Revision of Medicare Wage Index

Final Report

Part I

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EXECUTIVE SUMMARY

The Medicare statute requires that per discharge payments to inpatient hospital prospective payment system (IPPS) hospitals reflect area differences in the cost of labor. Based on the statutory provisions, the Centers for Medicare & Medicaid Services (CMS) adjust Medicare's IPPS payments for labor costs through the use of a hospital wage index. The goal of the hospital wage index is to accurately allocate payments to reflect differences in the relative cost of labor across IPPS hospitals in different areas, while maintaining budget neutrality. To construct the index, CMS use wage data from an annual survey of IPPS hospitals' labor costs required by the statute, and estimate an average hourly wage for wage areas. These wage areas are defined as metropolitan statistical areas (MSAs) and the residual or "rest of state" areas.

Under the current system hospitals have the opportunity to ask for a reclassification to alter their index values for a variety of reasons. Roughly one third of IPPS hospitals reclassify and acquire a different index value than the one originally assigned. The Medicare Payment Advisory Commission (MedPAC) asserts these reclassifications reflect problems with the current wage index and add complexity and potential inconsistencies to the payment system. To address these problems, in the Tax Relief and Health Care Act of 2006 (TRHCA), Congress ordered MedPAC to develop recommendations for revising the wage index and required CMS to take these recommendations into account.

In June 2007, MedPAC submitted a report with recommendations for revising the wage index. In their report MedPAC recommends repealing the existing hospital wage index statue – including reclassifications and exceptions – and establishing an alternative method to compute the index. In particular, MedPAC proposes that the hospital wage index be revised to achieve the following goals:

- Remove the circularity in the index;

- Distinguish differences in labor costs across wage areas from differences in the occupational mixes within hospitals;

- Account for geographic differences in benefits as well as wages;

- Limit the annual volatility in the index; and

- Limit the differentials between adjacent areas, and by extension, reduce the incentives for reclassifications and exceptions.

To help evaluate MedPAC's recommended revisions, CMS requested that Acumen prepare a report addressing the following questions:

1) What are the central differences between the data from the annual hospital wage survey currently used to construct the Medicare hospital wage index and MedPAC's proposed Bureau of Labor Statistics (BLS) data? How do these differences affect the calculation of wage index values?

2) How do the methods currently used by CMS to construct the Medicare hospital wage index differ from those proposed by MedPAC?

3) Do benefit costs need to be included in a Medicare hospital wage index?

4) If so, is there an alternative source of benefits data that is comparable to and less burdensome to collect than the benefits data currently collected in the annual wage data survey used to construct the Medicare wage index?

5) How does MedPAC's recommended method to adjust for occupational mix differences across areas compare to the Occupational Mix Adjustment (OMA) that is required by the Medicare statute?

6) How much year-to-year volatility would there be in the MedPAC recommended index relative to Medicare's current hospital wage index?

We address each of these questions, in this report. A more comprehensive investigation of the methodology that underlies the construction of a wage index will be presented in a forthcoming report.

Existing Wage Index Concerns and MedPAC Recommendations

MedPAC's recommended revisions to the hospital wage index focus on three concerns: circularity, volatility, and the treatment of geographic boundaries. The first two issues are associated with the source of data that is used to construct the hospital wage

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index (i.e., the annual survey of IPPS hospital labor costs).[1] The third concern is related to the methodology used to construct the wage index.

The first concern with the existing Medicare wage index is its inherent "endogeneity." By endogeneity, we mean changes in the index that are associated with the index itself. Two problems identified by MedPAC fall under this heading. First is the problem of circularity, where hospitals that choose to pay relatively high wages get higher index values, which in turn allows them to pay higher wages. Similarly, the opposite occurs when hospitals start with relatively low wages. This problem is exacerbated by the small number of hospitals in wage areas. The wage information of only one or two hospitals in a wage area determines the index for the whole area. The second problem is the fact that the Medicare wage index reflects labor expenses, not labor prices. Currently, CMS includes wage and benefit information in its calculation of the average hourly wage. The average hourly wage is weighted by hours and not by occupation. Thus the average wage of a nurse and that of a member of the clerical staff have the same weight in the hospital average wage. If hospitals decide to hire high proportions of skilled staff, this will be reflected on higher index values. This approach confounds information about the price of labor with information about the hospital's choice of occupational mix. Ultimately then, hospitals seek reimbursement both for their wage bill and for the occupational mix they choose to staff the hospital. CMS has recently applied an OMA to the wage index to address this issue. However, this adjustment is limited because it only takes into account information specific to nursing employees, which represent only 40% of hospital employment. And not considering the occupational mix of all hospital employees may result in an inaccurate adjustment.

Another major concern is the year-to-year volatility of the existing wage index. The index is based only on annual hospital cost reports of IPPS hospitals (lagged four years). The exclusive reliance on hospital reports is an issue in smaller markets in which there are relatively few observations. Nearly half of the hospital markets ─as they are currently defined─ include four or fewer hospitals. This small number of observations, in

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[1] It is important to note that the data used to construct the Medicare Wage Index is the result of a requirement in the Medicare statute.

conjunction with the entry and exit of hospitals, makes the current index volatile in ways that appear largely unrelated to the underlying labor market conditions in the wage areas.

The third issue concerns the way in which geographic boundaries are treated in the construction of the index. The primary wage area for the hospital wage index is a MSA. MSAs are designed to represent labor market areas with at least one urbanized area of 50,000 or more people (a "core area") and adjacent communities highly integrated both economically and socially to that core. By establishing index values at the MSA level, the basic hospital wage index can create boundary conditions such that two hospitals that are very close together (but on different sides of an MSA boundary) receive very different index values and, hence, very different payments. Over time, a series of exceptions have been put into place to address concerns over specific types of boundary conditions or for specific providers.

In this report, Acumen evaluates the degree to which MedPAC's recommendations address these issues. In particular, we analyze the differences between the data currently used by CMS and MedPAC's proposed BLS data. We evaluate whether benefits costs should be included in a wage index and discuss alternative data sources for benefit costs. We compare the Medicare and MedPAC methods used to adjust for geographic differences in the occupational mix of labor employed by the hospital. And, finally, we assess the extent of volatility in both indices.

General Challenges in Evaluating the Effectiveness of MedPAC Recommendations

The Medicare wage index and the MedPAC wage index rely on data sources that differ in fundamental ways. Each index is also constructed according to its own methodology. We would like to directly compare these two indices to separately identify the divergence in index values attributable to the use of different data sources and the differences that are a function of the particular methodologies. But the Medicare and BLS data are not collected at the same level of detail. The hospital cost report data used to calculate the Medicare wage index are collected exclusively from IPPS hospitals, and do not include details about the exact mix of occupations each hospital employs. The data collected by the BLS in its Occupational Employment Statistics (OES) program include occupational details, but are only available by industry at the MSA level. This

makes a direct comparison impossible. Therefore, we use a variety of different analytic techniques to untangle discrepancies due to the data sources from those due to methodological approaches. We also focus on the practical implications of these differences and measure their impacts on wage index values.

Data Sources and Methods

The primary data sources used in the analyses presented in this report are:

1) IPPS hospital cost report (wage and benefits cost) data collected between 2002 and 2005 provided by CMS and also available on the CMS website.

2) MSA-level occupational wage data for 2002-2005 found in the OES survey data, published by the BLS.

3) The 2006 American Community Survey (ACS) Public Use Microdata Sample File (PUMS).

IPPS Hospital Cost Report Data

The Medicare wage index is constructed using data derived from a survey of wages and wage-related costs for short-term, acute care hospitals. Although the Medicare wage index is updated yearly using the annual Medicare cost report, it is calculated by using the hospital cost reports collected four years prior. For the purposes of this analysis we will use average hourly wage data at the MSA-level from the IPPS hospital cost reports collected in 2002, 2003, 2004, and 2005. Benefits costs data come from both Worksheet S-3 and Worksheet A.

BLS Data

The MedPAC index is constructed using data collected in the OES survey. These data are produced on an annual basis. In this analysis, we use BLS occupational wage data aggregated at the MSA-level, for 2002, 2003, 2004, and 2005. Each year of BLS data consists of six panels (3 years) and includes survey data from 1.2 million establishments (including 70 percent of the workforce). Before being combined with the current panel's data, panels from prior periods are adjusted using the BLS Employment Cost Index (ECI). MedPAC also uses 2000 decennial census data to adjust the county-specific indices, and hospital cost data from Medicare to adjust the index for benefits.

American Community Survey Data

We are interested in determining whether differences in industry mix are related to differences in the Medicare and MedPAC index values. But the BLS does not publish occupational wage data for specific industries at the MSA level. To correct for this, we use worker level data derived from the 2006 ACS PUMS. The PUMS are a subset of the ACS and Puerto Rico Community Survey (PRCS) samples.

The ACS is a nationwide survey conducted by the U.S. Census Bureau. This survey uses a series of monthly samples to produce annually updated data for the same small areas (census tracts and block groups) as the decennial census long-form sample formerly surveyed. The survey includes estimates of demographic, housing, social, and economic characteristics every year for all states, as well as for all cities, counties, metropolitan areas, and population groups of 65,000 people or more for approximately three million households. Data are collected by mail, and personnel from the Census Bureau follow up with those who do not respond.

Using these three data sets we can gain a better understanding of the advantages and disadvantages associated with the use of Medicare's IPPS hospital cost report data (the "annual survey" that is required by statute) and the proposed alternative, BLS data. We can assess which data set provides information that can best address the issues with the existing hospital wage index and can most reliably be used to construct an accurate hospital wage index. Our analysis demonstrates the fact that inherent in the choice of data source is an acceptance of certain methodologies. For example, the average hourly wage calculated using IPPS data cannot take occupational details into account because this information is not included in the cost reports. Thus, although this report focuses on data issues, it also addresses some of the attendant methodological issues associated with both the MedPAC proposal and CMS's application of the current statute.

Methods

To address the differences between the Medicare and BLS data, we examine differences in the wage index values that follow from the use of each data source. To make this comparison, we must construct a wage index with BLS data. We construct this index by closely following the MedPAC method described in MedPAC (2007) and in

RTI (2007). However, our constructed index differs from the one calculated by MedPAC in several ways. First, we construct the index using only MSA-level data from the OES and do not introduce county-level adjustments using Census data. Second, we do not smooth large differences in index values between adjacent wage areas. Third, we construct only a hospital wage index and do not construct a hospital compensation index, which further adjusts for benefits. These adjustments allow us to focus more exclusively on data differences between the raw BLS and Medicare wage data.

