A Comparable Wage Index for Maryland

Prepared for
The Maryland State Department of Education

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(Revised)

In 2002, the Maryland General Assembly enacted Chapter 288, the Bridge to Excellence in Public Schools Act. The Act established new primary state education aid formulas based on adequacy cost studies. These adequacy cost studies – conducted in 2000 and 2001 under the purview of the Commission on Education Finance, Equity, and Excellence – employed the professional judgment and successful schools methods and other education finance analytical tools. State funding to implement the Bridge to Excellence Act was phased in over six years, reaching full implementation in fiscal year 2008. Chapter 288 requires that a follow-up study of the adequacy of education funding in the State be undertaken approximately 10 years after the enactment of the Bridge to Excellence in Public Schools Act. The study must include, at a minimum, (1) adequacy cost studies that identify (a) a base funding level for students without special needs and (b) per pupil weights for students with special needs, where weights can be applied to the base funding level, and (2) an analysis of the effects of concentrations of poverty on adequacy targets. The adequacy cost study will be based on the Maryland College and Career-Ready Standards (MCCRS) adopted by the State Board of Education. The adequacy cost study will include two years of results from the new state assessments aligned with the standards. These assessments were first administered state-wide in the 2014-2015 school year.

There are several additional components mandated to be included in the study. These components include evaluations of (1) the impact of school size, (2) the Supplemental Grants program, (3) the use of Free and Reduced-Price Meals eligibility as the proxy for identifying economic disadvantage, (4) the federal Community Eligibility Provision in Maryland, (5) prekindergarten services and the funding of such services, (6) equity and the current wealth calculation, and (7) the impact of increasing and decreasing enrollments on local school systems. The study also requires this update of the Maryland Geographic Cost of Education Index.

APA Consulting, in partnership with Picus Odden & Associates and the Maryland Equity Project at the University of Maryland, will submit a final report to the state no later than October 31, 2016.

This report, required under Section 3.2.3.6 of the Request for Proposals (R00R4402342), presents an updated Geographic Cost of Education Index, using comparable wage methodology.

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Executive Summary

This report (1) briefly reviews the rationale for estimating variations in educational costs by geographic locations, (2) estimates a comparable wage index for Maryland, and (3) provides an alternative for smoothing changes over time as the index is updated.

Schools and districts in different parts of the state face different costs to provide a comparable education to children. This is primarily because of differences in the wages that must be paid to teachers and other employees. There may also be variations between areas in terms of needs for physical inputs (e.g., schools and districts in different climates will have different needs for energy for heating and/or cooling); however, wages, which comprise the largest share of districts budgets by far, are much more subject to location-based variation (Odden and Picus, 2014).

This report focuses on geographic variations in wages. The current Maryland Geographic Cost of Education Index (GCEI) is based on two hedonic indices -- one for professional and one for non-professional district workers – together with a hedonic index of energy costs, and a non-varying measure of other instructional expenditures. The current GCEI is included in the Maryland school finance program as an add-on to the base foundation formula.

In an earlier report, the research team provided an analysis of the methods that could be used to estimate geographic variation in costs and recommended replacing the hedonic approach used for the current GCEI with the comparable wage methodology. The Maryland State Department of Education chose to move forward with the calculation of the comparable wage methodology as an option for updating the Geographic Cost of Education Index. This report presents comparable wage indices for professional and non-professional workers, which are then combined into an overall index that can be applied to the base foundation amount (analogous to the GCEI currently in use).

One of the advantages of the comparable wage approach over the hedonic method is that it is much easier to update and keep current. However, any update will necessarily mean slight changes in the index values, and although these changes will be smaller if the index is updated each year than if it updated less frequently, any changes will translate into changes in revenue for districts that can be politically controversial. This report provides an example of a way to smooth the year-to-year changes so that such changes are minimized as much as possible.

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I. Introduction

It is well-established that the cost of educating students is not the same across all schools and students. Costs can vary for many reasons, some of which are under the control of local school officials (such as decisions about the size of classes or about curricular offerings) but many costs cannot be controlled by local school districts. Costs outside the control of school officials include the costs associated with educating certain types of students – such as at-risk students, English Language Learner (ELL) students, and students with disabilities – and with operating in certain geographical locations. When allocating funds through a state finance formula, it is appropriate for policy makers to compensate districts for differences in these uncontrollable costs.

For many years, the Geographic Cost of Education Index (GCEI) in Maryland has been one way the state has accounted for some of the variation in the cost of providing a comparable education in different counties across the state. However, the hedonic methodology used to create the current GCEI is outdated. This report provides estimates for a cost adjustment based on an alternative method, using variation in wages of non-district workers to capture the necessary variation in district wages to appropriately compensate teachers and staff for both local cost of living and area amenities.

Section II of this report briefly reviews the need for estimating variations in education costs due specifically to geographic location. Section III provides estimates for an index based on the comparable wage methodology. Section IV suggests one option for smoothing changes over time as the index is updated in the future.

II. Measuring Variation in Wage Costs Associated With Geographic Location

One of the largest sources of variation across districts in the costs of providing a comparable education is differences in the wages that must be paid to attract and retain similar workers. Wages vary across geographic locations for many reasons. One reason is that the purchasing power of a dollar is not the same in all places. It costs more to achieve a given standard of living in Montgomery County or Howard County than in Allegany County or Garrett County (Duncombe and Goldhaber, 2003). Because it takes different amounts of money to buy the same bundle of goods in different locations, equivalent workers will demand different wages for equivalent jobs. If a district's wages are not sufficiently high to compensate workers for higher costs of goods and services, then it will be harder for that district to attract and retain workers in high-cost areas.

At the same time, the experience of living in some places is also more pleasant than the experience of living in other places. For example, although New York City and San Francisco have much higher costs of living than other cities, each city also offers amenities that may not be available in other cities or areas of their respective states. Of course, these cities may also have many disamenities (e.g., crime, poverty, and urban problems) that are not found in other cities. Nevertheless, if a location is attractive enough, net positive amenities can offset higher living costs, so workers may not expect or demand wages that are quite as high as would otherwise be expected. Thus, the true differences in wages needed to attract

and retain equivalent workers among locations will depend on a complex relationship between worker preferences, living costs, and local amenities.

There is a well-established body of literature on adjusting state aid formulas to account for this geographic variation in teacher wages. The interim *Geographic Cost of Education Adjustment for Maryland* report (Imazeki, 2015) provides a full discussion of the advantages and disadvantages of each method and recommends the use of a comparable wage index (CWI) for several reasons:

1. The data are easily and publicly available, and the statistical method of estimation is straightforward. This makes annual updates relatively easy, minimizing the large changes in allocations that can result when updates are less frequent.
2. The comparable wage approach does not require the analyst to make decisions about which specific variables to include or exclude (in contrast to the hedonic methodology). Moreover, the comparable wage methodology is well-established (see, for example, Taylor and Fowler, 2006) and analysts are in agreement about the specification of the model. Again, this simplifies estimation, as there is no need to collect data from multiple sources nor worry that variables available in one year are not available in another.
3. The data used for estimation is outside the control of local districts so there can be no 'gaming' of the resulting index.

