A Fiscal Model for Alaska:
Structure and Policy Applications

O. Scott Goldsmith
A FISCAL MODEL FOR ALASKA: STRUCTURE AND POLICY APPLICATIONS

Modeling of the Alaskan economy is a critical task because of the rapid growth and change which the state is experiencing. To a large extent, the forces generating this change are beyond the control of the state. The trans-Alaska oil pipeline is only the first of a series of events associated with exploration and development of Alaska’s petroleum resources which will generate growth and change but which will be essentially outside state control. However, state government decisions on taxation and expenditures can have a significant effect on the amount and composition of growth of the economy. In fact, the state government is in a unique position to influence the future course of the state of Alaska.

In order to assist state decisionmakers in tracing out the implications of their policy decisions, a state fiscal model has been constructed. The model has been integrated into already existing economic and demographic models of Alaska so that fiscal impacts can be traced throughout the economy. This paper is a preliminary report on the construction of the model and uses to which it may be put. The first section provides a description of the structure of the fiscal model and its links to the other models. Basic projections of Alaska’s fiscal position are presented in the second section. The model is then used to examine the implications of two alternative uses of the large state General Fund surplus. The concluding section discusses policy implications, other applications, and future work.

1.

The basic structure of the fiscal model can be divided into three components. The first consists of revenue generating activities and linkages from the economic model. The second is the various state government funds into which all revenues flow. The third is government expenditure activities and the linkages back to the economic model. Figure 1 provides a diagrammatic representation of the model structure. 2

Revenues can be divided into four general categories. The largest future source of revenues will be generated by activities within the petroleum industry. The level of activity in the petroleum sector is, in turn, essentially exogenous to the level of state economic activity.

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1 This research was supported by a grant from the National Science Foundation. Helpful comments and assistance have been received from Mike Scott and Dan Selver in the construction of the fiscal model. All remaining errors are the responsibility of the author.

2 Model equations are in Appendix A, while regression results are available from the author upon request.
Figure 1. MAP State Government Model Structure

Key:
- Link from Economic Model
- State Government Model Component
- Link to Economic Model

- Personal Income and Wealth
  - Personal Income Tax
  - Corporate Income Tax
  - Motor Fuel Tax
  - Business License Tax
  - Use Taxes
  - Ad Valorem Taxes
  - School Tax
  - Other Taxes
  - Fees
  - Airport Receipts
  - Ferry Receipts
  - Miscellaneous Receipts

- Nonpetroleum Sectors of Economy

- PETROLEUM SECTOR
  - Production Tax
  - Property Tax
  - Income Tax
  - Other Taxes

- Federal Government Transfers

- General Obligation Bonds

- General Fund
  - Debt Service
  - Highway Capital Expenditures
  - Non-Highway Capital Expenditures
  - Construction Industry Output
  - Operating Expenditures
    - Education
    - Social Services
    - Health
    - Natural Resources and Environmental Conservation
    - Public Protection
    - Administration of Justice
    - Development
    - Transportation
    - General Government
  - Transfers to Individuals
  - Transfers to Local Government

- Special Funds
  - Permanent Fund
    - Permanent Fund Interest
    - Permanent Fund Investments In Alaska

- State Government Wages and Salaries
Consistent sets of assumptions regarding the timing and level of future petroleum exploration and development activities have been assembled into petroleum scenarios through the use of a non-stochastic scenario generator model. Output from the scenario model consists of petroleum and construction sector employment figures which are input to the economic model, and also state petroleum revenues which are input to the fiscal model. The petroleum revenues consist of two major categories. There are several taxes, including the property tax on petroleum production-related facilities, the severance taxes, the reserves tax, the petroleum component of the corporate income tax, and several minor petroleum-related taxes. Revenues generated from state-owned resources consist of royalty payments, lease bonuses, and lease rentals. In addition, there are some federal shared royalties.

The level of revenues from the petroleum sector depends basically upon the amount of production, the average wellhead prices of oil and gas, the rate schedules for taxes, royalties and leases, and the composition of ownership of the individual producing fields. All are variable within the scenario model.

From the perspective of state policy, endogenous tax receipts are the most important component of revenues. They have historically lagged behind federal transfers as a source of revenues and will not grow as rapidly as petroleum revenues in the future, but policy changes affecting the structure of taxes will directly affect the level of income in the private economy which will lead to changes in demand for outputs and thus impact economic growth.

Of state taxes, the only one which is presently simultaneous with the economic model is the personal income tax because of the primary importance of this tax as a source of revenue and also because of data limitations. In 1976, 59 percent of non-petroleum tax revenues derived from the personal income tax.

Modeling of this tax was done in such a way to facilitate the examination of the impact of structural changes in the tax while at the same time maintaining simplicity. In addition, lack of even aggregate data on the components of Alaskan state returns prevented a more detailed model. Fortunately, the calculation of taxable income closely corresponds to the federal tax basis and aggregate information from federal returns from Alaska was utilized to fill in some gaps.

The 12-equation component essentially calculates adjusted gross income from personal income, independently calculates taxpayers from employment, exemptions from population, and deductions from the average taxpayer's adjusted gross income; and from this, Alaska taxable income is derived. Fiscal year liability is determined by applying a logarithmic representation of the tax schedule to the average taxable income. Calendar year liability is a weighted average of fiscal year liabilities. Stochastic equations in this model component, as in all others, are ordinary least
squares on a data base covering the period 1961 to 1975 with many exceptions because of shorter historical time series.

Disposable personal income is net of calendar year personal income tax receipts and thus changes in the schedule, the value of exemptions, allowable deductions, or tax credits are immediately reflected in changes in disposable personal income.

Other important taxes are linked to the economic model but are not simultaneous. Thus, the corporate income tax and the business license tax are functions of output while the motor vehicle tax is related to population and personal income. The attempt has been made to model these taxes structurally in order to independently identify the tax base and the tax schedule, but this has been with only limited success because of a limited amount of data on these variables.

Smaller categories of taxes are reduced form functions of disposable personal income or employment, with the exception of the smallest categories which are exogenous.

Historically, the most important revenue source to the state in absolute terms has been federal transfers. Only in 1976 has this category been exceeded by petroleum-related revenues and nonpetroleum tax revenues as sources of operating revenues. Detailed modeling of the pattern of federal transfers has not been undertaken because of the large element of uncertainty involved in attempting to extrapolate from the historical experience in this area.

Federal transfers to Alaska on a per-capita basis are presently about three times the national average because of sparse population and the high cost of living. As the state continues to adjust to its relatively new statehood status and its population continues to expand, its per-capita level of federal transfers should move closer to the national average. In addition, as the state begins to reap the benefits of petroleum development through increased state revenues, there will be political pressure in Washington to eliminate the privileged position the state has traditionally enjoyed.

With these factors in mind, a simple relationship between per capita federal transfers and the inverse of state population was calculated from a national cross section of states. The resultant national relationship has been used to simulate future growth of federal transfers with an adjustment for cost-of-living increases.

The final category of state revenues for operation consists of interest earnings and a variety of fairly small items which appear to be growing somewhat more rapidly than the general level of economic activity. Interest earned on the balances in all funds is paid into the General Fund. As petroleum revenues increase more rapidly than state expenditures, interest on state funds will generate a substantial amount of state revenue. Other components of this category, apart from interest, are fees and licenses, charges for services, fines, rents and sales of government property,
extraordinary items, and receipts from airport and ferry operations. Too small to be worthwhile modeling individually, these items are simulated based upon reduced-form functions of general economic activity or are allowed to grow at exogenously determined rates.

When all revenues have been calculated, they must be divided among the various funds within the state government. Because the state constitution explicitly prohibits the dedication of proceeds from taxes and licenses for any special purpose except programs which have joint federal/state participation, there are few special purpose funds in the state government. The General Fund receives the bulk of revenues, both restricted and unrestricted, from all sources.

A Permanent Fund was established in 1976 to receive a portion of income from state-owned petroleum resources and federal mineral revenue-sharing payments. Revenues dedicated to the Fund must be used only for income-producing investments and may not be used to finance either general operating expenditures or capital improvements of the state. Interest and profits from the Permanent Fund are paid into the General Fund.

