Revising the Medicare Wage Index to Account for Commuting Patterns

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1 Introduction

The Medicare statute requires that per-discharge payments to inpatient prospective payment system (IPPS) hospitals reflect geographic differences in the cost of labor. The purpose of the Medicare wage index is to allocate payments that are consistent with the relative cost of labor across IPPS hospitals in different areas, while maintaining budget neutrality. Under the current system, Medicare calculates an average hourly wage for each metropolitan statistical area (MSA) and residual, or "rest of state" area, to construct the hospital wage index. However, labor markets defined by fixed geographic boundaries often do not accurately reflect hospital labor markets. To improve the wage index, Acumen proposes an alternative formulation known as the Commuting-Based Wage Index (CBWI), which uses commuting data to create more flexible hospital-specific labor markets.

In theory, the extent of a hospital's labor market is limited by the level of compensation offered its workers, the compensation offered by neighboring hospitals, and the wage that workers require to provide their services. Given its location, a hospital's level of compensation will attract workers who live up to some distance away. The labor market boundary can be defined by the location of workers who are indifferent, at a given wage (or compensation) level, between commuting to a hospital in a particular wage area or to a hospital in a neighboring wage area. With this boundary as the outer edge of the labor market, one can trace the physical area that includes the hospital to define the hospital's wage area or labor market.

MSA-based labor markets often define hospital labor markets either too broadly or too narrowly. If a hospital's labor market is defined too broadly, hospitals facing different prices for labor within the same market would receive the same index value. One example of a broadly-defined labor market is the MSA made up of Riverside-San Bernardino-Ontario, CA. This MSA covers over 20,000 square miles and includes more than two million people. Within this MSA are both the city of San Bernardino and the town of Needles. San Bernardino has a population of about 200,000 and is only about 60 miles from Los Angeles. Fewer than 5,000 individuals live in the town of Needles, located in the heart of the Mojave Desert. Under the current wage index that relies on an MSA-based labor market definition, hospitals in both San Bernardino and Needles receive the same index values even though their actual labor markets are quite different.

MSAs also may define labor markets too narrowly, and hospitals facing similar prices of labor may receive very different index values. For example, a hospital in New York City likely will draw workers who live in New York City, as well as workers living in the suburbs. It may also hire workers from Poughkeepsie, NY, but not nearly as many as from New York City. However, the hospital has little to no chance of hiring workers who live in San Francisco, CA. In this case, it is clear that New York City and the surrounding suburbs should be included in the hospital's labor market, but San Francisco should not. Poughkeepsie presents a problem under

the MSA-based framework. Keeping Poughkeepsie separate from the New York City labor market would ignore the fact that the New York City hospitals hire some workers from Poughkeepsie; as a result the labor market would be defined too narrowly. However, combining the Poughkeepsie-Newburgh-Middletown, NY and New York-Northern New Jersey-Long Island, NY-NJ-PA MSAs would not account for the fact that only a small share of Poughkeepsie workers make the 80-mile commute to New York City.

2 Fundamentals of the CBWI

The innovation of the CBWI involves its use of detailed commuting data to define hospital labor markets. Each hospital's CBWI value is based on a weighted sum of benchmark area wages, where the weights are the proportions of workers commuting from each area. In principle, each hospital's labor market and CBWI value are unique. More generally, CBWI values will be similar (or different) to the extent that hospitals hire workers in similar (or different) proportions from the same (or different) commuting areas. Two hospitals would have identical CBWI values if they hired workers in the same proportions from exactly the same areas. The CBWI's greater precision in defining labor markets results from the use of data on the number of workers commuting from home to work between relatively small areas such as ZIP Codes or census tracts.

Using these more precisely-defined labor markets, the CBWI offers two key advantages for calculating index values compared to an MSA or county-based approach. First, since the CBWI uses ZIP Codes or census tracts to define benchmark area wages, CBWI values can vary for hospitals within the same MSA or county. ZIP Codes or census tracts are smaller areas than the MSAs and non-metropolitan ("rest of state") areas that are used in the current wage index. As a result, the CBWI can more precisely reflect wage differences within and across MSA boundaries. In fact, compared to wage indices based on MSAs and counties, CBWI values are not subject to sharp differences solely because nearby hospitals are located in different MSAs or counties. Second, the CBWI accounts for differences in the degree to which workers commute into and out of the hospital's area. In contrast, except for the outmigration adjustment, the current Medicare wage index implicitly assumes that all hospitals in an MSA hire their workers from the same areas and in identical proportions.

3 Calculation of the CBWI

Calculation of the CBWI value for each hospital relies on commuting data between the area where a hospital is located and the areas where its workers live (commuting areas). The commuting data can be represented as a matrix, with hospitals as rows and workers' commuting areas as columns. Within each row, the columns indicate the distribution of each hospital's workers by commuting area. One of the cells in each row corresponds to the same area where the hospital is located. The number of workers in this cell represents the hospital's workers who

live in the same area as the hospital's location. Other cells in the row reflect in-migration of workers from other areas. Within each column, the rows indicate the distribution of each commuting area's workers by hospital of employment. In the column for the area in which a given hospital is located, rows for other areas than the hospital's location indicate out-migration of workers to other hospitals. When an element of the matrix is zero, it means that no workers in an area commute to the hospital corresponding to that row of the matrix.

Table 3.1 below illustrates a hypothetical commuting matrix for workers in three hospitals (*1*, *2*, and *3*), all of whom commute from one of six ZIP Codes (*A*, *B*, *C*, *D*, *E*, or *F*). The information in Table 3.1 summarizes commuting patterns viewed from either a residential area or hospital perspective. The size of populations commuting from ZIP Codes range from 40 workers coming from ZIP Code *A* to 135 workers coming from ZIP Code *C* (see bottom row). Of the 40 workers commuting from ZIP Code *A*, 20 commute to Hospital *1*, 20 commute to Hospital *2*, and zero commute to Hospital *3*. The number of individuals employed at hospitals ranges from 75 working at Hospital *1* to 310 working at Hospital *2* (see second column). Of the 75 workers at Hospital *1*, 20 commute from ZIP Code *A*, 45 commute from ZIP Code *B* (where the hospital is located), eight commute from ZIP Code *C*, two commute from ZIP Code *D*, and none commute from ZIP Codes *E* and *F*.

Table 3.1: Commuting Matrix, Distribution of Workers by Hospital and ZIP Code

Hospital	Workers by Hospital	Workers by ZIP Code					
		A	B	C	D	E	F
1 (located in *B*)	75	20	45	8	2	0	0
2 (located in *C*)	310	20	80	120	50	30	10
3 (located in *F*)	150	0	3	7	20	40	80
Total Workers	535	40	128	135	72	70	90

Using such data on commuting patterns along with wage data from hospitals, calculating the CBWI involves the following steps:

1. Construct benchmarks for area wages;
2. Calculate benchmarks for hospital wages; and
3. Create CBWI values.

The wages of workers in Table 3.1 typically differ across hospitals and across areas. The CBWI links the wages of workers in hospitals to the wages of workers in areas. In Step 3, a hospital's final CBWI value is calculated as the ratio of its benchmark hospital wage (i.e., the CBWI numerator) calculated in Step 2 divided by the national average benchmark hospital wage (i.e., the CBWI denominator). Because Step 3 replicates the current Medicare wage index

methodology, the following discussion focuses on Steps 1 and 2. Appendix A presents a more formal discussion of all three CBWI steps.

Step 1: Construct Benchmarks for Area Wages: The first step produces a benchmark wage for each residential (or commuting) area. An area's benchmark wage corresponds to the "typical" wage for hospital workers residing in that area. One simple mechanism for calculating the benchmark area wage would set it equal to a weighted average of hospital wages paid to workers living in the area, where the weights measure the shares of residents in the area who work at each hospital. Just as a hospital's average wage level can be expressed as the average of the wages that the hospital pays workers in each commuting area weighted by the proportions of workers who commute to the hospital from each area, benchmark area wages for commuting areas can be expressed as an average of hospital wages weighted by the proportions of area residents who work at each hospital. Understanding these two proportions (i.e., the proportion of workers living in an area and the proportion of area residents working in a hospital) is critical to understanding the construction of the CBWI. Both proportions are derived directly from the basic commuting matrix described in Table 3.1. The proportion of hospital workers living in an area corresponds to the row proportions, and the proportion of area residents working in a hospital corresponds to the column proportions. In summary, Step 1 consists of using hospitals' wage data and the column proportions of the commuting matrix to calculate a benchmark area wage for each commuting area.