Following MedPAC, we construct a fixed-weight index that relates the average hourly wages by occupation (excluding benefits) weighted by the national hospital share of wages in a wage area. The MedPAC hospital wage index can be expressed as:

$$Index_j = \sum_i Z_{iN} \times \frac{w_{ij}}{w_{iN}} , \qquad (1)$$

where the fixed national hospital share of wages, $Z_{iN} = s_{iN} \times \frac{w_{iN}}{w_N}$,

w_{ij} is the average hourly compensation level in occupation i in all industries in wage area j and w_{iN} is the average hourly compensation level in occupation i in hospital industries nationally. The fixed weight, Z_{iN}, is estimated by the product of s_{iN}, which is the national employment share of occupation i, times the ratio of the average hourly national wage in occupation i in the hospital industry to w, the average hourly wage for all hospital occupations nationally. The use of national fixed weights means that wage areas with relatively higher hourly wage rates in hospital occupations will have higher index values, but that wage areas that employ a relatively greater share of workers from high wage occupations will not necessarily have higher index values.

In each section of this report, we address a separate and specific issue related to the current Medicare hospital wage index and the proposed BLS wage index. While the methods used are tailored to each section, we do consistently examine the difference between the Medicare wage index values and the MedPAC index values for the same wage area. We consider the distribution of these differences along a number of dimensions designed to explicitly address the concern at hand.

Overview of Findings

We summarize our findings below. The reported conclusions stem from our examination of the two sources of wage and benefit data; our analysis of the ways to account for the occupational mix employed by hospitals; and our review of the different approaches to curbing the volatility of the index.

Differences between BLS and Medicare data

There are three central differences between the Medicare data currently used to construct the wage index and the BLS data MedPAC used to calculate an alternative index. These are: (1) the underlying data sources used in the construction of each index; (2) the data collection methods, specifically the inclusion, exclusion or treatment of certain types of workers; and (3) the type of wage information contained in each of the indices. The Medicare wage index is constructed with reported average wages by hospital, which reflect the hospital's labor expense. In contrast, the BLS wage index uses average wages by hospital occupation, and reflects the price of labor that hospitals face.

Our major findings include:

- The Medicare wage index is more variable than the BLS wage index. In particular, the spread in index values between the hospital with the highest and the lowest values is greater for the Medicare wage index than for the BLS wage index.

- The BLS data do not include self-employed workers and account for the wages of part-time workers differently than the Medicare data. While these differences could, in principle, explain some of the differences between Medicare and BLS wage index values, adjusting for these differences results in very small changes to the index.

- Constructing the BLS wage index using wage information exclusively from hospitals as opposed to wage information from all industries affects wage index values for a substantial number of wage areas. Eighteen percent of MSAs and 20% of balance-of-state areas have wage index values that differ by more than 5% across the two methods. These differences could arise because BLS occupational

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data is less reliably measured for a single industry. They could also reflect geographic differences in inter-industry wage differentials.

- The use of an index based on labor expenses as opposed to labor prices emphasizes both a hospital's hiring decisions and the wages hospitals face in the labor market. This reliance on labor expenses produces wage index adjustments that inappropriately reward some hospitals and penalize others for the employee mix they select.

- A fixed-weight wage index, such as the BLS wage index, better captures the geographic variation in labor prices and substantially reduces the circularity issues that are problematic for an index based on labor expenses.

Benefit Costs

Acumen's analysis of benefit costs examines two questions. First, do benefit costs need to be included in a hospital wage index? And if they do, is there an alternative source of benefit data that would be less burdensome to collect and comparable to those currently used by CMS?

While the Medicare wage index includes benefit cost information from Worksheet S-3, the MedPAC compensation index relies on Worksheet A benefits data to adjust for geographic variation in benefit costs. In our analysis we compare these two sources of benefit data and suggest the Employer Costs for Employee Compensation (ECEC) from BLS as an alternative source of benefit cost data.

Our major findings include:

- The cost of benefits is a significant portion of total compensation that varies geographically. To accurately reflect the different labor costs in different regions of the country, a hospital wage index must take benefits into account.

- The benefit costs data submitted by hospitals and currently used in the Medicare wage index and MedPAC compensation index – Worksheet S-3 and Worksheet A – differ substantially. Worksheet S-3 is more consistent and reliable than Worksheet A.

- MedPAC's use of different sources for wage and benefits data has several disadvantages. If two different sources are used, inconsistencies in the definitions of wage and benefit costs across agencies are likely to arise. In addition, wage-benefit comparisons that can highlight outlying values would not be feasible. Finally, if MedPAC were to use Worksheet S-3 benefit data, continued submission and review of Worksheet S-3 would eliminate the potential savings from reduced data collection.

- As a result of these disadvantages, the BLS Employer Costs for Employee Compensation (ECEC) data should be given careful consideration as an alternative source of benefits data for adjusting the BLS wage index. It would be advantageous for CMS to work with BLS to determine the feasibility of expanding the geographic detail of the compensation data to make this a viable source of benefits data that could be used to construct the hospital wage index.

Occupational Mix Adjustment Using National Fixed Weights

A central feature of the proposed MedPAC hospital wage index is the way that it adjusts for differences in the occupational mix across geographic areas. Acumen's analysis uses BLS data to examine the impact of using fixed national weights and cross-industry wages to construct the wage index. This approach is compared to the OMA applied to the Medicare wage index, which considers the mix of nurses. Through this analysis we re-examine the consequence of combining information about the variation in the way hospitals are staffed with information about the geographic variation in the price of labor. The major findings of this section are as follows:

- Acumen believes that the use of national fixed occupation weights in the construction of the BLS wage index is not overly restrictive. Acumen analyzed the impact of changing the geographic basis of the weights from the nation to the state and found that a less restrictive set of occupation weights calculated for each state yields virtually identical BLS wage index values for almost all wage areas.

- MedPAC's choice of 30 occupations used to construct the fixed weights and the BLS wage index is reasonable. However, this specific set of occupations was not chosen using a clear predetermined rule. To rectify this, Acumen selected the 62

most prevalent four-digit hospital occupations, which account for approximately the same share of total wages as MedPAC's 30 occupations, to construct the fixed weights and the BLS wage index. Acumen believes this issue is important because wage index values are modestly sensitive to this choice. Roughly 14 percent of wage areas experience a 2 percent or greater change in their wage index values when a different, but equally reasonable, set of occupations are used to construct the index.

- Both the use of a national fixed weight index and the use of the OMA could, in principle, properly adjust for geographic differences in the occupational mix. The current use of the OMA to adjust wage index values does make a difference – almost 24 percent of wage areas have an adjustment to their wage index values of 2 percent or more when the OMA is used to adjust the wage index. However, Acumen believes that fixed weights are a better method to adjust for geographic differences in occupational mix than the OMA. The OMA is applied only to nursing employees, which represent just 40 percent of hospital employment.

Volatility

We calculate the extent of volatility in the Medicare and BLS wage indices using three different measures of volatility. We also explore two potential causes of volatility in the Medicare wage index. First, we determine the extent to which volatility in the Medicare wage index would be reduced by using a two-year rolling average of index values. Then we estimate the extent to which volatility in the Medicare wage index is associated with the number of hospitals in the wage area and with the annual change in the number of hospitals in a wage area. The major findings of this section are:

- The volatility of a wage index can either capture the underlying variance in costs, or it may reflect measurement error in the data. If an index exhibits "too much" volatility there are methods available to address this issue. One possibility is to average the index over time. However, reducing volatility by taking averages of index values across years may introduce another source of inaccuracy: the use of less timely data.

- As a result of analyzing several years of data Acumen found that the BLS wage index is less volatile than the Medicare wage index.

- The number of hospitals in a wage area and changes in the number of hospitals in a wage area are related to the volatility of the Medicare wage index. The use of a two-year rolling average of index values would be a reasonable approach to reducing the annual volatility of the Medicare wage index.

Conclusion

Taken together, our analyses of the wage and benefits data, the weighting techniques, and the factors that contribute to volatility highlight the trade-offs associated with each data set. Based on our assessment of these trade-offs, Acumen recommends that the BLS data be used to construct a hospital compensation index. This source of wage information is more accurate and reliable for the construction of the compensation index.

There are a number of benefits from using BLS data to construct the hospital wage index. First, the BLS data include information from establishments other than hospitals, so that the vast majority of wage areas are likely to have more observations from which to build an index. This increased number of observations helps, in turn, to lower the year to year volatility in the index. As seen in this report, relative to the Medicare data, the BLS data present lower year to year volatility.

Second, a measure of labor costs that is based on a broader set of industries, especially in small geographic areas, is more likely to be reflective of labor costs than of staffing decisions among a potentially small number of hospitals. Moreover, the fact that the BLS wage index is an index based on labor prices reduces the circularity issues suffered by the current Medicare wage index

Third, even if the Medicare wage index has recently incorporated an OMA to address the occupational mix of hospitals, the BLS method to adjust for geographic differences in occupational mix is a better option given that the OMA only represents less than half of all hospital employees. Finally, there is less geographic dispersion in wage index values in the BLS data relative to Medicare data.

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As described above, the analyses presented in this report show that the use of BLS data addresses some of the specific concerns with the current index identified by MedPAC, including, distinguishing the differences in labor costs across wage areas from differences in the occupational mixes within hospitals, and limiting the annual volatility in the index.

Nonetheless, there are a number of challenges involved with using BLS data that need to be acknowledged. First, in addition to the above mentioned advantages of using data from establishments from outside of the hospital industry to measure labor costs, there is a potential disadvantage from using data from these establishments. If there are both differences across industries in the wages paid to workers in specific occupations and if there are geographic differences in these inter-industry wage differentials, the use of data from establishments from outside of the hospital industry could lead to some measurement error in the BLS hospital wage index.

Analyses presented in this report suggest that a BLS wage index constructed using wage data exclusively from hospitals as opposed to wage information from all industries can affect wage index values. While it is possible that these differences arise because BLS occupational data is less reliably measured for a single industry, it is also possible that they indicate geographic differences in inter-industry wage differentials.

