Georges Bank Petroleum and New England Regional Income

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I. Introduction

There is a genuine possibility of petroleum production on the New England Continental Shelf. The last Department of Interior schedule I saw called for a Georges Bank lease sale in the summer of 1976. If this schedule is maintained, by mid-1977 we should have a pretty good idea of the scale of production possible for the Georges Bank, if any. Actual production could begin by 1980 with production peaking in the mid-eighties and early nineties.

Contemplating such a development, an obvious, if not particularly edifying question is: What's in it for us? What will be the economic impact on New England of Georges Bank petroleum? In order to answer this question, we must first ask ourselves: What's in it for the Nation? Having answered this question, we can then ask ourselves what portion of any increase in national income is likely to accrue to New England.

II. The Impact of Georges Bank Oil on National Income

With respect to "what's in it for the Nation," the answer is — possibly a great deal. As part of our work on offshore oil at MIT, we have constructed a computer program known as the Offshore Petroleum Development Model. The program, outlined in Figure 1, takes as input a number of geological variables describing a hypothetical offshore find (amount of oil in place, amount of gas in place, type of reservoir drive, permeability, viscosity, pay thickness, etc.). The input also includes variables describing the location of the find such as distance to shore, water depth over the field, and platform design wave height. Finally, the user of this program must also specify a number of financial and regulatory variables including the landed price of oil and gas, cost of capital, lease payment and royalty laws, and allowables.

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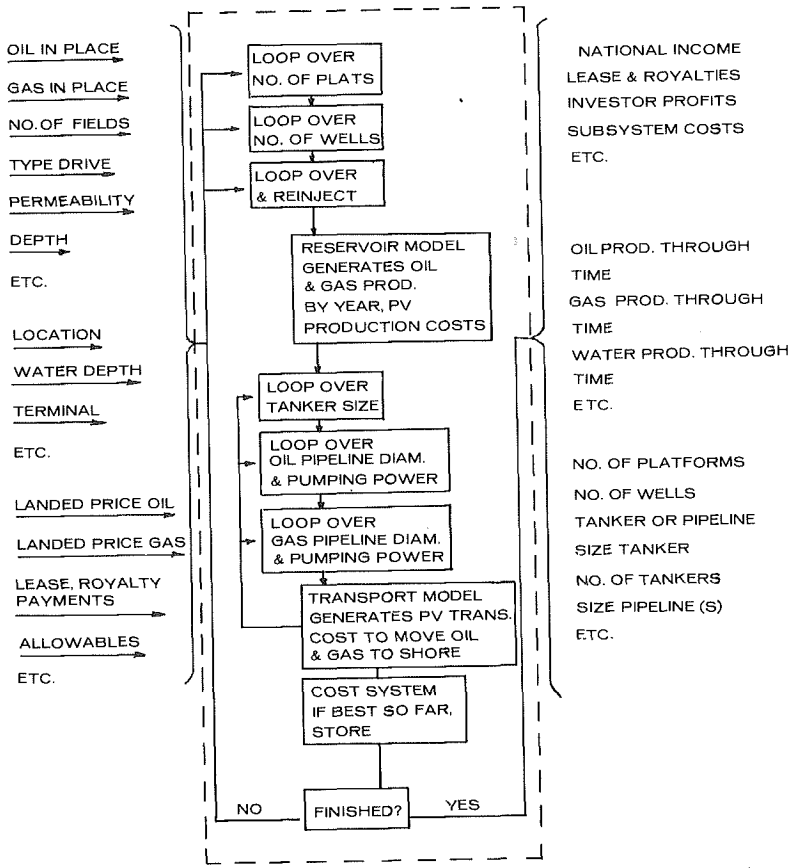
Figure 1

OFFSHORE DEVELOPMENT PROGRAM



The heart of the program is a reservoir model which simulates the stipulated reservoir's physical response by year to a particular development strategy. The computer examines a number of such production strategies, varying number of platforms and wells installed, and the amount of reinjection. For each such production strategy, the computer examines a number of different transportation systems for bringing the resulting oil and gas ashore.

The program selects that combination of production strategy (number of platforms, number of wells, amount of reinjection) and that transportation system (size of tankers and diameter of oil pipeline and/or diameter of gas pipeline) which maximizes the investor's present value after-tax profits. The output from the Offshore Development Model also includes the resulting oil and gas production through time, and the time stream of financial payments to public bodies and suppliers.

One can learn a number of things from such a model but the single most important result to date is illustrated by Figure 2. This figure shows the model's estimates of the unit resource cost of landing Georges Bank oil for a range of find sizes and types. The *unit resource cost* is the per barrel loss in national income associated with diverting the men, steel, energy, and capital required to produce this oil from alternate employment. It is an estimate of the national income these resources could have produced elsewhere if they were not used in producing this oil. Assuming reasonably full employment in the supplier markets, this loss in national income is approximated by the pre-tax, pre-lease bid and royalty, present valued cost to the developer, placed on a unit of output basis.

According to our analyses, the unit resource cost to the Nation depends sharply on the size of the find. Further, for large finds, this unit resource cost can be as low as $2.00 or $3.00 per barrel; far below the current cost to the Nation of landed OPEC crude — about $13.00 per barrel.

In other words, if we find a lot of oil on the Georges Bank, say one billion barrels recoverable, the present value increase in real national income could be as much as $10.00 per barrel or $5-$10 billion in aggregate.[1] Such numbers take on added significance when it is realized that almost all petroleum both in this country and abroad is produced from a very few, extremely large fields. Worldwide 65 percent of all petroleum reserves is contained in less than 50 fields. Some 50,000 oil fields have been found in the United States. However, the top 250 fields contain 65 percent of all remaining reserves. The top 11 fields, shown in Table 1, contain close to 50 percent of remaining reserves and the single largest field, Prudhoe Bay, 25 percent.

[1]These numbers and all the subsequent analysis assume that the OPEC cartel is not broken. If it is, and c.i.f. OPEC crude prices fall to the long-run cost of production and transport, about $2.50 per barrel, then even a very large find on the Georges Bank will be a marginal investment from the point of view of the country.

