 billion, and provide up to $1.66 billion in loan guarantees. Recently, necessitated by the withdrawal of one of four developers from the development consortium, the federal government also took an 8.5% working interest to

15/ There would obviously be redistributional implications, but their combined effect would be a zero or perhaps a negative sum.

16/ Even in the event that government borrowed the funds by issuing bonds, additional taxation is still required to pay for the interest and for provision for future payment. In short, borrowing merely allows flexibility in determining the timing of taxation.

17/ This information was obtained from provincial government officials.

18/ The analysis of the next section utilizes a total of pre-production and other capital expenditures of $4.8 billion, measured in 1984 dollars. This corresponds to the 6.2 billion 1990 dollars and the 8.5 billion as-spent dollars mentioned in the text. The 1984 numbers are used since more detailed breakdowns are not available.

ensure that the project would proceed. The federal government has defended its support by pointing to the amount of employment that it would create in a low-employment region.[19]

Because of the size of the Hibernia development project and the uncertainty regarding its impact on the province and the country, both the provincial and federal governments required an environmental impact statement (EIS) by the development consortium.[20] Mobil Oil, the largest participant in the consortium, provided the EIS, which had to identify the significant social, economic, and environmental impacts of the project. In May 1985, Mobil submitted the EIS to the Hibernia Environmental Assessment Panel.

Mobil's EIS is a comprehensive document dealing with the implications of the Hibernia development for the nation, Newfoundland, and specific regions of the province. It deals with the alternate technologies that were considered, the rates of oil production, the direct and indirect employment associated with the different phases of the project, the capital and operating costs, the environmental considerations, the social and demographic effects, the implications for Canadian oil self-sufficiency, and the total income and employment effects for both Canada and Newfoundland. As comprehensive as this list is, it is astonishing to discover no mention in the EIS of any payment of oil royalties to either level of government. This leaves the distinct impression that the project's GDP impact and the associated employment impact are the primary, if not sole, benefits that the province and Canada can expect. This impression is the result of a peculiar aspect of the Terms of Reference given to the Environmental Impact Assessment Panel; discussion of resource rents was explicitly prohibited![21]

Much of the previous discussion on project evaluation is applicable to the Hibernia development. The employment aspects of the project were used to justify government financial support and, at least more recently, with the low world price of oil, there has been little or no reference to potential resource rent from oil and gas production. As the previous sections imply, there is little in the way of economic rationale for government involvement in energy megaprojects of this type, except in special circumstances. As Newfoundland is a region of high unemployment, and since the expenditure on Hibernia may not have occurred without the government's contribution, one may argue that this is a legitimate exception to the rule. That case would be further strengthened if the employment and income effects from the project in the region can be expected to be large. Those magnitudes are the subject of the following section.

19/ In the Atlantic Accord (Government of Canada, 1985), both the federal and provincial governments suggested that the Hibernia project would contribute to economic growth and development and offer some relief of regional disparities. Similarly, "The Hibernia Announcements" (Department of Mines and Energy, 1990) stress the project's employment and business opportunities.

20/ The original Hibernia consortium consisted of Mobil Oil Canada Ltd. with 28.125% of the project, Gulf Canada Corporation and Petro-Canada Inc. with 25% each and Chevron Canada Resources Ltd. with the remaining 21.875%. In February 1993, Gulf announced that it would be withdrawing from the Hibernia project. This void in the consortium was filled in January 1993 when Gulf's share was divided as follows: Mobil and Chevron each assumed an additional 5% of the project, the Government of Canada took an 8.5% working interest and Murphy Oil Corporation assumed the remaining 6.5%.

21/ The EIS's emphasis on spin-offs and the neglect of resource rents is a matter of great concern. First, royalty payments on oil production are potentially large, depending, in part, on the price of oil. These royalties, if collected, could enable the province to cut taxes significantly, in order to generate economic activity elsewhere in the economy, and to finance a substantial increase in public services. The extent to which these goals can be achieved depends on the amount of the resource rent and the share which the province is to receive. This is not to deny that the immediate impact of having local firms and workers employed in the development stage is also important.

