An Analysis of Geographic Differences in School Operating and Construction Cost

Suggestions for Accounting for Differences in the Massachusetts Foundation Formula

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Table of Contents

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I. Executive Summary

Study Objective

The purpose of this study is two-fold: (1) evaluate the efficacy of the current Wage Adjustment Factor (WAF) in the State's Chapter 70 State aid funding formula and make recommendations for improving the WAF as necessary, and (2) determine whether a similar geographic adjustment factor is needed for State construction aid assistance and make recommendations for such a factor if such a factor is needed.

This investigation finds that there are in fact significant and meaningful cost-of-living differences between sub-state regions in Massachusetts. Massachusetts is not unique in this regard as empirical studies indicate that the same is true is several other states as well. Evidence from this study also indicates there are significant intrastate differences in construction costs in Massachusetts which would require some consideration in State funding decisions, if an objective and fair statistical mechanism to guide State aid funding support can be developed to adequately address those cost differences.

School Operating Costs

A survey of "best practices" employed in state aid distribution formulas indicates that the WAF contained in the Massachusetts Chapter 70 State aid formula would be consistent with those in use around the country if revised to measure differences between broader sub-state regions as opposed to individual towns. This study finds that the current WAF based on community-by-community average wage data fails to adequately distinguish between the "place-of-work"-orientation of the average wage data used and the need to measure cost-of-living differences based on where people live. Under the current WAF formula, town-by-town or city-by-city average wage levels are used as a proxy for cost-of-living differences in each community even though the average wage earned by workers in those communities differs significantly (both up and down) from the average wages earned by residents in each community.

Therefore, this study recommends that the community-by-community approach in the current WAF formula be replaced by an approach that utilizes the State's twenty-one Labor Market Areas (LMAs) as the building blocks for development of sub-state cost-of-living regions. These regions are developed using average wage data as a proxy measure for cost-of-living differences. Under the recommended approach, LMAs are statistically grouped to form five cost-of-

living districts.

The use of LMAs will address the primary deficiency in the current WAF by aligning the "place-of-work" configuration of the average wage data with the need to measure or cost-of-living differences for people based on where they live. LMAs, which are specified by the federal government with local input, by definition represent economically integrated areas within which workers may readily change jobs without changing their place of residence. Thus, using the average wage which prevails in a LMA as a proxy for cost-of-living of a LMA's resident population is a theoretically sound approach to address the disconnect between the "place-of-work" wage data and the cost-of-living proxy by place-of-residence in the current WAF formula. Further, grouping LMAs into statistically determined cost-of-living districts provides the Department with a theoretically sound and manageable method to adjust the personnel components of Foundation Formula for sub-state cost differences.

More specifically, this study recommends that the Department of Education adopt an improved WAF based on five groupings or clusters of LMAs called Cost-of-Living Zones. Towns in each LMA would be assigned an index according to the relative average wage difference between the LMA group in which the town is located and the average wage of all Cost-of-Living Zones identified in Massachusetts. This index would be transferred to the participating school district based on a weighting such as place of residence of enrolled students. The index level for each of the five LMA groups would be calculated by determining the median index in each LMA grouping or cluster.

The study recommends the use of groups of Cost-of-Living Zones for the design of an adjusted WAF for several reasons. These include:

1. Fairness: A Cost-of-Living Zone-based WAF is sound in economic theory and it would maintain a meaningful connection between intrastate local education cost differences as established under the current WAF.

2. Reliability: A Cost-of-Living Zone-based WAF would be more geographically appropriate in that it addresses the current Place-of-Work/Place-of-Residence conceptual flaw of the existing WAF. A Cost-of-Living Zone-based WAF also yields predictable and intuitively logical results initially and over time. Because of its broader geography, a Cost-of-Living Zone-based WAF would not be prone to wide swings from year-to-year.

3. Independence: A Cost-of-Living Zone-based WAF would use objective data from a reputable third party that could not be biased by parties with a vested interest in the outcome of the WAF calculations. Moreover, since a Cost-of-Living Zone-based WAF would employ data used to measure cost differences that are outside the direct influence of both the State and local school

districts, there likewise is little chance for counter-productive budget incentives or local education district expenditure behavior as well.

4. Simplicity: A Cost-of-Living Zone-based WAF is understandable and explainable to a wide variety of interested audiences. It represents an incremental approach for the Department and the local school districts, and is easily replicable and up-datable. The data on which the Cost-of-Living Zone-based WAF are published quarterly and annually just as with the current WAF. LMAs–and therefore the Cost-of-Living Zones are re-defined each decade based on worker commuting patterns from the decennial Census.

5. Ease of Administration: A Cost-of-Living Zone-based WAF would be cost effective in that the data are routinely published by a reputable third party and can be calculated using inexpensive, off-the-shelf spreadsheet programs and mapping software on a personal computer.

It is recommended that Massachusetts adopt the Cost-of-Living Zone-based WAF approach outlined here and move to a more broadly geographically defined WAF which adjusts only for identified cost-of-living differences between geographic regions. It should be noted that many states around the country to attempt to make cost-difference adjustments for non-geographic variables such as special education costs, size differences, quality of staff, and other factors–some of which may be within the control of the local school districts themselves. It is recommended the State continue to strive to improve its methods for estimating and recognizing such differential needs by other means (e.g. in calculations of average daily pupil counts, etc.), but the State should continue to focus its use of a Cost-of-Living Zone-based WAF approach only to identify and adjust for local education cost differentials based on geography. This is recommended because an adjusted WAF based solely on geographic cost differences is a cleaner, more straight-forward, and more objective approach for addressing those cost differences. Nevertheless, it is recommended that the Department of Education periodically review new developments in “best-practices” in geographic cost reimbursement research and theory and implement those advances as warranted.

Construction Costs

With respect to intrastate construction cost differences, this study recommends that the Massachusetts Department of Education move in the future to develop a construction aid index which is designed using a similar wage-differential model approach–a Facilities Reimbursement Index (FRI)--in three or potentially more sub-state regions. This study identified construction cost differences of between fifteen and twenty percent between the lowest and highest cost areas of the State indicating a potentially significant difference between the three or potentially four identified regions.

However, even though there appears to be quantified construction cost differences within the State, there are no currently-available and reliable data with which to construct a simple, geographically appropriate, replicable, up-datable, and politically independent index. In our opinion, current data on prevailing wages in the construction trades lack enough uniformity both geographically or occupationally to enable the construction of such an FRI index. It is recommended that the Massachusetts Department of Education monitor the data availability issue periodically (e.g. every two years), and assess whether it makes sense to undertake an effort to construct such an index at some point in the future. If the Department decides to pursue an effort to construct a FRI index, it should be aware that the lack of available and reliable data may necessitate the development of regional pro-form construction budgets and collection of primary data on construction costs/prevailing wage differences and all its attendant costs. This is recommended unless there are changes in the methods of collection of the current prevailing wage data which resides at the Department of Employment and Training and the Massachusetts Attorney General's Office, a new set of uniform standards for all school construction around the state, and a wage data base which comports to a true relationship between geographic space and labor costs is developed and published.

An Analysis of Geographic Differences in School Operating and Construction Cost--the Massachusetts Foundation Formula

II. Introduction

Over the last twenty-five years, there have been a number of published empirical studies relating to the development of formulae designed to address differences in the purchasing power of education budgets in different geographic regions (See the bibliography in Appendix I for a listing of these empirical works). Some of these studies have dealt with education cost differences between states, and others have attempted to deal with cost differences within states. Similarly, some of these studies have focused on only the personnel costs in local education districts,[1] and others have attempted to deal with total education expenditures of local education districts. Most of this research dealing with the issues of cost of education differences has focused on developing interstate or intrastate "cost-of-living" measures, the development of "education buying power" or "cost of education" measures, and/or the development of "teacher cost indices." The overriding objective in all of these studies dating back to the late 1960s and early 1970s was to improve equity in the distribution of public resources to local education.

This equity-based approach in the dispensation of public services or other public resources is consistent with similar equity-based policy decisions made on all levels of government. Generally speaking, these decisions involve the use of equalization formulas which utilize measures relating to of differences in wealth, income, various measures of economic and social need, and other indicators relating to the presence of "unacceptable" socioeconomic disparities. Examples of such policies range from the federal Medicaid formula and federal economic development programs to a number of State programs in Massachusetts, including the Chapter 70 State Aid formula for local school districts.

It also is well-documented in the literature that significant geographic

[1] It has been estimated that on average approximately 80% of local school budgets are comprised of personnel costs (NCES Report No. 92-033) using public elementary and secondary expenditure data from the National Center for Education Statistics.

differences–both inter-state and intrastate--exist today in the cost of local education around the country. These empirical studies have generally documented these cost differences using local education expenditure data and state education expenditure data in studies ranging from the simple to the sophisticated. The State of Massachusetts also recognizes that individual local school systems across the State face cost differences. The Massachusetts Department of Education currently uses two primary mechanisms to account for such cost differences in Chapter 70 local aid program. The first involves the calculation of a Foundation Budget, enrollment levels and enrollment composition variables in the Chapter 70 aid formula. The second mechanism involves the calculation of a wage adjustment factor (WAF) which attempts to adjust for geographic cost differences within the State of Massachusetts.