Second, the BLS wage index is calculated in such a way that is could be sensitive to geographic differences in the fraction of workers that are part time versus full time. This potential sensitivity is the result of the manner in which average hourly wages are calculated in the underlying BLS survey as opposed to the method used to construct the BLS wage index. As a result, it is difficult to correct for this limitation in the BLS data. While Acumen's analysis suggests that this potential sensitivity to the fraction of workers that are part time in an area is likely to be small, it remains a limitation of the BLS data.

Third, the BLS data do not include self-employed or contract workers. As a result, the BLS wage index could be sensitive to geographic differences in the fraction of workers that are self-employed or contract workers. While Acumen's analysis again suggests that this sensitivity is likely to be small, it is another limitation of the BLS data.

Overall and despite these limitations, Acumen believes that the methods recommended by MedPAC for constructing the hospital compensation index represent an improvement over existing methods and that the BLS data should be adopted so that the MedPAC approach can be implemented.

In a forthcoming report, Acumen will consider additional MedPAC recommendations for the hospital wage index, and will address issues related to the methodology of constructing a wage index, such as, ways to define wage areas as well as methods to smooth wage index values across contiguous wage areas.

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1 INTRODUCTION

The Medicare statute requires that per discharge payments to inpatient hospital prospective payment system (IPPS) hospitals reflect geographic differences in the cost of labor. Based on the statutory provisions, the Centers for Medicare and Medicaid Services (CMS) adjust Medicare's IPPS payments for labor costs through the use of a hospital wage index. This report evaluates the Medicare Payment Advisory Commission's (MedPAC) proposed revisions to this existing hospital wage index. In particular we examine the degree to which MedPAC's suggestions address the problems they identify with the current index, and evaluate whether the adoption of the MedPAC recommendations would lead to an improved system of hospital reimbursements.

These recommendations can be broadly described as those that involve wage data sources, and those that focus on methodological issues. MedPAC suggests that the wage data that comes from IPPS hospital cost reports is problematic for the calculation of a wage index for numerous reasons. In its place, MedPAC advocates the use of the Bureau of Labor Statistics (BLS) Occupational Employment Statistics (OES) Survey data. This data set includes information from different entities (not just IPPS hospitals) and at a different level of detail than the hospital cost reports that are currently used. MedPAC's recommendations also address methodological issues, including alternative ways to calculate average wages, formulate occupational adjustments, and techniques to smooth data over time, diminishing volatility.

In this report we provide an in-depth analysis of two different approaches to constructing a wage index that accounts for variation across hospitals and over time. Looking across hospitals, we compare the wage data from hospital cost reports to the OES wage data along a variety of dimensions, and ultimately contrast the wage index values that follow from the use of each distinct data set. Because wages only represent a portion of total labor compensation, we also consider the importance of benefit costs. Attention to benefits highlights the variation in approaches to compensation employed by hospitals around the country. But this variation also shows up in the mix of employees that hospitals select to provide health care in their communities. Thus, we also assess

how effectively the hospital's occupational mix is reflected in the wage index. To examine the variation in labor costs over time, we also assess the degree to which volatility in index values represents real changes in labor costs.

This report is organized as follows. In Section 2, we begin with a comparison of the data currently used to construct the Medicare wage index – the IPPS hospital cost report data – to the suggested alternative data, the BLS OES wage data. These data attempt to capture important details about geographic variation in wages that reflect both differences in the competitive forces of local labor markets and in the occupational mixes hospitals use to provide health care to their communities. Our aim is to detail the major differences between these data sets, in terms of the source of the wage information and the types of employees and businesses that are included or excluded. Section 3 addresses a variety of issues associated with benefit cost data and the importance of considering benefits in a hospital wage index. We examine how index values change when benefit costs are incorporated in the index and offer an alternative source for benefit information. In Section 4, we compare the current statutory approach – the Occupational Mix Adjustment (OMA) – to accounting for occupational diversity across hospitals, and MedPAC's proposed adjustment. Herein we measure the impact of national fixed weights on wage index values in contrast to the effect of the OMA. This is followed by an examination of volatility in the Medicare and BLS indices in Section 5.

2 COMPARISON OF BLS VS. MEDICARE DATA

We begin the analysis with a thorough examination of the data sources used to construct the Medicare hospital wage index and the MedPAC proposed index (hereafter BLS wage index). The following analysis examines three central questions regarding differences between the Medicare data currently used to construct the hospital wage index and the BLS data proposed by MedPAC. In the first section of the analysis we assess the differences between the underlying data sources used in the construction of each index. For this task we use OES data from the BLS, Census data and public and non-public hospital wage index values provided to us by CMS and MedPAC. The second section builds on the first by addressing the extent to which these differences are related to wage area characteristics. In the third section we address differences in methodology by comparing wage index values calculated using labor expenses with those that reflect labor prices.

The major findings of this section are:

- The Medicare wage index is more variable than the BLS wage index. In particular, the spread in index values between the hospital with the highest and the lowest values is greater for the Medicare wage index than for the BLS wage index.

- The BLS data do not cover self-employed workers and treat part-time workers differently than the Medicare data when calculating average wages. While these differences could, in principle, explain some of the differences between the Medicare and BLS wage index values, adjusting for these differences results in very small changes to the index.

- Constructing the BLS wage index using wage information exclusively from hospitals as opposed to wage information from all industries affects wage index values for a substantial number of wage areas. Eighteen percent of MSAs and 20% of balance-of-state areas have wage index values that differ by more than 5% across the two methods. These differences could arise because BLS occupational

data is less reliably measured for a single industry. They could also reflect geographic differences in inter-industry wage differentials.

- The use of an index based on labor expenses as opposed to labor prices emphasizes both a hospital's hiring decisions and the wages hospitals face in the labor market. This reliance on labor expenses produces wage index adjustments that inappropriately reward some hospitals and penalize others for the employee mix they select.

- A fixed-weight wage index, such as the BLS wage index, better captures the geographic variation in labor prices and substantially reduces the circularity issues that are problematic for an index based on labor expenses.

2.1 Differences Between the BLS Data and the Medicare Wage Data

The first section of the analysis consists of a comparison of the sources of data used to construct the proposed MedPAC hospital wage index (hereafter, BLS wage index) and the existing Medicare wage index. The proposed BLS wage index is constructed primarily from the Bureau of Labor Statistics' Occupational Employment Statistics (OES) data while the existing Medicare wage index is constructed from data provided to CMS by hospitals paid by Medicare under the IPPS for short-stay acute care cases. We examine both of these data sets below.

2.1.1. Summary of the Wage Data from Each Source

The current Medicare wage index is constructed from data provided to CMS by IPPS hospitals on Worksheet S-3 on their annual Medicare cost reports. These data include the total wages and total hours worked for employees who provide services to Medicare patients admitted to hospitals paid under the IPPS, and are collected at the hospital level. These data include information about part-time and full-time workers, and self-employed and contract laborers who work in reporting hospitals. The wage information of all hospital workers is summed within each hospital, so information linking specific wages to specific occupations is not reported. This information is incorporated into the index with a four year time lag, such that 2004 hospital cost report data were used to construct the FY 2008 wage index.

The BLS wage index is constructed from the OES survey. The OES survey is a semi-annual mail survey of non-farm establishments administered by the BLS. OES data from any given year are aggregated using six panels of data collected over three years. To update data from older periods, the OES program uses the Employment Cost Index (ECI), adjusting occupation-level wages according to the average movement of broader occupational divisions.[2] The establishments surveyed are selected from lists of establishments maintained by State Workforce Agencies for unemployment insurance purposes. Establishments are selected from every metropolitan area and state, across all surveyed industries, and from establishments of varying sizes. The OES program produces employment and wage estimates from hundreds of occupations (801 in 22 occupational groups) including healthcare practitioner (which includes registered nurses and technical occupations) and healthcare support occupations (which include nurse's aides). Although industries are defined down to the hospital level, the wages at the industry level are only available nationally. Thus, publicly available MSA level data only contain aggregated industry classifications (i.e. by occupation). Although both part-time and full time employees are included in the survey, an explicit account of part-time workers is not maintained in the calculation of average hourly wages. Further, in contrast to the Medicare data, self-employed persons and contract labor are not included in these estimates. These and other important differences between the Medicare and BLS-OES data are discussed in detail below.

2.1.2. *Main Differences between the Medicare and the BLS-OES Data*

The Medicare and BLS-OES data differ in significant ways. First, wage data are collected from different sets of employees. While the IPPS cost reports include the wages and hours worked for employees working in Medicare reimbursed acute care hospitals exclusively, the OES data reflects wages from employees for over 800 occupations in many different industries, including hospitals, home health agencies and skilled nursing

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[2] Please see BLS OES Technical Notes, October 6, 2008 (http://www.bls.gov/oes/current/oes_tec.htm). The OES uses data over time to increase the sample size of the survey. By increasing the sample size it can increase the reliability of the survey and reduce sampling error. But labor costs change over time, as evidenced by the ECI time series data. In order to make the data from all survey respondents comparable, the ECI is used to translate the costs from previous years into a cost number for the most recent year.

facilities. It is also important to note that the types of hospitals included in the BLS-OES survey differ from those considered by the annual Medicare survey. While the Medicare data only come from employees of IPPS hospitals, BLS hospital data come from employees of General Medical and Surgical Hospitals, Psychiatric and Substance Abuse Hospitals, Federal Hospitals, and Specialty Hospitals.[3] Whether the focus on IPPS short stay acute care hospitals as opposed to a wider range of hospitals affects the hospital wage index is beyond the scope of this study.

Including workers from all industries in the construction of the BLS wage index has benefits and potential drawbacks. There are two main benefits from using cross-industry wages. First, occupational wages will be measured more accurately because the sample sizes in the OES survey will be larger in each wage area if all industries are used. Additionally, occupational wages will be measured more accurately because the average wage for an occupation across all industries is likely to be a better reflection of the "market" wage for an occupation in a given wage area. A potential drawback of using cross-industry wages is that workers in some occupations might be more productive in the hospital industry than in other industries. These productivity differences should be reflected in wages and, therefore, in the wage index. Inter-industry productivity differences will only affect the wage index if these are very different across geographic areas and if the mix of employees by industry varies significantly across areas.