Based on the study team's recommendation in the interim report, the Maryland State Department of Education (MSDE) chose to move forward with the calculation of the comparable wage methodology as an option for updating the Geographic Cost of Education Index. The rest of this report focuses on that analysis.

The study team presented two other recommendations with regard to revising the GCEI in its interim report:

- The Energy Cost Index and the measure of other instructional expenditures should be removed so that the GCEI cleanly isolates the wage costs associated with geographic location.
- The GCEI should not be truncated, e.g. resetting negative values to 1.0, and should be integrated into the base foundation formula rather than treated as a separate, add-on program.

These recommendations are discussed within the body of this report where relevant.

III. The Maryland Comparable Wage Index

Table 1 shows the comparable wage indices for professional and non-professional workers.[1] Please see Imazeki (2015) and Appendix A of this report for a full description of the data and methods used to

[1] The terms "professional" and "non-professional" as used in this report are used to broadly distinguish between college educated workers and laborers, skilled, or semi-skilled trades workers. Due to the way the Census Bureau categorizes specific occupations within broad occupation code categories some occupations included within one or

estimate these indices. For comparison, unadjusted average salaries were also converted to an index format that is shown in the last two columns of Table 1. It is important to point out that the data used for the comparable wage analysis are taken from the U.S. Census Bureau's American Community Survey (ACS), which is administered annually and collects the individual-level data on income and demographics that are needed for this sort of analysis. The ACS is the only reliable source of this data that is consistently available every year. However, data with the number of individual responses necessary to compute a CWI are only identified for areas with at least 100,000 residents (called PUMAs or Public Use Microdata Areas). In many areas of Maryland, school districts (which coincide with county lines) contain multiple PUMAs so a single index value can be calculated for the district. However, in sparsely populated regions a single PUMA may span multiple counties and all districts within that area would necessarily have the same index value. Table 2 indicates which districts are combined within one PUMA.

Table 1: Comparable Wage and Average Salary Indices, 2014

Public Use Microdata Area (PUMA)	District	Professional CWI	Non-Professional CWI	Index of Average Salaries, Unadjusted, Professional Workers	Index of Average Salaries, Unadjusted, Non-professional Workers
100	Allegany	0.785	0.899	0.723	0.849
1200	Anne Arundel	1.145	1.104	1.256	1.146
500	Baltimore	1.080	1.080	1.115	1.080
800	Baltimore City	1.078	1.090	1.179	1.074
1500	Calvert	1.121	1.085	1.285	1.096
1300	Caroline	0.878	0.909	0.832	0.927
400	Carroll	0.979	0.910	0.874	0.832
700	Cecil	1.057	0.875	0.925	0.925
1600	Charles	1.014	1.115	0.827	1.011
1300	Dorchester	0.878	0.909	0.832	0.927
300	Frederick	1.010	1.028	1.105	0.985
100	Garrett	0.785	0.899	0.723	0.849
600	Harford	1.087	1.094	1.163	1.128
900	Howard	1.140	1.133	1.324	1.259
1300	Kent	0.878	0.909	0.832	0.927
1000	Montgomery	1.203	1.114	1.426	1.253
1100	Prince George's	1.121	1.166	1.122	1.184
1300	Queen Anne's	0.878	0.909	0.832	0.927
1400	Somerset	0.972	0.964	0.883	0.892
1500	St. Mary's	1.121	1.085	1.285	1.096
1300	Talbot	0.878	0.909	0.832	0.927

the other group would not generally be considered as professional or non-professional. See Appendix A for a more complete description of the two groups.

Public Use Microdata Area (PUMA)	District	Professional CWI	Non-Professional CWI	Index of Average Salaries, Unadjusted, Professional Workers	Index of Average Salaries, Unadjusted, Non-professional Workers
200	Washington	0.966	0.884	0.861	0.919
1400	Wicomico	0.972	0.964	0.883	0.892
1400	Worcester	0.972	0.964	0.883	0.892
	Minimum	0.785	0.875	0.723	0.832
	Maximum	1.203	1.166	1.426	1.259
	Range	0.418	0.291	0.703	0.428

Table 2: Maryland Districts within PUMAs

Public Use Microdata Areas	Districts
100	Allegany, Garrett
200	Washington
300	Frederick
400	Carroll
700	Cecil
1300	Caroline, Dorchester, Kent, Queen Anne's, Talbot
1400	Somerset, Wicomico, Worcester
1500	Calvert, St. Mary's
1600	Charles
1001-1007	Montgomery
1101-1107	Prince George's
1201-1204	Anne Arundel
501-506	Baltimore
601-602	Harford
801-806	Baltimore City
901-902	Howard

An important assumption of the comparable wage approach is that district employees have similar preferences as other workers. That is, a CWI for teachers captures average preferences for a location among all non-teacher workers, so using a CWI to adjust for district wage costs assumes teachers have similar preferences as other workers and therefore require similar wage adjustments. This comparability can be strengthened by estimating the CWI with a sample of workers more closely aligned with the target employees. Thus, for the estimates presented here separate indices are estimated for college-educated workers (the professional sample, most comparable to teachers, administrators, and other

certificated staff) and workers with any level of education possessing more technical skills (the non-professional sample, most comparable to maintenance workers, operations workers, etc.). The samples used for each of these indices also exclude all workers within the Census Bureau's industry code corresponding to "Elementary and Secondary Schools" (see Appendix A for a more complete discussion of the two samples). Although it would be technically possible to estimate additional indices for further subsets of employees (e.g., administrators and other non-teaching professionals separate from teachers), it is unlikely that the preferences differ among these two groups of workers[2] and estimating a separate index for each group would require making potentially arbitrary decisions about which occupations to include in the different samples.

For both the professional and non-professional indices, a value of 1.0 corresponds to the wage for the statewide average worker, so values above 1.0 indicate higher-than-average costs while values below 1.0 indicate lower-than-average costs. For example, wage costs for professional workers in Baltimore City are 7.2 percent higher than average (index value of 1.072) while wage costs in Washington County are 3.9 percent below average (index value of 0.961). Alternatively, one could say that wage costs are 11.1 percent higher in Baltimore City than in Washington County. The highest-cost region is Montgomery County where professional wage costs are 41.8 percent higher than in the lowest-cost region, Allegany and Garrett counties.

Wage costs for non-professional workers show less variance - the highest-cost region (Prince George's County) has costs only 29.0 percent higher than in the lowest-cost region (Cecil County).

To calculate the indices of average salaries in the last two columns of Table 1, simple means of salary were taken over all professional or non-professional workers within a PUMA. The average salary in each PUMA was then divided by the average salary across all Maryland PUMAs. Note that these same salaries are used to calculate the CWI, but in the CWI calculation the salaries are adjusted for individual worker characteristics such as experience or occupation. Thus, it is unsurprising that compared to unadjusted salaries, the comparable wage indices show much less variation. In general, areas with CWI values that are noticeably lower than the unadjusted salaries (such as Montgomery County) typically have larger concentrations of high-paying jobs or more experienced workers. The variation due to these types of demographic variables are stripped out in the comparable wage model, thus capturing the variation for an 'average' worker.