The key question with respect to equity in education funding formulae in the State of Massachusetts is how best to measure education cost differences between regions of the State. A recent study by Chambers and Fowler (1998) which was commissioned by the National Center for Education Statistics of the U.S. Department of Education speaks directly to the complexity of undertaking such a study. Costs notwithstanding, the preferred way to determine cost of education differences within the State would be to undertake detailed regional education expenditure studies, including adjustments for necessary geographical variation in costs, adjustments for costs within the discretion of the local school districts themselves (e.g. school system size) and teacher quality (e.g. education attainment of teachers, total years of teaching experience required for teachers, etc.). However, the costs associated with such detailed studies would likely be prohibitively expensive to most States and local jurisdictions, and would therefore likely never be undertaken.

This has led most states, including the State of Massachusetts, in the direction of developing cost-of-living measures as a proxy to gauge intrastate regional cost differences in education. These proxies implicitly focus on teachers' and administrators' salaries since it has been empirically demonstrated that these costs comprise the overwhelming majority of local education costs (see Footnote 1 above). Today, nearly all of the states that recommend the use of or actually use regional cost adjustments in education formulae use a cost-of-living or modified cost-of-living index approach (including the State of Ohio which uses a cost-of-living index based on prevailing wages). The one notable exception was the State of Texas which uses a cost-of-education index approach.

Whatever the basic approach employed by states who choose to make adjustments in local education funding formulae, each form has both strengths and weaknesses. It is therefore not simply a question of

developing the right or wrong formula or finding the perfect index to achieve greater equity in local school funding. Instead, the best approach for each state will be the result of understanding and developing an index or measure that is consistent with both the purpose of the local education finance policy and the level of resources that can reasonably be dedicated to meeting the overall state policy objective. As such, there is no right or wrong when it comes to methods or indexes to adjust for intrastate cost differences in local education funding formulae. There is only those indexes or proxies which best address the local education cost reimbursement public policy objective within the resource constraints available to undertake the studies and data collection needed to develop them.

Purpose of the Study

The purpose of this regional cost study is to identify and quantify regional education cost differences based on geography as they exist today in Massachusetts, and to explore and recommend a sound approach for incorporating those measurable and meaningful differences into the State's Chapter 70 and construction aid cost reimbursement formulas for local school districts. This study will determine the preferred method of amending the State's Chapter 70 aid formula and, if necessary, the construction aid distribution formulas to appropriately address any measurable and meaningful regional cost differences for each cost concept. This study will focus on: (1) making recommendations, if necessary, for improving the existing Wage Adjustment Factor (WAF) in the current State aid formula, and (2) make recommendations, if necessary, for developing a regional Facilities Reimbursement Index (FRFI) for the purpose of leveling the financial playing field for local school district construction expenditures which meet minimum State standards.

Suggested Criteria to Account for Geographic Cost Differences

Before addressing the question of how to design the "best" measure to help assure that local school districts have roughly equal purchasing power for their foundation budgets in all regions of the State, the following section puts forth a list of guideline criteria for developing an objective statistical measure to address intrastate cost differences Massachusetts. This list was employed in this study for evaluating the current WAF and for making recommendations as to how to improve the cost-difference adjustment procedures of the current WAF and/or for the design of regional construction cost index. In theory, these are attributes that any intrastate cost index would have as part of any sound local education transfer formula policy:

1. Fairness: The index should be sound both theoretically and intellectually. The index should generate meaningful results

with respect to cost-of-education differences, and should not systematically favor or disadvantage a portion of the State relative to others.

2. Reliability: The index should yield results which are predictable and intuitively logical in that it is based on economic concepts that reasonably relate cost of school operation to area economic conditions.

3. Independence: The chosen cost index should measure a cost concept or cost concepts that lie outside the direct control of both the State and the local school districts so as to avoid counter-productive budget incentives or budgeting behavior. As such, the index should not include data which can be influenced or biased by parties with a vested interest in the outcome of the index calculations and/or have even the appearance of a vested interest. The local school districts themselves should not be the source of any data in the calculation nor should the actions of local school districts (e.g. consolidations or separations, overall budget increases) have any bearing on the level or year-to-year movement of the index.

4. Simplicity: The index should be simple. The index should be understandable and be easily explainable to a wide variety of interested audiences. The recommended index should be easily replicable and up-datable as well.

5. Ease of Administration: The recommended index should be based on a manageable data set that is routinely published by a reputable third party. The index should be calculated using inexpensive, off-the-shelf programs and software on a personal computer.

There obviously are a number of different approaches that could result in an adjusted-WAF or construction cost index that would meet these criteria. For the purposes of this study, we will limit our investigation to two approaches, including: (1) those which specifically deal with geographic cost differences based on cost-of-living differences for the WAF in the Chapter 70 aid formula, and (2) those which geographic cost differences in construction costs dealing with prevailing wage rate differences. This approach was taken regarding the former since other components parts of the Chapter 70 aid formula are designed to deal with identified cost differences (e.g. Special Education) other than geography. With respect to construction the focus on prevailing wages was made

since the majority of intrastate cost differences are traceable to wages (or so-called installation expense). In short, by focusing on the cost-of-living differences in the Chapter 70 formula and on prevailing wages in the construction component, we have identified the primary factors behind regional geographic cost differences.

III. Geographic Cost of living Differences–A Discussion of the Economic Issues Involved

Literature Review of Best Practices for the Chapter 70 Local School Aid Study Component

As mentioned above, empirical studies relating to differences between regions in the cost of education has been undertaken in many forms over the last 25 years. These studies have included widely divergent methodologies and focus, and have evolved from relatively simple analyses on single variable–such as cost-of-living differences and using indexes to estimate "real" teacher salaries--to complex multi-variate studies which attempt to capture all factors potentially affecting cost differences between school districts. Typically, the later studies employ huge data sets and use sophisticated statistical and/or econometric techniques to complete these multiple variable regression/econometric equation analyses.

Early studies attempted to explain regional variations in teachers' salaries between states using statewide average salary data (Barro 1974, Brazer 1974), or differences within states using local district salary data (Augenblick and Adams 1979, Brazer 1974, and Grubb and Hyman 1975, Wendling 1979). Other studies employed a so-called Resource Cost Model (RCM) approach in an attempt to capture all of the factors believed to be affecting both inter-state and intrastate educational cost differences. Examples of such variables include the size of a school and or its location (e.g. urban versus non-urban). The RCM approach is a very detailed bottom-up approach to education cost analysis, and early studies of this type involved developing very detailed specifications of resource needs of schools and school districts of varying sizes (Chambers and Parrish 1982 and 1984). The later studies of this type have used sophisticated econometric techniques to estimate educational cost functions for schools with controls for "out-comes" and varying school populations (Duncombe, Ruggiero, and Yinger 1996).

The former type of study which focused on only teacher salaries was too narrow for the purposes of this investigation. The later type of study, the RCM approach, represented a very laborious approach which is clearly not practical or necessary given the objectives of the Massachusetts

Department of Education for its geographic cost differential adjustment. Moreover, the RCM approach would represent unneeded duplication of effort with respect to the identified needs of groups or types of students which is already accounted for by existing Foundation Budget and pupil/enrollment formulas under the existing Chapter 70 aid formula.

However, our survey of the literature yielded much useful information regarding the empirical evidence indicating that there were in fact considerable intrastate differences in the cost of education throughout the country and in Massachusetts (McMahon 1996, Chambers 1998). In addition, the literature revealed efforts underway in several other states around the country to address this issue, including those of California, Florida, Missouri, Ohio, and Texas. In addition, the State of Tennessee also recently completed an investigation titled "The True Cost of Education in Tennessee (1999)" which addressed the current state of thinking on the intrastate education cost issue in that state by comparing its procedures to those employed in Florida and Texas.

From these studies, it was clear that some cost adjustment for local education cost differentials within the State of Massachusetts was appropriate (Chambers 1998) even before our efforts to determine intrastate cost-of-living differences. Moreover, the literature also showed us that many states attempt to use education cost indexes to accomplish adjustments for all cost difference factors–including discretionary factors such as district size, special education needs and the like–and not just for those supply factors that are generally beyond the control of either the State or local school districts themselves. These scholarly attempts to account for all of the factors which affect local education cost differences space are laudable efforts and make for interesting academic exercises. However, they were not directly applicable to the objective function of this study. A bibliography of this work is provided in Appendix I of this report for those who are interested in current "best practices" in this research.