Second, the IPPS cost reports and the OES survey treat part-time workers differently in their calculation of average hourly wages. Medicare data explicitly account for part-time workers by including their hours worked in the average hourly wage calculation. The average hourly wage is simply the sum of wages divided by the sum of hours worked. If the wages of part-time workers are different from full time workers, this will be adjusted by the more limited hours of part-time workers. BLS data also includes wage information from both part-time and full time workers. However, unlike

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[3] For a comprehensive list of the sample of hospitals (NAICS 622) considered in the BLS-OES data, please see the following url: http://www.census.gov/cgi-bin/sssd/naics/naicsrch?chart_code=62&search=2007%20NAICS%20Search.

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the cost report method, the BLS weights the wages of all workers equally in its estimation of the average hourly wage because it divides the wages by number of employees instead of by number of hours worked.[4]

Further, Medicare wage data include contract and self employed hospital labor, while the BLS data does not include these workers in their survey. If hospitals in some areas rely more heavily on these types of workers, their absence from BLS data will bias the estimated wage indices that rely on this data.

Third, these sources of data reflect different ideas about the level of aggregation needed to construct an accurate wage index. To estimate the average hourly wage in a hospital (or market area) CMS sums the wages of all hospital workers, without distinguishing which salaries correspond to which occupations. This approach makes it difficult to separate two issues: the cost of labor and the labor mix used in hospitals. The average hourly wage between hospitals (or market areas) might be higher or lower, not necessarily due to the underlying wages, but because of the choice each hospital makes about the type and share of employees it hires. For example, highly skilled workers may earn higher wages than less skilled workers. If the share of highly skilled workers in one hospital is much larger than in another hospital, the average hourly wage in the former will be higher than the average hourly wage in the latter.

In an attempt to address this issue, the statute requires that CMS apply an occupational mix adjustment to its calculated index. However, this adjustment is limited and only applies to approximately 10 percent of the index. In contrast, the BLS wage index takes explicit account of each contributing occupation. As we will see in the next section, the BLS wage index values (at the market area level) are obtained by weighting average hourly earnings for each hospital occupation by the occupation's national share

[4] That is, average hourly wage in region r with j hospitals is calculated by CMS as $\dfrac{\sum_{j=1}^{N} Earnings_{jr}}{\sum_{j=1}^{N} Hours_{jr}}$, while the BLS average hourly wage for region r with i occupations is calculated as $\dfrac{1}{N}\sum_{i=1}^{N} \dfrac{Earnings_{ir}}{Hours_{ir}}$, where N is the total number of employees. These quantities are not the same. The former quantity gives a larger weight to employees who work a greater number of hours over the course of a year.

of wages. These occupational shares are fixed and do not vary by market area. In Section 4 of this report we explore in greater detail how CMS and BLS deal with the occupational mix issue.

Finally, another major difference between these two data sources is their treatment of benefits. Benefit costs are a relatively large and variable portion of compensation and, as such, should be included in a wage index that seeks to compensate hospitals for their labor costs.[5] Medicare wage data includes benefits, while BLS-OES wage data does not include them. The Benefit Costs Analysis (Section 3) in this report addresses this issue in depth.

In the following analysis, we will explain how some of the differences between the Medicare and BLS data imply that one data source is better suited to serve as the input for the construction of a geographic hospital wage index.

2.1.3. Methods

In this section, we describe the methods Acumen used to assess the differences between the Medicare and BLS-OES data. As explained in the previous section, the Medicare and BLS wage indices are constructed with wage data that differs in many respects. A side by side comparison of average hourly wages would confirm these differences without imparting any information about how these data sources reflect the geographic variation in labor costs. To understand this, relative wages (i.e., wage indices) are required. Our method for constructing the wage indices is as follows:

In constructing a wage index from the BLS-OES data, we closely follow the MedPAC method described in MedPAC (2007) and in RTI (2007). However, our constructed index differs from the one calculated by MedPAC in several ways. First, we construct the index using only MSA-level data from the OES and do not introduce county-level adjustments using Census data. Second, we do not smooth large differences in index values between adjacent wage areas. Third, we construct only a hospital wage index and do not construct a hospital compensation index, which further adjusts for

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[5] See ftp://ftp.bls.gov/pub/special.requests/ocwc/ect/ececqrtn.pdf for information about the size of and changes in the relative importance of benefits over time.

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benefits.[6] By doing so, we are focusing more exclusively on data differences between the raw BLS and Medicare wage data.

Following MedPAC, we construct a fixed-weight index that relates the average hourly wages by occupation (excluding benefits) weighted by the national hospital share of wages in a wage area. The MedPAC hospital wage index can be expressed as:

$$Index_j = \sum_i Z_{iN} \times {w_{ij}} \Big/ {w_{iN}}, \qquad (1)$$

where the fixed national hospital share of wages, $Z_{iN} = s_{iN} \times {w_{iN}} \Big/ {w_N}$,

w_{ij} is the average hourly compensation level in occupation i in all industries in wage area j and w_{iN} is the average hourly compensation level in occupation i in hospital industries nationally.[7] The fixed weight, Z_{iN}, is estimated by the product of s_{iN}, which is the national employment share of occupation i, times the ratio of the average hourly national wage in occupation i in the hospital industry to w_N, the average hourly wage for all hospital occupations nationally. The use of national fixed weights means that wage areas with relatively higher hourly wage rates in hospital occupations will have higher index values, but that wage areas that employ a relatively greater share of workers from high wage occupations will not necessarily have higher index values. We provide more discussion of this feature of the BLS wage index in Section 2.3 below.

The BLS's OES public use files from 2005 were used in constructing the index. We first create the fixed-occupation weights using the same 30 occupations and occupational groupings chosen by MedPAC. These occupations and occupational

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[6] The benefit costs issue is addressed in Section 3 of this report.

[7] The wage index can be equivalently expressed as $$Index_j = \frac{\sum_i s_{iN} \times w_{ij}}{\sum_i s_{iN} \times w_{iN}}$$. The first expression we use employs occupational wage shares as the national fixed weights. The second employs occupational employment shares as the national fixed weights. However, the two expressions yield identical wage index values. We express the fixed national weights as hospital share of wages rather than employment shares to be consistent with MedPAC methodology.

groupings are among the most prevalent occupations in the hospital industry nationally, and are listed along with their employment shares in Appendix Table A.1. The employment shares for each occupation are calculated as the fraction of all workers in the hospital industry nationally who are also in that occupation. The national wage shares are calculated as the percentage of wages that each hospital occupation accounts for relative to the total wage share of all hospital occupations.

Second, we construct the wage index following equation (1). For each wage area, we estimate the ratio of the average hourly wage to the national wage for each of the 30 occupations weighted by the fixed national wage shares and sum over all 30 occupations.

We compare this index with the pre-reclassification, no rural floor Medicare wage index, both with and without OMA, from FY 2009 (based on average hospital wages calculated from FY2005 hospital cost reports). Importantly, the underlying wage data from both data sources reference 2005.

The 2005 OES estimates are based on data collected over the previous three years, where wage estimates from past years are adjusted to reflect 2005 wages using the ECI. Although this procedure has the limitation of assuming that there are no substantial differences in wage growth by geography, industry, or detailed occupation, it has the advantages of significantly reducing sampling error and increasing the reliability of estimates for detailed occupations in small geographical areas.[8] For this reason, we compare a wage index constructed from 2005 OES data with Medicare data coming from FY2005 hospital cost reports.[9]

In comparing the two indices we first compute summary statistics (maximum, median, minimum, mean and standard deviation) for the distribution of each index. Second, we report summary statistics on the differences between these indices. Third and finally, we calculate the difference between the two wage indices for each wage area and report summary statistics on the distribution of these differences.

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[8] For more information about the ECI and the OES estimates, see http://www.bls.gov/oes/oes_ques.htm.
[9] We also use 2005 wage data because the geographic classification between the 2005 BLS and CMS wage data is similar and this facilitates the comparison.

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2.1.4. Results

In this section, we report the results of the comparison between the Medicare and BLS-OES data. The top panel of Table 2.1 reports the summary statistics for the BLS wage index and the pre-reclassification, no rural floor Medicare wage index without occupational mix adjustments. The bottom panel of the table reports summary statistics for the BLS wage index and the Medicare wage index with occupational mix adjustments.

Both the BLS wage index and the Medicare wage indices have been weighted by hospital discharges to have a mean of one. The Medicare wage index (either with or without occupational mix adjustments) varies more across wage areas than does the fixed-weight index we construct from the BLS-OES data. This is reflected in the higher maximum and the lower minimum of the Medicare wage index, and the larger standard deviation of the Medicare wage index relative to the BLS wage index.

Comparisons between the two indices for each wage area reflect the fact that a substantial number of MSAs have large differences in index values. This can be seen from the standard deviation in the distribution of percent differences between the two indices. The distribution of percent differences refers to the percent change in index values that hospitals experience when moving from the Medicare wage index to the BLS wage index. Thus, we can see by the median values that one half of the wage areas have BLS wage index values that are at least 1.22% (0.62%) higher than the Medicare wage index without (with) the OMA. Note that due to budget neutrality adjustments, these differences are not directly interpretable as payment changes at the hospital level.

Table 2.1: Comparison of Wage Indices (by MSA and Balance of State Areas), Estimated with Medicare Hospital Cost Report Data (FY2005) and the BLS OES Survey (2005)

	Medicare Wage Index *without* Occupational Mix Adjustments	BLS Wage Index	Percent Change between Distributions	Distribution of Percent Differences
Maximum	1.675	1.467	-12.42%	27.57%
Median	0.972	0.983	1.13%	1.22%
Minimum	0.709	0.783	10.44%	-29.18%
Mean	1.000	1.000	0.00%	0.59%
Standard Deviation	0.157	0.122	-22.29%	5.85%
Number of Areas	425	425		
	Medicare Wage Index *with* Occupational Mix Adjustments	BLS Wage Index	Percent Change between Distributions	Distribution of Percent Differences
Maximum	1.630	1.467	-10.00%	22.14%
Median	0.969	0.983	1.44%	0.62%
Minimum	0.715	0.783	9.51%	-27.24%
Mean	1.000	1.000	0.00%	0.50%
Standard Deviation	0.152	0.122	-19.74%	5.58%
Number of Areas	425	425		

Finally, by comparing the two results, we can see that use of the OMA does not appreciably change the summary statistics that define the distribution of the Medicare wage index. Thus, the Medicare wage index is more disperse across MSAs regardless of whether the OMA is applied. Moreover, large differences between the Medicare and BLS wage index values exist in both cases.