Calculation of an Overall Comparable Wage Index

The current Maryland GCEI is a weighted index of four components: (1) an index of uncontrollable wage variation for professional employees (both teaching and non-teaching); (2) an index of uncontrollable wage variation for non-professional employees; (3) an index of uncontrollable energy costs; and (4) a fixed amount for other expenditures (e.g. supplies, materials, equipment, and miscellaneous expenditures, all of which are assumed to remain constant across districts). In 2003, the weights for

[2] Indeed, Duncombe and Goldhaber (2003) show that in Maryland's districts the preferences of teachers and non-teacher professionals are statistically indistinguishable.

these four components were 80.5 percent, 10.5 percent, 2.0 percent, and 7.0 percent respectively, based on the share of expenditures spent in each of these areas. These shares / weights have held relatively steady over time (see Goldhaber and Duncombe, 2009). The three sub-indices are each constructed using hedonic methodology (described in Duncombe and Goldhaber, 2003; see Imazeki, (2015) for a comparison with the comparable wage methodology). The resulting index can be applied to the state foundation aid amount per pupil to generate an adjusted aid amount for each district.

If desired, the professional and non-professional comparable wage indices can be used to generate a similar overall index value for each district. As discussed in Imazeki (2015), energy costs are not generally included in the geographic cost adjustments in the funding formulas of other states.[3] This is because energy costs generally do not vary significantly across districts, can be problematic to estimate accurately, and constitute a very small percentage of overall expenditures.[4] In the interim report, the study team recommended excluding these costs from the geographic cost adjustment. However, for ease of application within the foundation formula, an alternative is to treat energy costs the same as other non-wage expenditures and simply hold them fixed across districts.[5] This analysis therefore includes energy costs with all other non-wage costs, held constant across districts, to create an overall index that can then be applied to the foundation formula base amount in the same way as the GCEI calculated by Duncombe and Goldhaber (2003, 2009). Following Duncombe and Goldhaber (2003, 2009), the overall index is based on weights driven by budget shares: 80.0 percent for professional workers, 10.0 percent for non-professionals, and 10.0 percent for all other expenditures.

The resulting overall index is shown in Table 3. As would be expected, the overall index has somewhat less variation than the professional CWI (a difference of 35.6 percent between the highest- and lowest-cost districts compared to almost 42 percent for just the professional CWI) but is highly correlated (0.99) so the pattern of high- and low-cost districts is the same.

As discussed in the interim report, in practice, Maryland has historically truncated the GCEI at 1.0; that is, any district with a GCEI value below 1.0 has been allocated revenue *as if* their GCEI value were 1.0. This is more expensive for the State but reduces the variation in revenue across districts. This puts high-cost districts at a disadvantage since the index is a measure of *relative* variation in costs. That is, the role of the GCEI is to compensate districts for the *relatively* higher wages they must pay to attract and retain equally qualified workers. When corresponding adjustments are not made to districts with relatively lower wages by truncating the index at 1.0, the ability of high-cost districts to fully adjust their wages is

[3] As also noted in Imazeki (2015), Alaska is one exception.

[4] According to Duncombe and Goldhaber (2003), energy costs are not constant (their estimated index ranges from 0.837 to 1.165) but energy costs are a very small proportion of total expenditures (2%) and very difficult to measure with any accuracy (e.g., Duncombe and Goldhaber estimate that their index, although requiring the collection of a significant amount of extra data from individual districts, captured less than a third of the variation in energy costs).

[5] The other option is to apply the professional and non-professional comparable wage indices separately, to their respective shares of the foundation amount. Numerically, this achieves the same result but requires more steps in its calculation.

reduced. To reiterate the recommendation in the interim report, the study team recommends that the State utilize the full range of values of the CWI.

Table 3: Comparable Wage Index, Overall, 2014

PUMA	District	Overall CWI
100	Allegany	0.818
1200	Anne Arundel	1.126
500	Baltimore	1.072
800	Baltimore City	1.072
1500	Calvert	1.105
1300	Caroline	0.894
400	Carroll	0.974
700	Cecil	1.033
1600	Charles	1.023
1300	Dorchester	0.894
300	Frederick	1.011
100	Garrett	0.818
600	Harford	1.079
900	Howard	1.126
1300	Kent	0.894
1000	Montgomery	1.174
1100	Prince George's	1.113
1300	Queen Anne's	0.894
1400	Somerset	0.974
1500	St. Mary's	1.105
1300	Talbot	0.894
200	Washington	0.961
1400	Wicomico	0.974
1400	Worcester	0.974
	Minimum	0.818
	Maximum	1.174
	Range	0.356

IV. Smoothing Disruptions Over Time

One of the benefits of a comparable wage index is that it can be easily updated over time as the ACS data is collected each year and the model estimation is straightforward. Table 4 shows what the overall Comparable Wage Index would have looked like in each year going back to 2008. The correlation from year to year is relatively high (ranging from 0.90 to 0.97), indicating that there is not much change in the pattern of costs (i.e., the rankings of which districts are high- or low-cost do not vary much). The actual changes in the index values, which will drive changes in revenue allocation from year to year, do vary

across districts, with some districts gaining or losing anywhere from less than one percent to almost five percent.[6] The next to last row at the bottom of the table shows the average change, in absolute value, across all districts for each year. However, these annual changes are generally much smaller than the changes would be if the index is not updated regularly. For example, the last column of the table shows the change in index values between 2008 and 2014 and indicates that some districts would see swings closer to seven or eight percent.

Even the smaller changes that districts will see with annual updates will likely be unpopular, at least in districts that see a decrease in their index value. One option that can minimize the annual shifts, while preserving the relative distribution of costs, is to use a multi-year average of the index. That is, the effective index value for a given district in a particular year is the average of the actual index values for the last three years. So, for example, the index values for 2014 would be the average of the individual index values from 2012, 2013, and 2014; the index values for 2015 would then be the average of the individual index values from 2013, 2014, and 2015. By including the prior two years in the average the year-to-year change that districts actually experience from 2014 to 2015 is given less weight and phased-in over time.

[6] Note that the index is a *relative* measure of wages - changes in the index value for any given district are not the same as changes in the *level* of wages but rather are a function of both changes in the underlying wages in that individual district and changes in the underlying wages in other districts.