The special funds are a small category consisting primarily of special revenue funds, of which the largest is federal revenue sharing, and the enterprise funds, of which the largest is the international airport fund.

Another major category of funds is the capital projects funds. These funds are used to receive and disburse the proceeds of general obligation bonds and other funds appropriated for capital outlays. Expenditures out of capital-projects funds and debt service required on the bonds have direct impacts on the economy, and so it is these expenditure activities which are modeled, rather than the funds themselves.

State government expenditures are divided into two primary categories, capital expenditures and operations expenditures. Capital expenditures are financed both out of general obligation bonds and out of the General Fund. A majority of General Fund capital expenditures originate as federal grants-in-aid for highway construction. Financing out of general-obligation bonds requires repayment at some future date out of General Fund proceeds and this requires a link between capital expenditures from general obligation bonds and the General Fund.

Capital expenditures are divided into highway and non-highway categories because of the differing percentages of expenditures in these categories which filter through to the private economy, and the differing ratios of value added to total bid value in highway construction and other construction categories.

The historical series on state capital expenditures has been quite volatile, making it difficult to estimate a functional relationship of expenditures to general economic conditions. Two factors contributing to this volatility are the fact that all
general obligation bonds must have the prior approval of the electorate and a large percentage of all capital expenditures have been federal grants-in-aid for highway construction which has tended to vary relatively independently of Alaska economic activity. For this reason, capital expenditures are assumed to grow in the long run according to very simple relationships. General Fund capital expenditures are related to the supply of funds. Highway expenditures grow as a fixed percentage of federal grants-in-aid, while non-highway expenditures grow with the level of the General Fund. Expenditures financed by general obligation bonds are demand-related, increasing with population and the cost of living.

State government capital expenditures are linked to the private economy through the construction industry. Reduced form equations relate the level of capital expenditures to the value added in the construction industry through government construction contracts. This amount is added to value added by private demand and other levels of government to get the total value of output in the construction industry.

Operating expenditures are determined by a set of nine expenditure equations, one for each major functional category of government operations. The choice of specification for these equations is somewhat arbitrary because the historical data series is quite short. Several alternative specifications, all of which appear theoretically plausible, are statistically significant, and none emerges as obviously superior. When projected into the future, the different specifications give different results with respect to the total size of the operating budget, although the budget mix is not nearly as sensitive to specification.

The difficulty lies in the structural change presently occurring in the state's fiscal position, which makes historical relationships a poor guide for future behavior in spending patterns by the executive and legislative branches of government. Prior to 1969, the state was in the process of adjusting to statehood and was receiving a very significant proportion of its funds from the federal government. In-state sources of revenue were meager and the relative level of public services fairly low. The bonus of more than $900 million received by the state for the 1969 Prudhoe Bay sale came at a time when annual revenues had not reached $200 million, and this one-time infusion of funds had a significant effect on spending at the state level. The $900 million was depleted by 1975, but not before some legislators had realized that although the original $900 million had seemed to be more than the state could ever hope to spend, once the business of spending began in earnest, $900 million was a very finite amount. Thus, there is now a more cautious approach to managing new sources of revenue and the state may be about to enter an era where a third type of relationship may hold between expenditures and available revenues.

The set of reduced form expenditure equations all use the same explanatory
variables to explain per capita expenditure levels. The variables are the level of current revenues, net of both transfers from the federal government and debt service, personal income per capita, and the lagged balance in the General Fund. These equations, together with savings out of General Fund revenues, form a system which could be estimated simultaneously. At this point, this has not been done and savings out of General Fund revenues have merely been treated as a residual. Federal transfers by functional category do not significantly affect the level of spending in each category and are netted out for this reason.

Operating expenditures by functional category determine the level of fiscal year personnel expenditures by functional category and these, in turn, determine wage and salary payments on a fiscal year basis. For consistency with the economic model, these are converted into calendar year wage and salary payments.\(^3\)

The state provides a significant amount of financial assistance to local communities in the form of direct tax-sharing programs, general revenue sharing, grants-in-aid, and education assistance. At the present time, the model ties all transfers to local government to the size of the state education budget since the overwhelming majority of such transfers are for education. Direct transfers to individuals are not modeled explicitly within each functional category. The single largest component of such transfers are to Natives as a result of the Native Claims Settlement Act. In the model, these are deducted from petroleum revenues before they enter the General Fund rather than being treated as a pass-through item.

The fiscal model is imbedded within and simulated simultaneously with the economic and demographic models, which will now be very briefly described. The general structure of the overall model is shown in Figure 2.

The economic model is driven by real disposable personal income which determines the level of demand in the endogenous sectors of the economy. Output or employment in the export sectors is determined exogenously. Employment is a function of output and, in turn, determines wages and salaries. The aggregated wages and salaries form the major component of personal income, thus completing the simultaneous system.\(^4\)

All relationships are derived from OLS regressions using historical data for the period 1961-1974. The most important exogenous sector in the economic model is petroleum industry activity. The scenario model, mentioned earlier in connection with petroleum revenues, is also used to provide exogenous input on employment in

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\(^3\)These equations are based on work by Michael Scott in “The MAP Expenditures Submodel for State Government Wages and Salaries,” Institute of Social and Economic Research working paper, 1976.

Figure 2. Alaska Model Components
the petroleum sector and petroleum-related employment in the construction sector.

A demographic model provides an age-sex distribution of the population. The linkage between economic activity and population growth operates through an equation determining net civilian migration to Alaska. It has been found that most of the variation in reported net civilian migration in the historical period is explained by the annual growth of civilian employment and the lagged change in relative per capita income.5

II.

The model is presently capable of simulating the Alaskan economy on an annual basis through the year 1990. This section briefly describes a base case simulation using the model.

This case assumes that the average wellhead price of oil produced in Alaska will be $7 per barrel and that petroleum exploration and development activity will continue to be strong throughout the projection period. In addition to areas already leased, activity will occur on outer continental shelf areas, National Petroleum Reserve Alaska, and on state and private lands in close proximity to these areas. These exogenous assumptions, formalized in the petroleum scenario, drive the economy.

On the basis of this scenario, aggregate economic growth is rapid throughout the projection period. This is exemplified by large increases in population (POP), employment (EM99), and personal income (PI) as indicated in Table 1.

The source of growth, petroleum activity, affects growth in two ways. First, petroleum-related employment increases personal income, which generates demands for goods and services. Second, petroleum revenues provide a basis for the expansion of state and local government activity to a rather spectacular degree.

Table 2 illustrates this increase in the capacity of the state government to undertake new programs and the state response, given a continuation of historic relationships. Petroleum-related revenues (RP9S) provide the bulk of revenues to the state throughout the period. Although a significant portion is siphoned off to the Permanent Fund, this source dominates total General Fund revenues (RGF99S). As expected, when the state is faced by large increases in revenues as well as population increase, state expenditures (E99S) increase rapidly. This continues the historic trend since statehood in 1959 of two-digit growth in state expenditures. Yet in spite of this growth in expenditures, a budget surplus results, and the accumulated surplus

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Table 1  
Base Case Aggregate Economic Variables

<table>
<thead>
<tr>
<th>Year</th>
<th>POP (10^3)</th>
<th>EM99 (10^3)</th>
<th>PI ($10^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977</td>
<td>387.361</td>
<td>181.804</td>
<td>3066.5</td>
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<td>1978</td>
<td>397.334</td>
<td>188.626</td>
<td>3407.41</td>
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<td>1979</td>
<td>414.245</td>
<td>200.429</td>
<td>3837.3</td>
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<td>1980</td>
<td>443.384</td>
<td>221.058</td>
<td>4487.64</td>
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<td>1981</td>
<td>468.713</td>
<td>254.215</td>
<td>5465.98</td>
</tr>
<tr>
<td>1982</td>
<td>527.167</td>
<td>271.775</td>
<td>6180.21</td>
</tr>
<tr>
<td>1983</td>
<td>567.052</td>
<td>295.062</td>
<td>7043.3</td>
</tr>
<tr>
<td>1984</td>
<td>581.393</td>
<td>296.321</td>
<td>7430.84</td>
</tr>
<tr>
<td>1985</td>
<td>599.9</td>
<td>302.236</td>
<td>7997.62</td>
</tr>
<tr>
<td>1986</td>
<td>619.821</td>
<td>309.842</td>
<td>8634.73</td>
</tr>
<tr>
<td>1987</td>
<td>644.853</td>
<td>321.939</td>
<td>9458.04</td>
</tr>
<tr>
<td>1988</td>
<td>671.17</td>
<td>334.891</td>
<td>10375.9</td>
</tr>
<tr>
<td>1989</td>
<td>694.157</td>
<td>344.939</td>
<td>11264.1</td>
</tr>
<tr>
<td>1990</td>
<td>710.748</td>
<td>349.893</td>
<td>12050.9</td>
</tr>
</tbody>
</table>

POP = population  
EM99 = employment  
PI = personal income

or General Fund balance (GFBAL) grows into the mid-1980s before beginning to taper off.