Step 2: Calculate Benchmarks for Hospital Wages (CBWI Numerator): Once the benchmark area wages are computed, one can use the row proportions of the commuting matrix to calculate each hospital's benchmark wage (i.e., the CBWI numerator). Whereas the benchmark area wage represents the typical wage for hospital workers residing in an area, the benchmark hospital wage represents the estimated cost of labor a hospital faces in its specific labor market. Mathematically, the benchmark hospital wage equals the weighted average of the benchmark area wages where the weights are based on the likelihood that a hospital draws workers from each residential area. In other words, the CBWI numerator equals each hospital's expected cost of labor as calculated using benchmark area wages and actual hiring proportions. The use of actual hiring proportions accounts for all factors that may affect commuting patterns, such as differences in commuting costs due to distance and geographical barriers (e.g., mountains and rivers), as well as differences in the size of the employee population among residential areas. In general, hospitals hire more workers from areas that have a larger number of healthcare workers. Hiring proportions from each area fall as commuting time and cost increase relative to the hospital's location.

4 Potential Impacts of the CBWI on Hospital Wage Indices

Since the CBWI is tailored to the circumstances of each hospital's labor, the effects of implementing the CBWI for specific hospitals can be expected to differ depending on a hospital's specific geographic location and hiring patterns. How each hospital's CBWI compares to the Medicare pre-reclassification wage index depends on the comparison of wages between (i) the CBWI labor market area derived from commuting patterns, and (ii) the Medicare MSA or "rest of state" rural area.

Examples where the CBWI will likely be higher than Medicare pre-reclassification wage index

The CBWI will be higher than the Medicare pre-reclassification wage index when the average wage for the CBWI commuting area is greater than the average wage for the MSA or state-rural area in which the hospital is located. The CBWI commuting area may be larger or smaller than the MSA or state-rural area used to compute the current Medicare wage index, and it may or may not be contained within the MSA/state-rural area. Consider, for example, a situation where workers in an urban core within an MSA are more expensive than their counterparts living outside the core. In this example, a hospital located near or at the center of the urban core will receive a higher wage index value assuming it hires more workers from the urban core than its peers located further away on the MSA's periphery. Moreover, a hospital located in a rural area that is adjacent to an MSA would receive a higher CBWI value compared to the Medicare pre-reclassification value when it draws a significant fraction of its workers from higher wage areas in the adjacent MSA. Correspondingly, a large rural hospital that draws workers from an urban MSA typically will be assigned a higher CBWI value than a small rural hospital that does not.

Examples where the CBWI will likely be lower than Medicare pre-reclassification wage index

In the example where the urban core within an MSA has the most expensive labor, hospitals located in the MSA but far away from the urban core will receive a lower CBWI value than the current wage index. This assumes that they draw a large share of their workers from the less expensive suburbs or nearby rural areas. Similarly, small hospitals in rural areas would receive lower wage index values under the CBWI than large rural hospitals if their hiring predominately occurred in the relatively lower wage rural areas.

Comparing CBWI values to Medicare post-reclassification wage index values

Whether the CBWI is higher or lower than the Medicare post-reclassification wage index depends primarily on the extent and magnitude of the gains from the current reclassification system. The CBWI tends to be higher than the Medicare post-reclassification index for hospitals that currently do not benefit from reclassification and those that employ more workers from relatively high-cost areas. The CBWI tends to be lower than the Medicare post-reclassification

index for hospitals where reclassification and other wage index adjustments have resulted in a hospital's inclusion in a higher cost MSA irrespective of the extent to which workers actually commute from that MSA to the reclassified hospital.

To investigate the effects of implementing the CBWI further, the following empirical impact analysis calculates hospitals' CBWI values using commuting data from the 2000 Census Transportation Planning Package (CTPP) and wage data from the FY 2008 Medicare IPPS hospital cost reports. This analysis compares hospitals' CBWI values against their Medicare pre-reclassification, Medicare post-reclassification, and MedPAC proposed indices. The key findings of this analysis are:

- Among the candidate indices, the CBWI has the highest correlation with a hospital's own reported wages.
- The CBWI is the only index that allows for both intra-MSA and intra-county variation in wage index values.
- The CBWI reduces the differences in wage index values for nearby hospitals located in different MSAs; the average difference in CBWI values between hospitals within six miles of each other is only 2 percentage points, while the average difference in current Medicare post-reclassification wage index values between the same hospitals is 5 percentage points.
- If Medicare implemented the CBWI methodology, approximately one in four hospitals would experience a change in wage index values of more than 5 percentage points.
- Under the CBWI framework, the typical *reclassified* hospital receives a wage index value that is 1.8 percentage points higher than its pre-reclassification value, but 2.5 percentage points lower than its post-reclassification value; the typical *non-reclassified* hospital receives a wage index value that is 0.6 percentage points lower than its pre-reclassification value, but 0.8 percentage points higher than its post-reclassification value.

5 Data Requirements for Potential Implementation of the CBWI

Detailed commuting and wage data are required to implement the CBWI. The commuting data must cover the entire nation and be able to identify both the share of each hospital's workers who live in each area and the share of residents in each area that work at each hospital. The only publicly-available data currently both nationwide in scope and containing a sufficient number of observations to estimate these commuting patterns reliably are CTPP data. CTPP data describe census tract-to-census tract commuting information for all workers in the sample. Specifically, the CTPP contains commuting information from over 15 million workers commuting from over 64,000 census tracts. However, these data, derived from the 2000 Census,

raise several questions: How different are commuting patterns of workers in all sectors of the economy from commuting patterns of hospital workers? Are Census data from 2000 too old to be usable? How rapidly do commuting patterns change over time? How frequently would commuting data need to be updated to be accurate? This report did not encounter any publicly-available data that could be used to compare the commuting patterns of all workers and hospital workers. Since the decennial Census long form has been replaced by the annual American Community Survey (ACS), it is not currently possible to update the 2000 CTPP data. Multiple years of ACS information can be pooled to provide more timely commuting data, but at no smaller geographic level than the county.

Preferably, CMS would collect data on employee place of residence directly from hospitals, providing precise information about worker commuting patterns. CMS could create a commuting data file by requiring hospitals to report employment by place of residence on a regular basis. These data would provide a timelier source of commuting information and better capture idiosyncrasies unique to hospital workers' commutes. Hospitals could only be required to report counts of the number of their workers living in each ZIP Code, which could protect employee confidentiality. As a further privacy safeguard, geographical areas with very small numbers of employees could be combined prior to reporting, with minimal impact to the accuracy of the CBWI. Although the collection of commuting data directly from hospitals would involve a larger administrative burden than would the use of publicly-available data, hospitals could extract this information directly from employee payroll records. Presumably, it would be easier for hospitals to provide the proportion of employees by ZIP Code than by census tract since employee ZIP Code is readily available from these payroll records. CMS could collect these annually or on a less frequent basis. In general Acumen believes that commuting patterns are sufficiently stable that it would not be necessary to collect the commuting data annually to match the same time period as the wage data.

Once a reliable source of commuting data is established, the CBWI can be constructed with almost any source of employer wage data, provided it can be linked to the geographic unit of the commuting data (e.g., ZIP Code or census tract). For example, the CBWI could use the current Medicare wage survey data because each hospital's street address and ZIP Code are known. Using the current Medicare wage survey and occupational mix adjustment to construct the CBWI would not require hospitals to submit any additional wage data. In fact, the CBWI constructed for this project uses the current Medicare wage survey data, which includes Medicare's current occupational mix adjustment of nursing wages.

Another potential wage data source is the Bureau of Labor Statistics (BLS) Occupational Employment Survey (OES) data. As mentioned in a previous report,[1] using the BLS OES data enables a more refined occupational mix adjustment based on a larger number of occupations. The publicly-available 2010 BLS OES data contain wage and employment information by MSA for over 350 occupations in the hospital industry.[2] However, OES wage data at the level of the individual hospital (or other employer) are not publicly-available. Thus, the CBWI would require confidential OES data at the individual employer level to link the employer's wages to specific geographic unit contained in the commuting data. An earlier report[3] examined the strengths and weaknesses of the various sources of wage data.

Issues pertaining to wage data, such as whether and how to adjust for occupational mix differences, are largely separable from the CBWI. For example, the steps described in this report (Section 3 and Appendix A) can be followed using occupational-mix-adjusted employer wages instead of observed employer wages to create occupational-mix-adjusted CBWI values. Further, although expanding CMS's collection of hospital wage data by occupation would involve an additional administrative burden for CMS and hospitals, the burden would be the same regardless of whether the refined occupational mix adjustment was applied to the current Medicare wage index or to the CBWI. Special data requirements and additional burden for the CBWI would only be necessary if the assumption of similar commuting patterns for all occupations were relaxed. Two States currently collect hospital wage data jointly by occupation and employee residence (i.e., New York by county, Maryland by ZIP Code).