Table 4: Comparable Wage Index 2008-2014

PUMA	District	CWI2008	CWI2009	CWI2010	CWI2011	CWI2012	CWI2013	CWI2014	Change 2008 to 2014
100	Allegany	0.853	0.889	0.844	0.856	0.846	0.768	0.818	-0.035
1200	Anne Arundel	1.076	1.072	1.112	1.092	1.108	1.093	1.126	0.050
500	Baltimore	1.047	1.066	1.071	1.049	1.060	1.064	1.072	0.025
800	Baltimore City	1.033	1.077	1.045	1.093	1.076	1.051	1.072	0.039
1500	Calvert	1.044	1.057	1.073	1.098	1.071	1.060	1.105	0.061
1300	Caroline	0.968	0.971	0.934	0.945	0.943	0.932	0.894	-0.074
400	Carroll	0.991	0.983	0.957	0.932	0.994	0.986	0.974	-0.017
700	Cecil	0.987	0.956	0.885	0.940	0.899	1.069	1.033	0.047
1600	Charles	1.106	1.077	1.163	1.087	1.086	1.058	1.023	-0.084
1300	Dorchester	0.968	0.971	0.934	0.945	0.943	0.932	0.894	-0.074
300	Frederick	1.014	1.020	1.054	1.016	1.049	1.081	1.011	-0.003
100	Garrett	0.853	0.889	0.844	0.856	0.846	0.768	0.818	-0.035
600	Harford	1.012	1.040	1.001	1.045	1.059	1.081	1.079	0.068
900	Howard	1.125	1.109	1.136	1.180	1.138	1.129	1.126	0.001
1300	Kent	0.968	0.971	0.934	0.945	0.943	0.932	0.894	-0.074
1000	Montgomery	1.141	1.159	1.190	1.166	1.156	1.169	1.174	0.033
1100	Prince George's	1.106	1.110	1.155	1.151	1.145	1.127	1.113	0.007
1300	Queen Anne's	0.968	0.971	0.934	0.945	0.943	0.932	0.894	-0.074
1400	Somerset	0.943	0.885	0.945	0.896	0.922	0.927	0.974	0.031
1500	St. Mary's	1.044	1.057	1.073	1.098	1.071	1.060	1.105	0.061
1300	Talbot	0.968	0.971	0.934	0.945	0.943	0.932	0.894	-0.074
200	Washington	0.902	0.929	0.891	0.929	0.920	0.990	0.961	0.059
1400	Wicomico	0.943	0.885	0.945	0.896	0.922	0.927	0.974	0.031
1400	Worcester	0.943	0.885	0.945	0.896	0.922	0.927	0.974	0.031
	Minimum	0.853	0.885	0.844	0.856	0.846	0.768	0.818	-0.084

PUMA	District	CWI2008	CWI2009	CWI2010	CWI2011	CWI2012	CWI2013	CWI2014	Change 2008 to 2014
	Maximum	1.141	1.159	1.190	1.180	1.156	1.169	1.174	0.068
	Range	0.288	0.275	0.345	0.324	0.310	0.401	0.356	0.151
	Correlation with prior year		0.936	0.909	0.939	0.972	0.895	0.933	
	Average change in CWI value from prior year (absolute value)		0.022	0.040	0.030	0.018	0.027	0.033	
	Average change 2008 to 2014 (absolute value)								0.045

Table 5 shows the values resulting from this moving average approach. The correlation from year to year is even higher (0.98 to 0.99) and the annual change in index values is much smaller for almost all districts.

Table 5: Three-Year Moving Average CWI, 2010 – 2014

PUMA	District	2008-10	2009-11	2010-12	2011-13	2010-14
100	Allegany	0.862	0.863	0.849	0.823	0.811
1200	Anne Arundel	1.087	1.092	1.104	1.098	1.109
500	Baltimore	1.061	1.062	1.060	1.057	1.065
800	Baltimore City	1.052	1.072	1.071	1.074	1.066
1500	Calvert	1.058	1.076	1.081	1.076	1.079
1300	Caroline	0.958	0.950	0.941	0.940	0.923
400	Carroll	0.977	0.957	0.961	0.971	0.985
700	Cecil	0.943	0.927	0.908	0.969	1.000
1600	Charles	1.116	1.109	1.112	1.077	1.055
1300	Dorchester	0.958	0.950	0.941	0.940	0.923
300	Frederick	1.029	1.030	1.040	1.049	1.047
100	Garrett	0.862	0.863	0.849	0.823	0.811
600	Harford	1.017	1.029	1.035	1.062	1.073
900	Howard	1.124	1.142	1.151	1.149	1.131
1300	Kent	0.958	0.950	0.941	0.940	0.923
1000	Montgomery	1.163	1.172	1.171	1.164	1.166
1100	Prince George's	1.124	1.139	1.150	1.141	1.129
1300	Queen Anne's	0.958	0.950	0.941	0.940	0.923
1400	Somerset	0.924	0.909	0.921	0.915	0.941
1500	St. Mary's	1.058	1.076	1.081	1.076	1.079
1300	Talbot	0.958	0.950	0.941	0.940	0.923
200	Washington	0.907	0.916	0.913	0.946	0.957
1400	Wicomico	0.924	0.909	0.921	0.915	0.941
1400	Worcester	0.924	0.909	0.921	0.915	0.941
	Minimum		0.863	0.849	0.823	0.811
	Maximum		1.172	1.171	1.164	1.166
	Range		0.309	0.322	0.340	0.355
	Correlation with prior year		0.994	0.996	0.981	0.985
	Average change in CWI value from prior year (absolute value)		0.011	0.008	0.012	0.014

V. Conclusion

This report has reviewed the rationale for estimating the variation in educational costs associated with geographic location. The focus has been on the comparable wage approach which captures geographic variation in wage costs, which are more sensitive to geographic location than other district inputs and also comprise the largest share of district budgets.

Following an earlier report on the strengths and weaknesses of alternative methods for estimating geographic costs, MSDE chose to proceed with the estimation of the comparable wage approach. The comparable wage approach is an attractive method for accounting for differences in regional costs in state funding formulas because of the relative simplicity of the model and the availability of data. A CWI is straightforward to create and update on an annual basis; it also has the advantage of being clearly beyond the control of local districts, as there are no data used that are generated by districts.

The overall CWI presented in this report is based on two underlying comparable wage models, one for professional workers comparable to teachers and other professional district workers, and one for non-professional workers comparable to maintenance, service, and other non-professional district workers. These are combined into a single index based on their relative budget shares. The resulting index varies from a maximum of 1.174 (seventeen percent higher costs than the average district) to a minimum of 0.818 (eighteen percent lower costs than the average district). The study team recommends that rather than truncating the index at 1.0, as has been done with the GCEI in the past, the State utilize the full range of the index, thereby reflecting variation in costs more accurately.

The CWI is highly correlated over time; however, year-to-year changes in index values can be minimized even further by using a moving average of the individual index values from the past two to three years. This does not impact the ranking of costs across districts but reduces the annual change experienced by districts as the index is updated.

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Appendix A
Estimating a Comparable Wage Index

A Comparable Wage Index (CWI) is calculated by measuring the variation in non-teacher wages across localities. CWIs therefore account for the impacts of both cost of living and area amenities. The assumption is that workers who are similar to teachers in terms of their levels of education, their training, and their job responsibilities will have similar preferences as teachers. For example, if non-teacher workers in the City of Baltimore are paid, on average, 10 percent more than non-teacher workers in the City of Cumberland, then the CWI would suggest Baltimore City Public Schools should receive 10 percent more revenue for teacher salaries than Allegany County Public Schools where the City of Cumberland is located.

