THE ENERGY CREDIT PROGRAM: ESTIMATING SHARES

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HOW MANY SHARES?

Alaskans could claim 3.688 million paying shares (held by those eighteen years of age and over) under an energy credit program instituted in 1980. This figure assumes that the program would have the following features:

1. An individual is eligible for one share for each year of residence.

2. Credits are paid to applying individuals eighteen years of age and above.

3. No share can be claimed for a year spent out of state.

4. All eligible individuals apply. Based upon experience with the longevity bonus program and depending upon how strictly the interpretation of "resident" is applied, the number of actual share recipients could be considerably less than the number of potential recipients.

PROGRAM COST

Assuming that energy credit payments were independent of any other liability to or from any government, the direct first yearcost of the program (not counting such things as increased personal income tax receipts) would be as follows:

TABLE 1. POTENTIAL DIRECT FIRST YEAR COST OF ENERGY CREDIT PROGRAM IN 1980

Energy Credit	Total Direct Cost (million $)
$ 10	$ 36.9
$ 25	$ 92.2
$ 50	$184.4
$100	$369.0

In subsequent years the cost would increase as the population grows and ages.

DISTRIBUTION OF SHARES

The distribution of shares among the population would be 33 percent to Natives, 65 percent to civilian non-Natives, and 2 percent to military and dependents. Average shares per capita (age 18 +) would be 35 for Natives, 12 for civilian non-Natives, and 2 for military and dependents. This distribution is shown in Table 2.

TABLE 2. ENERGY CREDIT SHARE ANALYSIS
SUMMARY

Population Group	Population (Thousand) Total	Age 18+	Shares Thousand	%	Shares Per Capita Age 18+
TOTAL POPULATION	410	270.1	3,688	-	13.66
Civilian					
Non-Native	294.1	200.4	2,402	65.1	11.99
Native	64.2	35.1	1,227	33.2	34.95
Military and Dependents					
In Barracks	11.7	11.7	18	.5	1.50
Not in Barracks	40.0	22.9	42	1.1	1.81