6 Responses to Comments from Stakeholders

In April 2011, CMS held an Open Door Forum (ODF) to solicit stakeholder comments on the CBWI. Stakeholders expressed mixed opinions. Many found the premise of the CBWI interesting and thought the approach showed merit. However, others rejected the proposal as impractical, problematic to implement, and redistributive to hospitals. This section includes an overview of the comments made during the ODF and provides corresponding responses. Specifically, this section addresses comments related to the following topics:

- The CBWI methodology
- Commuting data issues
- Implementation issues
- Exceptions to the CBWI methodology
- Empirical analysis of the CBWI

[1] MaCurdy, Thomas, Thomas DeLeire, Karla Lopez de Nava, Paulette Kamenecka, Yang Tan, and Sean McClellan. 2009. "Revision of Medicare Wage Index, Final Report, Part I." Burlingame, CA: Acumen, LLC.
[2] In the 2010 BLS OES publicly available data, there are 364 occupations with reported employment in the General Medical and Surgical Hospitals industry (NAICS 622100).
[3] *Ibid*

The following sections summarize key feedback from stakeholders in each of these five categories. Appendix B provides a more detailed list of the comments and responses.

6.1 CBWI Methodology

Some stakeholders commented that calculating the CBWI could lead to a circularity problem. When first encountered, the CBWI may appear circular since hospitals' wages are distributed among commuting areas, and then reconstructed from the average wage of those same commuting areas. The reason that this process is not circular is that as long as multiple hospitals hire from the same commuting areas, the benchmark area wages will be an average of wages from many hospitals. Each hospital's own wages contribute to benchmark area averages, but in general, no single hospital solely determines a benchmark area wage. In addition, since small geographic units are used for the commuting areas, the CBWI for most hospitals is a weighted average of many area benchmarks with contributions from many different hospitals' wages. As a result, circularity is no more of a problem in the CBWI than it is in the current system. Under the CBWI, circularity only fully exists in the event that one hospital hires all its workers from a single area, and it is the only hospital hiring from that area. The same problem may exist in the current system where an MSA contains a very small number of hospitals. In 2010, 92 geographic wage areas contained fewer than three hospitals. However, these areas comprise only about 4 percent of hospitals paid under the IPPS.

Although hospitals may be able to influence their wage index values in non-competitive areas, there are a variety of options to address the issue. In the case where all workers in a given area work at a single hospital, to prevent the hospital from being the sole determinant of the area wage, Medicare could combine ZIP Codes or census tracts to create larger areas. These larger commuting areas would ensure that area averages are based on wage data from more than one hospital. However, in such cases, there is a trade-off between the accuracy of the labor market area and the avoidance of circularity.

ODF participants raised another issue closely related to circularity. This concern questioned each hospital's potential to influence its CBWI value by changing its wage and hiring practices, such as paying higher-than-market wages, reducing hiring from relatively low-wage areas, or paying below-market wages. There are three reasons why these are not serious concerns. First, as noted above, hospitals generally have very limited ability to influence their own CBWI values because of the significant influence of competing hospitals. Second, even in the unlikely case that a hospital succeeded in raising its wage index value enough to offset the higher wages paid, it would not fully recoup the additional wage costs incurred unless Medicare was its sole payor or all its other payors paid Medicare rates. Third, the higher wage would have to be paid for multiple years prior to any recoupment due to the significant lag between the year that the wage data is collected and the year Medicare uses that wage data to affect hospital

payments. Hospitals always benefit financially from paying below-market wages, but that is the case under any circumstances and is not specific to the CBWI.

A commenter asked how well the CBWI would explain differences in hospital wages. This question raises the important point that, while a wage index should not pay a hospital the equivalent of its own wages, substantial divergences between hospitals' own relative wages and their wage index values are symptomatic of inaccuracies in defining labor market areas. Since these inaccuracies are the source of pressures for reclassification and other wage index adjustments, it is important that there be a high degree of correspondence between wage index values and hospitals' own relative wages. This report assesses this relationship using the CBWI constructed from the 2000 CTPP data and 2008 Medicare cost reports (see Section 4). The comparison of the Medicare pre-reclassification wage index, the Medicare post-reclassification wage index, and the MedPAC proposed wage index found that the CBWI was most highly correlated with hospitals' own relative wages, as shown in Table 6.1 below. This finding holds for all hospitals, for all reclassified hospitals, and for all non-reclassified hospitals (not shown).

Table 6.1: Correlation of Four Candidate Wage Indices with Hospital Reported Wages

Wage Index	Correlation with Hospital Wages
CBWI	0.94
Medicare Pre-Reclassification	0.89
Medicare Post-Reclassification	0.88
MedPAC	0.84

The CBWI methodology could be refined to address certain ODF public comments. For example, when estimating commuting shares, the CBWI methodology could use full-time equivalent (FTE) commuting shares rather than employment shares. This adjustment would require CMS to collect information from hospitals on average number of hours worked per employee living in each ZIP Code or census tract. Thus, there is a tradeoff between more accurate data and the additional administrative burden of collecting more data from hospitals.

Finally, stakeholders noted that the CBWI may disadvantage multi-hospital systems that have uniform pay scales but multiple sites. Since the CBWI uses data that are based on the wages that hospitals pay, a multi-hospital system that pays wages above the local market rate potentially would be adversely affected. Multi-hospital systems that pay workers below the local market rate, however, would benefit. If hospitals pay wages much lower than the local market, then, in the long run, the hospital will need to raise wages to meet its workforce needs.

6.2 Commuting Data Issues

Many comments made during the ODF addressed current and potential data sources for the CBWI. Respondents generally agreed that the commuting data for all workers from the 2000

Census were likely too old to be relevant. Also, stakeholders generally preferred the use of hospital-specific data. Hospital-specific data are relatively up-to-date, and commuting patterns derived from provider information would be specific to individual hospitals, improving precision.

Stakeholders also expressed worries that issues may arise with the use of ZIP Code-level data collected from hospitals. Most stakeholders voiced concern that collecting data by ZIP Code may increase the administrative burden for hospitals. The CBWI methodology, however, only requires information on the number or share of hospital workers residing in each ZIP Code. In particular, because wage-related costs by ZIP Code are not required, hospitals would not need sophisticated payroll systems in place to comply with these requirements. In fact, one commenter stated that it would be relatively straightforward to submit these data to CMS.

Stakeholders also noted that collecting and utilizing ZIP Code data could create privacy concerns. For the CBWI, CMS would only require the number of employees or hours worked by ZIP Code (and possibly occupation). No personally-identifiable data would be needed. Nonetheless, privacy could be a concern if only a small number of workers are hired from a ZIP Code. To minimize these issues, CMS could aggregate ZIP Codes to avoid a small-cell problem or provide a public-use file (PUF) with aggregated data and maintain private files with disaggregated data for construction of the actual CBWI.

Stakeholders also questioned the ability of the CBWI to account for employee turnover, changing commuting patterns, and the effects of housing development. Regardless of the source, commuting data can only provide a snapshot of employee commuting patterns at specific points in time. As a result, no data source would account for employee turnover or changes to employee location during the observation period. To mitigate this concern, CMS could increase the frequency with which the data are collected to capture employee turnover or changing commuting patterns related to housing or transportation development. This approach, however, may increase the administrative burden for providers and for CMS.

6.3 Implementation Issues

ODF participants also noted several implementation issues that must be resolved. Stakeholders commented on potential ways to facilitate the transition to the revised wage index and to ensure its continued accuracy. For the most part, these constitute areas in which CMS must decide on the appropriate policy or action, including the following:

- Phasing in the CBWI,
- Making data available for hospital review,
- Using consistent definitions and a transparent methodology, and

- Ensuring that the revised index constitutes an improvement over the current index.

Other comments were general questions regarding CBWI implementation that do not require CMS decision making. For example, stakeholders expressed concern about the combined effect of the revision of the wage index with other elements of healthcare reform on the size of provider reimbursements. The Medicare wage index is applied in a budget neutral manner regardless of the methodology used. Although changing the wage index methodology will benefit some providers and harm others, on average there will be no net effect on aggregate provider payments as long as the index remains budget neutral.

6.4 Exceptions to the CBWI Methodology

Many stakeholders commented that exceptions and reclassifications should continue to be part of the wage index methodology. Several respondents noted that many hospitals have benefited from the reclassification system, and that reclassifications were especially important for hospitals within commuting distance of New York City. The following exceptions were explicitly mentioned:

- 508 reclassification,
- Frontier State wage index, and
- Rural floor provision.