The other important aspect of this "best practices" review entailed the testing of the theoretical appropriateness of using average wages as a proxy to account for variations in the purchasing power of the Foundation Budget education dollar. This review showed that it was in fact possible to make a sound theoretical bridge from average wage levels to disparities in local education costs within the context of an appropriately functioning regional labor market and the so-called Hedonic Wage Model approach. In early studies, Chambers (1981, 1995) described the hedonic wage model as follows:

> *The intuitive notion underlying this theoretical structure is that individuals care both about the quality of their work environment as well as the monetary rewards associated with particular employment alternatives, and that they will seek to attain the greatest possible personal satisfaction by selecting a job with the appropriate combination of monetary and non-monetary rewards. Similarly, employers are not indifferent as to the characteristics of the individual to whom they offer particular jobs. The result of this simultaneous choices is the matching of individual employees with employers. It is the result of this matching process itself that reveals implicitly the differential rates of pay associated with the attributes of individual employees and the working conditions offered by employers. More formally, it is the supply of, and demand for, individuals with certain personal attributes to any particular kind of job assignment that determines the equilibrium wages of labor as well as the implicit market prices attached to personal and job characteristics.*
>
> *The implicit relationship observed between wages and the personal and job characteristics of individuals is referred to as the hedonic wage index. The word hedonic literally refers to the physical and psychic pleasures that one can derive from engaging in certain activities. In the context of labor markets, the word hedonic refers to the satisfactions or utility derived by employees from the characteristics of the workplace and the profits or perceived productive value derived by employers from the characteristics of employees they assign to certain jobs (p.51).*

Within the context of this study, the hedonic wage approach in the WAF deals more broadly with the functioning of regional labor markets overall instead of the narrower teacher salary focus originally envisioned by Chambers in his studies. Just as it is useful in explaining wage differentials between teachers and education professionals between regions, the hedonic wage concept also is useful for explaining wage differentials between regional labor markets overall (e.g. between labor market areas in the State of Massachusetts). In properly functioning regional labor markets, the same monetary and non-monetary attributes of a region can explain wage differentials for all job categories–not just for the categories which include teachers and other local education professionals' salaries--and thus the overall average wage for a region. Given the fact that over 80% of total local education costs in a district typically are personnel costs (see Footnote 1 above), the average wage approach in a properly constructed index can be a theoretically sound and

appropriate proxy for measuring education cost differences between regions within the State of Massachusetts.

With respect to this study, this "best practices" review of the literature indicates several important conclusions that pertain to the objectives of this study for the Massachusetts Department of Education. These include:

1. Intrastate differences in education costs and cost-of-living are typical and expected–even in a small state such as Massachusetts,

2. After adjusting for enrollment/student population differences, the resource needs of local education are closely linked to personnel costs,

3. Average wages in an area generally reflect cost-of-living differences, supply and demand for labor, and all amenities–both monetary and non-monetary–in a given area, and

4. Average wages reflect cost-of-living consistent with an area's relative attractiveness.

An Examination of the Current WAF Formula for Chapter 70 Aid

With the initiation of the use of the WAF, the Massachusetts Department of Education has in fact been employing appropriate theory in its efforts to adjust for intrastate local education cost differences based on geography. There is an impressive body of empirical evidence which shows that 80% of local education budgets across the State on average are comprised of personnel costs (a review of the State's Foundation budget in several jurisdictions confirm this view), the Massachusetts Department of Education's WAF approach is similarly well-ground in "best-practices" local education cost adjustment theory.

In addition, the current WAF approach meets nearly all of the evaluative criteria listed above, including: (1) Fairness: the WAF is sound in theory and is a meaningful proxy for measuring intrastate cost differences, (2) Independence: it is based on objective data from a reputable third part (MA Department of Employment & Training) with no vested interest in the outcome of the calculations, (3) Simplicity: the concept of wages as a proxy for cost-of-living differences is a relatively simple concept, and is easily replicable and up-datable, and (4) the WAF is easy to administer since it is calculated using elemental mathematical computations on a personal computer with off-the-shelf spreadsheet programs.

However, the current WAF approach fails to meet the reliability criterion of above criteria, does not support good education finance theory, and violates the use of "best practices" approaches because it does not accurately account for intra-state cost differences when applied on a community-by-community basis. Current methods used to calculate the WAF are partially based on average wages paid by employers in individual towns and cities within the State of Massachusetts.[2]

The primary conceptual problem with this community-by-community approach concerns the disconnect between the place-of-work orientation of the underlying wage data which measures the average wages of workers in each town versus the need to use these data as a cost-of-living proxy for the people who live in those same communities. Put another way, the current WAF approach is attempting to measure the cost-of-living differences for residents in individual communities by measuring the wages paid to those who work at employers located in each community–regardless of whether those workers actually live there (in most cases workers do not live in the same community in which they work). For example, the current WAF approach determines the average wage of Boston residents by measuring the average wage of workers who work in Boston, even though many workers who receive those wages actually live outside the city. This study recommends building upon the good theory embedded in the current WAF formula by correcting the "place-of-work" to "place-of-residence" incongruity through broadening the average wage approach to groups of LMAs called Cost-of-Living Zones as indicated below. A Cost-of-Living Zone-based WAF is more geographically appropriate in that it better aligns place-of-work with place-of-residence. A Cost-of-Living Zone-based WAF also yields predictable and intuitively logical results initially and over time. Moreover, because of its broader geography, a Cost-of-Living Zone-based WAF would not be prone to wide swings from year-to-year as well.

The Construction Aid Formula

The issue of making adjustments for recognized cost differences in local school construction budgets differs significantly from the WAF adjustment discussion under the Chapter 70 State Aid formula. The Massachusetts Department of Education currently makes no adjustments for intrastate regional differences in construction costs as part of this formula nor does the literature contain any authoritative empirical studies on "best practices" formula adjustments in this regard. Given the above, it appears

[2] The current WAF formula uses as the numerator the average wages paid by employers in the LMA in which the subject town is located weighted by .8 plus the average wages paid by employers in the subject town weighted by .2, divided by 3.

that the Department of Education would be breaking substantially new ground in local education finance if it were to develop intrastate regional adjustment factors for local construction aid.

IV. Methods Employed and the Analysis

Examining Differences in Labor Cost

After completing the above "best-practices" literature review, an investigation to determine cost-of-living differences was undertaken using currently available employment and wage data for the State of Massachusetts, and for parts of Rhode Island, Connecticut, and New Hampshire where Labor Market Areas are combined with Massachusetts employment data. State, county, and labor market area (LMA) data were assembled from the CES establishment survey, the ES-202 covered wage reports, and the household survey (see Appendix 3 for an explanation of the various employment surveys undertaken by the Massachusetts Department of Employment and Training in cooperation with the U.S. Department of Labor). These data were then assembled into three configurations (where possible), including: (1) the individual municipality level (ES-202 data only); (2) counties (ES-202 data and the Household Survey), and (3) labor market areas (for the CES survey data, the ES-202 data, and the Household Survey data).

On a conceptual level, it was decided that the ES-202 covered employment data at this time were preferable to the CES survey and the Household Survey data. There were several reasons for this determination. First, ES-202 data are reported on the most dis-aggregated level thereby offering the greatest flexibility among the possible alternative data sets that could be used in this analysis. Secondly, ES-202 data are part of a compulsory tax return filing for all businesses (e.g. it is not a "voluntary" survey), and include the theoretically correct average wage concept for the theoretically superior hedonic wage approach. Third, these data are also routinely reported in a standard construct (both within and between the states), and are updated on a regular basis. Consequently, it was determined that ES-202 data could potentially be employed in a geographically dis-aggregated or grouped format as was needed to achieve meaningful results.

Using ES-202 covered employment data, three potential aggregation/dis-aggregation alternatives were examined. These included:

1. Individual communities (e.g. the town level as in the current WAF) or groups of individual communities,

2. Counties or groups of counties (as has been done in several other states), and

3. Labor market areas or groups of labor market areas (as the Department of Education has briefly investigated previously).

The first alternative was rejected on conceptual grounds given the fact that ES-202 employment and wage data are reported by place of work–or at the employer level. Therefore, employment and wage data in an individual community reflect the employment and wage circumstances of those who work at employers located in that community and do not necessarily reflect the employment conditions, status and/or wage levels of those who live in that community where the reporting employers are located. As such, while the ES-202 data are indicative of the employment circumstances and wage levels of people who work in that individual community, they do not necessarily reflect the employment and wage levels of that individual community's residents. The one possible exception, of course, is the unlikely circumstance that all residents of that community work only for employers which happen to be located in that particular community as well.