FURTHER SHARE DISTRIBUTION DETAIL

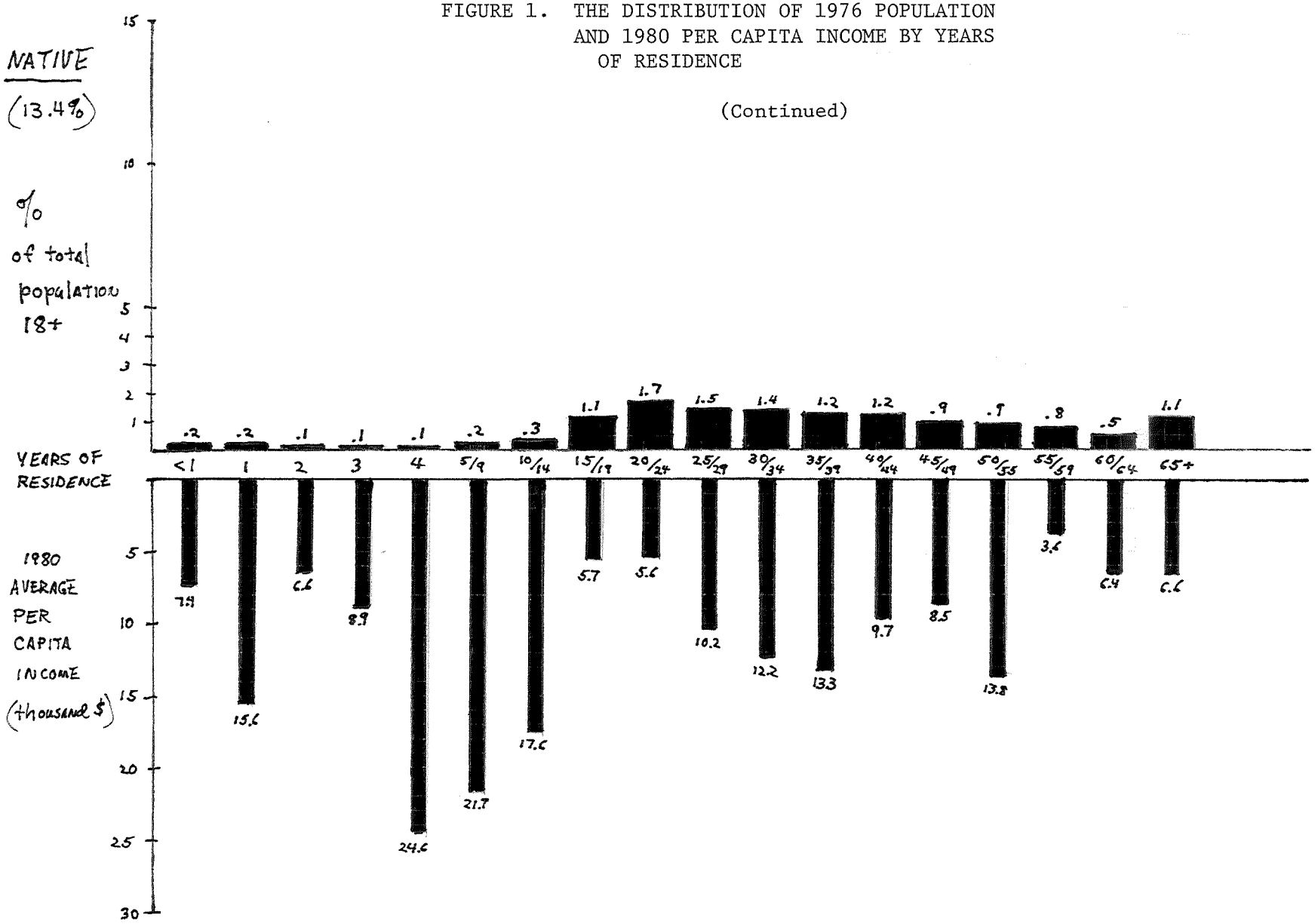
Income increases with years of residence for both Natives and non-Natives until very long residency is reached. The energy credit program would generally tend to favor both Natives and non-Natives with higher incomes. Figure 1 shows the distribution of years of residence for the population divided among Natives and non-Natives as well as the estimated average income of each residency group. From this figure, one can see which groups get the largest shares of the energy credit program as well as the impact the energy credit program could have on the income of each group.

GEOGRAPHIC DISTRIBUTION OF SHARES

As expected, the larger urban areas of the state have a more transient population and, consequently, would receive fewer shares per capita. Data from the 1970 Census compiled in Table 3 show this.

FIGURE 1. THE DISTRIBUTION OF 1976 POPULATION AND 1980 PER CAPITA INCOME BY YEARS OF RESIDENCE

(Continued)