The CBWI is intended to attenuate the need for these complex exceptions. The CBWI reduces the magnitude of the cliffs between nearby hospitals in different MSAs, and thus the gain from reclassification for most hospitals would be smaller than is currently the case. Further, because each hospital receives an individual wage index value tailored to its specific labor market, it is unclear what reclassification would mean under the CBWI framework.

6.5 Empirical Analyses of the CBWI

Most respondents indicated that additional analyses of the effect of the CBWI were needed to evaluate the methodology. Appendix C provides a high-level empirical analysis describing how implementing the CBWI could potentially affect different provider types. This appendix displays the mean and median change in wage index values between the CBWI and three alternative indices: the Medicare pre-reclassification, the Medicare post-reclassification, and the MedPAC indices. In addition, this report has considered variation in the CBWI values for neighboring hospitals. Certain stakeholders requested an evaluation of the year-to-year volatility in the CBWI values. However, since only one year of CTPP commuting data are available, it was not possible to conduct such an analysis. Other respondents asked for a comparison of census tract against the ZIP Code as the unit of comparison. Because the CTPP

data only report commuting patterns at the census tract level rather than the ZIP Code level, it was not possible to assess the accuracy of using census tracts versus ZIP Codes as the units of analysis.

7 Extension of the CBWI to Other Settings

In addition to adjusting reimbursement for inpatient hospitals, the hospital wage index modifies payments for skilled nursing facilities (SNFs), inpatient rehabilitation facilities (IRFs), inpatient psychiatric facilities (IPFs), long-term acute care hospitals (LTCHs), hospital outpatient services (HOPDs), ambulatory surgery centers (ASCs), home health agencies (HHAs), and hospice providers. Medicare could implement one of three options to adapt the index for use in these settings. First, Medicare could adapt the CBWI methodology to develop wage indices specifically for each one of the providers that use the Medicare wage index to adjust their payments. The administrative burden and resource requirements associated with this approach might be considerable. Second, as long as a hospital is located in close proximity to one of these other providers, Medicare could use the hospital's CBWI as the basis for the other healthcare provider's wage index.[4] Using hospital wages assumes that the relative wage differences between areas are similar for hospital workers and for other healthcare provider workers. Third, Medicare could base providers' values on those of nearby hospitals using the nearest-neighbor method. For each healthcare provider, this method would approximate wage index values based on a weighted average of the wage index values for nearby hospitals. Finally, it should be noted that adopting the CBWI for hospitals would not preclude continuing to use the current Medicare pre-reclassification wage index for these other providers.

8 Conclusion

The proposed alternative wage index framework improves on Medicare's existing wage index method by using commuting data to characterize hospital labor markets more accurately. Commuting information at a detailed geographic level allows for more flexible labor market definitions, which better reflect the areas from which hospitals draw their employees. Rather than constraining a hospital's labor market to the size of an MSA, CBWI labor markets reflect hospitals' specific commuting patterns.

The largest improvements in defining labor market areas would occur in areas where many hospitals compete for employees in the same areas, but are divided by boundaries of MSA and "rest of state" areas. In such situations, there would be little justification for reclassifying hospitals to other wage areas since each hospital's wage area comprises the geographic areas

[4] Given that the Hospice and Home Health payment methods use the beneficiary residence or place of service to adjust payments, the relevant commuting patterns would be from the employee residence to the beneficiary residence. This would add a new level of complexity to the collection of commuting data and is unlikely to be feasible.

from which it hires its workers. The CBWI would have less impact on labor market areas where only one or two hospitals compete for workers.

The CBWI's more flexible labor market definitions confer two key benefits. First, the CBWI allows wage index values to vary within an MSA, unlike the current Medicare wage index method. Because area wages are determined at the ZIP Code or census tract level, the CBWI can reflect intra-MSA variation in the price of labor. Second, the CBWI does not produce large differences—or "cliffs"—between wage index values for nearby hospitals in different MSAs. As nearby hospitals will likely hire workers from areas in similar—but not identical—proportions, the wage index values of these nearby hospitals will also be similar.

APPENDIX A: Detailed Formulation of the CBWI

The following discussion presents a formal representation of the steps involved in calculating hospitals' CBWI values. Section A.1 introduces two labor market identities that relate area wages, hospital wages, and commuting patterns. These identities serve as the foundation for the structure of the CBWI. Section A.2 describes the three specific steps required to compute budget-neutral CBWI values. Finally, Section A.3 summarizes the mathematical relationships used to calculate hospital CBWI values.

A.1 Identities Relating Hospital and Area Wages

The CBWI methodology relies on mathematical identities that relate hospital and area wages. Specifically, a hospital's average wage equals a weighted average of area wages, and an area's average wage equals a weighted average of hospital wages. In both instances, commuting propensities determine these weights. In essence, commuting information is the link that translates the wages prevailing in a particular labor market to the price of labor each hospital faces and vice versa. After introducing some basic notation in Section A.1.1, Sections A.1.2 and A.1.3 present these two labor market identities.

A.1.1 A Simple Characterization of a Hospital's Labor Market

As the key innovation of the CBWI is its use of commuting data to define hospital labor markets, this section provides a mathematical notation to describe such a market. To provide a concrete illustration of the use of this notation, Table A.1 replicates the hypothetical commuting matrix depicted in Table 3.1 above, and also includes data on total hospital wages and hourly wage rates paid by each hospital. (For simplicity, this table and the calculations below based on this table assume that a hospital pays the same wage to all of its workers, but the formulas presented below allow for a hospital to pay a distribution of wages with each of its workers receiving different hourly wages.)

Table A.1: Employee Residence and Hospital Earnings and Employment Data

Hospital	Total Wages	Number of Employees	Hourly Wages	ZIP Codes					
				A	B	C	D	E	F
1	$2,100	75	$28	20	45	8	2	0	0
2	$12,400	310	$40	20	80	120	50	30	10
3	$5,100	150	$34	0	3	7	20	40	80
Total Employment in Each ZIP Code				40	128	135	72	70	90

To quantify the employment patterns for the purpose of defining wage indices, designate ℓ_{jk} as the amount of labor hired by Hospital j from Area k.[5] In Table A.1, Hospital 2, hires 20 workers from ZIP Code A (ℓ_{2A}=20), 80 workers from ZIP Code B (ℓ_{2B}=80), 120 workers from ZIP Code C (ℓ_{2C}=120), 50 workers from ZIP Code D (ℓ_{2D}=50), 30 workers from ZIP Code E (ℓ_{2E}=30), and 10 workers for ZIP Code F (ℓ_{2F}=10). Thus, each hospital-area pair j, k corresponds with a different ℓ_{jk} cell in Table A.1. Note that in the case where the hospital does not hire any workers from an area, then ℓ_{jk}=0.

Given knowledge of the number of individuals commuting between each hospital-area pair, one can calculate the total number of workers in a Hospital j and in an Area k. Total employment of Hospital j (ℓ_j) equals:

(A.1) $$\ell_j = \sum_k \ell_{jk} ;$$

and the total number of workers employed by all hospitals in Area k equals:

(A.2) $$L_k = \sum_j \ell_{jk} .$$

Referring to Table A.1, the total employment of Hospital 2 is 310 (i.e., $\ell_2 = \ell_{2A} + \ell_{2B} + \ell_{2C} + \ell_{2D} + \ell_{2E} + \ell_{2F} = 20 + 80 + 120 + 50 + 30 + 10 = 310$). Hospital 1 and Hospital 3's values of ℓ_j appear in the column titled "Number of Employees." The total number of workers employed by all three hospitals in ZIP Code B is 128 (i.e., $L_B = \ell_{1B} + \ell_{2B} + \ell_{3B} = 45 + 80 + 3 = 128$). Values of L_k for the other ZIP Codes appear in the bottom row, titled "Total Employment in Each ZIP Code."

The quantity

(A.3) $$L = \sum_j \ell_j = \sum_k L_k$$

equals the size of the total labor force working in all hospitals or, equivalently, the size of the total labor force living in all residential areas. In Table A.1, summing either the column titled "Number of Employees" or the row titled "Total Employment in Each ZIP Code" gives a total labor force of 535 workers (i.e., $L = \ell_1 + \ell_2 + \ell_3 = L_A + L_B + L_C + L_D + L_E + L_F = 535$).

