AMERICAN INSTITUTES FOR RESEARCH

Alaska School District Cost Study:

Volume I – Summary of Results

Submitted to:

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Legislative Budget & Audit Committee
State Capitol, Room 121
Juneau, AK 99801-1182

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January 2003

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Acknowledgements

This study benefited from the input and participation of many people. The study team would like to express their appreciation for the efforts of the Technical Working Group, whose members provided critical guidance over the course of the project. Members of the Working Group are as follows:

- Kerry Jarrell (Bering Strait SD)
- Michael Fisher (Fairbanks North Star Borough SD)
- Melody Douglas (Kenai Peninsula Borough SD)
- Dave Jones (Kodiak Island Borough SD)
- Dennis Niedermeyer (Lake and Peninsula Borough SD)
- Lucienne Harger (North Slope Borough SD)
- Barbara Stocker (Sitka Borough SD)
- Karen Goodwin (Southeast Island SD)

We greatly appreciate their support during the data collection phase of this project and owe a great debt of gratitude for helping us accomplish a 100 percent response rate on virtually all of our data collection instruments. They not only provided encouragement, but help to the beleaguered school business offices who attempted to interpret our needs. This group of hardy individuals also contributed to the design of our approach to addressing the costs of goods, services, and travel.

A special word of thanks goes to Melody Douglas and Dave Jones, who worked closely with AIR in the final stages to review assumptions and make follow-up phone calls to individual school business officers to check data elements that were used in the construction of the final index numbers. There willingness to work in collaboration with the AIR research team made the results of our work a better product.

The Oversight Committee also provided critical guidance, and helped coordinate our requests for data during the course of the study. Its members are Pat Davidson, Representative Hugh Fate, Eddy Jeans, David Teal, and Senator Gene Therriault.

In particular, Eddy Jeans and his staff were instrumental in helping us obtain data from ADEED and in serving as liaisons with school business officials and superintendents. Elizabeth Sweeney spent countless hours on the phone with the research team, both reviewing the Chart of Accounts and individual district fiscal audits, and guiding decisions about assignment of budget shares. Karen Lipson worked with the research team to quickly provide personnel data in whatever form necessary. Tim Mearig obtained important building and facility data for the energy prototype analysis and served as a liaison with school district facilities managers.

The study team would like to thank all of the school and district personnel who responded to our surveys and requests for information. Without their efforts, this study would not have been possible.

Joanne Lieberman, who laid the foundation for the project and managed it in its early stages, was instrumental in creating a well-conceived study, and demonstrated an uncanny ability to anticipate every contingency and plan for every eventuality.

Gur Hoshen, Ann Win, and Bob Morris all provided technical assistance through their programming skills using SAS statistical software.

Last, but certainly not least, we wish to acknowledge the hard work and significant effort put forth by Phil Esra, who has provided tremendous editorial support in developing this document.

Executive Summary

The purpose of this study is to develop an improved methodology for measuring differences in the cost of school resources across geographic locations within Alaska. State policy makers in Alaska have long recognized the importance of adjusting state education aid for geographic cost differences and, for the past five years, have utilized a cost adjustment index derived from a study conducted by the McDowell Group (1998). The present study is intended to develop a geographic cost of education index (GCEI) that will replace the existing cost adjustment and provide a more sophisticated approach to measuring cost differences. The application of such geographic cost adjustments in state aid is intended to equalize the purchasing power of the educational dollar across local school districts.

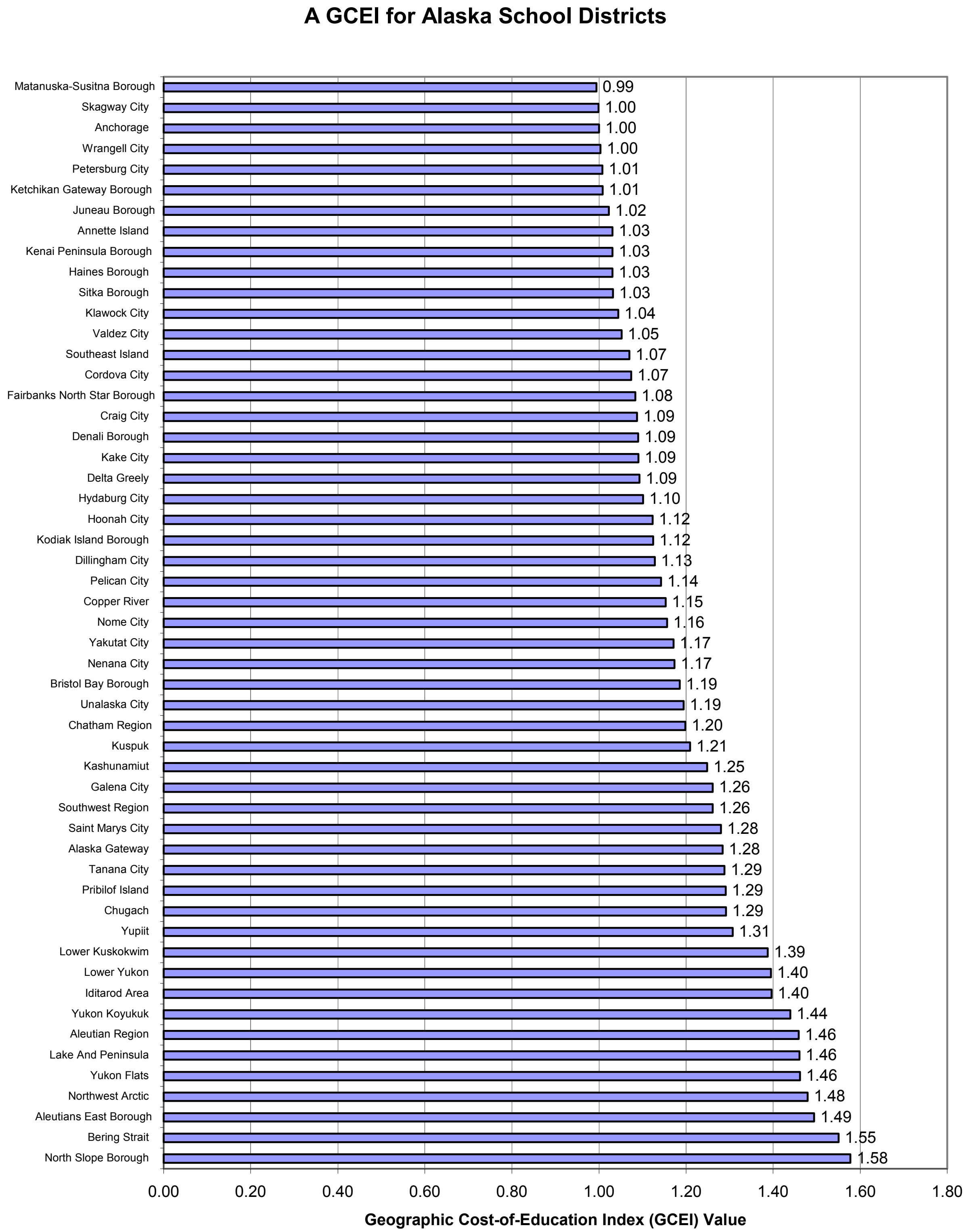
The costs of four major categories of school inputs are analyzed as part of this study:

- personnel services
- energy services
- supplies, materials, and small capital items
- travel

The AIR research team collaborated closely with a group of eight school business officers representing a diverse sample of districts from across Alaska. These eight school business officers formed a Technical Working Group (subsequently referred to as the TWG) that provided feedback on components of the methodology for this analysis, assistance in the design of data collection instruments, and support in data collection efforts.

Overall Variations in Costs

Based on the study's analysis, the purchasing power of the educational dollar varies tremendously in the State of Alaska. The highest-cost district needs to spend about 1.6 times what the lowest cost district spends in order to provide comparable educational services. Using Anchorage School District as the benchmark (i.e., with a GCEI of 1.00), the analysis of costs reveals that the North Slope Borough School District exhibits the highest cost of education, with an index value of 1.58 (see exhibit). This means that this district needs to spend about 58 percent more than the Anchorage School District to provide comparable educational services to the students it serves. On the other end of the spectrum is the Matanuska-Susitna Borough School District, with an index value of 0.99. This means that this district needs to spend about 1 percent less than the Anchorage School District to provide comparable educational services.



NOTES TO EXHIBIT: The districts listed on the vertical axis in this diagram are sorted in ascending order according to the value of the geographic cost-of-education index (GCEI), with the lowest on top.

Organizing the school districts by region reveals that the highest-cost districts in Alaska are located in the Far North (with average GCEIs of 1.38) and the Southwest (with average GCEIs of 1.31). The lowest-cost districts in the state are located in the Southeast (with an average GCEI of 1.07).

Differences between the values of the AIR GCEI and the current Alaska cost index for education may reflect a combination of methodology differences and changes in the costs of educational services since the last cost index was calculated. The largest differences are most likely attributable to methodological differences underlying the two studies' calculations.[1] The range, standard deviation, and mean values of the GCEI and the current Alaska cost index are quite similar. The AIR GCEI ranges from a low of 0.99 to a high of 1.58, while the range of the current Alaska cost adjustment is from 1.00 to 1.74. The standard deviation of the AIR GCEI is 0.17, and the standard deviation of the current adjustment is 0.21. Moreover, the correlation between the AIR GCEI and the Alaska cost index is 0.91, suggesting that the general patterns of variation in costs are quite similar between the AIR GCEI and the current Alaska cost index. More than 70 percent (38) of the districts exhibit a GCEI with less than a 0.10 difference from the current Alaska cost index. Forty-four percent (24) of the school districts in Alaska exhibit less than a 0.05 difference from the current Alaska cost index.

Personnel Cost Differences

Looking at the four major component indices reveals what one would expect. School personnel costs play a major role in explaining the variations in the overall costs of education across local school districts. The school personnel category accounts for a major portion of school district budgets, ranging in Alaska from 45 to 90 percent of total expenditures, with a median of 78 percent. AIR used econometric models of the school personnel labor market to provide a basis for simulations of the compensation levels that would be required if all districts employed *comparable* teachers, school administrators, and classified personnel. The key is comparability: what are the costs in different parts of the State of Alaska for school personnel with ***comparable*** levels of experience, education, and other demographic characteristics?

Using Anchorage as the basis for calculation of the index values (i.e., setting the Anchorage index to a value of 1.00), personnel costs range from a low of 0.93 in Southeast Island School District to a high of 1.28 in North Slope Borough School District. In other words, the highest-cost district pays, on average, about 28 percent more than Anchorage for comparable personnel, while the lowest-cost district pays about 7

[1] The actual values of the two indices are presented for purposes of comparison in Exhibit I-6 In Appendix I of the report entitled "*Alaska School District Cost Study: Volume II-The Technical Report.*"

percent less than Anchorage for comparable school personnel. Comparing these two districts to each other, North Slope pays 38 percent more than Southeast Island for comparable personnel.

Energy Cost Differences

A second component index, energy cost, is influenced by several factors. Alaska's significant climate variation across districts affects the consumption of fuels and energy required to provide heat to classrooms and school buildings. In addition, the degree of remoteness of each district affects the prices of these fuel and energy sources.

The study's approach to calculating energy costs relies on an engineering computer simulation model. This model requires the development of prototype buildings to permit estimation of the energy requirements to provide heating, cooling, and power for all aspects of school and district operations. Each prototype is associated with a specific climate parameter expressed in terms of heating degree-days. The estimated energy consumption levels necessary for the prototype buildings in different climatic zones are then combined with information on the unit energy prices at each school site throughout Alaska to estimate the cost of energy services.

The results of this analysis show a range of index values for the cost of energy services per square foot from 0.74 in the Juneau School District to 9.31 in the North Slope School District. Typically, the school districts with the highest index values are located within the very cold climate zone, largely represented by the Far North region. High costs in less cold districts can be attributed to the relative costs of energy sources faced by these districts.

Costs of Supplies, Materials, and Small Capital Items

The third component index, supplies, material, and capital equipment, is most influenced by geographic differences in shipping costs. The base prices of supplies purchased by districts in different parts of the state may vary to some extent because of volume purchasing, but this difference is small compared to the difference associated with the cost of transporting these items from the major centers of commerce to the remote areas of the state. The costs range from a low of 1.00 in Anchorage School District to a high of 6.81 in Pelican City School District.

In general, larger districts (i.e., districts with higher enrollment figures) tend to exhibit lower costs of goods. Larger districts are able to purchase items in bulk more easily than smaller districts. Another factor contributing to the lower index values for districts with greater enrollments is their proximity to the suppliers of these goods. These districts operate in or near Alaska's major centers of commerce. Transportation costs are lower, and competition among suppliers in these centers of commerce drives down prices.

Travel Costs

The fourth component index is the cost of travel. Because of the remote locations of some schools and communities in Alaska, travel costs can have a significant impact on the expenditures necessary to operate schools in the state. The majority of the low-cost districts in this index are city school districts and districts located near Anchorage or in another relatively accessible area of the state. These districts tend to have very low costs associated with travel between the district office and the school(s) in the district. For those districts located near Anchorage, travel costs to Anchorage for statewide training tends to be a relatively low-cost item. Districts located close to a center of commerce enjoy low costs for maintenance service travel, resulting in lower cost index values in this travel input index.

Summary of Recommendations

AIR makes a number of recommendations regarding implementation of the GCEI:

- Adoption of the new GCEI presented in this report.
- Improvements and expansion of the personnel databases currently collected by ADEED.
- Adoption of new data collections on non-personnel items including energy fuels; supplies, materials, and capital items; and travel costs.
- Updating the GCEI every 3 to 5 years.
- Using a professional economist for the analysis of personnel costs.
- Phasing in the new index over time to avoid disrupting district budgets.

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Exhibits

I. Introduction

The purpose of this study is to develop an improved methodology for measuring differences in the cost of school resources across geographic locations within the State of Alaska. State policy makers in Alaska have long recognized the importance of adjusting state education aid for geographic cost differences and, for the past five years, have utilized a cost adjustment index derived from a study conducted by the McDowell Group (1998). The present study is intended to develop a geographic cost of education index (GCEI) that will replace the existing cost adjustment used by the State of Alaska and provide a more sophisticated approach to measuring cost differences. The application of such geographic cost adjustments in state aid is intended to equalize the purchasing power of the educational dollar across local school districts.

The costs of four major categories of school inputs are analyzed as part of this study:

- Personnel services
- Energy services
- Supplies, materials, and small capital items
- Travel (as it affects maintenance services, administrative oversight of school operations, district level meetings for professional staff, and statewide professional meetings)

With the exception of energy services, each of these categories includes subcategories of inputs for which separate cost indices were calculated. For example, the personnel service index is derived from separate indices for teachers, administrators and other professional staff, and classified staff. Each subcategory is weighted to reflect its relative importance within each school district's budget.

Combining these subcategories into larger indices requires a technique developed by economists to take into account the substitution between inputs that occurs in response to relative differences in the prices of the inputs across districts.[2] Using this technique, the calculation of the GCEI value for a district 'j' weights each component cost index by the average of the budget share allocated to this input by the district 'j' and the Anchorage School District. This weight will subsequently be referred to as the budget share weight.[3] This weighting allows the overall GCEI to reflect the relative amount of a district's budget allocated to each input.

[2] For example, as the cost of using external skilled maintenance workers increases relative to the cost of internal maintenance workers (classified employees), one would expect districts to use internal employees more often to maintain the quality and level of services.

[3] This technique is referred to as a ***superlative*** or true cost index. For a more technical discussion, the reader is referred to the work of Diewert (1976) and Caves, Christensen, and Diewert (1982). The budget share weight for input 'i' in district 'j' is defined by $(1/2) H [S_{ij} + S_{iA}]$ where S_{ij} = the budget share of input 'i' in district 'j' and S_{iA} is the budget share for input 'i' in Anchorage (i.e., district 'A').

The following is an overview of the study's analysis and its results. A more detailed description of the methodology and the assumptions underlying this analysis may be found in a separate document entitled "*Alaska School District Cost Study, Volume II-The Technical Report"* (subsequently referred to as the *Technical Report*).

The AIR research team worked in close collaboration with a group of eight school business officers representing a diverse sample of districts from across Alaska. These eight school business officers formed a Technical Working Group (subsequently referred to as the TWG) that provided feedback on components of the methodology for this analysis, assistance in the design of data collection instruments, and support in data collection efforts.

Limitations to the Scope of the Present Study

It is important to point out what this study does do and what it does *not* do. The study develops a cost adjustment index that reflects the variations in the prices paid for comparable school inputs in different geographic locations in the state. However, this study does ***not*** address cost differences associated with pupil needs, nor does it address other factors related to the scale and concentration of district operations. For example, it does not address differences in the levels of staff and other non-personnel resources required to meet the different needs of students who are from disadvantaged backgrounds, students who are English language learners, or students with physical or mental disabilities. In addition, this study does not address the different administrative staffing requirements that may be associated with operating school districts in remote and sparsely populated regions of the state. While the study does address the differential costs of personnel travel within large remote school districts and does address the costs of transporting goods within these remote locations, it does not address the increased need for staff that may be required to provide necessary administrative and support services.[4]

Overview of the Report

Section II presents an overview of the results of the study, focusing on the range of costs represented by the GCEI. Sections III through VI describe the methodology and the results of the analysis for each of the four categories of inputs (personnel, energy, supplies and equipment, and travel). Section VII describes the procedure for assigning the budget weights and the calculation

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[4] These additional cost factors related to the measurement of pupil needs and the costs of operating districts in sparsely populated and remote regions of the state must be addressed through more comprehensive studies designed to estimate the costs of providing adequate educational services in Alaska. The previous work done by Chambers and Parrish (1984) represents one model for conducting these kinds of studies, while a newer proposal for costing out an adequate education in New York State prepared by Chambers, Smith, Parrish, and Guthrie (2002) provides an even more comprehensive and more up-to-date approach to addressing these complex issues. The newer methodology for measuring adequacy in education focuses more attention on the relationship between outcome standards for students and the levels of resources necessary to achieve those standards.

of the GCEI. Section VIII discusses implementation issues and issues related to the utilization and updating of the GCEI.

II. Overview of the GCEI

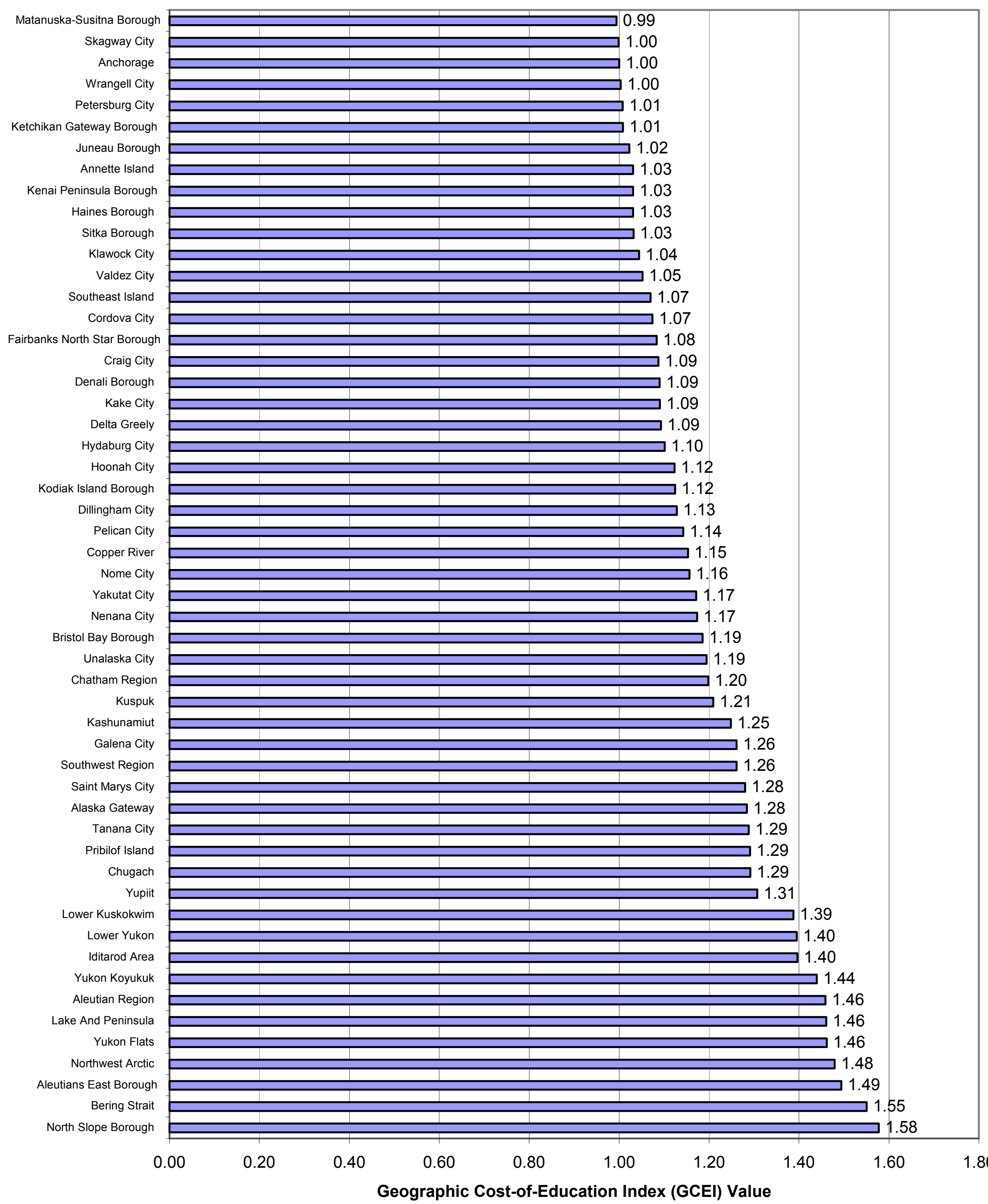
Based on the study's analysis, the purchasing power of the educational dollar varies tremendously in the State of Alaska. The highest-cost district needs to spend about 1.6 times what the lowest cost district spends in order to provide comparable educational services.

Another way to understand these variations is to select a benchmark district to which all districts can be compared. Following the conventional approach that has been used in Alaska for these kinds of studies, we use Anchorage, the largest and most urbanized district in the state, as the benchmark.[5] Thus, the value for the GCEI in Anchorage has been arbitrarily set at 1.00. Using Anchorage as the base, the analysis of costs reveals that the North Slope Borough School District exhibits the highest cost of education, with an index value of 1.58 (Exhibit II-1). This means that this district needs to spend about 58 percent more than the Anchorage School District to provide comparable educational services to the students it serves.

On the other end of the spectrum is the Matanuska-Susitna Borough School District, with an index value of 0.99. This means that Matanuska-Susitna needs to spend about 1 percent less than the Anchorage School District to provide comparable educational services.

[5] In most studies, the district attended by the average student is used as the benchmark school district. This is so that the GCEI, when applied to state aid allocations, will have no impact on the overall amount of aid to be allocated. That is, the GCEI would be neutral with respect to the total allocation of state education aid. In these situations, the district attended by the average student, which is in actuality a fictitious district that has been created purely for statistical purposes, is assigned a GCEI value of 1.00. In the case of Alaska, state policy makers have chosen to scale everything to Anchorage, which is far and away the largest school district in the state.

Exhibit II-1. A GCEI for Alaska School Districts



NOTES TO EXHIBIT: The districts listed on the vertical axis in this diagram are sorted in ascending order according to the value of the geographic cost-of-education index (GCEI), with the lowest on top.

Organizing the school districts by region (Exhibit II-2) reveals that the highest-cost districts in Alaska are located in the Far North (with average GCEIs of 1.38) and the Southwest (with average GCEIs of 1.31). The lowest-cost districts in the state are located in the Southeast. As discussed later in this report, the factor behind these numbers appears to be the impact of the degree of districts' remoteness on personnel salaries, transportation costs for goods and services, and travel costs for district staff. In addition, climatic factors have a significant impact on the cost of energy services. The attractiveness of living in the urban centers of Alaska in terms of access to shopping, medical services, and other cultural amenities clearly plays a role in personnel costs.

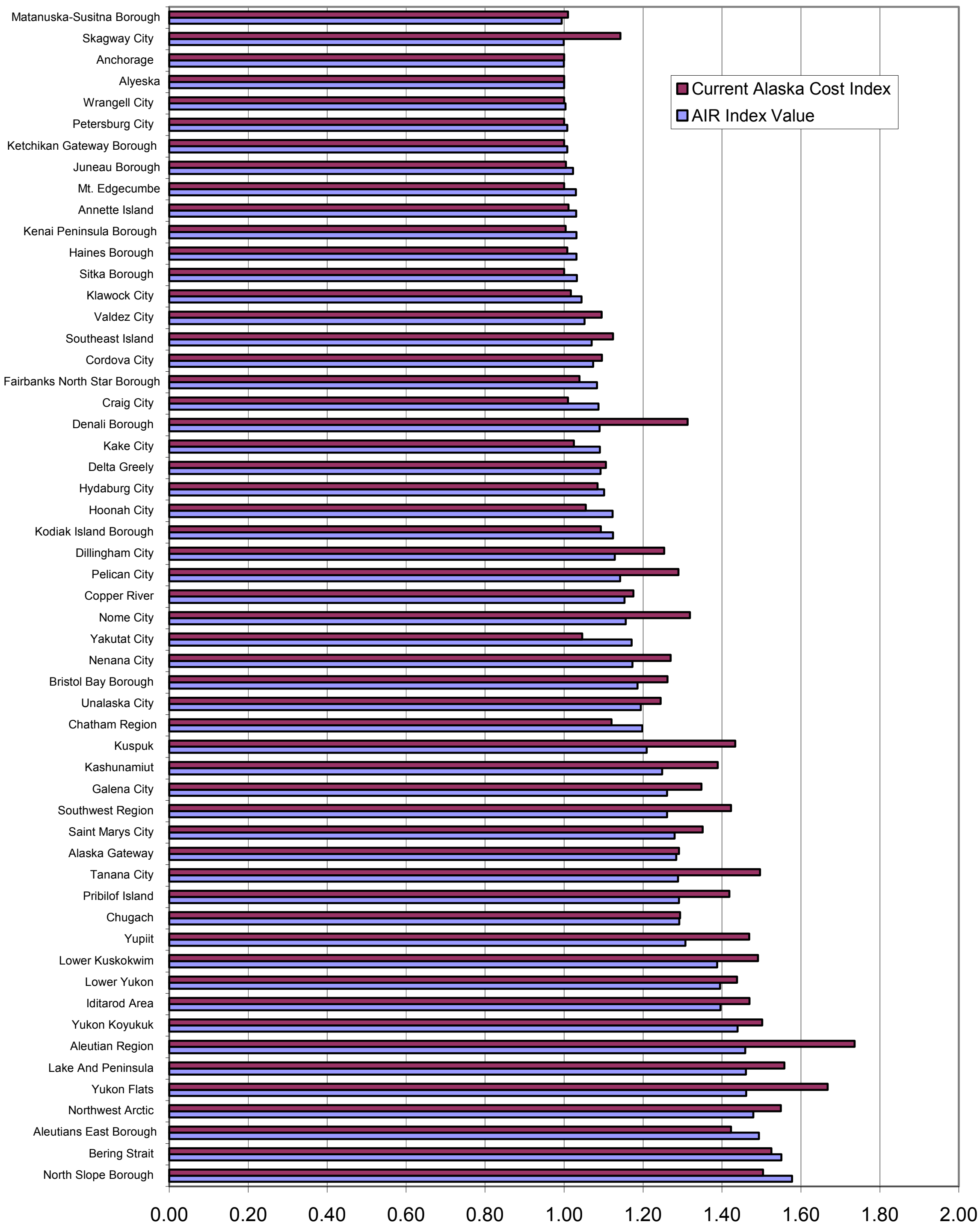
Exhibit II-2. Variations in the Geographic Cost of Education Index by Region

Region	Number of Districts	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	1.20	0.17	0.99	1.58
Far North	10	1.38	0.15	1.16	1.58
Interior	3	1.09	0.00	1.08	1.09
South Central	9	1.11	0.11	0.99	1.29
Southeast	17	1.07	0.06	1.00	1.20
Southwest	14	1.31	0.11	1.13	1.49

Exhibit II-3 compares the GCEI derived from this study with the education cost adjustment that is the current law in Alaska. Districts are in ascending order according to the AIR GCEI calculated in the present study. Differences between these cost index values may reflect a combination of methodology differences and changes in the costs of educational services since the last cost index was calculated. The largest differences are most likely attributable to methodological differences underlying the two studies' calculations.[6] The range, standard deviation, and mean values of the GCEI and the current Alaska cost index are quite similar. The AIR GCEI ranges from a low of 0.99 to a high of 1.58, while the range of the current Alaska cost adjustment is from 1.00 to 1.74. The standard deviation of the AIR GCEI is 0.17, and the standard deviation of the current adjustment is 0.21. Moreover, the correlation between the AIR GCEI and the Alaska cost index is 0.91.

[6] The actual values of the two indices are presented for purposes of comparison in Exhibit I-6 In Appendix I of this report.

Exhibit II-3. Current Alaska Index Compared to the AIR GCEI



However, there are a number of districts that exhibit significant differences between the two index values. Nine districts exhibit a difference of 0.15 or more (positive or negative) and 17 districts exhibit a difference of 0.10 or more. A difference of 0.01 means a one-percent difference relative to the benchmark district of Anchorage. For example, the Aleutian Region district exhibits a GCEI of 1.46, while the current Alaska cost index is 1.74, a difference of 0.28. In addition, the Denali Borough, Kuspuk, Nome City, Pelican City, Southwest Region, Tanana City, Yukon Flats, and Yupiit School Districts exhibit GCEI values that differ by 0.15 or more from the current values.

On the other hand, slightly more than 70 percent (38) of the districts exhibit a GCEI with a less than 0.10 difference from the current Alaska cost index. Forty-four percent (24) of the school districts in Alaska exhibit less than a 0.05 difference from the current Alaska cost index.

The next few sections present separate discussions of the four major components of the overall GCEI.

III. Personnel Costs

The Methodology

Because expenditures on school personnel dominate school district budgets, previous research on geographic cost differences in education has focused on analysis of labor markets for school personnel.[7] This has led to a growing recognition among education policy makers nationwide that districts in different parts of a state face different conditions in local labor markets, and that these conditions impact the ability of local school districts to recruit and employ comparable school personnel.

Many schools in Alaska are located in remote regions of the state, creating challenges in recruiting and employing professional school personnel. Costs of living are higher in the remote regions of the state because the cost of transporting consumer goods and services to these communities results in higher prices. In addition, access to cultural amenities and to shopping and medical facilities is more difficult in remote communities than it is in more urban areas such as Anchorage or Fairbanks. The degree of isolation can be significant, particularly during winter months, because of the time required to reach the more urban centers of the state. All of these factors impact the compensation (salaries and benefits) that must be paid to attract comparable school personnel.

This study addresses these personnel cost differences through sophisticated econometric models of the labor market for school personnel. The study goes beyond simply using average

[7] For a summary of the early work done on this topic see Chambers (1981a).

wages or annual salaries; the analysis starts by examining all of the factors that are associated with variations in school personnel. For example, the econometric model includes personal characteristics, characteristics of job assignments, and characteristics of the schools, districts and regions in which school personnel live and work. Because of differences in the labor markets for subcategories of personnel, separate statistical analyses were conducted for teachers, school administrators, and classified personnel.

These econometric labor market models for school personnel then provide the basis for a series of simulations of the compensation levels that would be required if all districts employed *comparable* teachers, school administrators, and classified personnel. The key is comparability: what are the costs in different parts of the State of Alaska for school personnel with ***comparable*** levels of experience, education, and other demographic characteristics?

The Results

As one would expect, school personnel costs play a major role in explaining the variations in the overall costs of education across local school districts. The school personnel category accounts for a major portion of school district budgets, ranging in Alaska from 45 to 90 percent of total expenditures, with a median of 78 percent.

Exhibit III-1 shows the personnel cost differences among Alaska's school districts. This graph displays the district personnel index values, with the lowest at the top and the highest at the bottom. Using Anchorage as the basis for calculation of the index values (i.e., setting the Anchorage index to a value of 1.00), personnel costs range from a low of 0.93 in Southeast Island School District to a high of 1.28 in North Slope Borough School District. In other words, the highest-cost district pays, on average, about 28 percent more than Anchorage for comparable personnel, while the lowest-cost district pays about 7 percent less than Anchorage for comparable school personnel. Comparing these two districts to each other, North Slope pays 38 percent more than Southeast Island for comparable personnel.

Exhibit III-1: Personnel Cost Index

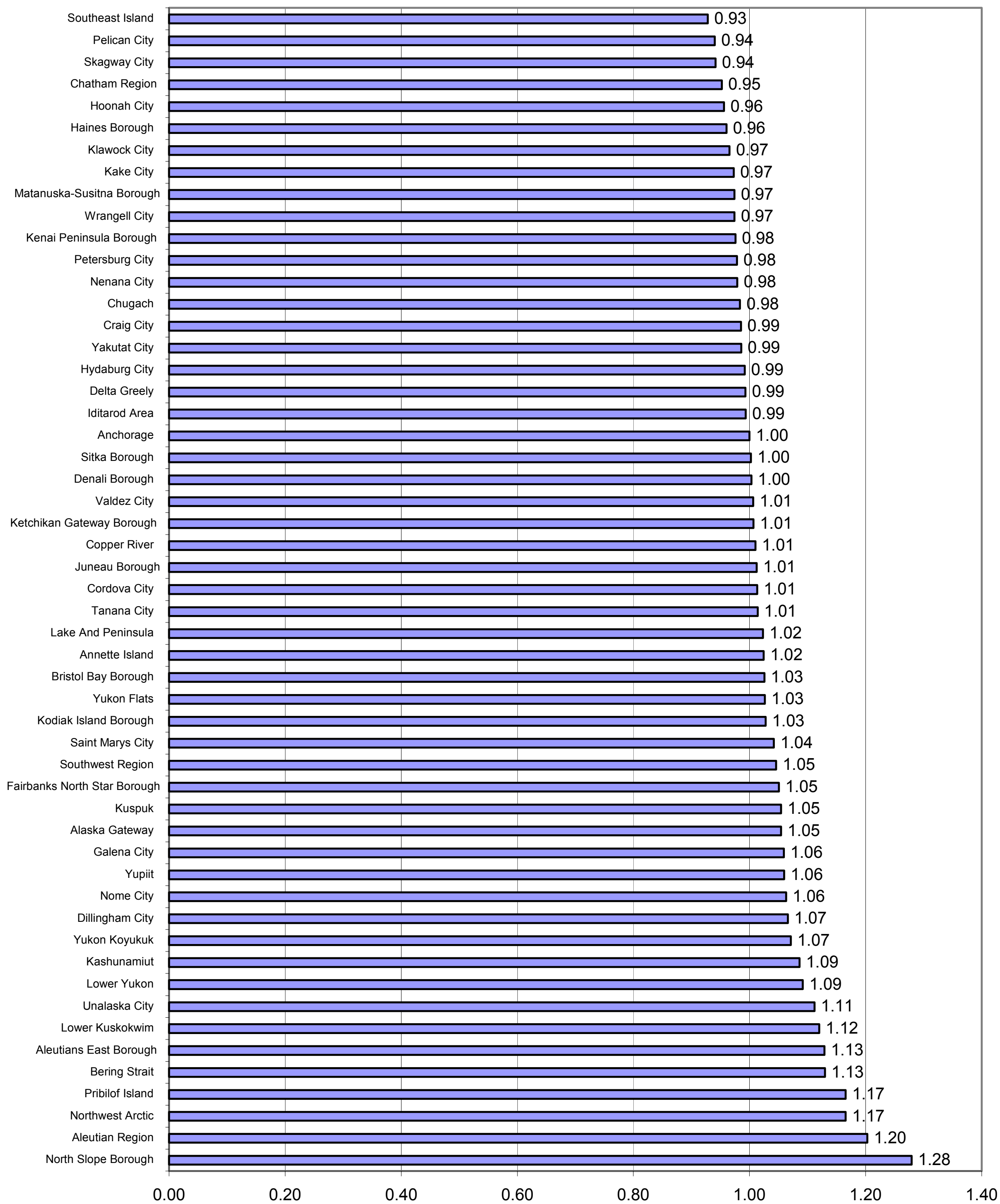


Exhibit III-2 displays the descriptive statistics associated with the personnel cost differences for various regions of the state. School districts located in the Southwest and Far North regions of the state exhibited the highest average costs while the districts located in the Southeast were among the lowest-cost districts in the state. In terms of distance from the nearest center of commerce, personnel costs generally were higher for the districts furthest (500 miles or more) from a major center of commerce, with an average index of 1.16 (16 percent above Anchorage).

Exhibit III-2. Descriptive Statistics for Personnel Cost Indices By Region[8]

District Characteristics	N	Mean	Standard Deviation	Minimum	Maximum
Region of the state					
Statewide	53	1.03	0.07	0.93	1.28
Far North	10	1.08	0.09	0.98	1.28
Interior	3	1.02	0.03	0.99	1.05
South Central	9	1.01	0.03	0.97	1.05
Southeast	17	0.98	0.03	0.93	1.02
Southwest	14	1.09	0.05	1.02	1.20
Distance from the nearest center of commerce*					
Statewide	53	1.03	0.07	0.93	1.28
Less than 10 miles	6	1.00	0.04	0.93	1.05
At least 10 miles	4	0.99	0.03	0.96	1.02
At least 50 miles	12	0.97	0.02	0.94	1.00
At least 100 miles	23	1.04	0.04	0.98	1.12
At least 500 miles	8	1.16	0.07	1.06	1.28

*The centers of commerce used for this analysis include Anchorage, Fairbanks, Juneau, Ketchikan, and Kodiak

IV. Costs of Energy Services

The Methodology

There are several factors that influence each district's energy costs. Alaska's significant climate variation across districts affects the consumption of fuels and energy required to provide heat to classrooms and school buildings. In addition, the degree of remoteness of each district

[8] Data sources: Teacher data from regression analysis for teacher salaries and benefits. Administrator data from tobit model for administrators. Classified personnel data from regression analysis for classified personnel salaries.

affects the prices of these fuel and energy sources. Also, some districts may operate older school buildings that require more fuel or energy to maintain similar comfort levels within classrooms.

The study's approach to calculating energy costs relies on an engineering computer simulation model. This model requires the development of prototype buildings to permit estimation of the energy requirements to provide heating, cooling, and power for all aspects of school and district operations. The AIR research team (including SBW Consulting engineers) consulted with officials in the Alaska Department of Early Education and Development (ADEED), the TWG, and the Anchorage School District to develop a series of prototype school buildings. Each prototype building encompasses a set of structural and operational characteristics of school buildings including square footage; the allocation of square footage among end uses (classroom and office space); the levels of insulation in the walls and ceilings; the heating, ventilation, and air conditioning systems; the lighting and equipment power densities; and the hours of operation. In addition, each prototype is associated with a specific climate parameter expressed in terms of heating degree-days.

The parameters that define each prototype are entered into an engineering simulation model to estimate the energy consumption levels required in the different climatic regions of the state. Part of this model also simulates the different efficiency levels of alternative sources of energy such as natural gas, electricity, fuel oil, wood, and liquid propane. The results of these prototype simulations serve as points from which equations are calculated to capture each school's individualized projected energy consumption, given its specific heating degree-days and fuel type used for each end use.

Finally, the estimated energy consumption levels necessary for the prototype buildings in different climatic zones are combined with information on the unit energy prices at each school site throughout Alaska to estimate the cost of energy services. With the assistance of the TWG, the AIR research team collected data on these price levels for each school site from the school district offices. Energy costs were calculated at the school building level and aggregated to the district level using the square footage of school buildings at each site as weights.

The Results

The results of this analysis (Exhibit IV-1) show a range of index values for the cost of energy services per square foot from 0.74 in the Juneau School District to 9.31 in the North Slope School District. Typically, the school districts with the highest index values are located within the very cold climate zone, largely represented by the Far North region. High costs in less cold districts can be attributed to the relative costs of energy sources faced by these districts. For example, energy prices per BTU (*British Thermal Unit*) within the Bristol Bay School District were second only to the North Slope Borough School District.[9] This resulted in a relatively high index value for Bristol Bay that was not caused by climate. For the North Slope Borough School District, it is clear that the combination of an extremely cold climate and the highest energy costs give this district the highest index value. It is likely that a significant component of these differences in energy prices can be attributed to variations in the cost of transporting fuels to the different school sites.

Located near the Bristol Bay School District is the Dillingham City School District. Unlike its neighbor, Dillingham has a low energy cost index value. While Dillingham is still in a high-cost area for energy prices, schools in the Dillingham School District generate their own electricity and use the waste heat to heat their schools, thereby saving a substantial amount of money. This is also reflected in their assigned budget weight for energy, which is among the lowest in the state at 6 percent of the total operating fund.

[9] A recent report entitled "Bristol Bay, Alaska, Comprehensive Economic Development Strategy" highlights the high cost of energy in the region and can be found on the Department of Commerce and Economic Development website at: http://www.dced.state.ak.us/cbd/oedp/pubs/BBNA_CEDS2002.pdf

Exhibit IV-1. Energy Cost Index

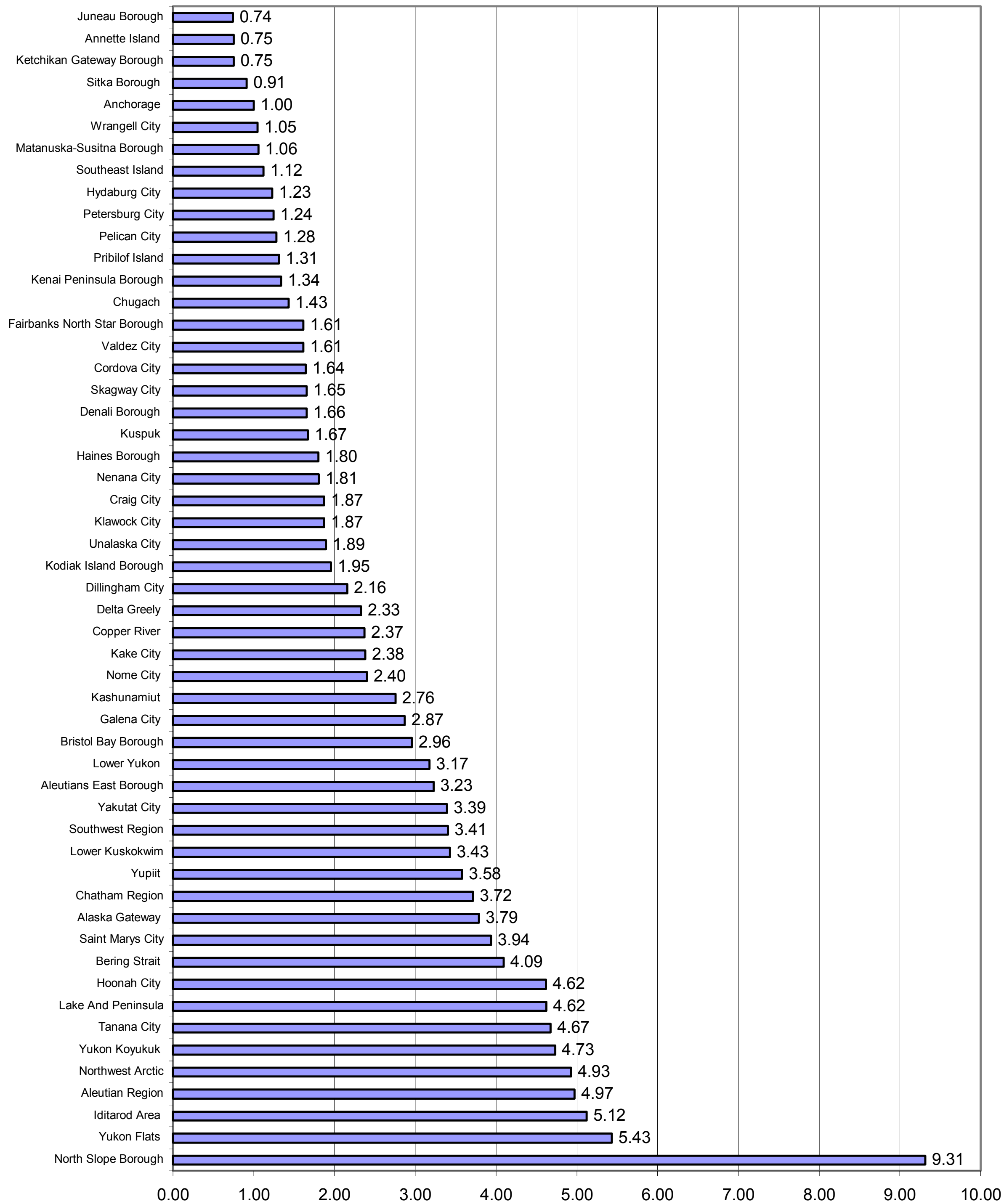


Exhibit IV-2 reveals that geographic location plays a significant role in the energy index values. Those districts located in the Far North region typically face a climate harsher than the rest of the state, and the cost of transporting fuel supplies here can also be much higher. Outside of the Far North region, the highest-cost districts tend to be in the Southwest region, where they may also face high costs for transportation of fuel. Schools located in the Far North region tend to have more efficiently insulated school buildings than school districts in other regions, but the fact remains that they face higher costs to heat their buildings.