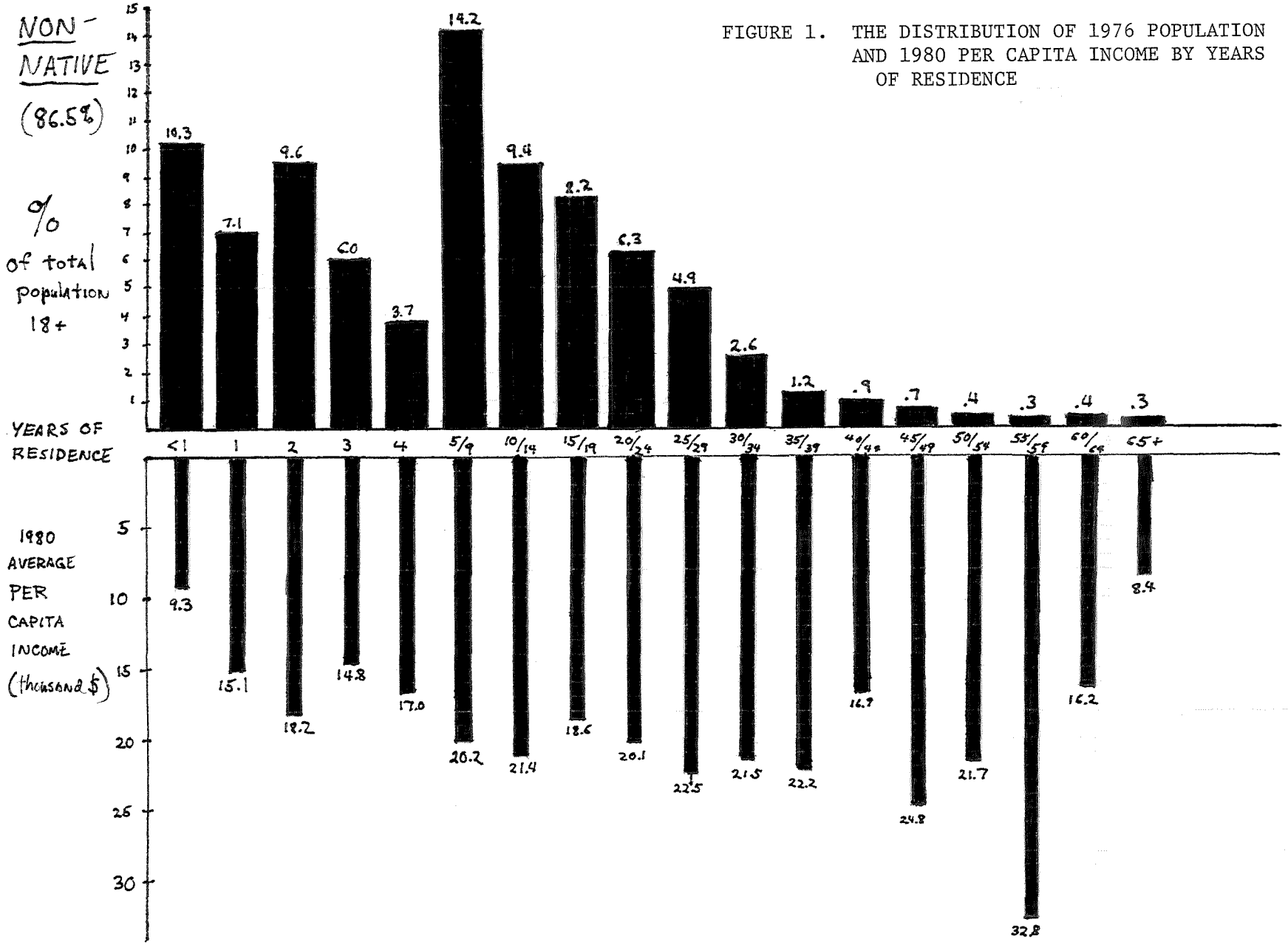


FIGURE 1. THE DISTRIBUTION OF 1976 POPULATION AND 1980 PER CAPITA INCOME BY YEARS OF RESIDENCE

TABLE 3. PERCENT OF FIVE-YEAR STATE RESIDENTS
BY CENSUS DIVISION, 1970

	(1) Total Population 5 Years Plus	(2) Resident in 1965	(1÷2) Percent Resident 5 Years Plus
Angoon	394	379	96.6
Bristol Bay	3,194	3,069	96.1
Bethel	6,427	5,986	93.1
Wade Hampton	3,302	3,054	92.5
Kobuk	3,826	3,532	92.3
Barrow	2,369	2,176	91.8
Nome	5,075	4,458	87.8
Skagway-Yakutat	1,795	1,485	82.8
Kuskokwim	2,033	1,504	74.0
Cordova-McCarthy	1,596	1,174	73.5
Seward	1,930	1,414	73.2
Matanuska-Susitna	5,948	4,356	73.2
Ketchikan	9,006	6,506	72.2
Wrangell-Petersburg	4,423	3,175	71.8
Valdez-Chitina-Whittier	2,848	1,990	69.9
Juneau	12,310	8,590	69.8
Yukon-Koyukuk	4,276	2,965	69.5
Sitka	5,715	3,858	67.5
Upper Yukon	1,514	1,021	67.4
Haines	1,328	875	65.9
Outer Ketchikan	1,562	928	59.4
Prince of Wales	1,795	1,062	59.2
Kenai-Cook Inlet	12,778	6,289	49.9
Kodiak	8,340	3,983	47.8
Anchorage	111,278	52,206	46.9
Southeastern Fairbanks	3,874	1,607	41.5
Fairbanks	41,152	16,633	40.4
Bristol Bay Borough	878	308	35.1
Aleutian Islands	7,323	2,097	28.6

EXAMPLE OF RESIDENCY DISTRIBUTION WITHIN AN AGE GROUP

In evaluating programs such as energy credits, it is important to keep in mind that the "weight" any individual is assigned rises with years of residency. A 65-year resident has a weight 65 times that of a one-year resident. Consequently, a relatively small number of long-term residents can add considerable cost to a program, and considering only the length of residency of the majority of individuals can be misleading. For example, Table 4 indicates the parameters of the residency distribution of the 20-to-24-year-old civilian non-Native population (probably the most skewed distribution).