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2.1.5. *Analysis*

These results reflect the fact that different data sources are used to construct the indices, and that the actual construction is carried out in different ways. First we consider the data issues.

The results strongly suggest that the underlying wage data from the BLS vary less across wage areas than do the wage data collected from hospital cost reports. This higher level of variation in the underlying Medicare wage data could be driven by a number of factors. It may reflect real differences in the quality of the data. It could also suggest that including or excluding certain groups of workers affects the variability in the data.

One possible explanation for this variation is that Medicare data are less stable than BLS-OES data. It is possible that the smaller number of observations in the Medicare data relative to the BLS data provide a less representative picture of the variation in wages. As mentioned above, CMS considers wages exclusively from IPPS hospitals, whereas the BLS-OES wage data are estimated from many different industries, including the hospital industry. And within the hospital industry, the BLS-OES data include wages from a different set of hospitals than the Medicare data. The BLS-OES data include information from short stay acute care hospitals, psychiatric and substance abuse hospitals, children's hospitals, federal hospitals and specialty hospitals, among others. The Medicare wage index is based on relatively few hospitals in each wage area compared with the BLS data that compiles information at the individual level.

Higher variation may also stem from the fact that Medicare wages include benefits, which could increase the variability of the data (as the receipt of benefits varies across workers). However, as shown in the impact analysis, the BLS compensation index constructed by MedPAC, which takes benefits into account, still shows less variability than the Medicare wage index.[10] Another issue is that the Medicare data, which are collected from hospitals, reflect both underlying wage variation across wage areas as well as variation in the types of the workers that hospitals in different areas choose to employ. For example, if some hospitals tend to employ more highly trained (and more highly

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[10] Please see Impact Analysis for the 2009 Final Rule: Interim Report - Revision of Medicare Wage Index at http://www.acumenllc.com/reports/CMS.

compensated) staff, the total wage bill per worker expressed in the Medicare data will be higher than their wages generally for the occupation, as expressed in the BLS-OES data.

Even so, the data differ in a number of additional ways that are not related to their reliability. First, the BLS wage index is based on workers' wages from 30 hospital-related occupations, while the Medicare wage index is based on wages from all workers involved with IPPS activities in hospitals. If very high or very low wage occupations are included in Medicare data but not OES data, the result could be larger variation. Furthermore, the OES data do not include self-employed or contract workers whose salaries tend to be lower than employees with the same job (see analysis below).

Second, the differences between the Medicare and BLS wage indices are driven by more than just the underlying difference in data sources. They are also driven by differences in the method used to calculate the index. Unfortunately, it is not possible to implement the MedPAC method on the Medicare data (because wages in the cost reports are not collected at the occupational level), nor is it possible to implement the CMS method on the OES data (because data specifically for the hospital industry are not available at the wage area level).

Third, the method of calculating hourly wages also leads to differences in the computed index. In particular, the Medicare method gives greater importance to employees with a greater number of hours over the course of the year. As mentioned above, the Medicare method appropriately accounts for the differences between part-time and full time labor, while the BLS method weighs each employee's wage equally when calculating average hourly wages, regardless of how many hours that employee works per year. Although part-time employees are included in both the Medicare and BLS data, the method used by the BLS gives greater importance to the wages of part-time and part-year workers relative to the Medicare wage index. We examine the importance of this issue below.

2.2 Are Differences Related to Wage Area Characteristics?

The previous section enumerates a number of ways in which the two data sets are different, and summarizes the measured differences between wage indices constructed with each data set. In the second part of this analysis we investigate whether these differences in index values can be explained by the differences in the data sets described above. Differences in the data sources are reflected in the measurable characteristics of wage areas. The specific factors we examine include the following: (i) differences in the industry mix, (ii) the number of part-time vs. full-time workers in a wage area, (iii) the number of self-employed workers in a wage area, and (iv) the number of hospitals in a wage area.

As we discussed in the previous section, the BLS occupational wage data (from the OES) are collected for different occupations in a wage area but across all industries. This is in contrast to the Medicare data, which are collected from hospitals only but do not distinguish among occupations. If there are large differences across industries in the wages paid to occupations represented in the hospital industry, this difference in the way the underlying data sources collect their data could be responsible for differences between the Medicare and MedPAC wage indices.

While part-time workers are included in both the Medicare data and in the BLS data, the difference in the manner in which average hourly wages are calculated in the BLS data versus in the Medicare data may lead the fraction of workers who are part-time in an area to be related to calculated wages. Additionally, because the OES does not include self-employed workers but the Medicare data do, average hourly wages may be incorrectly measured in areas with a substantial number of contract workers.

Finally, the number of hospitals in a wage area may impact the estimation of a wage index. This type of variable could decrease the variation in the difference between the indices. Because a larger number of hospitals would mean more observations about a certain market, markets with more hospitals may lead to a Medicare wage index that is more similar to the BLS wage index. Further, because the Medicare wage index is constructed with hospital data only, it does not take into account the competitive labor context that hospitals must face. As the number of hospitals in a labor market increases,

the pressure on hospital wages increases, and hospital wages are more consistent across hospitals and areas. Thus, in an area with numerous hospitals, the wages within and outside hospitals are expected to be consistent, making the difference between the Medicare and BLS wage indices smaller.[11]

2.2.1. Methods

The analysis explores whether differences in wage index values between the Medicare and BLS wage indices are related to differences in the fraction of hospital workers that are part-time and the fraction of hospital workers that are self-employed at the wage area level. We also explore whether the fraction of workers employed in hospitals and the number of hospitals in a wage area account for differences in wage index values.

We use worker-level data available from the Bureau of the Census's 2006 American Community Survey to estimate wage area characteristics. In particular, we estimate the fraction of workers that are part-time, that are self-employed, and the fraction of workers in "hospital-related occupations" (i.e., the 30 occupations represented in the BLS wage index) who are employed by the hospital industry. Using this information, we assess whether the wage areas with relatively more part-time workers, relatively more self-employed workers, and relatively fewer workers in the hospital industry are those areas with relatively larger differences between the Medicare wage index and MedPAC's proposed index.

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[11] Competitive pressure may be an issue, but it is activated at a threshold. Below a certain number of hospitals there is no competitive pressure and the Medicare wage index is expected to be different than the BLS wage index; above a certain number of hospitals there is pressure and the two indices should be consistent. Following the economic literature (Bresnahan and Reiss, 1991), we pose the threshold of 5 hospitals. We assume that once 6 firms compete in a market competitive prices prevail. (Cite: Bresnahan, Timothy and Peter Reiss, "Entry and Competition in Concentrated Markets," The Journal of Political Economy, Vol.99, No.5 (Oct., 1991), p.977-1009)

In particular, we estimate the following regression models:

$$I_i^C - I_i^O = \alpha + \beta^H S_i^H + \beta^P S_i^P + \beta^C S_i^C + \beta^N S_i^N + \varepsilon \qquad (1)$$

where:

I_i^C is the Medicare wage index value for wage area i,

I_i^O is the BLS wage index value for wage area i,

S_i^H is the share of workers that are in the hospital industry in wage area i,

S_i^P is the share of workers that are part-time in wage area i,

S_i^C is the share of workers that are self-employed in wage area i, and

S_i^N is the number of hospitals in wage area i.

The variable, $I_i^C - I_i^O$, is the value of the difference between the Medicare wage index value and the BLS wage index value for a particular wage area.[12]

2.2.2. Results

In this section, we report the results of the relationship between the differences between wage index values and wage area characteristics. In Model 1, we examine the correlation between the difference among the Medicare and BLS wage index values and the following wage area characteristics: the share of part time workers, the share of self employed workers, the share of hospital industry workers and the number of hospitals in a wage area. Model 2 is similar to Model 1 except that it analyzes the effects of these four variables on the *absolute* difference between the Medicare and BLS wage indices.

Table A.3 in the appendix presents the results from the regressions predicting the difference and the absolute difference between the Medicare hospital wage index with OMA and the BLS wage index.[13]

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[12] Table A.3 also presents the effects of the independent variables on the absolute difference between the indices.

[13] Table A.2 in the Appendix shows summary statistics of the dependent and independent variables.

The dependent variable for Model 1 is calculated by subtracting the BLS wage index from the Medicare wage index; thus a positive coefficient for an independent variable indicates that as the variable increases, the Medicare wage index is expected to increase relative to the BLS wage index, or that the BLS wage index decreases relative to the Medicare wage index, or that both indices decrease or increase but one of them does so at a bigger rate. The dependent variable in Model 2 is the absolute difference between the indices. We examine the absolute difference because it is possible that some of the differences in the data sources and the methodology of the wage indices will lead to differences in wage index values, but of indeterminate sign.

As expected, Model 1 shows a positive relationship between the share of part-time workers and the difference between the Medicare and BLS wage indices. Thus, assuming that part-time workers receive lower wages,[14] increases in the share of part-time workers in an area appear to depress the BLS wage index relative to the Medicare wage index, increasing the difference between them. We can also see this in Table 2.2, which shows the expected differences between the two indices given different values of the independent variables, holding the other variables at their mean. Moving from a region where 10 percent of workers are part-time to one where 30 percent are part-time increases the difference between the indices from -0.012 to 0.022 points.[15]

As in the case of part-time workers, Acumen's analysis confirms that self-employed workers earn less than employees. This suggests that increases in the number of self-employed workers decreases the BLS wage index relative to the Medicare wage index. Moving from an area with an average number of self-employed workers (approximately 5 percent) to one with 10 percent self-employed workers leads to a change in the expected values from 0.014 to 0.036 points. Finally, as expected, the

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[14] This assumption is confirmed by the data. Acumen, LLC analysis of the data shows that the wages of part-time workers are lower than the wages of full time workers.
[15] We chose to estimate the expected difference between the Medicare and BLS wage index values when the percent of part-time workers equals 10%, 20% and 30% percent because these numbers approximate the 10th, 50th and 90th percentile of the distribution of part-time workers. 14% of part-time workers represent the 10th percentile, 22% of part-time workers represent the 50th percentile and 31% percent of workers represent the 90th percentile. The same applies to why we chose to fix the self-employed workers to 0%, 5% and 10%. The distribution of self-employed workers is as follows: 2.4% of self-employed workers represent the 10th percentile, about 4% represent the 50th percentile, and about 7% represent the 90th percentile.