A.1.2 Identity 1: Calculating Hospital Wages Using Data on Area Wages

The first labor market identity demonstrates that a hospital's average wage level can be expressed as a weighted average of the wages that a hospital pays workers in each area, where the weights depend on commuting shares. Defining ω_j as the average wage rate paid by Hospital j, one can verify that

[5] In this appendix, ℓ_{jk} represents the number of workers; however, ℓ_{jk} can also represent total hours of employment or full-time equivalent (FTE) workers.

$$\omega_j = \sum_k S_{jk} W_{jk} \quad \text{(A.4)}$$

where W_{jk} equals the average wage paid by Hospital j to its workers who live in Area k, and S_{jk} is the share of Hospital j's labor force that is hired from Area k. The variable S_{jk} is calculated as follows:

$$S_{jk} = \frac{\ell_{jk}}{\ell_j} \quad . \quad \text{(A.5)}$$

In Table A.1, the share of Hospital 2's workforce hired from ZIP Code B (S_{2B}) is 26 percent (i.e., $S_{2B} = \ell_{2B} \div \ell_2 = 80 \div 310 = 0.26$). Equation (A.4) shows that if data on area wages and commuting patterns are known for each hospital, one can readily compute a hospital's average hourly wage.

A.1.3 Identity 2: Calculating Area Wages Using Data on Hospital Wages

The average wages workers receive in each residential area analogously depend on the wages individual hospitals pay. Defining W_k as the average wage rate earned by hospital workers in Area k, one can verify

$$W_k = \sum_j P_{jk} \omega_{jk} \quad \text{(A.6)}$$

where the variable ω_{jk} denotes the average wage for workers employed by Hospital j who live in Area k, and P_{jk} represents the fraction of workers residing in Area k that work at Hospital j. The variable P_{jk} is calculated as follows:

$$P_{jk} = \frac{\ell_{jk}}{L_k} \quad . \quad \text{(A.7)}$$

In Table A.1, the fraction of workers residing in ZIP Code B that work at Hospital 2, (P_{2B}) is 0.63 (i.e., $P_{2B} = \ell_{2B} \div L_B = 80 \div 128 = 0.63$). By construction, the average hospital wage for workers from a specific area equals the average area wage of workers who work at that hospital, so $\omega_{jk} = W_{jk}$. Equation (A.6) reveals that if both commuting data and establishment wage data are available by area, one can calculate the average wage in any residential area k.

A.2 Three Steps Required to Formulate the CBWI

The CBWI exploits the above labor market identities by basing each hospital's wage index value on a commuting-adjusted average of the wages in the surrounding areas. The key innovation of the CBWI is the use of commuting patterns to define a labor market. This methodology in essence creates a representation of a hospital's labor market where the likelihood

a hospital draws workers from any area is based on commuting patterns. The reliability of the CBWI values depends on the accuracy of both hospital wage data and the commuting patterns of hospital workers.

After selecting the sources of wage and commuting data, the formulation of the CBWI requires a three-step process:

1. Construct benchmarks for area wages;
2. Calculate benchmarks for hospital wages; and
3. Create CBWI values.

Implementing these steps requires both wage and commuting data. The CBWI can use wage data surveyed from either establishments or households. It relies on commuting data reflecting the share of healthcare or hospital workers in each residential area that work in individual hospitals, which emulates the commuting patterns for a region.

Sections A.2.1, A.2.2, and A.2.3 below discuss in detail the three steps required to calculate hospital wage index values under the CBWI framework. This discussion presents a simplified variant of the CBWI that ignores adjustments required for factors such as the hospital's occupational mix.

A.2.1 Step 1: Construct Benchmarks for Area Wages

The first step in the CBWI methodology calculates benchmark wages for each residential area. Denote the benchmark wage in any Area k as W_k^*. A variety of candidates exist for assigning values to benchmark area wages. A natural approach described in this section calculates W_k^* as the average wage in the corresponding residential Area k (W_k), which constitutes a flexible approach for capturing the labor costs faced by individual hospitals. Drawing on the second wage identity (A.6), this formulation of a benchmark wage for an area implies

$$W_k^* = W_k = \sum_j P_{jk} \cdot \omega_{jk} \quad \text{(A.8)}$$

where P_{jk} measures the proportion of labor input from in Area k working at Hospital j and ω_{jk} equals the wage paid by Hospital j to workers residing in Area k.

If hospital wage data are not available by individual areas, one can modify index relationship (A.8) by replacing the individual wage rates ω_{jk} by the average wage ω_j for the corresponding hospital to obtain[6]

(A.9) $$W_k^* = \sum_j P_{jk} \cdot \omega_j \ .$$

Substituting a single hospital wage rate ω_j for area-specific wage rates ω_{jk} implicitly assumes that a hospital pays a common wage rate to all of its workers given their skill levels. This assumption is maintained in Table A.1 and in the example calculations presented below.

To illustrate this step, Table A.2 presents the values of P_{jk} implied by Table A.1 for each ZIP Code, and Table A.3 reports each ZIP Code's implied benchmark area wage [e.g., for ZIP Code *B*, (0.35×$28) + (0.63×$40) + (0.02×$34) = $35.64]. While this analysis assumes calculation of benchmark wages at the ZIP Code level, other residential area definitions could be readily be used (e.g., census tracts, counties).

Table A.2: Share of Employees Working At Each Hospital, by ZIP Code

Hospital	Total Wages	Number of Employees	Hourly Wages	ZIP Code					
				A	B	C	D	E	F
1	$2,100	75	$28	0.50	0.35	0.06	0.03	0	0
2	$12,400	310	$40	0.50	0.63	0.89	0.69	0.43	0.11
3	$5,100	150	$34	0	0.02	0.05	0.28	0.57	0.89

Table A.3: Calculation of ZIP Code Benchmark Area Wage

Hospital	Total Wages	Number of Employees	Hourly Wages	ZIP Code					
				A	B	C	D	E	F
1	$2,100	75	$28	$14.00	$9.84	$1.66	$0.78	0	0
2	$12,400	310	$40	$20.00	$25.00	$35.56	$27.78	$17.14	$4.44
3	$5,100	150	$34	0	$0.80	$1.76	$9.44	$19.43	$30.22
ZIP Code Benchmark Area Wage				$34.00	$35.64	$38.98	$38.00	$36.57	$34.67

A.2.2 Step 2: Calculate Benchmarks for Hospital Wages

As the CBWI equals the ratio of the hospital's estimated cost of labor in its local labor market and the national average cost of labor, the CBWI's second step uses benchmark area wages to estimate the CBWI numerator (i.e., the benchmark hospital wage) of this ratio. The calculation of each provider's benchmark area wage draws on the first wage identity (A.4).

[6] If precise data are not available to calculate the commuting shares P_{jk} then one must estimate these commuting shares. In this case, then Equation A.7 becomes

$$W_k^* = \sum_j P_{jk}^* \cdot \omega_j$$

where the quantities P_{jk}^* represent the *estimated* values for commuting shares. For instance, to reduce the data collection burden on hospitals, Medicare may collect commuting information periodically. Thus, prior year's commuting data (i.e., P_{jk}^*) would serve as an estimate of true commuting patterns in the current year (i.e., P_{jk}).

Replacing the actual wage that hospitals pay workers in each area (W_{jk}) with the benchmark area wages (W_k^*) calculated in Step 1 produces the benchmark hospital wage (ω_j^*)[7]

(A.10) $$\omega_j^* = \sum_k S_{jk} \cdot W_k^* .$$

This relationship computes each benchmark hospital wage as a weighted average of the benchmark area wages with the weights measuring the share of workers a hospital draws from each residential area. One then uses the resulting hospital's benchmark wage as the CBWI's numerator.

To illustrate this step, Table A.4 presents the values of S_{jk} implied by Table A.1 for each ZIP Code, and Table A.5 reports each provider's benchmark hospital wage along with the contributions by ZIP Code to this index. Each ZIP Code's benchmark area wage is distributed across the three hospitals by multiplying the row proportions in Table A.4 by the ZIP Code benchmark area wage. As displayed in Table A.5, these values are summed across ZIP Codes to obtain each hospital's benchmark wage [i.e., for Hospital *2*, (0.06×$34.00) + (0.26×$35.64) + (0.39×$38.98) + (0.16×$38.00) + (0.10×$36.57) + (0.03×$34.67) = $37.27]. For Hospital *2*, the benchmark area wage for ZIP Code *C* factors into the benchmark hospital wage most heavily because the hospital hires the largest share of its workers from that area (i.e., 39 percent).