Exhibit IV-2. Comparison of Energy Index Values by Region

Region	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	2.65	1.64	0.74	9.31
Far North	10	4.54	2.09	1.81	9.31
Interior	3	1.87	0.40	1.61	2.33
South Central	9	1.80	0.86	1.00	3.79
Southeast	17	1.79	1.13	0.74	4.62
Southwest	14	3.08	1.06	1.31	4.97

V. Costs of Supplies, Materials and Small Capital Items

The Methodology

Shipping cost is the major factor underlying cost differences in supplies, materials, and capital equipment across local schools and districts in Alaska. The base prices of supplies purchased by districts in different parts of the state may vary to some extent because of volume purchasing, but this difference is small compared to the difference associated with the cost of transporting these items from the major centers of commerce to the remote areas of the state. After extensive deliberations between the TWG and the AIR research team, a limited set of items was selected to represent the purchases of school districts. This set of items reflects the impact of transportation costs on the final prices paid.

The index developed for this portion of the GCEI is based on variations in the prices paid across the state for one case (10 reams) of white copier paper (8.5” by 11”) and one 4’ by 5’ windowpane. AIR obtained this price information with a district questionnaire that requested information for each of the schools within the district. The total cost of the items reflects not only the cost of the item itself, but also the shipping and storage costs incurred for delivery of the item to the specific school site. The ream of copier paper was chosen as a proxy for instructional supplies, such as textbooks, and also for office supplies consumed by administrators. The windowpane represents the cost of bulky items that would commonly be purchased out of capital outlay expenditures. For districts located in the Far North region, this was usually a triple-paned window, while schools in less harsh climates more often purchased single- or double-paned windows.

The district questionnaire took into account the fact that using only one method of transportation is not feasible for some districts. For example, districts located above the Bering Strait will not always be able to ship goods by barge. The questionnaire asked for the percentage of time an alternative shipping method was utilized for each school site. All calculations were made at the school level and then aggregated to the district level by pupil enrollment weights.

The Results

Exhibit V-1 displays the aggregate cost index for supplies, materials, and small equipment items. The districts are sorted in order from lowest to highest cost. The costs range from a low of 1.00 in Anchorage School District to a high of 6.81 in Pelican City School District.

Exhibit V-2 shows the relationship between the cost of goods and district size (measured by enrollment). In general, larger districts tend to exhibit lower costs of goods. Larger districts are able to purchase items in bulk more easily than smaller districts. Another factor contributing to the lower index values for districts with greater enrollments is their proximity to the suppliers of these goods. These districts operate in or near Alaska's major centers of commerce. Transportation costs are lower, and competition among suppliers in these centers of commerce drives down prices.

These trends do not hold true for all districts. Chugach and Chatham School Districts are relatively close to Anchorage and Juneau, respectively. However, they have index values above the average value in this input category. Both districts reported high transportation costs, as did Pelican City School District. All reported prices of goods were verified for accuracy with the respondent by the data collectors at AIR and by representatives from ALASBO. Any corrections necessary were made, and the remaining data have been deemed accurate.

Exhibit V-1: Index for the Cost of Supplies, Materials, and Small Capital Equipment

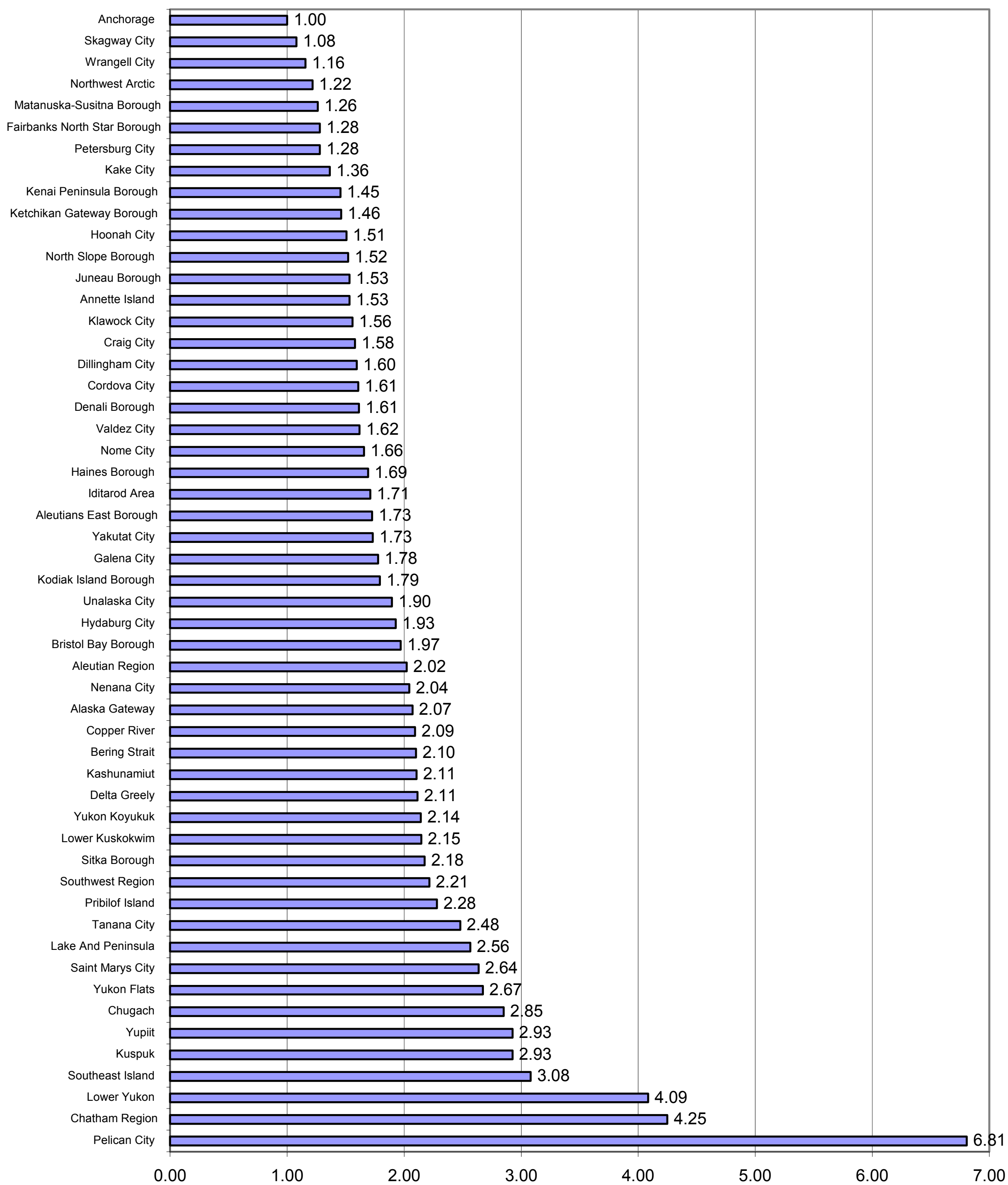


Exhibit V-2. Comparison of Total Goods Index Values by District Enrollment

Region	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	2.05	0.94	1.00	6.81
0 to <250	13	2.50	1.53	1.08	6.81
250-999	25	1.98	0.52	1.16	3.08
1000-2499	6	2.19	1.00	1.22	4.09
2500-9999	6	1.69	0.27	1.46	2.15
10,000+	3	1.18	0.16	1.00	1.28

VI. Costs of Travel

The Methodology

Because of the remote locations of some schools and communities in Alaska, travel costs can have a significant impact on the expenditures necessary to operate schools in the state. Travel cost affect the cost of maintenance services, itinerant instructional services, professional development activities, administrative oversight of school activities, and statewide meetings for professional staff. The distances of the district offices from the centers of trade impact access to skilled maintenance personnel and technicians.

With the advice of the TWG, the AIR research team estimated the cost of a specified service call by a skilled technician. The cost included the amount of time for the call (16 hours), the cost of the time required to travel to the school site, and the cost of transportation, lodging (where necessary), and meals. The rate for the service technician was based on the Anchorage rate adjusted to the nearest center of trade. For schools located in a center of trade, there was generally no cost associated with travel time. The cost of transportation was based on the mode of transportation most commonly used between the school site and the corresponding center of trade (i.e., airfare for air travel, or mileage reimbursement for automotive travel). Lodging and meals were set at $150 per day.

Travel costs associated with itinerant services and other services necessitating trips between the district office and the school site were estimated based on the appropriate mode of transportation and whether or not such travel was commonly associated with an overnight stay (common in some remote locations because of limited schedules of carriers). The data on the modes of transportation and the common airfares paid for travel were gathered through the questionnaires administered during the data collection process. Similarly, travel for statewide meetings was based on the cost of transportation, lodging, and meals for a trip to Anchorage from each of the school sites.

All travel costs and the costs of the maintenance services were assigned to the school site and aggregated to the district level based on the relative enrollment of the school. The three subcomponents of travel were aggregated into a single index for travel using the appropriate budget share weights described earlier.

The Results

The majority of the low-cost districts in this index are city school districts and districts located near Anchorage or in another relatively accessible area of the state. These districts tend to have very low costs associated with travel between the district office and the school(s) in the district. For those districts located near Anchorage, travel costs to Anchorage for statewide training tends to be a relatively low-cost item.

Districts located close to a center of commerce enjoy low costs for maintenance service travel, resulting in lower cost index values in this travel input index. This is evidenced in Exhibit VII-2, as there is a general trend of higher index values associated with travel in the more remote districts of the state.

Exhibit VII-3 reveals that districts in the middle ranges of enrollment (i.e., between 1,000 to 2,499 students) have the highest costs of travel relative to smaller or larger districts. This can be confirmed intuitively: districts with the highest enrollment numbers are located in areas where they have easier access to travel and readily available maintenance services, combined with a concentration of schools near the district office. Districts comprising the lowest enrollment category tend to be city school districts, making travel cost between schools and the district office almost negligible. However, the average travel index value for these schools is higher than for the largest district enrollment category. Since some small districts are in remote areas of the state, they will have higher travel index values associated with them. Districts with mid-range enrollments usually span a large area and can be in very remote areas of the state, thus generating higher index values for the districts in these categories.

Exhibit VI-1. Index for the Cost of Travel

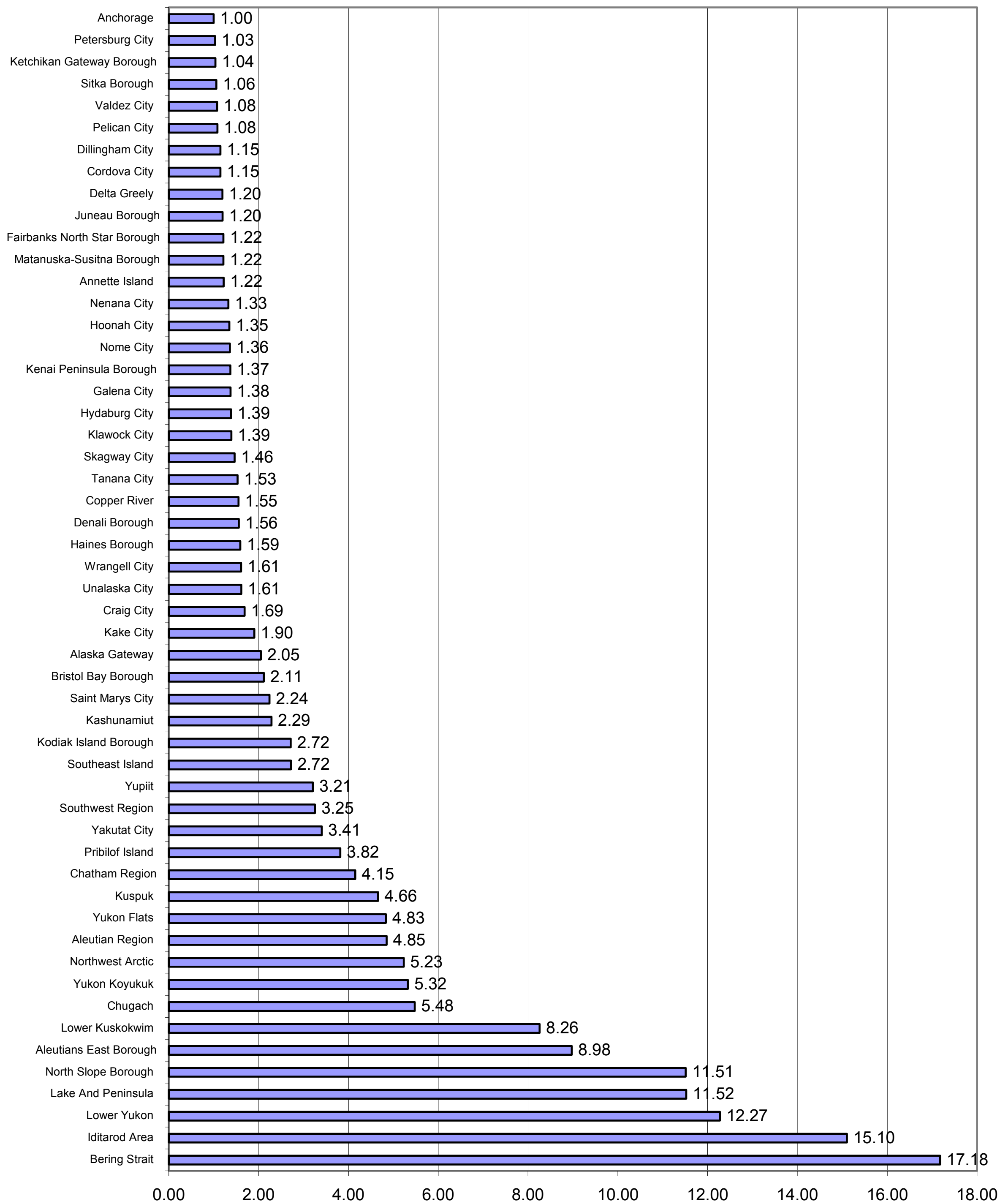


Exhibit VI-2. Comparison of Total Travel Index Values by Distance

Region	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	3.51	3.78	1.00	17.18
Less than 10 miles	6	1.42	0.65	1.00	2.72
At least 10 miles	4	1.29	0.09	1.22	1.39
At least 50 miles	12	2.01	1.36	1.06	5.48
At least 100 miles	23	4.06	3.96	1.03	15.10
At least 500 miles	8	6.82	5.43	1.36	17.18

Exhibit VI-3. Comparison of Total Travel Index Values by District Enrollment

Region	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	3.51	3.78	1.00	17.18
0 to <250	13	2.62	1.52	1.08	5.48
250-999	25	3.35	3.54	1.03	15.10
1000-2499	6	8.10	6.56	1.06	17.18
2500-9999	6	2.66	2.81	1.04	8.26
10,000+	3	1.14	0.13	1.00	1.22

VII. Overall Geographic Cost of Education Index

This project has undertaken a comprehensive analysis to address the various factors that affect the ability of districts in Alaska to access comparable school resources in the different regions of the state. The end product is a geographic cost-of-education index (GCEI), which addresses the following question:

How much more or less does it cost to recruit and employ comparable school personnel (i.e., teachers, administrators, and classified personnel); and to pay for comparable energy services (i.e., heating, lighting and power); comparable supplies, materials, and small capital equipment; and travel costs as they affect maintenance and operations, itinerant services, professional development, administrative oversight, and statewide professional meetings in different geographic locations around the state?

The GCEI is a cost adjustment index that permits translation of nominal dollar values into *real* dollars of purchasing power for school resources and services. It can be used to provide equal purchasing power by adjusting funding levels for individual school districts.

Determination of Budget Shares and Application of the Index Values

To calculate the GCEI, the AIR research team first needed to estimate the budget shares allocated by each district for each of the inputs. AIR utilized audited budget data provided by the ADEED. The budget shares were calculated based on the “operating budget” reported in the audited budget files. The operating budget data are organized into a matrix by function and object of expenditure. The assignment of each function and object cell in the budget matrix is presented in the *Technical Report* for this project. Once the budget cells were assigned to a component cost index, AIR calculated the index values for the four categories of inputs: personnel, energy, goods, and travel. A final overall GCEI was then calculated using the aggregate budget shares for each of these four categories of inputs. Exhibit VII-1 shows how each of the index values for the four major categories of inputs contributes to the overall GCEI. This exhibit reflects the overall contribution of each of the four input categories based on two elements: (a) the *relative costs* (i.e., reflected by the component geographic cost index) and (b) the *relative budget weights* (i.e., each district’s budget share averaged with that of Anchorage for each input category). To arrive at the overall GCEI, one needs simply to multiply the four input category values in the exhibit together.

EXHIBIT VII-1(a). GCEI Values and the Relative Impact of the Four Component Indices

District Name	GCEI	Personnel Contribution	Energy Contribution	Travel Contribution	Goods Contribution
Alaska Gateway	1.28	1.04	1.15	1.03	1.04
Aleutian Region	1.46	1.16	1.08	1.11	1.06
Aleutians East Borough	1.49	1.10	1.08	1.23	1.03
Anchorage	1.00	1.00	1.00	1.00	1.00
Annette Island	1.03	1.02	0.98	1.01	1.02
Bering Strait	1.55	1.10	1.12	1.22	1.04
Bristol Bay Borough	1.19	1.02	1.08	1.05	1.02
Chatham Region	1.20	0.96	1.10	1.07	1.06
Chugach	1.29	0.99	1.03	1.16	1.10
Copper River	1.15	1.01	1.05	1.02	1.06
Cordova City	1.07	1.01	1.03	1.01	1.02
Craig City	1.09	0.99	1.03	1.05	1.02
Delta Greely	1.09	0.99	1.05	1.01	1.03
Denali Borough	1.09	1.00	1.04	1.02	1.03
Dillingham City	1.13	1.05	1.04	1.01	1.02
Fairbanks North Star Borough	1.08	1.04	1.02	1.01	1.01
Galena City	1.26	1.04	1.08	1.02	1.11
Haines Borough	1.03	0.97	1.03	1.01	1.02
Hoonah City	1.12	0.96	1.12	1.02	1.02
Hydaburg City	1.10	0.99	1.01	1.02	1.07
Iditarod Area	1.40	0.99	1.19	1.14	1.03
Juneau Borough	1.02	1.01	0.99	1.01	1.02
Kake City	1.09	0.98	1.06	1.04	1.01
Kashunamiut	1.25	1.07	1.06	1.04	1.06
Kenai Peninsula Borough	1.03	0.98	1.01	1.02	1.02
Ketchikan Gateway Borough	1.01	1.01	0.98	1.00	1.02
Klawock City	1.04	0.97	1.04	1.01	1.02
Kodiak Island Borough	1.12	1.02	1.04	1.03	1.03
Kuspuk	1.21	1.05	1.04	1.06	1.05
Lake And Peninsula	1.46	1.02	1.17	1.16	1.06
Lower Kuskokwim	1.39	1.10	1.09	1.12	1.04
Lower Yukon	1.40	1.08	1.09	1.12	1.06
Matanuska-Susitna Borough	0.99	0.98	1.00	1.01	1.01
Nenana City	1.17	0.99	1.03	1.01	1.14
Nome City	1.16	1.05	1.06	1.01	1.02
North Slope Borough	1.58	1.23	1.15	1.09	1.02
Northwest Arctic	1.48	1.13	1.16	1.12	1.01
Pelican City	1.14	0.95	1.01	1.00	1.18
Petersburg City	1.01	0.98	1.02	1.00	1.01
Pribilof Island	1.29	1.13	1.02	1.07	1.05
Saint Marys City	1.28	1.03	1.10	1.04	1.08
Sitka Borough	1.03	1.00	1.00	1.00	1.03
Skagway City	1.00	0.95	1.03	1.01	1.01
Southeast Island	1.07	0.94	1.01	1.07	1.06
Southwest Region	1.26	1.04	1.08	1.06	1.06
Tanana City	1.29	1.01	1.20	1.01	1.04
Unalaska City	1.19	1.09	1.04	1.02	1.03
Valdez City	1.05	1.01	1.03	1.00	1.02
Wrangell City	1.00	0.98	1.00	1.02	1.01
Yakutat City	1.17	0.99	1.09	1.06	1.03
Yukon Flats	1.46	1.02	1.26	1.08	1.06
Yukon Koyukuk	1.44	1.06	1.18	1.11	1.04
Yupiit	1.31	1.05	1.07	1.08	1.08

EXHIBIT VII-1(b). GCEI Values and the Budget Weights of the Four Component Indices

District Name	GCEI	Personnel Budget Weight	Energy Budget Weight	Travel Budget Weight	Goods Budget Weight
Alaska Gateway	1.28	0.81	0.04	0.11	0.05
Aleutian Region	1.46	0.79	0.06	0.05	0.08
Aleutians East Borough	1.49	0.79	0.08	0.07	0.05
Anchorage	1.00	0.87	0.04	0.04	0.05
Annette Island	1.03	0.85	0.05	0.06	0.04
Bering Strait	1.55	0.80	0.06	0.08	0.05
Bristol Bay Borough	1.19	0.82	0.06	0.07	0.04
Chatham Region	1.20	0.83	0.04	0.08	0.04
Chugach	1.29	0.77	0.08	0.07	0.09
Copper River	1.15	0.81	0.05	0.06	0.08
Cordova City	1.07	0.84	0.05	0.06	0.05
Craig City	1.09	0.82	0.07	0.04	0.05
Delta Greely	1.09	0.84	0.05	0.06	0.05
Denali Borough	1.09	0.82	0.04	0.08	0.06
Dillingham City	1.13	0.84	0.05	0.05	0.05
Fairbanks North Star Borough	1.08	0.88	0.04	0.04	0.04
Galena City	1.26	0.66	0.06	0.07	0.20
Haines Borough	1.03	0.87	0.03	0.06	0.03
Hoonah City	1.12	0.81	0.07	0.07	0.05
Hydaburg City	1.10	0.75	0.05	0.06	0.12
Iditarod Area	1.40	0.78	0.05	0.11	0.06
Juneau Borough	1.02	0.89	0.04	0.04	0.04
Kake City	1.09	0.82	0.06	0.07	0.04
Kashunamiut	1.25	0.81	0.04	0.06	0.08
Kenai Peninsula Borough	1.03	0.84	0.07	0.05	0.04
Ketchikan Gateway Borough	1.01	0.86	0.03	0.06	0.05
Klawock City	1.04	0.84	0.04	0.07	0.04
Kodiak Island Borough	1.12	0.86	0.03	0.06	0.05
Kuspuk	1.21	0.83	0.04	0.08	0.04
Lake And Peninsula	1.46	0.77	0.06	0.10	0.06
Lower Kuskokwim	1.39	0.84	0.05	0.07	0.05
Lower Yukon	1.40	0.83	0.04	0.08	0.04
Matanuska-Susitna Borough	0.99	0.88	0.03	0.05	0.04
Nenana City	1.17	0.70	0.04	0.06	0.19
Nome City	1.16	0.85	0.04	0.07	0.04
North Slope Borough	1.58	0.84	0.04	0.06	0.06
Northwest Arctic	1.48	0.79	0.06	0.09	0.05
Pelican City	1.14	0.79	0.04	0.06	0.09
Petersburg City	1.01	0.85	0.03	0.07	0.04
Pribilof Island	1.29	0.81	0.05	0.07	0.06
Saint Marys City	1.28	0.79	0.05	0.07	0.07
Sitka Borough	1.03	0.87	0.04	0.04	0.04
Skagway City	1.00	0.82	0.04	0.06	0.07
Southeast Island	1.07	0.83	0.06	0.06	0.05
Southwest Region	1.26	0.81	0.05	0.07	0.07
Tanana City	1.29	0.78	0.03	0.12	0.05
Unalaska City	1.19	0.83	0.04	0.07	0.05
Valdez City	1.05	0.87	0.03	0.05	0.04
Wrangell City	1.00	0.85	0.04	0.05	0.05
Yakutat City	1.17	0.83	0.05	0.07	0.05
Yukon Flats	1.46	0.75	0.05	0.14	0.06
Yukon Koyukuk	1.44	0.78	0.06	0.10	0.05
Yupiit	1.31	0.80	0.06	0.05	0.07

VIII. Recommendations and Implementation

This section presents six recommendations to the Alaska State Legislature (ASL) based on this report. In each case, the recommendation is followed by a discussion of some of the details associated with implementation.

RECOMMENDATION 1: Adopt a New Cost Adjustment. *The ASL should replace the current Alaska cost index for education with the new AIR GCEI.*

The purpose of this report has been to produce a GCEI that can be used to adjust nominal distributions of state aid to reflect real purchasing power for the individual school districts in Alaska. The GCEI produced in this report is intended to replace the previous cost adjustment developed by the McDowell Group more than five years ago. A major difference between the AIR and McDowell studies is that, while both rely to some degree on existing information about educational spending patterns in Alaska School Districts, the AIR GCEI applies a methodology that goes beyond simply reflecting current spending behavior by school districts. The AIR GCEI includes only those factors that are *beyond the control of local school district decision makers*.

RECOMMENDATION 2: Improve Personnel Databases. *The ASL should direct the ADEED to improve and maintain the quality of the school personnel data systems in order to permit utilization of the hedonic wage model for updating the personnel components of the GCEI in the future. Specifically, this recommendation includes the following components:*

(a) Improve the quality of the current Certified Staff Assignment Reporting (CSAR) system by running routine auditing checks on the files to ensure that information reported on individual personnel are accurate.
(b) Convert the current data collected on certification for school personnel into an electronic form that is capable of being merged with the CSAR files.
(c) *Develop a data system similar in structure to the CSAR for classified staff (e.g., paraprofessionals, clerical support staff, custodial and skilled maintenance staff, and technical or managerial staff) so that these data may also be utilized for analysis of patterns of compensation using the hedonic wage method.*

Two categories of variables are necessary for the analysis of personnel compensation: the *personal qualifications and job assignment characteristics* and the *cost factors*. The first group of variables includes those that we want to control for (hold constant) in the simulations necessary to calculate the personnel cost indices. However, it is important to have as many control variables as possible that might impact the patterns of employment of different categories of school personnel. While the current Certified Staff Accounting Report (CSAR) was sufficient for the analysis in this project, AIR believes that there are some improvements that ADEED could make in its data collection procedures that would improve the quality of the database and analysis of personnel compensation.

First, AIR suggests that ADEED be charged with responsibility for maintaining and auditing the personnel files for accuracy. Data-checking routines should be put in place to examine changes over time and to search for inconsistencies in the information reported to ADEED. During the course of the analysis, AIR discovered some inconsistencies in the way data were reported for the same school district employees over time. For example, experience levels of the same employees over time sometimes decreased, and the birth dates for the same employees differed over time. If these data are to be used as the basis for future analysis of personnel compensation, it is important that they accurately reflect employee qualifications. It should be noted that if districts are informed that these personnel data will be used in the future to determine school funding distributions, they will be more likely to spend the time to ensure the accuracy of the records.

Second, AIR recommends that the ADEED consider using the certification applications of teachers to create electronic records of teacher examination test scores and colleges attended, both of which are on the applications. The test scores and the data on the colleges could be used by analysts to determine the average selectivity or quality of the colleges attended as a proxy for quality of the individuals who are employed by public schools. ADEED should also consider reorganizing the CSAR to permit analysts to ascertain the percentage of teacher assignments for which each teacher is appropriately or fully certified. ADEED should also attach a unique identifier to each certified employee, so that they may be more easily tracked throughout the years. These changes would provide a stronger and more comprehensive set of personal qualifications that would help in the analysis of variations in personnel compensation.

Third, given the differences in the labor markets for classified and certified personnel, AIR recommends that ADEED consider implementing a data collection for classified personnel similar to the one for certified personnel, adapted to the needs of that population of employees. Such a data collection should gather some of the following data elements, permitting future analyses to control more accurately for qualifications of classified staff:

- Identification codes to permit tracking of personnel over time
- Compensation in the form of hourly wage rates
- Job title (e.g., school secretary, custodian, skilled maintenance, teacher aide)
- Total hours of work per week and per year
- Educational preparation (e.g., high school diploma, vocational training in a relevant field)
- Years of experience in this type of work
- Years working for the present district
- Date of birth

- Gender
- Race-ethnicity

While AIR collected some of these data during this project, it was clear that many districts did not keep all of this information in an easily accessible form. Establishing such a regular and periodic data collection would provide the state with a valuable source of information about staffing of public schools and a source of data that could be used to analyze patterns of compensation for updating the GCEI. Having data that would allow tracking these patterns over time would allow ADEED to determine the stability of these patterns of variation, which is currently not possible given the single year of data collected for the present study. We do not know the extent to which turnover might be a factor in analyzing the patterns of compensation of classified personnel, as there were no time series data that would allow us to determine turnover rates as we were able to do for certified personnel.

RECOMMENDATION 3: Adopt Data Collection on Non-Personnel Elements. *AIR recommends that the ADEED develop regular and periodic data collections to gather information on the prices of energy services; the prices of certain supplies, materials, and small capital equipment; and the prices of travel between the schools and district office and the district office and Anchorage.*

While some of the factors that affect the costs of non-personnel inputs will not change substantially (if at all) over time, there are a number of factors that may be subject to change on a year-to-year basis. For example, it is expected that the following elements involved in the calculation of the non-personnel cost indices will be subject to change over time:

- prices of energy sources (e.g., heating oils or utility rates)
- airfare or other travel costs used to determine the cost of traveling between the school sites and the district office and between the district office and Anchorage or other centers of commerce
- delivered prices of the selected items used to estimate the relative cost of transporting goods to the districts from the centers of commerce

AIR suggests that the ADEED adapt the AIR data collection instruments for collecting some of the critical elements used as part of the analysis contained in this report. The procedures AIR utilized for the current project are relatively efficient and could easily be adapted with the help of school business officers such as those who served on the TWG for this project.

A key ingredient to the success of this kind of data collection is establishing each component as a standard part of the reporting system by ADEED. ADEED should expect a 100 percent response for maintaining and updating the GCEI, and district officials will adapt their own database systems to facilitate their ability to respond to such requests for data.

RECOMMENDATION 4: Frequency of Updates. *AIR recommends that the ASL conduct a study of school district cost differences at an interval of approximately every three to five years.*

Previous research suggests that the GCEI values are not likely to change very much from one year to the next or, for that matter, over a period of years. Such cost indices reflect relative differences in the costs of educational services. That is, while the absolute prices of certain inputs (e.g., the wages of school personnel) may change over time, the factors that affect the differences in prices across local school districts do not change very rapidly over time. Indeed, Chambers has done numerous studies of wage differences across school districts in the U.S., and has found that the correlations between these index values estimated at different points in time are quite high. Chambers (1981c) reported that the correlations between the Missouri GCEI for the 1974-75 and 1975-76 school years was 0.94. In California, the correlation across two different years, with a major property tax limitation measure passed between the two years (the famous Proposition 13), was 0.87. In a nationwide study of geographic cost differences using data for 1987-88, 1990-91, and 1993-94 (Chambers, 1997a), the correlation between the geographic cost indices for each pair of years (87-88 with 90-91, and 90-91 with 93-94) was 0.98, while the correlation across the six-year span was 0.96.

As a dramatic test of how such indices change over time, we decided to take the equivalent of the GCEI index values developed out of the previous Alaska cost study conducted by Chambers and Parrish (1984) and compare them to the values calculated in the current project.[10] The correlation between these two indices, which were calculated 18 years apart, exceeded 0.85.

The analysis of the Alaska personnel data is consistent with the findings of previous research on the stability of the index values over time. As part of our current project, the AIR research team acquired the personnel data files for four different school years from ADEED. Using these data, we were able to estimate a variety of statistical models and test the stability of these index values for different years. Correlations among the personnel indices calculated for different years were all well above 0.90, and for adjacent years these correlations were above

[10] The earlier study by Chambers and Parrish was designed to develop a more comprehensive model of the cost of an "adequate" education in Alaska schools and included measures of cost differences arising out of differences in pupil need, scale of district and school operations, and the prices of comparable school inputs. Thus, the implicit cost index calculated from this model is not strictly comparable to the GCEI calculated in this report. In part this results from the fact that the budget weights used to aggregate the component index values into an overall index are based on the service delivery systems specified by a committee of educators selected from school districts in Alaska. Nevertheless, the basic component indices from which the 1984 GCEI was calculated were developed using methods very similar to those used in the current study.

0.95. (The actual parameter estimates for these statistical models are presented in Appendix E of the *Technical Report* along with the correlations among all of the indices.)

The personnel components, which dominate the GCEI calculations, tend to be stable over a five to six year period of time. The non-personnel elements may tend to vary over a shorter time period, but there are no data other than the overall patterns to rely on for some assurance on these non-personnel components. Thus, AIR suggests that five-year studies on personnel are likely to be sufficient for changes in that component. However, it would be useful for further analysis of the patterns of change in the non-personnel components to be conducted over the next few years to explore how rapidly these components change. Given that the overall patterns over an 18-year period have been fairly stable, the non-personnel components could be done every three years until a database has been developed to sufficiently test the stability of these components. The energy component relies heavily on an engineering component that predicts the energy consumption levels, and this relies heavily on climatic norms that do not change dramatically over time. However, energy costs are also impacted by price differences in the energy fuel sources. Travel costs and other prices of goods do change from year to year, but much of the difference in these is associated with relative distances and the associated travel or transportation costs between points in Alaska. While these may change over time, the relative differences may not vary as much as the absolute values.

Recommendation 5: Use an Economist for Labor Market Analyses. *AIR recommends that the ASL employ or contract with a professional economist or an individual with proven experience and training in labor market studies to conduct the analyses of the compensation of school personnel that underlie the personnel cost index components.*

It is important to employ an individual with experience in labor market analysis and in the use of procedures such as the hedonic wage model. While the techniques appear fairly simple on the surface, this analysis does require an understanding of the conceptual framework and its limitations in empirical application. There are some significant judgments that need to be made in the selection of the independent variables, the measurement of the dependent variable, the choice of functional form, and the application of statistical techniques that require highly specialized training and experience. Employing an economist ensures that the person conducting future studies is familiar with standard techniques of analysis of labor markets. Because of changes over time in the labor markets, one cannot simply re-estimate the exact equations used for the current analysis of school personnel. It may also be important to take into account the potential for new measures of school, district, and regional characteristics that may be included in this analysis.

RECOMMENDATION 6: Phase in the New Index. *AIR recommends that the ALS develop procedures to phase in new GCEI numbers over time.*

It is important to recognize that the index values derived from the econometric models described in this report represent only approximations to the complex, real-world transactions that make up the labor markets for school personnel. While cost adjustments do not change rapidly over time, there are a number of factors that may result in some significant changes in the relative costs over time. For the current study, a completely different methodology was used to calculate the new GCEI than was used for the current district cost adjustment. In the future, even with a constant methodology, there may be changes in the index numbers that could have substantial impact on district budgets. Some of this occurs because of the statistical nature of the procedures used to estimate these index numbers. Even these estimates' relatively small standard error of one percent implies a confidence interval of plus or minus two percent. This means that over a five-year period, changes of as much as four percent could easily be accounted for by statistical error alone. A four percent change in budgets can mean hundreds of thousands of dollars in the budget of a given district. Therefore, in order not to cause any major disruptions in the flow of services, the ASL should consider methods for adjusting or phasing in new GCEI numbers over a period of approximately five years. For example, the allocations of aid could be adjusted so that any gap in funding resulting from changes in the GCEI over time would be closed at a rate of, for example, 20 percent per year. At the end of a five-year period, the full impact of the index value would be felt. Alternatively, the state could adopt a moving average technique that averages the values of the indices over a period of time (e.g., three years) so that changes are less disruptive.

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AMERICAN INSTITUTES FOR RESEARCH

Alaska School District Cost Study:

Volume II – The Technical Report

Submitted to:

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Legislative Budget & Audit Committee
State Capitol, Room 111
Juneau, AK 99801-1182

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January 2003

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Acknowledgements

This study benefited from the input and participation of many people. The study team would like to express their appreciation for the efforts of the Technical Working Group, whose members provided critical guidance over the course of the project. Members of the Working Group are as follows:

- Kerry Jarrell (Bering Strait SD)
- Michael Fisher (Fairbanks North Star Borough SD)
- Melody Douglas (Kenai Peninsula Borough SD)
- Dave Jones (Kodiak Island Borough SD)
- Dennis Niedermeyer (Lake and Peninsula Borough SD)
- Lucienne Harger (North Slope Borough SD)
- Barbara Stocker (Sitka Borough SD)
- Karen Goodwin (Southeast Island SD)

We greatly appreciate their support during the data collection phase of this project and owe a great debt of gratitude for helping us accomplish a 100 percent response rate on virtually all of our data collection instruments. They not only provided encouragement, but help to the beleaguered school business offices who attempted to interpret our needs. This group of hardy individuals also contributed to the design of our approach to addressing the costs of goods, services and travel.

The Oversight Committee also provided critical guidance, and helped coordinate our requests for data during the course of the study. Its members are Pat Davidson, Representative Hugh Fate, Eddy Jeans, David Teal, and Senator Gene Therriault.

In particular, Eddy Jeans and his staff were instrumental in helping us obtain data from ADEED and in serving as liaisons with school business officials and superintendents. Elizabeth Sweeney spent countless hours on the phone with the research team, both reviewing the Chart of Accounts and individual district fiscal audits, and guiding decisions about assignment of budget shares. Karen Lipson worked with the research team to quickly provide personnel data in whatever form necessary. Tim Mearig obtained important building and facility data for the energy prototype analysis and served as a liaison with school district facilities managers.

The study team would like to thank all of the school and district personnel who responded to our surveys and requests for information. Without their efforts, this study would not have been possible.

Joanne Lieberman, who laid the foundation for the project and managed it in its early stages, was instrumental in creating a well-conceived study, and demonstrated an uncanny ability to anticipate every contingency and plan for every eventuality.

Last, but certainly not least, we wish to acknowledge the hard work and significant effort put forth by Phil Esra, who has provided tremendous editorial support in developing this document.

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Chapter I. Introduction

Background and Motivation

The purpose of this report is to present the technical details underlying the development of the Geographic Cost of Education Index (GCEI) for the State of Alaska. The GCEI developed by the AIR research team is being proposed to replace the current cost adjustment used by the State of Alaska to adjust state aid to education. The application of such geographic cost adjustments in state aid are intended to equalize the purchasing power of the educational dollar across local school districts.

The analysis focuses on four categories of school inputs: school personnel; energy services; supplies, materials, and small capital equipment; and travel as it affects maintenance and operations, professional development, itinerant services, administrative oversight of schools, and attendance at statewide professional meetings.

Many schools in Alaska are located in remote regions of the state, and this creates challenges in recruiting and employing professional school personnel. Costs of living are higher in the remote regions of the state because the cost of transporting goods and services to these communities results in more expensive consumer goods and services. In addition, access to cultural amenities as well as shopping and medical facilities is more difficult in remote communities than it is in more urban areas such as Anchorage or Fairbanks. The degree of isolation can be significant, particularly during winter months, because of the distances and time required to reach the more urban centers of the state.

All of the factors mentioned above impact the compensation (salaries and benefits) that must be paid to attract comparable school personnel as well as personnel in other occupations across the state. Moreover, the distances between Alaska's schools and the state's centers of commerce also impact the costs paid for many other schooling inputs. It affects the costs of fuels for heating and providing power to school buildings. It raises the prices paid for various instructional and non-instructional supplies and materials, all of which have to be transported to these remote locations. The distances of schools from district offices also impact the costs of offering itinerant services, providing professional development, holding meetings among staff, and transporting materials and supplies among the sites. Similarly, the distances of the district offices themselves from centers of commerce impacts the access to trained professionals and technicians as well as to various sources of supplies, materials, and equipment necessary to the operations of the school district.

Finally, Alaska's harsh climate and the variations in the climate across districts affect the relative consumption of fuels required to provide heat and power. Also, some districts may operate older school buildings that require greater utilization of alternative power sources to maintain comfort levels within classrooms.

This project has undertaken a comprehensive analysis to address the various factors that affect the ability of districts in Alaska to access comparable school resources in the different regions of the state. The end product is a geographic cost-of-education index (GCEI), which addresses the following question:

> *How much more or less does it cost to recruit and employ comparable teachers, administrators, and other school personnel, and to pay for comparable non-personnel inputs (e.g., energy services, supplies, books, and materials) and services (e.g., maintenance and operations, professional development) in different geographic locations around the state?*

The GCEI is a cost adjustment index that permits translation of nominal dollar values into *real* dollars of purchasing power for school resources and services. It can be used to provide equal purchasing power by adjusting funding levels for individual school districts.

Scope of the Study

With this background in mind, it is important to point out what this study does do and what it does not do. Specifically, the current study develops a cost adjustment index that reflects the variations in the prices of comparable school inputs. However, the current study does not address cost differences associated with the composition of pupil needs, nor other factors related to the relative concentration of student populations. For example, it does not address differences in the levels of resources required to meet the different needs of students who are from disadvantaged backgrounds, students who are English language learners, or students who have certain physical or mental disabilities.

In addition, this study does not address the different administrative staffing requirements that may be associated with operating school districts in remote and sparsely populated regions of the state. While the study does address the differential costs of personnel travel within large, remote school districts and it does address the costs of transporting goods within these remote locations, it does not address the increased need for staff that may result from providing the appropriate administrative and support services needed to operate these districts.