This illustrates the non-coincidence of future revenue and expenditure growth in the state. The largest single revenue producer among the petroleum development projects is the Prudhoe Bay field, located on state lands. This source of revenue will reach peak production early in the simulation period, causing a bulge in revenue growth. Later petroleum development will not, in general, result in such a large payoff in terms of increased state revenues because of federal and private ownership of fields.\(^6\) By the mid-1980s, expenditures do exceed revenues and the balance in the General Fund begins to fall. However, at the end of the simulation period, the General Fund balance is still substantial.

The model also allows one to analyze the economic position of the “average” individual. Table 3 shows the movement of real disposable personal income per capita (DIRPA) and real state government expenditures per capita (E99SRPC) as the

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\(^6\)This is explored in some detail in Edward Porter, “The Economic Impact of Federal Energy Development in the State of Alaska,” a working paper, 1977,
Table 2
Base Case State Fiscal Variables ($10^6)

<table>
<thead>
<tr>
<th></th>
<th>RP9S</th>
<th>RGF99S</th>
<th>GFBAL</th>
<th>E99S</th>
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</thead>
<tbody>
<tr>
<td>1977</td>
<td>450,658</td>
<td>972,244</td>
<td>633,565</td>
<td>968,457</td>
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<tr>
<td>1978</td>
<td>873,008</td>
<td>1338,53</td>
<td>972,572</td>
<td>1109,53</td>
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<td>1979</td>
<td>1111,6</td>
<td>1636,43</td>
<td>1429,5</td>
<td>1298,51</td>
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<td>1980</td>
<td>1337,28</td>
<td>1976,65</td>
<td>1952,19</td>
<td>1585,97</td>
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<td>1981</td>
<td>1842,71</td>
<td>2516,4</td>
<td>2531,43</td>
<td>2081,91</td>
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<tr>
<td>1982</td>
<td>1918,38</td>
<td>2839,14</td>
<td>3164,83</td>
<td>2374,2</td>
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<td>1983</td>
<td>2092,63</td>
<td>3186,9</td>
<td>3594,26</td>
<td>2945,27</td>
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<td>1984</td>
<td>2369,05</td>
<td>3563,91</td>
<td>3977,43</td>
<td>3380,61</td>
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<td>1985</td>
<td>2628,18</td>
<td>3882,41</td>
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<td>1986</td>
<td>2839,97</td>
<td>4174,9</td>
<td>4591,4</td>
<td>4150,</td>
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<td>1987</td>
<td>3013,67</td>
<td>4444,37</td>
<td>4671,79</td>
<td>4611,85</td>
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<td>1988</td>
<td>3150,47</td>
<td>4684,25</td>
<td>4509,39</td>
<td>5114,34</td>
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<tr>
<td>1989</td>
<td>3218,54</td>
<td>4856,44</td>
<td>4081,47</td>
<td>5571,67</td>
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<tr>
<td>1990</td>
<td>3243,14</td>
<td>4956,82</td>
<td>3435,04</td>
<td>5908,68</td>
</tr>
</tbody>
</table>

RP9S = petroleum related revenues  
RGF99S = total General Fund revenues  
GF BAL = General Fund balance  
E99S = total state expenditures

economy grows. The growth in the former is concentrated in the earlier portion of the period, as the increase in high wage employment drives up personal income. Later growth is somewhat more concentrated in lower wage categories, and the progressive effect of the federal and state personal income taxes dampens the growth of disposable income relative to total personal income while at the same time, population growth continues to reduce all per capita variables.

The growth in real government expenditures per capita is much more dramatic. This also occurs primarily in the earlier part of the simulation period, because moderated growth in revenues and decline in the General Fund balance begin to dampen expenditure growth in the late 1980s. Overall, growth in expenditures per capita is possible in spite of the rapid population increase during the period.

Finally, Table 4 shows how the two most important non-federal taxes faced by individuals are growing. The personal income tax (RTIS) grows rapidly because of employment increases and the combined effect of high Alaskan incomes and a
Table 3
Base Case per Capita Economic Variables*

<table>
<thead>
<tr>
<th>Year</th>
<th>DIRPA</th>
<th>E99SRPC</th>
</tr>
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<tbody>
<tr>
<td>1977</td>
<td>2753.29</td>
<td>1089.41</td>
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<td>1978</td>
<td>2835.64</td>
<td>1162.41</td>
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<td>1979</td>
<td>2925.54</td>
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<tr>
<td>1980</td>
<td>3056.87</td>
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<td>1981</td>
<td>3364.49</td>
<td>1647.51</td>
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<td>1982</td>
<td>3221.84</td>
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<td>1983</td>
<td>3269.15</td>
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<td>1984</td>
<td>3218.39</td>
<td>1922.4</td>
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<td>1985</td>
<td>3208.76</td>
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<td>1986</td>
<td>3207.77</td>
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<td>1987</td>
<td>3229.94</td>
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<td>1988</td>
<td>3250.21</td>
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<td>3260.93</td>
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<tr>
<td>1990</td>
<td>3252.1</td>
<td>2182.56</td>
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</table>

*Deflated by 1967 national average to get real dollars

DIRPA  = real disposable personal income per capita
E99SRPC = real state expenditures per capita

progressive schedule. The property tax (RTFL) is the most important tax at the local level, and this also grows rapidly because of the general growth of the economy.

These two taxes provide the largest revenues related to endogenous economic activity. Comparison with Table 2 indicates, however, that the personal income tax provides a fairly small percentage of total state revenues and that local property tax receipts are dwarfed by petroleum-related revenues. The next section examines the impact of the reduction of each of these taxes in turn.
Table 4
Base Case Tax Revenues ($10^6)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>RTIS</th>
<th>RTPL</th>
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<tbody>
<tr>
<td>1977</td>
<td>101,263</td>
<td>95,7579</td>
</tr>
<tr>
<td>1978</td>
<td>104,35</td>
<td>91,1085</td>
</tr>
<tr>
<td>1979</td>
<td>129,578</td>
<td>104,728</td>
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<tr>
<td>1980</td>
<td>142,492</td>
<td>121,861</td>
</tr>
<tr>
<td>1981</td>
<td>175,82</td>
<td>147,966</td>
</tr>
<tr>
<td>1982</td>
<td>212,561</td>
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<tr>
<td>1983</td>
<td>245,872</td>
<td>216,867</td>
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<tr>
<td>1984</td>
<td>274,136</td>
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<td>1986</td>
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<td>1987</td>
<td>350,998</td>
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<td>1988</td>
<td>331,353</td>
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<td>1989</td>
<td>433,276</td>
<td>409,384</td>
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<td>1990</td>
<td>473,242</td>
<td>453,653</td>
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RTIS = state personal income tax
RTPL = local property tax

III.

We have constructed a detailed model of the state government sector in order to analyze alternatives suggested for present state revenue and expenditure policies.