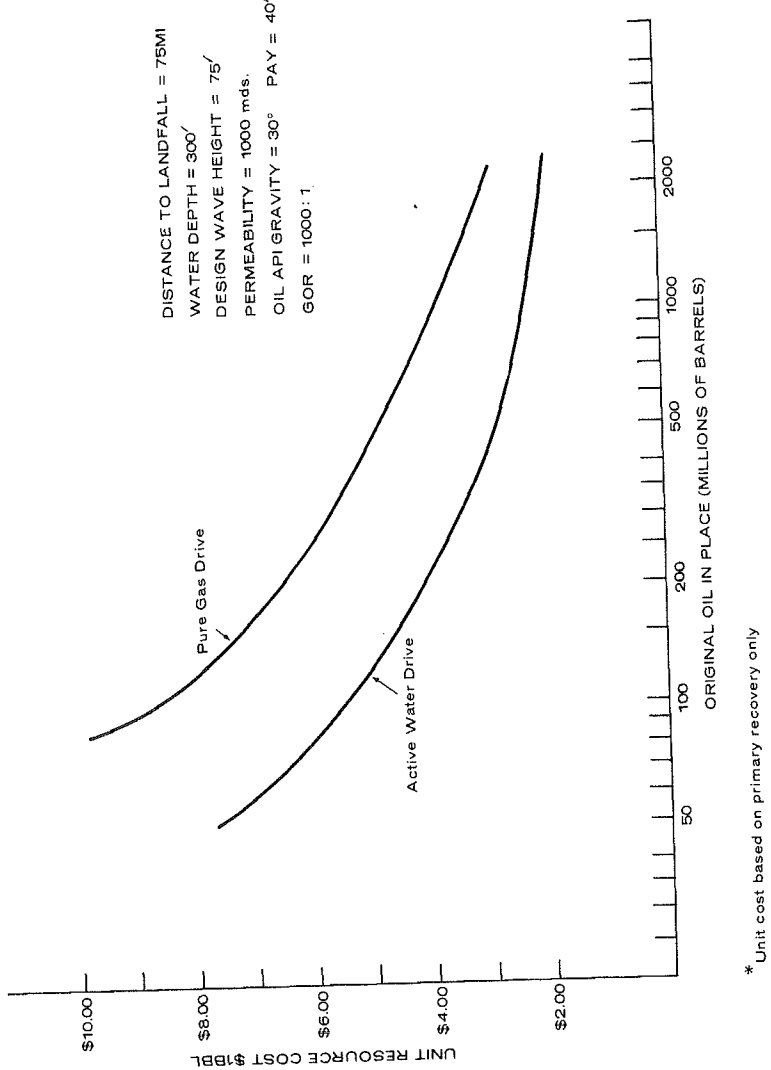


Figure 2

Table 1

DOMESTIC SUPER GIANTS
(Reserves in Millions of Barrels)

Field	Discovery Date	O&GJ Reserves
Prudhoe Bay	1968	9,600[1]
East Texas	1930	1,800
Yates	1926	1,000
Elk Hills	1919	1,000
Kern River	1899	850
Wilmington	1932	700
Wasson	1936	630
Kelly-Snyder	1948	500
Midway Sunset	1894	420
Hawkins	1940	300
West Ranch	1938	300
		17,000
Santa Ynez[2]		2,000-3,000

[1]Unofficial reports set recoverables at 12.5 billion.

[2]Not yet entered in reserves estimates.

The reason for this top-heavy distribution is simple. The range of field sizes in terms of original oil in place runs from over 100 billion barrels to a few hundred thousand barrels or less — over five orders of magnitude. In short, one very large find can be worth literally thousands of small finds. Further it is in the nature of petroleum that, with high probability, either you find a lot or you find nil. If conditions in a basin are favorable, a lot of oil will be formed and trapped. If not, little or none.

This should be kept in mind in interpreting the average "expected" find estimates which are currently being tossed around for the Atlantic outer continental shelf (O.C.S.). One hears estimates of 250 million barrels, 500 million barrels average "expected" recoverable for the Georges Bank. In my opinion these numbers are next to meaningless, not only because they are based on very little information and discredited estimation methods, but also because, whatever happens, it is extremely unlikely to be the average. In my layman's opinion, there is a better than even chance that we will find no commercial petroleum on the Georges Bank. However, if we do find commercial oil, we will find a lot, that is quantities well in excess of a billion barrels.

With this in mind and examining results such as Figure 2, I conclude that if Georges Bank petroleum is ever produced, it is quite likely to be landed at a resource cost well below, as much as $10.00 per barrel below, current OPEC prices.

If this is the case, the obvious next question is: Where will the resulting multi-billion dollar increase in national income associated with such oil show up? It has sometimes been alleged that in the absence of bonus bids, royalties, etc., the savings associated with domestic O.C.S. oil will be passed on to the consumer in the form of lower prices. In this case, the increases in national income would automatically accrue to the oil-consuming public.

However, in the absence of direct price regulation, this simply will not happen. Even assuming price competition among the O.C.S. leaseholders, the landed price of O.C.S. oil will not drop below the landed price of OPEC crude unless there is enough domestic production to push all foreign oil off the U.S. market — an extremely unlikely event.

The argument for this statement is as follows. Assuming competition, the landed price of O.C.S. oil will be determined by supply and demand. The supply curve of crude to the United States looks something like the line AA in Figure 3. The curved portion of that line represents domestic supply as a function of unit resource cost to the Nation. As indicated, some of this crude is quite cheap. The horizontal portion of that line represents the supply curve for imported crude. The reason why this portion of the curve is essentially horizontal is that the cartel of exporting countries, under OPEC leadership, attempts to adjust their f.o.b. prices such that from the U.S. point of view, it is as expensive to import from one source as from another. Essentially, once you meet the OPEC price, you can buy as much oil at that price as you want.[2]

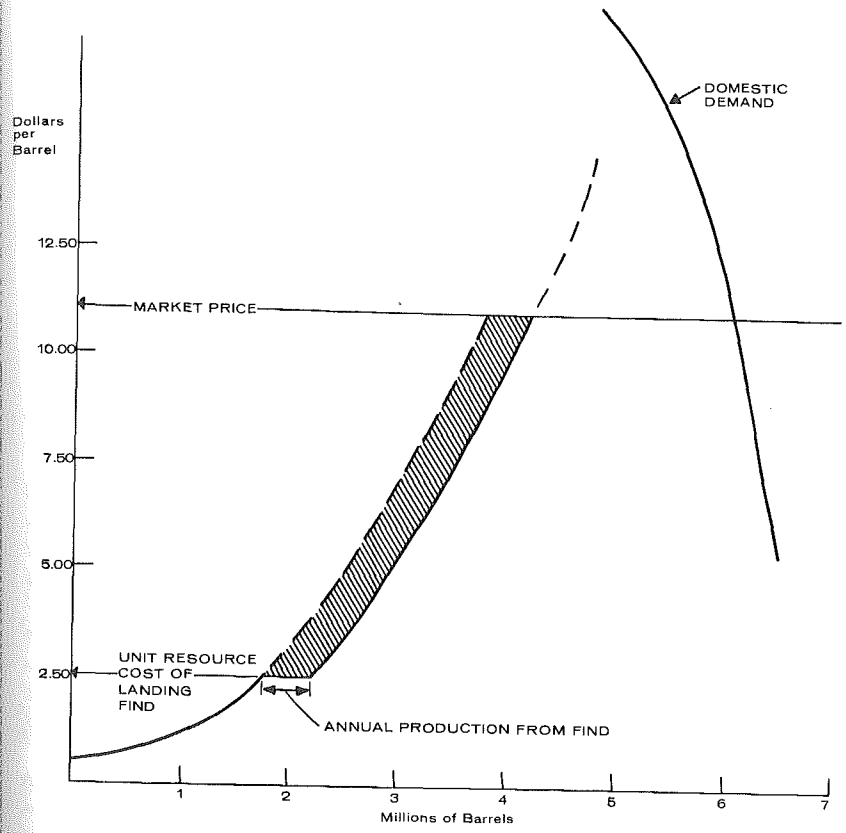
At present, the United States is importing about 2.25 billion barrels per year, about 38 percent of consumption. Unless domestic production increases to force all this oil off the market, the demand curve will intersect the supply on the horizontal portion of the supply curve. The vertical level of this intersection, the c.i.f. OPEC price, will determine the domestic price of crude. Price regulation aside, no domestic producer will sell his oil for less than the landed price of foreign crude, for he knows that there are domestic buyers who are paying this price to whom he can sell his oil.