These additional cost factors related to the measurement of pupil needs and the costs of operating districts in sparsely populated, remote regions of the state must be addressed through more comprehensive studies designed to estimate the costs of providing adequate educational services in Alaska. The previous work done by Chambers and Parrish (1984) represents one model for conducting these kinds of studies, while a newer proposal for costing out an adequate education in New York State prepared by Chambers, Smith, Parrish, and Guthrie (2002) provides an even more comprehensive and more up-to-date approach to addressing these complex issues. The newer methodology for measuring adequacy in education focuses more attention on the relationship between outcome standards for students and the levels of resources necessary to achieve those standards.

Collaboration with Alaska Policy Makers and Educators

In preparing to collect and analyze data in the creation of a Geographic Cost-of-Education Index (GCEI), the AIR research team collaborated with the educators and policymakers most knowledgeable about the factors affecting the cost of providing services in Alaska.

First, the AIR research team met with the School District Cost Study Oversight Committee. This Oversight Committee (OC) included representatives of the Alaska State legislature, legislative staff, and the Alaska Department of Education and Early Development (ADEED). The OC provided us guidance and helped coordinate our requests for data during the course of the study. Members of the AIR research team have had telephone meetings with ADEED staff about topics ranging from school facilities to school personnel. ADEED staff have provided AIR with valuable existing data sources pertaining to the following cost factors: certified personnel, classified personnel, school and district building facilities, fuel usage, and student populations.

Second, AIR established and met with a Technical Working Group (TWG) of eight school business officials representing a geographically diverse sample of Alaska school districts. During a series of meetings held during the course of the past 12 months, we discussed the goals and objectives of the project and came to an agreement on the overall strategy for conducting the work to be done. The TWG provided us feedback on our data collection instruments and strategies, and facilitated the data collection through direct connections with the school business officers in the remaining school districts throughout the state. With the assistance and support of the TWG, we were able to obtain an overall response rate of 100 percent on all of the major surveys and survey items we collected from local school districts.

The AIR research team met with the TWG early in the project in a meeting scheduled to coincide with the Alaska Association of School Business Officials (ALASBO), which was held in December of 2001. Subsequent to the ALASBO meeting, the AIR team met periodically through a series of teleconferences with the TWG. These meetings were designed to help us understand the perspectives of local school districts on the major factors affecting the cost of educational services across the state. These meetings gave us a better understanding of the cost factors from the district perspective and provided input from these local school personnel on approaches to collecting data on the cost factors affecting resource allocation in their districts.

We were able to learn what information they had that was not readily available from state sources, and how best to use this information in constructing appropriate cost adjustments.

Finally, the AIR research team met with the OC and two representatives of the TWG at a meeting in Anchorage in November of 2002. During this meeting preliminary results of the analysis were presented and discussed extensively. Further revisions in the data collection and analysis were carried out to respond to various issues and concerns raised about particular data elements during these two days of meetings. The two representatives of the TWG contacted the remainder of the TWG who in turn verified certain data elements with other school business officials in Alaska School Districts. This report presents the final numbers on all of the index components based on the original analysis and the revised data elements collected as a result of this meeting in Anchorage.

Overview

The analysis presented in the subsequent chapters focuses on the prices of the inputs purchased by schools to develop a GCEI. This series of indices addresses differences in the costs of school personnel, the costs of energy services, the costs of transporting goods and services to school sites, and the costs of within-district travel necessary for the operation of schools and their programs.

Chapter II presents an overview of the results of the study, with a focus on the range of costs we found across the state. We determine which districts are at the high and low ends of the cost spectrum, and compare the index numbers with actual expenditures.

Chapter III details the personnel cost component of the index. Personnel cost is the largest piece of education spending, and we present here a discussion of the methodology behind the multiple models we used to determine personnel index values. This chapter also contains a discussion of which model is most appropriate to use, and presents the actual index values. Chapters IV and V provide similar discussions of the energy and transportation/travel components of the index.

Chapter VI weighs the alternate approaches to calculating the GCEI. The fixed-market-basket approach is compared to the superlative index, and the individual component indices are discussed. Chapter VII offers conclusions and discusses implementation issues related to utilization and updating of the index.

Chapter II. Overview of Study Results

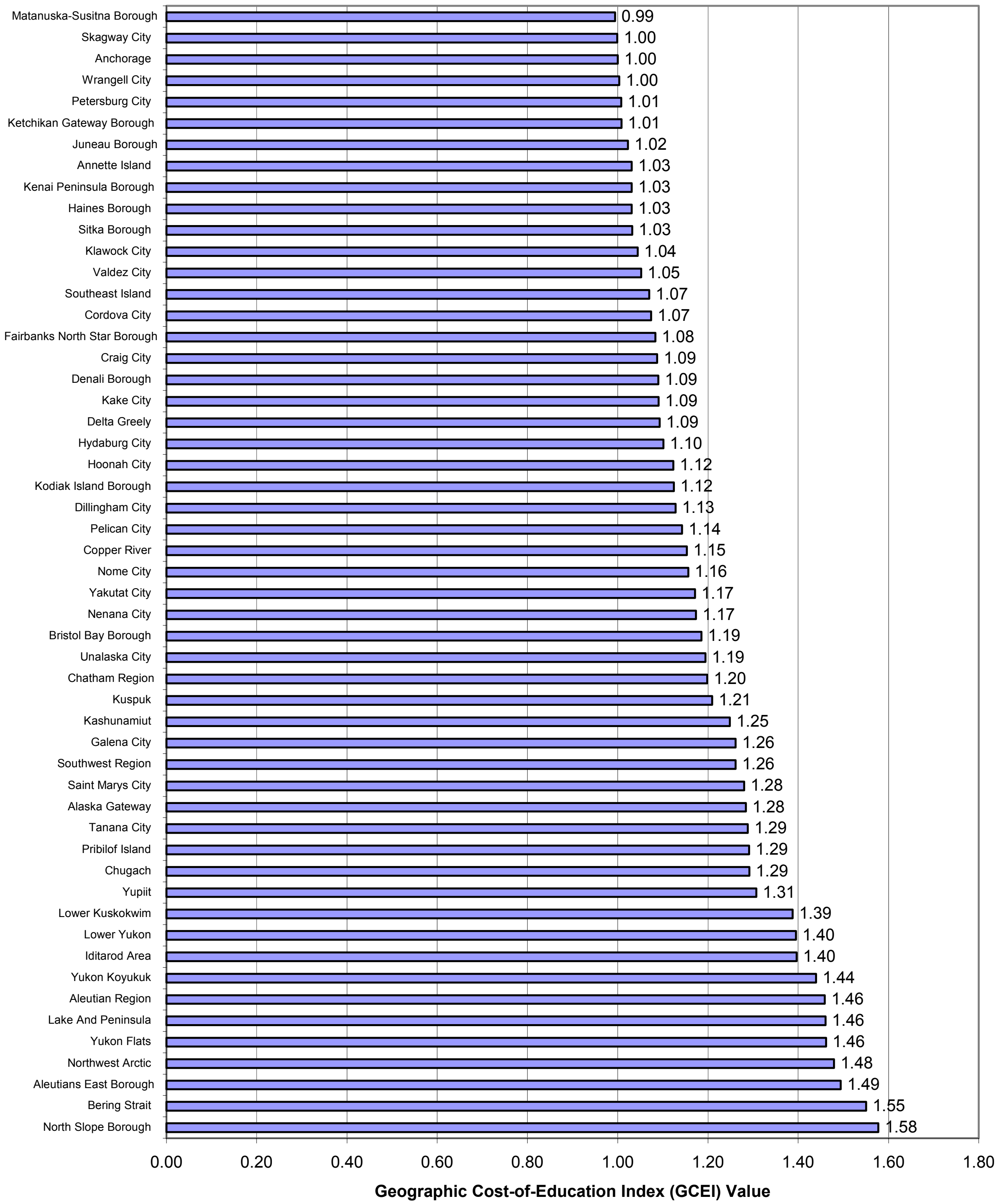
Based on the analysis conducted as part of this study, the purchasing power of the educational dollar varies tremendously in the State of Alaska. The highest cost district needs about 1.6 times what the lowest cost district needs in order to provide comparable educational services.

Another way to understand these variations is to select a benchmark district to which all districts can be compared. Following the conventional approach that has been used in Alaska for these kinds of studies, we use Anchorage, the largest and most urbanized district in the state, as the benchmark.[1] Thus, the value for the GCEI in Anchorage has been arbitrarily set at 1.00. Using Anchorage as the base, the analysis of costs reveals that the North Slope Borough School District exhibits the highest cost of education, with an index value of 1.58 (Exhibit II-1). This means that this district needs to expend about 58 percent more than the Anchorage School District to provide comparable educational services.

On the other end of the spectrum is the Matanuska-Susitna Borough School District, with an index value of 0.99. This means that this district needs to expend about 1 percent less than the Anchorage School District to provide comparable educational services to the students it services.

[1] In most studies, the district attended by the average student is often used as the benchmark school district. The reason for this is so that the GCEI, when applied to state aid allocations, will have no impact on the overall amount of aid to be allocated. That is, the GCEI would be neutral with respect to the total allocation of state education aid. In these situations, the district attended by the average student, which is in actuality a fictitious district that has been created purely for statistical purposes, is assigned a GCEI value of 1.00. In the case of Alaska, the State policy makers have chosen to scale everything to Anchorage, which is far and away the largest school district in the State.

Exhibit II-1. A GCEI for Alaska School Districts



NOTES TO EXHIBIT: The districts listed on the vertical axis in this diagram are sorted in ascending order according to the value of the geographic cost-of-education index (GCEI), with the lowest on top.

Organizing the school districts by region (Exhibit II-2) reveals that the highest-cost districts in Alaska are located in the Far North (with average GCEIs of 1.38) and the Southwest (with average GCEIs of 1.31). The lowest-cost districts in the state are located in the Southeast. Factors driving these numbers appear to be the impact of remoteness on personnel salaries, transportation costs for goods and services, and travel costs, as well as the differences in climatic factors that impact energy services as well as the relative attractiveness of these regions as places to live and work.

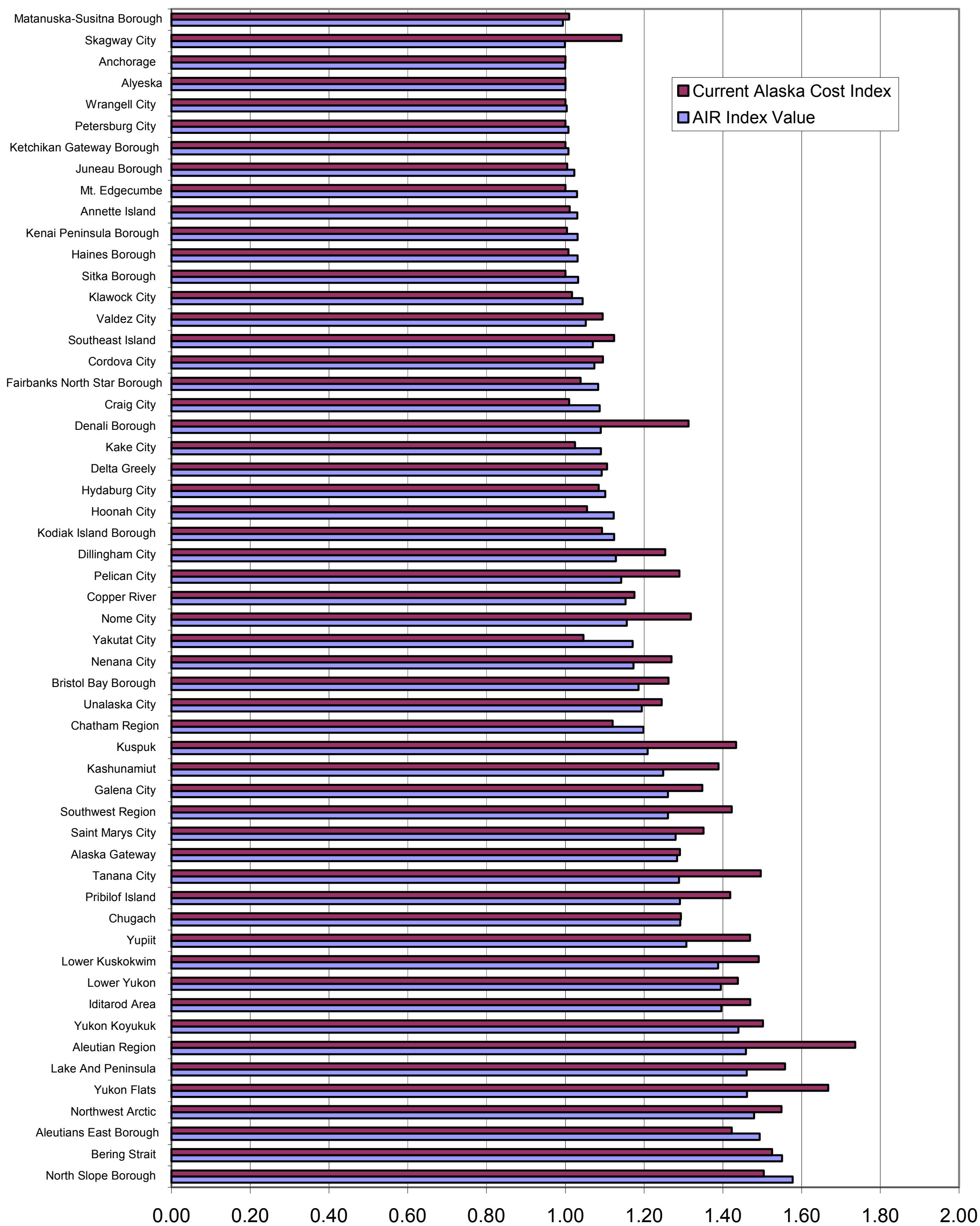
Exhibit II-2. Variations in the Geographic Cost of Education Index by Region

Region	Number of Districts	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	1.20	0.17	0.99	1.58
Far North	10	1.38	0.15	1.16	1.58
Interior	3	1.09	0.00	1.08	1.09
South Central	9	1.11	0.11	0.99	1.29
Southeast	17	1.07	0.06	1.00	1.20
Southwest	14	1.31	0.11	1.13	1.49

Exhibit II-3 compares the GCEI derived from the AIR study with the education cost adjustment that is the current law in Alaska. Districts are sorted in ascending order according to the value of the GCEI calculated in the AIR study. Differences between these cost index values may reflect a combination of methodology and changes in the costs of educational services since the last cost index was calculated. The largest differences are most likely attributed to methodological differences in the two studies underlying the calculations.[2] The range, standard deviation, and the mean values of the GCEI and the current Alaska cost index are quite similar. The GCEI calculated by AIR ranges from a low of 0.99 to a high of 1.58, while the range of the current Alaska cost index is from 1.00 to 1.74. The standard deviation of the AIR GCEI is 0.17, and the range of the current Alaska cost index is 0.21. Moreover, the correlation between the AIR GCEI and the Alaska cost index is 0.91.

[2] The actual values of the two indices are presented for purposes of comparison in Exhibit I-6 In Appendix I of this report.

Exhibit II-3. Current Alaska Index Compared to the AIR GCEI



However, there are a number of districts that exhibit significant differences in the respective index values. Nine districts exhibit a difference of 0.15 points or more (positive or negative) and 17 districts exhibit a difference of 0.10 or more. A point difference of 0.01 means a one percent difference relative to the benchmark district of Anchorage. For example, the Aleutian Region district exhibits a GCEI of 1.46, while the current Alaska cost index is 1.74, a difference of 0.32 points. In addition to the Aleutian Region School District, Denali Borough, Kuspuk, Nome City, Pelican City, Southwest Region, Tanana City, Yukon Flats, and Yupiit exhibit GCEI values that differ by 0.15 points or more from the current values.

On the other hand, slightly more than 70 percent (38) of the districts exhibit a GCEI with a less than 0.10 point difference from the current Alaska cost index. Forty-four percent (24) of the school districts in Alaska exhibit less than a 0.05 point difference from the current Alaska cost index.

Chapter III. School Personnel Inputs

Introduction

Alaska school districts spend anywhere from 45 to 90 percent of their budgets on the salaries and benefits of school personnel. This is by far the largest component of educational expenditures, and, therefore, is likely to exert the greatest influence over the variations in the costs of educational services across the state.

Two alternative approaches were used to analyze variations in the costs of school personnel. The first approach builds on the work of Goldhaber (1999) and Alexander et al. (2000), and relies on alternative sources of wage data to illustrate the relationship between labor markets for school personnel and for individuals in other non-education occupations within a region. We refer to this approach as the *comparable wage model* below.

The second approach is the *hedonic wage model* first adapted for the purpose of estimating geographic cost of education indices by Chambers (1981b) and which is now widely used by economists for this purpose.[3] Each of these approaches is described in more detail below. The goal in each case is to develop an index that reflects only those components of the variations in the compensation of school personnel that are outside the control of local school officials.

Controllable Versus Uncontrollable Factors in Analysis of School Personnel Inputs

The first step in the process of estimating the costs of school personnel involves understanding the full range of factors that affect the patterns of variation in the compensation of school personnel. The factors that drive these variations can be divided into two categories: *controllable* and *uncontrollable*.

What do we mean by *controllable* versus *uncontrollable* factors? Uncontrollable factors are those that are not subject to the choice of district or school officials. For example, the climate, labor market conditions, or other factors that affect the cost of housing in a region in which a district or school is located cannot be changed by school officials. These factors **do** impact the willingness of individuals to supply labor to the employer (in this case, the school district).

[3] See for example, Chambers, J.G. (1978, 1980, 1981a, 1981b, 1995), Chambers, J.G. and T.B. Parrish (1984, 1981b), Augenblick and Adams (1979), and Wendling (1979).

On the other hand, districts and schools can select the personnel and, hence, the characteristics of the staff they employ. These are, therefore, *controllable* factors. Over the long run, districts can adjust the levels of experience, education, and the job assignments of individual school personnel. Through the processes of selection and promotion, school district officials can determine whether they hire inexperienced or experienced teachers, teachers with full or partial certification, and teachers with different education levels, and they can assign these teachers to different schools within their districts. The salary scales can also influence the retention rates of teaching staff. The balance of experienced and inexperienced teachers, the percentage who hold master's degrees, and the class assignments of these teachers are all factors that may impact the willingness of an individual to accept a job, and they are all within the control of the district.

In the face of sudden changes in conditions (catastrophic or unforeseen events), *controllable* factors can temporarily be outside of local control. For example, if sudden changes in the economy cause changes in the population that result in declining enrollments in schools, this can result in a district facing a teaching force with a higher level of experience than they would have otherwise chosen. Thus, in these short-run events, even teacher characteristics can be outside local control and may be considered to be part of the *cost factors* in calculation of the cost-of-education index. This can only be determined as a matter of policy and based on evidence that external changes have occurred that create such changes for the district.

The Comparable Wage Model

One approach to addressing uncontrollable district cost variations is to use a measure of the cost of living in the district. The basic premise is that areas with a high cost of living will have to pay higher salaries to attract school employees, thereby increasing the cost of education. A cost-of-living index therefore becomes a proxy for a cost-of-education index.

There are two strategies for estimating variations in the local cost of living. One approach is to examine the cost of a specified collection of goods and services used by consumers in each community. This method is called the "market basket" approach, because the total costs of a "basket" of consumer goods and services in each community are compared to illustrate differences in the cost of living. The market basket approach is used to create familiar indices such as the Consumer Price Index. Three states (Florida, Colorado and Wyoming) currently use a geographic consumer price-of-living index they create for themselves to adjust distributions of state education aid across local districts.

The main problem is that the cost of living as measured by the prices of consumer goods and services and the cost of education are not necessarily the same thing, though they are related. On the surface, calculating a geographic cost-of-living index can be quite straightforward—although it can present some rather formidable theoretical and empirical challenges, as anyone involved in the production of various wage indices by the U.S. Bureau of Labor Statistics will tell you. The problem is that such cost-of-living indices do not fully capture all of the factors that impact decisions by employers and employees in the labor market.

Specifically, such indices do not generally account for variations in the amenities that characterize a regional labor market (to the extent that these factors influence the price of goods and services such as housing and haircuts, they would be partially reflected in a market basket—however, the weights are likely to be inappropriate). Therefore, cost adjustments based on a market basket may overcompensate districts that face a high cost of goods and services but which also have a number of amenities that make them a desirable place in which to work (Rothstein and Smith 1997).

Moreover, the basket of goods and services purchased by consumers is not the same as the basket of inputs purchased by districts to produce educational services. Consumers purchase housing, food, entertainment, energy services, and transportation, while school districts are purchasing the services of teachers and other school personnel, instructional supplies and materials, travel, and energy services. While some of these items are the same, school districts clearly purchase these items in different proportions than consumers. Thus, a geographic cost-of-living index is not necessarily appropriate to adjust educational dollars for differences in costs. By design, it measures only one component in the school district's basket of inputs—namely, labor.

The second approach to estimating the cost of living is the "comparable wage" approach. Because all types of workers tend to demand higher wages in areas with a higher cost of living or with fewer regional amenities, systematic regional variations in wages should reflect variations in the cost of attracting workers to a region. Therefore, one can calculate the cost of attracting educators by observing regional variations in the salaries of comparable workers who are not educators (Rothstein and Smith, 1997; Guthrie and Rothstein, 1999; Goldhaber, 1999). This approach takes advantage of the fact that the same factors that affect non-education wages also impact the wages of educational personnel.

There are a number of advantages to using a comparable wage model to measure the cost of education. The greatest advantage is that the wages of comparable non-education workers are clearly beyond the control of school administrators; there are no debates about the problematic distinction between controllable and uncontrollable costs. On the surface, calculating a comparable wage index can be quite straightforward. While there are still many complex measurement issues involved (Alexander et al. 2000), the comparable wage model can be compared relatively easily and directly.

There are also a number of disadvantages to the comparable wage model. First, a comparable wage model relies on comparability among workers. If comparability breaks down, then an index developed from a comparable wage model becomes a poor proxy for the cost of hiring educators. For example, if tastes for goods and services or local amenities differ according to worker types (perhaps professionals are more susceptible to the lure of city lights than other workers), then it can be inappropriate to include all types of workers in a comparable wage index. (On the other hand, a comparable wage index based on an overly small set of workers would be susceptible to measurement error.) Furthermore, if there are unobserved variations in the qualifications of individual workers across geographic regions, then the observed variations in the wages will reflect more than those factors that affect the supply of labor.

Finally, by design, a comparable wage index generally measures the wage variations in a broad labor market like a metropolitan area. It does not capture variations in the cost of education within a labor market.

A Comparable Wage Model for Alaska

The lack of data on consumer prices precludes us from using the market-basket approach to measure the cost of education in Alaska. However, data generously provided by the Department of Labor and Workforce Development permit credible estimates of a comparable wage index. In constructing a comparable wage model for Alaska, we follow the approach used in the Texas Cost-of-Education Index Study.

Wage Variations in Alaska

The Department of Labor provided information on average quarterly earnings by occupation for 27 labor market areas in Alaska. The data span the period from 1996 through mid-year 2001 at a level of occupational detail that differentiates between motorboat mechanics and motorcycle mechanics.

The data reveal substantial variation in wages across Alaska. Average annual earnings for the 2000-01 school year are nearly 3 times higher in North Slope Borough (the market with the highest average wage) than they are in Lake and Peninsula (the market with the lowest average wage).

There are two reasons why average wages might vary so dramatically across Alaska. First, all types of workers may demand higher wages in some parts of the state to reflect a higher cost of living or to compensate for the absence of attractive local amenities. Second, some types of workers—like lawyers—are paid more than other workers in all parts of the state, so areas with many lawyers will have higher average wages than areas with relatively few lawyers, all other things being equal.

The first source of local wage variation is common to all types of workers and would also be reflected in educator salaries; the second source is limited to specific types of workers and is unlikely to be reflected in educator salaries. Consequently, the first step in estimating local wage levels involves adjusting for the local mix of occupations so that the second source of wage variation is excluded. If every occupation were represented uniformly across the state, these adjustments would be straightforward—one would simply calculate the average wage for each occupation, use it to calculate the local deviation from the state wage for that occupation, and then calculate the local wage level as the average of the local deviations from the state wage. For example, if we observed that Juneau carpenters are paid 25 percent more than the state average carpenter wage, Juneau engineers are paid 25 percent more than the state average engineering wage, Juneau nurses are paid 25 percent more than the state average nursing wage, and so on, we would conclude that the wage level in Juneau is approximately 25 percent above the state average and adjust school district funding accordingly.

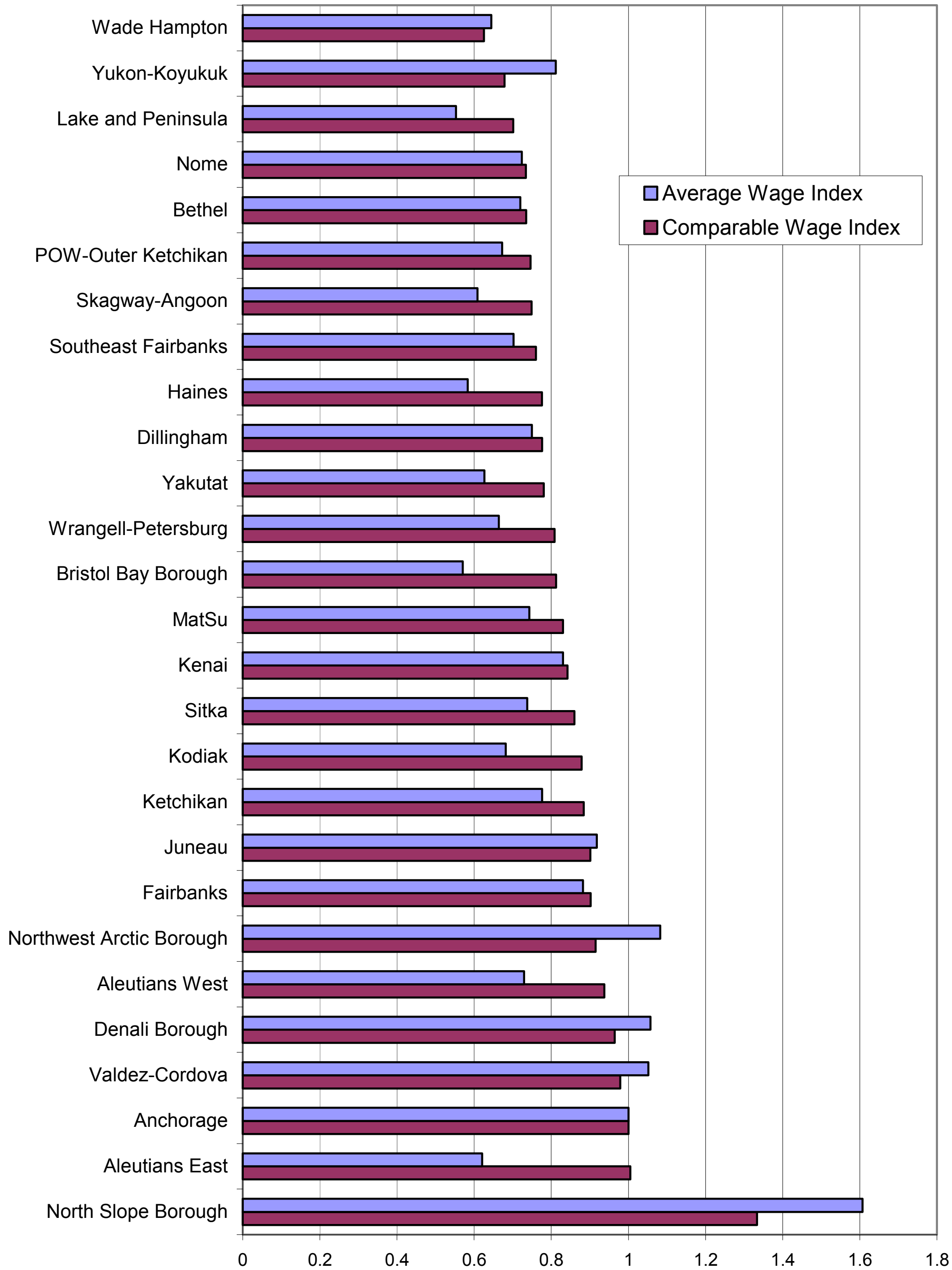
However, some occupations are observed in only a few Alaska communities (e.g., there are no drilling jobs where there is no oil). Therefore, the state average wage for these occupations would be a biased benchmark from which to compare local deviations. For example, if a particular high-wage occupation is found only in Anchorage, then Anchorage's deviation from the state average for that occupation would be zero, and averaging in that zero would make the wage level in Anchorage appear artificially low. But restricting our analysis to those occupations found in all parts of the state would also be inappropriate, because it would waste most of the available information on wages.

To construct a comparable wage index for each labor market, we used regression analysis to estimate the local wage level, with an indicator variable for each occupation and each market. The comparable wage index may be calculated by dividing the predicted wage level in each market by the wage level in Anchorage.

Our analysis reveals that much of the variation in average wages in Alaska arises from variations in occupational mix. Once we adjust for occupational mix, a very different picture emerges. Where average wages vary by nearly a factor of 3, the comparable wage index varies by no more than a factor of 2 (Exhibit III-1).

Adjustment for occupational mix also changes the relative position of a number of areas. In particular, consider the Aleutians East, where the average wage is well below the mean, but the index value is second only to the North Slope. Or consider Wade Hampton, which becomes the lowest-wage market in Alaska once the occupational mix is taken into account.

Exhibit III-1. Comparable Wage Index and Average Wage Index by Labor Market Area



To better ensure comparability to educators, we considered limiting the analysis only to those occupations that the Department of Labor and Workforce Development has identified as requiring a college degree. Unfortunately, restricting the sample in this way greatly reduces the precision with which the index values are measured. Seventeen of the Alaskan labor markets are measured with such error that the index value is insignificantly different from the least-cost area. For the remaining areas, the Northwest Arctic Borough and Kenai post the highest cost factors.

Caveats

The fine level of occupational detail ensures that workers who are being measured have very similar jobs, but unfortunately does not guarantee that they have similar qualifications or demographic characteristics. Therefore, it is difficult to determine the extent to which geographic wage differences within job categories are due to differences in the qualifications and characteristics of the people in those jobs as opposed to differences in the factors that affect the cost of living. In large samples, differences in qualifications and characteristics will tend to cancel out (perhaps the dentists are more experienced than average in Anchorage but the accountants are less so). However, a small community in which wages are generally low because most workers are young and inexperienced is indistinguishable from one in which wages are generally low because the cost of living is low.

It is important to point out that teachers and school personnel exist in almost all locations within the state, which is not true of other occupational categories. Moreover, it is difficult to determine the extent to which wage differences in other job categories are due to differences in the qualifications and characteristics of the people in those jobs as opposed to differences in the factors that affect true cost differences (cost of living and regional or job amenities). Because of these concerns, the cost adjustment produced by comparable-wage analysis approach is only one independent variable used in the creation of the cost-of-education index. The hedonic wage model, discussed below, incorporates this variable into the statistical analysis that supports the geographic cost-of-education index presented in Chapter II.

Hedonic Wage Model

The hedonic wage model uses econometric methods to examine the patterns of variation in compensation of school personnel in relation to personal characteristics, job assignment attributes, and the characteristics of schools, districts and regions in which teachers live and work. The word hedonic derives from the word *hedonism,* which refers to the pursuit of pleasure. In this context, the model conceptualizes the two sides of the labor market, the employer and the employee, each side attempting to attain the *greatest pleasure* resulting from the employment transaction. Employers are seeking to hire the best qualified applicants from a given pool, while employees are seeking to obtain the best and most attractive job in the market. The compensation resulting from this transaction is thus related to both the attributes offered by the employee to the employer and vice versa. The hedonic wage model, simply stated, uses econometric techniques to reveal the implicit relationship between compensation and these two collections of employee and employer characteristics.

Using this relationship, the analyst can then apply simulation techniques to answer the question: *how much more or less does it cost to recruit and employ comparable personnel in different geographic locations within a state.* This is accomplished by holding constant the *controllable characteristics* and estimating what the wages would be if all districts purchased some standardized personnel (e.g., personnel with identical levels of educational preparation, professional experience, and other demographic and professional characteristics).

Data for This Analysis

Data for this analysis came from a number of sources. The Alaska Department of Education and Early Development provided data on districts, certified personnel, and students. Data on classified personnel were collected directly from the 53 school districts in the state as part of our data collection activities (See Appendix B for a discussion). In addition, the individual school districts responded to surveys about compensation practices, locational characteristics, and a host of other issues. We were able to obtain data on certified personnel for four school years (1998-99, 1999-2000, 2000-2001, and 2001-2002). Access to such panel data permitted us to test the stability of the index numbers over time.

We also constructed a number of indicators of community characteristics using data from the Alaska Department of Labor and Workforce Development (DoLWD), the U.S. Bureau of the Census, and the National Oceanographic and Atmospheric Agency (NOAA). For all Census and NOAA data, the residential area is defined as the place in which the school is located. Because confidentiality concerns prevent the release of comparable wage data at such a fine level of locational detail, the definition of the region in which the school is located is somewhat broader for the comparable wage index. For those data, we assign each school to the DoLWD labor market in which it is located.

Data on the 2001-2002 school year are particularly rich, allowing us to measure not only the salaries paid to district personnel, but also the dollar value of housing benefits. Data on benefits are not available for prior school years, but data are available on salaries and individual characteristics. These additional data permit us to test for the stability across time of the compensation models, and for the sensitivity of the salary indices to the inclusion of benefits information. Using multiple years of salary data also permit us to identify those individuals who are not employed by the district the following year, and to incorporate the pattern of employee turnover into the estimation. We found that salary indices for full-time teachers are strikingly insensitive to variations in specification, to the use of alternative years of data, to the inclusion or exclusion of information on housing benefits, and to the formal modeling of turnover. In contrast, the salary indices for other certified personnel are highly influenced by analysis of turnover (not surprising given that the turnover rate for this group is 60 percent higher than the turnover rate for full-time teachers).[4]

The Salary Models

Following the general outline for hedonic wage model of teacher salary, we constructed models of educator salaries as a function of individual characteristics, the characteristics of the working environment, and the characteristics of the community in which the school is located.

The factors included in this analysis are outlined in Exhibit III-2. Undoubtedly, we have omitted community characteristics that could influence wages. However, these characteristics should also be reflected in the wages paid to other types of workers in the community. The comparable wage index was included to capture these effects.

Exhibit III-2. Factors Included in the Alaska Compensation Models

Individual Characteristics	School and Environmental Factors

• Total years of experience
• Educational attainment
• Age, gender and ethnicity
• An indicator for whether the teacher is a new hire
• Percent FTE spent teaching
• Assignment:
  o Elementary education teacher
  o Multiple-grade teacher
  o Math and science teacher
  o Special education teacher
  o Bilingual education teacher
  o Head teacher
  o Principal
  o Assistant Principal
  o Counselor
  o Librarian
  o Professional staff[5]
	• Percent of students who were:
	  o Asian
	  o Black
	  o Hispanic
	  o Native Alaskan
	• An indicator for whether the school is a high school.
	• School district membership
	• Distance to nearest center of commerce (in miles)
	• Climate[6]
	• An indicator for whether the community has water access[7]
	• Total labor force participation rate
	• An indicator for whether the community has electricity or gas services.
	• Comparable wage index[8]

4 The turnover rate for administrators was 21 percent, while the turnover rate for teachers was 13 percent.
5 The professional staff category includes job codes 20, 24, 25, 26, 27, 28, and 29.
6 The climate measures are the average annual number of heating and cooling degree days at the closest weather reporting station, and an indicator for whether rainfall at the closest reporting station is less than 25 inches.
7 Water access is measured as using the share of water area in all census communities within a 25 mile radius. All communities with more than 10 percent water area within the radius are deemed to have water access.
8 The comparable wage index represents the average local wage across all occupations (excluding primary and secondary education), adjusted for variations in the mix of occupations (see the discussion above).

Models of Teacher Compensation

Exhibit D1-b in Appendix D1 presents the baseline econometric model for Alaska teachers. The baseline model explains 75 percent of the variation in salaries and benefits observed in the 2001-02 school year. In general, the baseline model fits reasonable expectations—teachers with one year of experience earned 4 percent more than first-year teachers and teachers with a master's degree earned 5.6 percent more than teachers with less education. Salaries are higher in remote communities and communities with higher non-teacher wages and harsher climates. Salaries are lower in smaller school districts and communities with utility hook-ups and water access.

We construct index values from the salary models by predicting the salary that would be required from each school by the typical teacher in Alaska. A district's index value is the average predicted salary for its schools divided by the average predicted salary in the Anchorage school district.[9] Index values for the baseline teacher model range from .94 in Southeast Island to 1.18 in North Slope School District (Appendix I, Exhibit I-4).

We also estimated a variety of alternative models of teacher compensation, and used them to construct alternative indices. One alternative model excluded benefits from the measure of compensation. Another set of models used salary data from earlier years to construct index values for the 1999-2000 and 2000-2001 school years. A third formally adjusted for teacher turnover in a model of teacher salaries.[10]

As Exhibit E-2 (Appendix E) illustrates, the various alternative models yield remarkably similar index values. For example, the correlation between the baseline index and an index that excludes benefits is .99. The correlation between the baseline index and the turnover-adjusted index is .97.

Although the distribution of index values is largely insensitive to the variations in estimation strategy, there are important differences for particular districts. For example, excluding benefits lowers index values by more than 2 percentage points in Hydaburg and Annette Island. Adjusting for turnover raises index values in all but five districts. Index values for North Slope are 6 percentage points higher under the turnover-adjusted index than under the baseline index.

We consider the salary and benefits model as the baseline because it comes closest to capturing the complete labor costs facing districts. Models that exclude benefits are mis-

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[9] Anchorage is used as the benchmark district for all indices as explained in Chapter II.

[10] We use Tobit estimation to correct for turnover, treating as censored the salaries of individuals who subsequently quit. The idea is that individuals who quit were not receiving an adequate wage for the position. Because we do not know which employees will subsequently quit, we cannot use data from the 2001-2002 school year to estimate a Tobit model. Therefore, there is no salary and benefits version of the turnover-adjusted model.

specified because they explain only part of the teacher's compensation package. On statistical grounds, there is little reason to choose one of the mis-specified models over the salary and benefits model. The turnover-adjusted model is attractive, but the lack of data on which employees will subsequently quit forces us to exclude data on the 2001-2002 school year (and therefore data on benefits). Given the strong correlation between the baseline index and the turnover-adjusted index, we recommend using the index that makes use of the most recent and most complete data.

Models of Non-Teacher Compensation

There is reason to believe that teacher salaries may not track salaries paid to other school district personnel. To examine this idea, we constructed indices of the compensation paid to school personnel who are not full-time teachers. This category includes administrators (such as principals and assistant principals), professional staff (such as counselors, librarians, and speech therapists) and classified workers (such as educational aides and clerical staff).

The model for non-teaching, certified personnel is highly sensitive to adjustments for turnover, and we recommend that such adjustments be made. The turnover-adjusted model for certified personnel is intuitively appealing, indicating that salaries increase with age, experience and educational attainment. The model (Exhibit D1-a in Appendix D1) indicates that principals and assistant principals earn at least 27 percent more than other certified non-teachers, that counselors and librarians are systematically paid at least 5 percent less than other certified non-teachers, and that salaries fall as the percentage of time spent teaching increases. The model suggests that non-teachers are less sensitive than teachers to climate and more sensitive to local labor market conditions. As with full-time teachers, other classified personnel demand higher salaries in remote areas. See Exhibit D1-c (Appendix D1) for the model selected to estimate the classified personnel costs. Interestingly, while salaries for full-time teachers are lowest in small districts (all other things being equal), non-teacher salaries are highest in small districts.

As with the model for full-time teachers, we constructed index values by predicting the salary that would be required from each school by the typical certified non-teacher in Alaska. A district's index value is the average predicted salary for its schools, divided by the average predicted salary in the Anchorage school district. Index values for non-teaching, certified personnel range from .93 in Iditarod to 1.25 in the Aleutian Region (Appendix I, Exhibit I-4).

The model for classified personnel (Exhibit D1-c, Appendix D1) is estimated with less precision than the other models because we have less data on the individual characteristics of classified workers. However, the model fits reasonable expectations about compensation. Wages increase with age and experience in the district. Supervisors are paid 36 percent more than other classified workers, computer technicians are paid 15 percent more than other workers, and educational aides are paid 2 percent less than other workers, all other things being equal. Wages for classified personnel are higher where non-educator wages are higher, in remote areas, and in areas with a harsher climate. Classified wages are lowest in small and large districts, and highest in districts with 2,500 to 10,000 students. Index values for classified personnel range from .87 in Southeast Island to 1.48 in the North Slope District (Exhibit I-4 in Appendix I).

Summary of Results

As one would expect, the costs of school personnel play a major role in explaining the variations in the overall costs of education across local school districts, and the patterns of variation among the three different categories of personnel are also similar to one another. Exhibit III-3 displays the descriptive statistics for the teacher, administrator, and classified cost indices for various regions of the state, and it also reports the correlations among these three indices.

Using Anchorage as the basis for calculation of the index values (i.e., setting the Anchorage index to a value of 1.00), teacher costs range from a low of 0.94 to a high of 1.18 (Exhibit III-3). The highest-cost districts pay about 18 percent more than Anchorage for comparable teachers, while the lowest-cost districts pay about 6 percent less than Anchorage for comparable teachers. Administrator costs range from a low of 0.93 (7 percent less than Anchorage) to a high of 1.25 (25 percent higher than Anchorage), while classified costs range from 0.87 (about 13 percent lower than Anchorage) to 1.48 (48 percent higher than Anchorage).

The patterns of variation in the cost of teachers, administrator, and classified personnel are, as expected, quite similar to one another. The correlations among these three indices are 0.37 for teachers and administrators and 0.79 for teachers and classified personnel. The differences in the index values suggest that there are some different factors operating that affect the supply of teachers, administrators, and classified personnel, but they tend to move in the same general direction: districts facing higher teacher costs generally face higher costs for classified personnel and for administrative personnel. With respect to the regional breakdowns (Exhibit III-3) of school personnel costs, school districts located in the Far North and Southwest regions of the state exhibited the highest average costs while the districts located in the Interior had the lowest average value for administrators in the state, and districts in the Southeast had the lowest average costs for teachers and classified personnel.

Another major factor associated with personnel costs was the degree of remoteness as measured by the distance of the district from the nearest center of commerce. On average, the school districts furthest from the nearest center of commerce exhibited the highest personnel costs. Districts 500 or more miles from the nearest center of commerce paid about 13 percent more for comparable teachers, 13 percent more for comparable administrators, and 23 percent more for comparable classified personnel than districts less than 10 miles from the center of commerce.