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difference between the Medicare and BLS indices decreases in areas with a large number of hospitals (i.e. more than five hospitals).

Table 2.2: The Relationship between Wage Area Characteristics and the Difference between Wage Index Values from BLS and Medicare Data

Dependent Variable: Medicare-BLS	Expected Difference between Index Values
10% Working Part-time	-0.012
20% Working Part-time	0.005
30% Working Part-time	0.022
0% Self-Employed	-0.008
5% Self-Employed	0.012
10% Self-Employed	0.032
5 or fewer Hospitals	0.014
More than 5 Hospitals	0.001

Turning to the absolute difference regression, Model 2, we again find positive and significant coefficients for share of part-time and self-employed workers. In other words, increases in shares of part-time or self-employed workers are expected to increase differences between indices. With the number of hospitals variable, the difference between the indices is expected to be lower in areas with large numbers of hospitals. This suggests that wages for non-hospital workers are more similar to hospital worker wages as the number of hospitals in a wage area increases.

To examine whether there are non-linear relationships between the independent variables and the index differences we create a four-category ordered dependent variable and estimate differences using an ordered probit regression. The categories are large negative differences, small negative differences, small positive differences, and large positive differences. Negative differences occur when the BLS wage index is larger than the Medicare wage index, and positive differences occur when the Medicare wage index is larger than the BLS wage index. Observations with large negative differences are identified by those differences below the 25th percentile in the distribution of differences and large positive differences are those above the 75th percentile. Small negative differences are those between the 25th percentile and a difference of 0 (which is roughly

the 50th percentile, -0.001), and small positive differences are those between 0 and the 75th percentile.[16]

Table A.4 in the Appendix presents the results for the ordered probit regression predicting (small or large) positive and negative differences. When the share of part-time workers increases in an area, the differences move from being negative to positive (see Table 2.3), indicating that the Medicare wage index increases relative to the BLS wage index. We can observe in Table 2.3 that moving from an area with 10 percent part-time workers to one with 30 percent increases the probability of showing a large positive difference from 0.172 to 0.297, while decreasing the probability seeing a large negative difference from 0.338 to 0.202.

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[16] Specifically, the dependent variable takes the values of 0, 1, 2, and 3, where,
    0 represents negative differences that are smaller than -.0330 (which is the 25 percentile).
    1 represents negative differences that range from -.0330 to 0 (approximately the 50th percentile).
    2 represents positive differences that range from 0 to 0.037 (75th percentile), and,
    3 represents positive differences larger than 0.039.

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Table 2.3: Impact of Wage Area Characteristics on the Probability of Observing Positive or Negative Differences between the Wage Index Values (Medicare-BLS)

	Probability of Differences between Index Values
10% Working Part-time	
Probability of Large Negative Difference	0.338
Probability of Small Negative Difference	0.287
Probability of Small Positive Difference	0.204
Probability of Large Positive Difference	0.172
20% Working Part-time	
Probability of Large Negative Difference	0.265
Probability of Small Negative Difference	0.279
Probability of Small Positive Difference	0.227
Probability of Large Positive Difference	0.229
30% Working Part-time	
Probability of Large Negative Difference	0.202
Probability of Small Negative Difference	0.259
Probability of Small Positive Difference	0.242
Probability of Large Positive Difference	0.297
5 or fewer Hospitals	
Probability of Large Negative Difference	0.220
Probability of Small Negative Difference	0.266
Probability of Small Positive Difference	0.239
Probability of Large Positive Difference	0.275
More than 5 Hospitals	
Probability of Large Negative Difference	0.299
Probability of Small Negative Difference	0.284
Probability of Small Positive Difference	0.217
Probability of Large Positive Difference	0.200

Note: Negative differences occur when the BLS wage index is larger than the Medicare wage index, and positive differences occur when the Medicare wage index is larger than the BLS wage index. Observations with large negative differences are identified by those differences below the 25th percentile in the distribution of differences and large positive differences are those above the 75th percentile. Small negative differences are those between the 25th percentile and a difference of 0 (which is roughly the 50th percentile, -0.001), and small positive differences are those between 0 and the 75th percentile.

We also find that the probability of observing large positive differences decreases from 0.275 to 0.200 when we move from areas with fewer hospitals to areas with more than five hospitals. Additionally, the model predicts a 48 percent chance of showing a negative difference (summing probabilities of large and small negative differences) in areas with 5 or fewer hospitals, but a 57 percent chance of showing a negative difference in areas with greater than 5 hospitals, suggesting that the BLS wage index is likely to be relatively larger than the Medicare wage index in areas with more than five hospitals.

We do not report the impacts of the share of hospital workers in a wage area because this variable, as shown in Table A.3, lacks statistical significance. The absence of a relationship between the share of hospital workers in a wage area and the difference between the Medicare and BLS wage indices could reflect the fact that inter-industry differences in hospital-related occupational wages do not vary geographically. As such, this finding supports the use of cross-industry occupational wages in constructing the BLS wage index.

To more definitively assess whether using cross-industry occupational wages as opposed to hospital-only occupational wages to construct the BLS wage index has an impact on wage index values, we asked BLS to construct a separate BLS wage index using both sets of wage data.[17] Restricting the estimation of occupational wages at the wage area level to workers in the hospital industry would substantially impact wage index values for a large majority of wage areas (see Table 2.4). Only 25% of MSAs and 20% of balance-of-state areas have wage index values that differ by less than positive or negative 1% across the two methods. Moreover, 18% of MSAs and 20% of balance-of-state areas have wage index values that differ by more than positive or negative 5% across the two methods.

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[17] BLS graciously provided Acumen the summary statistics reported in Table 2.4. These statistics were produced from special tabulations of OES data. Note that OES pledges confidentiality to employers in the OES sample and does not publish data from individual reporters, in addition to using procedures to avoid disclosure of employer characteristics that might be inferred in OES estimates. The methodology for the construction of the indices is described in section 2.1.3.

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Table 2.4: Absolute Percent Changes, BLS Wage Index Constructed with National Fixed Weights and Local Cross-Industry Wages to BLS Wage Index Constructed with National Fixed Weights and Local Hospital Industry Wages

Percent Difference	MSAs		Balance of State Areas	
	Number	Percent	Number	Percent
Less than 1%	99	25.00%	33	19.30%
Between 1% and 2%	71	17.93%	32	18.71%
Between 2% and 3%	60	15.15%	39	22.81%
Between 3% and 4%	55	13.89%	19	11.11%
Between 4% and 5%	38	9.60%	13	7.60%
Between 5% and 6%	22	5.56%	13	7.60%
Between 6% and 7%	20	5.05%	11	6.43%
Between 7% and 8%	10	2.53%	5	2.92%
Between 8% and 9%	11	2.78%	1	0.58%
Between 9% and 10%	3	0.76%	0	0.00%
Greater than 10%	7	1.77%	5	2.92%

Note: MSAs are counted separately from the number of BOS areas. These are based on May 2007 OES wage estimates. It includes several BOS areas per state because the single BOS area is not a standard OES product. Data for Dover, DE and three areas in Puerto Rico are not included in the counts.

Thus, constructing the BLS wage index using only data from the hospital industry as opposed to data from all industries has a substantial impact on wage index values. This impact could stem from one of two sources. First, it may be that the BLS OES estimates of hospital occupational wages at the wage-area level are substantially less reliable (because they are based on fewer observations) than the estimates of cross-industry occupational wages. If so, the cross-industry estimates should be favored. Alternatively, the inter-industry differences in occupational wages could vary by wage area. If so, and if the estimates were reliable, then one should favor the hospital-industry only estimates. Unfortunately, it is not possible to distinguish between these two explanations: the wage differentials between industries could vary across wage areas either due to measurement error or to productivity differences.

Summarizing the results presented above, we find that:

- Wage areas with a greater fraction of part-time workers show larger positive differences between the Medicare and BLS wage index values, i.e., the BLS wage index decreases relative to the Medicare wage index.

- Wage areas with a greater fraction of self-employed workers also tend to have larger positive differences in the Medicare wage index values relative to the BLS wage index values.

- Wage areas with a high number of hospitals are less likely to have larger positive differences between the Medicare wage index values and BLS wage index than areas with fewer hospitals.

- Constructing the BLS wage index using occupational wages from the hospital industry instead of using cross-industry wages would affect index values for a substantial number of wage areas – 57% of Metropolitan Statistical Areas and 51% of Balance of State Areas would experience changes greater than 2% in their index values.

2.2.3. Analysis

The results presented in the previous section suggest that differences in the data collection method between the BLS and the Medicare data are correlated with the relative values of the indices. Excluding self-employed workers from the BLS data and treating part-time workers differently in the calculation of average hourly wages appear to be associated with a difference in index values. And although the share of workers in a wage area that are in the hospital industry appears to matter less in the regression analysis, the use of wage data from workers from industries other than the hospital industry does impact the values of the BLS wage index.

These regression results are suggestive, but not definitive. One limiting factor of this regression is that the number of wage area characteristics that we were able to

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examine was relatively limited.[18] Moreover, some of the wage area characteristics that we could not examine might be correlated with the fraction of workers in an area that are part-time or that are self-employed. If this is the case we cannot be certain that the differences that we observe between the Medicare and BLS indices are due to part-time and self-employment and not some other characteristic of a wage area.[19] Further, the importance of inter-industry information for a wage index remains unclear. The share of workers in the hospital industry may not provide enough information to illuminate the existence or absence of an inter-industry wage differential. Likewise, the BLS analysis of a BLS wage index that only relies on hospital data did not authoritatively answer this question.

To more fully explore the potential role of these wage area characteristics we offer additional analysis below. We specifically address two questions. First, should non-hospital workers be included in a hospital wage index? We also consider the question: should a hospital wage index be adjusted to account for the fraction of workers that are self-employed or part-time in a wage area? If these factors have a large impact on the values of a hospital wage index, accounting for them is important.