The base case simulations indicate that large revenue surpluses will be generated in the next 10 years in spite of rapid growth in state government expenditures. One policy alternative which is beginning to receive increasing discussion is a reduction of taxes either on personal incomes or on property. The reasons for proposing such a tax reduction are not clearly articulated but seem to fall into three categories. First, there is a feeling that Alaskans bear a relatively large burden as a result of these taxes.\(^7\) Second, there is the fear that the state government sector will grow too large.

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\(^7\)Analysis of available data indicates that the relative tax burden on Alaskans is largest for the Federal personal income tax because of the combination of the progressive tax schedule and higher incomes necessitated by the higher cost of living. However, since federal grants-in-aid to Alaska are approximately three times the national average on a per capita basis and higher incomes may already have been equilibrated at a level which takes into account the relatively larger tax bite, it is not obvious that there is any relative burden.
if the state continues to run at a surplus and the marginal utility of consumption in
the public sector will fall below that of the private sector. A reduction in taxes
would increase private incomes and redress the imbalance. A third rationale would
be that the surplus in the General Fund consists of idle money not providing any
benefit to the citizens of the state. An easy way to provide benefits directly would
be through distribution of some of the surplus through reduced taxes. In addition,
this would stimulate economic growth.

The long-range implications of a tax reduction have not been discussed in detail
by those suggesting changes. In addition, the different impacts resulting from
different forms of a tax reduction have not been analyzed. These suggested changes
in the tax structure will have significant implications for both the growth path of the
economy and the range of future options available to the state because of changes in
the size of the General Fund balance. Since the state is interested in trying to chart a
best course for future growth, it is important that the growth implications of these
suggestions be examined in detail.

Given the manner in which the state personal income tax has been modeled,
experimenting with structural changes in not only the schedule but also the level of
deductions, exemption credits, and general credits is a straightforward procedure.
This is not the case with the municipal property tax, which is presently modeled in a
reduced form specification as a function of personal income. The real problem,
however, comes in trying to properly integrate into the model changes in consumer
behavior resulting from a reduction or the elimination of the property tax.

Consider the reaction in the residential sector to the elimination of the
property tax. The cost of home ownership will initially fall by the amount of the
tax, although the cost of home purchase will be unchanged. The reduced cost of
home ownership will cause the demand for housing to rise, thus causing the price of
home purchase to rise somewhat. To potential home purchasers, the elimination of
the property tax is seen as a reduction in the cost of living. To homeowners,
however, who are not contemplating a home purchase, the income effect of the
price change is more important. They will experience an increase in their
discretionary income as well as in their wealth and will react, in terms of the model,
as though disposable personal income has increased.

In the policy experiment involving a reduction of the property tax, the effect
on the economy is simplified to be a reduction in the cost of living and an increase
in real disposable personal income as a result of this decrease. It should be
emphasized that this shortcut simplifies the analysis somewhat and may
underestimate the pure income effect of reduction of the property tax.

An additional problem in integration of a change in the property tax into the
model is that it is not possible at this level of analysis to accurately determine the
exact relationship between a change in the property tax and a change in the consumer price index which reflects the general economic impact of this change. A large percentage of the tax falls initially on the commercial and industrial sectors, but a major portion of this burden is transferred to consumers and laborers. Elimination of the tax will result in gains to producers, higher wages to workers, and lower prices to consumers in relation to their original tax incidence. In addition, output may rise. The tax reduction will only partially be reflected as a price reduction.

Finally, the data does not allow one to accurately calculate what percentage of the cost of living in Alaska is property tax. This information is only available for Anchorage.

For these reasons, the analysis of changes in property tax structure have not been done on the basis of a completely specified relationship between those changes and direct economic effects. However, this discussion indicates that a significant qualitative difference exists between the effect of a reduction in the personal income tax, which directly increases disposable personal income and has primarily an income effect, and the effect of a reduction of the property tax which both reduces the price of one good and raises incomes. Thus, the qualitative difference in these tax measures justifies the comparative analysis of the two.

Two experiments are reported in this section. In the first, the personal income tax is reduced in calendar year 1978 through a combination of a reduction in the base tax rate and a reduction of the progressivity of the schedule. The base rate falls from three percent to approximately two percent, while the progressivity is practically eliminated. In the first full fiscal year during which the change is in effect, 1979, personal income tax returns are lower by approximately $71 million from the base case of $121 million. It is further assumed that this reduction of taxes is financed not through a reduction in the level of public goods and services, but rather through drawing down on the balance in the General Fund.

The second experiment involved a reduction of the local property tax liability beginning in the year 1978. The percent reduction, 77 percent, was chosen to correspond as closely as possible to the amount by which the personal income tax was reduced in the initial year in the other experiment. A shortfall in local revenues is avoided by a transfer from the state to local government of an amount equivalent to the revenue loss from the property tax reduction. Again, there is no reduction in the level of state services as a result of the transfer, as the General Fund balance is drawn down to pay for the transfer program. It is assumed that the reduction in the property tax reduces the cost of living by 2 percent.8

8This is a rough estimate based upon examination of the relationship between property tax collections and personal income statewide, and housing costs as a percentage of the Anchorage CPI. The qualitative results do not seem sensitive to changes in this percentage.
The impact of these changes in the tax structure can be examined on several levels. In aggregate terms, the impact is reflected in the changes in employment and population as shown in Table 5 and in the totals shown in Figure B-1 (Appendix B). The reduction in the personal income tax stimulates economic growth through a direct increase in disposable personal income. This generates increased demands for goods and services which creates new employment opportunities and additional migration to the state. In early years, the growth in employment is very much accelerated by the tax reduction, but eventually a plateau is reached and the level of employment remains fairly stable above the base case. Since the tax cut remains in effect for the whole simulation period, the stimulative effect should be cumulative and result in continuing employment growth in excess of the base case. However, as government expenditures are increasingly financed out of the General Fund balance, this balance is drawn down and with it, revenues generated through interest on the balance. Both the level of the Fund and the level of revenues affect the amount of state spending, and so state spending declines in the latter simulation years. This causes employment in the state government to decline relatively, thus offsetting employment growth in the private sector. Population growth, on the other hand, continues throughout the period through natural increase. This is accentuated by the young average age of the migrants to the state.

The aggregate impact of the reduction of the municipal property tax is much less than that of a similar-sized reduction in the personal income tax. The reduction in the property tax causes the price level to fall, and this causes an increase in real disposable personal income. Induced spending is less and this results in a smaller increase in employment and population. The reduction in the price level occurs only once, and prices continue to grow at the same rate in the future as in the base case, although the difference between the base case and the reduced property tax case increases slowly over time. This has a very mild stimulative effect. Over time, however, state employment begins to drop off as in the previous case, and for the same reasons. Thus, by the end of the simulation period, employment is below the base case. Population impact also moderates over time but does remain positive.

Turning next to an analysis of the state fiscal position, it can be seen from Table 6 that there is a significant acceleration in the rate of depletion of the General Fund balance in either case. The income tax reduction results in a rate of depletion about twice that of the property tax primarily because of the much larger population increase generated by the tax cut through the increase in employment and disposable income.

The population increase results in an increase in demand for public expenditures, but the economic stimulation resulting from the tax cut is not sufficient to offset the initial loss in revenue which the tax cuts produced. As
### Table 5

**Employment and Population Impacts of Tax Changes ($10^3$)**

**(Difference from Base Case)**

**EM99 – ENDGENOUS**

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<thead>
<tr>
<th>Year</th>
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**POP – ENDGENOUS**

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**EM99 = employment**

**GOLPIT_ER = reduction in personal income tax**

**POP = population**

**GOLPITL_ER = reduction in municipal property tax**
**Table 6**

General Fund Balance Impacts of Tax Changes ($10^6)
(Difference from Base Case)

<table>
<thead>
<tr>
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<th>GOLDFTRL_ ER</th>
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GOLDFTR_ ER = reduction in personal income tax
GOLDFTRL_ ER = reduction in municipal property tax

Illustrated by Table 7, the decline in the General Fund balance in particular results in a significant reduction in interest revenue in each case proportionate to the decline in the General Fund balance.