Table A.4: Share of Hospital Employees Residing in Each ZIP Code, by Hospital

Hospital	Total Wages	Number of Employees	Hourly Wages	ZIP Code					
				A	B	C	D	E	F
1	$2,100	75	$28	0.27	0.60	0.11	0.03	0	0
2	$12,400	310	$40	0.06	0.26	0.39	0.16	0.10	0.03
3	$5,100	150	$34	0	0.02	0.05	0.13	0.27	0.53
ZIP Code Benchmark Area Wage				$34.00	$35.64	$38.98	$38.00	$36.57	$34.67

Table A.5: Calculation of Benchmark Hospital Wage

Hospital	Total Wages	Number of Employees	Hourly Wages	ZIP Code						Benchmark Hospital Wage
				A	B	C	D	E	F	
1	$2,100	75	$28	$9.07	$21.38	$4.16	$1.01	$0	$0	$35.62
2	$12,400	310	$40	$2.19	$9.20	$15.09	$6.13	$3.54	$1.12	$37.27
3	$5,100	150	$34	$0	$0.71	$1.82	$5.07	$9.75	$18.49	$35.84
Total Employment		535								

[7] Without direct information on the current values of commuting shares S_{jk}, the benchmark hospital wage (CBWI numerator) can be expressed as

$$\omega_j^* = \sum_k S_{jk}^* \cdot W_k^*$$

where the quantities S_{jk}^* represent estimated values of the proportion of employees at each hospital who live in each residential area. The values of S_{jk}^* are a proxy for the true commuting share values S_{jk}.

A.2.3 Step 3: Create CBWI Values

The final step centers the distribution of CBWI values at 1.0 and creates an index measuring how much higher or lower each hospital's labor costs are relative to this centered value. Accordingly, a CBWI value of 1.2 indicates that the hospital's labor costs are 20 percent higher than the national average, and a CBWI value of 0.8 indicates that the hospital's labor costs are 20 percent below the national average. This construction of the CBWI mirrors the last steps followed to compute the current Medicare wage index.

Calculating the centered CBWI value requires determining the national average benchmark hospital wage (i.e., the CBWI denominator). The national average benchmark hospital wage is calculated as the weighted average of the benchmark hospital wage values calculated in Step 2. In this calculation, the weights are the number of transfer-adjusted cases each hospital treats during the year. Weighting by hospital case-load allows the prices of labor for larger hospitals to have a greater impact on the national hospital average labor cost than those of smaller hospitals. Mathematically, one can calculate the national average benchmark hospital wage as:

(A.11)
$$\bar{\omega} = \frac{\sum_j Cases_j \cdot \omega_j^*}{\sum_j Cases_j}$$

where ω_j^* represents the estimated hospital price of labor calculated in Step 2, and the $Cases_j$ variable represents the number of annual cases Hospital j treats during the year. The term $\bar{\omega}$ in equation (A.11) represents the national average benchmark hospital wage.

The final CBWI value is simply the ratio of each hospital's benchmark wage (calculated in Step 2) divided by the national average benchmark hospital wage from euation (A.11):

(A.12)
$$CBWI_j = \frac{\omega_j^*}{\bar{\omega}}$$

For this report, we centered all wage indices (CBWI, pre-reclassification, post-reclassification, and MedPAC) at 1.0. This methodology facilitates the impact comparisons reported in Section 4 and Appendix C and avoids the need to conduct payment simulations for that purpose. If the CBWI were adopted, we would expect budget neutrality to be applied following the methods currently in use.

To illustrate Step 3, Table A.6 uses data from previous tables to determine the national average price of labor, and Table A.7 presents values for the normalized CBWI. As seen in Table A.6, the national average benchmark hospital wage equals [($35.62×35) + ($37.27×500) + ($35.84×200)] ÷ (35 + 500 + 200) = $36.80. As an example in Table A.7, the CBWI for

Hospital *2* can be calculated as follows: $37.27÷36.80 = 1.013. As noted above, since the national average benchmark hospital wage is weighted by cases, the case-weighted mean of the CBWI values will be 1.000.

Table A.6: Calculation of National AHE

Hospital	Total Wages	Number of Employees	Cases	Average Hourly Earnings	Benchmark Hospital Wage
1	$2,100	75	35	$28	$35.62
2	$12,400	310	500	$40	$37.27
3	$5,100	150	200	$34	$35.84
National Benchmark Hospital Wage					$36.80

Table A.7: Calculation of the CBWI Values

Hospital	Total Wages	Number of Employees	Average Hourly Earnings	Hospital Wage Level Index	Cases	CBWI
1	$2,100	75	$28	$35.62	35	0.968
2	$12,400	310	$40	$37.27	500	1.013
3	$5,100	150	$34	$35.84	200	0.974
National Benchmark Hospital Wage				$36.80	Weighted Avg.	1.000

A.3 Summary of Steps Required to Construct CBWI Values

By implementing this three-step process, this approach adopts flexible labor market definitions that reflect the hiring patterns of each hospital to produce similar, but not identical, values for nearby hospitals. Subsequently, these wage index values can be used to adjust provider payments for geographic variation in labor costs. Each hospital's CBWI value depends on estimated benchmark wages paid in each area, rather than the actual wages the hospital pays its own workers who live in a given area. As discussed in Section 6.1, the use of benchmark area wages attenuates the circularity problem that would occur if hospital wage index values were based exclusively on the provider's own reported average wage. A hospital can raise its CBWI by increasing the wages it pays only to the extent that this increase influences average area wages. This mechanism also is present in the current version of the Medicare wage index.

Table A.8 provides an overview each of three steps required to compute these CBWI values. Each row of the table describes the step number, step name, and the formulas used as part of the step.

Table A.8: Formulas Used to Calculate the CBWI

Step	Calculates	Formula
1	Benchmark Area Wages	W_k^* (Household Data)
		$W_k^* = \sum_j P_{jk} \cdot \omega_j$ (Establishment Data)
2	Benchmark Hospital Wage (CBWI Numerator)	$\omega_j^* = \sum_k S_{jk} \cdot W_k^*$
3	National Average Benchmark Hospital Wage (CBWI Denominator) and CBWI Values	$\bar{\omega} = \frac{\sum_j Cases_j \cdot \omega_j^*}{\sum_j Cases_j}$ $CBWI_j = \frac{\omega_j^*}{\bar{\omega}}$

APPENDIX B: Extended Responses to Stakeholder Comments

Stakeholders expressed mixed opinions regarding the proposed CBWI framework. Many providers found the premise of the CBWI interesting and thought the approach showed merit. One stakeholder wrote that the CBWI was "intriguing." Another stated that the commuting-based methodology was an improvement over the MedPAC "smoothing" method. Several providers "reject" the proposal, however, and one said that the CBWI was not practical, was problematic to implement, and was redistributive to hospitals. Overall, respondents found it difficult to form an opinion without understanding the CBWI's impact on different types of hospitals.

This appendix includes an overview of the comments made during the ODF, as well as material responding to each comment. The final section also includes an empirical analysis responding to commenter request for impact analyses. Specifically, this appendix addresses comments related to the following topics:

- CBWI methodology
- Commuting data issues
- Implementation issues
- Exceptions to the CBWI methodology
- Additional analysis of the CBWI

The following sections discuss each of these areas in turn.

B.1 CBWI Methodology

Many stakeholders posed questions and made comments regarding how the CBWI is calculated in practice. Some stakeholders were concerned that computing the CBWI values based on ZIP Code level data would be overly burdensome. Stakeholders also noted that calculating the CBWI could lead to a circularity problem. Additionally, ODF participants discussed the extent to which the CBWI is able to explain differences in hospital wages. Respondents raised several refinements that could be made to the CBWI methodology, including an occupational mix adjustment, accounting for hours worked, and incorporating non-wage benefits. Stakeholders also commented on the inclusion of certain occupations and wage-related costs in the CBWI, as compared to the current Medicare wage index. Moreover, stakeholders brought up concerns that measuring commuting patterns at the ZIP Code or census tract level may be inappropriate and cause wage index cliffs between neighboring hospitals. Finally, several respondents had questions regarding possible extensions of the CBWI to adjust payments for non-acute providers. Table B.1 summarizes these comments and provides corresponding responses.