Whether or not one should include non-hospital industry workers in the construction of the wage index depends upon a number of factors. On the one hand, including workers from occupations that work in the hospital industry across all industries may better reflect the underlying variation in the price of labor. This larger set of workers contains within it more information about wages than the more restricted set of workers in the hospital industry. This is because hospitals in different areas may make different choices with regard to the skill-level of their staff (occupational mix of staff of individual hospitals may differ too much, thus, cross industry information gives a better picture of the full skill distribution of hospital workers). On the other hand, there are well-documented inter-industry wage differentials (which arise for unknown productivity differences, among other reasons) that may vary geographically. If there is geographic

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[18] The full regression results are presented in the appendix. The R^2 is relatively low for both versions of the linear model.
[19] For example, occupational mix and benefit costs are handled very differently across the indices and both indices use very different construction methodologies.

variation in the cross-industry productivity of workers, then including non-hospital workers could be a problem.

In both cases, one would observe geographic variation in the premium or penalty to their hourly wage that workers in hospitals receive relative to workers in the same occupations but in different industries. Whether or not including non-hospital workers is correct depends upon the reasons for these differentials.

If there is little or no geographic variation in the inter-industry wage differentials, including non-hospital workers in the construction of the wage index does not affect the index values and may be beneficial for the construction of the wage index due to the increase in sample size that results from considering cross-industry wages. However, if there is geographic variation in the inter-industry wage differential, the set of occupations should be restricted to those with little geographic variation. For example there might be greater cross-industry variation in the wages paid to managers than to nurses.

Another fundamental way in which the two data sources differ is their treatment of the self employed and part-time workers. The regression analysis above suggests that these wage area characteristics explain some of the difference between the Medicare and BLS wage index values. We consider the question: Should the BLS wage index be adjusted to account for self-employed and part-time workers?

Theoretically, the differences between the ways the OES and Medicare wage data are collected could lead to biases in the BLS wage index. We illustrate the potential effects of these differences with some examples below.

There are two data differences between the OES and Medicare data that, in theory, could affect the calculation of the wage index. The first is that the OES does not include self-employed workers. If the self-employed are paid less well than hospital employees and if there is geographic variation across wage areas in the fraction of workers that are self-employed, variation in OES average hourly wages will be a potentially inaccurate measure of the variation in "true" average hourly wages.

<u>Example of Variation in Self-Employment</u>

For example, suppose workers in different areas are differentially likely to be self-employed. Moreover, suppose self-employed workers are paid less than employees that work for the hospital, herein called "regular workers." Self-employed workers are paid $10 per hour while regular workers are paid $12 per hour (see Table 2.5).

Table 2.5: Example: Variation in Self-Employment

	Employees	**Self-Employed**	**Average Labor Price**
City A			
Percentage of workers hired from this category	90%	10%	
Average Wage	$12	$10	$11.80
City B			
Percentage of workers hired from this category	80%	20%	
Average Wage	$12	$10	$11.60

A wage index based on the OES would only focus on employees, which are paid $12 per hour in both locations. However, because a greater fraction of workers are self-employed in city B in this example, actual hourly wages are lower there (by roughly 2%).

Thus, the wages in the OES likely need to be adjusted for geographic differences in the fraction of workers that are self-employed. However, we expect the impact of any adjustment to be small because there is little variation in the fraction of workers that are self-employed across wage areas, according to Acumen's analysis of the ACS.

In a similar manner, we consider the argument for adjusting for the fraction of workers that are part-time is similar. While the wages of part-time and part-year workers are included in both data sources, the formula used to construct average hourly wages differs across data sources (as discussed in the previous section). Variation in the number of part-time and part-year workers can therefore influence the variation in the calculated average hourly wage differently whether one uses the Medicare or BLS data. Again, we illustrate with an example below.

Example of Variation in Part-Time Work

For example, suppose part-time workers work 1000 hours per year while full-time workers work 2000 hours per year. Moreover, suppose part-time workers are paid $10 per hour while full-time workers are paid $12 per hour (see Table 2.6). Finally, suppose there is geographic variation in the fraction of workers that are part-time.

Table 2.6: Example: Variation in Part-Time Work

	Full-Time	Part-Time	BLS Method of Calculating Average Wage	Medicare Method of Calculating Average Wage
City A				
Hours Worked	2,000	1,000		
Wage	$12	$10	$11.80	$11.89
Percentage of workers hired from this category	90%	10%		
Percentage of hours worked from this category	95%	5%		
City B				
Hours Worked	2000	1000		
Wage	$12	$10	$11.60	$11.78
Percentage of workers hired from this category	80%	20%		
Percentage of hours worked from this category	90%	10%		

In this example, the BLS method of calculating average labor wages, which weights part-time and full-time workers equally, yields more variation in labor wages than does the Medicare method, which weights full-time workers more. The equal weight that the BLS wage index assigns to part-time and full-time workers might make the index less accurate in estimating average wage variation.

To address this issue directly, we adjust the BLS wage index to account for geographic variation in the fraction of workers that are part-time and that are self employed (see Appendix B). We "adjust" for the equal weighting of part-time and full time workers, and for the absence of data from self employed workers. However, this adjustment yields no substantial change in index values. Moreover, even after making this adjustment, there is less variability in BLS wage index values across wage areas than in the Medicare wage index (see Table B.2 in the Appendix). These results are consistent

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with the results in section 2.3. Thus, Acumen's view is that the BLS wage index does not need to be adjusted to account for these differences.

2.3 Price versus Expenses

A geographic wage index should reflect underlying differences in the price of labor across different labor market areas. The existing Medicare wage index can be thought of as reflecting variation in labor expenses which are partially chosen by hospitals (i.e. endogenous), not labor prices.

2.3.1. *Why is a price index preferred?*

Acumen's view is that a hospital wage index should measure geographic variation in the price of labor, not variation in labor expenses, which are affected by the hospital's staffing choices. The following example illustrates this point. Suppose there are three cities: A, B, and C. Suppose that hospitals in these cities can make different choices with regard to the skill level of their technicians and hire expensive or inexpensive diagnostic technicians.

We want to create a geographic index that reflects differences in the price of employing technicians across the three cities (see Table 2.7). We could do this either by constructing an index that reflects differences in the total expense of employing technicians across cities or by constructing an index that reflects differences in the price of technicians across cities. These two indices will differ to the extent that there are occupational mix differences across cities.

First, note that the price of each type of technician is 20% higher in city A than in city B (0.20 = [12 – 10] / 10, for inexpensive technicians; and 0.20 = [24 – 20] / 20 for expensive ones) and 50% higher in city C than in city B (for example, 0.50 = [15 – 10] / 10). Thus we would expect hospitals in city A to have index values that are 20% greater and hospitals in city C to have index values that are 50% greater than hospitals in city B.

Now suppose that the occupation mix differs across cities. In particular, suppose hospitals in cities A and C choose to hire expensive technicians 50% of the time while hospitals in city B always choose to hire inexpensive technicians. These choices are reflected in the calculation of average labor expenses. The average labor expenses in city A is $18 because half of the technicians are of the inexpensive variety (.5 x $12) and half are expensive (.5 x $24). Adding the labor expenses for each type of technician, $6 and $12, we arrive at our average labor expense of $18 for city A. Because city B makes different hiring decisions, its average labor expense is much lower, $10. Average labor expenses are 80% higher in city A than in city B (because $18 is 80% higher than $10, i.e. 0.80 = [18 − 10] / 10), and are 125% higher in city C than in B (1.25 = [22.5 − 10] / 10). Therefore, in deciding whether one wants to construct a geographic index that reflects variation in labor prices or one that reflects variation in labor expenses, the question one must consider is, should hospitals in city A receive wage index values that are 80% greater or 20% greater than hospitals in city B? Should hospitals in city C receive wage index values that are 125% or 50% greater than hospitals in city B? In our view, a price index is more appropriate because a labor expense index reflects variation both in the price of labor and in the choices that hospitals make in the types of workers to hire.

Table 2.7: Price Index versus Expense Index, Example 2

	Inexpensive Technicians	Expensive Technicians	Average Labor Expense	Expense Index	Average Labor Price	Price Index
City A			$18	1.07	$16	0.97
Average Wage	$12	$24				
Percentage of technicians hired from this category	50%	50%				
National Fixed Weights	2/3	1/3				
City B			$10	0.59	$13.33	0.81
Average Wage	$10	$20				
Percentage of technicians hired from this category	100%	0%				
National Fixed Weights	2/3	1/3				
City C			$22.50	1.34	$20	1.21
Average Wage	$15	$30				
Percentage of technicians hired from this category	50%	50%				
National Fixed Weights	2/3	1/3				
Nation			$16.83	1	$16.44	1
Average Wage	$12.33	$24.67				
National Fixed Weights	2/3	1/3				

Assuming that there are only three cities (i.e. wage areas), to construct the labor expense index, one calculates the average labor expense nationwide as the average of the labor expense in each city ($16.83 is the average of $18, $10, and $22.50). The labor expense index is the ratio of the average labor expense in each city to the average labor expense nationwide. For example, the labor expense index value for city A is 1.07 since 1.07 = 18 / 16.83.

To construct the price index, we first need to construct our national fixed weights. Nationwide, in our example, two-thirds of hospital employees are inexpensive technicians and one-third are expensive technicians. These represent the fixed weights in

the construction of the price index. To construct the price index, one calculates the weighted average wage in each city, where the weight for inexpensive technicians is two-thirds and the weight for expensive technicians is one-third. These weighted averages are $16 in city A, $13.33 in city B, and $20 in city C. One also calculates the average price of labor nationwide, which is $16.44. The price index for each city is the ratio of the average price of labor in that city to the average price of labor nationwide. For example, in city A the price index is 0.97 as 0.97 = $16 / $16.44.