TABLE 4. CIVILIAN NON-NATIVES
AGED 20 - 24

(years)

Mean Years of Residency	7.51
Median Years of Residency	3
Modal Years of Residency	< 1

The largest percentage of individuals in this age group respond to the residency question that they have been in the state less than one year. Fifty percent have been in the state three years or less. Nonetheless, because some have lived in the state all of their lives, the number of shares for which the average individual in this group could qualify is 7.51.

RELIABILITY OF ESTIMATE OF SHARES

Because it is based upon a sample survey of length of residence done in 1976 and because the 1980 population can only be estimated at this time, the estimate of shares cannot be completely accurate. The analysis has attempted to minimize the possibility of serious error in the estimate. The least precision is possible in the estimation of the movements of recent migrants. Fortunately, because they are new to the state, they have the least impact on the number of credits. In contrast, those groups with the most credits tend to be the most stable and, thus, their movements are easier to estimate. This question is addressed in more detail in the accompanying appendixes.

APPENDIX A. THE 1976 SURVEY OF INCOME AND EDUCATION AND BIAS IN THE SAMPLE

The Survey of Income and Education (SIE), which is the primary data source for this study of Alaskan residency, was a national survey conducted by the U.S. Bureau of the Census in the spring of 1976. The primary purpose of the survey was to estimate by states the number of children, 5-to-17 years of age, living in families classified below the poverty level. At the same time, however, information was collected by individual, family, and household on demographic characteristics, educational attainment, migration, income, ethnicity, and labor force characteristics.

The Institute of Social and Economic Research (ISER) has obtained a copy of the Alaskan sample and has begun utilizing it to address a variety of questions. In the course of these analyses, several sample biases have been uncovered because the sample drawn tended to underrepresent certain groups. To date, the following misrepresented groups have been identified: Natives, military, rural residents, residents in group quarters, and institutionalized persons.

Table A.1 shows the percentage distribution of individuals on the survey and the estimated population in April of 1976.

In this analysis, Natives have received a heavier weight than non-Natives to correct for their underrepresentation. In addition, each age cohort has been weighted to bring it into conformity with the Native age distribution from the 1970 Census. The discrepencies in the age distribution of the Native population between the 1970 Census and the SIE sample are shown in Table A.2. (There is some question that the Native population was properly counted in the 1970 Census. The methodology chosen for this analysis is independent of this "self enumeration" problem.)

The reason for the relative oversampling of young Natives may be that several rural census divisions were not included in the SIE sample.

TABLE A.1. SURVEY OF INCOME AND EDUCATION SAMPLE COMPARED TO 1976 ESTIMATED ALASKAN POPULATION

	Survey of Income and Education		Estimated Population	
	Number	Percent	Thousand	Percent
Total	7,378	-	411.1[a]	-
Native	851	11.53	58.3[b]	14.18
Non-Native	6,527	88.47	352.8	85.82
Military	313	4.24	23.9[c]	5.81
Non-Military	7,065	95.76	387.2	94.19
Group Quarters	62	.84	?	-
Institutionalized	0	0	?	-

[a]Department of Commerce and Economic Development, "Year End Performance Report," interpolation from July 1 estimates for 1975 and 1976.

[b]1970 Census augmented by natural increase.

[c]Department of Commerce and Economic Development, "Year End Performance Report," adjusted to include Coast Guard personnel.