Given this situation, let us consider what will happen if we make a large find on the O.C.S. As we have seen, the landed resource cost of such oil can be less than $3.00 per barrel. The effect of such a find on the supply curve of domestic oil is shown by the line BB in Figure 3. The find is equivalent to a rightward shift of the supply curve at the unit resource cost of landing this find — $2.50 per barrel in the sketch. The amount of the shift is equal to the annual production from the find. Note that unless the amount of the shift is sufficient to push all foreign oil off the domestic

[2]This is not the case during actual embargoes. From time to time, the exporter cartel may call an embargo to raise the overall level of the horizontal portion of the curve. However, it is in the interest of the cartel to keep these embargoes relatively short; as soon as the price rise has been effected, the embargo is lifted and once again one can purchase as much crude as one wants at the new price.

Figure 3

SKETCH OF U.S. OIL SUPPY AND DEMAND WITH LARGE NEW FIND



market, there will be no change in price, for the intersection of the demand curve and supply curve is still at the same horizontal level. *Under competition, market price will not be affected by any individual O.C.S. find unless the aggregate of such finds pushes all foreign oil off the U.S. market.* To the extent that the relevant markets are not completely competitive this conclusion holds a fortiori.

The fact that price is not affected does not mean that there has been no increase in national income. In fact, the annual increase in national income associated with the hypothetical find sketched in Figure 3 is the hatched area in this figure. This is the difference between the unit cost to the Nation of imported crude and the unit resource cost of the O.C.S. find multiplied by the amount of the find. In the situation shown, we are replacing $11.00 foreign crude with $2.50 domestic crude for a net gain in national income of $8.50 per barrel.

The hatched area, the national gravy if you like, is known as the *economic rent* associated with the find. This economic rent will be split between the Federal taxpayer and the investor in the development. The former will see lease payments, royalties, and income taxes which would not occur if the resource were not developed. Either his Federal taxes will be less than they otherwise would be or he will receive more public resources for the same taxes. The investor will see profits in excess of what he would have achieved without the development. Here I am using profits in a restricted sense to mean profits above and beyond the normal return to capital which the investor could earn elsewhere, for this normal return to capital has been included in the unit resource cost by the present value process.

The actual split between the taxpayer and the developer will depend on the type and effectiveness of the Federal O.C.S. management policy being employed. On the one extreme, simple homesteading and no income taxes, the entire increase in national income, all the economic rent would go to the developer in the form of excess profits. The original British system approximated this extreme. On the other extreme are systems in which the developer is forced to bid away all or almost all the excess profits in the form of lease payments, royalties, and taxes, in which case all the economic rent would accrue to the public. The present Norwegian system may be approaching this extreme.

From the point of view of any individual American, this split between the developer and the taxpayer should be a matter of some interest especially since Congress is currently considering dismantling a system which, while far from perfect, appears to have directed the bulk of the economic rent associated with O.C.S. oil to the taxpayer.[3] However, this is not the subject of today's discussion; and paradoxically, how the split comes out may not be too critical from the point of view of total New England regional income. This is the subject of the next section.

[3]For a discussion of this issue, see: Devanney, "The OCS Petroleum Pie," *MIT Sea Grant Report,* MITSE 75-10, Feb. 1975.

III. New England Regional Income

There are five ways that offshore oil could affect real New England income:

1) by changing the real price New England consumers pay for petroleum,

2) by reducing New England's Federal tax burden or increasing the profits of New England investors in offshore development,

3) by reducing regional (state and local) taxes for the same level of public services,

4) by increasing the real earnings of New Englanders employed by the petroleum development,

5) through the *net* effect of respending of any of the above four increases in regional income.

The only reason for laying out this obvious list is that most studies of regional income concentrate entirely on one or two of the above aspects of the problem to the exclusion of the others. Often they grossly exaggerate the aspect they have chosen to examine while missing completely other impacts which in reality are likely to be larger.

Regional Petroleum Price Changes

We have already argued that, however cheap the offshore petroleum actually is, as long as there are no price controls this petroleum will have no effect on market prices. It now appears reasonably certain that there will be no price control on "new" oil such as Georges Bank production. In fact, the President is going in the other direction and relaxing "old" oil price controls. Therefore, I do not believe that price control of Georges Bank oil is a realistic possibility.

For historic, political reasons, the situation with respect to Georges Bank gas is considerably less clear. Our analysis of hypothetical gas finds on the Georges Bank indicates that nonassociated gas can be landed from a large find for less than 60¢/Mcf while the marginal resource cost of landing associated gas can be less than 30¢/Mcf. Once again these resource costs are far below the $2.00/Mcf and higher than New Englanders are paying on the margin for foreign gas.

Continued, if somewhat relaxed, gas price control is a real possibility. Assuming such price control, gas will continue to be rationed in New England. At the controlled price, more gas will be demanded than supplied. In this case, the increase in real regional income associated with a gas find will be the consumer's surplus associated with the new gas at current New England prices plus any difference between the present regional price of gas and the regulated landed price of Georges Bank gas. Given a large gas find, the increase in regional income could be quite considerable. If we discover ten trillion cubic feet of gas (a large find) under reasonably strict price control, the increase in real consumer income could easily be $5 billion present value. Undoubtedly a portion of such gas would be supplied to the New York market but New England consumers could reasonably expect to see 25 percent or more of this increase.

As we shall see, the resulting increase in real New England income of a billion dollars or more present value completely overwhelms in magnitude the possible increases in regional income due to jobs and regional taxes.[4]

Reduction in Federal Taxes for the Same Level of Federal Public Service and/or Increase in Profits to New England Investors

As argued earlier, the great bulk of any increase in national income due to offshore oil will be somehow split between the developers in the form of profits above the normal return to capital and the Federal taxpayer in the form of lease payments, royalties and taxes which would not occur without the development. Contrary opinions held in some circles, notwithstanding, New Englanders are Americans, and as such can be both offshore investors and Federal taxpayers.

New England represents about 5 percent of the country's population and of its wealth. If we assume that the benefits to the Federal taxpayer of offshore revenues are spread evenly over the country and that New England investors participate in offshore ventures in a manner roughly proportional to their overall share of the country's wealth, then about 5 percent of the economic rent associated with a find would accrue to the region. For a one billion barrel recoverable find, this share could amount to $500 million at present value. For a 100 million barrel find, the share will likely be negligible for the resource cost of the landed oil from such a discovery is probably close to the current market price.

Notice that the 5 percent to New England conclusion holds no matter what the split is between the investor and the Federal taxpayer, provided only that New Englanders share in the investment and in Federal taxes in similar proportions.

The actual split of the economic rent between investor and Federal taxpayer is unlikely to have a critical effect on *total* regional income. It will, however, determine which groups in New England are the primary beneficiaries of the increase in regional wealth. If the investors end up

[4]This does not necessarily imply that New England should lobby for continued gas price control. From the point of view of the region, gas price decontrol involves the following pluses and minuses.

