

IS RATIONAL FISCAL PLANNING IN A RESOURCE-BASED  
ECONOMY POSSIBLE? THE CASE OF ALASKA

by

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Introduction

The State of Alaska, anticipating substantial levels of revenues in excess of requirements over the next decade because of oil and gas production on state lands, faces an unusual fiscal planning problem. The question is how to dispose of these excess revenues to maximize benefits to the citizens of the state, recognizing that the "surplus" is temporary and that when the oil boom has passed, the tax base and revenue-generating capacity of the state will contract dramatically. This problem is not unique to Alaska but is presently being faced by Alberta and may be faced by Newfoundland in the future. In the United States, all the states producing energy from nonrenewable resources face this planning problem.

Several strategies have been suggested for dealing with this question, and a straightforward economic model which optimizes net present value of benefits can be used to demonstrate the proper mix of strategies which should be chosen in each year. The difficulty arises in implementation of the model because of the problem of determining whose benefits are to be maximized. In some cases, rational planning may not be possible.

This paper is divided into three sections. The first provides a brief description of the setting of the problem. This is followed by a presentation of the theoretical model from which optimal allocations of expenditures over time can be derived to maximize the net present value of benefits. Several problems of model specification are discussed. The final section deals with the main question of the paper: under what conditions is rational intertemporal planning for public consumption possible.

## I. The Setting of the Problem

Alaska currently ranks second, after Texas, in oil production in the United States. Unlike Texas and other oil producing states, over 90 percent of Alaska's production is concentrated in a single field at Prudhoe Bay (1.5 million barrels per day), and the economy of the state is not significantly diversified so the tax base of the state rests completely on petroleum. The lack of diversification is primarily the result of its high labor costs (25 to 50 percent above U.S. averages), small market size (400 thousand population), and distance from large markets (Anchorage, the largest city, is about 1,500 air miles from Seattle, the nearest point in the coterminous United States). The economy has historically been based upon natural resource extraction and the present petroleum boom is just the most current manifestation of that pattern.<sup>1</sup>

The state levies several taxes on oil and gas production and transportation and has a one-eighth royalty interest in the Prudhoe Bay field. In the current fiscal year (1981), these taxes and royalties are projected to yield an income to the state of \$3.6 billion. In contrast, the 1980 operating budget was \$1.7 billion. At current rates of production and modest rates of growth of the state budget, these annual surpluses are expected to continue through the 1980s, resulting in a substantial accumulation of funds.

When production from the Prudhoe Bay field begins to decline in the late 1980s, revenues from petroleum and, consequently, total revenues will fall. Earnings on accumulated funds will postpone the fall, but only temporarily. The decline in petroleum revenues is inevitable because the probability of finding another field of the same magnitude as Prudhoe Bay is almost nil,<sup>2</sup> and much of the oil development expected to occur in Alaska in the next two decades will be on federal lands onshore and offshore. The state does not have an ownership share in oil

on federal lands and only limited rights to share in the revenues generated by production of such oil.

When revenues fall, the state will begin to experience a "fiscal crunch," where falling revenues squeeze the level of expenditures, a now-familiar phenomenon in northeastern and midwestern states. For Alaska, the crunch will be particularly severe because of the large proportion of total state revenues which come from petroleum and the large state and local government sector which is directly supported by those revenues. The federal government is presently concerned with this phenomenon in Texas, Oklahoma, and Louisiana. These three states, in 1978, derived 21.2 percent of their own source general revenues from direct mineral revenues. In Alaska, the comparable figure is over 90 percent.<sup>3</sup>

To summarize, the state has more money than it needs for current expenditures and will inevitably face a "fiscal crunch" at some future time. The question for state fiscal planning is how the wealth represented by the flow of revenues from petroleum can be best managed to maximize the benefits derived from that wealth and minimize the costs of a "fiscal crunch."

## II. A Wealth Management Model

The alternatives for wealth management fall into four general categories, as follows:<sup>4</sup>

1. Accumulate the current surpluses in a "rainy day" account (invested outside the region) to be spent when the petroleum revenues are gone.
2. Invest in regional economic development programs to provide an alternative tax base when the petroleum revenues are gone.
3. Consume the current surpluses in the form of increased public goods and services.

4. Distribute the current surpluses to individuals who would individually decide on the mix of private and public savings, investment, and consumption they prefer. (This alternative is sometimes called privatization.)

Each of these alternatives has significant appeal and a planning model is necessary to determine what the proper mix should be. The problem can be easily formalized by viewing the state share of oil in the ground as an asset (A) with an estimable present value. Under current tax policy and wellhead prices, that value is approximately \$80 billion. Each year a portion of the asset should be transformed into various uses ( $a_{it}$ ) so that over the whole planning horizon, the benefits of consumption to the state in those uses is maximized.