The analogy to this circumstance would be equating the cost-of-living for residents of the City of Boston with the employment circumstances and average wages of all those who work within the City limits–even though many workers, particularly those workers earning a high average wages, live outside the city limits. Put another way, under this approach the cost of living for residents of the Town of Burlington, MA would be determined by the average wage of employers located within the town lines despite that fact that many town residents work at employers located within the City of Boston.

Option number 2, which utilizes a county level organization to the ES-202 data was then investigated given the fact that several other states–including the states of Florida, Ohio and Tennessee–use this approach. This study found that although that helped to improve the incongruence between the place-of-work to place-of-residence issue that was prevalent on the individual community level of dis-aggregation, the use of county boundaries or groupings of counties within the State of Massachusetts (or any other New England state for that matter) were still arbitrary from an economic standpoint.[3] Therefore, this configuration did

[3] This is not meant as a criticism of decisions made in those other states as much as it represents a recognition of different patterns of governmental organization in those areas. The BLS generally defines Labor Market Areas in all areas of the country

not fully address the problem of finding congruence between the ES-202 place-of-work data and the place-of-residence cost-of-living proxy approach described above.

This study therefore recommends option number 3 be employed. This alternative calls for the configuration of regions along the boundaries of so-called labor market areas or groups of labor market areas for the purposes of making improvements to the WAF geographic adjustment approach. This method is being recommended given the fact that the size and shape of Labor Market Areas are defined based on the relationship between where people live and where they work.

In theory, labor market areas are economically integrated within which workers may readily change jobs without changing their place or residence (BLS Handbook of Methods, 1997). Labor Market Areas are defined using commuting pattern data from the 1990 Census and input from state Departments of Employment and Training or Employment Security. The Labor Market Area approach represents an aggregation of individual cities and towns in the State (see Table 1 for a complete listing of towns and cities in Massachusetts LMAs. Chart 1 presents these LMAs in a graphic display.). This aggregation to labor market areas represents an economically determined assemblage of individual communities in Massachusetts which effectively addresses the major conceptual concern of using data variables as a proxy to define cost-of-living differences even though they are reported by place-of-work.

The use of labor market areas raises the issue of wage data which cross state lines because of the methods employed by the U.S. Bureau of Labor Statistics (BLS) in the New England Region. For the most part, BLS defines labor market areas in terms entire counties, except for the New England region where cities and towns are used.[4] In the State, five labor market areas (the Boston MA-NH PMSA, the Lowell MA-NH PMSA, the Lawrence MA-NH PMSA, the Providence-Fall River-Warwick RI-MA MSA, and the Worcester MA-CT PMSA) include portions of other states in their federal geographical definition. At times, the overlap can be significant. For example, the Boston, MA Consolidated Metropolitan Statistical Area defines a Labor Market Area that is intertwined with the southern part of the State of New Hampshire. In fact, the New Hampshire State Planning

except New England in terms of entire counties. The New England region is an exception to that nation-wide practice of defining LMAs along county boundaries. Instead, LMAs are defined in the New England states–including Massachusetts--using individual cities and towns.

[4] BLS Handbook of Methods (1997), Bureau of Labor Statistics, p.238.

Office has estimated that more than half (59.0%) of the entire state of New Hampshire's population lived within this Boston MA-CMSA area). At other times, the overlap is insignificant. For example, the Worcester MA-CT labor market area includes only the Town of Thompson in the State of Connecticut (Population 9,019 as of July 1, 1997[5] or just 1.8% of the total population of the entire Worcester MA-CT LMA estimated at 488,340 persons also as of July 1, 1997).

This overlap raises the issue of the appropriateness of using data from the states of Connecticut, New Hampshire and Rhode Island in the determination of the WAF factor in the Chapter 70 aid formula in the State of Massachusetts. However, from a theoretical and a practical perspective, this should not be a concern to the Department since the objective function of the WAF is to accurately measure cost-of-living differences in all areas of the State. As mentioned above, the labor market theory behind the concept of LMAs is to define economically-integrated geographic regions where workers may change jobs without changing their place of residence. Given that definition, the use of LMAs for this establishment-oriented average wage data is perhaps the best method available to account for the "place-of-work" reporting orientation of the ES-202 data and the need to measure place-of-residence cost-of-living in the WAF factor. For example, to measure average wages of residents in the Fall River LMA region based only on employers reporting in the eight Massachusetts towns in the entire LMA which is comprised of 41 cities and towns, would be to overlook the economic significance of wages earned by many Massachusetts residents in the area who work at establishments located outside the boundaries of Massachusetts. Data from 1997 indicated that this erroneous approach would understate the true average wage of residents in the Fall River LMA by just under ten percent. Measuring the average wage for Massachusetts in the four cross-state LMAs based on only Massachusetts employers in those areas would clearly present and incomplete and inaccurate picture of the average wage–and therefore the true cost-of-living difference–in at least three and potentially four of the five areas inter-state LMAs (the exception being the Worcester LMA where only one Connecticut town is present).

Exploring Options to Account for Geographic Differences in Labor and Construction Cost

The first step in testing the efficacy of a WAF approach or an adjusted WAF approach to dispensing Chapter 70 State Aid is determining whether or not differences in cost-of-living exist between regions. Using the benefit of the theoretical linkage between cost-of-living and average

[5] Source: Connecticut Department of Public Health.

wages outlined above, we undertook a statistical test to calculate the significance of any cost-of-living differences based on wages which exist today with different regions of the State based on LMA divisions. The testing procedures employed are well-known, standard tests for determining statistically significant differences between data observations. This test is called Analysis of Variance or ANOVA.

An analysis of variance (ANOVA) is a standard statistical procedure used to compare more than two means in order to determine if there is significant difference between the means, thereby leading to the conclusion that there is a significant difference between data observations (populations). This procedure is used instead of multiple pair-wise comparisons due to the compounding of the type I error rates associated with each pair-wise test. To correctly conduct an analysis of variance, there are three assumptions concerning the data associated with the ANOVA procedure. These assumptions include:

1. The populations are normally distributed,

2. The populations have a common variance and,

3. The populations are independent, meaning that one population is not related to another and the outcome from one population is not related to another.

These assumptions in relation to the Labor Market Area average wage data are addressed in the discussion below.

The basis of the ANOVA procedure is the premise that for means that are not significantly different from each other, the ratio of between-sample variation to within-sample variation is smaller than for means that are significantly different. The ANOVA procedure first calculates the within-sample variation and the between-sample variation, usually called the sum of squares *between* and *within*. Second, the respective sum of squares are divided by their respective degrees of freedom to give the mean square *between* and *within*. Third, the mean square *between* is divided by the mean square *within* to give the test statistic which follows an F-distribution (Ott, 1993).

In order to determine if the Labor Market Areas (LMAs) of Massachusetts were significantly different from each other, ES-202 data were compiled for LMAs in the State. This was done by taking the sum of the total wages for each major private sector industry in the State (or by two-digit SIC) and dividing that number by the sum of the average employment for each major private sector (or by two-digit SIC). These data were compiled for

the years 1995-1997, and these LMA yearly averages were then used to construct the ANOVA table. In order to address the ANOVA data assumptions discussed above, frequency distribution histograms were constructed for each of the three years to determine the distribution of the data.

It was found that each year approximated a normal distribution, and the common variance assumption was tested using the Hartley's Test, where the null hypothesis is all the variances are equal to each other. The test statistic is the maximum variance divided by the minimum variance and follows an F-distribution. The null hypothesis was not rejected with a p-value of .001, meaning that the variances are not significantly different from each other. The assumption of independence was supported given the data used were compiled for separate LMAs.

LMAs are defined by the Bureau of Labor Statistics as "a geographic area consisting of a central community and contiguous areas which are economically integrated into that community"(BLS, 1997). As these areas are considered separate from each other, the assumption of independence is satisfied. The ANOVA procedure was then performed on the yearly LMA average wage. The null hypothesis is $\mu_1 = \mu_2 = ... \mu_{21}$, which will be rejected if the test statistic is greater than the critical F value. The test statistic, which follows an F-distribution, was 22.06781, significantly larger than the $F_{critical}$ {" =.001, 20, 40} = 3.14. The conclusion from these results was to reject the null hypothesis, meaning to reject the conclusion that the means are equal. Therefore, we conclude from this investigation that there is a statistically significant cost-of-living difference between regions as defined by LMAs in the State. Through this approach, we find it is in fact appropriate to adjust the State's Chapter 70 for cost-of-living differences on the LMA level based on cost-of-living differences as defined above in order to level the playing field for local school districts in their effort to attract quality teaching and other professionals.

Following the successful completion of the above-described statistical test, the average wage (in this case a weighted average mean wage) for each LMA was then reduced to an index relative to the weighted average median of all twenty-one Massachusetts labor market areas (See Table 2).[6] With respect to this analysis, these indexes ranged from a low of .751

[6] For the purposes of this analysis, a weighted average wage of the past three years (corresponding to 1995, 1996, and 1997) were employed. This weighted average approach was used to help dampen the effects of any large year-to-year changes. This approach is recommended in lieu of the current WAF formula which uses 1/3 of the actual difference of the individual community's average wage from the statewide

of the overall LMA average in the Balance of Western MA LMA to a high of 1.569 in the Boston MA-NH PSMA LMA (See Tables 2 and 3).