Specifically, following Taylor and Fowler (2006), a CWI is created by estimating the following equation:

$$LnAnnualSalary_i = \beta_W W_i + \beta_O O_i + \beta_I I_i + \beta_R R_i + \varepsilon_i$$

In this equation,

- the dependent variable is the natural log of annual salary;
- W_i is a vector of characteristics of worker *i*;
- O_i is an indicator variable for worker *i*'s occupation;
- I_i is an indicator variable for worker *i*'s industry;
- R_i is an indicator variable for the region that worker *i* lives in; and
- ε_i is an idiosyncratic error term.

The resulting coefficients are then used to predict a wage in each region for a worker with average characteristics (that is, average values of all worker characteristics). Summary statistics for this analysis are presented in Appendix B.

Estimation of this model requires data on individual worker characteristics as well as industry, occupation, wages, and location. These variables are all available in the American Community Survey (https://www.census.gov/programs-surveys/acs/data/pums.html), which is administered annually.[7] The American Community Survey (ACS) is an ongoing national survey administered by the U.S. Census Bureau that is sent to 3.5 million people each year, collecting information on income, housing, education, and migration, as well as the employment variables mentioned previously. The ACS replaced the long form of the decennial Census and is now the only national source of this type of information. Data with the individual responses necessary to compute a CWI are available in the ACS Public Use

[7] In 2000 and earlier, the relevant variables were only collected on the long form of the decennial Census. Taylor and Fowler (2006) discuss how to use Occupational Employment Statistics data from the Bureau of Labor Statistics to update a CWI in the years between Censuses; thus, annual adjustments can still be made between Census years prior to 2005 when the relevant variables became available annually as part of the American Community Survey.

Microdata Sample for areas with at least 100,000 residents (called PUMAs or Public Use Microdata Areas).

A CWI is therefore relatively straightforward to create and can easily be updated on an annual basis. The comparable wage model does not require an analyst to decide which specific area costs and amenities to include as the overall impact of all relevant variables is simply captured by the regional indicator variables. A CWI also has the advantage of being clearly beyond the control of local districts; it does not use any district-generated data. It can also be used, or adjusted for use, for all labor costs (e.g. certified staff, non-certified staff, teachers, administrators, or classified staff).

One possible concern is that a CWI does assume comparability of workers. That is, the CWI captures average preferences for location among all non-teacher workers, so using a CWI to adjust for district wage costs assumes teachers have similar preferences as other workers and therefore require similar wage adjustments. If teacher preferences are systematically different than other worker preferences – an unlikely possibility – then a CWI may not be appropriate. Comparability can be strengthened by estimating the CWI with a sample of workers more closely aligned with teachers (e.g. workers with college degrees).

There are several approaches used by analysts to increase the comparability of the sample of workers to teachers and other educators. One approach is to compare the regional salary differences of all college educated workers (Taylor & Fowler, 2006). This approach assumes that most, if not all, college educated workers will have similar preferences in their response to differences in local costs and amenities. Another approach is to attempt to select a comparison group from among occupations most similar to teachers and other educators (Allegretto, Corcoran and Mishel, 2004). While this latter approach attempts to select a sample of workers that may be more similar to teachers and other educators, the process of selecting specific comparison occupations tends to be highly subjective and open to debate. For this analysis, the research team chose to more closely follow the first approach which eliminates the subjectivity of picking and choosing occupations similar to teaching.

Given that earlier versions of Maryland's Geographic Cost of Education Index included separate indices for professional and non-professional workers, this analysis creates parallel professional and non-professional indices using the comparable wage methodology. For the estimates presented here, separate indices are estimated for professional workers (teachers, administrators, and other certificated staff) and non-professional workers (maintenance workers, operations workers, transportation workers, etc.). The professional sample includes all college educated workers in occupations not included in the non-professional sample. Workers within the non-professional sample were chosen from occupation code areas representing unskilled, semi-skilled, and skilled occupations. The samples used for each of these two indices are also restricted to exclude teachers[8] and other workers with the industry code corresponding to "Elementary and Secondary Schools."

[8] Excluded teacher occupation codes are 2300 through 2340, which identify preschool, elementary, secondary, special education, and other teachers.

The non-professional sample includes occupations that require specialized skills similar to those found among classified workers in a school district; specifically, the sample was restricted using Census occupation codes falling within the five larger categories of 1) food preparation and service; 2) building and grounds cleaning and maintenance; 3) office and administrative support; 4) natural resources, construction and maintenance; and 5) production, transportation and material moving. These same codes were then *excluded* from the professional sample (i.e., every occupation included in the Census file is in one sample or the other. See Table C1 for the list of occupations included in the sample of professional workers and Table C2 for the list of occupations included in the sample of non-professional workers. [9]

All of the individual workers included in the professional sample, regardless of their occupation, are reported as having earned at least a bachelor's degree. The occupations included in this sample fall within the five Census occupation categories of 1) management, business, and financial occupations; 2) computer, engineering, and science occupations; 3) education, legal, community service, arts, and media occupations (excluding elementary and secondary employees); 4) healthcare practitioners and technical occupations; and 5) certain service occupations. Because these Census occupation areas include a wide range of occupations they may include some occupations that do not, on their face, seem all that similar to teachers or school administrators. However, it is important to keep in mind that the purpose of the comparable wage index is to capture variation in the overall level of wages for 'similar workers' (for example, college educated individuals) and those workers may not chose occupations that seem perfectly aligned with teaching. Deciding who are 'similar workers' can be a highly subjective task which is why most other analyses of comparable wages simply use *all* non-teacher workers without trying to delineate any further. Although one can debate whether certain occupations belong in one sample or the other, it is important to note that the theory behind the comparable wage methodology does not justify excluding specific jobs (only specific workers), so in theory every occupation should be assigned to one group or the other.

It is also important to note that a CWI is intended to capture variation across labor markets, generally measured at a broad geographical level (e.g. across a metropolitan area). The smallest area for which a CWI value can be calculated using the ACS data is a PUMA (areas with at least 100,000 residents). In densely populated regions, a PUMA may represent one part of a city or county, but in sparsely populated regions a PUMA may span multiple counties.[10] A CWI cannot measure cost variations across districts within the measured geographical area so all districts within that area would necessarily have the same index value.[11]

[9] The list of codes at https://usa.ipums.org/usa/volii/c2ssoccup.shtml shows changes made to the codes over time. Additional information about changes are included in the readme files for each release of the ACS.
[10] PUMAs are based on boundaries drawn after the decennial census. Full documentation can be found at https://www.census.gov/geo/reference/puma.html.
[11] This is likely to be less important in states with geographically large districts and/or districts that line up with established municipal boundaries, such as Maryland, where school district boundaries coincide with county lines.