Table B.1: Comments and Responses Regarding the CBWI Methodology

Comment	Response
A circularity problem could arise in hospitals hiring under the CBWI.	See Section 6.1 of this report for an additional discussion of how the CBWI accounts for the circularity problem.
How is occupational mix accounted for in the CBWI?	The answer to this question depends on the occupational detail of the wage data used to construct the CBWI. If the S-3 cost report data adjusted by the current occupational mix adjustment were used, then the CBWI would account for occupational mix in the same way as the current index. The creation of a more refined occupational mix adjustment using BLS OES data is discussed in Section 5 of this report, and more detail is provided in Acumen's *Revision of Medicare Wage Index: Final Report, Part I*. (MaCurdy et al. 2009)
Computing the average wage across different residential areas may not reflect the real world, since hospitals, especially ones in rural areas, may have to pay above-average wages to attract workers from distant areas.	One could modify the CBWI to account for compensating differentials remote hospitals have to pay to attract workers. This would require CMS to 1) estimate the compensating differentials for worker commutes, 2) create commuting-cost-free benchmark wages, and 3) calculate benchmarks for hospital wages (i.e., CBWI numerators) using a weighted average of benchmark area wages which also take into account the estimated compensating differentials.
The CBWI assumes that all workers work the same number of hours. Can the CBWI differentiate between full-time and part-time staff?	As described in Section 6.1, the CBWI methodology can estimate the share of labor hospitals hire from each area based on the number of hours employees work in each area—rather than the count of the number of employees—if hospitals make these data available.
In the current index, some highly-compensated occupations (e.g., physicians, certified nurse anesthetists, nurse practitioners, and physician assistants) are not included.	Decisions about which occupations to include in the wage index calculation relate to the wage data and are largely independent of the CBWI.
How are non-wage benefits accounted for in the CBWI?	Similar to the previous comment, the treatment of non-wage benefits depends on the wage data used to construct the CBWI. If the S-3 cost report data were used, non-wage benefits would be included. More information on the use of benefits data in the wage index can be found in Acumen's *Revision of Medicare Wage Index: Final Report, Part I*. (MaCurdy et al. 2009)
Hospitals hire from a very high number of ZIP Codes, which will make it burdensome to calculate individual hospital wage index values.	This report's empirical analysis has already calculated CBWI values for all hospitals using CTPP data and found these calculations to be entirely feasible and not overly burdensome to calculate.
Reporting wage and hours data by ZIP Code may increase administrative burden.	Medicare could explore methods to minimize the administrative burden in the case where hospitals would submit information on employee counts by ZIP Code. A series of focus groups to test new data submission policies, for instance, could identify mechanisms by which hospitals' administrative burden could be reduced.
Can regression models be used to determine how well the CBWI explains variance in hospitals' average pay rates?	Table 6.1 describes how well the CBWI is correlated with a hospital's average pay rates compared to the other three candidate indices.
Index wage cliffs could inadvertently arise under the CBWI because neighboring hospitals could receive different wage index values.	The results of the empirical application discussed in Section 4 indicate that the CBWI reduced the size of the cliffs for nearby hospitals relative to the current wage index.

Comment	Response
The CBWI may disadvantage multi-hospital systems which may have uniform pay scales but multiple sites.	The CBWI is calculated using data describing the wages that hospitals pay. Therefore, under the CBWI, a multi-hospital system that pays wages above the local market rate would be adversely affected; multi-hospital systems which pay workers below the local market rate, however, would benefit. If hospitals pay wages much lower (higher) than the local market will bear, however, in the long run, hospitals will need to raise (lower) wages to have the desired supply of labor.
The CBWI should define residential areas as counties, rather than census tracts or ZIP Codes to ensure that there is enough data in each area sample, especially if data are stratified by occupation.	An advantage of the CBWI is that wage index values are based on smaller geographic areas than the current wage index. The CBWI can be easily adapted to account for different sample sizes in residential areas. In cases where commuting data is not missing from a specific area, ZIP Codes can be combined into aggregations of ZIP Codes, county-level areas, or MSA-level areas. Because hospital worker commuting data are not yet available, an empirical analysis describing the extent of this issue is not currently feasible.
Will the CBWI methodology include the same wage-related costs as the current calculation?	As described in Section 5, if the S-3 hospital cost report is used to calculate hospital wages, then yes. If an alternative source of data (e.g., BLS) were to be used, then no.
The current hospital wage index is used to adjust payment for non-acute providers as well.	The CBWI can be readily extended to accommodate other provider settings as described in Section 7.
Rural floor provisions should continue.	CBWI values could be altered to meet alternative policy goals.

Many stakeholders also made comments and posed questions regarding the use and availability of wage data for specific types of workers. In general, the CBWI can accommodate any source of wage data and could readily account for different labor types if sufficient data were available. Stakeholders commented on the ability of the CBWI to account for employee turnover, changing commuting patterns, and the effects of housing development. In addition, questions arose about incorporating contract labor and temporary staff into the CBWI. Table B.2 summarizes these comments.

Table B.2: Comments and Responses Regarding Components of Wage Data

Comment	Response
How are different definitions of wages and hours (e.g., overtime, pay conversions, on call hours) accounted for?	It depends on how they are treated in the wage data. In the current S-3 hospital cost report data, paid salaries are defined as "the total of paid wages and salaries […] including overtime, vacation, holiday, sick, lunch, and other paid-time-off, severance, and bonuses."[8]
How are home office employees accounted for?	Once again, this is a wage data issue rather than an issue specific to the CBWI. The CBWI could easily be expanded to incorporate home office workers into the wage index as long as these data were made available.[9]
How are non-healthcare wages' impacts on hospital healthcare average hourly wages accounted for?	Medicare already includes non-healthcare workers in the hospital wage costs. "Employees […] who do not meet the criteria of any of the 19 specified occupational categories, must be included in the 'all other occupations' category."[10]
How is employee turnover accounted for? And how are employees that move to a different ZIP Code during the reporting period accounted for? The CBWI could ignore the presence/pace of housing development if it occurs too rapidly to be captured in the data used.	Whatever the source of commuting data CBWI uses, these data would only provide a snapshot of employee commuting patterns at specific points in time. The index would not account for employee turnover or changes to employee location during the observation period. One could increase the frequency with which the data are collected to better account for turnover, changing commuting patterns, or housing development. More frequent data collection, however, creates additional administrative costs for Medicare.

B.2 Commuting Data Issues

Many comments made during the ODF addressed current and potential commuting data sources for the CBWI. Respondents generally agreed that the Census 2000 data were likely too old to be relevant; respondents also preferred hospital-specific data sources. With regard to the collection of ZIP Code level data from hospitals, many stakeholders expressed concern over a potential increase in administrative burden, while other respondents noted that collecting and

[8] Centers for Medicare and Medicaid Services (CMS). "Medicare Wage Index Occupational Mix Survey." https://www.cms.gov/AcuteInpatientPPS/downloads/occmix_survey_06final.pdf.
[9] *Ibid.* According to Medicare's occupational mix survey "To simplify data collection and reduce the reporting burden for hospitals, the occupational mix survey excludes staff allocated from the home office. Home office salary costs in the wage index typically reflect administrative positions. Therefore, if Medicare were to include home office data in the occupational mix survey, the data would generally be placed in the 'all other occupations' category."
[10] *Ibid*

utilizing ZIP Code data could create privacy concerns. These comments and corresponding responses are included in Table B.3.

Table B.3: Comments and Responses Regarding Potential Data Sources for the CBWI

Comment	Response
Where will commuting data come from?	Section 5 describes the potential commuting data sources Medicare could use to calculate the CBWI.
The Census 2000 data are out-of-date.	Medicare will continue to evaluate alternative data sources such as hospital data providing employee counts (or hours) by ZIP Code.
The use of ZIP Code data could create privacy concerns.	Medicare would only require either: i) the number of employees of each occupation type that commute from each ZIP Code, or ii) the number of hours worked by employees of each occupation type by ZIP Code. Medicare need not require personally-identifiable data to compute the CBWI. To further attenuate privacy issues, Medicare could aggregate certain ZIP Codes to avoid a small-cell problem, or develop a public use file (PUF) with aggregated data and private files with disaggregated data.
Many payroll systems could not break down wage-related costs at the ZIP Code level, as required for the CBWI.	The CBWI only requires information on the number or share of hospital workers residing in each ZIP Code by occupation type; wage-related costs by ZIP Codes are not required.
Can the CBWI use current data sources or another source (e.g., BLS data)?	The CBWI can use any source of wage data that can be linked to the geographic unit of the commuting data. As noted earlier in this report, the CBWI would require confidential BLS OES data.

B.3 Implementation Issues

ODF participants also noted several implementation issues that must be resolved. Stakeholders commented on potential ways to facilitate the transition to the revised wage index and to ensure its continued accuracy. For the most part, these constitute areas in which Medicare must decide on the appropriate policy or action, including the following:

- Phasing in the CBWI
- Instituting a hold-harmless provision
- Making data available for hospitals to examine and review
- Using consistent definitions and a transparent methodology
- Ensuring that the revised index constitutes an improvement over the current index

Other comments were general questions regarding CBWI implementation that do not require Medicare decision making. Table B.4 summarizes these comments and associated responses and clarifications.

Table B.4: Comments and Responses Regarding Implementation Issues

Comment	Response
Will the CBWI replace or augment the existing wage index?	The CBWI would replace the existing wage index.
In addition to the revised wage index, other elements of healthcare reform would likely reduce payment rates to providers. How will Medicare ensure that providers' payments are not decreased too quickly?	The Medicare wage index would be implemented in a budget neutral manner regardless of the methodology used. Although changing the wage index methodology will have varying effects on providers, on average there will be no net effect on aggregate provider payments.