All LMAs were then ranked and grouped based on where they scored when examined relative to the statewide LMA median. Each LMA was assigned to a group determined by calculating the standard deviation of the LMA average wage relative to the median of all LMAs. In this manner, each group or cluster of LMAs represents LMAs with statistically similar average wage/cost-of-living characteristics. A review of the preliminary grouping is displayed in Table 3. Five groups are indicated by the analysis ranging from those that are -2 standard deviations below the median to those ranging +3 standard deviations above the median measure. The results are predictable with the Boston LMA indicating a median of 1.569 and being in the +3 standard deviation group and Balance of Western Massachusetts and Provincetown being in the -2 standard deviation group. The median measure for each group is displayed on Table 3 and Chart 2 displays a map indication the geographical distribution of the preliminary grouping.

A review of the preliminary grouping indicates possible inconsistencies that deserve further analysis. The scoring for the area known as Balance of Central Massachusetts which includes the three towns of Warren, Brimfield and Wales located between the LMAs of Springfield and Worcester appears to be inconsistent with the adjacent communities. Accordingly, these communities were reassigned to the Worcester LMA as driving times to this LMA are shortest. Additionally, the towns of Bourne and Falmouth, which are not included in the LMA of Barnstable-Yarmouth, appear to be economically more consistent with other Cape towns than the Massachusetts mainland. For this reason, these towns were assigned to the Barnstable-Yarmouth LMA.

Following the above discussed adjustments, the LMAs were re-analyzed for appropriate grouping. Using the same methods as described above, LMAs were grouped by standard deviation from the all LMA median by relative average wage/cost-of-living. The adjusted grouping indicates five LMA groups as shown on Table 4. The median value for each group is calculated as shown on Tables 5 and 6 and ranges from a low of .741 for the group including Balance of Western Massachusetts, Provincetown, and North Adams to a high of 1.468 for the group including only the Boston LMA. Chart 3 displays a map showing the geographical distribution of the adjusted LMA grouping.

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average. The index is developed relative to the median all-LMA wage as a measure of central tendency to balance the extreme high and low ends of the data spectrum.

We believe that the adjusted data more accurately reflects an appropriate grouping of LMAs into an array of areas of common cost-of-living regions or districts within the State of Massachusetts. It is our recommendation that the Massachusetts Department of Education pursue a policy of adjusting State Aid Foundation Formula personnel allocations to school districts by the median relative wage index for each of the five groups based on the median measure for the entire group. By way of example, Table 6 shows Foundation Budgets for school districts located in the +1 standard deviation group would receive foundation credits for personnel at a rate of 1.038 times the formula prescribed amount. Likewise, personnel budgets for school districts in other Cost-of-Living Zones would be adjusted using the appropriate factor based on the geographic location of the school district.

Optional Considerations and Alternative Methods of Adjustment
However, there are several potential approaches to calculating the actual value of the new adjusted-WAF index which may or may not comport to the example in Table 6 presented above. Because of this, a number of alternative approaches for calculating the actual adjusted-WAF factor were investigated because we recognize that other considerations enter into the final choice of methods. In fact, a range of reasonable alternatives exist available to the Massachusetts Department of Education. They include:

1. Use of the relative wage/cost-of-living index as is indicated for each LMA–allowing for both additions and reductions in the level of Chapter 70 support such that for those areas at an index level determined to be less than less than 1.0 receive proportionally less than the formula amount and those with a greater than 1.0 receive more–the alternative described above;

2. Use of the relative wage/cost-of-living index as is indicated for each LMA, but treating all areas with an index level of less than 1.0 as a 1.0 in the Chapter 70 aid formula;

3. Use of the relative wage/cost-of-living index for each LMA but standardize the lowest index level to 1.0 thereby establishing the lowest cost-of-living area as the hold-harmless, lowest common denominator for the purposes of Chapter 70 support,

4. Use of the relative average wage index/cost-of-living index for groups of LMAs–allowing reductions in aid for those groups of LMAs where the median index for the group is less

than one,

5. Use of the relative wage/cost-of-living index as is indicated for groups of LMAs, treating all groups of LMAs with an index level of less than 1.0 as a 1.0 in the Chapter 70 aid formula.

6. Use the relative average wage/cost-of-living index for groups of LMAs but setting the lowest grouped index level to 1.0 thereby establishing the lowest cost-of-living area as the lowest common denominator for the purposes of Chapter 70 support.

This study recommends the use of a grouping or clustering approach (Option 4) where the various LMAs are configured in Cost-of-Living Zones based on an array of relative average wage by standard deviation around the all-LMA median wage. We believe that this approach comes the closest to reflecting the actual intrastate regional cost differences in cost-of-living as measured by regional wage differences. This approach would produce adjustments ranging from .741 in the -2 standard deviation group to +1.468 in the +3 standard deviation group. The specific median measures are shown on Table 6 and Chart 3.

From the map, this analysis indicates there is a clear cost-of-living distinction for residents between western Massachusetts (e.g. from the eastern boundary of the Worcester LMA west) and the Brockton-Fall River-New Bedford-Cape/Islands at the low end of the range to the Boston MA-NH LMA and the Lawrence-Lowell LMAs at the higher end of the cost-of-living range. By using this relative index approach, the prospect of “cliffing” between individual communities which border each other is limited to the Worcester-Boston border, and the southeastern part of the state where four LMAs border the higher cost-of-living Boston MA-NH LMA. Moreover, this alternative is incremental to the existing WAF, which in a straight-forward manner addresses the principal flaw of the existing WAF (which allows for indexes of less than 1.0). It is replicable, cost-effective, and understandable and explainable to the varied number of interested audiences as well. It is an independent, neutral approach in that the data set employed is not readily susceptible to be biased for the purposes of giving one school district a competitive advantage in recruiting and/or retaining teachers versus another.

Examining Differences in Construction Cost

Intrastate differences in construction costs were studied by examining

data published by the R.S. Means Company, Inc.[7] R.S. Means collects and publishes data for use by the construction trades in the preparation of construction bid documents. Examination of this independently collected construction cost data for the State of Massachusetts indicates that statistically significant cost differences exist between regions. Using standard statistical techniques, construction cost data for 14 cities in Massachusetts were examined. The results of these tests indicate that three or potentially four statistically different cost regions exist.

Sub-state construction cost data for Massachusetts was obtained from R.S. Means for the last three years (1997-1999).[8] R.S. Means publishes construction costs for 14 cities in Massachusetts, including: Boston, Brockton, Buzzards Bay, Fall River, Fitchburg, Framingham, Greenfield, Hyannis, Lawrence, Lowell, New Bedford, Pittsfield, Springfield and Worcester. Two types of construction cost data were obtained from R.S. Means: (1) City based cost indices for total (material and labor) construction costs; (2) City based construction wages for 47 construction trades.[9]

A review of the Means data indicates that cities in eastern Massachusetts–most notably Boston--tend to have higher construction costs than those in western Massachusetts–most notably Pittsfield. However, such comparisons are not based on tests of statistical significance. The first step in determining if statistically significant sub-state construction cost differences exist, involved performing an analysis of variance for the mean total construction and wage costs of the 14 cities identified (Refer to the ANOVA explanation in the Chapter 70 WAF section above). This test indicates whether any differences exist between the mean construction costs for the cities. The ANOVA analysis for total construction costs indicated that the mean value was significantly different for at least one city in the 1997-1999 time period(Refer Appendix IV.Table A). The ANOVA analysis for construction wages indicated that the mean value was also significantly different for at least one city in the 1997-1999 period (Refer to Appendix IV. Table B).

The second step in evaluating construction cost differences involves understanding which cities (and how many cities) exhibit statistically

[7] R.S. Means, located in Boston Massachusetts, is a nationally recognized source of building construction cost data in the United States.

[8] It should be noted here that the Means construction cost data are as of January of the year indicated.

[9] R.S. Means' construction wages are based on 'prevailing" or union wages.

different costs. This requires the use of a multiple-comparison procedure in which each of the 14 cities is compared to the other.[10] For purposes of this analysis, two multiple-comparison procedures were used. The first test, referred to as the Tukey test, was used to provide a conservative measure of which cities display significant cost differences.[11] The results of the Tukey test, according to cost category, are displayed below.

Test 1–Tukey

A. Total Construction Costs (1997-1999):

> Pittsfield, Greenfield and Springfield were found to have significantly lower costs than Boston, Lowell, Lawrence, Fall River, Brockton, New Bedford, Framingham, Hyannis, Worcester and Buzzards Bay.