Appendix B

Table B1: Summary Statistics

Variable	ACS Code	Mean - Professional	Mean – Non-Professional
Salary	WAGP	75,774.47	40,319.37
Hours worked per week	WKHP	41.78	39.89
Worked 48-49 weeks during last 12 months (worked 50-52 omitted category)	WKW = 2	0.02	0.02
Worked 40-47 weeks	WKW = 3	0.03	0.04
Worked 27-39 weeks	WKW = 4	0.02	0.03
Worked 14 to 26 weeks	WKW = 5	0.01	0.02
Worked <14 weeks	WKW = 6	0.00	0.01
Age	AGEP	44.14	43.69
Male	SEX = 1	0.48	0.57
White	RAC2P = 1	0.71	0.66
AA degree	SCHL = 20	NA	0.08
BA degree	SCHL =21	NA	0.12
Masters	SCHL = 22	0.18	0.03
Professional Degree	SCHL = 23	0.05	0.00
Ph.D.	SCHL = 24	0.04	0.00
PUMA 100	POWPUMA = 100	0.02	0.03
PUMA 200	POWPUMA = 200	0.02	0.03
PUMA 300	POWPUMA = 300	0.04	0.05
PUMA 400	POWPUMA = 400	0.02	0.02
PUMA 500	POWPUMA = 500	0.15	0.15
PUMA 600	POWPUMA = 600	0.04	0.04
PUMA 700	POWPUMA = 700	0.01	0.01
PUMA 800	POWPUMA = 800	0.16	0.15
PUMA 900	POWPUMA = 900	0.06	0.06
PUMA 1000	POWPUMA = 1000	0.19	0.12
PUMA 1100	POWPUMA = 1100	0.10	0.11
PUMA 1200	POWPUMA = 1200	0.11	0.10
PUMA 1300	POWPUMA = 1300	0.02	0.04
PUMA 1400	POWPUMA = 1400	0.03	0.04
PUMA 1500	POWPUMA = 1500	0.03	0.03
PUMA 1600	POWPUMA = 1600	0.01	0.02
N (observations)		10,252	5919

Appendix C

Table C1: General Occupation Categories Included in Sample of Professional Workers*

2010 Census Occupation Code	Occupation
0010	Chief executives and legislators
0020	General and operations managers
0040	Advertising and promotions managers
0050	Marketing and sales managers
0060	Public relations and fundraising managers
0100	Administrative services managers
0110	Computer and information systems managers
0120	Financial managers
0135	Compensation and benefits managers
0136	Human resources managers
0137	Training and development managers
0140	Industrial production managers
0150	Purchasing managers
0160	Transportation, storage, and distribution managers
0205	Farmers, ranchers, and other agricultural managers
0220	Construction managers
0230	Education administrators
0300	Architectural and engineering managers
0310	Food service managers
0330	Gaming managers
0340	Lodging managers
0350	Medical and health services managers
0360	Natural sciences managers
0410	Property, real estate, and community association managers
0420	Social and community service managers
0425	Emergency management directors
0430	Miscellaneous managers, including funeral service managers and postmasters and mail superintendents
0500	Agents and business managers of artists, performers, and athletes
0510	Buyers and purchasing agents, farm products
0520	Wholesale and retail buyers, except farm products
0530	Purchasing agents, except wholesale, retail, and farm products
0540	Claims adjusters, appraisers, examiners, and investigators
0565	Compliance officers
0600	Cost estimators
0630	Human resources workers
0640	Compensation, benefits, and job analysis specialists
0650	Training and development specialists
0700	Logisticians
0710	Management analysts

2010 Census Occupation Code	Occupation
0725	Meeting, convention, and event planners
0726	Fundraisers
0735	Market research analysts and marketing specialists
0740	Business operations specialists, all other
0800	Accountants and auditors
0810	Appraisers and assessors of real estate
0820	Budget analysts
0830	Credit analysts
0840	Financial analysts
0850	Personal financial advisors
0860	Insurance underwriters
0900	Financial examiners
0910	Credit counselors and loan officers
0930	Tax examiners and collectors, and revenue agents
0940	Tax preparers
0950	Financial specialists, all other
1005	Computer and information research scientists
1006	Computer systems analysts
1007	Information security analysts
1010	Computer programmers
1020	Software developers, applications and systems software
1030	Web developers
1050	Computer support specialists
1060	Database administrators
1105	Network and computer systems administrators
1106	Computer network architects
1107	Computer occupations, all other
1200	Actuaries
1220	Operations research analysts
1240	Miscellaneous mathematical science occupations, including mathematicians and statisticians
1300	Architects, except naval
1310	Surveyors, cartographers, and photogrammetrists
1320	Aerospace engineers
1340	Biomedical and agricultural engineers
1350	Chemical engineers
1360	Civil engineers
1400	Computer hardware engineers
1410	Electrical and electronics engineers
1420	Environmental engineers
1430	Industrial engineers, including health and safety
1440	Marine engineers and naval architects
1450	Materials engineers

2010 Census Occupation Code	Occupation
1460	Mechanical engineers
1520	Petroleum, mining and geological engineers, including mining safety engineers
1530	Miscellaneous engineers, including nuclear engineers
1540	Drafters
1550	Engineering technicians, except drafters
1560	Surveying and mapping technicians
1600	Agricultural and food scientists
1610	Biological scientists
1640	Conservation scientists and foresters
1650	Medical scientists, and life scientists, all other
1700	Astronomers and physicists
1710	Atmospheric and space scientists
1720	Chemists and materials scientists
1740	Environmental scientists and geoscientists
1760	Physical scientists, all other
1800	Economists
1820	Psychologists
1840	Urban and regional planners
1860	Miscellaneous social scientists, including survey researchers and sociologists
1900	Agricultural and food science technicians
1910	Biological technicians
1920	Chemical technicians
1930	Geological and petroleum technicians, and nuclear technicians
1965	Miscellaneous life, physical, and social science technicians, including social science research assistants
2000	Counselors
2010	Social workers
2015	Probation officers and correctional treatment specialists
2016	Social and human service assistants
2025	Miscellaneous community and social service specialists, including health educators and community health workers
2040	Clergy
2050	Directors, religious activities and education
2060	Religious workers, all other
2100	Lawyers, and judges, magistrates, and other judicial workers
2105	Judicial law clerks
2145	Paralegals and legal assistants
2160	Miscellaneous legal support workers
2200	Postsecondary teachers
2400	Archivists, curators, and museum technicians
2430	Librarians
2440	Library technicians

2010 Census Occupation Code	Occupation
2540	Teacher assistants
2550	Other education, training, and library workers
2600	Artists and related workers
2630	Designers
2700	Actors
2710	Producers and directors
2720	Athletes, coaches, umpires, and related workers
2740	Dancers and choreographers
2750	Musicians, singers, and related workers
2760	Entertainers and performers, sports and related workers, all other
2800	Announcers
2810	News analysts, reporters and correspondents
2825	Public relations specialists
2830	Editors
2840	Technical writers
2850	Writers and authors
2860	Miscellaneous media and communication workers
2900	Broadcast and sound engineering technicians and radio operators, and media and communication equipment workers, all other
2910	Photographers
2920	Television, video, and motion picture camera operators and editors
3000	Chiropractors
3010	Dentists
3030	Dietitians and nutritionists
3040	Optometrists
3050	Pharmacists
3060	Physicians and surgeons
3110	Physician assistants
3120	Podiatrists
3140	Audiologists
3150	Occupational therapists
3160	Physical therapists
3200	Radiation therapists
3210	Recreational therapists
3220	Respiratory therapists
3230	Speech-language pathologists
3245	Other therapists, including exercise physiologists
3250	Veterinarians
3255	Registered nurses
3256	Nurse anesthetists
3258	Nurse practitioners and nurse midwives
3260	Health diagnosing and treating practitioners, all other
3300	Clinical laboratory technologists and technicians