B.4 Exceptions to the CBWI Methodology

Stakeholders generally agreed that exceptions and reclassifications should continue to be part of the wage index methodology. Several respondents noted that many hospitals have benefited from the reclassification system, and that reclassifications were especially important for hospitals within commuting distance of New York City. The CBWI is intended to attenuate the need for these complex exceptions. The CBWI reduces the magnitude of the cliffs between nearby hospitals in different MSAs and thus the gain from reclassification for most hospitals would be smaller than is currently the case. Further because each hospital receives its own wage index value within its own commuting-based labor market, it is unclear what reclassification would mean under the CBWI framework. Nevertheless, upon observing the actual wage index values hospitals would receive under the CBWI, Medicare would need to determine whether to continue some or all of the current exceptions and reclassifications. Table B.5 outlines the comments and responses regarding exceptions and reclassifications.

Table B.5: Comments and Responses Regarding Exceptions to the CBWI Methodology

Comment	Response
Exceptions and reclassifications should continue to be part of the revised wage index. 508 reclassifications should be permanently reinstated. Will the Frontier State wage index of 1.0 still apply under the CBWI?	The CBWI is intended to attenuate the need for these complex exceptions. The CBWI reduces the magnitude of the cliffs between nearby hospitals in different MSAs, and thus the gain from reclassification for most hospitals would be smaller than is currently the case. Further because each hospital receives its own individual wage index value, it is unclear what reclassification would mean under the CBWI framework.
Outmigration adjustments should be computed annually, rather than every three years.	Because the CBWI uses commuting data explicitly to estimate hospital wages, the separate outmigration adjustment would be unnecessary under the CBWI framework. The frequency with which commuting data need be updated is an issue for further examination.
A stop-loss floor should be used to reduce year-to-year volatility in the CBWI values.	This report has not tested the year-to-year volatility of CBWI values, and thus the need for measures to address volatility is unclear at this time.
A moving average (e.g., using data from two years) should be used to reduce year-to-year volatility.	The issue of computing a moving average of the CBWI values is separate from the broader CBWI methodology. Acumen evaluated the use of a moving average to reduce volatility in an earlier report (MaCurdy et al. 2009).
How are RRCs accounted for under the CBWI?	RRCs are not treated any differently under the CBWI.
How are CAHs accounted for under the CBWI?	CAHs are not subject to the wage index.

B.5 Additional Analyses of the CBWI

Most respondents indicated that additional analyses of the effect of the CBWI were needed to evaluate the methodology. Table B.6 includes comments and responses regarding additional analyses required to permit well-informed evaluations of the CBWI.

Table B.6: Comments and Responses Regarding Additional Analyses of the CBWI

Comment	Response
An impact analysis needs to be conducted.	Appendix C evaluates how the CBWI would change index values compared to alternative indices.
Year-to-year volatility in wage index values under the CBWI needs to be analyzed.	Since the only current source of commuting data come from the 2000 CTPP, one cannot determine the effect of changing commuting patterns on CBWI values.
The accuracy of using census tracts versus ZIP Codes as the units of analysis need to be assessed.	Because Medicare does not currently collect commuting data at the ZIP Code level, this analysis is not currently feasible.
The variation in CBWI values for neighboring hospitals needs to be evaluated.	Section 4 summarizes the results of an analysis comparing the difference in CBWI values by distance between hospital pairs.

APPENDIX C: Impact Analysis Overview

This section evaluates how the CBWI would change index values compared to alternative indices. These three baseline comparison wage indices are: Medicare pre-reclassification, Medicare post-reclassification, and MedPAC wage indices. For each comparison, the table compares the mean and median change in wage index values by hospital type, providing the difference in mean and median values[11] between candidate indices broken down into different provider types. The five tables included below divide providers by: i) urban/rural status, ii) region, iii) bed size for rural hospitals, iv) bed size for urban hospitals, and v) reclassification status.

In this analysis, Acumen calculates the CBWI values using the 2000 CTPP to estimate census tract-to-census tract commuting patterns. The CTPP data, however, only report commuting information for all workers rather than specifically for hospital or healthcare workers. Thus, this report uses data from the 2000 Census to estimate the number of healthcare workers living in each area. By assuming hospital-worker commuting patterns mirror those of all workers, one can calculate the number of workers commuting between each census tract pair as the number of healthcare workers living in each census tract multiplied by the share of all workers from the CTPP data who commute to a census tract where a hospital is located.

Acumen selected the Census files because they are the only data currently available which are publicly available, nationwide in scope and contain a sufficient number of observations to estimate commuting patterns reliably. Medicare would likely not use the 2000 Census data in practice because these data are over a decade out-of-date, and may not reflect the most recent commuting patterns. Consequently, the following tables are accurate only to the extent to which the 2000 Census data accurately reflect current commuting patterns.

Table C.1: Wage Index Differentials, by Urban/Rural Location

Urban/Rural Location	N	CBWI v. Pre		CBWI v. Post		CBWI v. MedPAC	
		Mean	Median	Mean	Median	Mean	Median
Urban Hospitals	2419	-0.003	0.003	0.004	0.014	0.002	0.001
Large urban areas	1299	-0.005	0.002	0.005	0.017	0.009	0.004
Other urban areas	1079	0.000	0.004	0.002	0.012	0.001	0.000
Rural hospitals	978	0.015	0.020	-0.021	-0.023	-0.013	-0.012

[11] The candidate wage index difference in the mean and median values in all the tables in Appendix C are calculated in two steps. For each hospital, one first calculates the difference between the CBWI and the baseline index. In the second step, one calculates the mean or median value of these differentials.

Table C.2: Wage Index Differentials, by Census Region

Census Region	N	CBWI v. Pre		CBWI v. Post		CBWI v. MedPAC	
		Mean	Median	Mean	Median	Mean	Median
East North Central	501	0.002	0.006	0.007	0.014	-0.005	-0.004
East South Central	336	0.003	0.003	-0.001	0.010	-0.026	-0.027
Middle Atlantic	410	-0.011	-0.002	-0.018	-0.002	0.005	-0.006
Mountain	218	0.008	0.008	0.013	0.023	0.038	0.047
New England	143	-0.002	0.003	-0.028	-0.026	0.001	-0.007
Pacific	410	-0.002	0.005	-0.005	0.001	0.026	0.020
South Atlantic	593	0.000	0.002	0.004	0.008	-0.013	-0.008
West North Central	266	0.007	0.009	0.014	0.024	0.006	0.007
West South Central	520	0.002	0.002	0.007	0.017	0.007	0.007

Table C.3: Wage Index Differentials, by Bed Size for Rural Hospitals

Rural Hospital Bed Size	N	CBWI v. Pre		CBWI v. Post		CBWI v. MedPAC	
		Mean	Median	Mean	Median	Mean	Median
0-49	318	-0.010	-0.013	-0.022	-0.026	-0.031	-0.039
50-99	370	0.004	0.003	-0.018	-0.016	-0.019	-0.023
100-149	172	0.020	0.022	-0.025	-0.025	-0.001	0.000
150-199	68	0.027	0.028	-0.028	-0.039	-0.012	-0.002
200+	45	0.040	0.050	-0.015	-0.022	-0.012	-0.002

Table C.4: Wage Index Differentials, by Bed Size for Urban Hospitals

Urban Hospital Bed Size	N	CBWI v. Pre		CBWI v. Post		CBWI v. MedPAC	
		Mean	Median	Mean	Median	Mean	Median
0-99	538	-0.020	-0.010	-0.012	0.000	-0.004	-0.001
100-199	800	-0.007	0.000	-0.004	0.004	0.000	-0.002
200-299	469	-0.004	0.003	0.003	0.013	0.011	0.007
300-499	406	0.001	0.004	0.006	0.014	0.007	0.003
500+	165	0.003	0.004	0.014	0.022	0.005	0.006

Table C.5: Wage Index Differentials, by Reclassification Status

Reclassification Status	N	CBWI v. Pre		CBWI v. Post		CBWI v. MedPAC	
		Mean	Median	Mean	Median	Mean	Median
All Reclassified Hospitals	814	0.018	0.015	-0.025	-0.023	0.001	-0.006
All Non-Reclassified Hospitals	2583	-0.006	0.001	0.008	0.016	0.000	0.000
All Section 401 Reclassified Hospitals	25	-0.004	0.006	0.036	0.057	-0.036	-0.032
All Lugar Reclassified Hospitals	62	0.037	0.029	-0.034	-0.027	-0.014	-0.027