Exhibit III-3. Descriptive Statistics for Personnel Cost Indices By Region[11]

Personnel Category	N	Mean	Standard Deviation	Minimum	Maximum
Teachers					
Statewide	53	1.03	0.06	0.94	1.18
Far North	10	1.07	0.07	0.99	1.18
Interior	3	1.02	0.03	1.00	1.07
South Central	9	1.00	0.03	0.96	1.05
Southeast	17	0.99	0.04	0.94	1.08
Southwest	14	1.08	0.05	1.01	1.17
Administrators					
Statewide	53	1.02	0.07	0.93	1.25
Far North	10	1.01	0.08	0.93	1.17
Interior	3	0.96	0.02	0.94	0.97
South Central	9	1.00	0.04	0.96	1.11
Southeast	17	1.01	0.05	0.94	1.09
Southwest	14	1.06	0.09	0.96	1.25
Classified Personnel					
Statewide	53	1.03	0.12	0.87	1.48
Far North	10	1.13	0.15	0.98	1.48
Interior	3	1.01	0.03	0.98	1.04
South Central	9	1.01	0.05	0.96	1.09
Southeast	17	0.92	0.03	0.87	1.02
Southwest	14	1.11	0.08	0.99	1.23

Correlations among the personnel cost indices

Personnel Categories	Teachers	Administrators	Classified
Teachers	1	0.37	0.79
p-value	--	0.0063	<.0001
Administrators	0.37	1	0.52
p-value	0.0063	--	<.0001
Classified Personnel	0.79	0.52	1
p-value	<.0001	<.0001	--

[11] Data sources: Teacher data from regression analysis for teacher salaries and benefits. Administrator data from tobit model for administrators. Classified personnel data from regression analysis for classified personnel salaries.

Chapter IV. The Costs of Energy Services

While the cost of energy services generally does not account for a substantial portion of the budget in the lower 48 states, it can represent a significant proportion of spending in Alaska school districts. In fact, based on our data collection, we estimate that energy services account for between 4 percent and 23 percent of school district budgets.

Successful analysis of geographic cost differences requires a thorough understanding of the different energy requirements of different regions and the concomitant costs. AIR and its consultants (SBW Consulting, Inc. of Seattle, Washington) employed an updated version of the engineering approach to energy cost analysis used by Drs. Chambers and Parrish in their 1984 Alaska Cost Project.

This technique is based on the understanding that differences in energy costs arise from three sources: (1) differences in the energy requirements necessary to compensate for climatic variations across the state; (2) differences in the prices paid for energy sources such as fuel oil and electricity, including transportation and storage costs; and (3) differences in the efficiency of alternative fuel sources.

Approach to Energy Cost Analysis

The approach taken to assess annual energy costs for each school involved an engineering analysis to estimate the annual energy use of schools (by fuel type) and an economic analysis to estimate the annual energy cost. The engineering analysis included the definition and application of a series of energy utilization equations, based on prototypical schools that collectively represent the range of physical, operational, and climatic characteristics that exist across the existing school stock. The prototypes were not real buildings; however, they were defined using data from real buildings and the judgment of experienced facilities staff from across the state of Alaska. The energy consumption characteristics of each prototype represent average performance across a group of schools with similar characteristics. By defining a set of prototypes spanning all climate regions of the state, the linear equations generated to capture energy consumption will create values specific to each school based upon its total heating degree-days (HDD). The term prototype as used in this section will refer to the points in these linear equations. These break points in the equation occur in the cold climate zone, at 11,327 HDD. Schools below this point receive values generated by a set of equations considering fuel type and end-use source, assuming that insulation values are not increasing at a significant rate. Schools above 11,327 HDD receive values generated using a different set of equations, which does assume that insulation levels increase as HDD increase. Data received from a representative sample of school districts support this assumption.

An hourly simulation of annual end-use (e.g., lighting, space heating) energy performance was prepared for each prototype, using the DOE 2.1E computer simulation model, developed by the U.S. Department of Energy. The output from the simulation was energy use per square foot of gross floor area. An estimate of annual consumption was developed for each school by applying the appropriate energy use per square foot to the respective floor area of the school. Energy consumption was also estimated for outbuildings and district buildings using a more simplified analysis (see Analysis of Other Buildings, below). Estimates of annual energy consumption for each fuel were converted to annual energy cost through an economic analysis that applied school-specific fuel prices.

Prototype Definition

The scope of the energy cost analysis allowed for the definition and application of three school prototypes. These three prototypes served as the points from which to construct the linear equations that were applied to each school, based upon its HDD. Examination of school characteristics and energy consumption data supplied by school districts throughout Alaska and discussions with Tim Mearig, an architect with the Alaska Department of Education, led to the definition of three prototypes as follows:[12]

Exhibit IV-1. Features of Three School Prototypes

Prototype Number	Climate Zone
1	Moderate
2	Cold
3	Very Cold

Three zones (moderate, cold, and very cold) were appropriate for all schools within the state. Differences in schools between the cold and very cold climate zones included increased thermal integrity (i.e., greater insulation levels, more efficient windows) in addition to weather conditions. Differences in schools between the moderate and cold climate zones included only weather conditions. This is why the break point for the linear equations exists within the cold climate zone at 11,327 HDD.

Data Collection

A DOE 2.1E model was developed for each of the three prototypes. To specify each model, average building physical characteristics, average building operational characteristics, and average weather conditions were established for the group of schools that the prototype represented—those with similar heating degree-days. Initially, the physical and operational

12 Detailed characteristics and specifications of the prototype buildings are presented in Appendix F.

characteristics data were to be collected as part of the survey that was being administered to each school district by AIR. The survey was also to collect fuel price information. However, this method proved to be too cumbersome for all but the fuel price data. As a result, an alternative means for collecting characteristics data was developed that involved obtaining data from the Anchorage School district and a committee of facilities staff from the following sample of nine school districts from across the state.

1. Anchorage (cold)
2. Fairbanks (very cold)
3. Bering Strait (very cold)
4. Kenai Peninsula (cold)
5. Kodiak Island (cold)
6. Lake and Peninsula (cold)
7. North Slope (very cold)
8. Sitka (moderate)
9. Lower Yukon (very cold)

Building operational characteristics data were collected via a mail survey that was sent to facilities staff from each of these eight school districts. Survey results were compiled and analyzed to produce reasonable operational characteristics assumptions for each prototype.

Building physical characteristics data were collected in two steps. First, “as-built” construction plans were selected by facility staff from the Anchorage school district to represent characteristics for an average high school and average elementary school. An analysis of billing records for all schools in the district was also used to select the most representative buildings. Important physical characteristics data were extracted from these plans and summarized for review by the committee members.

The second step involved the review of the Anchorage data summaries by the eight members of the committee. Each member was asked to make edits to the Anchorage values to reflect conditions that exist in their districts. Based on the responses from the committee members and an analysis of billing data from selected rural school districts, it was determined that a separate rural K-12 prototype was needed to adequately address the characteristics of rural schools.

Climate Zones

Analysis of characteristics data from the committee also showed that the thermal integrity (i.e., increased insulation, more efficient windows) of schools increased between the cold and very cold climate zones. This was accounted for when making modification from prototype 2 to

3. The following cities were selected to represent the three climate zones. They include cities for which appropriate typical weather data were available from the National Weather Service.

Exhibit IV-2. Selected Climate Zone Cities

Climate Zone	Representative City
Moderate	Kodiak
Cold	Talkeetna
Very Cold	Big Delta

Analysis of Prototype Energy Consumption

Inputs to the model for each prototype were derived from the physical and operational characteristics data that were collected. The models were run and the estimates of end-use energy consumption output from each model were checked for reasonableness against available billing data. The results were also checked across prototypes to be sure that appropriate and expected trends were observed across school types and climate zones. The final output for each prototype was total annual energy consumption by fuel type, expressed as thousands of Btu per square foot of gross floor area.

Analysis of Other Buildings

The prototype analysis of annual energy consumption was limited to the school buildings represented by the prototypes. It did not consider the energy consumption of district buildings and outbuildings, such as utility sheds and covered play areas. For many school districts, annual energy consumption associated with one or more of these building types is large enough that it could not be ignored in the energy cost analysis. The scope of the analysis did not allow for specific prototypes for these building types, since the consumption associated with these building types was never a large fraction of the total school district energy consumption. The analysis of outbuildings was limited to the development of a simple factor that was applied to the prototype results. The analysis of district buildings was limited to the development of energy use per square foot estimates from Anchorage billing data and weather adjustment factors from the prototype results. The results from this effort were incorporated into the final estimates of energy consumption by fuel type from the prototype analysis.

Annual Energy Costs

School-specific data on fuel types (by end use) and fuel prices were collected by AIR in the survey administered to all of the school districts. The fuel type and price data were integrated with the results of the prototype analysis to estimate the cost of energy for each school. Total cost for each school by fuel type was calculated by multiplying the energy use per square foot from the prototype analysis by the floor area for the school and the appropriate fuel unit prices. The total cost for each school was the sum of the costs for all fuels. Total costs for outbuildings were calculated by applying the appropriate factor from the prototype results. Total costs for district buildings were calculated using the same method as the prototypes.

It becomes apparent with the use of a prototype building that "standardizes" energy requirements that there may be energy cost differences that have been achieved through varying capital cost expenditures for specific school buildings in different parts of the state. For instance, schools or districts facing colder climates may well have decided to build schools with better or different kinds of insulation or to provide increased insulation in existing schools in order to reduce the energy requirements necessary to heat buildings. Resulting lower energy costs are likely to be a result of higher building costs. To the extent that these schools have indeed made such capital improvements, our projections may overestimate actual energy costs. While this element of capital costs is beyond the scope of the present project, it is one that nevertheless will need to be considered by the Department of Education and Early Development in the funding of school construction.

For a detailed description of the energy cost index and the specifications included in the design of the prototypical school building, the reader is referred to the section of Appendix F on the energy cost methodology and computations.

Rates, Usage, and Total Energy Costs

The energy price data expressed in dollars per kilowatt hour of electricity, per gallon of fuel oil, per cord of wood, per 100 lb. bottle of liquid propane, per ton of coal, per pound of peat, per 1,000 cubic feet of natural gas, and per 1000 BTUs of steam were obtained or estimated for each school site. These values, when multiplied by the calculated (i.e., simulated) consumption, incorporating factors for prototype and climate, indicate the estimated usage requirements of these heating fuels, as derived from the computer simulation (see description in Appendix F) for each prototype school building assigned to each school. To arrive at energy cost estimates, these usages will be multiplied by the appropriate energy prices existing at each school. As mentioned above, the resulting ***energy cost/square foot*** may differ from actual expenditures depending on individual school districts' specific constraints (e.g., insulation, how efficiently facilities are operated, or hours of operation).

Summary Of Results For Energy Cost Analysis

Whereas a school district may spend from 3 to 5 percent of their total budget on energy in the lower 48 states, a school district in Alaska may spend up to 23 percent of its total operating fund budget on energy.[13] Budget shares equaling such a large portion of the total operating fund require a separate analysis when creating a cost-of-education index. To consider the variation across these school districts, which span three climate zones ranging from moderate to very cold, data were collected from all school districts by AIR. The effort provided data for all 53 school districts on the fuel types and associated costs for a variety of end uses, such as heating school buildings, heating water, cooking, and heating swimming pools. These fuel types and costs were later combined with the energy prototype appropriate for the specific school.

An engineering approach to building the prototypes yielded the following results per prototype. The end-use consumption values are in kBTU (thousand British Thermal Units) per square foot in the modeled fuel (either gas or electricity).[14] The modeled fuel type of each end use was selected based on the fuel types supplied in the fuel cost data for West High School and North Star Elementary School from the Anchorage School District, which were the typical secondary and elementary school based upon the preliminary analysis of the Anchorage School District.

Exhibit IV-3 contains the end-use consumption values that were used if the fuel type of an end-use was electricity. Exhibit IV-4 contains the consumption values for fossil fuel. To obtain the end-use consumption cost for each building, the building square footage was multiplied by the appropriate values from Exhibit IV-3 and Exhibit IV-4, then multiplied by the unit price cost per kBTU from the data collection instruments obtained from each district.

Building End-use Consumption Cost = (energy unit price) x (prototype energy utilization per sq.ft.) x (sq.ft)

Exhibit IV-5 includes the consumption multipliers for outbuildings and district buildings by climate zone. The outbuilding consumption multiplier is given for fossil fuels, and it is assumed that that the end-use is that of heating. Any electric consumption, such as for lights, should be very minor compared to the fossil fuel energy use. The district building consumption is provided for both electric and gas fuels based on the consumption of the Anchorage School District buildings. The climate zone variations for moderate and very cold climates were derived from the "Space Heat" and "Everything Else" end-use consumption values of the prototypes to determine fossil fuel and electric consumption values.

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[13] This budget share was arrived at by summing together all expenditures within the Operating Funds coded under the object code of "Utility Services," as well as those coded in the "Supplies, Materials, and Media" object code under the function code for "Operations & Maintenance." This is based upon the *1996 Chart of Accounts*. The Yukon Flats School District has 23 percent of its total operating fund budget allocated to these accounts.

[14] Data received on energy costs and consumption were converted to kBTU (thousand British Thermal Units) for the purpose of comparison (e.g., 1 kBTU = 3,413 kilo Watts Hours of electricity).

Exhibit IV-3. Electric End Use Consumption, kBTU per Square Foot per Year

Prototype Number	Climate zone	Space Heat	Hot Water	Cooking	Swimming Pool	Everything Else
1	Moderate	34.80	2.18	0.85	13.42	25.03
2	Cold	65.78	2.35	0.85	13.42	27.82
3	Very Cold	80.18	2.50	0.85	13.42	28.69

Exhibit IV-4. Non-Electric End Use Consumption, kBTU per Square Foot per Year

Prototype Number	Climate zone	Space Heat	Hot Water	Cooking	Swimming Pool	Everything Else
1	Moderate	43.50	2.72	1.27	16.77	71.51
2	Cold	82.22	2.94	1.27	16.77	79.49
3	Very Cold	100.22	3.12	1.27	16.77	81.97

Exhibit IV-5. District and Outbuilding Consumption, kBTU per sq. ft. per year

Building Type & End Use	Fuel Consumption, kBtu/sqft/yr		
	Moderate Climate	Cold Climate	Very Cold Climate
Outbuildings			
Fossil fuel end use	43.5	82.2	100.2
District buildings			
Electric end use	51.0	56.7	58.4
Fossil fuel end use	37.6	71.0	86.5

Notes:
Outbuildings based on the heating end use of the prototypes.
District buildings for the cold climate based on Anchorage billing data.
District buildings for the moderate and very cold climate based on Anchorage billing data with climate adjustments from the rural prototypes.

Linear equations were derived using the three prototypes as points in the equation. The end-use values generated by fuel types – shown in Exhibits IV-3 and IV-4 – served as the dependent variable, while heating degree days associated with each of these prototypes served as the independent variable. Once these equations were created, the heating-degree days associated with each school in the state served as the independent variable for that school. All schools received a value for "Space Heat" and "Everything Else." However, only those schools with reported swimming pools, active on-site cooking, and hot water received values for these categories. The idea is that if the schools do not have these amenities, then they cannot be incurring energy costs associated with them. The method of deriving the relationship between energy usage and heating-degree days allows us to project energy costs for each school based on its specific climatic conditions.

Taking an average weighted by square footage of prototype-based energy costs for each school site within the district generated an average energy cost for each school district. Dividing the average cost for the district by the average cost for Anchorage produces the energy index value for the district. In the energy index equation below, "i" represents the district for which the index value is created, and "A" is the base Anchorage School District. Any school in a district is represented by "j."

$$\text{Energy Index}_i = \frac{\dfrac{\Sigma j\,(\text{school square ft.})_{ij} \times (\text{energy unit price})_{ij} \times (\text{prototype energy utilization per sq.ft.})_{ij}}{\Sigma j\,(\text{school square ft.})_{ij}}}{\dfrac{\Sigma j\,(\text{school square ft.})_{Aj} \times (\text{energy unit price})_{Aj} \times (\text{prototype energy utilization per sq.ft.})_{Aj}}{\Sigma j\,(\text{school square ft.})_{Aj}}}$$

where:

3j = the sum over relevant values of j (i.e., sum over all schools within a district i),

$(\text{school square ft.})_{ij}$ = square footage of school j of district i

$(\text{energy unit price})_{ij}$ = unit price of energy resources in school j of district i;

$(\text{prototype energy utilization per sq.ft.})_{ij}$ = kBTUs of energy required per square foot in school j of district i.

The results of this analysis show a range of index values for the cost of energy per square foot from 0.74 in the Juneau School District to 9.31 in the North Slope School District. The prototype models showed greater sensitivity to climate variation for schools below 11,327 heating degree-days. Conversations with representative school districts indicated that schools located above this point in prototype models increase insulation levels with respect to heating degree days. Typically, the school districts with the highest index values are located within the very cold climate zone, largely represented by the Far North region. The explanation for the high cost in less cold districts can be attributed to the relative costs of energy sources faced by these districts. For example, energy prices per BTU within the Bristol Bay School District were second only to the North Slope Borough School District.[15] This resulted in a relatively high index value for Bristol Bay, which was not caused by its relative climate. For the North Slope Borough School District, it is clear that the combination of an extremely harsh climate and the highest costs of energy give this district the highest index value. It is likely that a significant component of these differences in energy prices between districts can be attributed to the cost of transporting the fuels to the school sites.

Located near the Bristol Bay School District is Dillingham. Unlike its neighbor, the Dillingham City School District has a low energy cost index value. Whereas Dillingham is still in a high-cost area for energy prices, schools in the Dillingham School District generate their

[15] A recent report entitled "Bristol Bay, Alaska, Comprehensive Economic Development Strategy" highlights the high cost of energy in the region and can be found on the Department of Commerce and Economic Development website at: http://www.dced.state.ak.us/cbd/oedp/pubs/BBNA_CEDS2002.pdf

own electricity and use the waste heat to heat their schools, thereby saving a substantial amount of money. This is also reflected by their assigned budget weight for energy, which is among the lowest in the state at 6 percent of the total operating fund.

An examination of Exhibit IV-6 reveals that geographic location in the state plays a large role in the determination of the energy index values. Those districts located in the Far North typically face a climate harsher than the rest of the state, and the cost of transporting fuel supplies can be much higher in this region than in other area of the state. Outside of the Far North region, the highest cost districts tend to be in the Southwest region, where they may face high energy costs for transportation of fuel. Schools located in the Far North have more efficiently insulated school buildings than do school districts that have milder climates and more moderately priced fuels. Regardless of the efficient ways these school districts have combated the climate with greater insulation and thicker windows, the fact remains that they face higher costs to heat their buildings. Additionally, expenditures for energy tend to account for a larger percentage of the operating fund in the Far North than in any other region of the state—up to 23 percent of the budget allocations of the operating fund.

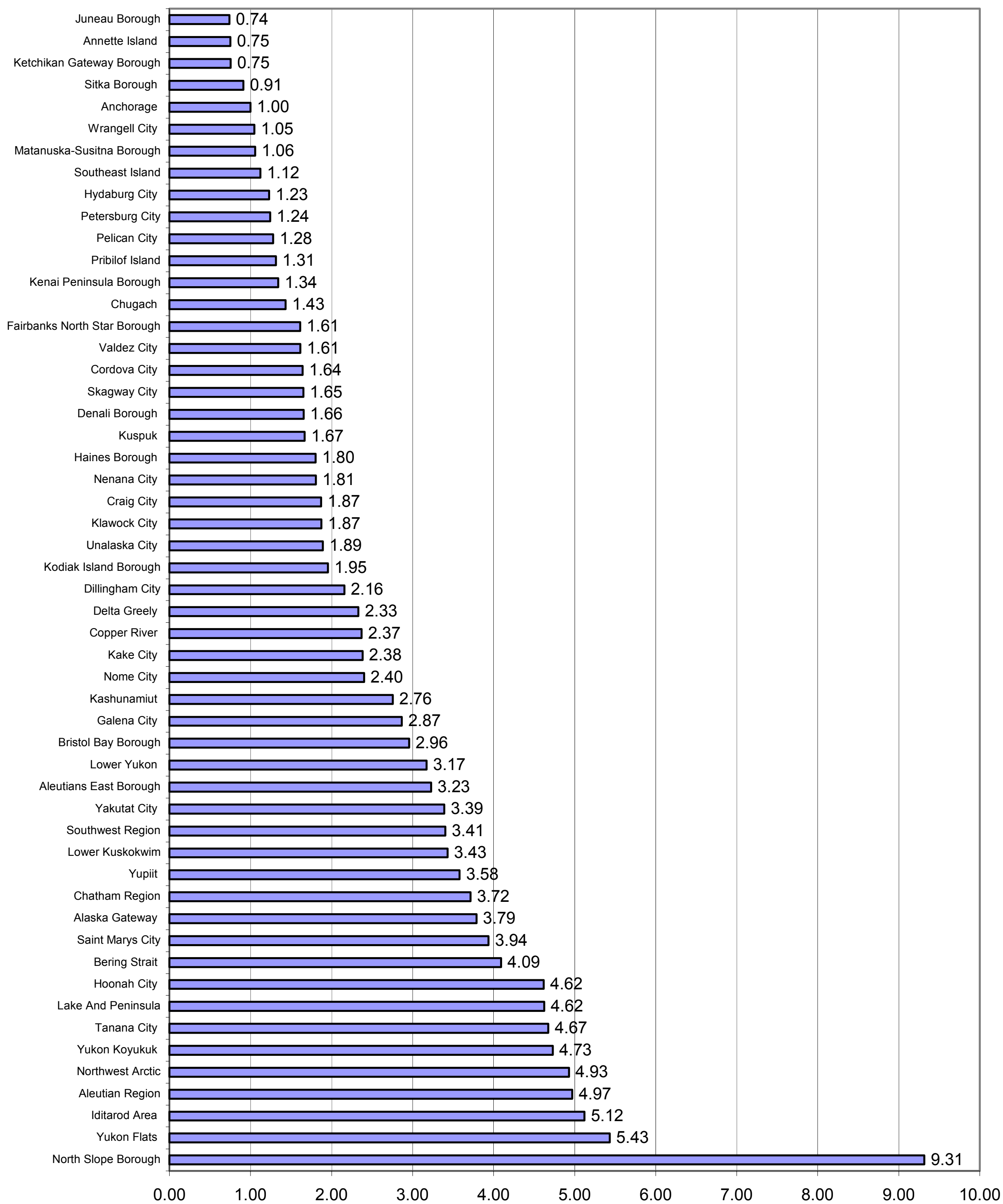
Exhibit IV-6. Comparison of Energy Index Values by Region

Region	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	2.65	1.64	0.74	9.31
Far North	10	4.54	2.09	1.81	9.31
Interior	3	1.87	0.40	1.61	2.33
South Central	9	1.80	0.86	1.00	3.79
Southeast	17	1.79	1.13	0.74	4.62
Southwest	14	3.08	1.06	1.31	4.97

Exhibit IV-7. Comparison of Energy Budget Shares by Region

Region	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	9.35%	4.00%	3.69%	22.95%
Far North	10	13.82%	5.33%	7.24%	22.95%
Interior	3	7.86%	3.13%	4.63%	10.86%
South Central	9	7.91%	3.83%	4.20%	17.11%
Southeast	17	7.74%	2.12%	3.69%	10.81%
Southwest	14	9.36%	2.77%	5.16%	16.46%

Exhibit IV-8. Energy Cost Index



Chapter V. Analysis of Non-Personnel Costs

In prior cost-of-education studies outside of Alaska, expenditures for such non-personnel items as supplies and materials, purchased services, travel and capital equipment have often been excluded because of the difficulty of grouping such a wide assortment of items for cost analysis. It was also believed that it was safe to assume that the prices for these types of items would not vary significantly within a single state. The assumption of little price variation for non-personnel resources within the same state cannot be made in the case of Alaska, though, given the difficulty of accessing many Alaskan communities. This difficulty of accessing communities has a significant impact on the costs of transporting goods and services and the cost of travel.

Moreover, in most states the percentage of the budget allocated to these (non-energy-related) non-personnel items is relatively low. However, this statement is not true for school districts in Alaska. These components of the budget range from a low of 6 percent to a high of 45 percent of the total operating budget for Alaska's school districts.

Unfortunately, these types of non-personnel inputs represent a very large number of specific items on which to attempt collecting data. Because of the potential complexities of a detailed survey about the costs of these non-personnel inputs, the AIR research team sought the assistance of the Technical Working Group (TWG). The TWG played a significant role in helping the AIR research team to develop a methodology, define the parameters, and devise a data collection strategy for this component of the study.

This chapter is divided into two major sections: one focused on the costs of goods and one focused on the costs of travel as they impact the cost of maintenance services and other school district operations.

Costs Of Goods

Precisely measuring cost variations for the large and varied mix of items falling in this resource category would constitute a major study in itself. To conduct a detailed cost analysis of these materials, from reams of paper to computers, is beyond the scope of this project and the benefits would not warrant the cost of doing so. However, less detailed methods can be applied that will provide adequate indices.

For this component of the project, we met with the school district business officers who made up the TWG to discuss possible data collection strategies. Based on extensive discussion and deliberations between the TWG and the AIR research team, it was decided to select a limited set of items that could be used to represent the purchases of school districts and that would reflect the impact of transportation costs confronted by districts in shipping these items to the various school sites. The TWG played a critical role in selecting the set of goods on which AIR would collect data and in helping the AIR research team in designing an appropriate data collection strategy (see the included separate folder for the data collection instruments used for this project).

The Approach to Estimating the Cost of Goods

Shipping cost is the major factor underlying cost differences in supplies, materials, and capital equipment across local schools and districts in Alaska. The base prices for districts in different parts of the state may vary to some extent because of volume purchasing, but this difference is small compared to the difference associated with the cost of transporting these items from the major centers of commerce to the remote areas of the state. For this reason, districts were asked to report the cost of each item, and also to list the cost of the item plus shipping and storage costs associated with obtaining the listed item.

The index we developed is based on variations in the prices paid for one case (10 reams) of white copier paper (8.5" by 11") and one 4' by 5' windowpane in the schooling communities of the state. This price information was obtained from a district questionnaire that requested information for each of the schools within the district. Both items were chosen through a series of conference calls with the entire TWG and were designed to serve as proxies for a set of items used by each school. The total cost of the items reflects not only the cost of the item itself, but also the shipping and storage costs incurred for delivery of the item to the specific school site. The ream of copier paper was chosen as a proxy for instructional supplies, such as textbooks, and also for office supplies consumed by administrators.

The windowpane is meant to represent the cost of bulky items that would commonly be purchased out of capital outlay expenditures. Each school district was instructed to report the cost of the typical 4' by 5' windowpane used at each school site within the district. For districts located in the Far North region, this was usually a triple-paned window, while schools in less harsh climates more often purchased single- or double-paned windows.

The district questionnaire took into account the fact that using only one method of transportation is not feasible for some districts. For example, districts located above the Bering Strait will not always be able to ship goods by barge. Therefore, an alternative method of transportation may be necessary. The questionnaire asked for the percentage of time this alternative method is utilized for each school site. All calculations were made at the school level and then aggregated to the district level by pupil enrollment weights. The index for each good is calculated by taking the pupil-weighted values for each school based on the proportion that each shipping method is used. The district's value is then divided by the value for the Anchorage School District. The equation for each good is found below, where the subscript "i" represents the district for which the index value is generated, and subscript "A" stands for the base Anchorage School District. Any good is represented by subscript "k" in school "j." The symbol 3j means the sum over all schools (j) within a district A (Anchorage) or the comparison district "i." The symbols (% #1) and (% #2) refer to the percentage of time that the good was shipped via method 1 (e.g., barge) versus method 2 (e.g., air freight).

$$\text{Good Index}_{ik} = \frac{\dfrac{\Sigma j\,(\text{school enrollment})_{ijk} \times \{[(\text{method \#1 total cost})_{ijk} \times (\%\ \#1)_{ijk}] + [(\text{method \#2 total cost})_{ijk} \times (\%\ \#2)_{ijk}]\}}{\Sigma j\,(\text{school enrollment})_{ij}}}{\dfrac{\Sigma j\,(\text{school enrollment})_{Ajk} \times \{[(\text{method \#1 total cost})_{Ajk} \times (\%\ \#1)_{Ajk}] + [(\text{method \#2 total cost})_{Ajk} \times (\%\ \#2)_{Ajk}]\}}{\Sigma j\,(\text{school enrollment})_{Aj}}}$$

The Results Of The Analysis Of The Cost Of Goods

Exhibit V-1 presents the descriptive statistics for the index values for the cost of goods in Alaska school districts.[16] The cost of purchasing, transporting, and storing goods did not show a correlation between increased distance from the nearest center of commerce and higher index values in this category. In some cases, school districts located in the center of commerce had higher index values than those located in the farthest areas of the state. Northwest Arctic School District purchases a case of paper for about the same price as Pelican City School District does, and Northwest Arctic is located much farther from a center of commerce than Pelican City. So why does Pelican City have an index value more than three times that of Northwest Arctic?

Exhibit V-1. Comparison Of Index Values For Office And Instructional Supplies, By Distance To The Nearest Center Of Commerce

Distance	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	1.95	1.82	0.98	13.57
Less than 10 miles	6	1.66	1.21	1.00	4.11
At least 10 miles	4	1.37	0.28	0.98	1.63
At least 50 miles	12	2.86	3.57	0.98	13.57
At least 100 miles	23	1.78	0.66	1.10	4.08
At least 500 miles	8	1.56	0.26	1.23	1.96

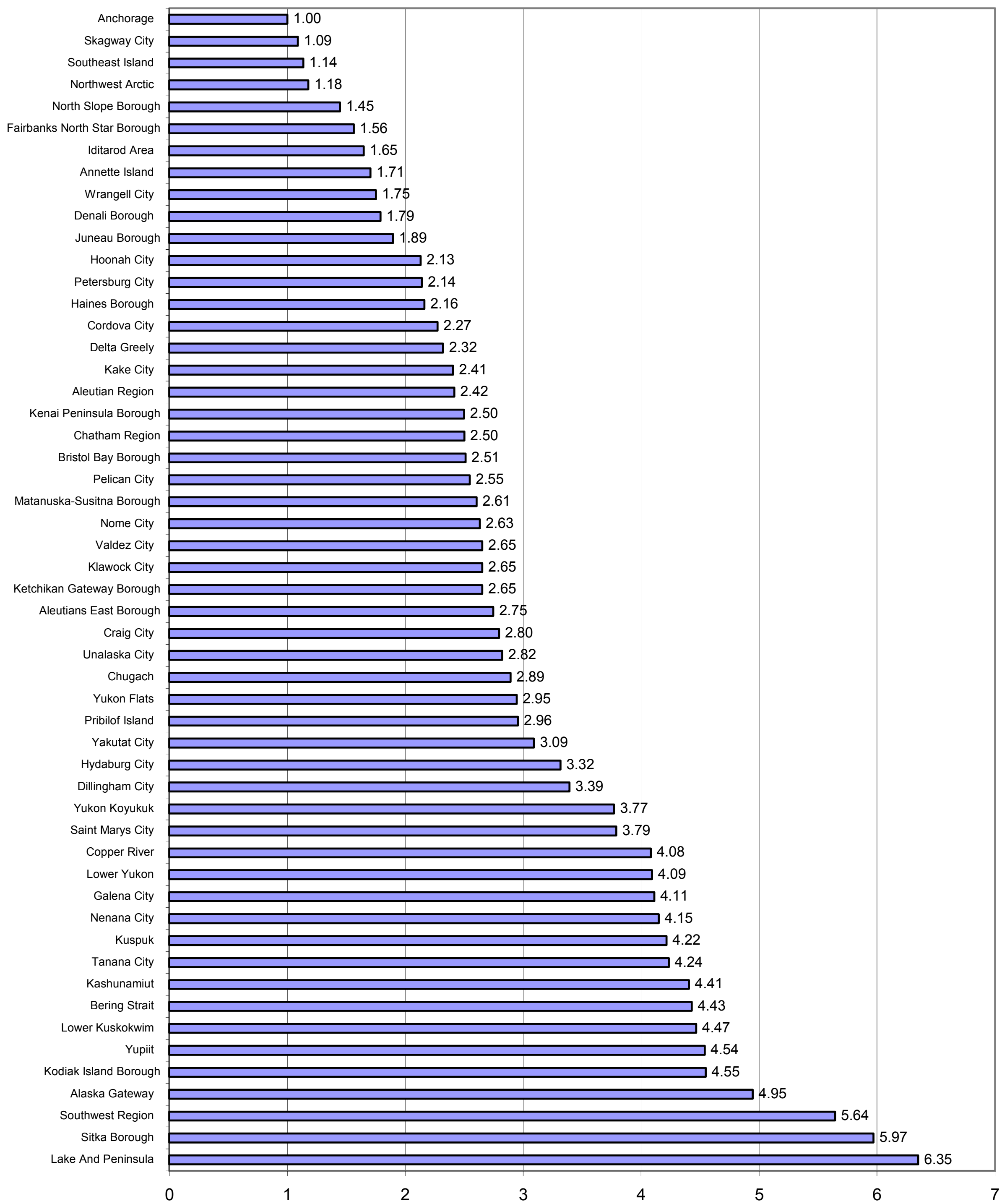
[16] Detailed discussions of the data and procedures for analyzing the cost of goods and for calculating the index presented in Exhibit V-1 are presented in Appendices G and I.

The explanation for this lies in the districts' relative size. Northwest Arctic has among the largest district enrollments in the state, while Pelican City has among the smallest. Larger districts are able to buy supplies in larger quantities and therefore reduce shipping cost per unit purchased. Smaller districts do not have this luxury, and their small shipments can be quite costly. In the particular case of Pelican City, it must ship office and instructional supplies via waterways, which tends to be a more expensive method of transportation than scheduled air shipments. In general, as evidenced by Exhibit V-2, larger district enrollment is correlated with smaller index values in the category.

Exhibit V-2. Comparison Of Index Values For Office And Instructional Supplies, By District Enrollment

District Enrollment	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	1.95	1.82	0.98	13.57
0 to <250	13	2.88	3.39	1.07	13.57
250-999	25	1.72	0.64	0.98	4.11
1000-2499	6	1.94	1.06	1.23	4.08
2500-9999	6	1.29	0.23	1.05	1.62
10,000+	3	1.07	0.13	0.98	1.22

Exhibit V-3. Index: Maintenance Supplies



The same explanation of size-related advantages tells part of the story for index values associated with small capital items, shown in Exhibit V-4; the rest is partially explained by travel costs in a particular region. The three largest districts in the state have relatively low index values in this category. This is most likely due to the larger volume of supplies these districts purchase for their schools. To obtain a more complete picture, we look at trends observed by region, in Exhibit V-5. Districts located in each region of the state have at least one district with an index value greater than 2. However, districts in the Southwest region (a region with relatively high shipping costs) consistently have higher index values than those in other regions of the state. Still, these trends do not completely explain the index values in this category. It is interesting to note that there is a weak positive correlation of 0.33 between high shipping costs and a higher index value. This highlights the importance of including shipping costs in the index value for small capital outlay items.

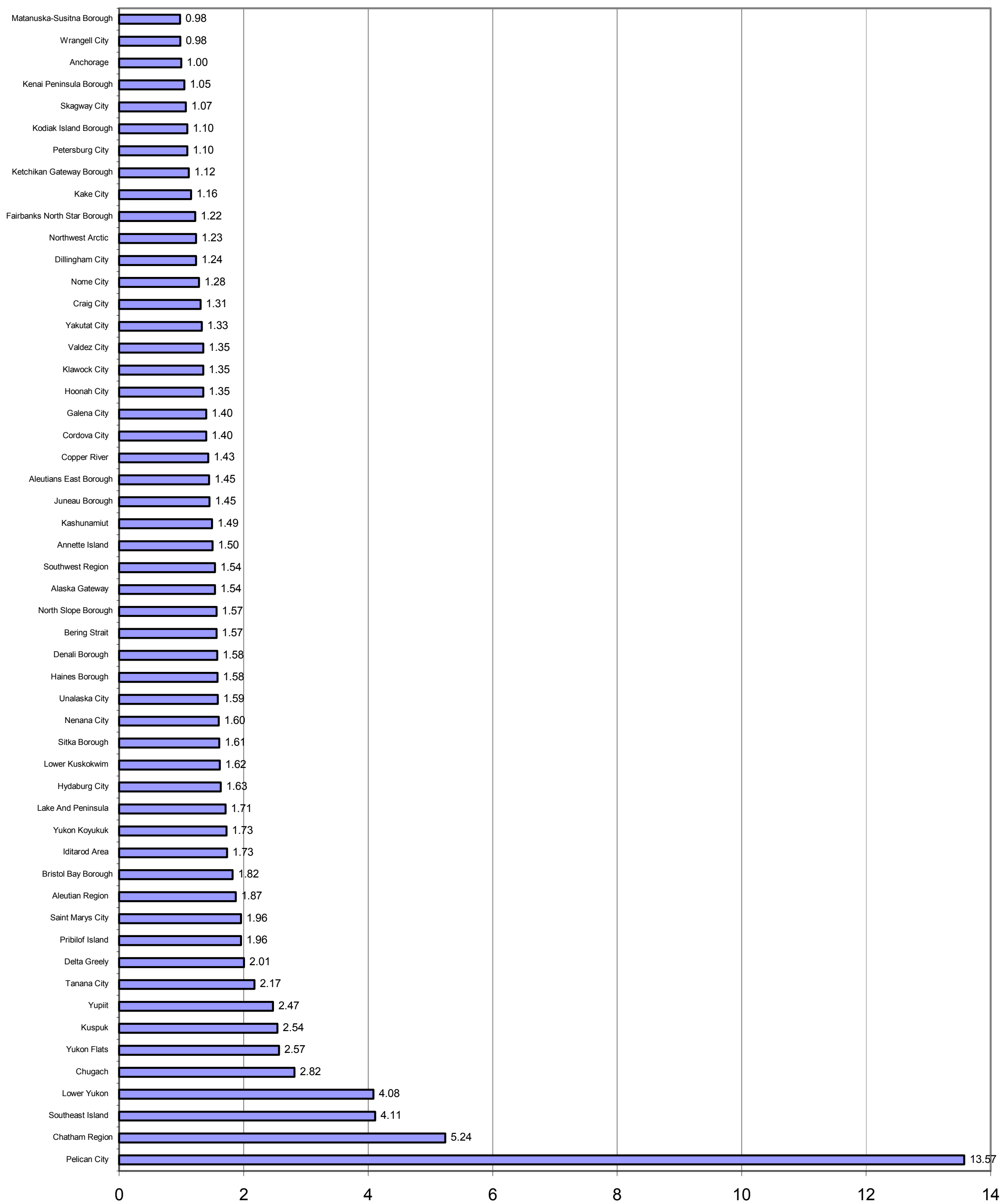
Exhibit V-4. Comparison Of Index Values For Small Capital Items, By District Enrollment

District Enrollment	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	3.02	1.27	1.00	6.35
0 to <250	13	2.77	0.78	1.09	4.24
250-999	25	3.10	1.33	1.14	6.35
1000-2499	6	3.54	1.86	1.18	5.97
2500-9999	6	3.36	1.15	1.90	4.55
10,000+	3	1.72	0.81	1.00	2.61

Exhibit V-5. Comparison Of Index Values For Small Capital Items, By Region

District Enrollment	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	3.02	1.27	1.00	6.35
Far North	10	3.05	1.26	1.18	4.43
Interior	3	1.89	0.39	1.56	2.32
South Central	9	3.06	1.24	1.00	4.95
Southeast	17	2.47	1.09	1.09	5.97
Southwest	14	3.88	1.17	2.42	6.35

Exhibit V-6. Index: Office and Teaching Supplies



Travel for purchased services

Because the expenditure category of travel for purchased services is largely composed of personnel services (e.g., for skilled maintenance or technicians) that are not available in many of the communities of Alaska, it has been assumed that the main source of cost variation in this category is associated with the cost and the time of travel from the nearest “center of trade” to the school site. A skilled technician, for example, will often travel from Anchorage or some other large community in Alaska to reach many of the schools of the state. There are two dimensions to the expense associated with this travel: the cost of transporting the person to the site and the cost of any lodging required in remote locations where day trips are not possible. To derive a cost index for this category of expenditures, data were gathered on the cost and time of travel between the schooling communities of the state and the most likely communities of origin for such skilled technicians (“center of trade” communities).

The necessary cost and time of travel calculations can be broken into two segments: from the school to the district office, and from the district office to the closest “center of trade” community. These data were collected on a district questionnaire and from other sources. They are based on the “best mode of transportation” (e.g., plane, marine highway) as indicated on the questionnaire.

Another part of the additional cost includes the compensation of the technician for travel time. The cost per hour for such a technician is based on the average hourly rate received by foremen in the Anchorage School District. The rate of the Anchorage foreman is multiplied by the index value for classified staff in the district containing the “center of trade” community. The purchased service index is based on the estimated cost of a 16-hour service call in Anchorage as compared to the other schooling communities of the state. These standardized service calls are determined as follows:

[(16 hours + travel time) x Anchorage Rate x “Center of Trade” index value for classified staff] + Travel cost

The cost of travel to a school site that does not require an overnight stay is simply the cost of travel from the center of trade to the school site, via the district office. Travel to a school that requires an overnight stay incorporates an additional $450 for lodging and meals (i.e., $150 per day).[17]

Where travel is not a major expense factor, as in Anchorage, the length of stay will have little effect. In the remote areas, the assumption of a 16-hour service call tends to temper the influence of travel on the index — a shorter service call duration would result in travel costs being a larger proportion of the total cost. However, the cost of travel time for those schools in

[17] This rate for lodging and meals was established through discussions with the TWG.

remote regions of the state can still be a significant factor that contributes to a higher cost index for certain districts.

Analysis of the index shows an expected trend: index values tend to rise as the distance from the district office to the nearest center of commerce increases. It is important to note that the center of commerce is not necessarily the same as the center of trade. Where one district receives its purchased services for maintenance may be quite different from what constitutes a center of commerce. Organizing the index values by distance to the nearest center of commerce, as in Exhibit V-7, indicates that districts located in more remote areas of the state incur higher costs to obtain purchased maintenance services that are more readily available to less remote districts. However, as shown in Exhibit V-8, it does not appear that schools in more remote districts rely any more heavily on the use of purchased services as a substitute for their own staff. On average, school districts across all categories of proximity to the nearest center of commerce appear to be spending about 2 to 3 percent of their total operating budget on purchased services. Therefore, schools in more remote areas of the state do not seem to be relying more heavily on contracting out for purchased services.