TABLE A.2. COMPARISON OF NATIVE AGE DISTRIBUTION FROM SIE AND 1970 CENSUS

	SIE		CENSUS	
Age Cohort	Number	Percent	Thousand	Percent
15 - 17	94	15.8	3,824	13.6
18 - 19	42	7.1	1,895	6.7
20 - 24	98	16.5	3,564	12.7
25 - 29	60	10.1	3,245	11.5
30 - 34	56	9.4	3,031	10.8
35 - 39	42	7.1	2,515	8.9
40 - 44	49	8.2	2,515	8.2
45 - 49	43	7.2	2,310	6.6
50 - 54	30	5.0	1,856	5.9
55 - 59	31	5.2	1,651	5.0
60 - 64	14	2.4	1,409	3.3
65 +	36	6.1	930	6.8

Table A.3 shows that a majority of household interviews were in urban Alaska. Since it is not possible to identify the geographic location of individuals sampled, it is not possible to adjust for any systematic undersampling of rural Alaska except through a weighting of the Native population. (It is not clear at this time whether places under 2500 were sampled in regions where a place of that size exists.)

The military appear underrepresented in the sample but are actually overrepresented because only those not living in barracks were sampled. For purposes of a residency study, it cannot be assumed that barracks-domiciled military have the same characteristics as those living in family quarters or off base. Thus, the two groups were handled separately, and the military sample was deflated to be consistent with an estimate of total nonbarracks military (about 52 percent of the total).

It was not possible to weight persons in group quarters because of an absence of an independent estimate of their relative numbers. As noted above, several census divisions which would have had large numbers of individuals in group quarters (pipeline camps and oil field camps) were not sampled. Thus, there is clearly an underestimate. Since 1976 was a year with abnormally large numbers of people in group quarters, this undersampling may not be a problem given the objective and methodology of the study. Institutionalized persons were not counted in the SIE. It is assumed that the majority of them are military personnel living in barracks.

Two questions on the survey questionnaire relate to length of residency in Alaska. Each respondent was asked how long he had lived in the state. Acceptable answers were: always, under one year, or a specified number of years. If the respondent answered "always," the question eliciting the respondent's age was then necessary to determine years of residence.

Two sources of bias can enter into the analysis using these responses. First, a respondent may not know his age or the number of years he has been in the state. Second, the question on length of residence may be interpreted

TABLE A.3. CENSUS DIVISIONS INCLUDED AND EXCLUDED: SURVEY OF INCOME AND EDUCATION

Included	Households Interviewed	Excluded
Juneau	170	Angoon
Kenai-Cook Inlet	165	Barrow
Kodiak	84	Bristol Bay Borough
Ketchikan	103	Cordova-McCarthy
Anchorage	1,442	Haines
Fairbanks	502	Kobuk
Bethel	93	Outer Ketchikan
Aleutian Islands	101	Prince of Wales
Sitka	120	Seward
Yukon-Koyukuk	80	Southwest Fairbanks
Wade Hampton	28	Upper Yukon
Matanuska-Susitna	224	Wrangell-Petersburg
Nome	105	
Kuskokwim	37	
Valdez-Chitina-Whittier	180	
Bristol Bay	4	
Skagway-Yakutat	2	

in three ways by an individual born in the state but spending time elsewhere, for example, in the military. He may respond that a) he was always a resident, b) he was a resident for the number of years since his return to the state, or c) he may correctly add up the number of years he has lived in the state, excluding interruptions. There is no way of accurately estimating the bias introduced from misinterpretation of this question. It seems more likely that incorrect interpretation (a), rather than (b), would be chosen, thus somewhat overestimating the number of years of residence. However, Table A.4 shows that, for the Native population, the number of years of residency claimed was on average well under the age of the respondent, indicating a correct response to this question.

Income reported on the SIE is for calendar year 1975 and includes the following sources: wages and salaries, self-employment income, Social Security benefits, Supplemental Security income, public assistance or welfare payments, interest, dividends, rents, veterans' payments, unemployment compensation, workmen's compensation, pensions, and alimony. Not included are nonmonetary transfers such as food stamps, etc.

The validity of inferences for a population drawn from the analysis of any sample depends upon the size of the sample relative to the population. The smaller the sample, the larger the standard error and the less certain one can be about inferences. In this analysis, some of the "cells," or subsets of the sample, are quite small; and, thus, inferences drawn from them must be considered speculative. The analysis is nonetheless valid because it is dependent upon the aggregate results rather than that of any individual cell.