Pluses:
1) increase in consumers' surplus of those New Englanders who would receive any additional domestic gas brought into the region as a result of decontrol,
2) increases in New England investor and Federal taxpayer income associated with higher pre-tax gas producer profits.

Minuses:
1) loss in real income to current New England gas consumers associated with the higher price,
2) loss in real income associated with the differences in the prices of any offshore gas discovered with and without control.
We have not analyzed this trade-off.

keeping most of the rent, then relatively wealthy New Englanders will get the lion's share. If the Federal Government takes the bulk of the economic rent and spends this additional income on, say, welfare programs, then poor New Englanders will be the principal beneficiaries.

In any case, New England's share of the national economic rent associated with an oil find is likely to be roughly 5 percent of the total. The resulting increase in regional income may well be the second largest regional impact, following the benefits from a large gas find with price controls. In present value terms, this increase in regional income resulting from a large find could be several hundred million dollars.

Local Employment

We now turn to the much ballyhooed regional employment and local tax impact. In addressing this impact, the first notion we have to disabuse ourselves of is any necessary connection between Georges Bank oil and regional refining. According to Section I, if oil is produced from the Georges Bank, it is likely to have a resource cost more than $5.00 per barrel less than current market price. It will cost about 25¢ per barrel to move Georges Bank oil to New England in quantity via pipeline. It will cost about 60¢ per barrel to take this oil to the mid-Atlantic via tanker. This differential is not particularly impressive. A developer of a large find would have no problem with refining his oil in the mid-Atlantic.[5]

For a small find, which would be landed by tanker in any case, this argument holds a fortiori for the differential in tanker cost from Georges Bank to New England and from Georges Bank to the mid-Atlantic is less than 15¢/barrel.

Further, our simulation of hypothetical reservoir production histories indicates that even a very large, two billion barrel recoverable find could supply the entire 1.2 million barrel per day New England market for at most two or three peak production years. This implies that either the bulk of Georges Bank crude during peak production years will have to go to non-New England refineries or that any New England refineries will have to be prepared to refine non-Georges Bank crude for the greater portion of their lives.

Right now domestic refineries are operating well below capacity. In general domestic refineries have found it is cheaper and a lot less troublesome to expand existing plants rather than invest in entirely new grassroot facilities. There is great uncertainty as to what the country's future crude and product import policy will be. Finally, if the OPEC countries carry out their announced plans of drastically expanding refining capacity, even the long term looks bleak for expansion of domestic refining.

[5]A corollary to this is that even if the region wanted to, New England could not prevent development on the Georges Bank by denying the oil a landing place on the New England coast.

In summary, New England refining and Georges Bank oil can be regarded as largely independent issues. If New England refining makes sense from the point of view of the region, it makes sense without Georges Bank crude. If New England refining doesn't make sense, it doesn't make sense with Georges Bank oil. In this situation it is entirely misleading to credit (debit) any changes in New England income due to regional refining to offshore oil. Therefore, we can concentrate solely on the offshore oil support activities.

Let's begin with direct support. The magnitude of direct-support activities is considerably smaller than sometimes suggested. The exploration phase is likely to begin with at most two or three rigs. If, and only if, the results are favorable, this could rise to a maximum of four to six rigs. The exploratory drilling phase will last perhaps five years — a good deal less if the first wells are discouraging.

Our reservoir simulations indicate that even an extremely large multi-billion barrel find could be produced from no more than 30 platforms representing some 500 wells.[6] Not all these platforms would be manned. These platforms would be erected over a five- or six-year period.

So let's assume the maximum as has been done in Table 2. Each exploratory rig will require a stand-by boat plus 12 supply boat movements per month. Each platform will require about 30 supply boat movements per month during the two-year drilling phase dropping to less than four per month afterwards.

If the oil is piped to New England, main transmission-line laying will be accomplished in one, or at most two, summers. In any case, there will be some gathering network work. Pipelaying generates about 80 boat movements per month. Industry experience indicates that a single shoreside berth can support about 30 boat movements.[7] Putting these numbers together leads to the totals in Table 2. Note that even under the assumption of a massive find, less than 20 shoreside berths will be required and at most some 50 nonpipelaying vessels. A generous rule of thumb is five shoreside acres per berth. Many places, e.g., Aberdeen, get by with much less. Assuming five acres per berth, the full shoreside requirements could fit within the South Boston Navy Base with plenty of room to spare or on a small corner of the Newport Navy Base. We repeat these are maximums. The support base for Ekofisk, a 2.5 billion barrel find in Stavanger, contains less than 10 acres. The Scottish North Sea, in excess of 15 billion barrels, is largely supported from less than 50 acres at Peterhead.

A manpower schedule consistent with the above hypotheses is shown in Table 3. The percentages of New Englander participation in this employment are frankly guesses which seem reasonable to me based on my

[6]The Forties Field, a two billion barrel find in the North Sea, will be produced from four platforms. This is typical of North Sea practice.

[7]N. Trimble, "How Many Supply Bases Does Scotland Need?" *Offshore Services,* November 1974.

Table 2

HYPOTHETICAL SCENARIO — MULTI-BILLION BARREL FIND ON THE GEORGES BANK

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Number of Expl. Rigs	2	4	6	6	4	2	0	—	—	—	—
Number of Platforms			5	10	15	20	25	30	—	—	—
Number of Vessels to Support											
Expl. Rigs	4	8	12	12	8	4	0	—	—	—	—
(Vessel Movements per Month)	(24)	(48)	(60)	(60)	(48)	(0)	—	—	—	—	
Number of Vessels to Support											
Platform Installation			15	30	30	30	30	30	15	0	—
(Vessel Movements per Month)			(150)	(300)	(300)	(300)	(300)	(300)	(150)	(0)	—
Number of Vessels to Support											
Pipelaying			8	8		8		8			
(Vessel Movements per Month)			(80)	(80)		(80)		(80)			
Number of Vessels for Field											
Maintenance					2	5	7	10	12	15	—
(Vessel Movements per Month)					(20)	(50)	(70)	(100)	(120)	(150)	—
Total Number of Non-Pipelaying Vessels	4	8	35	50	40	49	37	40	27	15	—
Total Number of Vessel Movements per Month	(24)	(48)	(290)	(420)	(370)	(450)	(370)	(480)	(270)	(150)	—
Number of Berths Required	2	4	12	15	14	17	14	18	10	6	—