Table 8 indicates that the initial reduction in total revenues is less than the tax cut in the case of the personal income tax reduction because of the new revenues generated by the stimulative effect of the tax cut on the economy. Quite rapidly, however, reductions in General Fund interest revenue increase to the point where they exceed new taxes generated, and the negative impact on General Fund revenues exceeds the reduction in personal income tax collections.

The reduction in revenue available to fund state programs is almost identical in size in the case of a property tax reduction. The composition of the reduction is different, however, in that in this case there is very little offset to lost revenues as a result of stimulation of the economy. Initially, there is a positive impact from these other sources, but by the end of the simulation period, the negative employment impact results in a total negative net revenue impact slightly larger than the sum of
Table 7
Impact on General Fund Interest Revenue of Tax Changes ($10^6)
(Difference from Base Case)

<table>
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<th>RINS</th>
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GOLDPIT\_ER = reduction of personal income tax
GOLDTPL\_ER = reduction of municipal property tax

the property tax reduction and the interest income reduction. This is in contrast to the first case, where the negative net revenue impact is less than the sum of the tax reduction and the foregone interest income. This is illustrated in Figure B-2 of Appendix B.

The pattern of state expenditures varies between the cases, as illustrated in Table 9 and is a function of the specification of the expenditure equations. The income tax reduction increases population and, thus, the demand for public services. At the same time, the revenue available to fund services declines. At first, the increased demand predominates and expenditures rise compared to the base case, but eventually the effect of the decrease in supply of funds becomes stronger and expenditures fall off quite rapidly. In the case of the reduction in the property tax, the level of expenditures falls immediately and continues to drop in a smooth curve over time. The fall in expenditures is immediate in spite of both an increase in population and the use of the General Fund balance to pay for the tax reduction, because the level of expenditures is a function of the General Fund balance as well as of immediate year revenues and demands.
Table 8
Impact on Total General Fund Revenues and Personal Income Tax
Revenues of Personal Income Tax Cut ($10^6)
(Difference from Base Case)

<table>
<thead>
<tr>
<th></th>
<th>RGF998 - ENDOGENOUS</th>
<th>RTIS - ENDOGENOUS</th>
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RGF998 = total General Fund revenues
RTIS = personal income tax

Finally, it is possible to look at the impact of these policy changes on a per capita basis. Both tax changes have resulted in increases in real disposable personal income per capita, the income tax cut through a direct increase, and the property tax cut through a reduction in the cost of living. The impact of the latter is less than the former in the short run and approaches zero in the long run, as indicated in Table 10.

In either case, the long run impact on real disposable personal income is less than the impact in the short run. The value of the tax reduction in either case increases in nominal terms each year as nominal income rises. Three factors are operating, however, to reduce the real impact in per capita terms over time. The first is the increase in nominal prices. The other two are a result of the changing pattern of growth resulting from the tax reductions. In either case, there is an initial increase in employment, but this increase occurs primarily in the trade and services sectors, where the average wage is somewhat lower than the statewide average. In addition,
Table 9
Impact on State Expenditures of Tax Changes ($10^6)
(Difference from Base Case)

<table>
<thead>
<tr>
<th>Year</th>
<th>GOLDPIT_ER</th>
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<tbody>
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<td>-0.000977</td>
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GOLDPIT_ER = reduction in personal income tax
GOLDPTL_ER = reduction in municipal property tax

there is population growth, and this growth has been shown to have a continuing positive impact even when the employment impact has moderated. This is most clearly evident in the case of the property tax reduction where at the end of the simulation period, employment is lower, but population higher, than the base case.

Real per capita state government expenditures increase initially in both cases and then begin to decline as shown in Table 11. The initial increase in the case of the income tax reduction results from the fact that most of the initial population increase takes place among employed persons, so that personal income per capita rises and this generates a strong demand for public services. This effect is overcome rapidly by declining state government revenues. The initial increase in the case of the property tax results from the same effect but in addition, from the fact that the price index initially rises more slowly than in the base case. In the long run, the decline in this case is less rapid because of the slower population growth and the slower depletion of the General Fund balance.

The General Fund balance impact in real per capita terms is consistently negative, as shown in Table 12. It is interesting that by the end of the simulation
Table 10
Impact on Real Disposable Income per Capita of Tax Changes*
(Difference from Base Case)

<table>
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*Deflated by 1967 U.S. national average to get real dollars

GOLDPIT_ER = reduction in personal income tax
GOLDPTL_ER = reduction in municipal property tax

period, the real per capita General Fund balance has declined below its original value in the income tax case and is close to that point in the property tax case.

Since either of the policies examined here would presumably be instituted primarily to provide relief to those individuals subject to the taxes being reduced, it is logical to investigate if, in the long run, such individuals are better off. One method of doing this would be to look at the impact on such a typical individual of the present value of the sum of his real disposable personal income, his share of government expenditures, and his share of the General Fund available for future spending at the end of the simulation period. This is obviously a gross simplification of a complex question, but it is justified because it is a computation which does provide some insight into the question of long-run impact.

Assuming a discount rate of 7 percent, the sum of the present value of these
Table 11
Impact on Real State Expenditures per Capita of Tax Changes

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<td>1979</td>
<td>29.7053</td>
<td>1.63086</td>
</tr>
<tr>
<td>1980</td>
<td>11.0063</td>
<td>-8.08984</td>
</tr>
<tr>
<td>1981</td>
<td>-16.9868</td>
<td>-20.3203</td>
</tr>
<tr>
<td>1982</td>
<td>-22.8</td>
<td>-23.9053</td>
</tr>
<tr>
<td>1983</td>
<td>-52.2573</td>
<td>-35.0117</td>
</tr>
<tr>
<td>1984</td>
<td>-96.53</td>
<td>-48.2874</td>
</tr>
<tr>
<td>1985</td>
<td>-116.798</td>
<td>-61.1787</td>
</tr>
<tr>
<td>1986</td>
<td>-146.124</td>
<td>-73.304</td>
</tr>
<tr>
<td>1987</td>
<td>-176.262</td>
<td>-85.1406</td>
</tr>
<tr>
<td>1988</td>
<td>-210.483</td>
<td>-98.1279</td>
</tr>
<tr>
<td>1989</td>
<td>-251.765</td>
<td>-113.26</td>
</tr>
<tr>
<td>1990</td>
<td>-300.018</td>
<td>-131.226</td>
</tr>
</tbody>
</table>

*Deflated by 1967 U.S. national average to get real dollars

GDPF1ER = reduction in personal income tax
GDPF11ER = reduction in municipal property tax

three items for the two cases is shown in Table 13. (This table is graphed on an annual basis in Appendix B.) Here the impact on real disposable personal income is measured as the change in the average per capita tax liability for the altered tax in each case. This is somewhat biased, but the bias in either case should be of second order of importance. For the income tax case, the impact is exaggerated because the average per capita return is less after the change, including new employment and population, than it would be excluding new employment and population. This same influence operates to distort the impact in the case of the property tax, but in addition, it is not correct to reason that the whole change in the tax will result in an increase in disposable personal income. State expenditure and General Fund balance figures are calculated from earlier tables.