> Boston was found to have significantly higher costs than the 13 other cities.

>> *Summary*: Pittsfield, Greenfield and Springfield are located in western Massachusetts. Boston is in eastern Massachusetts. The other 10 cities, from Fitchburg to Lowell did not display significantly different costs. These results would suggest at least three geographic divisions based on significantly different construction costs (Refer to Appendix IV. Table C).

B. Construction Wages (1997-1999):

> Greenfield, Pittsfield and Springfield were found to have significantly lower construction wage costs than the other 11 cities.

> Boston was found to have significantly higher wage construction wage costs than the other 13 cities.

>> *Summary*: Greenfield, Pittsfield and

[10] Each city constitutes a separate population and thus has its own mean value. Each of the 14 city means must be compared to each other, to determine which and how many values, are significantly different.

[11] This test is conservative in that for a given application it will indicate fewer significant differences than other multiple-comparison procedures. Refer to Ott, page 836. This procedure makes use of an “experimentwise error rate” rather than a “controlled per-comparison error rate” as found in some multiple-comparison procedures.

Springfield, all western cities ranked as the significantly lowest cost cities. Boston, in the east, ranked as the significantly highest cost city. This result alone suggests a broad geographic division of the state into 3 cost regions: Western, Central and Cape, and Boston (Refer to Appendix IV. Table D).

C. Test 1 Conclusion:

Analysis of the Total Construction and Construction Wage cost data indicate that significant cost differences exist between cities. The results suggest that cities with common cost levels may be contiguous, thus forming geographic regions. These results suggest a broad geographic division of costs into 3 sub-state regions: West, Central & Cape, and Boston. However, this data does not suggest that the number of differing cities is large.

The low number of differing cities may be attributed in part to the conservative nature of the Tukey test. The primary motivation for the use of this test was to demonstrate, that even with a conservative analysis, significant sub-state construction cost differentials exist in Massachusetts.

Test 2–Duncan Test

The Duncan multiple-comparison test was used in an attempt to gain a more definite measure of the geography of construction costs in Massachusetts. The Duncan Test is in general regarded as a less conservative test than Tukey, but more accurate[12]. The results of this test are displayed below.

A. Total Construction Cost (1997-1999):

> Pittsfield, Greenfield and Springfield were found to have significantly lower costs than the other 13 cities.

> Buzzards Bay and Fitchburg were found to have significantly lower costs than Boston, Lowell, Lawrence, Fall River, Brockton, New Bedford and Framingham.

[12] Regarded as a "very powerful" and popular multiple-comparison procedure. Error rate for this test is not based on a per-comparison basis or experimentwise basis. Employs the concept of a "protection level." For a detailed description refer to Ott, pages 825-828.

> Boston was found to have significantly higher costs than the other 13 cities.

>> *Summary*: Like the Tukey test results, Pittsfield, Greenfield and Springfield were identified as the significantly lowest cost cities. These results suggest a low construction cost region in western Massachusetts and a high cost region as Boston. This test identified a third group with significant cost differences, consisting of Buzzards Bay in eastern Massachusetts and Fitchburg in north central Massachusetts (Refer to Appendix IV. Table E).

B. Construction Wages (1997-1999):

> Greenfield, Pittsfield and Springfield were found to have significantly lower costs than the other 11 cities.

> Boston was found to have significantly higher costs than the other 13 cities.

>> *Summary*: Similar to Tukey Test results. Suggests a broad geographic division of the state into 3 cost regions: western, central and cape, and Boston (Refer to Appendix IV. Table F).

C. Test 2 Conclusion

The results of the Duncan test in general reaffirm the conclusions reached from the Tukey Test, that significant construction cost differences exist between cities in Massachusetts. In both the Tukey and Duncan results, the cites of western Massachusetts are distinguished as the significant low cost region and Boston is distinguished as the significant high cost region. Furthermore, the Duncan Test results from the Total Construction cost data suggest another division or group of cities (Buzzards Bay and Fitchburg) may also exist. This would suggest four or more distinct cost regions (Refer to Appendix IV. Charts A & B).

Regional Construction Cost--Overall Conclusion

Using total construction cost (materials, equipment and labor) and construction wages (47 construction trades) for 14 cities in

Massachusetts, from 1997 to 1999, statistically significant construction cost differences between cities, can be demonstrated. Test results from both data sets indicate approximately 3 cities may constitute the low cost city group and that Boston forms the highest cost group. The western Massachusetts cities of Pittsfield, Greenfield and Springfield are found to be the low cost region and Boston is found to be the high cost region. These results suggest that the remaining 10 cities may all have similar costs, somewhere between the high costs of Boston and the low costs of western Massachusetts. Furthermore, these results also suggest a fourth cost group within this group of 10 cities may exist. Geographically, the results from this data suggest that these "medium" cost cities are located between Boston and Greenfield/Springfield, and along the Cape. Significantly more observations including additional city and annual data are required to support a statistically valid conclusion as to how to draw regional cost boundaries. Although the results seem to indicate that there are construction cost differences they indicate a lack of sufficient detail to develop statistically meaningful cost regions in a fashion similar to that recommended to account for intra state cost-of-living differences.

It is important to note that this analysis is based on three years of data. A more in-depth analysis based on a longer time series may or may not yield more distinct geographic cost differences among cities, in addition to providing a greater understanding of which factors specifically drive differences in construction costs between cities.

V. Recommendations and Conclusions

The Wage Adjustment Factor

The purpose of the study was to explore the possibilities and recommend–if possible--an improved mechanism for more fairly/equitably dispensing Chapter 70 and construction State aid to different geographic locations within the State. This study finds that there is significant empirical evidence indicating there are meaningful variations in local school operating expenditures between regions in Massachusetts.

This study recommends that the Massachusetts Department of Education use an adjusted WAF based on five groups of labor market areas to replace the current WAF in the Chapter 70 State aid formula.

A survey of "Best Practices" yielded useful information about methods employed elsewhere to account for cost-of-education differences. These methods varied widely in approach, objectives, and sophistication among several states. This review indicated that the use of wage data–in an appropriately constructed index–was a theoretically sound proxy for

measuring underlying cost-of-living differences between regions within the State. This wage-based method–known as the hedonic wage model in education finance circles--is well-suited as a tool to isolate the impact of monetary and non-monetary regional amenities and the cost-of-living of residents in economic regions known as labor market areas. Since research and a review of foundation budgets in Massachusetts indicated that more than 80% of total school system expenditures are accounted for by personnel costs (with the other 20% being goods purchased by school districts in extra- regional–if not national markets), a cost-of-living proxy based on a hedonic wage model concept using regional labor market areas was determined to be the best theoretical method to the development of an adjusted WAF for Chapter 70 State Aid.

More specifically, this study recommends the Department of Education utilize an improved WAF based on statistical grouping of the State's twenty-one Labor Market Areas as published by the Massachusetts Department of Employment & Training for the Chapter 70 State Aid formula.[13] The new adjusted Wage Adjustment Factor (WAF2) would be constructed to replace the current WAF index in order to simulate cost-of-living differences between regions using five clustered LMA regions/categories called Cost-of-Living Zones. Under the Cost-of-Living Zone-based WAF, towns and cities in each LMA would be assigned an index according to the median index of relative wage differences for the Cost-of-Living Zone in which the local school district is assigned.

The use of Cost-of-Living Zones are recommended for the construction of the new WAF2 for several reasons, including:

1. It is Fair: A Cost-of-Living Zone-based WAF is sound in theory and it would maintain a meaningful connection between intrastate local education cost differences as established under the current WAF. The use of Cost-of-Living Zones for an adjusted WAF will also produce consistent results over time since they encompass larger geographic areas and more appropriately reflect regional economic relationships. Year to year fluctuations or changes in average wages will therefore yield more stable and predictable results over time, and reduce the potential for wide year-to-year swings in the cost index and therefore in local education cost reimbursements.

2. It is Reliable: A Cost-of-Living Zone-based WAF would be

[13] With adjustments as explained in the text.

more geographically appropriate in that it addresses the current Place-of-Work/Place-of-Residence conceptual flaw of the existing WAF. A Cost-of-Living Zone-based WAF also yields predictable and intuitively logical results initially and over time. Because of its broader geography, a Cost-of-Living Zone-based WAF would not be prone to wide swings from year-to-year. The use of Cost-of-Living Zones also represent a dynamic concept. These data are systematically updated on an annual basis, and the LMAs themselves–and therefore the Cost-of-Living Districts--are similarly updated periodically when data on commuting patterns become available from each decennial census.

3. It is Independent: A Cost-of-Living Zone-based WAF would use objective data from a reputable third party (the Massachusetts Department of Employment and Training) which could not be biased by parties with a vested interest in the outcome of the WAF calculations. Moreover, since a Cost-of-Living Zone-based WAF would employ data used to measure cost differences that are outside the direct influence of both the State and local school districts, there is little chance for counter-productive budget incentives or local education district expenditure behavior as well.