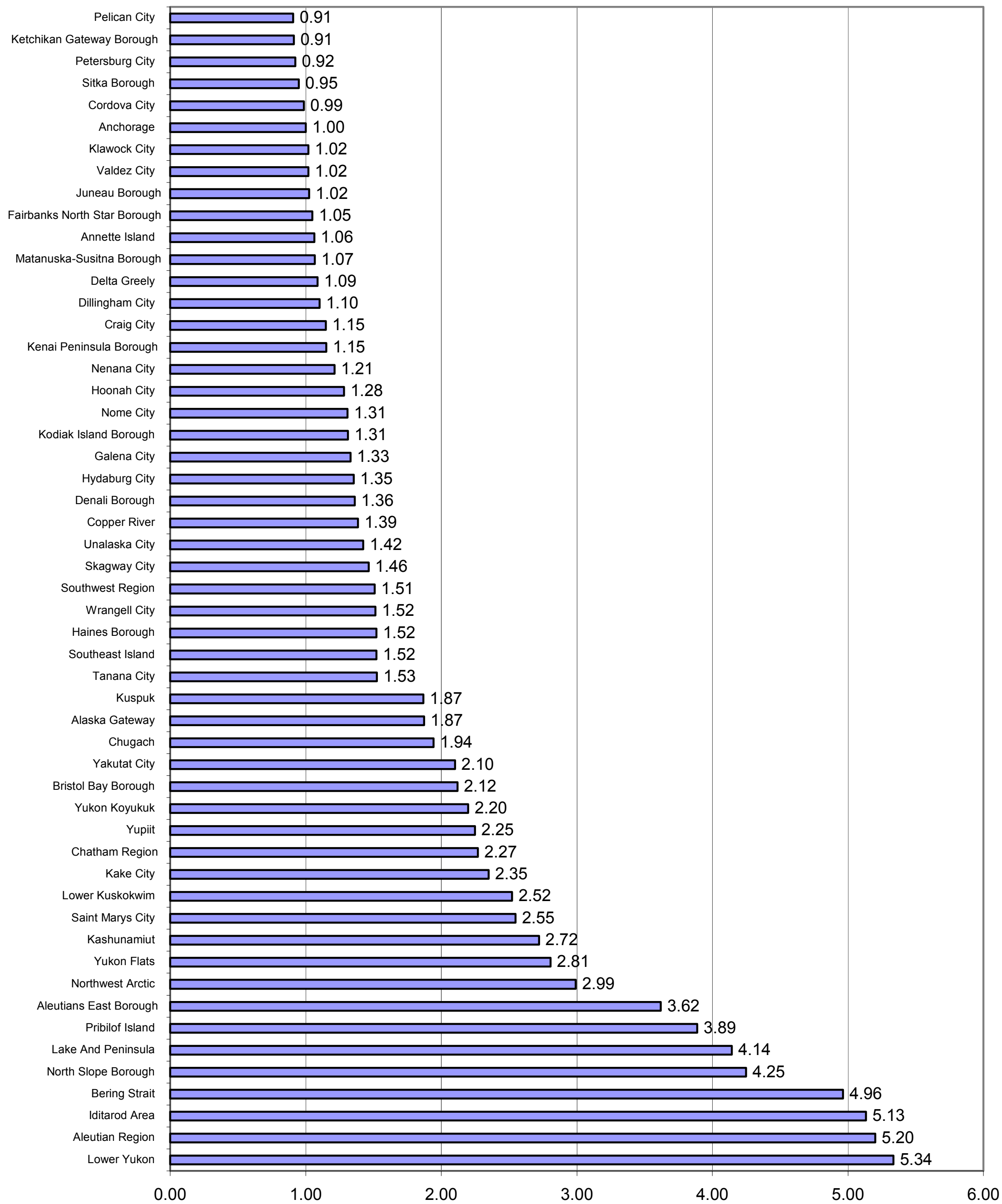
Exhibit V-7. Comparison Of Index Values For Purchased Services, By Distance To The Nearest Center Of Commerce

Distance	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	2.01	1.24	0.91	5.34
Less than 10 miles	6	1.11	0.22	0.91	1.52
At least 10 miles	4	1.19	0.15	1.06	1.35
At least 50 miles	12	1.46	0.50	0.91	2.35
At least 100 miles	23	2.17	1.23	0.92	5.34
At least 500 miles	8	3.46	1.47	1.31	5.20

Exhibit V-8. Comparison Of Budget Share For Purchased Services, By Distance To The Nearest Center Of Commerce

Distance	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	2.02%	1.50%	0.64%	8.20%
Less than 10 miles	6	3.21%	2.90%	0.77%	8.20%
At least 10 miles	4	3.22%	2.40%	1.12%	6.00%
At least 50 miles	12	1.87%	1.00%	0.65%	3.60%
At least 100 miles	23	1.63%	0.70%	0.75%	3.90%
At least 500 miles	8	1.92%	1.40%	0.64%	4.80%

Exhibit V-9. Index: Maintenance Travel



Costs of Travel by District Employees

Costs Of Travel To And From District Offices

Some of the services provided by employees within Alaskan school districts have a substantial travel component. The cost of itinerant services varies considerably across the state due to differences in related travel costs. For this reason, it is necessary to create an index for such travel to capture the relative cost differences. The cost of the trip used for the index is based upon the roundtrip cost between school and district using the most common method of travel. Since it is school district personnel making these trips, there is no consideration given to labor costs in this calculation—these are captured in separate personnel indexes. All calculations were made at the school level, and then aggregated to the district level by teacher full-time equivalent (FTE) weights. Where an overnight stay was required, a per diem of $450 was added to the cost of the trip for the school. The trip index reflects the cost of a trip from the district office to the schooling community as reported on a questionnaire.

The extent to which a district uses itinerant staff travel is reflected in the budget share used to weight the index. These budget shares are derived from audited school district budget reports for fiscal year 2000, obtained from ADEED.

The equation for this cost index is found below, where the subscript “i” represents the district for which the index value is generated, and subscript “A” stands for the base Anchorage School District. Any school “j” found within a district is denoted by the subscript “r” if it is a remote school, while non-remote schools contain the subscript “n.”

$$\text{Trip Index}_i = \frac{\text{Trip Cost}_{ir} + \text{Trip Cost}_{in}}{\dfrac{\Sigma j\,(\text{school FTE})_{Aj} \times (\text{roundtrip cost from school to d.o.})_{Aj}}{\Sigma j\,(\text{school FTE})_{Aj}}}$$

where

$$\text{Trip Cost}_{ir} = \frac{\Sigma j\,(\text{school FTE})_{ijr} \times (\text{roundtrip cost from school to d.o.})_{ijr} + (450)_{ijr}}{\Sigma j(\text{school FTE})_{ij}}$$

and

$$\text{Trip Cost}_{in} = \frac{\Sigma j\,(\text{school FTE})_{ijn} \times (\text{roundtrip cost from school to d.o.})_{ijn}}{\Sigma j\,(\text{school FTE})_{ij}}$$

Costs Of Travel To Anchorage

A second component of travel by district employees is teacher travel to Anchorage for professional development. This cost is determined by the cost per trip to Anchorage (the transportation cost was determined from the district questionnaire, with hotels and meals determined on average for all districts, excluding Anchorage). This index is also calculated at the school level, and then aggregated up to the district level by FTE. The calculation for a district’s index value for travel to Anchorage can be found below as Trip Index$_i$. The difference here is that the per diem is given to all schools in the amount of $450. The exception to this is any school located within Anchorage, which receives a per diem of $75, to cover the cost of mileage and meals for three days of professional development.

The calculation of the index for professional development occurring in Anchorage is found below. As in the above equation, "j" represents any school, where"i" stands for any district, and "A" is the base district Anchorage.

$$\text{Trip Index}_i = \frac{\dfrac{\Sigma j\,(\text{school FTE})_{ij} \times (\text{roundtrip cost from school to Anchorage})_{ij} + (450)_{ij}}{\Sigma j\,(\text{school FTE})_{ij}}}{\dfrac{\Sigma j\,(\text{school FTE})_{Aj} \times (\text{roundtrip cost from school to d.o.})_{Aj} + (75)_{Aj}}{\Sigma j\,(\text{school FTE})_{Aj}}}$$

Results of the Analysis of Travel Costs

Because many school and district offices are located in areas unreachable by road, the cost of travel varies greatly across the state. The differences found in the index values for travel are the greatest among all of the individual index components examined in this report.

Exhibit V-10. School to District Office Travel

Distance	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	26.36	50.30	1.00	222.60
Less than 10 miles	6	3.66	5.33	1.00	14.33
At least 10 miles	4	1.12	0.25	1.00	1.49
At least 50 miles	12	8.78	17.99	1.00	49.55
At least 100 miles	23	32.08	51.98	1.00	182.40
At least 500 miles	8	65.91	80.91	1.00	222.60

Travel between schools and the district office can be seen as a function of district enrollment and the concentration of the district, among other factors. A comparison of index values by district enrollment is found in Exhibit V-11. Larger school districts tend to be located in more urban areas, where the school buildings and main office buildings are more concentrated. In the more rural areas of the state, lower district enrollment numbers are found in regions that span large areas of land or water. The cost of serving students in these smaller school districts through the use of itinerant staff and the cost of travel for professional development are higher.

A caveat to this association of district size with higher index values for travel between the schools and district office is that not all school districts with lower district enrollment cover large areas. In fact, a number of city school districts can be found among the categories with lower enrollments. These school districts have index values of zero in this category because their only school is located within the same structure or vicinity as their district office. Therefore, the combination of a small district enrollment and a large land area (or set of islands) to traverse in getting to the district office from the schools within the district contribute to a larger index value in this category. The districts that tend to have higher index values are those in the middle rage of district enrollment. This is due to the existence of a number of schools within the district, spread out over a larger area of land or water. Again, this is related to concentration.

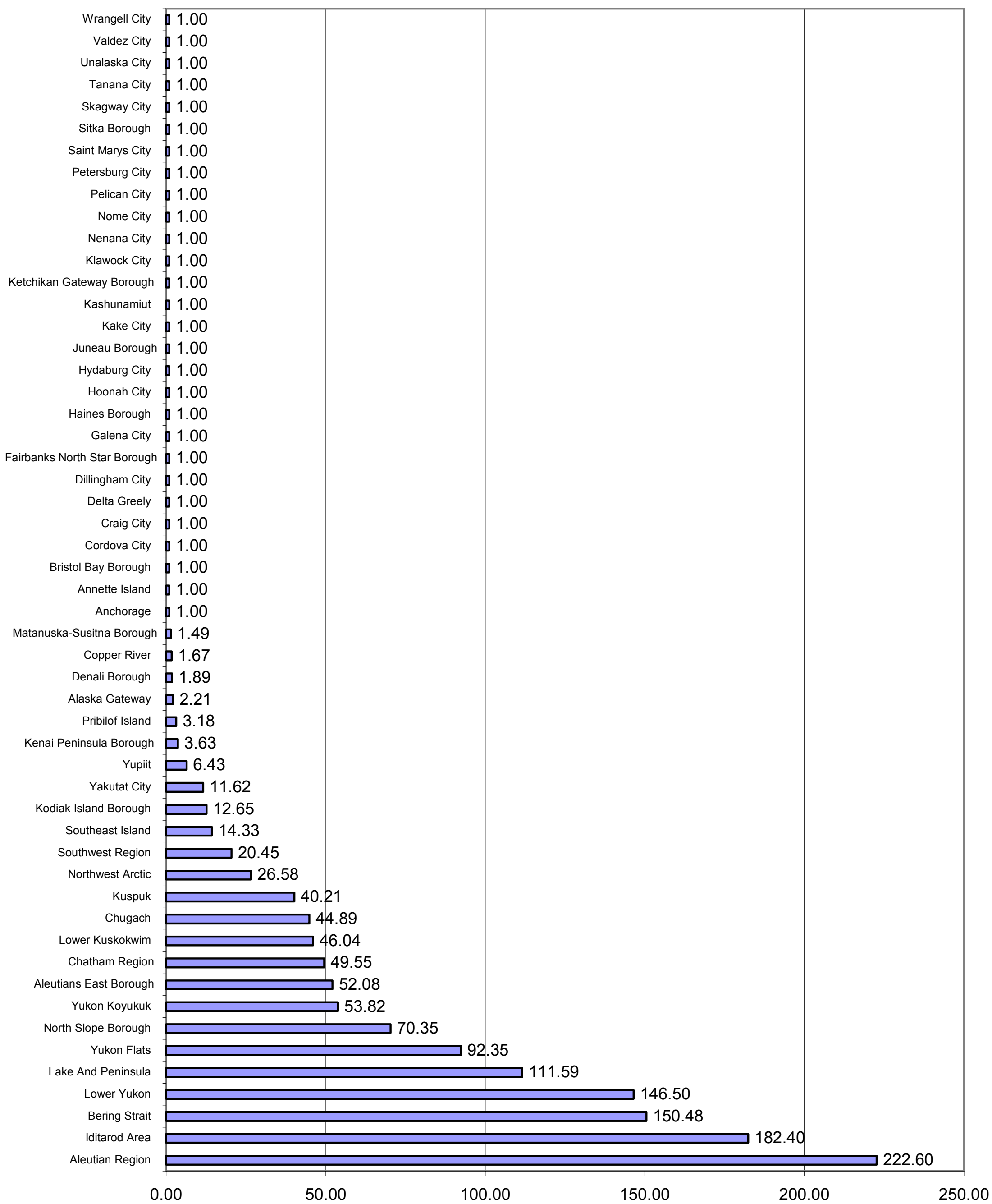
One district with a high index value for the travel categories is Bering Strait, whose staff must rent a helicopter for travel from the district office to Diamede School, located on an island in the Bering Strait. The Aleutian Region School District is composed of a set of islands, making travel within the district extremely costly. High-cost air travel of this nature is not uncommon among the school districts in and neighboring the Bering Sea. Thus, the large index values in these categories are warranted, especially when one considers that the district in the denominator of the index equation (i.e., Anchorage) has a minimal travel cost.

Exhibit V-11. Comparison Of Travel Between Schools And The District Office, By District Enrollment

District Enrollment	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	26.36	50.30	1.00	222.60
0 to <250	13	26.14	61.43	1.00	222.60
250-999	25	23.70	44.78	1.00	182.40
1000-2499	6	65.99	68.76	1.00	150.48
2500-9999	6	10.89	17.80	1.00	46.04
10,000+	3	1.16	0.28	1.00	1.49

Another telling trend in this index category is observed by region. The districts located in the Far North and Southwest regions tend to have higher index values than do school districts located in other areas of the state. This is most likely due to lower concentrations in the districts in these regions and the reduced number of alternative methods of travel in the Far North and Southwest.

Exhibit V-12. Index: Travel, Schools to District Office



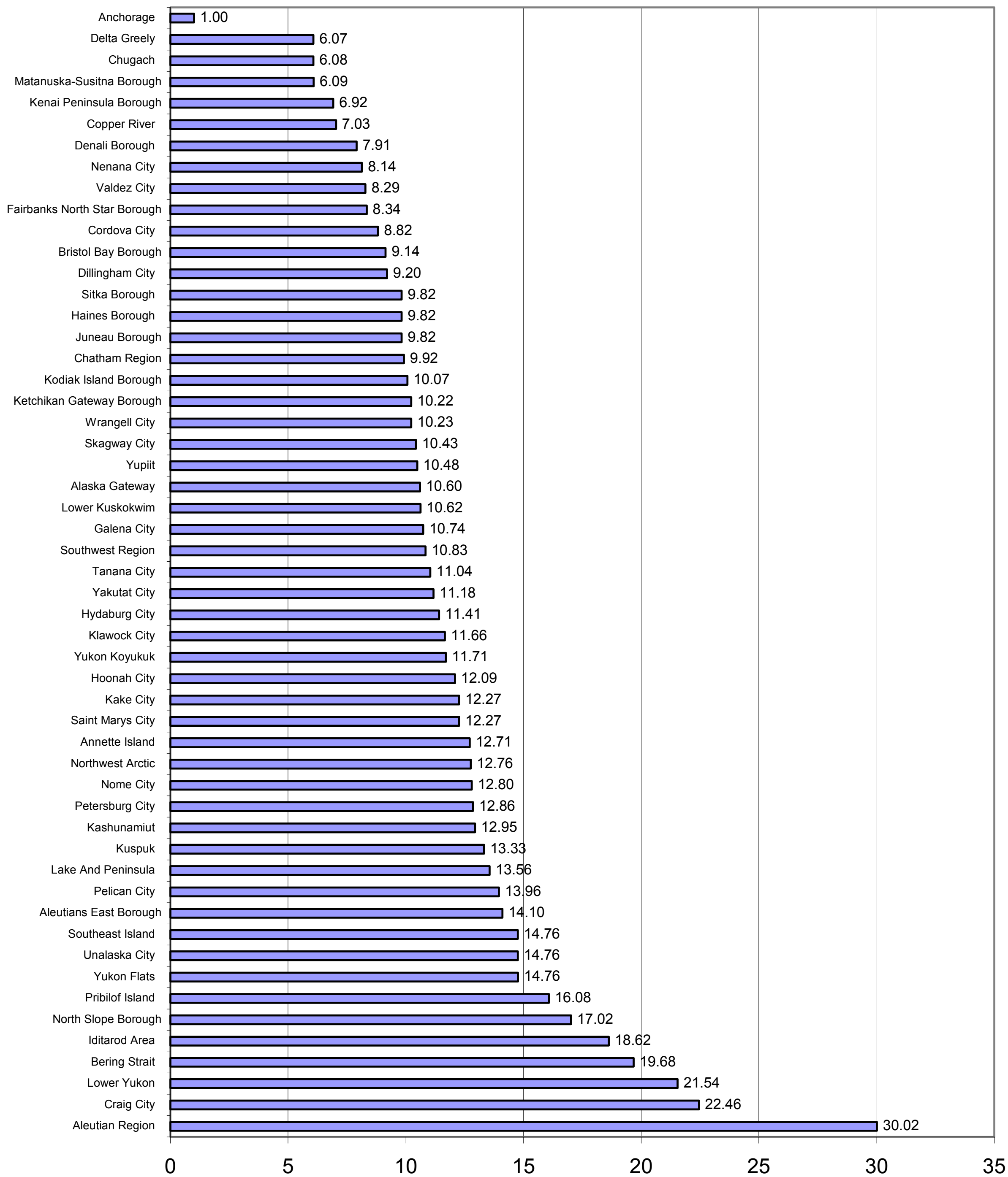
Regional proximity to Anchorage can help to explain the trend observed in index values for the travel costs associated with statewide professional development in Anchorage. This trend is presented in Exhibit V-13 below. Generally, school districts located the farthest away from

Anchorage, in the Far North and Southwest regions, face the highest cost of travel to the city of Anchorage. These higher index values are a product of higher costs associated with air travel from these districts to Anchorage and the vast distance between the regions. The apparent anomalies within each category were examined and verified for accuracy by staff at ADEED. Due to the lack of an extensive road infrastructure in the state, even districts in the same region as Anchorage or neighboring areas may face the high cost of alternatives to traveling by road.

Exhibit V-13. Comparison Of Travel From Schools To Anchorage, By Region

District Enrollment	N	Mean	Standard Deviation	Minimum	Maximum
Statewide	53	11.87	4.62	1.00	30.02
Far North	6	8.51	4.53	1.00	14.76
Interior	4	10.57	3.04	6.09	12.71
South Central	12	10.89	4.32	6.07	22.46
Southeast	23	11.64	3.30	7.03	21.54
Southwest	8	17.15	5.69	12.76	30.02

Exhibit V-14. Index: Teacher Professional Development Travel to Anchorage



Chapter VI. Calculation of the Overall Geographic Cost-of-Education Index (GCEI)

The reality of measuring cost differences in education is much the same as measuring differences in the cost of living for consumers. In education, the goal is to measure how much more or less it costs to provide the same ***quality*** of educational services in two different geographic locations or at two different points in time. For consumers, the goal is to measure how much more or less it costs to permit the consumer to be equally well off (i.e., to achieve ***equal satisfaction*** with the collections of goods and services they consume) in two different geographic locations or at two points in time. In the case of the consumer, the difficulty lies in the inability to measure consumer satisfaction, while, in the case of educational services, the difficulty lies in the inability to establish an unambiguous measure of ***educational quality***.

Educational quality is not a readily measurable concept. It is difficult to measure all of the direct outcomes of the educational process, and there is often little agreement as to what constitutes the appropriate set of outcomes.[18] Also, the technology by which educational outcomes are produced is not well understood. While there is an ever-growing literature, there is still much to be learned about which inputs, input combinations, or processes are most effective. This lack of a clear understanding of the production technology also makes it difficult to allocate resources in the most cost-effective manner. Possible trade-offs among inputs are not well understood, and the determination of the cost of comparable inputs is a complex undertaking.[19]

For these reasons, it is difficult to establish a clear-cut relationship between expenditures and the quality of educational services and to quantify the potential trade-offs among school inputs (e.g., teachers, aides, and support personnel). Thus, for the purpose of developing estimates of cost differences in education, there has been a reliance on what are referred to by economists as *fixed-market-basket (FMB)* cost indices. The issues are quite analogous to the problem of measuring consumer satisfaction and the analyses of consumer price differences. Using the fixed-market-basket assumption, the overall GCEI is defined as the weighted average of the component indices for the personnel and non-personnel inputs purchased by school districts. The weights used to aggregate these component indices into a single overall GCEI are the budget shares for each input: that is, the average proportion of total current expenditures

[18] The movement towards comprehensive standards-based reform in education is creating some pressure on the part of states to establish uniform sets of standards to apply to all children and to establish program accountability in terms of outcomes rather than inputs. For a discussion of the relationship between student achievement and skills in the real world, see Levin (1997).
[19] See Chambers (1981a and 1995) for a discussion of sorting out teacher cost differences, and see Levin (1975) for an example of the complexities and data requirements for cost-effectiveness analysis.

allocated to the corresponding input. The resulting GCEI represents the patterns of variation in the costs of a fixed market basket of comparable educational inputs.

Over the past century, economists have developed a very rich literature on the economic theory of index numbers.[20] This literature focuses to a large extent on the development of procedures for measuring levels of input, output, and productivity.[21] Through this literature, economists have developed techniques for calculating *true* cost-of-living indices that reflect the patterns of substitution between consumer goods that occur in the face of relative differences in the prices of these goods. That is, when the price of coffee increases relative to the price of tea, consumers may substitute tea for coffee while still maintaining overall levels of satisfaction. Using this analogy in education, one could imagine that a change in the relative cost of teachers versus administrative staff or teacher aides (classified personnel) would cause school districts to substitute the relatively cheaper input for the other in order to maintain educational quality.

The fixed-market-basket index does not account for these patterns of substitution, and hence more sophisticated economic models are required to calculate the GCEI. For this purpose, economists have developed what is referred to in the literature as a *superlative index,* which can, under certain assumptions, be used to estimate a *true* GCEI. Additional data on the actual budget weights in each district are necessary to calculate this *superlative GCEI*.

This chapter describes both the fixed-market-basket approach and the superlative-index approach to calculating the GCEI. For the purpose of the final GCEI in Alaska, we have utilized the superlative index. While the two indices are highly correlated with one another, there are a few districts where there are noticeable differences between the two. This is discussed at the end of this chapter.

Fixed-Market-Basket (FMB) Approach

The fixed-market-basket (FMB) index approach measures the overall differences in costs of education by observing the differences in total costs required to purchase a fixed quantity of school inputs in the face of differences in the prices of the individual school inputs. This FMB can be used to compare costs for a single district or collection of districts over time or to compare the costs between two districts at a single point in time as is done for a geographic cost of education index. In other words, the basket of goods and services (i.e., school inputs) is fixed, regardless of each individual district's actual purchases.

One advantage to the FMB approach in calculating the overall GCEI is that it has been utilized consistently in virtually all of the previous studies, and it is most easily understood. The

[20] For a survey of the economic theory of index numbers, see Diewert (1979).

[21] For excellent examples of this literature, the reader is referred Caves, Christensen, and Diewert (November 1982 and March 1982).

FMB has intuitive appeal because of its simplicity. Another advantage is that it generally requires somewhat less effort in data collection because the necessary budget share data are often readily available from state-level sources, and there is no need to obtain more detailed data to make the calculations.

One problem inherent to this approach is obvious: different district budgets exhibit proportions of education inputs that differ significantly from one another. While the allocations of district budgets among inputs do vary, it is surprising how consistent these patterns are for the vast majority of districts throughout the nation. In most districts in the nation, about 80 percent of school district budgets are spent on school personnel, including about 50 percent of the total on teachers, with another 3 to 5 percent on personnel services and 15 percent on various non-personnel resources. However, this variation in the allocation of district budgets is significantly wider in Alaska. For example, the percentage of Alaska school district budgets expended on teachers' salaries and benefits ranges from about 25 percent to 65 percent. Spending on energy services ranges from a low of about 1 percent to a high of about 20 percent, while spending on supplies and materials ranges from about 2 to 31 percent of the total budget. Travel for teachers ranges from 0.1 percent to about 5 percent of the budgets. Therefore, picking one district to serve as a baseline will, in some cases, create misleading index numbers due to different budgeting decisions and approaches. A more subtle issue is the way in which different prices of the same inputs (i.e., teacher salaries) can affect budgeting decisions. If teachers are a relatively scarce, more expensive resource in one district, that district may spend more on teacher aides and hire fewer teachers in an attempt to achieve the same level (i.e., quality) of educational services.

This substitution of one input for another that occurs as relative prices of the inputs change is commonly referred to as *commodity or input substitution* in the economic literature on the development of price indices. The notion underlying commodity substitution is easily understood, though the impact on outcome measures like *consumer satisfaction* or *educational quality* is difficult to measure. It is simply the notion that one can produce the same level of educational quality (or consumer satisfaction) with various combinations of the inputs, i.e., teachers and aides.

Superlative Indexes and Commodity Substitution Bias

Recognizing the issue of commodity substitution, how does one deal with the bias that occurs with the FMB estimates of the GCEI? Economists for years contended that the only way to resolve this problem required detailed knowledge of the parameters that underlie the input-output relationships in education. As Caves, Christensen, and Diewert (November, 1982) state it:

> *Comparisons based on econometric estimates of the structure of production have often been viewed as being more desirable than index number comparisons; this view is based on the belief that index numbers are consistent only with restricted structures of production. Our results show that this belief is erroneous; in fact, the structures of production, which we have considered in this paper are so general that they would be difficult to estimate econometrically. (p. 1411)*

What Caves, Christensen, and Diewert show is a way to estimate the differences in the costs of living between two individuals at a point in time or for the same individual between two points in time using only observable information on prices and quantities purchased. They show that an index number originally proposed by Tornqvist (1936) can be used to measure the geometric mean of two cost-of-living indexes based on the *utility functions* of two different consumers facing different prices, purchasing different quantities, and with differences in taste.[22] This is the equivalent of saying that the Tornqvist index can be used to compare the costs of education between two districts with differing perceived technologies for producing educational services, facing different prices, and purchasing different quantities of school inputs.

One of the critical features of this formula relative to that of the FMB CEI is that to calculate the superlative index requires information on the budget shares for each input from each observation (i.e., each school district) included in the analysis as well as relative price differences of the specific inputs.

Determination of Budget Shares and Application of the Index Values

To apply the procedures for calculation of the GCEI (whether using the FMB or superlative index approach), we first needed to estimate the budget shares for each of the inputs for which we have a component cost index value. We utilized the audited budget data provided by the ADEED and focused on the operating budget. The operating budget data are organized into a matrix by function and object of expenditure. Appendix G contains the details of how these two index numbers (i.e., the FMB-GCEI and the SGCEI) are calculated along with a simple example to illustrate the potential impact of these approaches. The matrix corresponding to the budget database is presented in Exhibit I-1 and identifies the particular input cost index to be assigned to each of the cells (i.e., budget components) in the matrix.

The inputs for which we have calculated indices and which are assigned to one of the cells in the budget matrix are listed below:

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22 A *utility function* is a specific theoretical construct used by economists to measure consumer satisfaction and well-being, and it forms the basis for the theory of consumer demand for goods and services.

- Personnel inputs:
  - Teachers
  - Administrators and support personnel
  - Classified personnel
- Non-personnel inputs:
  - Energy services
  - Goods
    - Paper (representing instructional materials, books and other supplies)
    - A windowpane (representing items purchased under capital outlay)
  - Travel costs for
    - teacher professional development
    - specialists, other itinerant staff, district support personnel traveling between the schools and the district office
    - school administrators
    - district administrators
    - maintenance and operation for purchased services

Under the FMB approach, we would use the Anchorage budget data to calculate the appropriate standardized budget shares against which the index would be calculated for every school district.[23] We will subsequently refer to this FMB index as the FMB-GCEI.

Using the Tornqvist superlative approach, we would use the arithmetic average of the budget share data for each district and for Anchorage to calculate the overall, weighted, relative cost of education index (see Equation I-4 in Appendix I). This index will subsequently be referred to as the Superlative Geographic Cost of Education Index (SGCEI).

A Comparison of the FMB and Superlative Indices

In most states, one would not anticipate a great difference between the SGCEI and the FMB-GCEI because there is little difference in the budget shares across districts. However, in Alaska, budget shares for different inputs vary significantly across local school districts, and this argues for using the SGCEI because it does a superior job of accounting for substitution across inputs that may occur in the face of significant changes in the relative price or cost of those inputs. Therefore, based on the economic theory of index numbers (Diewert, 1976), the SGCEI represents a *true* cost index for educational services, and we believe that the SGCEI is a more appropriate choice for calculation of the Alaska school district cost adjustment. All of the charts

[23] In studies in other states, the common approach to developing the standardized budget shares is to use the pupil-weighted average budget shares. By using the pupil-weighted averages, you treat all students within the state with equal weight in the calculations and you maintain the neutrality of the impact of the cost index calculations on state aid distributions.

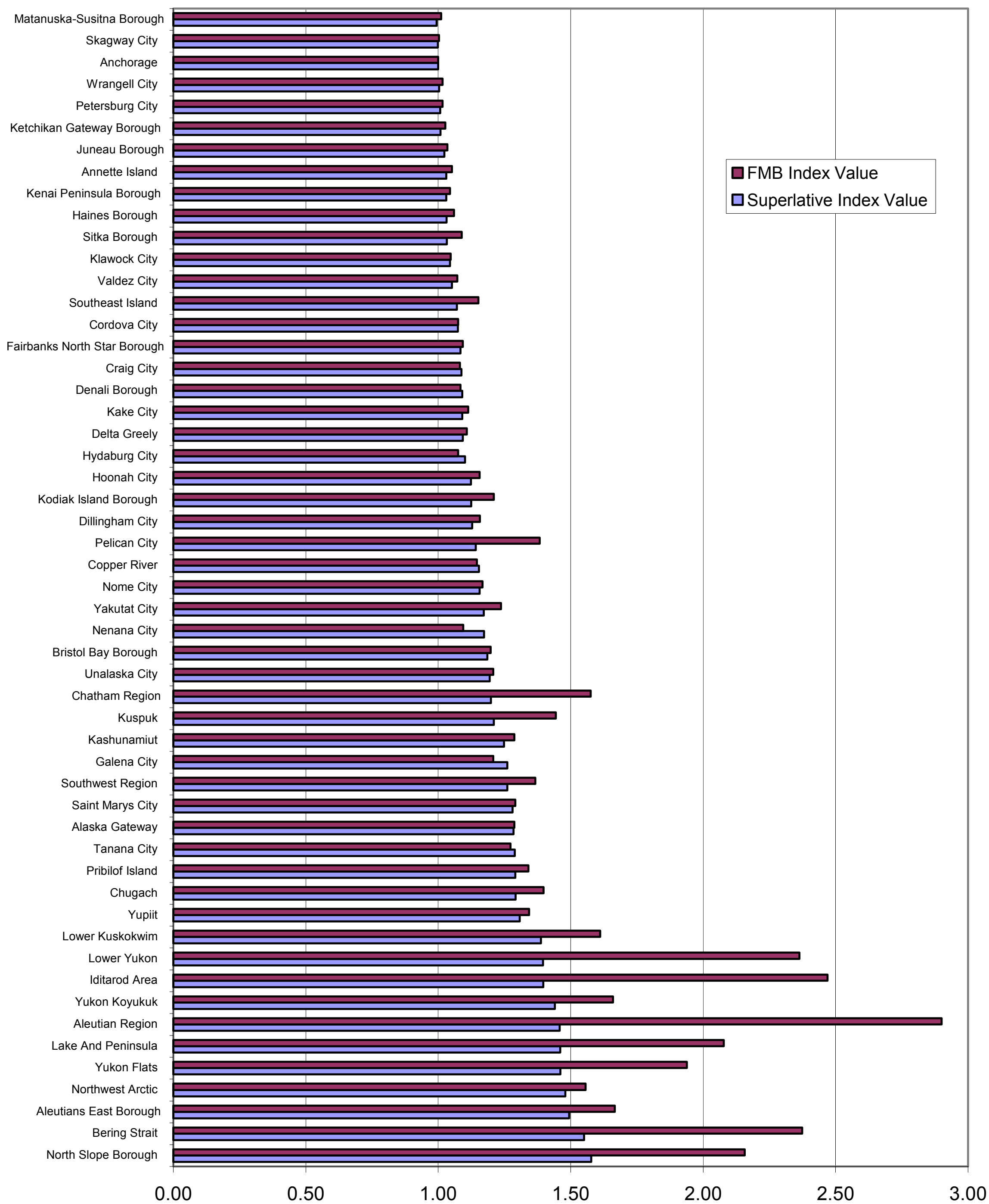
presented and discussed in Chapter II of this report are based on the SGCEI described in this Chapter.

Exhibit VI-1 presents the FMB-GCEI and the SGCEI for each of the 53 school districts in Alaska. The districts are sorted in this horizontal bar graph according to the value of the SGCEI, from lowest to highest. For the purposes of comparison, the FMB-GCEI is shown on top of the corresponding SGCEI. For most districts, the two index values are almost identical, and the correlation between the two is 0.84.

Some school districts exhibit larger variation between the two GCEI values than do others. For example, the SGCEI for Aleutian Region School District is 1.46, but the FMB-GCEI for the same district is 2.90. The reason for the variation in values between the indexes is explained by the relative budget weights assigned to the individual index components. The FMB-GCEI is based on the budget weights of Anchorage, while the SGCEI is based on the average of the budget weight of Anchorage and the budget weight of the district for which the index value is created. Aleutian spends a smaller percentage of its total operating budget on both teachers and classified staff than does Anchorage. However, Aleutian spends a greater percentage than Anchorage spends on energy, which is a high-cost item for Aleutian. Also, Aleutian allocates a greater portion of its budget to travel than does Anchorage, and Aleutian exhibits large index values associated with all types of travel. Moreover, the geographic location and configuration of the district prevents the Aleutian Region School District from substituting alternative input combinations to produce educational services. These differences in the percentages of the total operating budget that are assigned to the individual index components show how the FMB-GCEI and SGCEI can differ within a school district.

Volume 1 – Summary of Results shows four categories of inputs, which combine to create the SGCEI. The four categories of personnel, energy, travel, and goods have all been discussed earlier in this report. Each of the four component inputs was created by using the same mathematical approach as the overall SGCEI. That is, each specific budget share within a district was averaged with the value of the appropriate budget share in Anchorage to arrive at the budget weight. The major difference is the rescaling of the budget shares, which does not alter the relative impact of each component. For example, if we were creating an index for all personnel in the district, then the sum of the budget shares for teachers, administrators, and classified staff becomes the denominator for which each of the addends is divided. The budget weights for any one group of the input categories sum to 1, whereas it would sum to less than 1 in the overall SGCEI because it represents only one of four inputs in the overall SGCEI. The natural log of each smaller component (e.g., teachers) of the input group (e.g., personnel) was multiplied by its rescaled budget weight, and the smaller components were summed together. The exponential of this log-form sum was taken to arrive at the input component values reported in *Volume 1*. The calculation of the input component indexes displayed in *Volume 1* can be thought of as an intermediate step to arriving at the same overall SGCEI.

Exhibit VI-1. Comparison of the Fixed Market Basket GCEI and the Superlative GCEI



NOTES TO EXHIBIT: The districts listed on the vertical axis in this diagram are sorted in ascending order according to the value of the Superlative Geographic Cost of Education Index (SGCEI), with the lowest on top.

Chapter VII. Implementation Issues

This section presents six recommendations to the Alaska State Legislature (ASL) based on this report. In each case, the recommendation is followed by a discussion of some of the details associated with implementation.

RECOMMENDATION 1: Adopt a New Cost Adjustment. *The ASL should replace the current Alaska cost index for education with the new AIR GCEI.*

The purpose of this report has been to produce a GCEI that can be used to adjust nominal distributions of state aid to reflect real purchasing power for the individual school districts in Alaska. The GCEI produced in this report is intended to replace the previous cost adjustment developed by the McDowell Group more than five years ago. A major difference between the AIR and McDowell studies is that, while both rely to some degree on existing information about educational spending patterns in Alaska School Districts, the AIR GCEI applies a methodology that goes beyond simply reflecting current spending behavior by school districts. The AIR GCEI includes only those factors that are *beyond the control of local school district decision makers*.

RECOMMENDATION 2: Improve Personnel Databases. *The ASL should direct the ADEED to improve and maintain the quality of the school personnel data systems in order to permit utilization of the hedonic wage model for updating the personnel components of the GCEI in the future. Specifically, this recommendation includes the following components:*

- *(a) Improve the quality of the current Certified Staff Assignment Reporting (CSAR) system by running routine auditing checks on the files to ensure that information reported on individual personnel are accurate.*
- *(b) Convert the current data collected on certification for school personnel into an electronic form that is capable of being merged with the CSAR files.*
- (c) *Develop a data system similar in structure to the CSAR for classified staff (e.g., paraprofessionals, clerical support staff, custodial and skilled maintenance staff, and technical or managerial staff) so that these data may also be utilized for analysis of patterns of compensation using the hedonic wage method.*

Two categories of variables are necessary for the analysis of personnel compensation: the *personal qualifications and job assignment characteristics* and the *cost factors*. The first group of variables includes those that we want to control for (hold constant) in the simulations necessary to calculate the personnel cost indices. However, it is important to have as many control variables as possible that might impact the patterns of employment of different categories of school personnel. While the current Certified Staff Accounting Report (CSAR) was sufficient for the analysis in this project, AIR believes that there are some improvements that ADEED could make in its data collection procedures that would improve the quality of the database and analysis of personnel compensation.

First, AIR suggests that ADEED be charged with responsibility for maintaining and auditing the personnel files for accuracy. Data-checking routines should be put in place to examine changes over time and to search for inconsistencies in the information reported to ADEED. During the course of the analysis, AIR discovered some inconsistencies in the way data were reported for the same school district employees over time. For example, experience levels of the same employees over time sometimes decreased, and the birth dates for the same employees differed over time. If these data are to be used as the basis for future analysis of personnel compensation, it is important that they accurately reflect employee qualifications. It should be noted that if districts are informed that these personnel data will be used in the future to determine school funding distributions, they will be more likely to spend the time to ensure the accuracy of the records.

Second, AIR recommends that the ADEED consider using the certification applications of teachers to create electronic records of teacher examination test scores and colleges attended, both of which are on the applications. The test scores and the data on the colleges could be used by analysts to determine the average selectivity or quality of the colleges attended as a proxy for quality of the individuals who are employed by public schools. ADEED should also consider reorganizing the CSAR to permit analysts to ascertain the percentage of teacher assignments for which each teacher is appropriately or fully certified. ADEED should also attach a unique identifier to each certified employee, so that they may be more easily tracked throughout the years. These changes would provide a stronger and more comprehensive set of personal qualifications that would help in the analysis of variations in personnel compensation.

Third, given the differences in the labor markets for classified and certified personnel, AIR recommends that ADEED consider implementing a data collection for classified personnel similar to the one for certified personnel, adapted to the needs of that population of employees. Such a data collection should gather some of the following data elements, permitting future analyses to control more accurately for qualifications of classified staff:

- Identification codes to permit tracking of personnel over time
- Compensation in the form of hourly wage rates
- Job title (e.g., school secretary, custodian, skilled maintenance, teacher aide)
- Total hours of work per week and per year
- Educational preparation (e.g., high school diploma, vocational training in a relevant field)
- Years of experience in this type of work
- Years working for the present district

- Date of birth
- Gender
- Race-ethnicity

While AIR collected some of these data during this project, it was clear that many districts did not keep all of this information in an easily accessible form. Establishing such a regular and periodic data collection would provide the state with a valuable source of information about staffing of public schools and a source of data that could be used to analyze patterns of compensation for updating the GCEI. Having data that would allow tracking these patterns over time would allow ADEED to determine the stability of these patterns of variation, which is currently not possible given the single year of data collected for the present study. We do not know the extent to which turnover might be a factor in analyzing the patterns of compensation of classified personnel, as there were no time series data that would allow us to determine turnover rates as we were able to do for certified personnel.

RECOMMENDATION 3: Adopt Data Collection on Non-Personnel Elements. *AIR recommends that the ADEED develop regular and periodic data collections to gather information on the prices of energy services; the prices of certain supplies, materials, and small capital equipment; and the prices of travel between the schools and district office and the district office and Anchorage.*

While some of the factors that affect the costs of non-personnel inputs will not change substantially (if at all) over time, there are a number of factors that may be subject to change on a year-to-year basis. For example, it is expected that the following elements involved in the calculation of the non-personnel cost indices will be subject to change over time:

- prices of energy sources (e.g., heating oils or utility rates)
- airfare or other travel costs used to determine the cost of traveling between the school sites and the district office and between the district office and Anchorage or other centers of commerce
- delivered prices of the selected items used to estimate the relative cost of transporting goods to the districts from the centers of commerce

AIR suggests that the ADEED adapt the AIR data collection instruments for collecting some of the critical elements used as part of the analysis contained in this report. The procedures AIR utilized for the current project are relatively efficient and could easily be adapted with the help of school business officers such as those who served on the TWG for this project.

A key ingredient to the success of this kind of data collection is establishing each component as a standard part of the reporting system by ADEED. ADEED should expect a 100 percent response for maintaining and updating the GCEI, and district officials will adapt their own database systems to facilitate their ability to respond to such requests for data.

RECOMMENDATION 4: Frequency of Updates. *AIR recommends that the ASL conduct a study of school district cost differences at an interval of approximately every three to five years.*

Previous research suggests that the GCEI values are not likely to change very much from one year to the next or, for that matter, over a period of years. Such cost indices reflect relative differences in the costs of educational services. That is, while the absolute prices of certain inputs (e.g., the wages of school personnel) may change over time, the factors that affect the differences in prices across local school districts do not change very rapidly over time. Indeed, Chambers has done numerous studies of wage differences across school districts in the U.S., and has found that the correlations between these index values estimated at different points in time are quite high. Chambers (1981c) reported that the correlations between the Missouri GCEI for the 1974-75 and 1975-76 school years was 0.94. In California, the correlation across two different years, with a major property tax limitation measure passed between the two years (the famous Proposition 13), was 0.87. In a nationwide study of geographic cost differences using data for 1987-88, 1990-91, and 1993-94 (Chambers, 1997a), the correlation between the geographic cost indices for each pair of years (87-88 with 90-91, and 90-91 with 93-94) was 0.98, while the correlation across the six-year span was 0.96.

As a dramatic test of how such indices change over time, we decided to take the equivalent of the GCEI index values developed out of the previous Alaska cost study conducted by Chambers and Parrish (1984) and compare them to the values calculated in the current project.[24] The correlation between these two indices, which were calculated 18 years apart, exceeded 0.85.

The analysis of the Alaska personnel data is consistent with the findings of previous research on the stability of the index values over time. As part of our current project, the AIR research team acquired the personnel data files for four different school years from ADEED. Using these data, we were able to estimate a variety of statistical models and test the

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[24] The earlier study by Chambers and Parrish was designed to develop a more comprehensive model of the cost of an "adequate" education in Alaska schools and included measures of cost differences arising out of differences in pupil need, scale of district and school operations, and the prices of comparable school inputs. Thus, the implicit cost index calculated from this model is not strictly comparable to the GCEI calculated in this report. In part this results from the fact that the budget weights used to aggregate the component index values into an overall index are based on the service delivery systems specified by a committee of educators selected from school districts in Alaska. Nevertheless, the basic component indices from which the 1984 GCEI was calculated were developed using methods very similar to those used in the current study.

stability of these index values for different years. Correlations among the personnel indices calculated for different years were all well above 0.90, and for adjacent years these correlations were above 0.95. (The actual parameter estimates for these statistical models are presented in Appendix E along with the correlations among all of the indices.)