A central issue to consider regarding spin-off effects and resource rents is that the two are not independent of one another. The choice of one

Employment and GDP Effects of Hibernia Development

As shown earlier, the project-specific multiplier for Hibernia is the multiplicative product of the GDP multiplier and the capture rate for the project. Based on a review of the relevant literature and statistics, this paper uses a GDP multiplier for the Newfoundland economy of 1.28.[22] In other words, for an initial one dollar increase in GDP the subsequent rounds of spending increases GDP by a further 28 cents. This estimate of the GDP multiplier, was calculated based on estimated parameter values of the various components of the multiplier as identified in equation (2). Those values are 0.85 for c, 0.55 for i, 0.185 for t, 0.09 for t_1, and 0.775 for r, where these represent the consumption, import, direct tax, indirect tax, and retention parameters, respectively.

This estimate of the expenditure multiplier is consistent with those made by others for different regions. For instance, Davis (1986), for British Columbia, estimated values for multipliers between 1.19 to 1.49, and Miller (1979) found, for several provinces, multipliers ranging from 1.19 to 1.90. Black (1981), King (1981), and McGuire (1983) have found similar magnitudes for various regions of the United Kingdom.

The other component of the project-specific GDP multiplier is the capture rate, k, which by definition is a fraction. For most projects taking place in a small economy, like Newfoundland's, its value is likely to be closer to zero than to one.[23] Therefore, whatever the project, the associated project-specific multiplier is very unlikely to be greater than one, or even close to that value, for most projects in that economy.

To determine an estimate of the Newfoundland economy's capture rate for the Hibernia project, the total development expenditure was divided into four expenditure categories: (i) materials, (ii) equipment, (iii) services and (iv) contracting. Each of these categories was subdivided into expenditures that would take place inside and outside Newfoundland. Ranges were then constructed on the amount of the expenditure occurring in Newfoundland that would translate into provincial GDP.

Table 1 illustrates the derivation of the development phase capture rates for the Hibernia project. The table shows that for the $4.8 billion (at 1984 prices) in total expenditure presented in the EIS, approximately 21.6% is expected to be spent in Newfoundland. However, as discussed earlier, not all that 21.6% can be expected to translate into provincial GDP. This is particularly true for both materials and equipment. As shown in Table 1, 25 to 35% of materials expenditure and 15% to 25% of equipment expenditure translate into provincial income. For services and contracting, with their higher labour content, provincial income will increase between $0.60 and $0.80 for each dollar of expenditure in the province. As suggested in Table 1, the overall capture rate on the total development expenditure falls in the

type of technology, such as a fixed production system, combined with local preference policy, may maximize local participation and spin-offs. At the same time, however, there will be implications for the magnitude of the resource rents. Any policy which makes costs higher than the minimum possible costs will be at the expense of resource rent. Of course, there may be good reasons for trading off some higher costs of development against future royalty payments; but, as emphasized by Osberg (1986), it is essential that policy-makers be aware of that trade-off. The EIS dealt with only one side of the trade-off, local content and spin-off effects, and neglected the other entirely. At the same time, it also appears that the magnitude of the spin-off effects given in the EIS are grossly overestimated.

22/ All of the quantitative estimates provided in this paragraph were obtained by the authors through a detailed examination of official documents. More details on these estimates and their source are available from the authors upon request.

23/ The capture rate is probably closer to zero than to one for most projects taking place in Newfoundland because the skilled labour force, technology and industrial structure are such that most of a project's key components would have to be imported.

Table 1: Hibernia Development Expenditure by Category and Projected Capture Rates: Fixed Production System

	Expenditures (mil.1984$)	Proportion of Expenditure to be Spent in Newfoundland (%)	Share of NF-based Expenditure that Translates into GDP (%)	Capture Rates, lows and highs (%)
Materials	720	18	25-35	4.5-6.3
Equipment	720	5	15-25	0.75-1.25
Services	1,200	26	60-80	15.6-20.8
Contracting	2,160	26	60-80	15.6-20.8
Total	4,800	21.6	54.2-72.7	11.7-15.7

Sources:
Expenditure Breakdown: Atlantic Consulting Economists Ltd. (1985, p.49).
Proportions to be spent in Newfoundland (NF): Atlantic Consulting Economists.
Notes:
1/ Column 5 = Column 3 multiplied by Column 4
2/ The totals for columns 3, 4 and 5 are weighted averages.

range of 11.7 to 15.7%. Therefore, if development proceeds as outlined in the EIS, the provincial capture rate probably would be in the 12 to 16% range.