4. It is Simple: A Cost-of-Living Zone-based WAF is understandable and explainable to a wide variety of interested audiences. It represents an incremental approach for the Department and the local school districts, and is easily replicable and up-datable. The data on which the Cost-of-Living Zone-based WAF are published quarterly and annually just as with the current WAF. LMAs–and therefore the Cost-of-Living Zones--are re-defined each decade based on worker commuting patterns from the decennial Census.

5. It is Easy to Administer: An LMA-based WAF would be cost effective in that the data are routinely published by a reputable third party and can be calculated using inexpensive, off-the-shelf spreadsheet programs and mapping software on a personal computer. Moreover, a grouped LMA approach also represents an appropriate degree of dis-aggregation from the standpoint of cost and complexity of administering Chapter 70 State Aid. Collecting, storing, and calculating data in small local areas within the State would involve enormous data collection and

administrative cost burdens that would likely exceed the utility gains realized from developing such an index. Finally, these data are systematically updated on an annual basis, and the LMAs themselves–and therefore the Cost-of-Living Zones are similarly updated periodically when data on commuting patterns become available from each decennial census.

It is recommended that Massachusetts move incrementally to a Cost-of-Living Zone-based index which adjusts only for identified cost-of-living differences between intrastate geographic regions. Many states around the country attempt to use such indexes to adjust for special education costs, size differences, quality of staff, and other factors–some of which may in fact be within the control of the local school districts themselves (e.g. size). It is recommended the State should continue to improve its methods for estimating and recognizing the differential needs of local school districts based on the composition of student populations, special education needs, and other factors through current pupil-count procedures, but the State should continue to use a Wage Adjustment Factor-like approach as a means for identifying and adjusting for local education cost differentials based on geography. An index constructed as recommended above based solely on geographic cost differences is a theoretically cleaner, more straight-forward, and more understandable approach for addressing cost of education differences between regions of the State.

In addition, it is recommended that the Department of Education periodically review and remain cognizant of new developments in "best-practices" in geographic cost reimbursement research and theory. Possible areas for further development include:

1. Testing for differences and potentially extending the Cost-of-Living Zone-based index to include non-labor components of the foundation budget for local school districts should it be determined that significant cost differences exist for such non-labor expenditures,

2. Improving the Cost-of-Living Zone-based Index to include other un-controllable explanatory measures such as a more sophisticated measure of labor market competitiveness (e.g. further refining the wage rate data coverage to include the "non-covered" working population, and/or adjusting for items such as the part-time versus full-time employment and the like), and potentially including crime rates and/or housing prices,

3. Potentially bifurcate the total private sector wage data to a more representative sub-component of the labor force which could track even more closely with local school district personnel costs without excessive cost endogeniety.

The Construction Cost

With respect to intrastate construction cost differences, this study recommends–if reliable data were available to do so–that Massachusetts should move toward adjusting State construction aid to local school districts using a similar wage-based Facilities Reimbursement Index (FRI). This index would ideally be designed to measure intrastate construction cost differences in three or potentially more sub-state regions. This conclusion was reached because the Means construction cost data indicate that most of the variation in construction costs between regions within the State occurs in the labor/wage component of total construction costs.[14]

However, there currently are two major obstacles prohibiting the development and use of such a wage-based proxy approach for intrastate construction cost differences at this time. First and perhaps most importantly is the fact that there are serious data shortcomings relating to the objective and valid determination of labor cost differences between intrastate geographic regions. Most of these problems are tied to the current requirement that prevailing wages be used in local school construction projects. This requirement results in unique data problems in the construction of a reliable and independent FRI, primarily because the inconsistencies in the geographic composition of the various local unions (e.g. by occupation), and because the prevailing wage data are inconsistent with current labor market area definitions (or any other systematic aggregation scheme). For example, plumbers in the Town of Easton may be in the prevailing wage numbers for the City of Boston, but the prevailing wages for electricians may be in the City of Brockton.

This irregular and inconsistent geographic configuration in the prevailing wage data not only makes it impossible to calculate a FRI based on prevailing wage data themselves, it also makes it impossible to use other potentially valid data sets to do the same. One option that was investigated involved the use of ES-202 average wage data for the Construction sector in the same way the average wage data was employed in the adjusted-WAF2 factor in Chapter 70 aid. However, this attempt was also found to not be appropriate since there was no

[14] This is intuitively logical since it is likely that construction materials markets are regional for the entire northeast, if not national in scope.

systematic way to establish linkages between the wages/prices that local education districts actually pay for construction labor and the reliable and independent data sets that could potentially be used to construct such an index (e.g. average wages for total construction or average wages in public sector construction as published by the ES-202 program).

Moreover even if all of the above were not true, it also is unlikely that even the ES-202 data set could be meaningfully used to construct such an index on a sub-state basis. This is because average wages paid by a construction employer located in a particular city or town in Massachusetts may have little bearing on the location of where the workers are hired or where the work is actually done. This is of course the nature of construction work, and the disconnect between average wages paid by construction employers and geographic space where the work is performed in all likelihood makes the construction of a WAF2-like adjustment for construction inappropriate both at this time and in the future.

Therefore, even though this study identified significant construction differences between intrastate areas in Massachusetts, there currently is no reliable and independent data with which to construct a simple, geographically appropriate, replicable, up-datable, and politically neutral index at this time. In order to address these data problems, it is our opinion that the only valid approach available to the Department at this time would be to develop representative, pro-forma construction budgets in designated regions of the State and begin the tedious and potentially costly process of systematically collecting sub-state construction cost data to develop such a regional cost index. Because of the considerable costs likely to be required to undertake such an approach, we cannot recommend that the Department undertake this primary data collection effort until a full feasibility study is completed to specifically address the issue of whether the funding formula equity benefits would be roughly equal or greater than the level of expenditures required to develop the pro-forma regional budgets and the collection of regional construction cost/price data. Until then, we recommend the Department monitor the construction cost data issue and periodically assess whether it makes sense to undertake such an effort at some subsequent time when either more reliable intrastate construction cost data and/or the resources become available.

VI. Appendices

I. Bibliography
II. Description of Data Sources
III. An Overview of Major Employment Data Series
IV. Regional Construction Cost Statistics and Results

Appendix I

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Appendix II

Description of Data Sources

1. Bureau of the Census, *Current Population Survey,* 1995-1997.

2. Bureau of the Census, *Current Employment Statistics*, 1995-1997.

3. Bureau of the Census, *County Business Patterns*, 1996.

4. Bureau of Labor Statistics, *Covered Employment and Wages* (ES-202), 1995-1997.

5. RS Means Building Construction Data, 55th, 56th, and 57th Annual Edition, 1997-1999.

6. RS Means, Unpublished Occupational Wage Data, 1997-1999

Appendix III

An Overview of Major Statistical Data Sources

The following represents a discussion of the various data sources which were considered and reviewed as potential cost-of-living proxy measures for the recommended grouped LMA/Operating Cost District approach to the WAF. The data source series listed here represent a compendium of the options available for the development of such a wage-based cost-of-living proxy. While there are other data sources (e.g. the ACCRA[15] Cost-of-Living Index, various housing price indexes, the Consumer Price Index) which may present a snapshot of cost-of-living from time to time for some municipalities in Massachusetts, none of those data sources or series were selected since they either: (1) lacked the geographic coverage and specificity required, and/or (2) covered only a portion of the total scope of expense items included in cost-of-living (e.g. was not a simple, all-inclusive cost-of-living proxy concept), and/or (3) did not represent a valid time series data set which is crucial for the calculation a meaningful, stable and predictable adjusted-WAF.

I. The "Covered" Employment and Wages (ES-202) Program:

The Covered Employment and Wages (ES-202) program serves as a near census of monthly employment and quarterly wage information by detailed industry at the national, State and county levels. It includes information about all workers (unrelated to hours paid) covered by State unemployment insurance (UI) laws and Federal workers covered by the Unemployment Compensation for Federal Employees (UCFE). Excluded are members of the armed forces, the self-employed proprietors, domestic workers, unpaid family workers, and railroad workers. ES-202 data is available quarterly and is based on the number of employees by place of work. The program is estimated to include 98% of total non-farm employees and about ½ of all agricultural workers–by far the most comprehensive of all employment surveys.

A number of other statistical data series are comparable in some respects to those provided in the ES-202 program. These series all have certain applications, strengths, and shortcomings. Because of its broad universe of coverage, continuity, and currency, the ES-202 program is one of the

[15] Refers to American Chamber of Commerce Researchers Association (ACCRA).

most useful and it is in fact used to benchmark other employment series because of the comprehensive nature of the data (e.g. the Current Employment Statistics (CES) program utilizes these data in its annual re-benchmark process). However, it important to note that because the ES-202 program includes all employees covered by unemployment insurance, unrelated to position and hours paid, the data includes both part- and full-time workers. This may present some problems with respect to the calculation of average wages in some areas for some industrial categories. However, when used in a relative cost-of-living proxy calculation, this shortcoming is somewhat diminished to be a differential between the region's part-time labor force and the overall State average.