The present value difference between the two cases for the typical taxpayer is striking. The actual values in Table 13 are dependent upon the rate of discount and the relative weights placed upon each of the components. It seems clear though that
Table 12
Impact on Real per Capita General Fund Balance of Tax Changes*

<table>
<thead>
<tr>
<th>Income Tax Reduction</th>
<th>Property Tax Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977</td>
<td>0</td>
</tr>
<tr>
<td>78</td>
<td>- 115</td>
</tr>
<tr>
<td>79</td>
<td>- 259</td>
</tr>
<tr>
<td>80</td>
<td>- 391</td>
</tr>
<tr>
<td>1981</td>
<td>- 537</td>
</tr>
<tr>
<td>82</td>
<td>- 640</td>
</tr>
<tr>
<td>83</td>
<td>- 740</td>
</tr>
<tr>
<td>84</td>
<td>- 849</td>
</tr>
<tr>
<td>85</td>
<td>- 921</td>
</tr>
<tr>
<td>1986</td>
<td>- 969</td>
</tr>
<tr>
<td>87</td>
<td>- 989</td>
</tr>
<tr>
<td>88</td>
<td>- 974</td>
</tr>
<tr>
<td>89</td>
<td>- 919</td>
</tr>
<tr>
<td>90</td>
<td>- 824</td>
</tr>
</tbody>
</table>

*Deflated by 1967 U.S. national average to get real dollars

Table 13
Total Real per Capita Impact for "Typical" Taxpayer*

<table>
<thead>
<tr>
<th></th>
<th>Income Tax</th>
<th>Property Tax</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) real disposable personal income</td>
<td>+ 654</td>
<td>+ 823</td>
</tr>
<tr>
<td>2) real state expenditures</td>
<td>- 594</td>
<td>- 332</td>
</tr>
<tr>
<td>3) real General Fund balance</td>
<td>- 338</td>
<td>- 143</td>
</tr>
<tr>
<td>total</td>
<td>- 278</td>
<td>+ 348</td>
</tr>
</tbody>
</table>

*Deflated by 1967 U.S. national average to get real dollars
for a wide variety of discount rates and weights, as well as latitude in the percentage of property tax reduction becoming increased disposable personal income, the option of reducing the property tax is superior for the rational, typical taxpayer.

The reasons for the difference are, first, that over time the two tax changes result in different gains in disposable income for the taxpayer as the bases on which the taxes are collected grow at different rates and the changed rate structures operate on those bases. Second, the different population impacts in the two cases affect government spending and the General Fund balance differently.

IV.

The economic impacts of fiscal policy changes in an open economy are complex, and insights into those changes can be obtained by using an economic model. The model, if properly specified and used, traces the effects of policy change throughout the economy. The analysis presented in this paper has clearly demonstrated that there are costs as well as benefits associated with tax cut proposals and that the relative impact is a function of the type of tax cut proposed as well as its magnitude. In addition, it points out that there may be a real advantage for Alaskans in the adoption of a policy with regard to government spending which emphasizes reduction in the cost of living rather than growth in employment and population. The basic reason for this is the inelasticity of state revenues to growth in aggregate economic activity. Study should be directed toward policies more specifically aimed at reductions in the cost of living rather than across-the-board tax cuts. The present analysis merely indicates the general qualitative impacts of such policies.

With regard to the fiscal model itself, it can be applied to a variety of policy questions in addition to those examined here.\textsuperscript{9} It is still in the early stages of development, and refinements are being incorporated as research continues. In particular, the specification of the expenditure equations requires more analysis because the model is sensitive in the aggregate to this. Also, a more detailed version of local government should be added, since significant growth in local government is anticipated in Alaska as petroleum development continues.

\textsuperscript{9}For example, different government expenditure programs are analyzed in Scott Goldsmith, "Fiscal Options and the Growth of the Alaskan Economy," paper presented at the Pacific Northwest Regional Economic Conference, Eugene, Oregon, May 1977.
APPENDIX A

State Fiscal Model Variables and Equations*

All expressions beginning with C are coefficients of stochastic equations except those listed below.

All expressions ending in X are an exogenous component of an expression unless listed below.

All variables in millions of dollars unless noted. (Per capita variables in dollars.)

A numeral at the end of an expression indicates a sub-total of the variable unless listed below.

AEX - exemptions (number)
AGI - Alaska adjusted gross income
AHG - average highway gallons of fuel consumed \((10^3)\)
ANCRA - native claims payments
ATD - tax deductions

ATDCH - change in tax deductions
ATI - taxable income
ATIA - taxable income per tax return
BL - business licenses (number)
BTRATE - initial business license fee

CAPEXP - capital expenditures from the permanent fund
COIA - federal cost of living adjustment
COL shoes - federal cost of living (%)
CRF - capital recovery factor on bonds
DEBTP76 - post 1976 debt

DIVPF - permanent fund dividends
DPI - disposable personal income
DFIP - real disposable personal income \((1967US=100)\)
ECDS - commerce and economic development operating expenditures
ECPS - bond fund capital expenditures

ECPHY - bond highway capital expenditures
ECPSNY - bond non-highway capital expenditures
ERDS - education operating expenditures
EGGS - general government operating expenditures
EHS - health operating expenditures

*Regression results available from author on request.
EBWS - health and social services operating expenditures
EJUS - justice operating expenditures
EMSP - federal government employment \((10^3)\)
EMRM - military employment \((10^3)\)
EMSS - miscellaneous operating expenditures

EM99 - total employment
ENNRS - natural resource operating expenditures
EPPS - public protection operating expenditures
ESSS - social service operating expenditures
E99S - state government expenditures net of capital expenditures and debt service

E99S - total state government expenditures
ETRS - transportation operating expenditures
EXCAP - capital expenditures
EXCAPPFR - capital expenditures on ferries
EXCUR - state current expenditures from funds

EXDSS - debt service on general obligation bonds
EXHYCAP - highway capital expenditures
EXHYHCAP - non-highway capital expenditures
EXOPS - state operating expenditures as sum of functional expenditures
FAGI - federal adjusted gross income

GFIAL - general fund balance
GFCAP - general fund capital expenditures
GFCAPHY - general fund highway capital expenditures
GFCAPNHY - general fund non-highway capital expenditures
GFER - growth rate of ferry revenues

GIA - growth rate of international airport revenues
GR - gross receipts
GTR - gross taxable receipts
LOANPF - permanent fund loans
MILEMPC - percent of federal employment that is military

NTCOM - non-taxable component of gross receipts of individual business
PDCON - price deflator in construction \((1958=100)\)
PERCDS - personnel expenditures in commerce and economic development
PEREDS98 - personnel expenditures in education net of U of Alaska
PERGGS - personnel expenditures in general government

PERHES - personnel expenditures in health
PERJUS - personnel expenditures in justice
PERNRS - personnel expenditures in natural resources
PERPFS - personnel expenditures in public protection
PERSSS - personnel expenditures in social services
PERTES - personnel expenditure: in transportation
PBRUA - personnel expenditures University of Alaska
PFBAL - permanent fund balance
PFFPER - percent of eligible petroleum revenues channeled into permanent fund
PI - personal income
PRFPC - real personal income per capita (1967US=100)
POP - population \(10^3\)
POPC - civilian population \(10^3\)
PRTRANS - percentage of local property tax reduction picked up by state
QRREVQ - difference per taxpayer in personal income tax liability before and after change in tax policy
RATIOL - equilibrating ratio in savings routine
RES - local government component of difference between personal income and disposable personal income
RFAS - vehicle related fees
RFDPER - percent of cost of living increase "built in" to federal transfers
RFDSN - federal-state transfers
RFDSNPC - federal-state transfers per capita \(10^3\)
RFERS - ferry revenues
RFOAS - non-vehicle related fees
RFTS - total fee and license revenues
RGF99S - total general fund revenues
RIAS - international airport revenues
RINS - general fund interest revenue
RIPF - permanent fund interest income
RMIS - miscellaneous revenues
ROR - rate of return on general fund balance
RORPF - rate of return on permanent fund
RPBS - bonus petroleum revenues
RPFSP - permanent fund revenues
RPRI - relative price index (1967US=100)
RP7S - petroleum revenues eligible to be channeled into permanent fund
RP8S - recurrent petroleum revenues
RP9S - petroleum revenues
RSPFFS - fee revenues channeled to special fund
RSFS - special fund revenues
RTAS - alcohol tax revenues
RTBS - business license tax revenues
RTCIS - cigarette tax revenues
RTCIS - corporate income tax revenues
RTIS - fiscal year personal income tax revenue
RTISC - calendar year personal income tax revenue
RTISCA - personal income tax revenues
RTISOLD - personal tax revenues per taxpayer without policy changes
RTMF - motor fuel tax revenues
RTOTR - miscellaneous tax revenues
RTPIF - federal income tax revenue