The personnel components, which dominate the GCEI calculations, tend to be stable over a five to six year period of time. The non-personnel elements may tend to vary over a shorter time period, but there are no data other than the overall patterns to rely on for some assurance on these non-personnel components. Thus, AIR suggests that five-year studies on personnel are likely to be sufficient for changes in that component. However, it would be useful for further analysis of the patterns of change in the non-personnel components to be conducted over the next few years to explore how rapidly these components change. Given that the overall patterns over an 18-year period have been fairly stable, the non-personnel components could be done every three years until a database has been developed to sufficiently test the stability of these components. The energy component relies heavily on an engineering component that predicts the energy consumption levels, and this relies heavily on climatic norms that do not change dramatically over time. However, energy costs are also impacted by price differences in the energy fuel sources. Travel costs and other prices of goods do change from year to year, but much of the difference in these is associated with relative distances and the associated travel or transportation costs between points in Alaska. While these may change over time, the relative differences may not vary as much as the absolute values.

Recommendation 5: Use an Economist for Labor Market Analyses. *AIR recommends that the ASL employ or contract with a professional economist or an individual with proven experience and training in labor market studies to conduct the analyses of the compensation of school personnel that underlie the personnel cost index components.*

It is important to employ an individual with experience in labor market analysis and in the use of procedures such as the hedonic wage model. While the techniques appear fairly simple on the surface, this analysis does require an understanding of the conceptual framework and its limitations in empirical application. There are some significant judgments that need to be made in the selection of the independent variables, the measurement of the dependent variable, the choice of functional form, and the application of statistical techniques that require highly specialized training and experience. Employing an economist ensures that the person conducting future studies is familiar with standard techniques of analysis of labor markets. Because of changes over time in the labor markets, one cannot simply re-estimate the exact equations used for the current analysis of school personnel. It may also be important to take into account the potential for new measures of school, district, and regional characteristics that may be included in this analysis.

RECOMMENDATION 6: Phase in the New Index. *AIR recommends that the ALS develop procedures to phase in new GCEI numbers over time.*

It is important to recognize that the index values derived from the econometric models described in this report represent only approximations to the complex, real-world transactions that make up the labor markets for school personnel. While cost adjustments do not change rapidly over time, there are a number of factors that may result in some significant changes in the relative costs over time. For the current study, a completely different methodology was used to calculate the new GCEI than was used for the current district cost adjustment. In the future, even with a constant methodology, there may be changes in the index numbers that could have substantial impact on district budgets. Some of this occurs because of the statistical nature of the procedures used to estimate these index numbers. Even these estimates' relatively small standard error of one percent implies a confidence interval of plus or minus two percent. This means that over a five-year period, changes of as much as four percent could easily be accounted for by statistical error alone. A four percent change in budgets can mean hundreds of thousands of dollars in the budget of a given district. Therefore, in order not to cause any major disruptions in the flow of services, the ASL should consider methods for adjusting or phasing in new GCEI numbers over a period of approximately five years. For example, the allocations of aid could be adjusted so that any gap in funding resulting from changes in the GCEI over time would be closed at a rate of, for example, 20 percent per year. At the end of a five-year period, the full impact of the index value would be felt. Alternatively, the state could adopt a moving average technique that averages the values of the indices over a period of time (e.g., three years) so that changes are less disruptive.

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Appendix A.
Data Sources

Certified Staff. A primary data source for the analysis of certified school personnel (teachers, school administrators, and other professional personnel) is the *Certified Staffing Accounting Report (CSAR)* submitted by each district to ADEED. The CSAR provides basic information on the personal characteristics and job assignments of all certified school personnel in the state of Alaska. These variables include salary, total years of experience, educational background, race-ethnicity, age, gender, job title, and teaching assignment codes. Virtually all of these variables are within the control of the local district. That is, district administrators can select the characteristics of its staff as long as sufficient turnover exists in the district. AIR received four years of the CSAR data from ADEED, from the 1998-1999 school year to the 2001-2002 school year. These data were used in analysis of salaries and turnover for teachers, administrators and other certified professional staff.

Benefits. Part of our data collection involved asking districts about contributions or expenditures for such things as housing subsidies for professional staff. The data were collected on a number of benefits, including: medical, dental, vision, travel, and life insurance; housing subsidies; travel benefits; and retirement benefits.

Classified Staff. While there are some differences in the patterns of wage variations for classified staff across local school districts, they do represent a substantially smaller percentage of the overall school district budget. Moreover, there is generally a correlation between classified cost differences and those observed for teachers and other certified school personnel.[25] AIR collected original data from district payroll records on pay rates and hours of work per year, a limited set of personal characteristics, and job-related characteristics for a large sample of classified school personnel employed by Alaska school districts. The personal characteristics included: birthdate, gender, and race-ethnicty. These data were combined with school- and district-level data for use in the classified staff salary regression model.

School and District Data. ADEED provided AIR with a set of files containing location and enrollment data on each school. The enrollment data spanned five years, from the 1997-1998 school year to the 2001-2002 school year, and included ethinicity counts at each school. Data on school enrollments were then aggregated to the district level. Additional information was provided by ADEED on the gross square footage of each building within the school districts in Alaska.

Climate Data. Climate data were obtained from the National Oceanographic Association of America (NOAA) for all weather stations in Alaska. These datasets include data on precipitation and temperature , reported in 30-year normals by month and year. The termerature data were reported in heating, cooling, and total degree days, which were used in the salary

[25] The correlation between teachers' salaries and benefits and the salaries of classified staff in the superlative index is 0.71.

models. To assign data to each school, values were taken from each weather station around the school and weighted by proximity of the school to the specific station.

Census Data. The Alaska Department of Community and Economic Development (DCED) reported Census 2000 data at a community level. Data on each community fell into the four following large categories: demographic, social, economic, and housing. These communities contained in the DCED datasets were then combined with the school-level data obtained from ADEED. This provided a clearer picture of the communities within which these schools were located. The data were helpful in the analysis of comparable wages and salary models.

Appendix B.
Data Collection

For a copy of the data collection instruments, please contact Eddy Jeans at the Alaska Department of Education and Early Development:

Eddy Jeans
Manager of School Finance and Facilities
School Finance Section
Dept of Education & Early Development
801 W 10th Street, Suite 200
Juneau, AK 99801-1894

Appendix C.

Comparable Wage Model Technical Information

District Name	Labor Market Area	Comparable Wage Index	Average Wage Index	Average Wage
North Slope Borough	31 North Slope Borough	1.33	1.61	$49,172
Aleutians East	57 Aleutians East	1.00	0.62	$18,991
Anchorage	62 Anchorage	1.00	1.00	$30,606
Valdez-Cordova	75 Valdez-Cordova	0.98	1.05	$32,193
Denali Borough	47 Denali Borough	0.96	1.06	$32,355
Aleutians West	58 Aleutians West	0.94	0.73	$22,319
Northwest Arctic Borough	33 Northwest Arctic Borough	0.91	1.08	$33,125
Fairbanks	44 Fairbanks	0.90	0.88	$26,983
Juneau	86 Juneau	0.90	0.92	$28,089
Ketchikan	95 Ketchikan	0.88	0.78	$23,763
Kodiak	73 Kodiak	0.88	0.68	$20,866
Sitka	87 Sitka	0.86	0.74	$22,576
Kenai	71 Kenai	0.84	0.83	$25,407
MatSu	61 MatSu	0.83	0.74	$22,741
Bristol Bay Borough	55 Bristol Bay Borough	0.81	0.57	$17,456
Wrangell-Petersburg	91 Wrangell-Petersburg	0.81	0.66	$20,324
Yakutat	79 Yakutat	0.78	0.63	$19,175
Dillingham	50 Dillingham	0.78	0.75	$22,944
Haines	85 Haines	0.78	0.58	$17,839
Southeast Fairbanks	46 Southeast Fairbanks	0.76	0.70	$21,493
Skagway-Angoon	80 Skagway-Angoon	0.75	0.61	$18,619
POW-Outer Ketchikan	93 POW-Outer Ketchikan	0.75	0.67	$20,594
Bethel	52 Bethel	0.74	0.72	$22,012
Nome	34 Nome	0.73	0.72	$22,141
Lake and Peninsula	59 Lake and Peninsula	0.70	0.55	$16,925
Yukon-Koyukuk	41 Yukon-Koyukuk	0.68	0.81	$24,838
Wade Hampton	51 Wade Hampton	0.63	0.64	$19,719

Appendix D1.

Final Estimating Equations for Administrators, Teachers, and Classified Personnel

Exhibit D1-a. Final Econometric Model for Explaining the Patterns of Compensation for Administrators and Other Non-Teaching Personnel

The LIFEREG Procedure

Model Information

Data Set	WORK.TCHR
Dependent Variable	lsal
Dependent Variable	cens
Number of Observations	2801
Noncensored Values	2200
Right Censored Values	601
Left Censored Values	0
Interval Censored Values	0
Missing Values	731
Name of Distribution	Normal
Log Likelihood	910.50923045

Analysis of Parameter Estimates

Parameter	DF	Estimate	Standard Error	95% Confidence Limits		Chi-Square	Pr > ChiSq
Intercept	1	10.0926	0.1314	9.8352	10.3501	5903.05	<.0001
percent_teaching	1	-0.0008	0.0003	-0.0015	-0.0002	6.58	0.0103
fy2000	1	-0.0149	0.0069	-0.0284	-0.0014	4.68	0.0306
fy2001	1	0.0135	0.0074	-0.0011	0.0281	3.31	0.0690
adjexp	1	0.0334	0.0044	0.0247	0.0421	56.47	<.0001
adjexp2	1	-0.0007	0.0007	-0.0021	0.0007	1.06	0.3042
adjexp3	1	-0.0000	0.0000	-0.0001	0.0000	1.17	0.2804
adjexp4	1	0.0000	0.0000	0.0000	0.0000	4.03	0.0447
female	1	-0.0295	0.0068	-0.0429	-0.0162	18.84	<.0001
age1	1	0.0055	0.0004	0.0047	0.0063	181.27	<.0001
age_missing	1	0.1520	0.1039	-0.0516	0.3557	2.14	0.1433
degree3	1	0.0446	0.0088	0.0273	0.0619	25.45	<.0001
degree4	1	-0.0107	0.0522	-0.1131	0.0917	0.04	0.8373
degree5	1	0.0886	0.0262	0.0372	0.1401	11.41	0.0007
ethnic_black	1	-0.0177	0.0161	-0.0492	0.0138	1.21	0.2707
ethnic_hisp	1	0.0222	0.0247	-0.0263	0.0707	0.81	0.3694
ethnic_asian	1	0.0107	0.0248	-0.0379	0.0593	0.19	0.6669
ethnic_indian	1	0.0408	0.0314	-0.0207	0.1023	1.69	0.1936
ethnic_nativeAK	1	-0.0511	0.0201	-0.0905	-0.0117	6.46	0.0110
assign_elem	1	0.0065	0.0100	-0.0131	0.0260	0.42	0.5172
assign_mathsci	1	-0.0219	0.0314	-0.0835	0.0397	0.48	0.4864
assign_multgrade	1	-0.0324	0.0132	-0.0583	-0.0065	6.00	0.0143
assign_se	1	-0.0245	0.0194	-0.0624	0.0135	1.60	0.2063
assign_004	1	-0.0953	0.0625	-0.2178	0.0271	2.33	0.1271
headtchr	1	0.1020	0.0462	0.0114	0.1926	4.87	0.0274
principal	1	0.2702	0.0119	0.2468	0.2936	513.48	<.0001
asst_principal	1	0.2778	0.0151	0.2482	0.3073	339.41	<.0001
counselor	1	-0.0534	0.0124	-0.0777	-0.0290	18.45	<.0001
librarian	1	-0.0840	0.0127	-0.1090	-0.0590	43.50	<.0001
prof	1	-0.0714	0.0119	-0.0947	-0.0482	36.16	<.0001
secondary_school	1	0.0132	0.0087	-0.0038	0.0301	2.31	0.1287
totlfpr_radius	1	0.2106	0.0635	0.0863	0.3350	11.02	0.0009
wage_index	1	0.2064	0.0570	0.0948	0.3180	13.13	0.0003
utilities	1	0.0193	0.0147	-0.0095	0.0481	1.73	0.1885
hdd	1	0.0000	0.0000	-0.0000	0.0000	0.95	0.3288
hdd2	1	-0.0000	0.0000	-0.0000	0.0000	0.85	0.3578
cdd	1	-0.0005	0.0004	-0.0013	0.0003	1.40	0.2370
minDistanceCC	1	0.0001	0.0000	0.0000	0.0001	8.18	0.0042
lowrain	1	0.0007	0.0130	-0.0247	0.0261	0.00	0.9563
water_radius	1	0.0100	0.0094	-0.0084	0.0284	1.13	0.2875
member_lea_1000	1	-0.0625	0.0378	-0.1366	0.0116	2.73	0.0982
member_lea_2500	1	-0.0771	0.0362	-0.1479	-0.0062	4.54	0.0330
member_lea_10000	1	-0.0822	0.0379	-0.1566	-0.0079	4.70	0.0302
member_lea_250	1	-0.1004	0.0358	-0.1706	-0.0301	7.85	0.0051
AKNative	1	0.0567	0.0211	0.0154	0.0980	7.24	0.0071
Asian	1	-0.1583	0.0545	-0.2652	-0.0514	8.42	0.0037
Black	1	0.0024	0.0627	-0.1206	0.1253	0.00	0.9697
Hispanic	1	-0.1408	0.0943	-0.3257	0.0441	2.23	0.1355

Exhibit D1-b. Final Econometric Model for Explaining the Patterns of Compensation for Full-Time Teachers

The REG Procedure
Model: MODEL1
Dependent Variable: lsalben

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	41	198.77919	4.84827	450.24	<.0001
Error	6076	65.42752	0.01077		
Corrected Total	6117	264.20670			

Root MSE	0.10377	R-Square	0.7524
Dependent Mean	10.75471	Adj R-Sq	0.7507
Coeff Var	0.96488		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	10.20922	0.05590	182.64	<.0001
adjexp	1	0.03961	0.00197	20.15	<.0001
adjexp2	1	-0.00070202	0.00023621	-2.97	0.0030
adjexp3	1	-0.00001535	0.00001040	-1.48	0.1399
adjexp4	1	3.261337E-7	1.482422E-7	2.20	0.0278
newjob	1	-0.01926	0.00449	-4.29	<.0001
female	1	0.00203	0.00303	0.67	0.5034
age1	1	0.00359	0.00017620	20.40	<.0001
age_missing	1	0.15539	0.01882	8.25	<.0001
degree1	1	-0.11023	0.03959	-2.78	0.0054
degree3	1	0.05555	0.00376	14.76	<.0001
degree4	1	0.09734	0.07405	1.31	0.1887
degree5	1	0.12567	0.03013	4.17	<.0001
ethnic_black	1	-0.00466	0.01085	-0.43	0.6679
ethnic_hisp	1	-0.04236	0.01112	-3.81	0.0001
ethnic_asian	1	-0.01910	0.01042	-1.83	0.0668
ethnic_indian	1	-0.00443	0.01528	-0.29	0.7720
ethnic_nativeAK	1	-0.04410	0.00653	-6.75	<.0001
assign_elem	1	0.00566	0.00382	1.48	0.1390
assign_mathsci	1	0.00645	0.00605	1.07	0.2867
assign_multgrade	1	-0.01482	0.00363	-4.08	<.0001
assign_se	1	0.01004	0.00493	2.04	0.0418
assign_004	1	-0.01684	0.01552	-1.09	0.2779
headtchr	1	0.11578	0.01342	8.63	<.0001
secondary_school	1	0.00838	0.00394	2.13	0.0333
totlfpr_radius	1	0.07236	0.02777	2.61	0.0092
wage_index	1	0.11904	0.02117	5.62	<.0001
utilities	1	-0.01607	0.00610	-2.64	0.0084
hdd	1	-0.00001460	0.00000739	-1.97	0.0484
hdd2	1	5.6724E-10	2.79442E-10	2.03	0.0424
cdd	1	0.00188	0.00018556	10.12	<.0001
minDistanceCC	1	0.00009835	0.00000947	10.39	<.0001
lowrain	1	-0.03616	0.00678	-5.34	<.0001
water_radius	1	-0.01627	0.00408	-3.99	<.0001
member_lea_1000	1	0.07546	0.01151	6.56	<.0001
member_lea_2500	1	0.06851	0.01140	6.01	<.0001
member_lea_10000	1	0.08661	0.01266	6.84	<.0001
member_lea_250	1	0.05949	0.01119	5.32	<.0001
AKNative	1	0.07309	0.00872	8.38	<.0001
Asian	1	0.07588	0.02416	3.14	0.0017
Black	1	-0.06900	0.03324	-2.08	0.0380
Hispanic	1	-0.01548	0.04912	-0.32	0.7526

Exhibit D1-c. Final Econometric Model for Explaining the Patterns of Compensation for Classified Personnel

The REG Procedure
Model: MODEL1
Dependent Variable: lsal

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	29	174.68213	6.02352	203.94	<.0001
Error	5798	171.24507	0.02954		
Corrected Total	5827	345.92720			

Root MSE	0.17186	R-Square	0.5050
Dependent Mean	2.70680	Adj R-Sq	0.5025
Coeff Var	6.34913		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	2.04715	0.08061	25.39	<.0001
YrsDist	1	0.03549	0.00105	33.90	<.0001
YrsDist2	1	-0.00077121	0.00004160	-18.54	<.0001
female	1	-0.04651	0.00557	-8.35	<.0001
age1	1	0.00150	0.00025307	5.94	<.0001
age_missing	1	0.07201	0.01702	4.23	<.0001
ethnic_black	1	0.00545	0.01213	0.45	0.6529
ethnic_hisp	1	-0.02306	0.01302	-1.77	0.0766
ethnic_asian	1	-0.04193	0.01011	-4.15	<.0001
ethnic_indian	1	-0.00034938	0.03328	-0.01	0.9916
ethnic_nativeAK	1	-0.03636	0.00882	-4.12	<.0001
computer_tech	1	0.15191	0.02723	5.58	<.0001
supervisor	1	0.36133	0.02830	12.77	<.0001
clerical	1	0.03382	0.00767	4.41	<.0001
ed_aide	1	-0.02360	0.00520	-4.54	<.0001
totlfpr_radius	1	0.09289	0.03604	2.58	0.0100
wage_index	1	0.23167	0.02726	8.50	<.0001
utilities	1	0.01002	0.00755	1.33	0.1845
hdd	1	-9.0039E-7	0.00001066	-0.08	0.9327
hdd2	1	7.05444E-10	3.99757E-10	1.76	0.0777
minDistanceCC	1	0.00013954	0.00001319	10.58	<.0001
lowrain	1	0.00392	0.01132	0.35	0.7291
water_radius	1	-0.01802	0.00602	-2.99	0.0028
member_lea_1000	1	0.02416	0.00947	2.55	0.0108
member_lea_2500	1	0.10758	0.00785	13.70	<.0001
member_lea_10000	1	0.03760	0.01262	2.98	0.0029
AKNative	1	0.08075	0.01557	5.19	<.0001
Asian	1	-0.09344	0.04261	-2.19	0.0283
Black	1	0.04845	0.05942	0.82	0.4149
Hispanic	1	0.00743	0.08426	0.09	0.9297

Appendix D2.
Alternative Estimating Equations for School Personnel

Exhibit D2-a. Administrators and Professional Staff: the Salary and Benefits Model

The REG Procedure
Model: MODEL1
Dependent Variable: lsalben

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	46	55.25048	1.20110	78.57	<.0001
Error	990	15.13450	0.01529		
Corrected Total	1036	70.38498			

Root MSE	0.12364	R-Square	0.7850
Dependent Mean	10.94831	Adj R-Sq	0.7750
Coeff Var	1.12933		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	10.18317	0.17910	56.86	<.0001
percent_teaching	1	0.00005879	0.00047198	0.12	0.9009
adjexp	1	0.03274	0.00648	5.06	<.0001
adjexp2	1	-0.00088241	0.00096054	-0.92	0.3585
adjexp3	1	-0.00000674	0.00005090	-0.13	0.8947
adjexp4	1	3.247347E-7	8.71209E-7	0.37	0.7094
newjob	1	-0.02233	0.01084	-2.06	0.0396
female	1	-0.03170	0.00969	-3.27	0.0011
age1	1	0.00343	0.00053109	6.45	<.0001
age_missing	1	0.10388	0.05846	1.78	0.0759
degree3	1	0.04454	0.01157	3.85	0.0001
degree4	1	0.07724	0.07310	1.06	0.2909
degree5	1	0.07501	0.03429	2.19	0.0289
ethnic_black	1	-0.00972	0.02309	-0.42	0.6739
ethnic_hisp	1	-0.01121	0.02762	-0.41	0.6850
ethnic_asian	1	-0.02282	0.03637	-0.63	0.5305
ethnic_indian	1	-0.04977	0.03717	-1.34	0.1809
ethnic_nativeAK	1	0.05248	0.02786	1.88	0.0599
assign_elem	1	-0.00574	0.01369	-0.42	0.6751
assign_mathsci	1	0.02951	0.03561	0.83	0.4075
assign_multgrade	1	0.01596	0.01940	0.82	0.4108
assign_se	1	0.11768	0.02247	5.24	<.0001
assign_004	1	-0.07090	0.06553	-1.08	0.2795
headtchr	1	0.00541	0.04435	0.12	0.9029
principal	1	0.37206	0.01623	22.93	<.0001
asst_principal	1	0.36020	0.01989	18.11	<.0001
counselor	1	0.01927	0.01676	1.15	0.2506
librarian	1	0.02399	0.01773	1.35	0.1762
prof	1	-0.00368	0.01643	-0.22	0.8227
secondary_school	1	0.01811	0.01055	1.72	0.0863
totlfpr_radius	1	0.15159	0.08681	1.75	0.0811
wage_index	1	0.04946	0.07128	0.69	0.4880
utilities	1	0.00644	0.01942	0.33	0.7402
hdd	1	0.00000450	0.00002221	0.20	0.8393
hdd2	1	-1.9546E-11	8.53375E-10	-0.02	0.9817
cdd	1	-0.00127	0.00052143	-2.44	0.0147
minDistanceCC	1	0.00005793	0.00002962	1.96	0.0507
lowrain	1	-0.00261	0.02012	-0.13	0.8967
water_radius	1	0.02496	0.01445	1.73	0.0844
member_lea_1000	1	0.07868	0.04378	1.80	0.0726
member_lea_2500	1	0.03880	0.04404	0.88	0.3785
member_lea_10000	1	0.06854	0.04822	1.42	0.1555
member_lea_250	1	0.03587	0.04179	0.86	0.3910
AKNative	1	0.03740	0.02808	1.33	0.1833
Asian	1	-0.02420	0.06812	-0.36	0.7225
Black	1	-0.04890	0.09138	-0.54	0.5927
Hispanic	1	-0.15070	0.13004	-1.16	0.2468

Exhibit D2-b. Full-Time Teachers: the Turnover-Adjusted Model

The LIFEREG Procedure

Model Information

Data Set	WORK.TCHR
Dependent Variable	lsal
Dependent Variable	cens
Number of Observations	17011
Noncensored Values	14723
Right Censored Values	2288
Left Censored Values	0
Interval Censored Values	0
Missing Values	5049
Name of Distribution	Normal
Log Likelihood	9284.8514448

Analysis of Parameter Estimates

Parameter	DF	Estimate	Standard Error	95% Confidence Limits		Chi-Square	Pr > ChiSq
Intercept	1	10.1651	0.0388	10.0890	10.2412	68511.7	<.0001
fy2000	1	-0.0178	0.0023	-0.0224	-0.0133	59.04	<.0001
fy2001	1	0.0154	0.0026	0.0104	0.0205	36.20	<.0001
adjexp	1	0.0437	0.0014	0.0411	0.0463	1045.78	<.0001
adjexp2	1	-0.0010	0.0002	-0.0014	-0.0006	25.90	<.0001
adjexp3	1	-0.0000	0.0000	-0.0000	0.0000	1.87	0.1714
adjexp4	1	0.0000	0.0000	0.0000	0.0000	7.62	0.0058
female	1	0.0025	0.0021	-0.0016	0.0066	1.45	0.2293
age1	1	0.0045	0.0001	0.0043	0.0048	1248.04	<.0001
age_missing	1	0.1726	0.0320	0.1098	0.2353	29.03	<.0001
degree1	1	-0.1737	0.0259	-0.2244	-0.1230	45.13	<.0001
degree3	1	0.0631	0.0027	0.0578	0.0683	556.39	<.0001
degree4	1	0.0871	0.0467	-0.0045	0.1787	3.48	0.0623
degree5	1	0.1317	0.0215	0.0895	0.1739	37.38	<.0001
ethnic_black	1	-0.0047	0.0072	-0.0188	0.0094	0.43	0.5143
ethnic_hisp	1	-0.0209	0.0078	-0.0361	-0.0057	7.27	0.0070
ethnic_asian	1	-0.0093	0.0070	-0.0231	0.0044	1.78	0.1825
ethnic_indian	1	-0.0040	0.0098	-0.0232	0.0152	0.17	0.6823
ethnic_nativeAK	1	-0.0442	0.0045	-0.0531	-0.0354	96.06	<.0001
assign_elem	1	-0.0059	0.0025	-0.0108	-0.0010	5.48	0.0192
assign_mathsci	1	0.0054	0.0044	-0.0032	0.0140	1.52	0.2171
assign_multgrade	1	-0.0176	0.0024	-0.0223	-0.0129	54.21	<.0001
assign_se	1	0.0130	0.0032	0.0067	0.0192	16.63	<.0001
assign_004	1	-0.0378	0.0103	-0.0580	-0.0177	13.50	0.0002
headtchr	1	0.1076	0.0098	0.0884	0.1269	120.43	<.0001
secondary_school	1	0.0022	0.0031	-0.0038	0.0082	0.53	0.4665
totlfpr_radius	1	0.0819	0.0192	0.0443	0.1195	18.19	<.0001
wage_index	1	0.1443	0.0148	0.1153	0.1732	95.36	<.0001
utilities	1	-0.0129	0.0044	-0.0215	-0.0043	8.63	0.0033
hdd	1	-0.0000	0.0000	-0.0000	-0.0000	17.19	<.0001
hdd2	1	0.0000	0.0000	0.0000	0.0000	18.63	<.0001
cdd	1	0.0013	0.0001	0.0011	0.0016	100.14	<.0001
minDistanceCC	1	0.0001	0.0000	0.0001	0.0001	245.85	<.0001
lowrain	1	-0.0102	0.0043	-0.0187	-0.0017	5.53	0.0187
water_radius	1	-0.0210	0.0028	-0.0265	-0.0154	54.99	<.0001
member_lea_1000	1	0.0381	0.0091	0.0203	0.0559	17.56	<.0001
member_lea_2500	1	0.0634	0.0086	0.0465	0.0803	54.07	<.0001
member_lea_10000	1	0.0469	0.0094	0.0284	0.0653	24.82	<.0001
member_lea_250	1	0.0435	0.0087	0.0266	0.0605	25.28	<.0001
AKNative	1	0.0696	0.0061	0.0577	0.0815	130.64	<.0001
Asian	1	0.1370	0.0178	0.1021	0.1719	59.11	<.0001
Black	1	-0.1283	0.0233	-0.1739	-0.0827	30.41	<.0001
Hispanic	1	-0.0350	0.0377	-0.1089	0.0390	0.86	0.3541

Exhibit D2-c. Full-Time Teachers: the Salary Model

The REG Procedure
Model: MODEL1
Dependent Variable: lsal

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	43	622.89251	14.48587	1184.98	<.0001
Error	17547	214.50434	0.01222		
Corrected Total	17590	837.39685			

Root MSE	0.11056	R-Square	0.7438
Dependent Mean	10.72926	Adj R-Sq	0.7432
Coeff Var	1.03050		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	10.13937	0.03434	295.23	<.0001
fy2001	1	0.03014	0.00221	13.67	<.0001
fy2002	1	0.04416	0.00209	21.12	<.0001
adjexp	1	0.04312	0.00127	33.97	<.0001
adjexp2	1	-0.00096498	0.00016197	-5.96	<.0001
adjexp3	1	-0.00001025	0.00000753	-1.36	0.1731
adjexp4	1	3.274282E-7	1.133263E-7	2.89	0.0039
newjob	1	-0.01993	0.00278	-7.16	<.0001
female	1	0.00271	0.00190	1.42	0.1545
age1	1	0.00397	0.00011286	35.21	<.0001
age_missing	1	0.16272	0.01638	9.93	<.0001
degree1	1	-0.18599	0.02294	-8.11	<.0001
degree3	1	0.05768	0.00238	24.22	<.0001
degree4	1	0.08579	0.04194	2.05	0.0408
degree5	1	0.11074	0.01804	6.14	<.0001
ethnic_black	1	-0.00430	0.00668	-0.64	0.5203
ethnic_hisp	1	-0.02847	0.00697	-4.09	<.0001
ethnic_asian	1	-0.01107	0.00648	-1.71	0.0877
ethnic_indian	1	-0.00736	0.00923	-0.80	0.4252
ethnic_nativeAK	1	-0.03643	0.00406	-8.97	<.0001
assign_elem	1	0.00171	0.00222	0.77	0.4410
assign_mathsci	1	0.00784	0.00391	2.01	0.0447
assign_multgrade	1	-0.01910	0.00218	-8.75	<.0001
assign_se	1	0.00918	0.00305	3.01	0.0026
assign_004	1	-0.03368	0.00940	-3.58	0.0003
headtchr	1	0.09019	0.00833	10.82	<.0001
secondary_school	1	0.00534	0.00272	1.96	0.0498
totlfpr_radius	1	0.09345	0.01695	5.51	<.0001
wage_index	1	0.12976	0.01307	9.93	<.0001
utilities	1	-0.01141	0.00385	-2.96	0.0031
hdd	1	-0.00001966	0.00000449	-4.38	<.0001
hdd2	1	7.92115E-10	1.74218E-10	4.55	<.0001
cdd	1	0.00172	0.00011632	14.75	<.0001
minDistanceCC	1	0.00010924	0.00000592	18.47	<.0001
lowrain	1	-0.02297	0.00404	-5.69	<.0001
water_radius	1	-0.01678	0.00253	-6.64	<.0001
member_lea_1000	1	0.06483	0.00760	8.53	<.0001
member_lea_2500	1	0.07364	0.00729	10.10	<.0001
member_lea_10000	1	0.07755	0.00801	9.68	<.0001
member_lea_250	1	0.05326	0.00727	7.32	<.0001
AKNative	1	0.06117	0.00531	11.51	<.0001
Asian	1	0.11211	0.01560	7.19	<.0001
Black	1	-0.11687	0.02110	-5.54	<.0001
Hispanic	1	-0.02361	0.03293	-0.72	0.4735

Appendix E.

Index Values of Salary Models, and Correlations between Final and Alternative Equations

Exhibit E-1. Index Values of Salary Models

		PRIMARY			ALTERNATIVE		
		Admin Tobit	Teacher Regression: Salary & Benefits	Classified Regression: Wage	Teacher Regression: Salary	Teacher Tobit	Admin Regression: Salary & Benefits
	district_ID	admintobit	tchrben	class02	tchr02	tchrtobit	adminben
Denali Borough	2	0.97	1.00	1.01	1.01	1.03	0.94
Alaska Gateway	3	0.97	1.05	1.09	1.05	1.09	0.96
Aleutian Region	4	1.25	1.17	1.23	1.18	1.22	1.04
Anchorage	5	1.00	1.00	1.00	1.00	1.00	1.00
Annette Island	6	0.95	1.08	0.93	1.06	1.07	0.94
Bering Strait	7	1.05	1.11	1.19	1.11	1.13	1.07
Bristol Bay Borough	8	1.01	1.03	1.03	1.03	1.06	0.99
Chatham Region	9	1.05	0.95	0.92	0.94	0.96	0.93
Chugach	10	1.11	0.96	0.98	0.96	0.99	0.95
Copper River	11	0.99	0.99	1.05	1.00	1.03	0.98
Cordova City	12	0.99	1.04	0.96	1.04	1.05	0.99
Craig City	13	0.95	1.02	0.90	1.01	1.02	0.96
Delta Greely	14	0.94	1.00	0.98	1.00	1.00	0.95
Dillingham City	15	1.02	1.08	1.05	1.07	1.09	1.01
Fairbanks North Star Borough	16	0.97	1.06	1.04	1.06	1.05	0.94
Galena City	17	0.97	1.04	1.14	1.06	1.06	0.96
Haines Borough	18	0.94	0.99	0.90	0.98	0.98	0.97
Hoonah City	19	1.06	0.95	0.93	0.94	0.96	0.95
Hydaburg City	20	1.00	1.02	0.91	1.00	1.03	0.88
Iditarod Area	21	0.93	1.01	0.98	1.00	1.03	0.95
Juneau Borough	22	0.99	1.01	1.02	1.02	1.03	0.98
Kake City	23	1.09	0.97	0.93	0.96	0.99	0.96
Kenai Peninsula Borough	24	0.97	0.96	1.03	0.97	0.99	0.97
Ketchikan Gateway Borough	25	0.99	1.04	0.92	1.03	1.02	1.00
Klawock City	27	1.05	0.97	0.91	0.97	0.98	0.93
Kodiak Island Borough	28	0.97	1.03	1.03	1.04	1.06	0.98
Kuspuk	29	0.99	1.06	1.07	1.05	1.08	1.01
Lake And Peninsula	30	0.96	1.04	0.99	1.03	1.05	0.97
Lower Kuskokwim	31	1.04	1.07	1.23	1.08	1.12	1.03
Lower Yukon	32	1.02	1.09	1.13	1.08	1.09	1.06
Matanuska-Susitna Borough	33	0.96	0.98	0.96	0.98	0.98	0.97
Nenana City	34	0.93	0.99	0.98	0.98	0.98	0.95
Nome City	35	1.03	1.05	1.12	1.05	1.08	1.05
North Slope Borough	36	1.17	1.18	1.48	1.21	1.24	1.14
Northwest Arctic	37	1.07	1.14	1.24	1.14	1.16	1.06
Pelican City	38	1.03	0.95	0.90	0.94	0.96	0.93
Petersburg City	39	0.94	1.01	0.91	1.00	1.02	0.95
Pribilof Island	40	1.25	1.13	1.22	1.13	1.16	1.05
Sitka Borough	42	1.00	1.02	0.93	1.01	1.01	1.02
Skagway City	43	1.04	0.95	0.90	0.95	0.96	0.91
Southeast Island	44	1.01	0.94	0.87	0.94	0.95	0.90
Southwest Region	45	0.97	1.06	1.03	1.05	1.07	0.98
Saint Marys City	46	1.12	1.01	1.09	1.01	1.05	1.01
Unalaska City	47	1.05	1.14	1.08	1.15	1.17	1.05
Valdez City	48	1.01	1.02	0.98	1.01	1.02	1.00
Wrangell City	49	0.94	1.01	0.89	1.00	1.01	0.95
Yakutat City	50	1.09	0.97	0.97	0.97	1.00	0.97
Yukon Flats	51	0.93	1.03	1.06	1.02	1.06	0.97
Yukon Koyukuk	52	0.94	1.10	1.06	1.09	1.11	0.95
Tanana City	53	1.04	1.00	1.03	0.99	1.02	0.93
Yupiit	54	0.98	1.06	1.08	1.05	1.09	0.99
Kashunamiut	55	1.02	1.08	1.14	1.08	1.12	1.03
Aleutians East Borough	56	1.10	1.14	1.12	1.13	1.15	1.05

Exhibit E-2. Correlations Between Final and Alternative Equations

Pearson Correlation Coefficients, N = 55[26]
Prob > |r| under H0: Rho=0

Correlation Between Primary Model and 2 Alternative Models for Teachers

	Teacher Regression: Salary	Teacher Tobit
Teacher Regression: Salary & Benefits	0.98881 *<.0001*	0.96753 *<.0001*

Correlation Between 2 Alternative Teacher Salary Models

	Teacher Tobit
Teacher Regression: Salary	0.98227 *<.0001*

Correlation Between Primary Model and Alternative Model for Administrators

	Admin Regression: Salary & Benefits
Admin Tobit	0.47594 *.0002*

[26] The 55 districts include the 53 districts in the study and the Alyeska and Mt. Edgecumbe school districts. In the study, the Alyeska school district receives the Anchorage index value, and the Mt. Edgecumbe school district receives the Sitka index value.

Appendix F.

Energy Prototypes

This appendix contains the basic characteristics that were used in developing the DOE2 prototype models for the Urban Cold Climate region of Alaska. The prototypes were primarily derived from plans and characteristics provided by the Anchorage School District. One model was derived from plans of West High School, which has characteristics and total fuel consumption typical of Anchorage high schools. The other model was based on plans of North Star Elementary School, which was determined to be typical of Anchorage elementary and middle schools.

West High School (Urban, Cold Climate, High School Prototype)

The West High School envelope characteristics obtained from construction plans are summarized in Table 1. These include area summaries by use zone for floor, gross wall, roof and window surfaces. It also includes the summary of exterior perimeter footing length and maps the observed use zones in to the zones utilized in the hourly computer model. The envelope area data was then scaled to a 100,000 square foot building model with seven thermal zones. Table 2 provides the summary of the floor and envelope areas scaled to the hourly model.

Additional envelope characteristics obtained from the plans are as follows:

- Wall insulation is R19 with metal stud framing.
- Roof insulation is R38 on flat roof.
- Windows are double pane with thermally broken aluminum frames.

Table 3 provides a summary of the lighting and miscellaneous equipment power densities used in the model. The lighting power densities were calculated from data obtained from the lighting plans of West High School. The equipment power densities were obtained from school prototype models based on previous work completed for the Pacific Northwest Region. These models utilized end-use metered data with extensive audit data to determine equipment power densities and consumption.

The HVAC systems include variable air volume air handlers serving the classroom zones with constant volume air handles serving other areas. There is a central plant with boilers that provide hot water for space heating, domestic water heating and swimming pool heating.

Tables 4 and 5 summarize the operational characteristics of the prototype for the regular school term and the summer school term, respectively. The operating hours are summarized by zone for lighting, miscellaneous equipment, occupants and HVAC occupied settings. The operating hours were obtained from the Operational Characteristics surveys completed by committee members representing eight school districts across the state. There were relatively small differences in operating hours reported in the surveys.

North Star Elementary School (Urban, Cold Climate, Elementary School Prototype)

The North Star Elementary School envelope characteristics obtained from construction plans are summarized in Table 6. These include area summaries by use zone for floor, gross wall, roof and window surfaces. It also includes the summary of exterior perimeter footing length and maps the observed use zones in to the zones utilized in the hourly computer model. The envelope area data was then scaled to a 100,000 square foot building model with six thermal zones. Table 7 provides the summary of the floor and envelope areas scaled to the hourly model.

Additional envelope characteristics obtained from the plans are as follows:

- Wall insulation is R15 with metal stud framing.
- Roof insulation is R38 on flat roof.
- Windows are double pane with thermally broken aluminum frames.

Table 8 provides a summary of the lighting and miscellaneous equipment power densities used in the model. The lighting power densities were calculated from data obtained from the lighting plans of North Star Elementary School. The equipment power densities were obtained from school prototype models based on previous work completed for the Pacific Northwest Region. These models utilized end-use metered data with extensive audit data to determine equipment power densities and consumption.

The HVAC systems include variable air volume air handlers serving the classroom and office zones with constant volume air handles serving other areas. Radiant baseboard heat supplements in the perimeter areas of the classroom and office spaces. There is a central plant with boilers that provide hot water for space heating and domestic water heating.

Tables 9 and 10 summarize the operational characteristics of the prototype for the regular school term and the summer school term, respectively. The operating hours are summarized by zone for lighting, miscellaneous equipment, occupants and HVAC occupied settings. The operating hours were obtained from the Operational Characteristics surveys completed by committee members representing eight school districts across the state. There were relatively small differences in operating hours reported in the surveys.