The SIE file is stored on the University of Alaska computer and is accessed using SPSS.

TABLE A.4. YEARS OF RESIDENCY CLAIMED BY NATIVES BY AGE GROUP:

SURVEY OF INCOME AND EDUCATION

Age Groups	Years of Residency Claimed
15 - 17	15.78
18 - 19	17.16
20 - 24	19.81
25 - 29	21.72
30 - 34	27.62
35 - 39	32.23
40 - 44	39.88
45 - 49	44.51
50 - 54	51.00
55 - 59	52.13
60 - 64	60.29
65 +	70.64

APPENDIX B. A THEORETICAL MODEL OF POPULATION DYNAMICS

A population at time t=o can be divided into cohorts, c_o, as follows:

$$c_o(i,j,k,m,n) \qquad \text{B.1.}$$

where i = age
j = sex
k = length of residence
m = socioeconomic characteristics such as income and education
n = ethnicity

The probability that an individual in a cohort at time t will be in the cohort in the region at t+1 can be described as follows:

$$p_t(i,j,k,m,n,t) \qquad \text{B.2.}$$

This states that the probability of an individual within a cohort dying or moving from the region is a function of the characteristics of that cohort as well as of time which serves as a proxy for unobserved variables. In the case of Alaska, one unobserved variable reducing the probability of out-migrating over time might be the increase of the population of the state which makes it more attractive as a place to live, other things being equal.

The proportion of a given cohort, c_o, remaining in the region after T years could be described as:

$$_oc_T(i+T,j,k+T,m,n) = c_o(i,j,k,m,n) \cdot \prod_{t=1}^{T} p(i+t,j,k+t,m,n,t) \qquad \text{B.3.}$$

The total population remaining at T, $_oC_T$, is the sum of all cohorts.

$$_oC_T = \sum_i \sum_j \sum_k \sum_m \sum_n c_o(i,j,k,m,n) \cdot \prod_{t=1}^{T} p(i+t,j,k+t,m,n,t) \qquad \text{B.4.}$$

Total population at T, POP_T, includes births and in-migrants between the t=o and T. For in-migrants at t=1, for example, those remaining at T would be as follows:

$$ {}_1C_T(i,j,k,m,n) = \sum_i \sum_j \sum_k \sum_m \sum_n c_1(i,j,k,m,n) \cdot \prod_{t=2}^{T} p(i+t,j,k+t,m,n) \qquad B.5. $$

where $c_1(i,j,k,m,n)$ is in-migration at time t=1.

Total population at T is then the following sum,

$$ \sum_{k=0}^{T} {}_kC_T \qquad B.6. $$

The data requirements to operationalize this model are immense, but the Census and the Survey of Income and Education (SIE) provide sources for some of the variable and parameter values.

1. Initial population--$c_o(i,j,k,m,n)$ - Obtainable directly from the 1970 Census.

2. The probability of an individual in a given cohort remaining--$p_t(i,j,k,m,n,t)$ - These probabilities can be approximated by combining the 1970 Census and the SIE. For each age, sex, race, income level, education level, and length of residence (less than five years or more than five years), a cohort c_o can be identified, and the following equation can be constructed:

$$ c_o(i,j,k,m,n) \cdot \prod_{t=1}^{5} p_t(i+t-1,j,k+t-1,m,n,t) = {}_oc_5(i+5,j,k+5,m,n) \qquad B.7. $$

where c_o and ${}_oc_5$ are obtained from the 1970 Census and the SIE, respectively.

This equation can be solved for the probability of remaining in the cohort over the five-year interval:

$$\prod_{t=1}^{5} p_t(i+t-1,j,k+t-1,m,n,t) \qquad \text{B.8.}$$

Unfortunately, one cannot assume that $p_t = p_{t+i}$, so that this single equation can only be solved for an approximation of the value of p_t. However, the complete set of such equations could be solved simultaneously by assuming values for a small subset of the p_t (such as the p_t for those aged 60 and over).