Table 3

MAN-POWER SCHEDULE FOR MULTI-BILLION BBL FIND SCENARIO

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Expl. Rig Crews	200	400	600	400	200	0	—	—	—	—	
(Likely N.E. Participation)	(nil)	(100)	(150)	(200)	(200)	(100)	(0)	—	—	—	—
Rig Support Vessels	40	80	120	120	80	40	0	—	—	—	—
	(nil)	(30)	(60)	(90)	(70)	(40)	(0)	—	—	—	—
Platform Installation			500	1,000	1,000	1,000	1,000	1,000	1,000	500	0
			(200)	(500)	(600)	(700)	(700)	(700)	(700)	(450)	(0)
Vessels Supporting Platform Installation			150	300	300	300	300	300	300	150	0
			(100)	(250)	(300)	(300)	(300)	(300)	(300)	(150)	(0)
Pipelaying and Supporting Vessels			300	300		300		300			
			(nil)	(nil)		(nil)		(nil)			
Platform Maintenance and Supporting Vessels					170	350	520	600	870	1,050	1,050
					(120)	(250)	(450)	(500)	(800)	(1,000)	(1,000)
Shoreside Non-Management	20	40	120	200	200	250	250	250	150	60	60
	(20)	(40)	(120)	(200)	(200)	(250)	(250)	(250)	(150)	(60)	(60)
Total	260	520	1,890	2,520	2,200	2,250	2,100	2,450	2,350	1,750	1,110
Total New England	(20)	(170)	(620)	(1,250)	(1,300)	(1,450)	(1,700)	(1,750)	(1,950)	(1,650)	(1,060)

observations of the offshore industry in the Gulf and the North Sea. Local participation will be quite low in the very transient pipelaying and exploratory drilling activities, but can add up to the great bulk of the non-supervisory jobs in production drilling, platform maintenance and nonpipelaying vessel operation. Accepting for the moment my guesses, we find that even a relatively massive development on the Georges Bank will generate a peak of perhaps 2,000 jobs, with a permanent employment of about half that. The direct employment numbers are consistent with Grigalunas's excellent study.[8] In my opinion, they represent upper bounds.

The major indirect employment possibilities are:

1) rig and platform building;
2) supply boat building and maintenance;
3) driving/mud, chemicals, cement/helicopters/etc.;
4) oil transhipment terminal/gas treatment and pipeline.

I don't believe the specialist category (3) is worth worrying about. Unless the development is unusually long lived, these services will be provided by non-New Englanders. The aggregate numbers involved are not large. Finally, any New Englander who has the training and experience to handle this work will not be unemployed.

Unlike Grigalunas, I am not sanguine about the possibilities of rig- and platform-building in New England. New England is at a competitive disadvantage with respect to the South in weather and labor costs. Further, the Gulf is beginning to play out, in which case there is likely to be excess already established rig- and platform-building capacity there. Finally, the world's shipyards are entering a superslump which is likely to last three or more years. These yards are therefore turning to rig building. We recently made a trip to the Gulf and talked to about a dozen rig and platform builders about their using the Boston Navy Base. To a man they were completely disinterested. Discoveries on the Georges Bank offer no competitive advantage to a rig builder. Builders of these mobile investments must be prepared to compete with the world. Therefore, any New England rig-building activity cannot depend on nor be credited to a Georges Bank development. A Georges Bank find would offer some cushion to a local platform builder. Towing costs from the Gulf will be about $750,000 higher than from New England. However, this amounts to less than 15 percent of the delivered cost of the platform and it is not at all clear that a new, cold weather yard could operate on this 15 percent as compared with established, warm weather facilities. Further, a regional yard will have much less than a 15 percent cushion over already planned expansions of rig and platform building in the mid-Atlantic. Finally, the Georges Bank market will most likely be limited to 20 or fewer platforms. All in all, not a particularly promising situation. I don't believe there will be any offshore platforms built in New England as a result of a Georges Bank find.

[8] T. Grigalunas, "Offshore Petroleum and New England," University of Rhode Island, Marine Technical Report No. 37, 1975.

Supply vessel building suffers from the same problems as rig building, although weather is not nearly as important for covered construction. More to the point, supply boats are completely mobile. Therefore, a find on Georges Bank will offer no competitive advantage to local builders. If a local supply boat builder can compete for contracts with a Georges Bank development, then it will be able to compete for contracts without such a development (as Blount has been able to do occasionally). Therefore, supply boat building activity cannot be credited to a Georges Bank find.

Supply boat maintenance is a different story. Supply boats operating on the Georges Bank will be maintained locally to keep the time out of service down. A large find on the Georges Bank will undoubtedly result in the installation of a supply boat maintenance yard, (or what is the same thing, continued existence of one of the local repair yards which would otherwise go under). However, the numbers are not large. Noncrew maintenance of a 50 boat fleet will require fewer than 150 men per year.

This leaves shoreside oil terminal/gas treatment and pipeline facilities. If the oil is brought ashore to New England and then shipped out, construction of a transhipment terminal will be required. This would be approximately a $20 million project involving perhaps 1,500 man-years on construction. Permanent employment would be less than 50. I regard this as an unlikely prospect. If the crude is not to be refined in New England, it will be cheaper to provide offshore storage and tanker loading facilities than to pipe it ashore and then load it.

Shoreside gas treatment plant and supporting pipelines is a more likely possibility. A very large gas find could result in several thousand man-years for treatment plant construction and perhaps another 1,000 man-years to connect the plant to the existing gas grid. This would be very short-term employment. The permanent effect on regional employment would likely be negative as the additional gas would supplant more labor intensive sources of energy, such as oil presently being handled by barge and truck within the region.

Therefore, respending effects aside, I am prepared to go with the figures of Table 3 plus perhaps 3,000 man-years, expended over two years, for gas treatment and pipelines in the case of a large gas find as an upper bound on regional employment associated with Georges Bank petroleum. To put these figures into context, the Boston Navy Base shutdown represented a gross loss of 5,000 jobs to the region. There are currently 650,000 people unemployed in New England, 200,000 in eastern Massachusetts and Rhode Island alone. Even a massive find on the Georges Bank is equivalent only to a good-sized but not particularly large industry entering the region.

The Net Effect of Offshore Development Jobs on Regional Income

To me the interesting question from the region's point of view is not how many people will work in offshore oil, but rather what the increase

will be in New England wealth as a result of this employment. The change in regional income due to offshore oil depends critically on what the regional resource employed would be earning without the development. If we had a full employment situation in the region, then the fact that a New Englander is earning $6.00 per hour on shore means very little for he could be earning $6.00 per hour doing something else. Under full employment no portion of the offshore industry's payrolls could be credited to New England income. At the other extreme, if we had complete unemployment, in which case this same New Englander would be on welfare, then the entire difference between his gross earnings and his Federal welfare would be a net increase in the real wealth of the region. Notice it is the employment opportunities of the actual people employed that count.

Currently, of course, we have rather severe unemployment in the region, especially in the Rhode Island-southeastern Massachusetts area. Therefore, despite the fact that the offshore development will undoubtedly hire the most easily employed — young, mobile males with at least a high school education and perhaps some vocational skills — I think it is currently fair to credit the development with the bulk of at least the short-term New England payroll net of Federal welfare. If we had full or close to full employment, this procedure would grossly overstate the impact of offshore oil on regional income through employment effects.

At 10 percent real, the present value of New England employment associated with Table 3 is about 9,000 man-years. Generously assuming a differential of $10,000 per man-year between gross earnings and Federal welfare payments, the present value of the increase in regional income associated with this employment would be $90 million. Construction of a large gas treatment plant and connecting pipelines might add 20 percent to these figures.

In other words, under the twin assumptions of a relatively massive development and severe regional unemployment, the increase in New England real income associated with offshore oil initial employment might be as high as about $100 million at present value. Reductions in the assumed size of the find on improvements in the region's employment situation would result in sharp reductions in this estimate.

Local Taxes

On the basis of estimated property evaluations, Grigalunas has estimated that onshore support facilities associated with a large find will pay as much as $1 million per year in property taxes. At 10 percent for 25 years, this would result in gross revenues of about $10 million at present value. It is quite likely that actual revenues will be less as the various states and towns bid against each other for the facility by offering tax abatements, holidays, etc. This process appears already to have started in Rhode Island.