The multiplier effect on provincial GDP associated with the Hibernia development project is, as discussed earlier, simply the capture rate multiplied by the GDP multiplier. Therefore, with capture rates ranging from a low of 12% to a high of 16% and a multiplier of 1.28, the provincial project-specific multiplier associated with Hibernia would fall between a low of 0.15 and a high 0.20; that is, for each dollar of development expenditure, Newfoundland GDP can be expected to rise by 15 to 20 cents.[24,25] Rather than choose the midpoint and work with a single value, it is more prudent, because of the high level of uncertainty regarding the capture rate, to use both the low and high scenarios. Thus, for the total project development expenditure of $4.8 billion (1984), the project-specific multipliers imply GDP will rise by a low of $0.72 billion (0.15 times $4.8 billion) or a high of $0.96 billion (0.20 time $4.8 billion). Of these amounts, $0.20 billion and $0.27 billion represent the respective induced impact.[26] These dollar figures are expressed in 1984 prices and span the fourteen-year development phase.

To figure out the total employment effect in the province due to the development phase simply requires the substitution of the required data into equation (3). Recall that in (3), total employment is the sum of the project-specific employment and the induced employment. The former is 10,270 person-years spread over the fourteen year development phase, according to the EIS.[27] Calculation of the

24/ For the United Kingdom, King (1981) found that the value of project-specific multipliers ranged from 0.23 to 0.62. Since Newfoundland is only a small part of the Canadian economy and in light of the capital-intensive nature of offshore development, the multiplier effects for Newfoundland would likely lie at the lower end of or below this range. Therefore, 0.15 to 0.20 as a range of estimates for the Hibernia multiplier in Newfoundland seems quite reasonable.

25/ Note, however, that the 0.15 to 0.20 range is assumed to hold on average during the period. This is not to say that observations outside this range will not occur for some sub-periods.

26/ The estimates for the low- and high-impact cases were calculated as (1.28-1)(0.15)($4.8 billion) and (1.28-1)(0.20)($4.8 billion), respectively.

27/ See Mobil Oil Canada Ltd. (1985, p.214) for this figure and its annual breakdown.

induced impact requires additional data, one of which is the induced component of the GDP impact. As estimated above, that ranges from a low of $0.20 billion to a high of $0.27 billion (1984). The other datum required is the ratio of employment to GDP, where employment is expressed in full-time equivalence. In the calculations that follow, we use the ratio of full-time equivalent jobs in Newfoundland to real provincial GDP. That number is 27,400, which means that associated with each billion in provincial GDP (in 1984 dollars) there are 27,400 jobs. Thus, using equation (3), the induced employment impact of Hibernia ranges from the equivalent of 5,480 to 7,398 person-years of employment over the fourteen year development phase, for the low- and high-impact cases, respectively. Total employment is then 15,750 person years (10,270 + 5,480) for the low case and 17,668 person-years (10,270 + 7,398) for the high case. The implied employment multipliers are 1.53 and 1.72, respectively.

In summary, the projections of the employment and GDP of development expenditures for the two cases are:

	Low Impact	High Impact
Capture rate (%)	12	16
GDP impact (billion 1984$)	0.72	0.96
Employment impact (person years)	15,750	17,668

and if these figures are divided by the fourteen years over which they occur, the annualized average employment impact is merely 1125 person years for the low-impact case and 1262 person years for the high-impact one. The corresponding annual average figures for the GDP impact are, in 1984 dollars, $51.4 and $68.6 million, respectively. Relative to either the total expenditure on development or to the size of the government assistance provided, these figures are small.

It would be interesting to compare these projections with those of the EIS. Unfortunately this cannot be done. The EIS provides estimates of the total impact of Hibernia on provincial GDP and annual employment over the fourteen-year "development" phase. But, production begins after the fifth year and the EIS does not isolate the effect of development on GDP from that of production. Since the focus of this paper is on the impact of development spending, and to ease comparison with the EIS, only the first five years are examined.