2010 Census Occupation Code	Occupation
3310	Dental hygienists
3320	Diagnostic related technologists and technicians
3400	Emergency medical technicians and paramedics
3420	Health practitioner support technologists and technicians
3500	Licensed practical and licensed vocational nurses
3510	Medical records and health information technicians
3520	Opticians, dispensing
3535	Miscellaneous health technologists and technicians
3540	Other healthcare practitioners and technical occupations
3600	Nursing, psychiatric, and home health aides
3610	Occupational therapy assistants and aides
3620	Physical therapist assistants and aides
3630	Massage therapists
3640	Dental assistants
3645	Medical assistants
3646	Medical transcriptionists
3647	Pharmacy aides
3648	Veterinary assistants and laboratory animal caretakers
3649	Phlebotomists
3655	Healthcare support workers, all other, including medical equipment preparers
3700	First-line supervisors of correctional officers
3710	First-line supervisors of police and detectives
3720	First-line supervisors of firefighting and prevention workers
3730	First-line supervisors of protective service workers, all other
3740	Firefighters
3750	Fire inspectors
3800	Bailiffs, correctional officers, and jailers
3820	Detectives and criminal investigators
3840	Miscellaneous law enforcement workers
3850	Police officers
3900	Animal control workers
3910	Private detectives and investigators
3930	Security guards and gaming surveillance officers
3940	Crossing guards
3945	Transportation security screeners
3955	Lifeguards and other recreational, and all other protective service workers
4300	First-line supervisors of gaming workers
4320	First-line supervisors of personal service workers
4340	Animal trainers
4350	Non-farm animal caretakers
4400	Gaming services workers
4410	Motion picture projectionists

2010 Census Occupation Code	Occupation
4420	Ushers, lobby attendants, and ticket takers
4430	Miscellaneous entertainment attendants and related workers
4460	Embalmers and funeral attendants
4465	Morticians, undertakers, and funeral directors
4500	Barbers
4510	Hairdressers, hairstylists, and cosmetologists
4520	Miscellaneous personal appearance workers
4530	Baggage porters, bellhops, and concierges
4540	Tour and travel guides
4600	Childcare workers
4610	Personal care aides
4620	Recreation and fitness workers
4640	Residential advisors
4650	Personal care and service workers, all other
4700	First-line supervisors of retail sales workers
4710	First-line supervisors of non-retail sales workers
4720	Cashiers
4740	Counter and rental clerks
4750	Parts salespersons
4760	Retail salespersons
4800	Advertising sales agents
4810	Insurance sales agents
4820	Securities, commodities, and financial services sales agents
4830	Travel agents
4840	Sales representatives, services, all other
4850	Sales representatives, wholesale and manufacturing
4900	Models, demonstrators, and product promoters
4920	Real estate brokers and sales agents
4930	Sales engineers
4940	Telemarketers
4950	Door-to-door sales workers, news and street vendors, and related workers
4965	Sales and related workers, all other
9000	Supervisors of transportation and material moving workers
9030	Aircraft pilots and flight engineers
9040	Air traffic controllers and airfield operations specialists
9050	Flight attendants
9800	Military officer special and tactical operations leaders
9810	First-line enlisted military supervisors
9820	Military enlisted tactical operations and air/weapons specialists and crew members
9830	Military, rank not specified

* This sample includes only workers with Bachelor's degrees or higher and excludes the Elementary and Secondary Education occupation code area and occupation codes 2300 – 2340 (teachers). It also excludes any codes specifically included in the sample of non-professional workers.

Table C2: Occupations Included in Sample of Non-Professional Workers

2010 Census Occupation Code	Occupation
4000	Chefs and head cooks
4010	First-line supervisors of food preparation and serving workers
4020	Cooks
4030	Food preparation workers
4040	Bartenders
4050	Combined food preparation and serving workers, including fast food
4060	Counter attendants, cafeteria, food concession, and coffee shop
4110	Waiters and waitresses
4120	Food servers, non-restaurant
4130	Miscellaneous food preparation and serving related workers, including dining room and cafeteria attendants and bartender helpers
4140	Dishwashers
4150	Hosts and hostesses, restaurant, lounge, and coffee shop
4200	First-line supervisors of housekeeping and janitorial workers
4210	First-line supervisors of landscaping, lawn service, and grounds keeping workers
4220	Janitors and building cleaners
4230	Maids and housekeeping cleaners
4240	Pest control workers
4250	Grounds maintenance workers
5000	First-line supervisors of office and administrative support workers
5010	Switchboard operators, including answering service
5020	Telephone operators
5030	Communications equipment operators, all other
5100	Bill and account collectors
5110	Billing and posting clerks
5120	Bookkeeping, accounting, and auditing clerks
5130	Gaming cage workers
5140	Payroll and timekeeping clerks
5150	Procurement clerks
5160	Tellers
5165	Financial clerks, all other
5200	Brokerage clerks
5220	Court, municipal, and license clerks
5230	Credit authorizers, checkers, and clerks
5240	Customer service representatives

2010 Census Occupation Code	Occupation
5250	Eligibility interviewers, government programs
5260	File clerks
5300	Hotel, motel, and resort desk clerks
5310	Interviewers, except eligibility and loan
5320	Library assistants, clerical
5330	Loan interviewers and clerks
5340	New accounts clerks
5350	Correspondence clerks and order clerks
5360	Human resources assistants, except payroll and timekeeping
5400	Receptionists and information clerks
5410	Reservation and transportation ticket agents and travel clerks
5420	Information and record clerks, all other
5500	Cargo and freight agents
5510	Couriers and messengers
5520	Dispatchers
5530	Meter readers, utilities
5540	Postal service clerks
5550	Postal service mail carriers
5560	Postal service mail sorters, processors, and processing machine operators
5600	Production, planning, and expediting clerks
5610	Shipping, receiving, and traffic clerks
5620	Stock clerks and order fillers
5630	Weighers, measurers, checkers, and samplers, recordkeeping
5700	Secretaries and administrative assistants
5800	Computer operators
5810	Data entry keyers
5820	Word processors and typists
5840	Insurance claims and policy processing clerks
5850	Mail clerks and mail machine operators, except postal service
5860	Office clerks, general
5900	Office machine operators, except computer
5910	Proofreaders and copy markers
5920	Statistical assistants
5940	Miscellaneous office and administrative support workers, including desktop publishers
6005	First-line supervisors of farming, fishing, and forestry workers
6010	Agricultural inspectors