Whatever the gross revenues are, they must be netted by the cost of any additional public services required by the facilities (sewers, roads, water, etc.). Both Texas and Louisiana have claimed that these deductions

are larger than the revenues from offshore development for property and ad valorem state taxes cannot be assessed on the offshore facilities themselves. I happen to think that the Texas and Louisiana arguments overstate the case against offshore development but, in any event, the resulting numbers will be quite small, in the few millions of dollars at present value.

State corporate income taxation would offer a more interesting possibility *if it could be applied to the profits on production.* As mentioned earlier, depending on Federal lease management, these profits could run into billions of dollars. Four or five percent of such profits would represent a handsome sum indeed. Unfortunately, the production facilities will not be within state boundaries. Therefore, it seems to me that the states do not have any way of forcing the producing corporations to pay any state corporate income tax. I will assume they do not. It might be something for the states' lawyers to look into, or the region's congressional delegation to think about.

Respending Effects

A portion of the increases in regional income from categories 1 through 4 will be respent within the region. To the extent that there is unemployment of regional resources in these regional respending markets, this will result in differences in income to New Englanders supplying these goods and services. However, it is easy to overestimate the net effect of such respending on regional income. A large proportion of the direct increase in income will be respent outside the region. In a resource poor region like New England, a sizable proportion of the money spent within the region will be used to import extraregional resources. The regional input is mainly labor. Even under the severest conditions, not all this regional labor would otherwise be unemployed. In estimating changes in regional income associated with some development, it is important to work with the net multiplier and not with the gross multiplier.[9] The latter is a concept often misused by input-output enthusiasts.

I don't know what the net regional multiplier for offshore oil is. However, I would hazard a guess that, even in these times of severe regional unemployment, no more than one-third of the additional direct New England income would represent *increases* in income to New Englanders in the secondary markets. An infinite chain based on this guess would lead to a net regional multiplier of 1.5.

Whatever this net multiplier is, it should be applied to all the direct increases in regional income whether they be due to decreases in petroleum price, reduction in Federal taxation burden, increases in shareholder profits, or increases in take-home pay, provided only that the respending patterns are roughly similar.

[9]The gross multiplier is the total amount of economic activity required to support a unit of direct investment. The net multiplier deducts from this total the value of the output of these resources in alternative employment. It is the latter concept which is relevant to estimates of *changes* in regional income.

Table 4

ESTIMATES OF DIRECT CHANGES IN NEW ENGLAND INCOME DUE TO MULTI-BILLION BARREL FIND ON GEORGES BANK

	Present Value at 10% (Millions of $)	Present Value per Capita	Annual Over 20 Years per Capita
Difference in Gas Price and Gas Supply (Assumes Continued Price Control)	1,000	$ 80	$10
Region's Share of National Economic Rent Associated with Oil	500	40	5
Increase in Take-Home Pay of New Englanders Employed in Offshore Oil	100	10	2
Regional Taxes Net of Additional Cost of Regional Service	nil to 10	0	0
Total	1,600	130	20

IV. Summary

Table 4 summarizes our results. The table indicates estimates of the increase in New England income associated with a very large find on the Georges Bank. These numbers are obviously very rough, plus-or-minus-a-factor-of-two type figures. But even such rough estimates admit several obvious conclusions.

The first is that the savings associated with gas price control policies can be much larger than employment effects. The second is that, assuming a large oil find but little gas or gas price decontrol, the major effect on regional income will be a rather invisible one — a break on Federal taxes which would otherwise not occur coupled with an increase in the income of New Englanders who have invested in the oil industry.

Finally, and perhaps most importantly, even a large find on the Georges Bank will not be a panacea for the region's economic ills. The numbers shown are rough estimates of upper bounds. Even a massive development will employ at the very most 5,000 New Englanders and very likely many fewer. Currently regional unemployment is over 600,000; and it is not clear that all the offshore employment will be drawn from the ranks of the unemployed.

The second column puts our estimates on a per New Englander basis. The numbers shown represent the equivalent per capita increase in real

wealth on a one-shot basis. The third column amortizes these increases over 20 years at 10 percent. According to our estimates, even a massive development will increase per capita income only by about $20 per year. Once again I repeat these are upper bounds. The actual amounts will almost certainly be less.

In short, offshore oil can, under very favorable circumstances, generate a rather tidy increase in regional income. However, the bulk of this increase will show up in unexpected, rather invisible forms. Finally, even in aggregate the possible amounts do not appear worth losing our collective heads over. Some deliberate, careful thought is still in order to insure that the region gets the best deal possible from offshore oil.

Discussion

Alex Steinbergh*

I would like to cover four points in my discussion. First, I will compare Professor Devanney's analysis with some of our own firm's forecasts for New England's onshore development impacts. Secondly, I will indicate what the pace of development is likely to be without new OCS legislation. Thirdly, I will discuss what I think will happen given the probability of new OCS legislation. Lastly, I will point out some of the things we in New England can do to prepare for Georges Bank development and maximize the benefits that Professor Devanney talks about.

Devanney's OCS Analysis

I feel that Professor Devanney has done an excellent job in assessing the regional benefits associated with Georges Bank oil and gas development, especially in focusing on the fact that the major benefits will be those associated with the feedback of economic rents into the region in the form of lower taxes and increased profits. One may criticize his failure to cover some of the potential environmental costs associated with OCS development, such as the potential losses associated with oil spills, onshore impacts of additional land requirements, and additional onshore air and water pollution. However, these impacts have been pretty well documented in a study of offshore development in the Atlantic Ocean that both MIT and Resource Planning Associates were associated with two years ago. The general conclusion reached by that study, and also recently by most responsible members of the environmental community, is that, on balance, oil and gas drilling do not have excessive environmental risks. Certainly, proper installation, offshore monitoring, and contingency plans can bring the risk down to acceptable limits. Similarly, we believe that the

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adverse onshore environmental impacts, although perhaps of more concern than the offshore impacts, can be controlled if state and local governments, as well as the Federal Government, have a say in the planning process and if enough funds are available to do this planning.

In planning for OCS development, the first, and perhaps most important, analysis to be done is a comprehensive benefit/cost study at both national and regional levels. I think Professor Devanney's paper provides a framework for such an analysis. Incidentally, I am not aware that the Bureau of Land Management (BLM), despite the millions of dollars it has invested in environmental impact studies in OCS regions around the country, has done a regional income analysis such as this for any individual sale. The massive finds that Professor Devanney has assumed to illustrate the maximum benefits to New England — 2 billion barrels of oil and 10 trillion cubic feet of gas — are certainly optimistic. The U.S. Geological Survey recently estimated between 2- and 4-billion barrels of oil and 5-14 trillion cubic feet in all the Atlantic coast OCS areas, including the Mid-Atlantic and South Atlantic regions as well as Georges Bank. However, I agree with Professor Devanney that if there is oil and gas, and if it is economical to recover it in large amounts, we ought to look at the impacts of large finds.