The function to be maximized is the present value of a stream of discounted future utilities where the utilities at time  $t$ ,  $U(C_t)$ , are a function of consumption in that year, and future utilities are discounted to the present by the discount rate  $r$ .

$$\max \int_0^{\infty} U(C_t) e^{-rt} dt \quad (1)$$

Use of the asset in any period,  $a_t$ , is the sum of the alternatives.

$$a_{1t} + a_{2t} \dots a_{nt} = a_t \quad (2)$$

Consumption is a function of the alternative uses.

$$C_t = f(a_{1t}, a_{2t}, \dots, a_{nt}) \quad (3)$$

The choice of uses is subject to the constraint on the initial availability of the asset.

$$\int_0^{\infty} a_t dt \leq A \quad (4)$$

Solution of this problem by the proper choice of the variables,  $a_{it}$ , yields the maximum benefits from the use of the asset as well as a general rule for choosing a strategy (set of uses at each point in time). The asset should be allocated at each point in time to each use,  $a_{it}$ , so that the net present value of the last bit (the "marginal" quantity) of the asset allocated among all competing uses is equivalent and is equal to the "user cost" of the asset,  $\lambda$ , which increases over time at the rate  $r$ . The user cost is a measure of the fact that the asset is non-renewable, and an increase in consumption in the present reduces the potential level of production in the future.<sup>5</sup>

$$\frac{dU}{da_{it}} = \lambda e^{rt} \quad (5)$$

For example, there may be only two alternatives--converting some of the oil into other investment assets through its sale and consuming some of the oil by selling it and buying a government service. These two uses of the asset should be combined each year so that the rate of return on investments just equals the net present value of the stream of benefits, current and future, of the marginal (least beneficial) government service purchased with the asset.

In theory, this problem is solvable; in practice, there are many complex issues involved in the choice of the model parameters. Among the more important ones are the following:

1. At what rate should the future be discounted, if at all? Since benefits accruing at different times in the future are being evaluated, there must be some means of comparing them. Conventional economic wisdom would suggest use of the social rate of time discounting for the discount rate, but because the asset being analyzed is the result of a unique event and is, in a sense, owned by all generations of Alaskans, one could argue against any discounting of future benefits derived from use of the resource.

2. What time horizon should be used in the analysis? Infinite time horizons can give impossible results in problems of this type, especially if there is no discounting of the future. Technically, there is no difficulty introduced by not initially choosing a time horizon because the solution to the problem can include the time horizon for consumption of the asset. Practically, however, there could be a problem if the time horizon for consumption spans several generations.

3. How should uncertainty be handled? It is not possible to say with absolute certainty that oil revenues will decline or to identify when they will decline or that an alternative tax base will not emerge to replace oil. An asset reserve margin could be incorporated into the utility function to handle this.

4. How are different categories of benefits or returns on investments to be measured and equated? Benefits will be in several forms including monetary returns, employment, public goods and services, etc. How is the value of an investment which creates one job in the private sector to be compared with an alternative which generates an income to the public sector of \$10 thousand annually? Detailed economic models can estimate the effects of different strategies, but some public decision-making process is necessary to compare the benefits of different outcomes.

5. How should the government decision-making process be restructured so that it can more adequately address multi-year allocation questions? The current process of allocation of funds is done on an annual basis by legislators with a 2-to-4-year tenure. They may not properly represent the interests of their constituents because of this constraint on their behavior.

### III. When is the Wealth Management Model Rational?

#### III.A. A Planning Conundrum

Each of these issues is a complex, fascinating problem, but all can be handled at least conceptually within the general framework of planning for the optimal allocation of the resource. The final concern addressed in this section is more fundamental in nature. To isolate it, let us assume away any problems associated with the five aforementioned points. Thus, we assume all individuals and society know their discount rates; a one-generation planning horizon is indicated by the parameters of the model; there is no uncertainty; all benefits and costs can be accurately measured and equated; and decision makers perfectly reflect their constituencies.

The problem that remains is that the population is not stable. This creates a fundamental difference in the application of this model to the Alaska (or Alberta or Newfoundland or Wyoming) case from that of Saudi Arabia. In the latter case, the population group over which benefits are being measured is known. It is not constant because of natural increase and death, but there are no entrants into the club of those who can partake in the benefits except by birth.

This is not so in a regional economy in the United States or Canada where because of open borders individuals are free to migrate to optimize their economic condition and are automatically enfranchised wherever they go.

Consequently, the population will be changing over time as people migrate in and out of the region. This migration will, in fact, be a function of the wealth optimization strategy chosen. For example, if the strategy chosen were primarily one of saving in a rainy day account, there would be little, if any, induced population growth through migration into the region. On the other hand, if it were to maximize



economic growth to try to develop an alternate tax base, there would be a substantial increase in population through migration to fill the jobs created by the development program.