Table 1: West High School Building Envelope Areas

Use Zone:	Floor Area, sq. ft.	Floor Area, percent	Model Zone Name	Wall Area, sq. ft.	Roof Area, sq. ft.	Perimeter Length, ft.	Window Area, sq. ft.
Classroom	109,566	35.5%	Class	48,639	91,386	3,253	6,520
Office/admin	19,932	6.5%	Office	5,479	19,644	403	564
Gym/auditorium	26,912	8.7%	Auditorium	7,942	17,760	94	0
kitchen	2,720	0.9%	Kitchen	0	2,720	0	0
dining	10,920	3.5%	Auditorium	7,254	10,920	348	148
library	13,088	4.2%	Office	2,164	13,088	148	0
hall/corridor	53,444	17.3%	Hall	1,260	48,804	880	992
locker room/bathroom	13,789	4.5%	Hall	5,087	12,924	329	200
mechanical/electrical	13,018	4.2%	Storage	7,784	5,506	208	0
swimming pool	10,368	3.4%	Pool	8,200	10,368	192	32
Storage	15,204	4.9%	Storage	4,724	13,448	308	56
Theatre	20,048	6.5%	Auditorium	13,800	10,448	320	0
Total	309,009	100%		112,333	257,016	6,483	8,512

Table 2: High School Building Envelope Areas Scaled to Prototype Model

Model Zone	Floor Area, %	Floor Area, sq. ft.	Exterior Wall Area, sq. ft.	Roof Area, sq. ft.	Perimeter Length, ft.	Window Area, sq. ft.
Class	35%	35,000	15,740	29,574	1,053	2,110
Kitchen	1%	1,000	-	880	-	-
Auditorium	19%	19,000	9,384	12,662	247	48
Hall	22%	22,000	2,054	19,976	391	386
Pool	3%	3,000	2,654	3,355	62	10
Storage	9%	9,000	4,048	6,134	167	18
Total	100%	100,000	36,353	83,174	2,098	2,755

Table 3: High School Model Lighting and Equipment Power Densities

Model Zone	Lighting Watts per sq. ft.	Equipment Watts per sq. ft.
Class	1.94	1.0
Kitchen	1.30	35.0
Auditorium	1.20	1.0
Hall	0.63	1.0
Pool	1.80	1.0
Storage	0.66	1.0

Table 4: High School Operating Hours for Regular School Term

Model Zone	lights	Equipment	People	HVAC
Class	hrs 8-16	hrs 8-16	hrs 8-16	hrs 8-16
Office	hrs 8-17	hrs 8-17	hrs 8-17	hrs 8-17
Kitchen	hrs 8-16	hrs 8-16	hrs 8-16	hrs 8-16
Auditorium	hrs 8-22	hrs 8-22	hrs 8-22	hrs 8-22
Hall	hrs 8-22	hrs 8-22	hrs 8-22	hrs 8-16
Pool	hrs 8-22	hrs 8-22	hrs 8-22	hrs 8-22
Storage	hrs 8-16	hrs 8-16	hrs 8-16	hrs 8-16

Heating setpoint occupied: 71F; unoccupied: 71F

Table 5: High School Operating Hours for Summer School Term

Model Zone	lights	Equipment	People	HVAC
Class	hrs 8-12	hrs 8-12	hrs 8-12	hrs 8-12
Office	hrs 8-17	hrs 8-17	hrs 8-17	hrs 8-17
Kitchen	none	none	none	none
Auditorium	hrs 8-17	hrs 8-17	hrs 8-17	hrs 8-17
Hall	hrs 8-12	hrs 8-12	hrs 8-12	hrs 8-12
Pool	hrs 8-17	hrs 8-17	hrs 8-17	hrs 8-17
Storage	hrs 8-12	hrs 8-12	hrs 8-12	hrs 8-12

Heating setpoint occupied: 71F; unoccupied: 71F

Table 6: North Star Elementary School Building Envelope Areas

Use Zone:	Floor Area, sq. ft.	Floor Area, percent	Model Zone Name	Wall Area, sq. ft.	Roof Area, sq. ft.	Perimeter Length, ft.	Window Area, sq. ft.
Classroom	34,720	47.0%	Class	15,873	38,220	1,221	2,358
Office/admin	3,628	4.9%	Office	2,808	4,000	216	384
Gym/auditorium	6,776	9.2%	Auditorium	1,846	6,776	0	0
kitchen	1,512	2.0%	Kitchen	650	1,700	50	0
dining	4,488	6.1%	Auditorium	998	4,488	24	0
library	2,480	3.4%	Office	2,522	2,500	158	216
hall/corridor	12,168	16.5%	Hall	1,495	13,500	10	0
locker room/bathroom	2,592	3.5%	Hall	0	2,900	0	0
mechanical/electrical	2,794	3.8%	Storage	390	3,000	30	0
swimming pool		0.0%		0	0	0	0
Storage	2,636	3.6%	Storage	806	2,900	62	0
Theatre	0	0.0%		0	0	0	0
Total	73,794	100%		27,388	79,984	1,771	2,958

Table 7: Elementary School Building Envelope Areas Scaled to Prototype Model

Model Zone	Floor Area, %	Floor Area, sq. ft.	Exterior Wall Area, sq. ft.	Roof Area, sq. ft.	Perimeter Length, ft.	Window Area, sq. ft.
Class	47%	47,000	21,510	51,793	1,655	3,195
Office	8%	8,000	7,223	8,808	507	813
Kitchen	2%	2,000	881	2,304	68	-
Auditorium	15%	15,000	3,854	15,264	33	-
Hall	20%	20,000	2,026	22,224	14	-
Pool	0%	-	-	-	-	-
Storage	8%	8,000	1,621	7,995	125	-
Total	100%	100,000	37,114	108,388	2,400	4,008

Table 8: Elementary School Model Lighting and Equipment Power Densities

Model Zone	Lighting Watts per sq. ft.	Equipment Watts per sq. ft.
Class	1.61	1.0
Office	1.42	2.7
Kitchen	1.30	35.0
Auditorium	1.95	1.0
Hall	0.46	1.0
Pool	0.00	1.0
Storage	0.66	1.0

Table 9: Elementary School Operating Hours for Regular School Term

Model Zone	lights	Equipment	People	HVAC
Class	hrs 8-16	hrs 8-16	hrs 8-16	hrs 8-16
Office	hrs 8-17	hrs 8-17	hrs 8-17	hrs 8-17
Kitchen	hrs 8-16	hrs 8-16	hrs 8-16	hrs 8-16
Auditorium	hrs 8-22	hrs 8-22	hrs 8-22	hrs 8-21
Hall	hrs 8-22	hrs 8-22	hrs 8-22	hrs 8-16
Pool	n/a	n/a	n/a	n/a
Storage	hrs 8-16	hrs 8-16	hrs 8-16	hrs 8-16

Heating setpoint occupied: 72F; unoccupied: 72F

Table 10: Elementary School Operating Hours for Summer School Term

Model Zone	lights	Equipment	People	HVAC
Class	hrs 8-12	hrs 8-12	hrs 8-12	hrs 8-12
Office	hrs 8-17	hrs 8-17	hrs 8-17	hrs 8-17
Kitchen	none	none	none	none
Auditorium	hrs 8-16	hrs 8-16	hrs 8-16	hrs 8-16
Hall	hrs 8-12	hrs 8-12	hrs 8-12	hrs 8-12
Pool	n/a	n/a	n/a	n/a
Storage	hrs 8-12	hrs 8-12	hrs 8-12	hrs 8-12

Heating setpoint occupied: 72F; unoccupied: 72F

Appendix G.
Detailed Analysis Of The Cost Of Goods

Chapter V discusses the approach to creating and the analysis of the various non-personnel indices. Here, we look at an example of how one would apply an equation used to calculate one of those indices. The example is of the index for any good. The general equation is the first equation found below. All calculations were made at the school level and then aggregated to the district level by pupil enrollment weights. The index for each good is calculated by taking the pupil-weighted values of each school, considering the proper proportion of times each method is used to ship the goods. In this discussion, “total cost” is the cost of the item plus the cost of shipping. The district value is then divided by the value of the Anchorage School District. The equation for each good is found below, where the subscript “i” represents the district for which the index value is generated, and subscript “A” stands for the base Anchorage School District. Any good is represented by subscript “k” in school “j.”

$$\text{Good Index}_{ik} = \frac{\dfrac{\Sigma\,(\text{school enrollment})_{ijk} \text{ x } \{[(\text{ method \#1 total cost})_{ijk} \text{ x } (\%\ \#1)_{ijk}] + [(\text{method \#2 total cost})_{ijk} \text{ x } (\%\ \#2)_{ijk}]\}}{\Sigma\,(\text{school enrollment})_{ij}}}{\dfrac{\Sigma\,(\text{school enrollment})_{Ajk} \text{ x } \{[(\text{ method \#1 total cost})_{Ajk} \text{ x } (\%\ \#1)_{Ajk}] + [(\text{method \#2 total cost})_{Ajk} \text{ x } (\%\ \#2)_{Ajk}]\}}{\Sigma\,(\text{school enrollment})_{Aj}}}$$

We now that this equation and use it in an example of how the equation is actually applied. First, we specify what the general terms, so that we can calculate the index value for the district in our example.

General term	Example
District *i*	District 57
School *j*	School 1
	School 2
	School 3
Good *k*	One case (10 reams) of white copier paper (8.5” by 11”)

Next, look at the data for the district.

District #57

			One case (10 reams) of white copier paper (8.5” x 11”)						
			Method #1 of purchasing item			Method #2 of purchasing item			
School ID	School Name	School Enrollment	Trans. Method code	Cost of **one case**	Cost of item **plus** shipping	Trans. Method code	Cost of item when bought using this method	Cost of item **plus** shipping	Percent of copier paper bought using this other method
570001	School 1	23	A_S	$29.90	$38.48	W	$27.90	$43.95	30%
570002	School 2	15	A_S	$29.90	$38.48	W	$27.90	$43.95	20%
570003	School 3	23	A_S	$29.90	$38.48	A_C	$30.25	$58.50	10%

To calculate the index for instructional and office supplies in district 57, let's look at one school at a time.

The general equation for each school in the district is:

$$\text{School}_{jk} = \{[(\text{ method \#1 total cost})_{jk} \text{ x } (\% \text{ \#1})_{jk}] + [(\text{method \#2 total cost})_{jk} \text{ x } (\% \text{ \#2})_{jk}]\}$$

We start with School 1, and examine the data we are given for this school. School 1 uses two methods to get paper. Usually, the school receives paper via scheduled air delivery, which comes to a total cost of $38.48 for the case of paper plus shipping. However, 30 percent of the time, School 1 must use a more costly method of obtaining paper. When School 1 ships via water, we see that the cost of the item is $2 less, but the total cost of the item is $43.95. School 1 uses this alternative method 30 percent of the time. The equation for the cost of paper at School 1 is:

Average Cost of Paper for School 1 = {[($38.48) x (.70)] + [($43.95) x (.30)]} = $40.12

As the data reveal, School 2 in District 57 has the same cost for shipping paper to it as School 1. However, School 2 ships paper via scheduled air 80 percent of the time. Therefore, our equation for the cost of paper at School 2 is:

Average Cost of Paper for School 2 = {[($38.48) x (.80)] + [($43.95) x (.20)]} = $39.57

School 3 has the same cost for method #1 as do the other two schools, but it utilizes this method 90 percent of the time. The alternative method for School 3 is via chartered air, which has a total cost of $58.50. The average cost of School 3 is:

Average Cost of Paper for School 3 = {[($38.48) x (.90)] + [($58.50) x (.10)]} = $40.48

To aggregate these costs to the district level, we must consider how much each school consumes. The way we have chosen to do this is to weight the average cost at each school by the pupil enrollment. First, we sum the total enrollment of the three schools at District 57, which equal 61. Then, we weight the average cost of paper at each school by its enrollment divided by the district enrollment. This mean that the average cost at School 1 is multiplied by 23/61 because it has 23 students. Since School 2 has only 15 students, the average cost of paper at this school is weighted by 15/61. School 3 also has 23 students, so its average cost receives the same weight as School 1.

Average Cost of Paper for District 57 = {[($40.12) x (23/61)] + [(#39.57) x (15/61)] + [($40.48) x (23/61)]} = $40.12

This is the same as saying we multiply the average cost of paper at each school by its enrollment, then sum together these totals and divide by the district enrollment

Average Cost of Paper for District 57 = $\dfrac{\{[(\$40.12) \text{ x } (23)] + [(\#39.57) \text{ x } (15)] + [(\$40.48) \text{ x } (23)]\}}{61}$ = $40.12

Finally, divide the Average Cost in District 57 by the base district Anchorage to get the instructional and office supplies index value for District 57. The average cost of paper in Anchorage is $21.44.

[*note*: the average cost of paper for Anchorage is calculated using the same method as hypothetical District 57]

Instructional Supplies Index for District 57 = $\dfrac{\$40.12}{\$21.44}$ = 1.87

The final index value for instructional and office supplies is 1.87 for District 57.

Appendix H.
Detailed Analysis Of The Cost Of Travel

The costs of non-personnel services, such as travel costs, are examined in Chapter V of the report. District-wide professional development would entail travel from each school site to the district office. To calculate the cost of such professional development, we developed a set of equations described below. Here, we use the example of hypothetical District 57. The general equation is the first equation found below. All calculations were made at the school level and then aggregated to the district level by weighting by the teacher full-time equivalents (FTE) at each school. The trip index considers whether or not the school is located in a remote area of the district. A school is termed "remote" if travel to the school site from the district office requires an overnight stay. Travel to remote schools is more costly due to required lodging and additional meals. The addition of a $450 per diem calculated into the cost of lodging and meals. This per diem figure of $450 was determined through a series of conversations with the TWG. The district value is then divided by the value of the Anchorage School District. The equation for this cost index is found below, where the subscript "i" represents the district for which the index value is generated, and subscript "A" stands for the base Anchorage School District. Any school "j" found within a district is denoted by the subscript "r" if it is a remote school, while non-remote schools contain the subscript "n."

$$\text{Trip Index}_i = \frac{\text{Trip Cost}_{ir} + \text{Trip Cost}_{in}}{\dfrac{\Sigma\,(\text{school FTE})_{Aj} \times (\text{roundtrip cost from school to d.o.})_{Aj}}{\Sigma(\text{school FTE})_{Aj}}}$$

where

$$\text{Trip Cost}_{ir} = \frac{\Sigma\,(\text{school FTE})_{ijr} \times (\text{roundtrip cost from school to d.o.})_{ijr} + (450)_{ijr}}{\Sigma(\text{school FTE})_{ij}}$$

and

$$\text{Trip Cost}_{in} = \frac{\Sigma\,(\text{school FTE})_{ijn} \times (\text{roundtrip cost from school to d.o.})_{ijn}}{\Sigma(\text{school FTE})_{ij}}$$

We now look at the general equation and use it in an example of how the equation is actually applied. First, we specify what the general terms, so that we can calculate the index value for the district in our example.

General term	Example
District *i*	District 57
Remote School *jr*	School 3
Non-remote Schools *jn*	School 1 School 2

Next, look at the data for the district.

District #57						
			School to District Office Travel			
School ID	School Name	School FTE	Trans. Method code	One-way travel time (hh:mm)	Roundtrip cost	Overnight stay required
570001	School 1	3	A_S	2:00	$939	N
570002	School 2	1	A_S	1:30	$840	N
570003	School 3	2	A_C	5:00	$1,210	Y

To calculate the index for travel between each school and the district office in district 57, let's look at one school at a time.

First, me must see if each school is a "remote" school or a "non-remote" school. By looking in the data column titled "Overnight stat required," we see that only School 3 is a remote school. Schools 1 and 2 are non-remote.

Therefore, the equation for School 3 must be that of a remote school, which adds the per diem of $450.

Cost of Travel from District Office to School 3 = $1,210 + $450 = $1,660

Schools 1 and 2 do not require an overnight stay, so their equations follow the non-remote general form.

Cost of Travel from District Office to School 1 = $939
Cost of Travel from District Office to School 2 = $840

To aggregate these costs to the district level, we must consider how many trips are made from each school to the district office. The way we have chosen to do this is to weight the average cost at each school by the pupil enrollment. First, we sum the total enrollment of the three schools at District 57, which equal 61. Then, we weight the average cost of a trip from each school by its enrollment divided by the district enrollment. This means that the average cost of $1,660 at School 1 is multiplied by 3/6 because it has 3 of the districts 6 FTEs. Since School 2 has only 1 FTE, the average cost of a trip from this school is weighted by 1/6. School 3 has 2 FTEs, so its average cost receives a weight of 2/6.

Average Cost of Travel to D.O. for District 57 = {[($1660) x (3/6)] + [($939) x (1/6)] + [($840) x (2/6)]} = $1267

This is the same as saying we multiply the average cost of a trip from each school by its FTE, then sum together these totals and divide by the district FTE.

$$\text{Average Cost of Travel to D.O. for District 57} = \frac{\{[(\$1660) \text{ x } (2)] + [(\$939) \text{ x } (1)] + [(\$840) \text{ x } (3)]\}}{6} = \$1{,}267$$

Finally, divide the Average Cost in District 57 by the base district Anchorage to get the instructional and office supplies index value for District 57. The average cost of a trip from the district office to a school in Anchorage is $6.50.

[*note*: the average cost of a trip from the district office to a school for Anchorage is calculated using the same method as that used for hypothetical District 57]

$$\text{Index for Travel between Schools and District Office for District 57} = \frac{\$1{,}267}{\$6.50} = 195$$

The final index value for travel between schools and the district office is 195 for District 57.

Appendix I.
Calculation of the GCEI

Index Calculation and Formulas

Fixed-Market-Basket (FMB) Approach

Briefly, the FMB index approach makes the assumption that the public school district purchases the *same inputs* over time to produce educational services for the students enrolled. It makes use of data about the prices and quantities of these inputs (e.g., teachers and instructional aides). Exhibit I-A illustrates how a fixed-market-basket index may be constructed for a public school district. In this simple example, it is assumed that there are only two inputs utilized by this school district: namely, teachers and instructional aides. Obviously, a real public school district uses many inputs to produce educational services, and the GCEI presented in this report reflects these other inputs. However, for the purposes of illustration, this simple two-input model of a public school district may be used to demonstrate one of the problems that arises in the construction of price indexes. The problem is that the combinations of inputs (i.e., market-baskets) used to produce a given level of services or outputs are not fixed, and the estimated index of cost differences (whether geographic or inflationary) will depend upon which observation is chosen as a base for purposes of calculating the index.

Exhibit I-A shows the budget or expenditures of a two-input school under alternative assumptions for two different districts, A and B, designated in column 1. *[The reader should note that districts A and B can either be the same district at two points in time or different districts at a single point in time. The analysis and interpretation will be the same]* Columns 2 through 5 represent the prices (S, W) and quantities (T, A) of the two inputs -- teachers and aides -- purchased by districts A and B. The first six columns are relatively self-explanatory. In district A, district A paid annual wages amounting to $31,000 per full-time-equivalent (FTE) teacher and employed 0.0500 FTE teachers per pupil (i.e., 1 teacher for every 20 students). In addition, district A paid an average price of $15,000 per FTE instructional aide and employed 0.0125 FTE aides per pupil (i.e., 1 FTE aide for every 80 students). In district B, the annual wage of a full-time teacher is $33,000 (10 percent higher than district A) and the district employed 0.0550 FTE teachers per pupil (i.e., 1 FTE teacher for every 18.2 pupils). FTE salaries for instructional aides are $15,500 in district B (3.3 percent higher than in district A) and the district employed 0.02 FTE aides per pupil (i.e., 1 for every 50 students).

The total in column 6 is the actual per pupil budget of each district. Based on these figures, district A spends $1,688 per pupil and district B spends $2,125 or 25.93 percent more than district A. But how much of this increase in the budget was due to inflation in the prices of school inputs, and how much was due to increases in the quantities of school inputs purchased?

Exhibit I-A. Hypothetical Example of a Fixed-Market-Basket Public School District Price Index

District	Average Annual Teacher Wage	FTE Teachers per Pupil	Average Annual Wage for Aides	FTE Aides per Pupil	Total Budget per Pupil	Simulated Budgets Using Inputs From: District A	Simulated Budgets Using Inputs From: District B	Alternative FMB, CEIs Using Inputs From: District A	Alternative FMB, CEIs Using Inputs From: District B
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A	$30,000	0.0500	$15,000	0.0125	$1,688	$1,688	$1,950	100.00	91.76
B	$33,000	0.0550	$15,500	0.0200	$2,125	$1,844	$2,125	109.26	100.00
Index: B/A	1.1000	1.1000	1.0333	1.6000	1.2593	1.0926	1.0897	1.0926	1.0897
% Diff.	10.00%	10.00%	3.33%	60.00%	25.93%	9.26%	8.97%	9.26%	8.97%

Columns 7 and 8 simulate the budget for these sample districts under alternative assumptions about the market basket of school inputs purchased. Column 7 simulates what the each district's budget would have been if it had purchased the same quantities of school inputs as district A. Column 8 simulates what the district budget would have been in each year if it had purchased the same quantities of school inputs as did district B..

Comparison of these simulated budgets using the fixed-market-baskets of inputs permits one to develop estimates of price inflation between the two years, since the only differences between the two budgets presented in each column are the differences in prices of the inputs. For example, using district A purchases of inputs as the base, one defines the *CEI* to be 100.00 for district A (the base district), and computes an index of 109.26 (the ratio of $1,844 to $1,688) for district B. Since the quantities of inputs are fixed, the only difference between these two simulated budgets are in the prices paid for the inputs. An estimate of inflation between the two years using year 1 as the base is calculated as follows:

$$\text{Estimate of price inflation} = 100 \times (1{,}844 - 1{,}688)/1{,}688$$
$$= 9.26\%$$

If districts A and B are simply the same district in two different years and A represents the first year of the series and B represents a subsequent year of the series, this representation of the *CEI* would be referred to as a *Laspeyre index* (which is defined as the index based purchases in the earliest year in the series of data).

The problem that arises becomes apparent when a different base district (or year) is selected to calculate the FMB index. If district B purchases of inputs are used as the base (see columns 8 and 10), the *CEI* for district A is 91.76 and the *CEI* for district B is 100.00. Once again, since the quantities of inputs are fixed, the only difference between these two simulated budgets are in the prices paid for the inputs. An estimate of inflation between the two districts using district B as the base is calculated as follows:

Estimate of price inflation = $100 \times (\$2{,}125-\$1{,}950) / \$1{,}950$
= 8.97%

In both cases, the ratio is the difference, divided by district A's simulated budget. Again, if this comparison is of the same district at two points in time, the *CEI* calculated based on the later year's purchases of inputs (district B in this case) is commonly referred to by economists as a *Paasche index*.

Both of these indexes represent fixed-market-basket public school district price indexes. Each essentially represents a weighted average of the price inflation for the two school inputs where the weights are the quantities of inputs purchased. These weights simply measure the importance of each input in the overall budget for school services. It is no surprise that the two indexes result in different estimates of inflation because each uses a different set of weights. The *Laspeyre index*, which uses district A (i.e., year 1) budget shares, in this instance provides a higher estimate of inflation (9.26 percent) than the *Paasche index* (8.97 percent), which uses district B (i.e., year 2) budget shares.

It should also be noted that in this simple example the *quality* of school inputs is assumed to be constant between districts A and B. Consequently, salary differences in this simple example are assumed to reflect differences in the prices of comparable teachers and aides.

Because data are simply not available on all of the detailed quantities and prices of the individual items actually purchased by school districts, it is necessary to use an alternative expression to define the FMB *CEI*. That is, data on the quantities and prices of books and computers and even different categories of personnel (administrators, teachers, custodians, and aides) are not available in the simple form expressed in Exhibit I-A. The data that are available are generally expressed in the form of shares of school district budgets allocated to different categories of inputs and different indexes from various sources on the changes in the prices paid for individual inputs.

The FMB *CEI* presented above can be expressed in the following form:

Eq.I-1 $$\textit{FMB-CEI} = TCI_B \times TSHARE_A + ACI_B \times ASHARE_A$$

where

TCI_B = the teacher cost index for district B (the ratio of FTE teacher salaries for district B to FTE teacher salaries in the base district A in this case);

$TSHARE_A$ = the proportion of school district budgets allocated to teachers salaries in the base district A (i.e., the *budget share* for teachers);

ACI_B	=	the instructional aide cost index for district B (the ratio of FTE aide salaries for district B to FTE aide salaries in the base district A in this case);
$ASHARE_A$	=	the proportion of school district budgets allocated to instructional aides in the base district A (i.e., the *budget share* for aides).

Using the data from table 1, one can calculate the *Laspeyre index* as follows:

TCI_B	=	100 × \$33,000/\$30,000 = 110.00
$TSHARE_A$	=	\$30,000 × 0.0500/\$1,688 = .89
ACI_B	=	100 × \$15,500/\$15,000 = 103.33
$ASHARE_A$	=	\$15,000 × 0.0125/\$1,688 = .11

Eq. I-2 Laspeyre Index (comparing B to A) = 110.00 × .89 + 103.33 × .11 = 109.26

The *Laspeyre index* is the one most commonly used for the development of price indexes and is currently the methodology used by the Bureau of Labor Statistics (BLS) for the calculation of the consumer price index. However, it should be noted that the BLS does change the budget weights (shares) corresponding to each component about every ten years to account for differences in spending patterns over time.

Using the data from table 1, one can calculate the *Paasche index,* which uses district B as the base district, as follows:

TCI_A	=	100 × \$30,000/\$33,000 = 90.91
$TSHARE_B$	=	\$33,000 × 0.0550/\$2,125 = .85
ACI_A	=	100 × \$15,000/\$15,500 = 96.77
$ASHARE_B$	=	\$15,500 × 0.0200/\$2,125 = .15

Eq. I-3 Paasche Index (comparing A to B) = 90.91 × .85 + 96.77 × .15 = 91.76.

Inverting this *Paasche index* to compare district B to district A, the index of relative cost differences is 108.97 (=100 × 100/91.76).

It can be seen that whichever way the indices are calculated (i.e., using actual quantities or budget shares as weights), the *Laspeyre* and *Paasche* indices are different because each uses a different base measurement. While both indices purport to measure the true cost difference between district A and B, it can be shown that the *Laspeyre* index over-estimates the rate of inflation (using district A and B to represent the same district at two points in time), while the *Paasche* index under-estimates the rate of inflation. The reason for this lies in the fact that neither of these FMB indexes account for the substitution of one input for another that occurs as relative prices of the inputs change. This is commonly referred to as *commodity substitution* in the literature on the development of price indices.

The notion underlying commodity substitution is easily understood, though more difficult to measure. It is simply the notion that one can produce the same level of educational quality (or consumer satisfaction) with various combinations of the inputs, i.e., teachers and aides. Using the example in table 1, the relative price of teachers is higher in district B. There are two ways to illustrate this. First, district B pays 10 percent higher teachers salaries than district A, while district B pays only 3.3 percent higher salaries for aides. Second, the ratio of teacher salaries to aide salaries is higher in district B (i.e., 2.13 = 33,000/15,500) than district A (i.e., 2.00 = 30,000/15,000).

Whichever way one measures it, one might expect that district B could produce the same quality educational services as district A by substituting teachers aides for teachers. But it is precisely this impact on quality of educational services that one cannot measure. In fact, in the simple example in table 1, one can see that there has been a substitution away from teachers to aides in district B relative to district A. That is, the ratio of teachers to teacher aides is higher in district A (i.e., ratio of teachers to aides is 4.0 = 0.0500/0.0125) than in district B (i.e., ratio of teachers to aides is 2.75 = 0.0550/0.0200). But district B purchases more of both inputs because it simply has greater revenues to spend on educational services. While the FMB *CEI* controls for the level of usage of teachers and aides in calculating the impact of inflation, it does not account for the possibility of this substitution between inputs that may tend to occur in educational production. Substituting purchases away from the relatively more costly input will tend to reduce the difference in expenditure required to achieve a given level of educational output (or quality).

Superlative Indexes and Commodity Substitution Bias

Recognizing this problem, how does one deal with the commodity or input substitution bias that occurs with the FMB estimates of the *CEI*. Economists for years contended that the only way of resolving this problem required detailed knowledge of the parameters that underlie the input-output relationships in education. As Caves, Christensen, and Diewert (November, 1982) state it:

> *Comparisons based on econometric estimates of the structure of production have often been viewed as being more desirable than index number comparisons; this view is based on the belief that index numbers are consistent only with restricted structures of production. Our results show that this belief is erroneous; in fact, the structures of production, which we have considered in this paper are so general that they would be difficult to estimate econometrically. (p. 1411)*

What Caves, Christensen, and Diewert show is a way to estimate the differences in the costs of living between two individuals at a point in time or for the same individual between two points in time using exclusively observed information on prices and quantities purchased. They show that an index number originally proposed by Tornqvist (1936) can be used to measure the geometric mean of two cost of living indexes based on the utility functions of two different consumers facing different prices, purchasing different quantities, and with differences in taste. This is the equivalent of saying that this Tornqvist index can be used to compare the costs of education between two districts with differing perceived technologies for producing educational services and facing different prices and purchasing different quantities of school inputs. Formally, this index may be written as follows:

Eq. I-4. $$\ln TCEI(B,A) = \Sigma_r\ (1/2)\cdot(P_r(B)+P_r(A))\cdot[\ln (CI_r(B,A))]$$

where $TCEIL(B,A)$= the *Tornqvist* cost-of-education index between districts B and A,

Σ_r = the sum over all school inputs, r

$CI_r(B,A)$ = the cost index for the r^{th} school input (e.g., teachers, school administrators, teachers' aides, books, supplies and materials) comparing districts B relative to A;

$P_r(B)$, $P_r(A)$= the average proportion of total expenditures allocated to the r^{th} school input in districts B and A, respectively.[27]

One of the critical features of this formula relative to that of the FMB CEI is that to calculate the superlative index requires information on the budget shares for each input from each observation included in the analysis as well as relative price differences. Again, districts A and B may represent a single district at two points in time or two districts at the same point in time.

Expanding the comparisons of two districts A and B to a multilateral setting necessitates the use of a benchmark district. In Alaska, that benchmark district is Anchorage. In the formula above, district A is Anchorage and district B represents any other district in the state. Each school district in turn is compared to the Anchorage.[28]

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[27] The Tornqvist index assumes a translog production technology with identical second-order coefficients on the school input prices. This equality also requires expenditure-minimizing behavior and permits only the identification of the geometric averages of the true indexes rather than each individual index derived from the perspective of each district. Diewert (1976) showed that the Tornqvist index is exact for the homogeneous translog form and is, for this reason, regarded as a *superlative index*. A *superlative index* is defined as one that is exact for a 'flexible' aggregator functional form (Diewert, 1976).

[28] The use of the arithmetic mean value of the various statistics in *equation 6* preserves the transitivity of the index in comparisons across more than two districts. For a more complete discussion of the issues involved in multilateral comparisons, the reader is referred to Caves, Christensen, and Diewert (March 1982).

Exhibit I-B illustrates the steps involved in calculation of the Tornqvist's superlative cost-of-education index (SCEI) between district B and the hypothetical district A. New columns 4 and 7 have been added to Exhibit I-A to present the budget shares needed to calculate the SCEI in equation 6. The natural log (*ln*) of the cost index for each input component (i.e., teachers and aides) is presented below columns 2 and 5. The average budget share for each input, which is required to calculate the SCEI si presented below columns 4 and 7. The natural log of the SCEI is calculated as follows:

0.08727 – 0.09531 H 0.8715 + 0.03279 H 0.1285

Exhibit I-B. Hypothetical Example Comparing the Tornqvist Index to the Fixed-Market-Basket Index for Public Schools

	Teachers			Aides				Simulated Budgets Using Inputs From:		Alternative FMB, CEIs Using Inputs From:	
District	**Average Annual Wage**	**FTE per Pupil**	**Budget Share**	**Average Annual Wage**	**FTE per Pupil**	**Budget Share**	**Total Budget per Pupil**	**District A**	**District B**	**District A**	**District B**
A	$30,000	0.0500	$1,500	$15,000	0.0125	$188	$1,688	$1,688	$1,950	100.00	91.76
			88.89%			11.11%					
B	$33,000	0.0550	$1,815	$15,500	0.0200	$310	$2,125	$1,844	$2,125	109.26	100.00
			85.41%			14.59%					
Index Calculations											
	CI(B,A)										
CI(B,A)	1.1000			1.0333			1.2593	1.0926	1.0897	1.0926	1.0897
Tornqvist Index											
			Avg Share			***Avg Share***	***ln TCEI(B,A)***	***Tornqvist Index***			
ln CI(B,A)	0.09531		87.15%	0.03279		12.85%	0.097276518	1.0912			

Finally, the SCEI – *ln (0.08727) = 1.0912* which falls between the Layspayre or district A-based index of 1.0926 and the Paasche or district B-based index of 1.0897 calculated previously.

Budget Matrix

Below is the budget matrix corresponding to the function and objects of expenditure included in the operating budget reported by Alaska school districts to the ADEED. Each cell contains a symbol corresponding to the school input cost index that will be assigned to that share of the budget. Under an FMB-GCEI, we would use the Anchorage budget data to calculate the appropriate standardized budget shares against which the index would be calculated for every school district. Under the SGCEI approach, we would use the budget share data for each district relative to the budget shares for Anchorage as in Equation I-4 to calculate the overall cost index.

Legend to the budget matrix on the following page:

- *teachers* is the budget share allocated to teachers only, which are those cells associated with direct instruction within the operating codes ranging from 100 to less than 400
- *classified* is for all classified staff at the school or district level
- *teach/class* refers to the benefits section of the budget share being divided among teachers and classified staff, with the weighting determined by the proportion of salaries given to each group within an operating fund
- *admin* is for administrators from schools and the district office, as well as certified staff not coded as teachers (e.g., specialists, guidance counselors)
- *admin/class* refers to the benefits section of the budget share being divided among administrators and classified staff, with the weighting determined by the proportion of salaries given to each group within an operating fund
- *energy* is the amount spent on energy and utility services
- *paper* is the amount spent on instructional materials and office supplies (the cost of purchasing and transporting a case of paper is used as a proxy of this cost, and that is why the budget share is named as such)
- *food* is the amount spent on food supplies (the cost of purchasing and transporting a case of milk cartons is used as a proxy of this cost, and that is why the budget share is named as such)
- *window* is the amount spent on maintenance (the cost of purchasing and transporting a window is used as a proxy of this cost, and that is why the budget share is named as such)
- *travel_1* is for teacher professional development to the district office and to Anchorage (with 50 percent of the total going to each budget share)
- *travel_2* is between schools and the district office (which may include specialists, other itinerant staff, district administrator support, or travel for personnel
- *travel_3* is for school administrators
- *travel_4* is for district administrators
- *travel_5* is for maintenance and operation, what is referred to as purchased services in Chapter 5

Exhibit I-1. Budget Matrix

ALASKA DEPARTMENT OF EDUCATION AND EARLY DEVELOPMENT   Date: 11/6/2000

FY00 AUDITS   *these codes corresond with the 1996 C.O.A.*

School District

Operating Fund	100 Instruction	200 Spec. Ed. Instruction	220 Spec. Ed. Support	300 Support Students	350 Support Instruction	400 School Admin.	510 District Admin.	550 Dist. Admin. Support	600 Operations & Maint.	700 Student Activities		Total Including Instruction
Certified Salaries	teacher	teacher	teacher	teacher	teacher	admin	admin	admin	admin	admin		0
Non-Certified Salaries	classified	classified	classified	classified	classified	classified	classified	classified	classified	classified		0
Employee Benefits	teacher/class	teacher/class	teacher/class	teacher/class	teacher/class	admin/class	admin/class	admin/class	admin/class	admin/class		0
Professional/Tech Services	admin	admin	admin	admin	admin	admin	admin	admin	admin	admin		0
Staff Travel	travel_1	travel_2	travel_2	travel_2	travel_2	travel_3	travel_4	travel_2	travel_5	travel_2		0
Student Travel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		0
Utilities Services	energy	energy	energy	energy	energy	energy	energy	energy	energy	energy		0
Other Purch. Srvs./Insurance	travel_1	travel_2	travel_2	travel_2	travel_2	travel_3	travel_4	travel_2	travel_5	travel_2		0
Supplies,Materials,Media	paper	paper	paper	paper	paper	paper	paper	paper	energy	paper		0
Tuition and Stipends	teacher	teacher	teacher	teacher	teacher	admin	admin	admin	admin	admin		0
Other/Indirect	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		0
Capital Outlay/EQ/Property	window	window	window	window	window	window	window	window	window	window		0
TOTALS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		$0

Special Rev. Funds	Transportation	Food Service	Teacher Housing	Community Service	Title 1	Title 1 Carryover	Title VI	Title VI Carryover	Other Special Revenue Funds		Special Ed. Title VI-B	Title 1 Migrant Ed
Expenditures:					Title 1 Instruction	Title 1 Support	Title VI Instruction	Title VI Support	Instruction	Support		
Certified Salaries	admin	admin	admin	admin	teacher	teacher	teacher	teacher	teacher	teacher	teacher	teacher
Non-Certified Salaries	classified	classified	classified	classified	classified	classified	classified	classified	classified	classified	classified	classified
Employee Benefits	admin/class	admin/class	admin/class	admin/class	teacher/class	teacher/class	teacher/class	teacher/class	teacher/class	teacher/class	teacher/class	teacher/class
Professional/Tech Services	admin	admin	admin	admin	admin	admin	admin	admin	admin	admin	admin	admin
Staff Travel	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2
Student Travel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Utilities Services	energy	energy	energy	energy	energy	energy	energy	energy	energy	energy	energy	energy
Other Purch. Srvs./Insurance	travel_2	food	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2	travel_2
Supplies,Materials,Media	paper	food	paper	paper	paper	paper	paper	paper	paper	paper	paper	paper
Tuition and Stipends	admin	admin	admin	admin	teacher	teacher	teacher	teacher	teacher	teacher	teacher	teacher
Other/Indirect	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Capital Outlay/EQ/Property	window	window	window	window	window	window	window	window	window	window	window	window
TOTALS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Exhibit I-2. Listing of the Budget Shares and Their Corresponding Indexes for use in the SGCEI and FMB-GCEI

Budget Share	*Index*
Budget Share: ADMINS	Index: Administrators (Tobit)
Budget Share: CLASSIFIED	Index: Classified Staff (Regression)
Budget Share: ENERGY	Index: Energy
Budget Share: SUPPLIES: Food	Index: Food
Budget Share: Amount with NO CODE	"Index value of 1"
Budget Share: SUPPLIES: Instructional and Office	Index: Office and Teaching Supplies
Budget Share: TEACHERS	Index: Teachers (Salary & Benefits Regression)
Budget Share: TRAVEL: District Admins	Index: Superintendent P.D. in ANC Travel
Budget Share: TRAVEL: Maintenance	Index: Maintenance Travel
Budget Share: TRAVEL: School Admins	Index: School Oversight Travel
Budget Share: TRAVEL: Schools to D.O.	Index: Schools to D.O. Travel
(0.5) * Budget Share: TRAVEL: Teachers	Index: Teachers P.D. to D.O. Travel
(0.5) * Budget Share: TRAVEL: Teachers	Index: Teachers P.D. to ANC Travel
Budget Share: SUPPLIES: Maintenance	Index: Maintenance Supplies

Exhibit I-3. Budget Shares

District Name	Budget Share: ADMINS	Budget Share: CLASSIFIED	Budget Share: ENERGY	Budget Share: Amount with NO CODE	Budget Share: SUPPLIES: Instructional and Office	Budget Share: TEACHERS	Budget Share: TRAVEL: District Admins	Budget Share: TRAVEL: Maintenance	Budget Share: TRAVEL: School Admins	Budget Share: TRAVEL: Schools to D.O.	Budget Share: TRAVEL: Teachers	Budget Share: TRAVEL: Teachers: Half	Budget Share: SUPPLIES: Maintenance
Alaska Gateway	10.54%	17.57%	17.11%	-0.53%	4.02%	46.15%	0.38%	2.44%	0.03%	0.90%	0.39%	0.19%	0.99%
Aleutian Region	33.95%	9.94%	5.16%	3.30%	7.82%	27.93%	6.29%	1.45%	0.03%		0.81%	0.40%	3.33%
Aleutians East Borough	8.50%	12.95%	8.83%	3.03%	3.80%	49.33%	1.52%	3.09%	0.10%	2.52%	5.13%	2.56%	1.20%
Anchorage	5.69%	23.51%	4.20%	-0.01%	3.14%	57.79%	0.02%	3.58%	0.02%	0.49%	0.15%	0.08%	1.41%
Annette Island	10.24%	19.86%	7.16%	2.19%	2.71%	52.04%	0.98%	1.12%	0.18%	2.83%	0.64%	0.32%	0.04%
Bering Strait	6.39%	22.73%	11.32%	1.73%	3.55%	44.63%	0.96%	1.02%		1.84%	4.60%	2.30%	1.22%
Bristol Bay Borough	8.07%	17.49%	9.93%	2.40%	2.02%	51.19%	0.15%	3.91%	0.16%	0.66%	3.57%	1.78%	0.46%
Chatham Region	13.83%	15.14%	10.81%	2.23%	2.74%	49.61%	1.73%	1.40%	0.35%	0.62%	0.59%	0.30%	0.94%
Chugach	9.89%	15.90%	9.54%	-0.70%	6.23%	40.60%	2.30%	1.99%		4.75%	1.74%	0.87%	7.77%
Copper River	8.55%	20.82%	7.86%	-0.03%	6.77%	45.90%	0.79%	1.51%	0.09%	2.30%	0.61%	0.31%	4.82%
Cordova City	7.15%	19.41%	7.65%	0.16%	4.14%	54.56%	0.39%	2.10%	0.05%	1.84%	1.12%	0.56%	1.45%
Craig City	9.53%	17.08%	4.66%	2.64%	4.46%	50.97%	0.55%	1.89%	0.02%	2.47%	4.71%	2.36%	1.04%
Delta Greely	8.31%	18.58%	8.10%	0.72%	2.74%	54.59%	0.35%	2.51%	0.13%	0.91%	1.16%	0.58%	1.89%
Denali Borough	8.65%	20.91%	10.86%	1.17%	7.24%	47.40%	0.85%	1.44%	0.04%	0.62%	0.40%	0.20%	0.43%
Dillingham City	7.10%	17.92%	5.94%	3.95%	3.82%	55.18%	0.58%	1.04%	0.06%	3.12%	0.36%	0.18%	0.92%
Fairbanks North Star Borough	5.79%	21.97%	4.63%	0.28%	3.56%	60.83%	0.09%	0.77%	0.01%	1.14%	0.74%	0.37%	0.21%
Galena City	6.50%	14.23%	9.64%	1.80%	30.96%	24.29%	0.97%	1.87%	2.13%	1.52%	1.33%	0.67%	4.76%
Haines Borough	10.27%	19.05%	7.46%	1.55%	2.06%	57.62%	0.82%	0.65%	0.07%	0.02%	0.15%	0.08%	0.27%
Hoonah City	10.31%	19.98%	10.36%	0.50%	3.83%	44.21%	0.24%	5.98%	0.08%	2.36%	1.41%	0.71%	0.74%
Hydaburg City	14.21%	12.08%	8.29%	3.57%	15.67%	36.85%	0.89%	4.42%	0.17%	0.66%	0.26%	0.13%	2.94%
Iditarod Area	5.07%	22.01%	17.61%	-0.27%	6.58%	42.72%	0.98%	0.83%	0.22%	0.95%	2.00%	1.00%	1.31%
Juneau Borough	5.55%	25.31%	3.69%	-0.48%	3.20%	59.29%	0.08%	0.82%	0.08%	1.35%	0.76%	0.38%	0.35%
Kake City	10.16%	17.98%	9.74%	2.74%	3.53%	47.97%	0.78%	3.60%	0.02%	2.81%	0.07%	0.04%	0.59%
Kashunamiut	13.99%	19.58%	7.52%	2.34%	7.56%	40.73%	1.37%	0.75%	0.16%	1.08%	1.28%	0.64%	3.65%
Kenai Peninsula Borough	5.87%	16.31%	5.72%	0.45%	2.28%	58.16%	0.08%	8.15%	0.08%	0.56%	0.51%	0.25%	1.82%
Ketchikan Gateway Borough	7.56%	19.49%	6.88%	0.99%	3.30%	57.85%	0.13%	1.13%	0.07%	0.88%	0.23%	0.12%	1.48%
Klawock City	10.54%	16.25%	8.87%	2.70%	3.62%	53.88%	1.83%	0.66%	0.30%	0.22%	0.68%	0.34%	0.45%
Kodiak Island Borough	8.01%	19.68%	7.89%	1.14%	2.85%	56.78%	0.18%	0.76%	0.20%	0.37%	0.39%	0.19%	1.76%
Kuspuk	7.44%	24.97%	11.26%	1.26%	2.87%	47.39%	0.76%	1.38%	0.16%	1.54%	0.04%	0.02%	0.93%
Lake And Peninsula	4.63%	14.64%	16.46%	3.03%	4.79%	47.04%	1.30%	2.15%	0.17%	3.59%	0.08%	0.04%	2.13%
Lower Kuskokwim	7.88%	30.58%	9.45%	-0.46%	3.58%	41.87%	0.21%	1.36%	0.26%	2.49%	1.59%	0.79%	1.18%
Lower Yukon	8.73%	18.53%	10.97%	0.91%	2.64%	52.27%	1.39%	1.17%	0.21%	1.73%	0.13%	0.06%	1.34%
Matanuska-Susitna Borough	5.19%	20.76%	4.95%	-0.05%	3.00%	63.36%	0.05%	1.35%	0.03%	0.34%	0.24%	0.12%	0.79%
Nenana City	8.48%	12.10%	7.24%	2.23%	26.64%	31.97%	0.64%	1.88%	0.09%	0.97%	1.00%	0.50%	6.75%
Nome City	4.74%	20.75%	9.70%	0.66%	2.34%	56.66%	0.31%	1.34%	0.25%	1.21%	0.48%	0.24%	1.56%
North Slope Borough	4.09%	35.19%	8.67%	1.75%	3.84%	40.93%	0.45%	0.64%	0.08%	1.27%	0.47%	0.23%	2.62%
Northwest Arctic	7.50%	22.15%	14.30%	-0.31%	4.80%	41.33%	0.60%	4.80%	0.18%	2.78%	0.35%	0.17%	1.52%
Pelican City	12.61%	28.29%	7.78%	5.19%	6.50%	29.19%	0.23%	2.18%		0.64%	0.51%	0.25%	6.90%
Petersburg City	6.63%	17.40%	10.42%	1.06%	3.11%	58.83%	0.22%	1.20%	0.11%	0.42%	0.05%	0.03%	0.55%
Pribilof Island	9.30%	22.41%	10.62%	2.02%	3.91%	43.47%	1.42%	1.37%	0.10%	1.54%	0.96%	0.48%	2.89%
Saint Marys City	12.31%	15.82%	10.20%	2.97%	4.23%	42.23%	2.87%	1.83%	0.28%	0.55%	0.66%	0.33%	6.05%
Sitka Borough	9.63%	12.73%	4.67%	0.41%	2.89%	64.72%	0.45%	3.25%	0.08%	0.28%	0.38%	0.19%	0.51%
Skagway City	8.51%	20.02%	7.52%	3.33%	5.33%	47.87%	0.33%	2.05%	0.08%	0.33%	0.16%	0.08%	4.47%
Southeast Island	8.57%	20.44%	7.52%	0.51%	4.35%	49.48%	0.84%	4.80%	0.01%	1.60%	1.18%	0.59%	0.70%
Southwest Region	8.41%	17.48%	9.01%	0.46%	7.01%	49.66%	0.88%	2.16%	0.13%	1.13%	1.33%	0.67%	2.33%
Tanana City	21.56%	17.76%	19.98%	3.00%	4.41%	30.45%	0.69%	1.40%		0.32%	0.02%	0.01%	0.40%
Unalaska City	13.25%	14.94%	8.98%	4.58%	3.38%	49.89%	1.04%	1.63%	0.07%	0.35%	0.38%	0.19%	1.50%
Valdez City	8.24%	20.16%	6.27%	1.48%	2.39%	59.17%	0.21%	0.82%	0.18%	0.37%	0.04%	0.02%	0.68%
Wrangell City	7.42%	20.78%	6.07%	1.57%	4.16%	55.77%	1.03%	0.80%	0.09%	0.38%	0.51%	0.26%	1.42%
Yakutat City	11.84%	18.62%	9.61%	0.39%	4.28%	48.46%	1.74%	0.95%	0.49%	0.92%	0.70%	0.35%	2.00%
Yukon Flats	11.05%	17.39%	22.95%	1.66%	4.71%	35.19%	1.85%	2.41%	0.08%	0.80%	0.12%	0.06%	1.81%
Yukon Koyukuk	11.77%	14.84%	16.79%	-0.59%	4.69%	43.38%	2.07%	2.00%	0.46%	2.07%	1.02%	0.51%	1.51%
Yupiit	10.37%	27.66%	6.69%	1.59%	7.69%	35.75%	2.20%	1.52%	0.04%	2.44%	1.59%	0.79%	2.48%