The calculation of all these p_t would be a large task. In addition, the number of such p_t depends upon the number of characteristics describing the population cohorts. Since it can safely be assumed that these probabilities are heavily dependent upon the cohort characteristics, a large number of such cohorts would be desirable.

3. In-migrants--$c_t(i,j,k,m,n)$ - From the SIE, the characteristic distribution of the population that has been in the state less than one year can be determined.

Neither time nor funding is presently available to operationalize this model, so a simplified methodology must be substituted to address the question of energy credit shares based upon residency. On the basis of this theoretical model, however, one can ask how close a more simplified procedure approximates the results of an ideal model. Given the methodology used in this report and described in Appendix C, the most important question to ask about the ideal model is whether it describes a system which is stable in terms of residency.

By that, we mean the constancy of the distribution of the years of residence for a given age cohort within the population. (Over time, does

the percentage of a given age group with a given number of years of residence remain constant?) Unfortunately, this will not be the case except under very strict assumptions, including that the p be independent of time, total population be constant, and the cohort distribution of additions to the population be constant.

In the case of the Alaskan population, the following conditions are more likely:

1. p increasing as a function of time as individuals experience increased survival rates and preferences to remain in the state rise with time.

2. Population growing because of increase in in-migration. It may be possible for the system to reach a condition of stability, given population increase, but the probability of this occurring is essentially zero.

The potential bias that these characteristics of the Alaskan population introduce into the analysis will be discussed in more detail in Appendix C.

APPENDIX C. METHODOLOGY FOR ESTIMATING ENERGY CREDIT SHARES

The methodology used in this study is to apply an estimate of the average years of residency by age group to an estimate of total population divided into comparable age groups. The average years of residency estimate is derived from the Survey of Income and Education (SIE), and the population estimate is derived from the MAP population model.

The population is divided into five categories with different migration proclivities. These are civilian non-Native, civilian Native, military in barracks, military residing in alternative housing, and military dependents. A cross-tabulation relating age to years of residency was generated for the civilian non-Natives, civilian Natives, and military in alternative housing from the SIE file. From this, the average years of residency for each age group was calculated. These averages are shown in Table C.1.

The SIE did not cover military living in barracks, and this analysis did not separately analyze the residency characteristics of military dependents. An estimate was made of the percentage of military living in barracks, and their average length of residency was assumed to be 1.5 years, independent of age. Military dependents were assumed to have the same average years of residency as the average for total military not in barracks.

An estimate of the 1980 population combines independent estimates of total, Native, military, and military dependents. The estimate of civilian non-Native/non-military dependents is obtained as a residual. These estimates are shown in Table C.2.

TABLE C.1. AVERAGE YEARS OF ALASKAN RESIDENCY BY AGE GROUP

Age Group	Civilian Non-Native	Civilian Native	Non-barracks Military
18 - 19	9.4	17.2	8.5
20 - 24	7.5	19.8	1.6
25 - 29	6.7	21.7	1.9
30 - 34	7.9	27.6	2.2
35 - 39	9.1	32.2	2.0
40 - 44	11.9	39.9	2.4
45 - 49	14.2	44.5	2.0
50 - 54	17.1	51.0	-
55 - 59	18.9	52.1	-
60 - 64	26.1	60.3	-
65 +	33.1	70.6	-
Average	11.5	35.7	1.9

SOURCE: Survey of Income and Education.

Note: The estimate of 8.5 for the 18-to-19-year-old non-barracks military was based upon a sample of 4 and thought to be unrepresentative. Consequently, 1.2 was assumed as the average years of Alaskan residence for that age group.

TABLE C.2. ESTIMATED 1980 ALASKAN POPULATION

(thousands)

Total[a]		410
Civilian Non-Native		294.1
Civilian Native[b]		64.2
Military[c]		24.0
In Barracks[d]	11.7	
Not in Barracks	12.3	
Military Dependents[e]		27.7

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[a]Author's estimate.

[b]MAP population model based upon 1970 Census data and subsequent rates of natural increase.

[c]Estimate based upon trend during the 1970s indicated in State of Alaska Department of Labor data.

[d]Estimated as a percentage of total military based upon present level of barracks-domiciled military of 12.0 thousand. Conversation with Paul Lien, Elmendorf Air Force Base.