Changing population size in itself is not a problem if it can be adequately estimated as a function of the chosen strategy. The difficulty is that the new migrants may have very different preferences concerning optimal strategies, and if this is the case, then what previously appeared to be an optimal strategy is, in retrospect, suboptimal.

Whether this is, in fact, a problem depends upon the form that the benefit function takes. There are basically two possible formulations. One way to measure the benefits of a particular strategy would be to sum the benefits of the individuals within the region to determine total benefits. This is analogous to a "people prosperity" approach in regional planning. The other would be to consider the benefits to the region independent of the benefits to the particular citizenry at any point in time. The benefits of the strategy would accrue to individuals, but in this second view the government would be acting on behalf of unborn and unrepresented generations of citizens and would be explicitly recognizing the region's fiscal responsibility and accountability to future generations. This is similar to a "place prosperity" focus.

The implication for planning of adoption of a benefit function which is some weighted sum of the benefit functions of the individuals in the region at any time (people prosperity) is that rational planning is not possible. An optimal planning strategy for use of the asset over time is impossible to identify because population change resulting from migration will change the character of the benefit function over time in such a way that a path which appears optimal a priori will ex post turn out to be non-optimal.

This can be demonstrated with an example. Consider a situation in which 60 units of an asset must be publicly consumed within three planning periods in a regional economy. There is no discount rate, and units consumed are equivalent to units of utility or benefit of the asset. Initially, there are two equal-sized groups of citizens in the region, identical except that one is mobile and the other is not.<sup>6</sup> There are no births or deaths during the three periods.

In analyzing their personal preferences for the timing of consumption of the asset, the mobile group compares the stream of future benefits from the consumption of the public resource against the alternatives available in other regions. The nonmobile group analyzes the stream of public benefits available in the region of current residence only.

Initially an optimal consumption strategy decided upon by the non-migrators might be 20, 20, 20 and by the migrators 30, 30, 0. This would be the case if the migrators calculated that in period 3 they could move to some other region where they could obtain public benefits greater than the 0 they could receive by remaining in the region in period 3. A compromise solution growing out of the political process might be 25, 25, 10 where all citizens' votes for an overall three-period strategy received equal weight. This is strategy 1 in Table A, the intertemporal allocation of consumption of the asset preferred by people in the region initially.

Consumption at a high rate in period 1 induces population growth through in-migration to fill jobs in the expanded regional economy. Thus, in the second period, a new group of migrators adds to the population. For simplicity, we assume they are all migrants who will stay one period. Their votes have the same weight in the choice of an optimal consumption plan as the two previously resident groups, and they have the same preferences as the other migrant group. Now of the 35 units remaining in period 2, two-thirds of the population wants to consume

TABLE A. DIFFERENT CONSUMPTION STRATEGIES FOR  
PUBLIC WEALTH MANAGEMENT

Strategy	Time Period		
	1	2	3
1. Preferred by those present in period one	25	25	10
2. Preferred by those present in period two	16.7	36.7	6.7
3. Preferred by those present in period three	20	20	20
4. Consumption strategy resulting if everyone gets a vote for those times they will be present, and the strategy is determined before period one	18.3	27	14.7
Actual - Individuals vote when present	25	29	6

Note: The preferences of each group over the three periods are as follows:

	1	2	3
1. Nonmigrators	20	20	20
2. First migrators	30	30	0
3. Second migrators	0	60	0

Different allocations result from different weightings for each group's preferences (zero or one) and whether the allocation decision is made sequentially (period by period) or simultaneously. Strategies 1 through 4 are simultaneous while the actual allocation is sequential.

If  $w_{ij}$  is the weight given group  $i$  in period  $j$ , then the weights are as follows:

Strategy	Period 1			Period 2			Period 3		
	$w_{11}$	$w_{21}$	$w_{31}$	$w_{12}$	$w_{22}$	$w_{32}$	$w_{13}$	$w_{23}$	$w_{33}$
1	1	1	0	1	1	0	1	1	0
2	1	1	1	1	1	1	1	1	1
3	1	0	0	1	0	0	1	0	0
4	1	1	0	1	1	1	1	0	0
Actual	1	1	0	1	1	1	1	0	0

it all and one-third wants to consume half. The optimal consumption scheme voted on in period 2 is approximately 29, 6.

In the final period, the transients all leave after having decided they can receive more than six units of public goods elsewhere, and six units are consumed in the final period by the nonmigrating group.