RTPL - state-local transfers
RTSS - school tax revenues
RTVS - ad valorem tax revenues
RT98 - non-petroleum tax revenues
R99S - total revenues

SAVS - amount withheld from operating expenditures after initial determination of spending level
TGH - total highway gallons of fuel consumed \(10^3\)
TPPF - transfers from permanent fund to individuals
TPPV - total highway vehicles \(10^3\)
TT - tax returns

TXCR - personal income tax credit lump sum
TXCRPC - personal income tax credit as percent of liability
VACAP - real value added in capital expenditures \(1958=100\)
VAEX - value of an exemption (units)
VAEXCH - change in value of exemption (units)

VAHYCON - value added in highway construction
VANHYCON - value added in non-highway construction
WSCDS - wages and salaries in commerce and economic development
WSEDS - wages and salaries in education
WSGC - federal civilian wages and salaries

WSGGS - wages and salaries in general government
WSGM - military wages and salaries
WSGS - wages and salaries paid in state government
WSHES - wages and salaries in health
WSJUS - wages and salaries in justice

WSNRS - wages and salaries in natural resources
WSPPS - wages and salaries in public protection
WSSSS - wages and salaries in social services
WSSTRS - wages and salaries in transport
WS99 - total wages and salaries \(1967=100\)

XXA9 - agriculture sector state product \(1958=100\)
XXP9 - mining (petroleum) sector state product \(1958=100\)
XX99 - gross state product \(1958=100\)
5: \[ \text{LG}(\text{FAGI}) = \text{CRITSA}+\text{CRITSD} \times \text{LG}(\text{FJ}) \]
6: \[ \text{COLA} = (1-1/(1+GCL\text{ART})) \times \text{WSGC} \]
7: \[ \text{AGI} = \text{FAGI}+\text{COLA}-\text{WSGM} \]
8: \[ \text{LG}(\text{TT}) = \text{CRITSC}+\text{CRITSD} \times \text{LG}(\text{EM99}) \]
9: \[ \text{LG}(\text{AX}) = \text{CRITSD}+\text{CRITSP} \times \text{LG}(\text{POPC}) \]
10: \[ \text{LG}(\text{ATD/TT}) = \text{CRATD1}+\text{CRATD2} \times \text{LG}(\text{AGI/TT}) \]
11: \[ \text{ATI} = \text{AGI-AX} \times (\text{VAEX}+\text{VAEXCH})-\text{ATD}-\text{ATDCH} \]
12: \[ \text{ATIA} = \text{ATI/TT} \]
13: \[ \text{LG}(\text{RTISCA1}) = \text{CRITSF} \times \text{CRITSFCH} \times (1-\text{CHPITRT}) \times \text{CRITSS} \times \text{LG}(\text{ATIA}) \]
14: \[ \text{RTISCA} = \text{RTISCA1} \times \text{TXCR} \times \text{TXRFC} \times \text{RTISCA1} \]
15: \[ \text{RTISE} = \text{RTISCA} \times \text{TT} \]
16: \[ \text{RTIS} = \text{CRITSH} \times \text{RTISE}(-1)+\text{CRITSJ} \times \text{RTISC} \]
17: \[ \text{LG}(\text{RTPIF/TT}) = \text{CRFTA} \times \text{CRFTB} \times \text{LG}(\text{FAGI/TT}) \]
18: \[ \text{LG}(\text{RES/POP}) = \text{CRITSL} \times \text{CRITSM} \times \text{LG}(\text{PI}(-1) \times 1000/\text{POP}(-1)) \]
19: \[ \text{DPFI} = \text{PI-CNC1} \times \text{ANCSA-RTISC-RES-RTPIF+TPPF} \]
20: \[ \text{LG}(\text{BL}) = \text{CRTE8A} \times \text{CRTE8B} \times \text{LG}(\text{XX99}) \]
21: \[ \text{LG}(\text{GR}) = \text{CRTBS8A} \times \text{CRTBS8D} \times \text{LG}(\text{XX99-XXA9-XXA9}) \]
22: \[ \text{RTBS1} \equiv (\text{BL}+\text{BL}(-1))/2 \times \text{STRATE} \]
23: \[ \text{GTR} = \text{GR-EL} \times (-1) \times \text{NTCOM} \]
24: \[ \text{LG}(\text{RTBS2}/\text{BL}(-1)) = \text{CRTBSE} \times \text{CRTBSF} \times \text{LG}(\text{GTR}(-1)/\text{BL}(-1)) \]
25: \[ \text{RTBS} \equiv \text{RTBS1}+\text{RTBS2} \]
26: \[ \text{LG}(\text{RTCS1}) = \text{CRTCSA} \times \text{CRTCSD} \times \text{LG}(\text{XX99}(-1)+\text{WS99}(-1)/\text{RPI}(-1)) \]
27: \[ \text{RTCS} = \text{RTCSA} \times \text{RTCSPX} \]
20: \[ \text{LOG(TPTV)} = \text{CRVVA+CRVBD*LOG(POP)} \]
27: \[ \text{LOG(ANQ)} = \text{CRVVC+CRVVD*LOG(PIRPC)} \]
30: \[ \text{THG} = \text{ANQ*TPTV} \]
31: \[ \text{LOG(RTHF)} = \text{CRVVE+CRVVF*LOG(THG)} \]
32: \[ \text{LOG(RTVS)} = \text{CRTOA+CRTOB*LOG(PIR(-1))} \]
33: \[ \text{LOG(RTAS)} = \text{CRTOC+CRTOB*LOG(PIR(-1))} \]
34: \[ \text{LOG(RTCIS)} = \text{CRTDG+CRTDH*LOG(PIR(-1))} \]
35: \[ \text{EMGM} = \text{MILEMPC*EMGF} \]
36: \[ \text{LOG(RTSS)} = \text{CRTOE+CRTOF*LOG(EMP*EMGM)} \]
37: \[ \text{RT95} = \text{RTIS+RTCS+RTIS+RTHF+RTAS+RTCIS+RTVS+RTSS+RTOTS} \]
38: \[ \text{RF95} = \text{RF90+RPBS} \]
39: \[ \text{RIAS} = \text{RIAS(-1)*(1+GIA)} \]
40: \[ \text{RIFF} = \text{RFDAL(-1)*R0RPF} \]
41: \[ \text{RFERS} = \text{RFERS(-1)*(1+6FER)} \]
42: \[ \text{RINS} = \text{R0R*GFDAL(-1)} \]
43: \[ \text{LOG(RFAS)} = \text{CRVGE+CRVGH*LOG(TPTV(-1))} \]
44: \[ \text{LOG(RFOS)} = \text{CRNC+CRND*LOG(PI(-1))} \]
45: \[ \text{LOG(RSFFS)} = \text{CRNG+CRNH*LOG(P0P(-1))} \]
46: \[ \text{RFTS} = \text{RFAS*RFOS} \]
47: \[ \text{LOG(RMIS)} = \text{CRVE+CRVF*LOG(PI(-1))} \]
48: \[ \text{RFPSNPC} = 0.382+62.9*(1/P0P) \]
49: \[ \text{RFPSN} = \text{RFPSNPC*P0P+RFDNS(-1)-RFDNSX(-1))*(CPI/CPI(-1)-1)*RFDPER+RFDNSX} \]
50: \[ \text{RDFPS} = \text{RFPS-FFFER*RFPS+RT95-0.625*RTCIS+RFTS-RSFFS+RFERS+RINS+RFPS+RMIS+RP9X+RIFF-PTTRANS+RTPL} \]
RSFS' == RIAS+0.625*RTCIS+RSFFS+RSFSX
RFFS == FFFER*RP79+DIVPF
R99S == RGF99S+RSFS+RFFS