[e]Same ratio to military as 1970 Census (1.15).

This procedure gives a correct estimate of 1980 energy credit shares only under very strict conditions, as follows:

1. The 1980 population estimate is correct.

2. The SIE file is an accurate representation of the population from which it is drawn.

3. The average number of years of residency per individual per age group is unchanged between 1976 and 1980.

Clearly none of these conditions is exactly satisfied. Fortunately, the probability of error in the estimation of length of residence is highest for those groups with the shortest length of residency, and this tends to minimize the size of the aggregate potential error. That is, the error of not counting one 1-year resident is only 1/65 the error of not counting one 65-year resident. Longer-term residents are a more stable group and thus easier to identify.

The total population estimate could conceivably be in error by ten thousand. The majority of the error would fall in the civilian non-Native group since the Native and military population movements are quite predictable. The error would then be concentrated among recent civilian non-Native migrants with short residencies. Because of their short residencies, an error in estimating their numbers would not greatly alter the estimate of aggregate shares.[1]

Several problems identified with the sample used in the SIE have been discussed in Appendix A as well as the steps taken to correct those biases. The sample has been weighted by independent calculation of the military and Native groups as well as the age distribution of the Native population. A bias against rural areas may still persist in the weighted sample as well

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[1]This assumes the "wave" theory of migration where the level of gross migration exceeds that of net migration. Each wave of gross migration brings a large number of individuals into a region; but when the wave retreats, it takes many of the same individuals, or individuals with similar characteristics, with it.

as an underestimation of individuals in group housing. These biases will tend to be partially offsetting.

The most serious problem with this methodology is in the assumption that the vector of average residency by age coefficients for the civilian non-Native population has remained constant between 1976 and 1980. The theoretically possible error is enormous. At one extreme, between 1976 and 1980, the entire population may have "turned over," and so in 1980 there is no civilian non-Native who would be eligible for an energy credit share. At the other extreme, nearly everyone in the state in 1976 may have remained and after four years would be eligible for four additional shares. This increment would be maximized if the change in population were all accounted for by a maximum increase in the over-eighteen population who have been residents all of their lives with any offsetting declines coming among the under-eighteen population. The increase in the number of credit shares between 1976 and 1980 would then be approximately 4 x (population over 17 + 18 x the population 17). This is an unlikely prospect since children do not normally migrate without their parents; the survival rate of the over-eighteen population is less than unity; all fourteen-to-seventeen-year-old persons are not permanent residents; and younger people are more likely to migrate.

The year 1976 was unusual because of the large amount of in-migration to work on the pipeline. Thus, the average years of residency for a given age group measured in 1976 would be a low estimate for a year like 1980 when in-migration is lower. The SIE sample does not include a large number of persons in group quarters, so it can safely be assumed that it underestimates the percentage of recent migrants in each age group.

The year 1980 population is the result of several years of net out-migration which would tend to eliminate individuals with short residencies. Thus, even though the SIE sample has been corrected for the large number of recent migrants in 1976, use of it to estimate 1980 residence patterns may result in somewhat of an underestimation of totals.

Only one independent estimate of residency exists with which to compare the results of this analysis. The longevity bonus program provides a payment to anyone 65 years of age or above who has lived in Alaska for 25 years. The average annual number of recipients under this program is shown in Table C.3. The estimate of the number of possible recipients in 1976 using the SIE sample is approximately 7,000, compared to about 5,500 actual recipients. The reason for the difference between potential and actual recipients could be the result of several factors. The sample may overrepresent the aged. The study has attempted to correct for any possible bias from such a cause. The longevity bonus requires 25 years continuous residency as a requirement. This characteristic of residents cannot be identified from the SIE sample. A more likely cause is probably the fact that not all of those individuals who are eligible or feel they are eligible actually apply for and receive benefits.

TABLE C.3. AVERAGE ANNUAL RECIPIENTS
ALASKA LONGEVITY BONUS PROGRAM

Fiscal Year	Number
1976	5,445
1977	5,822
1978	6,756
1979 (planned)	6,950
1980 (estimated)	7,500

SOURCE: State of Alaska, Executive Budget and Office of Longevity Bonus Program coordinator.

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