As far as gas is concerned, 10 trillion cubic feet would provide about 500 billion cubic feet a year for 20 years. This is approximately twice New England's current consumption level. Ten trillion cubic feet is about what BLM is now officially estimating in the Gulf of Alaska. In other words, Devanney's assumptions reflect a pretty big find. Professor Devanney assumes that it would be brought ashore for gas processing plant treatment and that there would probably be a reversal of the existing pipeline system in New England to pipe it towards New York, so that New England would be able to tap off the pipeline. The biggest area of controversy, of course, is the extent to which New England would be able to use this gas. On an economic basis, OCS natural gas would seem to have many advantages. However, the economic benefits to be derived from this gas depend heavily on what the Federal Power Commission has to say about user allocation priorities.

In general, however, Professor Devanney's estimates of both direct and indirect benefits, totaling some $2-3 billion on a present value basis, are similar to our own forecasts, although we have not assumed deregulation and therefore have lower benefits for natural gas. We have estimated the share of the rent coming to New England as about $375 million on a present value basis, and we have slightly higher estimates of the benefits of new jobs to New Englanders. Even so, assuming that there will be no new refineries, we can expect at most 5,000-6,000 new jobs for New Englanders, with perhaps another 6,000-8,000 new jobs for people coming into the region, and perhaps 15,000-20,000 new residents for New England. We feel that this is still a relatively significant net benefit to the region, but not one to get overly excited about in the existing unemployment situation.

Pace of Development Without New OCS Legislation

Given existing OCS legislation and assuming that OCS development will proceed, how will this development be carried out? We feel it will be very slow. Government participation in OCS development is currently controlled by two Acts. The first is the OCS Land Act of 1953, which is administered through the Bureau of Land Management and the U.S. Geological Survey (USGS). This Act has worked remarkably well in the Gulf, and provides the Department of the Interior with the powers to lease offshore lands, and regulate offshore production and the pipeline to shore. The second major Act, the Coastal Zone Management Act of 1972, which is administered by the Department of Commerce, provides a framework for onshore planning through grants to state coastal land management offices to develop land-use plans. However, the lack of coordination between the two Acts constitutes a major problem. Add to this the fact that the Federal Energy Administration is promoting energy development in OCS lands and the EPA and Council on Environmental Quality (CEQ) are resisting development without adequate environmental controls and you begin to see the regulatory environment in which OCS oil and gas development is currently operating. The Department of the Interior is trying. It has developed a number of regulations to improve these decision procedures and get the states more involved. However, BLM has just begun to scratch the surface and much more advanced planning is needed.

To illustrate the problems, let me give a quick review of the proposed procedure for the development of Georges Bank, the schedule for which incidentally is somewhat similar to those in other OCS regions that are to be developed concurrently. In June of this year, BLM invited companies to nominate parcels to be offered for lease. On August 18, the oil companies nominated almost 2,000 tracts totaling 11 million acres for the August 1976 proposed lease sale. The tracts are 25 to 100 miles offshore, the closest one being 25 miles off Nantucket. The largest interest was in the southern part of Georges Bank off Massachusetts and Rhode Island. Certain negative nominations were submitted by coastal states, fishing interests, public works, etc. In October, BLM will probably narrow down the tracts left in process to around 3-4 million acres. This estimate is based on what happened in the Baltimore Canyon Lease Sale, where about 3 million acres were nominated and less than 1 million acres were tentatively selected for resale. The Interior will start working on its draft Environmental Impact Statement (EIS) and will publish it in January. There will be public hearings in March and, if everything goes smoothly, the EIS will come out in June and by next summer we will have a lease sale.

However, in actuality we can expect extensive delays in this schedule. Currently, there are two developments that I think show there will be delays. First, before the Interior is allowed to lease any of the frontier regions, it must issue a final EIS on its entire leasing program. This has been held up for a number of reasons, not the least of which were the problems associated with the nomination and resignation of Secretary

Hathaway. But basically the EIS will probably be delayed another two to three months to reflect many of the concerns of all the coastal states. Secondly, the California sale, which was scheduled for November, and the Gulf of Alaska sale, which is now scheduled for December, will probably also be delayed. Both California and Alaska through Governors Brown and Hammond have threatened suits, and we feel this pattern will continue unless there is new legislation.

In other words, BLM is running behind schedule. Why? For two reasons. The first, I think, is just bureaucratic rigidity and the limitations imposed by existing legislation, which make it difficult for BLM to adequately address the onshore impacts that are the greatest concern to the states. BLM has not done a careful cost/benefit analysis for any of the regions. This is an optional procedure in the National Environmental Protection Act (NEPA) procedure that BLM has opted not to follow which I think is a mistake. I think an analysis similar to Professor Devanney's should have been done for all of the regions.

The second reason is that the states in the meantime are embarking on their merry way through the coastal zone management program grants and some state funding is allocated to preparing for OCS development. Most of these states have had little experience with the whole oil and gas exploration, development, and production process, which Professor Devanney has described, and there has simply been too little funding and too little time to become aware of what they need to plan for.

The most significant thing that BLM has done was announced in the last month — the establishment of the requirements for lease development plans. Under these regulations, lessees of the oil companies would be required to submit development plans to the USGS supervisor prior to the development phase. The governors of the coastal states would have a 60-day comment period — no veto, but a comment period — and the USGS supervisor would have the responsibility for saying whether the oil companies could go ahead. These regulations are still in the process of being finalized, but if they remain unchanged, the oil companies would provide the states with considerable information concerning not only the facilities but the prospective onshore and environmental impacts. EPA has reviewed the Interior's plan and wants even greater detail. They want to require a full environmental impact statement before going into the development stage, and they want some recourse if the governor of a state still feels that the development plan is inaccurate and inconsistent with his coastal zone management plan.

So you see BLM is operating in a very difficult environment and I think substantial delays will occur unless it is changed. The real change, I think, must be legislation.

Possible Effects of New OCS Legislation

Right now, two of the foremost requirements of OCS development that require regional planning are included in parts of the two Senate bills, S581 and S586, that passed in July, and HR 6218, which is currently

under discussion in the House. Funds are needed for three specific purposes. First, funds are needed for front-end planning. On a national basis, this might amount to $5-$10 million for the New England states' planning. Secondly, funds are needed to defray the costs of onshore services consequent upon location of pipelines, tanks, refineries, and petrochemical complexes. And finally, an oil spill fund is necessary to provide some compensation for cleanup costs and damages, should they occur.

Legislation is also needed to get the states involved in the review process on a comprehensive and meaningful basis, without giving them the right of a veto.

Incidentally, I would agree that two aspects of the proposed legislation do not need to go through, and do not provide major benefits for the region. One is changes in the existing bidding procedures, which seem to be working pretty well. The other is the separation of the exploration and development processes, which is the measure the oil companies are fighting the hardest, and which our analysis has shown does not offer significant benefits. Until legislation is passed on some of these issues, it will be difficult for OCS development to occur.

Possible New England Actions

Finally, what should New England do to prepare itself for OCS development and to maximize its net regional benefits? In addition to supporting the two regional aspects of legislation which I have just discussed and which are currently before the House, there are two other needs. First, there is a need to form a regional planning group to take full advantage of Federal funding and to interact with the Federal Government. There are examples of this going on in some of the other regions. FEA and HUD have a joint funding arrangement now where they are part of the OCS planning process in the Mid-Atlantic states and California. More significantly, there is a need for an interdisciplinary team comprised of members of groups represented in this room, to interact with BLM in the preparation of its draft Environmental Impact Statement.