LOG(RTISOLD) = CRITSF+CRITSG*L0G(ATIA+(AEX*VAEXCH+ATDCH)/TT)
GREVQ = RTISOLD-RTISCA
SAUS == SAUX-TAXCHPC*TT*GREVQ

GFCAPHY = IF YR LT 1979 THEN GFCAPHYX ELSE 0.55*RFDSN+0.5*NEWCAPX
ECPSHY = IF YR LT 1979 THEN ECPSHYX ELSE ECPSHY(-1)*(POP/POP(-1)+RPI/RPI(-1)-1)
GFCAPNHY = IF YR LT 1979 THEN GFCPNHYX ELSE 0.05*RGF99S+0.5*NEWCAPX
ECPSNHY = IF YR LT 1979 THEN ECPNSHNY ELSE ECPNSHNY(-1)*(POP/POP(-1)+RPI/RPI(-1)-1)

EXHYCAP == GFCAPHY+ECPSHY
EXNHYCAP == GFCAPNHY+ECPSNHY

VANHYCON = CCX1A+CCX1B*EXHYCAP
VANHYCON = CCX2A+CCX2B*(EXNHYCAP-EXCAPFER(-1))
POCON = CCX3A+CCX3B*WSCN(-1)
VACAP == (VANHYCON+VANHYCON)/(POCON/100)
GFCAP == GFCAPHY+GFCAPNHY
ECP5 == ECP5H+ECP5N
EXCAP == GFCAP+ECP5

DEBT76 = DEBT76(-1)+ECP5
EXDSS = EXDSSX+CRF*DEBT76

LOG(EE6S1/POP(-1)) = EX1A+EX1B*LOG(RGF99S-RFDSN-EXDSS+PTTRANS*RTPL)+EX1D*LOG(PI/POP)+EX1E*LOG(GFBAL(-1))
LOG(ES6S1/POP(-1)) = EX2A+EX2B*LOG(RGF99S-RFDSN-EXDSS+PTTRANS*RTPL)+EX2D*LOG(PI/POP)+EX2E*LOG(GFBAL(-1))
74: \[ \text{LOG} (E_{HE51}/\text{POP(-1)}) = EX3A+EX3B*\text{LOG} (RGF99S-RFDSN-EXDSS+PTTRANS*RTPL)+(EX3D)*\text{LOG} (PI/\text{POP})+EX3E*\text{LOG} (GFBAL(-1)) \]

75: \[ \text{LOG} (E_{ENRS1}/\text{POP(-1)}) = EX4A+EX4B*\text{LOG} (RGF99S-RFDSN-EXDSS+PTTRANS*RTPL)+(EX4D)*\text{LOG} (PI/\text{POP})+EX4E*\text{LOG} (GFBAL(-1)) \]

76: \[ \text{LOG} (E_{EPPS1}/\text{POP(-1)}) = EX5A+EX5B*\text{LOG} (RGF99S-RFDSN-EXDSS+PTTRANS*RTPL)+(EX5D)*\text{LOG} (PI/\text{POP})+EX5E*\text{LOG} (GFBAL(-1)) \]

77: \[ \text{LOG} (E_{EJUS1}/\text{POP(-1)}) = EX6A+EX6B*\text{LOG} (RGF99S-RFDSN-EXDSS+PTTRANS*RTPL)+(EX6D)*\text{LOG} (PI/\text{POP})+EX6E*\text{LOG} (GFBAL(-1)) \]

78: \[ \text{LOG} (E_{ECS1}/\text{POP(-1)}) = EX7A+EX7B*\text{LOG} (RGF99S-RFDSN-EXDSS+PTTRANS*RTPL)+(EX7D)*\text{LOG} (PI/\text{POP})+EX7E*\text{LOG} (GFBAL(-1)) \]

79: \[ \text{LOG} (E_{EGS1}/\text{POP(-1)}) = EX8A+EX8B*\text{LOG} (RGF99S-RFDSN-EXDSS+PTTRANS*RTPL)+(EX8D)*\text{LOG} (PI/\text{POP})+EX8E*\text{LOG} (GFBAL(-1)) \]

80: \[ \text{LOG} (E_{ETRS1}/\text{POP(-1)}) = EX9A+EX9B*\text{LOG} (RGF99S-RFDSN-EXDSS+PTTRANS*RTPL)+(EX9D)*\text{LOG} (PI/\text{POP})+EX9E*\text{LOG} (GFBAL(-1)) \]

81: \[ \text{EEDS28} = EX1B*SAVS \]

82: \[ \text{ESSS28} = EX2B*SAVS \]

83: \[ \text{EHES28} = EX3B*SAVS \]

84: \[ \text{ENRS28} = EX4B*SAVS \]

85: \[ \text{EPPS28} = EX5B*SAVS \]

86: \[ \text{EJUS28} = EX6B*SAVS \]

87: \[ \text{ECS28} = EX7B*SAVS \]

88: \[ \text{EGS28} = EX8B*SAVS \]

89: \[ \text{ETRS28} = EX9B*SAVS \]

90: \[ \text{RATIO1} = (\text{EEDS28}+\text{ESSS28}+\text{EHES28}+\text{ENRS28}+\text{EPPS28}+\text{EJUS28}+\text{ECS28}+\text{EGS28}+\text{ETRS28})/\text{SAVS} \]

91: \[ \text{EEDS2} = \text{EEDS28}*\text{RATIO1} \]

92: \[ \text{ESSS2} = \text{ESSS28}*\text{RATIO1} \]

93: \[ \text{EHES2} = \text{EHES28}*\text{RATIO1} \]
ENRS2 = ENRS20*RATIO1
EPFS2 = EPFS20*RATIO1
EJUS2 = EJUS20*RATIO1
ECDS2 = ECDS20*RATIO1
EGGS2 = EGGS20*RATIO1
ETRS2 = ETRS20*RATIO1
EEDS = EEDS1+EEDSX-EEDS2
ESSS = ESSS1+ESSSX-ESSS2
EHES = EHES1+EHESX-EHES2
ENRS = ENRS1+ENRSX-ENRS2
EPFS = EPFS1+EPPSX-EPFS2
EJUS = EJUS1+EJUSX-EJUS2
ECDS = ECDS1+ECDSX-ECDS2
EGGS = EGGS1+EGGSX-EGGS2
ETRS = ETRS1+ETRSX-ETRS2
EHES = EHES1+EHESX
EMSS = ENRS+EPFS+EJUS+EGGS
PEREDS99 = PE1A+PE1B*EEDS
PERSSS = PE2A+PE2B*ESSS
PERHES = PE3A+PE3B*EHES
PERNRS = PE4A+PE4B*ENRS.
PERPPS = PE3+PECS*EPPS
PERCDS = CEOD*ECD5
PERGGS = PE9A+PE9B*E9GS
PERJUS = PE6A+PE6B*EJUS
PERTRS = PE9A+PE9B*ETRS
PERUA = CEUA*EUA
WSEDS = PEREDS9B+CWS1+PERUA*CWS2
WSSS = PERSSS*CWS1
WHDES = PERHES*CWS1
WNRs = PERNRS*CWS1
WSPPS = PERPPS*CWS1
WSJUS = PERJUS*CWS1
WSCDS = PERCDS*CWS1
WGGS = PERGGS*CWS1
WSTRS = PERTRS+CWS1
WSGFSY = WSEDS+WSSS+WHDES+WNRs+WSPPS+WSJUS+WSCDS+WSTRS+WGGS
WSGS = CWS1+CWS2*WSGFSY
EXOPS = EEDS1+ESSS1+EHEI+E8RS1+EPPS1+EJUS1+ECD5+E9GS1+ETRS1
EXCUR = CEX1+CEX2*EXOPS
E99S = EXCUR+EXCAP
E98S = EPPS-EXDSS-EXCAP
GFBAL = IF GFBAL(-1)+RGE9S+E99S+ECPS LT 0 THEN 1 ELSE GFBAL(-1)+RGE9S+E99S+ECPS
FFBAL = FFBAL(-1)+RFFS-TPPF-CAFEXP=LDANPF
Figure B-1. Population and Employment Totals for All Simulations
Figure B-2. Impact on Components of Revenue of Tax Cut Experiments
(measured from base case)
Figure B-3. Components of Real Impact of Tax Changes for the Typical Taxpayer
REFERENCES