The actual consumption strategy has been 25, 29, 6. Is this in any sense optimal? The question can be answered by reference to Table A which shows the preferred consumption strategy for different groups in comparison to the actual consumption package. There is no production plan that can be termed optimal over all periods. Strategy 1 is optimal from the perspective of those present in period 1; but from the perspective of period 2 and those then present, it has resulted in too much consumption in period 1. The same holds for strategy 2 viewed from the third period.<sup>7</sup> There is no strategy that is consistently preferred over the others. Thus, planning decisions which appear to be optimal are, in retrospect, not preferred.

There is a different optimal pattern of consumption from the perspective of the individuals within the region at each time period, and in a democratic system there is no way to choose among those consumption paths. From the analysis of Table A, one can only generalize to the point of saying that citizens in all time periods after the first "regret" the high level of consumption in earlier periods; it is higher than they would have chosen; consequently, in the end consumption apparently occurred at too fast a rate.

It is not possible to eliminate the problem of inconsistencies in the optimal strategy viewed from different points in time by perfectly anticipating future population shifts and their accompanying preference shifts. Strategy 4 lets everyone who will be in the region at any time period vote on a strategy for consumption. It does not appear optimal

to those present from the perspective of any of the time periods and, consequently, would not be implemented. In addition, because the migration and consumption decisions are related, if the low level of consumption called for in the first period in this strategy were implemented, it might not stimulate in-migration in the second period and anticipated and actual population in period 2 may be different.

### III.B. A Possible Solution

The alternative formulation of the benefit function is based upon a version of place prosperity. The welfare function is not the weighted average of actual individual preferences but rather a generalized aggregate of the population. The rationale is that there will always be a population in the region and public goods and services will always be needed to support that population. Thus, it is the responsibility of the regional government to provide for the delivery of those services at reasonable cost, not only in the present but also in future years. This is also consistent with the view that the resource is "owned" by all generations of Alaskans and it is not only the present generation, which has had the good fortune (luck) to find the resource, that should have a voice in the decision concerning its use in consumption.

This approach suggests several alternative formulations of the social benefit function. The most straightforward would be to treat the population as if it were all permanent residents. The preferences of the current population would not be used in the benefit function, but rather those of an equivalent number of permanent residents. If the preferences of a representative permanent resident could be identified, then a unique strategy could be chosen which would be optimal from the perspective of all time periods.

The obvious practical difficulty with this approach is that it is politically difficult to implement where only present residents have a voice in the allocation decision. The challenge is to devise political

mechanisms and develop a political consciousness which allow democratic choice in the broader sense of allowing all groups, present and future, who may be affected by the decisions to have a vote on the best strategy.

Such an approach may also be optimal from the national perspective. Economists generally argue that a place prosperity approach to regional planning is inefficient because it inhibits the free movement of resources to locations where they can be put to their highest and best use. In this case, however, such an approach may be efficient in the long run for the nation as a whole if there are nonmigrators or people slow to respond to economic incentives. A benefit function which assumes that everyone is a nonmigrant will reduce the boom-bust cycle of the economy by flattening and extending the consumption pattern over time. A smaller boom followed by a smaller bust may be less costly to the nation as a whole because it is likely to leave a smaller population as a residual after the boom has passed and thus less likely to require a federal assistance program to aid the bust economy or to stimulate out-migration.

## ENDNOTES

1. An economic history of Alaska appears in George Rogers, The Future of Alaska, Johns Hopkins, Baltimore, 1962.
2. Prudhoe Bay is among the fifteen largest fields in the world and is nearly twice as large as the next largest field in the United States, East Texas. See Oil and Gas Journal, August 1977, Vol. 75, No. 35, p. 102.
3. U.S. General Accounting Office, Long-Term Economic Planning Needed in Oil and Gas Producing States, U.S. G.P.O., Washington, D.C., 1980. This report is summarized as follows:

The state budgets and economies of Texas, Oklahoma, and Louisiana rely heavily on oil and gas industry. With rising energy prices, the region's potential overdependence on this industry is masked by current economic prosperity. Heavy reliance in the region on diminishing, nonrenewable resources should invite continued reassessment; long-range planning is needed.

We recommend that existing Federal planning assistance programs include a focus on the specific issue of how the region should deal with declining oil and gas resources. . . .

4. A fifth alternative, leaving the oil in the ground to appreciate in value is not, in the case of Prudhoe Bay, possible.
5. For a detailed explanation of this model, see Oscar Burt and Ronald G. Cummings, "Production and Investment in Natural Resource Industries," American Economic Review, Vol. LX, No. 4, September 1970, pp. 576-590.
6. In this example, nonrational planning results because some of the population is not mobile. This condition is not necessary in the general case, only that different people have different preferences for use of the public good.
7. This type of problem was first discussed by Robert Strotz, "Myopia and Inconsistency in Dynamic Utility Optimization," Review of Economic Studies 23 (1956), pp. 165-180.