2010 Census Occupation Code	Occupation
6040	Graders and sorters, agricultural products
6050	Miscellaneous agricultural workers, including animal breeders
6100	Fishing and hunting workers
6120	Forest and conservation workers
6130	Logging workers
6200	First-line supervisors of construction trades and extraction workers
6210	Boilermakers
6220	Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers
6230	Carpenters
6240	Carpet, floor, and tile installers and finishers
6250	Cement masons, concrete finishers, and terrazzo workers
6260	Construction laborers
6300	Paving, surfacing, and tamping equipment operators
6320	Construction equipment operators except paving, surfacing, and tamping equipment operators
6330	Drywall installers, ceiling tile installers, and tapers
6355	Electricians
6360	Glaziers
6400	Insulation workers
6420	Painters and paperhangers
6440	Pipelayers, plumbers, pipefitters, and steamfitters
6460	Plasterers and stucco masons
6515	Roofers
6520	Sheet metal workers
6530	Structural iron and steel workers
6600	Helpers, construction trades
6660	Construction and building inspectors
6700	Elevator installers and repairers
6710	Fence erectors
6720	Hazardous materials removal workers
6730	Highway maintenance workers
6740	Rail-track laying and maintenance equipment operators
6765	Miscellaneous construction workers, including solar photovoltaic installers, septic tank servicers and sewer pipe cleaners
6800	Derrick, rotary drill, and service unit operators, and roustabouts, oil, gas, and mining

2010 Census Occupation Code	Occupation
6820	Earth drillers, except oil and gas
6830	Explosives workers, ordnance handling experts, and blasters
6840	Mining machine operators
6940	Miscellaneous extraction workers, including roof bolters and helpers
7000	First-line supervisors of mechanics, installers, and repairers
7010	Computer, automated teller, and office machine repairers
7020	Radio and telecommunications equipment installers and repairers
7030	Avionics technicians
7040	Electric motor, power tool, and related repairers
7100	Electrical and electronics repairers, transportation equipment, and industrial and utility
7110	Electronic equipment installers and repairers, motor vehicles
7120	Electronic home entertainment equipment installers and repairers
7130	Security and fire alarm systems installers
7140	Aircraft mechanics and service technicians
7150	Automotive body and related repairers
7160	Automotive glass installers and repairers
7200	Automotive service technicians and mechanics
7210	Bus and truck mechanics and diesel engine specialists
7220	Heavy vehicle and mobile equipment service technicians and mechanics
7240	Small engine mechanics
7260	Miscellaneous vehicle and mobile equipment mechanics, installers, and repairers
7300	Control and valve installers and repairers
7315	Heating, air conditioning, and refrigeration mechanics and installers
7320	Home appliance repairers
7330	Industrial and refractory machinery mechanics
7340	Maintenance and repair workers, general
7350	Maintenance workers, machinery
7360	Millwrights
7410	Electrical power-line installers and repairers
7420	Telecommunications line installers and repairers
7430	Precision instrument and equipment repairers
7510	Coin, vending, and amusement machine servicers and repairers
7540	Locksmiths and safe repairers
7560	Riggers
7610	Helpers--installation, maintenance, and repair workers

2010 Census Occupation Code	Occupation
7630	Miscellaneous installation, maintenance, and repair workers, including wind turbine service technicians
7700	First-line supervisors of production and operating workers
7710	Aircraft structure, surfaces, rigging, and systems assemblers
7720	Electrical, electronics, and electromechanical assemblers
7730	Engine and other machine assemblers
7740	Structural metal fabricators and fitters
7750	Miscellaneous assemblers and fabricators
7800	Bakers
7810	Butchers and other meat, poultry, and fish processing workers
7830	Food and tobacco roasting, baking, and drying machine operators and tenders
7840	Food batchmakers
7850	Food cooking machine operators and tenders
7855	Food processing workers, all other
7900	Computer control programmers and operators
7920	Extruding and drawing machine setters, operators, and tenders, metal and plastic
7930	Forging machine setters, operators, and tenders, metal and plastic
7940	Rolling machine setters, operators, and tenders, metal and plastic
7950	Machine tool cutting setters, operators, and tenders, metal and plastic
8030	Machinists
8040	Metal furnace operators, tenders, pourers, and casters
8100	Model makers, patternmakers, and molding machine setters, metal and plastic
8130	Tool and die makers
8140	Welding, soldering, and brazing workers
8220	Miscellaneous metal workers and plastic workers, including multiple machine tool setters
8250	Prepress technicians and workers
8255	Printing press operators
8256	Print binding and finishing workers
8300	Laundry and dry-cleaning workers
8310	Pressers, textile, garment, and related materials
8320	Sewing machine operators
8330	Shoe and leather workers
8350	Tailors, dressmakers, and sewers

2010 Census Occupation Code	Occupation
8400	Textile bleaching and dyeing, and cutting machine setters, operators, and tenders
8410	Textile knitting and weaving machine setters, operators, and tenders
8420	Textile winding, twisting, and drawing out machine setters, operators, and tenders
8450	Upholsterers
8460	Miscellaneous textile, apparel, and furnishings workers except upholsterers
8500	Cabinetmakers and bench carpenters
8510	Furniture finishers
8530	Sawing machine setters, operators, and tenders, wood
8540	Woodworking machine setters, operators, and tenders, except sawing
8550	Miscellaneous woodworkers, including model makers and patternmakers
8600	Power plant operators, distributors, and dispatchers
8610	Stationary engineers and boiler operators
8620	Water and wastewater treatment plant and system operators
8630	Miscellaneous plant and system operators
8640	Chemical processing machine setters, operators, and tenders
8650	Crushing, grinding, polishing, mixing, and blending workers
8710	Cutting workers
8720	Extruding, forming, pressing, and compacting machine setters, operators, and tenders
8730	Furnace, kiln, oven, drier, and kettle operators and tenders
8740	Inspectors, testers, sorters, samplers, and weighers
8750	Jewelers and precious stone and metal workers
8760	Medical, dental, and ophthalmic laboratory technicians
8800	Packaging and filling machine operators and tenders
8810	Painting workers
8830	Photographic process workers and processing machine operators
8850	Adhesive bonding machine operators and tenders
8910	Etchers and engravers
8920	Molders, shapers, and casters, except metal and plastic
8930	Paper goods machine setters, operators, and tenders
8940	Tire builders
8950	Helpers--production workers
8965	Miscellaneous production workers, including semiconductor processors
9110	Ambulance drivers and attendants, except emergency medical technicians
9120	Bus drivers

2010 Census Occupation Code	Occupation
9130	Driver/sales workers and truck drivers
9140	Taxi drivers and chauffeurs
9150	Motor vehicle operators, all other
9200	Locomotive engineers and operators
9240	Railroad conductors and yardmasters
9260	Subway, streetcar, and other rail transportation workers
9300	Sailors and marine oilers, and ship engineers
9310	Ship and boat captains and operators
9350	Parking lot attendants
9360	Automotive and watercraft service attendants
9410	Transportation inspectors
9420	Miscellaneous transportation workers, including bridge and lock tenders and traffic technicians
9415	Transportation attendants, except flight attendants
9510	Crane and tower operators
9520	Dredge, excavating, and loading machine operators
9560	Conveyor operators and tenders, and hoist and winch operators
9600	Industrial truck and tractor operators
9610	Cleaners of vehicles and equipment
9620	Laborers and freight, stock, and material movers, hand
9630	Machine feeders and offbearers
9640	Packers and packagers, hand
9650	Pumping station operators
9720	Refuse and recyclable material collectors
9750	Miscellaneous material moving workers, including mine shuttle car operators, and tank car, truck, and ship loaders