Secondly, there is a need for industry to be more aware of the opportunities that will occur during all parts of the OCS development process. Even though Professor Devanney suggested the bulk of construction activity will go to firms outside the region, New England firms will have significant opportunities to participate in or perhaps to increase the region's 5 percent share of the induced national income associated with OCS development. These opportunities will be accentuated by the fact that concurrent development is forecast by the Federal Government in Alaska, California, the Gulf of Mexico, and the Mid-Atlantic and South Atlantic regions. Offshore development will take place in all of these areas. As a result, importing and exporting of workers will be less likely, so that there will be a chance for onshore employment within the region.

In summary, I agree with Professor Devanney that the opportunity looks bright for OCS development and, if not for all New England industries, at least for New England energy consulting firms.

Discussion

Vince P. Ficcaglia and Michael C. Huston*

We have a number of points in regard to the Devanney paper. In particular we would like to concentrate more on some of the issues that revolve around the economic impacts associated with outer continental shelf (OCS) developments. I think that as far as the topic that Professor Devanney addressed in his paper, the conclusions that he reaches and some of the numbers that he estimates are indeed similar to what we at Arthur D. Little have found. It is true that in any sort of measure of economic impact regarding OCS the most critical input is, of course, just how much oil and perhaps gas would be available off the Georges Bank development. Is there enough in it that we should really be concerned? Or, as the numbers indicate, $3 per head on a regional basis does not seem like an awful lot of money. True, there have been a variety of estimates based upon seismic studies of just how much oil and perhaps gas there is on Georges Bank. Professor Devanney is quite right that, given the nature of the beast, we could go from a very small oil find to quite a substantial amount of oil. This is supported in a number of studies already done in the New England area regarding OCS development commissioned by the Council on Environmental Quality, the New England Regional Commission, even the Massachusetts Port Authority and also the fine study just completed by Professor Gregalunis at the University of Rhode Island. In addition, however, these studies extended the analysis to include the possible implications of more onshore petroleum-related developments in the region. Most of these studies suggest this would create storage problems, onshore creep storage, the problem of gas-processing operations, the likelihood of petroleum-refining operations developing, in some cases petrochemical operations and, of course, construction and capital needs.

Now while Professor Devanney is correct in saying that we cannot credit or, depending upon which side of the fence you are on, blame OCS for the presence, perhaps the likely presence, of petroleum refineries in New England, the potential economic impact to the region of such a development ought to be analyzed. I think it's imperative to be aware of what could indeed occur and how development of such an industry could affect New England. In the past few years a number of proposals have

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been submitted by various industry spokesmen for the likely location of some refinery operations in Maine, New Hampshire, Rhode Island and even in Massachusetts. There's a new book out on the Maine experience by Peter A. Bradford which is quite informative and gives a very good review of the history of this entire issue in Maine. Granted also that it's very likely, given an OCS find in Georges Bank, that the amount of oil we are talking about is not going to answer New England's oil problems. At most, we are probably talking about 250,000 to 275,000 barrels per day, which is less than one-quarter of present New England oil needs. So the issue of OCS oil is not going to solve the problem of oil demand in New England and despite any possible location of refineries in the area, New England is still going to have to import oil into the region.

So should we move toward refinery operations here in New England as a result of the OCS operations? One has to be concerned not with just OCS development but the entire operation of an energy-related industry that could develop and its implications for the six-state area. Professor Devanney has indicated that only a very small number of jobs will be available as a result of OCS operations and that in a region with 600,000 unemployed, 4,000 jobs won't make much impact. However, I think our scale of reference has to be narrowed down a bit, and the jobs and their impacts put in proper perspective, not in terms of the entire region but in terms of the states or the localities that are likely to bear the brunt of most of this impact. Moreover, the total number of jobs we are talking about in the OCS-related operations may indeed be small. If we do include the likely impact that could come about with petroleum-refining operations, some gas-processing operations, onshore creep storage operations, it could increase by a factor of two or so. Still, many of these jobs would be only temporary. The job associated primarily with the rig operations during the exploration phase, and the support of that operation in the exploration phase, lasts at most, I think, about four or five years. The platform-related operations also are of a temporary nature. So that the benefits in terms of jobs or income that could accrue to the state or to the local area have to be weighed in terms of the disruptive effects that the movements in and out of the labor force, in and out of the region, of such numbers of individuals could play on these areas.

In addition, there was little mention in the Devanney paper of some of what I would call the less obvious, maybe in some cases the less glamorous, considerations regarding what could indeed occur under such a development, and certainly could work against some of the benefits that many people like to identify with this sort of development. These concern taxation, more importantly the benefit under present tax laws of having a refinery locate in a particular city or town. The Massachusetts and Rhode Island tax statutes provide very little incentive right now. The question of whether to treat a refinery as real or personal property is now being tried in the courts.

The questions that must be addressed on the environmental side unfortunately were not much alluded to in the paper. These run the gamut

of the whole question of impacts upon the real estate market. We have seen some unfortunate results in some places on the Gulf of Mexico, in the Alaska area, and even in areas associated with New York City. These questions include problems of land use, of density, of concentration of activity versus dispersion of activity. All, I feel, must be addressed if one is to get some sense of what indeed we are facing, what is indeed possibly in store for New England and how best we can approach this matter. I think that industry wouldn't mind seeing the states and perhaps the towns start to address some of these issues.

In his paper Professor Devanney applied what he calls the net approach to estimating the economic impacts. Many of the studies that we at ADL and others have done for the Federal Government have adopted what Professor Devanney calls the gross approach to measuring these impacts. In the gross approach what we are identifying is the sum total of the jobs: the income, the earnings, the output and the other variables that would be associated with the development and that would occur in the particular area under study. On the other hand, the net approach tries to estimate the share of total regional effects that represent an increase in national income or national earnings and as a result all payments such as changes in income must be adjusted to reflect the real or opportunity cost of labor that is used in the region. That is, what would the regional resources be earning without the development? I think that is a fair process to go through. However, under conditions of widespread unemployment such as are present in New England most of the increase in income could be credited to the area and to the Nation, and would indeed be close to that estimated by the gross approach.

The final issue that I would like to address briefly is that no matter which measure we talk about, the gross or the net, there is a need to measure these impacts. One approach is to use input-output interindustry techniques. This procedure does allow for a more complete, more comprehensive identification of the possible impacts. The benefits received from this approach far exceed some of the inherent weaknesses.

In summary let me make the following two points. First I think that the studies made over the past four or five years have pretty well identified for the New England region at a macroeconomic level what lies ahead. The amount of oil that could possibly come ashore, the implications for regional income, and the regional number of jobs have been pretty well documented. On the other hand, I think that we have a long way to go in helping out and preparing at the local level for these impacts where most of them are going to be felt. The states and the localities are right now, I think, in a position of great need as investors are scurrying around New England looking for a possible profitable venture. The people of Chatham, of Nantucket and other towns are starting to get up in arms over what they conceive could be some adverse effects to their areas. It is here that we are going to have to direct our focus if we are to realize the benefits and at the same time some of the possible adverse impacts that could result from such a development.