Moreover, this data series represents the most consistent and stable data series over time. For example, BLS and the states verify and update–if needed–the Standard Industrial Classification (SICs), location, and ownership classification of all reporting units on a 3-year cycle, and the SICs have remained very stable since 1988. The series also has extensive quality control measures to correct questionable data entries and missing data when necessary, and the reporting unit response is compulsory for those covered by the Unemployment Insurance program instead of a voluntary survey response that is characteristic of most other employment series. Therefore, based on its broad coverage, continuity (over a relatively long time horizon), and its currency in publication, the ES-202 data series was determined to be the most useful in developing the cost-of-living proxy measure for the adjusted-WAF construct.

II. An Overview of Other Statistical Data Series:

(1) Employment Series:

a. The Current Employment Statistics (CES) program is a monthly survey conducted by State employment security agencies in cooperation with the Bureau of Labor Statistics. The survey provides an estimate of monthly non-farm employment, average weekly hours, and average hourly and weekly earnings based on payroll records from a sample of non-farm business establishments (including government). These data are published in considerable industry and geographic detail. The CES data excludes unpaid family workers, domestic workers in private homes, proprietors, and other self-employed persons.

Because the CES program is a sample of establishments and not a sample of individuals or households, it counts a person who is employed by two or more establishments at each place of employment. Moreover, the CES program provides paid hours and weighted weekly earnings for

production workers in manufacturing and non-supervisory workers in non-manufacturing. In contrast, the ES-202 data covers total quarterly payroll data for all employees, unrelated to position and hours paid. The narrower coverage in the earnings data (limited to factory production workers in manufacturing and non-supervisory workers in non-factory sectors) make this data source impractical for use as a comprehensive cost-of-living proxy for this study. For these reasons we rejected the use of this series as a valid proxy measure for cost-of-living differences in Massachusetts.

b. The Current Population Survey (CPS)

The Current Population Survey (CPS) series provides statistics on the labor force status of the civilian noninstitutional population 16 years of age and over. It is conducted using a sample of households, representative of the civilian noninstitutional population. The CPS program produces reliable national monthly estimates, but the sample does not permit the production of reliable monthly estimates for the States.

Because the CPS program is based on a sample of households and not on a sample of establishments, its focus is on individuals and it tabulates data by place of residence, whereas establishment based surveys such as the ES-202 program and the CES program focus on jobs and tabulate data by place of work. The fact that the CPS program is based on a sample of households has a number of benefits. For example, the CPS program includes categories of workers that are excluded from the ES-202 program, namely certain farm and domestic workers, proprietors, the self employed, employees of certain nonprofit organizations, and railroad workers. The CPS program also includes social, demographic, and economic population characteristics that are not available in the ES-202 program data and the CPS program only counts a person once, even if they hold more than one job.

However, because CPS is a household survey, it is available only in limited industrial and geographic detail. Given the lack of appropriate sub-state geographic detail, it was determined that this data set could not be employed in the development of a cost-of-living proxy for sub-state cost differences as needed in this study.

c. The County Business Patterns (CBP)

The County Business Patterns (CBP) series is an annual data set published by the Census Bureau and it is extracted from the Standard Statistical Establishment List, a file of all known single and multi-establishment companies maintained by the Census Bureau. Additional data is obtained from various Census programs, such as the Survey of Manufacturers, as well as from administrative records from the Internal

Revenue Service and Social Security Administration.

The CBP data is available at the national, State, and county levels and it includes detailed industry data on the total number of establishments , mid-March employment, first quarter and annual payroll, and number of establishments by employment class-size. The employment figures consist of full- and part-time employees, who are in the payroll in mid-March. The series does not include the self-employed, domestic service workers, railroad employees, agricultural production workers. CBP also excludes government units, all of which are included in the Es-202 programs.

Because CBP measures payroll once-a-year in mid-March, total annual payroll figures (and average wage when annual payroll divided by annual employment) may under or over estimate wages in a given year, especially in seasonal businesses. This data source's once per year snapshot approach and its lack of timeliness (1996 is the most current year available as of this writing) from the standpoint of publication, made it impractical to use this data set as a cost-of-living proxy for this study.

(2) Other Series:

In addition to earnings data from the various employment data series, a number of other data sources were reviewed for appropriateness in this study for use as a cost-of-living proxy in an adjusted-WAF construct. These included cost-of-living and other cost indexes that are either available or are used in other states for such intra-state cost differences. All of these data sources were rejected for use in the adjusted-WAF approach because of a significant shortcoming which essentially disqualified the data source for use in the adjusted-WAF. These rejected data sources and the principal reason for not using the source are summarized below.

a. The American Chamber of Commerce Research Association Cost-of-Living Index

The American Chamber of Commerce Research Association Cost-of-Living Index is perhaps the most widely accepted and used cost of living index to measure inter-area cost of living differences in the nation. The index is reported quarterly for some 300 places around the country for areas of at least 40,000 population. Several areas within the State of Massachusetts are part of the 300 areas. At least some states around the country (e.g. New Mexico) use these data to measure intra-state cost-of-living differences for K through 12 education funding formulas. However, this data source was rejected because of its incomplete and changing

geographic coverage, the changing composition of products and services surveyed between areas, and the inability to use the index for comparative purposes over time (e.g. as a time series). In fact, the ACCRA Cost of Living Index Committee cautions against interpreting differences between either quarters or between differences of less than three percent overall and less than five percent for individual product or service components within the same quarter as reflecting any significant difference in cost between areas. The above issues relating to interpretation and the lack of full geographic coverage simply make the ACCRA index impractical for use in the adjusted-WAF index.

b. Bureau of Labor Statistics Consumer Price Index

The BLS Consumer Price Index represents a second alternative in this area that was explored for use in an adjusted-WAF. The Consumer Price Index measures the average change in prices for a fixed market basket of goods and services for urban consumers. The BLS calculates the index monthly and publishes it for 85 urban areas throughout the country, including the Boston metro area in Massachusetts. In addition, coverage in the State also includes the average for several size categories of small and medium metro areas in the northeastern region of the United States. This data series represents includes price changes for a comprehensive fixed market basket of goods from a broad sample of sources (retail stores, landlords, and owners of housing units), and has been calculated in roughly the same way for decades. The index is a widely used indicator of inflation and is used as a means for adjusting income payments (e.g. Social Security benefits and labor contracts) in a wide range of settings.

However, this data set was similarly rejected for use in the adjusted-WAF based on its incomplete geographic coverage for the State and the inability to use the index as a relative measure of cost-of-living differences between areas. Regarding the later, it is important to note that the Consumer Price Index measures how much prices have changed in a particular area and does not show how the level of prices may be higher or lower in a given area versus another. In addition, the composition of the market basket measured may or may not apply to the living costs of the sub-populations in different parts of Massachusetts, and using an average for the entire northeastern region of the U.S. for parts of the State that are not independently measured (representing the majority of the State) renders this data source inappropriate for use as a cost-of-living proxy in this study.

c. Cost-of-Education/Teacher-Cost Indexes

Several states around the country also have developed Cost-of-Education/Teacher-Cost Indexes which attempt to impart greater equity in their respective state K through 12 education finance formulas. This cost-

based approach has in fact been adopted in some states such as Texas, and attempts to measure differences in local education expenditures for teaching and other education professionals.

However, these and other cost of education-based index approaches were rejected in this study primarily because of their complexity and inappropriateness. Regrading the former, the overwhelming majority of these indexes are an artifact of complex regression analyses or complicated econometric constructs which are virtually impossible to explain to non-technical groups and constituencies. Regarding the later, it was determined that to reimburse local districts for cost differences when those cost were under the control of the local education unit (e.g. as in the case of teacher and administrator salaries) was inappropriate since it would likely encourage inefficiency–if not the padding of local education costs. The analogy for this being the price escalation and over-utilization of services in the area of health care. Moreover, many of these approaches–aside from being complicated--are still experimental in terms of their development.

It is recommended that these complicated cost-based approaches that encourage inefficiencies be avoided. However, the science of such formulae continues to advance, and it is recommended that the Department of Education continue to monitor developments in this area and assess advances on an on-going basis for potential use in the State's Chapter 70 aid formula.

Appendix IV

Regional Construction Cost Statistics and Results

Tables A & B: MEANS data and ANOVA Results
Tables C & D: Tukey Test Results
Tables E & F: Duncan Test Results
Charts A & B: Graphs of Duncan Test Results