Project-related expenditures, during each of the first five years of development, range from $80 to $770 million per year, and total $2,455 million (at 1984 prices) (Mobil, 1985, Table 4.1-2, p. 184). Over the same period, annual employment effects in the province, in terms of those involved in putting the production facilities in place, range from 175 to 2,145 person-years of employment, and total 5,985 (Mobil, 1985, Table 4.2-7, p. 214). Using the method described in this paper to estimate the total impact on provincial GDP and employment over those five years, the expenditure of $2,455 million is multiplied by the project's low- and high-impact multiplier values of 0.15 and 0.20, respectively. This results in an estimated total impact on GDP of $368 million for the low case and $491 million for the high. Similarly, the total employment impact for the first five years is approximated using the formulation in equation (3). The total employment attributable to the project during that period is 10,083 to 13,453 person years. The ratio of this total to project-specific employment is the employment multiplier. Here its calculated value is 1.68 for the low-impact case, and 2.25 for the high-impact one.

Now, let us compare these estimates of the initial five-year impacts, with those presented in the EIS. According to the EIS the increment to real GDP over the five-year period, inclusive of multiplier effects, would be $938 million (Mobil, 1985, Table 4.4-3, p. 231); well in excess of the range $368 million to $491 million estimated above here. A similarly large discrepancy arises when translating this increment in GDP into associated employment. The employment impact presented in the EIS is 26,400 person-years over the five years (Mobil 1985, Table 4.4-4, p. 231). This is in contrast to the range 10,083 to 13,453 person-years

calculated herein. In short, the EIS overestimates the provincial GDP and employment impacts of Hibernia development by 91 to 155% and 96 to 162%, respectively; quite significant differences.

Conclusion

There is often too much emphasis placed on the income and employment involved in putting new public and private facilities in place. One item that leads to such unwarranted emphasis is the belief that multiplier effects are large, generating increases in employment and income well in excess of the expenditures and employment directly involved. It is argued here that, when projects are for public benefit, then such multiplier effects are largely illusory and should not play any role in deciding whether the project should proceed.

For private projects, that would not have otherwise occurred within the economy in one form or another, multiplier effects may represent additional gains when there is a substantial amount of unemployment. Still, even with these types of projects, should government assistance be requested, it is necessary to ascertain whether the investment would have occurred in either case, and it is also important to realize that multiplier effects may well not be very large. In the most favourable of circumstances, the project-specific GDP multiplier is unlikely to be greater than one. This means that for each dollar of expenditure on a facility, the consequent rise in regional GDP, inclusive of the direct effect of that expenditure, is unlikely to exceed one dollar.

To add substance to these points the effects of the Hibernia development were considered, a development that arguably meets the criteria for government assistance, particularly if the multiplier effects are large in some sense. This paper finds that the investment expenditures on Hibernia do not generate employment and income effects that are large relative to the total expenditure, or even relative to the level of federal government assistance. Moreover, the environmental impact statement of the development consortium provides estimates of GDP and employment effects that are substantially higher than what can be realistically expected. In short, the jobs-creation argument for the justification of government assistance to Hibernia is very weak. Perhaps other considerations, like infant industry arguments, could justify government's assistance, but this study suggests that the multiplier effects arising from the development do not appear to be important enough to do so. It seems a remote possibility that any private energy project would meet the criteria suggested here for government aid.

Epilogue

On April 15, 1993, following the completion of this paper, *The Globe and Mail*, Toronto (pp. B1-2), reported that the Hibernia consortium announced that the cost of Hibernia oil would be 21% lower than the estimate included in the EIS would suggest. According to that group, technological improvements and changes in design would permit these savings, which would accrue during both development (15% saving) and production (26% saving) phases. These cost reductions are roughly comparable to the government subsidy for the project that was secured based on the higher cost estimates. In addition, the same newspaper article notes that the estimate of recoverable reserves has risen to 666 million barrels, which would imply an increase in estimated revenues of at least 10%. With higher revenues and lower costs, one must wonder why public-sector assistance remains necessary, and why the Government of Canada recently had to purchase an 8.5% interest in the project.

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