Exhibit I-4. Index Values

District Name	Superlative Index Value	FMB Index Value	Index: Administrators	Index: Classified Staff	Index: Energy	Index: Maintenance Travel	Index: Office and Teaching Supplies	Index: Teachers P.D. to D.O. Travel	Index: Teachers P.D. to ANC Travel	Index: Schools to D.O. Travel	Index: Superintendent P.D. in ANC Travel	Index: School Oversight Travel	Index: Teachers	Index: Maintenance Supplies
Alaska Gateway	1.28	1.29	0.97	1.09	3.79	1.87	1.54	2.21	10.60	2.21	1.89	2.21	1.05	4.95
Aleutian Region	1.46	2.90	1.25	1.23	4.97	5.20	1.87	276.38	30.02	222.60	3.22	166.27	1.17	2.42
Aleutians East Borough	1.49	1.67	1.10	1.12	3.23	3.62	1.45	77.08	14.10	52.08	2.27	25.89	1.14	2.75
Anchorage	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Annette Island	1.03	1.05	0.95	0.93	0.75	1.06	1.50	1.00	12.71	1.00	2.30	1.00	1.08	1.71
Bering Strait	1.55	2.37	1.05	1.19	4.09	4.96	1.57	186.23	19.68	150.48	2.06	113.05	1.11	4.43
Bristol Bay Borough	1.19	1.20	1.01	1.03	2.96	2.12	1.82	1.00	9.14	1.00	1.64	1.00	1.03	2.51
Chatham Region	1.20	1.58	1.05	0.92	3.72	2.27	5.24	74.36	9.92	49.55	1.54	23.57	0.95	2.50
Chugach	1.29	1.40	1.11	0.98	1.43	1.94	2.82	74.34	6.08	44.89	1.00	14.04	0.96	2.89
Copper River	1.15	1.15	0.99	1.05	2.37	1.39	1.43	1.67	7.03	1.67	1.25	1.67	0.99	4.08
Cordova City	1.07	1.07	0.99	0.96	1.64	0.99	1.40	1.00	8.82	1.00	1.60	1.00	1.04	2.27
Craig City	1.09	1.08	0.95	0.90	1.87	1.15	1.31	1.00	22.46	1.00	4.07	1.00	1.02	2.80
Delta Greely	1.09	1.11	0.94	0.98	2.33	1.09	2.01	1.00	6.07	1.00	1.10	1.00	1.00	2.32
Denali Borough	1.09	1.08	0.97	1.01	1.66	1.36	1.58	1.89	7.91	1.89	1.41	1.89	1.00	1.79
Dillingham City	1.13	1.16	1.02	1.05	2.16	1.10	1.24	1.00	9.20	1.00	1.67	1.00	1.08	3.39
Fairbanks North Star Borough	1.08	1.09	0.97	1.04	1.61	1.05	1.22	1.00	8.34	1.00	1.50	1.00	1.06	1.56
Galena City	1.26	1.21	0.97	1.14	2.87	1.33	1.40	1.00	10.74	1.00	1.94	1.00	1.04	4.11
Haines Borough	1.03	1.06	0.94	0.90	1.80	1.52	1.58	1.00	9.82	1.00	1.78	1.00	0.99	2.16
Hoonah City	1.12	1.16	1.06	0.93	4.62	1.28	1.35	1.00	12.09	1.00	2.19	1.00	0.95	2.13
Hydaburg City	1.10	1.07	1.00	0.91	1.23	1.35	1.63	1.00	11.41	1.00	2.07	1.00	1.02	3.32
Iditarod Area	1.40	2.47	0.93	0.98	5.12	5.13	1.73	236.19	18.62	182.40	1.74	126.07	1.01	1.65
Juneau Borough	1.02	1.03	0.99	1.02	0.74	1.02	1.45	1.00	9.82	1.00	1.77	1.00	1.01	1.89
Kake City	1.09	1.11	1.09	0.93	2.38	2.35	1.16	1.00	12.27	1.00	2.22	1.00	0.97	2.41
Kashunamiut	1.25	1.29	1.02	1.14	2.76	2.72	1.49	1.00	12.95	1.00	2.34	1.00	1.08	4.41
Kenai Peninsula Borough	1.03	1.04	0.97	1.03	1.34	1.15	1.05	3.63	6.92	3.63	1.20	3.63	0.96	2.50
Ketchikan Gateway Borough	1.01	1.03	0.99	0.92	0.75	0.91	1.12	1.00	10.22	1.00	1.85	1.00	1.04	2.65
Klawock City	1.04	1.05	1.05	0.91	1.87	1.02	1.35	1.00	11.66	1.00	2.11	1.00	0.97	2.65
Kodiak Island Borough	1.12	1.21	0.97	1.03	1.95	1.31	1.10	19.98	10.07	12.65	1.78	4.97	1.03	4.55
Kuspuk	1.21	1.44	0.99	1.07	1.67	1.87	2.54	40.21	13.33	40.21	1.83	40.21	1.06	4.22
Lake And Peninsula	1.46	2.08	0.96	0.99	4.62	4.14	1.71	165.38	13.56	111.59	1.84	55.26	1.04	6.35
Lower Kuskokwim	1.39	1.61	1.04	1.23	3.43	2.52	1.62	67.95	10.62	46.04	1.67	23.10	1.07	4.47
Lower Yukon	1.40	2.36	1.02	1.13	3.17	5.34	4.08	169.94	21.54	146.50	2.22	121.96	1.09	4.09
Matanuska-Susitna Borough	0.99	1.01	0.96	0.96	1.06	1.07	0.98	1.49	6.09	1.49	1.08	1.49	0.98	2.61
Nenana City	1.17	1.09	0.93	0.98	1.81	1.21	1.60	1.00	8.14	1.00	1.47	1.00	0.99	4.15
Nome City	1.16	1.17	1.03	1.12	2.40	1.31	1.28	1.00	12.80	1.00	2.31	1.00	1.05	2.63
North Slope Borough	1.58	2.16	1.17	1.48	9.31	4.25	1.57	96.64	17.02	70.35	2.56	42.82	1.18	1.45
Northwest Arctic	1.48	1.56	1.07	1.24	4.93	2.99	1.23	33.45	12.76	26.58	2.06	19.39	1.14	1.18
Pelican City	1.14	1.38	1.03	0.90	1.28	0.91	13.57	1.00	13.96	1.00	2.53	1.00	0.95	2.55
Petersburg City	1.01	1.02	0.94	0.91	1.24	0.92	1.10	1.00	12.86	1.00	2.33	1.00	1.01	2.14
Pribilof Island	1.29	1.34	1.25	1.22	1.31	3.89	1.96	3.18	16.08	3.18	2.87	3.18	1.13	2.96
Saint Marys City	1.28	1.29	1.12	1.09	3.94	2.55	1.96	1.00	12.27	1.00	2.22	1.00	1.01	3.79
Sitka Borough	1.03	1.09	1.00	0.93	0.91	0.95	1.61	1.00	9.82	1.00	1.78	1.00	1.02	5.97
Skagway City	1.00	1.00	1.04	0.90	1.65	1.46	1.07	1.00	10.43	1.00	1.89	1.00	0.95	1.09
Southeast Island	1.07	1.15	1.01	0.87	1.12	1.52	4.11	16.77	14.76	14.33	2.51	11.77	0.94	1.14
Southwest Region	1.26	1.37	0.97	1.03	3.41	1.51	1.54	20.45	10.83	20.45	1.67	20.45	1.06	5.64
Tanana City	1.29	1.27	1.04	1.03	4.67	1.53	2.17	1.00	11.04	1.00	2.00	1.00	1.00	4.24
Unalaska City	1.19	1.21	1.05	1.08	1.89	1.42	1.59	1.00	14.76	1.00	2.67	1.00	1.14	2.82
Valdez City	1.05	1.07	1.01	0.98	1.61	1.02	1.35	1.00	8.29	1.00	1.50	1.00	1.02	2.65
Wrangell City	1.00	1.02	0.94	0.89	1.05	1.52	0.98	1.00	10.23	1.00	1.85	1.00	1.01	1.75
Yakutat City	1.17	1.24	1.09	0.97	3.39	2.10	1.33	15.09	11.18	11.62	1.92	7.98	0.97	3.09
Yukon Flats	1.46	1.94	0.93	1.06	5.43	2.81	2.57	146.14	14.76	92.35	2.34	36.02	1.03	2.95
Yukon Koyukuk	1.44	1.66	0.94	1.06	4.73	2.20	1.73	65.49	11.71	53.82	1.56	41.60	1.10	3.77
Yupiit	1.31	1.34	0.98	1.08	3.58	2.25	2.47	6.43	10.48	6.43	1.81	6.43	1.06	4.54

Exhibit I-5. Categorical Information

District Name	Total District Operating Fund: FY00	District Enrollment	MSA Code	Geographic Region Name	Size	Distance from D.O. to nearest center of commerce	Classroom Teachers (Full-Time Equiv)
Alaska Gateway	$5,373,281.00	490	75	South Central	2 250-999	4 At least 100 miles	9.30
Aleutian Region	$1,228,458.00	61	58	Southwest	1 0 to <250	5 At least 500 miles	2.00
Aleutians East Borough	$5,464,362.00	301	57	Southwest	2 250-999	5 At least 500 miles	11.48
Anchorage	$311,273,670.00	49526	62	South Central	5 10,000+	1 Less than 10 miles	44.74
Annette Island	$3,677,542.00	331	93	Southeast	2 250-999	2 At least 10 miles	9.20
Bering Strait	$23,419,588.00	1735	34	Far North	3 1000-2499	5 At least 500 miles	11.98
Bristol Bay Borough	$2,904,805.00	277	55	Southwest	2 250-999	4 At least 100 miles	10.96
Chatham Region	$2,704,458.00	248	80	Southeast	1 0 to <250	3 At least 50 miles	8.25
Chugach	$1,713,906.00	177	75	South Central	1 0 to <250	3 At least 50 miles	3.04
Copper River	$5,765,693.00	700	75	South Central	2 250-999	4 At least 100 miles	9.32
Cordova City	$3,797,526.00	478	75	South Central	2 250-999	4 At least 100 miles	16.64
Craig City	$3,193,801.00	543	93	Southeast	2 250-999	3 At least 50 miles	16.25
Delta Greely	$6,420,459.00	850	46	Interior	2 250-999	3 At least 50 miles	13.98
Denali Borough	$3,875,143.00	312	47	Interior	2 250-999	3 At least 50 miles	10.47
Dillingham City	$5,426,491.00	578	50	Southwest	2 250-999	4 At least 100 miles	20.61
Fairbanks North Star Borough	$108,243,790.00	15659	44	Interior	5 10,000+	1 Less than 10 miles	37.76
Galena City	$15,147,510.00	3340	41	Far North	4 2500-9999	4 At least 100 miles	16.73
Haines Borough	$3,552,705.00	402	85	Southeast	2 250-999	3 At least 50 miles	10.96
Hoonah City	$3,041,735.00	226	80	Southeast	1 0 to <250	2 At least 10 miles	9.45
Hydaburg City	$1,505,246.00	91	93	Southeast	1 0 to <250	2 At least 10 miles	4.25
Iditarod Area	$6,252,546.00	656	41	Far North	2 250-999	4 At least 100 miles	5.20
Juneau Borough	$36,362,688.00	5494	86	Southeast	4 2500-9999	1 Less than 10 miles	41.05
Kake City	$1,909,779.00	166	91	Southeast	1 0 to <250	3 At least 50 miles	6.15
Kashunamiut	$3,210,513.00	313	51	Southwest	2 250-999	4 At least 100 miles	21.30
Kenai Peninsula Borough	$73,233,548.00	9925	71	South Central	4 2500-9999	1 Less than 10 miles	22.68
Ketchikan Gateway Borough	$17,489,593.00	2517	95	Southeast	4 2500-9999	1 Less than 10 miles	21.12
Klawock City	$2,118,136.00	191	93	Southeast	1 0 to <250	3 At least 50 miles	7.14
Kodiak Island Borough	$22,517,580.00	2743	73	South Central	4 2500-9999	4 At least 100 miles	23.53
Kuspuk	$6,627,779.00	474	52	Southwest	2 250-999	4 At least 100 miles	4.58
Lake And Peninsula	$8,895,930.00	528	59	Southwest	2 250-999	4 At least 100 miles	4.86
Lower Kuskokwim	$44,153,971.00	3695	52	Southwest	4 2500-9999	4 At least 100 miles	14.73
Lower Yukon	$18,551,676.00	1898	51	Southwest	3 1000-2499	4 At least 100 miles	15.71
Matanuska-Susitna Borough	$79,543,329.00	13008	61	South Central	5 10,000+	2 At least 10 miles	32.85
Nenana City	$4,027,766.00	1889	41	Far North	3 1000-2499	4 At least 100 miles	14.84
Nome City	$6,455,807.00	761	34	Far North	2 250-999	5 At least 500 miles	22.87
North Slope Borough	$40,696,630.00	2187	31	Far North	3 1000-2499	5 At least 500 miles	25.45
Northwest Arctic	$25,815,962.00	2188	33	Far North	3 1000-2499	5 At least 500 miles	19.41
Pelican City	$597,493.00	23	80	Southeast	1 0 to <250	3 At least 50 miles	3.40
Petersburg City	$4,994,592.00	678	91	Southeast	2 250-999	4 At least 100 miles	15.70
Pribilof Island	$1,914,471.00	144	58	Southwest	1 0 to <250	5 At least 500 miles	7.84
Saint Marys City	$1,658,111.00	143	51	Southwest	1 0 to <250	4 At least 100 miles	12.50
Sitka Borough	$11,760,802.00	1640	87	Southeast	3 1000-2499	3 At least 50 miles	27.42
Skagway City	$1,647,449.00	132	80	Southeast	1 0 to <250	3 At least 50 miles	11.90
Southeast Island	$3,212,107.00	285	93	Southeast	2 250-999	1 Less than 10 miles	4.91
Southwest Region	$9,916,963.00	771	50	Southwest	2 250-999	4 At least 100 miles	12.55
Tanana City	$1,176,712.00	80	41	Far North	1 0 to <250	4 At least 100 miles	6.00
Unalaska City	$3,952,718.00	355	58	Southwest	2 250-999	5 At least 500 miles	14.07
Valdez City	$8,040,397.00	863	75	South Central	2 250-999	4 At least 100 miles	19.41
Wrangell City	$4,043,265.00	497	91	Southeast	2 250-999	3 At least 50 miles	10.94
Yakutat City	$2,022,629.00	168	79	Southeast	1 0 to <250	4 At least 100 miles	13.63
Yukon Flats	$6,229,257.00	349	41	Far North	2 250-999	4 At least 100 miles	8.36
Yukon Koyukuk	$8,179,716.00	495	41	Far North	2 250-999	4 At least 100 miles	6.25
Yupiit	$5,242,263.00	404	52	Southwest	2 250-999	4 At least 100 miles	11.34

Exhibit I-6. Comparison of the AIR GCEI and the Current Alaska Cost Index
(data are sorted alphabetically by district name)

District Name	Superlative GCEI	Current Alaska Cost Index	Difference between the Superlative GCEI and the Current Index	Districts with an absolute difference >= 0.15 (=1)	Districts with an absolute difference >= 0.10 (=1)	Districts with an absolute difference < 0.05 (=1)
Alaska Gateway	1.28	1.29	(0.01)	0	0	1
Aleutian Region	1.46	1.74	(0.28)	1	1	0
Aleutians East Borough	1.49	1.42	0.07	0	0	0
Alyeska	1.00	1.00	-	0	0	1
Anchorage	1.00	1.00	(0.00)	0	0	1
Annette Island	1.03	1.01	0.02	0	0	1
Bering Strait	1.55	1.53	0.03	0	0	1
Bristol Bay Borough	1.19	1.26	(0.08)	0	0	0
Chatham Region	1.20	1.12	0.08	0	0	0
Chugach	1.29	1.29	(0.00)	0	0	1
Copper River	1.15	1.18	(0.02)	0	0	1
Cordova City	1.07	1.10	(0.02)	0	0	1
Craig City	1.09	1.01	0.08	0	0	0
Delta Greely	1.09	1.11	(0.01)	0	0	1
Denali Borough	1.09	1.31	(0.22)	1	1	0
Dillingham City	1.13	1.25	(0.13)	0	1	0
Fairbanks North Star Borough	1.08	1.04	0.04	0	0	1
Galena City	1.26	1.35	(0.09)	0	0	0
Haines Borough	1.03	1.01	0.02	0	0	1
Hoonah City	1.12	1.06	0.07	0	0	0
Hydaburg City	1.10	1.09	0.02	0	0	1
Iditarod Area	1.40	1.47	(0.07)	0	0	0
Juneau Borough	1.02	1.01	0.02	0	0	1
Kake City	1.09	1.03	0.07	0	0	0
Kashunamiut	1.25	1.39	(0.14)	0	1	0
Kenai Peninsula Borough	1.03	1.00	0.03	0	0	1
Ketchikan Gateway Borough	1.01	1.00	0.01	0	0	1
Klawock City	1.04	1.02	0.03	0	0	1
Kodiak Island Borough	1.12	1.09	0.03	0	0	1
Kuspuk	1.21	1.43	(0.22)	1	1	0
Lake And Peninsula	1.46	1.56	(0.10)	0	1	0
Lower Kuskokwim	1.39	1.49	(0.10)	0	1	0
Lower Yukon	1.40	1.44	(0.04)	0	0	1
Matanuska-Susitna Borough	0.99	1.01	(0.02)	0	0	1
Mt. Edgecumbe	1.03	1.00	0.03	0	0	1
Nenana City	1.17	1.27	(0.10)	0	1	0
Nome City	1.16	1.32	(0.16)	1	1	0
North Slope Borough	1.58	1.50	0.07	0	0	0
Northwest Arctic	1.48	1.55	(0.07)	0	0	0
Pelican City	1.14	1.29	(0.15)	1	1	0
Petersburg City	1.01	1.00	0.01	0	0	1
Pribilof Island	1.29	1.42	(0.13)	0	1	0
Saint Marys City	1.28	1.35	(0.07)	0	0	0
Sitka Borough	1.03	1.00	0.03	0	0	1
Skagway City	1.00	1.14	(0.14)	0	1	0
Southeast Island	1.07	1.12	(0.05)	0	0	0
Southwest Region	1.26	1.42	(0.16)	1	1	0
Tanana City	1.29	1.50	(0.21)	1	1	0
Unalaska City	1.19	1.25	(0.05)	0	0	0
Valdez City	1.05	1.10	(0.04)	0	0	1
Wrangell City	1.00	1.00	0.00	0	0	1

District Name	Superlative GCEI	Current Alaska Cost Index	Difference between the Superlative GCEI and the Current Index	Districts with an absolute difference >= 0.15 (=1)	Districts with an absolute difference >= 0.10 (=1)	Districts with an absolute difference < 0.05 (=1)
Yakutat City	1.17	1.05	0.13	0	1	0
Yukon Flats	1.46	1.67	(0.21)	1	1	0
Yukon Koyukuk	1.44	1.50	(0.06)	0	0	0
Yupiit	1.31	1.47	(0.16)	1	1	0
Mean value	**1.19**	**1.24**	**-0.04**			
Standard deviation	**0.17**	**0.21**	**0.09**			
Minimum value	**0.99**	**1.00**	**-0.28**			
Maximum value	**1.58**	**1.74**	**0.13**			
Number of districts with significant differences in index values				**9**	**17**	**24**

The personnel index reported in *Alaska School District Cost Study: Volume I – Summary of Results* reflects a district-level aggregation of all three personnel indices. To arrive at this index value, one must consider only the budget share spent by the district on personnel. Each of the three personnel budget shares (i.e., teachers, administrators and other certified, and classified) is then divided by the sum of the personnel budget for that district. This provides us with the new budget shares to calculate this aggregate personnel index, which will give us the overall cost of personnel considering the usage of each of the three groups of employees comprising this category. Each of the three personnel indices is weighted by its appropriate budget shares, as derived by taking the average recalculated budget shares of the district and the base district Anchorage. This creates a Tornqvist cost-of-personnel index, similar to the Tornqvist cost-of-education index described in greater mathematical detail earlier in this appendix.

The other indices presented in *Alaska School District Cost Study: Volume I – Summary of Results* – that is, the energy index, the cost-of-goods index, and the travel index – were all created similarly, using the methods described above. The energy index considers only the index value for energy, so its aggregate is the same as the energy index presented in this volume of the study. The cost-of-goods index uses the appropriately-rescaled budget share weights of the index values for instructional supplies and small capital items in its aggregate construction. The rescaling of the budget weights for the aggregate goods index uses the sum of the instructional supplies budget share and small capital items budget share as the denominator. The aggregate travel index uses the appropriately-rescaled budget share weights of the index values for any and all travel indices considered in this volume of the study, using the sum of the travel budget shares as the denominator when rescaling.

The tables on the following pages present the four aggregate indices, along with a breakdown of their individual index components. The columns next to the individual index components show the appropriately-rescaled budget weight for the corresponding index component. To calculate the overall index for that category, one would sum the logarithm of each component index, each weighted by the respective budget weight. Then, take the exponential of the logarithmic form. This will generate the overall index value for that particular aggregate – the value presented in the column after the district name.

Goods Index

	Overall Goods Index	Index: Paper	Budget Weight: Paper	Index: Window	Budget Weight: Window
Denali Borough	1.61	1.58	81.65%	1.79	18.35%
Alaska Gateway	2.07	1.54	74.59%	4.95	25.41%
Aleutian Region	2.02	1.87	69.54%	2.42	30.46%
Anchorage	1.00	1.00	68.95%	1.00	31.05%
Annette Island	1.53	1.50	83.71%	1.71	16.29%
Bering Strait	2.10	1.57	71.71%	4.43	28.29%
Bristol Bay Borough	1.97	1.82	75.26%	2.51	24.74%
Chatham Region	4.25	5.24	71.65%	2.50	28.35%
Chugach	2.85	2.82	56.73%	2.89	43.27%
Copper River	2.09	1.43	63.69%	4.08	36.31%
Cordova City	1.61	1.40	71.53%	2.27	28.47%
Craig City	1.58	1.31	75.06%	2.80	24.94%
Delta Greely	2.11	2.01	64.09%	2.32	35.91%
Dillingham City	1.60	1.24	74.73%	3.39	25.27%
Fairbanks North Star Borough	1.28	1.22	81.74%	1.56	18.26%
Galena City	1.78	1.40	77.82%	4.11	22.18%
Haines Borough	1.69	1.58	78.66%	2.16	21.34%
Hoonah City	1.51	1.35	76.35%	2.13	23.65%
Hydaburg City	1.93	1.63	76.58%	3.32	23.42%
Iditarod Area	1.71	1.73	76.17%	1.65	23.83%
Juneau Borough	1.53	1.45	79.60%	1.89	20.40%
Kake City	1.36	1.16	77.30%	2.41	22.70%
Kenai Peninsula Borough	1.45	1.05	62.28%	2.50	37.72%
Ketchikan Gateway Borough	1.46	1.12	69.00%	2.65	31.00%
Klawock City	1.56	1.35	78.98%	2.65	21.02%
Kodiak Island Borough	1.79	1.10	65.39%	4.55	34.61%
Kuspuk	2.93	2.54	72.26%	4.22	27.74%
Lake And Peninsula	2.56	1.71	69.07%	6.35	30.93%
Lower Kuskokwim	2.15	1.62	72.11%	4.47	27.89%
Lower Yukon	4.09	4.08	67.68%	4.09	32.32%
Matanuska-Susitna Borough	1.26	0.98	74.06%	2.61	25.94%
Nenana City	2.04	1.60	74.37%	4.15	25.63%
Nome City	1.66	1.28	64.44%	2.63	35.56%
North Slope Borough	1.52	1.57	64.18%	1.45	35.82%
Northwest Arctic	1.22	1.23	72.45%	1.18	27.55%
Pelican City	6.81	13.57	58.73%	2.55	41.27%
Petersburg City	1.28	1.10	77.01%	2.14	22.99%
Pribilof Island	2.28	1.96	63.22%	2.96	36.78%
Sitka Borough	2.18	1.61	76.92%	5.97	23.08%
Skagway City	1.08	1.07	61.65%	1.09	38.35%
Southeast Island	3.08	4.11	77.52%	1.14	22.48%
Southwest Region	2.21	1.54	72.01%	5.64	27.99%
Saint Marys City	2.64	1.96	55.03%	3.79	44.97%
Unalaska City	1.90	1.59	69.10%	2.82	30.90%
Valdez City	1.62	1.35	73.46%	2.65	26.54%
Wrangell City	1.16	0.98	71.79%	1.75	28.21%
Yakutat City	1.73	1.33	68.57%	3.09	31.43%
Yukon Flats	2.67	2.57	70.58%	2.95	29.42%
Yukon Koyukuk	2.14	1.73	72.30%	3.77	27.70%
Tanana City	2.48	2.17	80.29%	4.24	19.71%
Yupiit	2.93	2.47	72.30%	4.54	27.70%
Kashunamiut	2.11	1.49	68.22%	4.41	31.78%
Aleutians East Borough	1.73	1.45	72.46%	2.75	27.54%

Travel Index

	Overall Travel Index	Index: Teachers P.D. to D.O. Travel	Budget Weight: Teachers P.D. to D.O. Travel	Index: Teachers P.D. to ANC Travel	Budget Weight: Teachers P.D. to ANC Travel	Index: Schools to D.O. Travel	Budget Weight: Schools to D.O. Travel	Index: Super. P.D. in ANC Travel	Budget Weight: Super. P.D. in ANC Travel	Index: School Oversight	Budget Weight: School Oversight	Index: Maint. Travel	Budget Weight: Maint. Travel
Denali Borough	1.56	1.89	3.89%	7.91	3.89%	1.89	15.05%	1.41	12.84%	1.89	0.88%	1.36	63.44%
Alaska Gateway	2.05	2.21	3.25%	10.60	3.25%	2.21	16.69%	1.89	4.77%	2.21	0.67%	1.87	71.36%
Aleutian Region	4.85	276.38	3.26%	30.02	3.26%	222.60		3.22	36.84%	166.27	0.44%	5.20	50.41%
Anchorage	1.00	1.00	1.80%	1.00	1.80%	1.00	11.57%	1.00	0.37%	1.00	0.56%	1.00	83.89%
Annette Island	1.22	1.00	3.70%	12.71	3.70%	1.00	30.38%	2.30	8.71%	1.00	1.84%	1.06	51.67%
Bering Strait	17.18	186.23	14.55%	19.68	14.55%	150.48	16.72%	2.06	5.91%	113.05		4.96	48.00%
Bristol Bay Borough	2.11	1.00	11.46%	9.14	11.46%	1.00	9.71%	1.64	1.07%	1.00	1.22%	2.12	65.09%
Chatham Region	4.15	74.36	4.05%	9.92	4.05%	49.55	12.35%	1.54	18.67%	23.57	4.04%	2.27	56.85%
Chugach	5.48	74.34	4.94%	6.08	4.94%	44.89	27.83%	1.00	10.85%	14.04		1.94	51.16%
Copper River	1.55	1.67	3.79%	7.03	3.79%	1.67	27.41%	1.25	7.66%	1.67	1.17%	1.39	56.18%
Cordova City	1.15	1.00	5.98%	8.82	5.98%	1.00	22.51%	1.60	3.77%	1.00	0.70%	0.99	61.06%
Craig City	1.69	1.00	13.12%	22.46	13.12%	1.00	18.59%	4.07	3.04%	1.00	0.38%	1.15	51.74%
Delta Greely	1.20	1.00	6.64%	6.07	6.64%	1.00	14.75%	1.10	3.68%	1.00	1.53%	1.09	66.76%
Dillingham City	1.15	1.00	2.66%	9.20	2.66%	1.00	35.96%	1.67	5.79%	1.00	0.90%	1.10	52.04%
Fairbanks North Star Borough	1.22	1.00	7.63%	8.34	7.63%	1.00	26.61%	1.50	1.78%	1.00	0.44%	1.05	55.92%
Galena City	1.38	1.00	5.16%	10.74	5.16%	1.00	15.51%	1.94	6.40%	1.00	13.88%	1.33	53.89%
Haines Borough	1.59	1.00	3.13%	9.82	3.13%	1.00	6.31%	1.78	24.21%	1.00	2.33%	1.52	60.88%
Hoonah City	1.35	1.00	4.41%	12.09	4.41%	1.00	17.49%	2.19	1.37%	1.00	0.68%	1.28	71.63%
Hydaburg City	1.39	1.00	1.90%	11.41	1.90%	1.00	10.98%	2.07	7.12%	1.00	1.64%	1.35	76.45%
Iditarod Area	15.10	236.19	10.97%	18.62	10.97%	182.40	15.33%	1.74	9.99%	126.07	2.45%	5.13	50.28%
Juneau Borough	1.20	1.00	7.05%	9.82	7.05%	1.00	27.56%	1.77	1.54%	1.00	1.63%	1.02	55.17%
Kake City	1.90	1.00	1.15%	12.27	1.15%	1.00	25.08%	2.22	5.56%	1.00	0.40%	2.35	66.66%
Kenai Peninsula Borough	1.37	3.63	2.25%	6.92	2.25%	3.63	8.79%	1.20	0.64%	3.63	0.69%	1.15	85.38%
Ketchikan Gateway Borough	1.04	1.00	3.25%	10.22	3.25%	1.00	23.78%	1.85	2.92%	1.00	1.70%	0.91	65.10%
Klawock City	1.39	1.00	5.50%	11.66	5.50%	1.00	8.73%	2.11	25.04%	1.00	4.30%	1.02	50.93%
Kodiak Island Borough	2.72	19.98	5.99%	10.07	5.99%	12.65	15.59%	1.78	4.85%	4.97	5.53%	1.31	62.04%
Kuspuk	4.66	40.21	1.14%	13.33	1.14%	40.21	25.66%	1.83	10.01%	40.21	2.33%	1.87	59.72%
Lake And Peninsula	11.52	165.38	1.16%	13.56	1.16%	111.59	30.43%	1.84	9.08%	55.26	1.45%	4.14	56.72%
Lower Kuskokwim	8.26	67.95	7.62%	10.62	7.62%	46.04	26.82%	1.67	1.99%	23.10	2.48%	2.52	53.47%
Lower Yukon	12.27	169.94	1.58%	21.54	1.58%	146.50	24.47%	2.22	15.26%	121.96	2.53%	5.34	54.59%
Matanuska-Susitna Borough	1.22	1.49	3.87%	6.09	3.87%	1.49	14.32%	1.08	1.38%	1.49	0.96%	1.07	75.60%
Nenana City	1.33	1.00	6.37%	8.14	6.37%	1.00	16.40%	1.47	7.16%	1.00	1.30%	1.21	62.39%
Nome City	1.36	1.00	4.26%	12.80	4.26%	1.00	22.57%	2.31	4.48%	1.00	3.82%	1.31	60.62%
North Slope Borough	11.51	96.64	4.92%	17.02	4.92%	70.35	27.68%	2.56	7.91%	42.82	1.65%	4.25	52.92%
Northwest Arctic	5.23	33.45	1.90%	12.76	1.90%	26.58	21.76%	2.06	3.62%	19.39	1.29%	2.99	69.53%
Pelican City	1.08	1.00	4.46%	13.96	4.46%	1.00	14.74%	2.53	3.45%	1.00		0.91	72.60%
Petersburg City	1.03	1.00	1.53%	12.86	1.53%	1.00	16.35%	2.33	5.66%	1.00	3.12%	0.92	71.81%
Pribilof Island	3.82	3.18	5.36%	16.08	5.36%	3.18	20.07%	2.87	13.36%	3.18	1.19%	3.89	54.65%
Sitka Borough	1.06	1.00	3.06%	9.82	3.06%	1.00	8.99%	1.78	5.27%	1.00	1.18%	0.95	78.44%
Skagway City	1.46	1.00	2.22%	10.43	2.22%	1.00	11.36%	1.89	5.84%	1.00	1.72%	1.46	76.65%
Southeast Island	2.72	16.77	4.41%	14.76	4.41%	14.33	15.27%	2.51	5.15%	11.77	0.33%	1.52	70.43%
Southwest Region	3.25	20.45	6.80%	10.83	6.80%	20.45	15.82%	1.67	8.03%	20.45	1.42%	1.51	61.12%
Saint Marys City	2.24	1.00	3.58%	12.27	3.58%	1.00	10.26%	2.22	23.33%	1.00	2.51%	2.55	56.75%
Unalaska City	1.61	1.00	3.61%	14.76	3.61%	1.00	10.80%	2.67	15.16%	1.00	1.28%	1.42	65.54%
Valdez City	1.08	1.00	1.54%	8.29	1.54%	1.00	17.21%	1.50	6.73%	1.00	5.77%	1.02	67.21%
Wrangell City	1.61	1.00	5.47%	10.23	5.47%	1.00	12.53%	1.85	18.43%	1.00	1.88%	1.52	56.23%
Yakutat City	3.41	15.09	4.54%	11.18	4.54%	11.62	15.36%	1.92	18.28%	7.98	5.39%	2.10	51.88%
Yukon Flats	4.83	146.14	1.47%	14.76	1.47%	92.35	13.38%	2.34	17.78%	36.02	1.02%	2.81	64.88%
Yukon Koyukuk	5.32	65.49	4.24%	11.71	4.24%	53.82	19.38%	1.56	13.78%	41.60	3.31%	2.20	55.05%
Tanana City	1.53	1.00	1.10%	11.04	1.10%	1.00	12.36%	2.00	14.34%	1.00		1.53	70.81%
Yupiit	3.21	6.43	6.01%	10.48	6.01%	6.43	21.44%	1.81	14.32%	6.43	0.54%	2.25	51.69%
Kashunamiut	2.29	1.00	7.81%	12.95	7.81%	1.00	17.41%	2.34	14.93%	1.00	2.03%	2.72	50.01%
Aleutians East Borough	8.98	77.08	11.27%	14.10	11.27%	52.08	15.99%	2.27	6.33%	25.89	0.69%	3.62	54.43%

Energy Index

	Overall Energy Index	Budget Weight: Energy
Denali Borough	1.66	100.00%
Alaska Gateway	3.79	100.00%
Aleutian Region	4.97	100.00%
Anchorage	1.00	100.00%
Annette Island	0.75	100.00%
Bering Strait	4.09	100.00%
Bristol Bay Borough	2.96	100.00%
Chatham Region	3.72	100.00%
Chugach	1.43	100.00%
Copper River	2.37	100.00%
Cordova City	1.64	100.00%
Craig City	1.87	100.00%
Delta Greely	2.33	100.00%
Dillingham City	2.16	100.00%
Fairbanks North Star Borough	1.61	100.00%
Galena City	2.87	100.00%
Haines Borough	1.80	100.00%
Hoonah City	4.62	100.00%
Hydaburg City	1.23	100.00%
Iditarod Area	5.12	100.00%
Juneau Borough	0.74	100.00%
Kake City	2.38	100.00%
Kenai Peninsula Borough	1.34	100.00%
Ketchikan Gateway Borough	0.75	100.00%
Klawock City	1.87	100.00%
Kodiak Island Borough	1.95	100.00%
Kuspuk	1.67	100.00%
Lake And Peninsula	4.62	100.00%
Lower Kuskokwim	3.43	100.00%
Lower Yukon	3.17	100.00%
Matanuska-Susitna Borough	1.06	100.00%
Nenana City	1.81	100.00%
Nome City	2.40	100.00%
North Slope Borough	9.31	100.00%
Northwest Arctic	4.93	100.00%
Pelican City	1.28	100.00%
Petersburg City	1.24	100.00%
Pribilof Island	1.31	100.00%
Sitka Borough	0.91	100.00%
Skagway City	1.65	100.00%
Southeast Island	1.12	100.00%
Southwest Region	3.41	100.00%
Saint Marys City	3.94	100.00%
Unalaska City	1.89	100.00%
Valdez City	1.61	100.00%
Wrangell City	1.05	100.00%
Yakutat City	3.39	100.00%
Yukon Flats	5.43	100.00%
Yukon Koyukuk	4.73	100.00%
Tanana City	4.67	100.00%
Yupiit	3.58	100.00%
Kashunamiut	2.76	100.00%
Aleutians East Borough	3.23	100.00%

Personnel Index

	Overall Personnel Index	Index: Admin	Budget Weight: Admin	Index: Classified	Budget Weight: Classified	Index: Teacher	Budget Weight: Teacher
Denali Borough	1.00	0.97	8.89%	1.01	27.10%	1.00	64.01%
Alaska Gateway	1.05	0.97	10.37%	1.09	25.34%	1.05	64.29%
Aleutian Region	1.20	1.25	26.91%	1.23	20.43%	1.17	52.66%
Anchorage	1.00	1.00	6.55%	1.00	27.02%	1.00	66.43%
Annette Island	1.02	0.95	9.50%	0.93	25.60%	1.08	64.90%
Bering Strait	1.13	1.05	7.61%	1.19	28.92%	1.11	63.47%
Bristol Bay Borough	1.03	1.01	8.53%	1.03	24.91%	1.03	66.56%
Chatham Region	0.95	1.05	12.07%	0.92	23.15%	0.95	64.78%
Chugach	0.98	1.11	10.72%	0.98	25.48%	0.96	63.79%
Copper River	1.01	0.99	8.95%	1.05	27.34%	0.99	63.71%
Cordova City	1.01	0.99	7.68%	0.96	25.48%	1.04	66.85%
Craig City	0.99	0.95	9.41%	0.90	24.52%	1.02	66.07%
Delta Greely	0.99	0.94	8.37%	0.98	24.91%	1.00	66.71%
Dillingham City	1.07	1.02	7.70%	1.05	24.68%	1.08	67.62%
Fairbanks North Star Borough	1.05	0.97	6.54%	1.04	25.91%	1.06	67.55%
Galena City	1.06	0.97	10.49%	1.14	29.32%	1.04	60.19%
Haines Borough	0.96	0.94	9.18%	0.90	24.47%	0.99	66.35%
Hoonah City	0.96	1.06	10.19%	0.93	26.92%	0.95	62.89%
Hydaburg City	0.99	1.00	14.52%	0.91	23.08%	1.02	62.40%
Iditarod Area	0.99	0.93	6.91%	0.98	29.28%	1.01	63.82%
Juneau Borough	1.01	0.99	6.35%	1.02	27.55%	1.01	66.10%
Kake City	0.97	1.09	9.95%	0.93	25.32%	0.97	64.73%
Kenai Peninsula Borough	0.98	0.97	6.92%	1.03	23.66%	0.96	69.41%
Ketchikan Gateway Borough	1.01	0.99	7.73%	0.92	24.99%	1.04	67.28%
Klawock City	0.97	1.05	9.81%	0.91	23.58%	0.97	66.61%
Kodiak Island Borough	1.03	0.97	8.01%	1.03	25.16%	1.03	66.83%
Kuspuk	1.05	0.99	7.94%	1.07	29.16%	1.06	62.91%
Lake And Peninsula	1.02	0.96	6.77%	0.99	24.55%	1.04	68.69%
Lower Kuskokwim	1.12	1.04	8.18%	1.23	32.54%	1.07	59.28%
Lower Yukon	1.09	1.02	8.76%	1.13	25.16%	1.09	66.08%
Matanuska-Susitna Borough	0.97	0.96	6.18%	0.96	25.13%	0.98	68.69%
Nenana City	0.98	0.93	11.34%	0.98	25.03%	0.99	63.63%
Nome City	1.06	1.03	6.16%	1.12	26.14%	1.05	67.70%
North Slope Borough	1.28	1.17	5.83%	1.48	35.45%	1.18	58.73%
Northwest Arctic	1.17	1.07	8.56%	1.24	29.11%	1.14	62.33%
Pelican City	0.94	1.03	12.27%	0.90	33.69%	0.95	54.04%
Petersburg City	0.98	0.94	7.27%	0.91	24.01%	1.01	68.72%
Pribilof Island	1.17	1.25	9.46%	1.22	28.41%	1.13	62.13%
Sitka Borough	1.00	1.00	8.80%	0.93	20.82%	1.02	70.38%
Skagway City	0.94	1.04	8.85%	0.90	26.61%	0.95	64.54%
Southeast Island	0.93	1.01	8.73%	0.87	26.53%	0.94	64.74%
Southwest Region	1.05	0.97	8.84%	1.03	25.08%	1.06	66.08%
Saint Marys City	1.04	1.12	12.02%	1.09	24.76%	1.01	63.23%
Unalaska City	1.11	1.05	11.76%	1.08	23.08%	1.14	65.16%
Valdez City	1.01	1.01	7.98%	0.98	25.02%	1.02	67.00%
Wrangell City	0.97	0.94	7.69%	0.89	25.88%	1.01	66.43%
Yakutat City	0.99	1.09	10.78%	0.97	25.30%	0.97	63.92%
Yukon Flats	1.03	0.93	11.96%	1.06	27.18%	1.03	60.87%
Yukon Koyukuk	1.07	0.94	11.68%	1.06	24.11%	1.10	64.21%
Tanana City	1.01	1.04	18.72%	1.03	26.24%	1.00	55.04%
Yupiit	1.06	0.98	10.30%	1.08	32.26%	1.06	57.44%
Kashunamiut	1.09	1.02	12.69%	1.14	26.69%	1.08	60.63%
Aleutians East Borough	1.13	1.10	9.28%	1.12	22.66%	1.14	68.06%