As the example above illustrates, a price index, i.e., a fixed-weight index, better captures variation in labor prices than an expense index. Analogous to this example, a fixed-weight wage index, such as the BLS wage index, better captures the geographic variation in labor prices than the Medicare wage index. This is because the Medicare wage index reflects labor expenses and labor expenses vary across wage areas for two reasons: (i) labor prices vary and (ii) hospitals in some areas will choose to hire more expensive types of workers. A geographic price index should only reflect variation in labor prices, not variation in expenses that are partly the result of the staffing decisions of individual hospitals. A comparison of the expense index and the price index in Table 2.7 highlights the problems inherent in the expense approach. Hospitals in cities A and C are assigned expense index values that reflect their employment choices, not the prices they face for labor. As a result, the expense index value for city C is 127% higher than the value for city B, but the price of labor is only 50% higher.

2.4 Conclusion

The analysis above reflects the fact that differences between the indices are likely driven both by data issues and methodological issues. The data issues we examine include the importance of part-time work, self-employed workers, as well as the industry mix and number of hospitals in a wage area. Without taking into account methodological considerations, we find that the BLS-OES wage data is less variable and better able to capture geographic variation in labor prices than the Medicare wage data. In addition, the BLS wage data does not suffer from the endogeneity problems associated with the Medicare hospital cost report data.

Further, each data source maintains a certain level of detail that suggests the use of different methods to calculate the wage index. Because the IPPS data does not maintain occupational details, average hourly wages include wage and benefit information for all hospital employees. In this analysis we are unable to examine how the aggregation of wages within a hospital affects the index. One issue with this approach was illustrated by the examples that highlight the differences between taking account of the price of labor versus accounting for labor as an expense. Aggregation also affects the degree to which the index provides information about the hospital's occupational mix. This issue is the subject of Section 3.

To have a fuller picture of the differences between the Medicare and BLS indices we must consider all of the components that contribute to the compensation index. This includes wages, and benefits and weighting factors. The next step is to consider the role of benefit costs. The Medicare wage index folds benefit cost information into the average wage calculation. MedPAC uses an alternative approach, but draws its benefit cost data from hospital cost reports. We examine both the data and the methods used to incorporate this significant element into the wage index in the next section.

In this section we examine two questions. First, do benefit costs need to be included in a hospital wage index? And if they do, is there an alternative source of benefit data that would be comparable and less burdensome than the currently used Worksheet S-3 benefit data, or the MedPAC proposed Worksheet A data?

We demonstrate how including benefits in a hospital wage index affects index values and how benefits are necessary to accurately reflect geographic variations in total labor costs. We also show that the differences between the benefit data in Worksheets A and S-3 are substantial. These differences suggest that using Worksheet A in place of Worksheet S-3 is not feasible. Given this finding, we also discuss whether other sources of benefit costs data, such as the Employer Costs for Employee Compensation (ECEC) series, can serve as a viable alternative to Worksheet S-3 benefit data for the construction of a compensation index.

This section proceeds as follows: Section 3.1 demonstrates the importance of including benefits data in a hospital wage index. We construct different versions of the Medicare hospital wage indices in order to analyze the effects that incorporating benefits has on wage index values. We provide background on the sources of benefit cost data currently used to construct the Medicare wage index and the MedPAC compensation index. We also estimate benefits as a share of total compensation using Worksheet S-3 data to analyze geographic variation in benefits. We conclude this section with a brief discussion regarding the review process undertaken to prepare Worksheet S-3 data before it is used to construct the hospital wage index.

In Section 3.2, we present the results of an empirical analysis that compares the different sources of benefit-cost data. In the first part of the analysis (Section 3.2.1), we examine the distributions and differences of the Worksheet A and Worksheet S-3 benefit data. In the second part (Section 3.2.2), we investigate whether differences between these data sources vary with a number of hospital attributes, including geographical location, hospital size, and teaching status.

Section 3.3 discusses the advantages of having a single agency collect data on both wages and benefits. We offer some reasons why BLS data are reliable, and discuss the possibility of using the BLS National Compensation Survey (NCS) as an alternative source of benefits data. We also consider how this might be a limited option given the absence of hospital-industry compensation data at the wage area level.

The major findings of this section are:

- The cost of benefits is a significant portion of total compensation that varies geographically. A hospital wage index that accurately reflects the different labor costs in different regions of the country must take benefits into account.

- The benefit costs data submitted by hospitals and currently used in the Medicare wage index and MedPAC compensation index – Worksheet S-3 and Worksheet A – differ substantially. Worksheet S-3 is more consistent and reliable than Worksheet A.

- Hospitals of all types (i.e., rural and urban hospitals, hospitals in all regions of the country, hospitals of all sizes, and both teaching and non-teaching hospitals) have large reporting discrepancies between Worksheets A and S-3.

- MedPAC's use of different sources for wage and benefits data has several disadvantages. If two different sources are used, inconsistencies in the definitions of wage and benefit costs across agencies are likely to arise. In addition, wage-benefit comparisons that can highlight outlying values would not be feasible. Finally, if MedPAC were to use Worksheet S-3 benefit data, continued submission and review of Worksheet S-3 would eliminate the potential savings from reduced data collection.

- As a result of these disadvantages, the BLS Employer Costs for Employee Compensation (ECEC) data should be given careful consideration as an alternative source of benefits data for adjusting the BLS wage index. It would be advantageous for CMS to work with BLS to determine the feasibility of expanding the geographic detail of the compensation data to make this a viable source of benefits data that could be used to construct the hospital wage index.

3.1 Importance of a Compensation Wage Index

       To provide a context for this analysis, we first discuss the importance of including benefits in a hospital wage index and provide background on benefit costs and their contribution to total compensation in U.S. industries, including the hospital industry. Second, we review how benefit costs are incorporated into the existing Medicare hospital wage index and into the proposed MedPAC compensation index. Finally, we discuss why the data provided on the two worksheets might differ and why the Worksheet S-3 data is more consistently reported across hospitals.

3.1.1. *Why Should a Hospital Wage Index Take Benefits into Account*

Benefits, or wage related costs, account for a substantial share of the total compensation in most U.S. industries. These benefits include the employer's share of the Federal Insurance Contributions Act (FICA) tax (which includes Social Security and Medicare taxes), unemployment insurance, workers' compensation, health, life, and disability insurance, 401(k) and other defined contribution retirement benefits, defined benefit pensions, supplemental pay (e.g., overtime pay and shift differentials), paid leave, and other benefits.[20] According to the BLS, the cost of benefits for private industry workers represented 29.3 percent of total compensation in September 2008. That percentage was slightly higher – 31.4 percent – for workers in the hospital industry (BLS 2008).[21] These figures vary by geographic region.[22] This variation is evident both in BLS data that reports benefits information for all industries and from analysis of the benefit and wage data reported on Worksheets S-3. Table 3.1 presents benefits as a share of total

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[20] Note that paid leave includes vacation, holiday, sick leave and personal leave. Supplemental pay includes shift differentials, nonproduction bonuses, and premium pay for work in addition to the regular work schedule such as overtime, weekends, and holidays. See, for example, http://www.bls.gov/news.release/pdf/ecec.pdf.

[21] Bureau of Labor Statistics. (2008). "Employer Costs for Employee Compensation—September 2008." Available at http://www.bls.gov/news.release/pdf/ecec.pdf. It is important to note that these reported benefits (30.3 percent benefit share of total compensation and 32.1 percent benefit share for workers in the hospital industry) include paid leave and supplemental pay as part of benefits pay, not wage pay. If we adjust these shares to make them comparable with Worksheets A and S-3 benefit information, they would decrease to 26 percent and 25.5 percent respectively.

[22] For geographic variation, please see ftp://ftp.bls.gov/pub/special.requests/ocwc/ect/ececqrtn.pdf.

compensation[23] (i.e. the ratio of benefits to total compensation, or "benefit shares"),

estimated with Worksheet S-3 data, and shows how benefit shares vary by geographic

region and type of hospital.[24] We can see that hospitals in the Northeast-Mid Atlantic

have higher average benefit shares compared to Southern hospitals. Additionally,

hospitals in urban areas tend to report lower benefits shares than hospitals in rural areas.

These differences are statistically significant.

Table 3.1: Benefit Costs as a Fraction of Total Compensation, by Region and Type of Hospital: Worksheet S-3 Data

	Number of Hospitals	Average	Std Dev.
All IPPS Hospitals	3,348	18.90%	0.049
Region			
Northeast-Mid Atlantic	549	20.20%	0.042
Midwest	747	20.00%	0.042
West	593	18.80%	0.063
South	1,344	18.00%	0.045
Type			
Urban	2,394	18.60%	0.049
Rural	954	19.80%	0.049

In addition, workers in the hospital industry have seen their benefits as a fraction

of total compensation increase over time, consistent with average trends for all workers in

the U.S.[25] These trends reflect the fact that benefits are an important and growing portion

of compensation. Wages *and* benefits together define the value of a job to employers and

employees alike. Benefits can be structured in a multitude of ways to encourage workers

to be more productive or responsive to on the job needs. BLS's NCS data reflect this

fact. Any geographic compensation index that attempts to reflect the true cost of

employment must accurately account for geographic variation in both sources of

payment.

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[23] Total compensation refers to the wages used to construct the Medicare wage index. These wages are calculated by combining wages and benefits.

[24] A detailed explanation of how we estimate Worksheet S-3 benefits is provided below in section 3.2.2.

[25] Please see Table 1 (Civilian workers, by major occupational group: employer costs per hours worked for employee compensation and costs as a percentage of total compensation, 2004-2008) in the Employer Costs for Employee Compensation Historical Listing at ftp://ftp.bls.gov/pub/special.requests/ocwc/ect/ececqrtn.pdf.

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Given that benefits account for a large share of total compensation, it is important to understand the relative effects benefits may have on a hospital wage index. We examine both how raw benefits numbers differ across wage areas, and also consider how the inclusion of these data impacts the wage index. To explore this question we compare two versions of the Medicare wage index, one that includes benefit costs, and another that does not include benefit costs.

The Medicare hospital wage indices are constructed from Worksheet S-3 of IPPS hospital costs reports. CMS uses these reports, which includes data on wages, hours worked, and wage-related costs (i.e. benefits) by hospital, to estimate the average hourly compensation rate (including both wage and benefit costs) by hospital and wage area. These estimates of average hourly compensation are used to construct the Medicare hospital compensation index.[26] To construct a hospital wage index without benefits, we simply subtract the benefits – lines 13, 14 and 18 of the hospital cost reports – from the total provider wages used to construct Medicare's hospital wage index. Wage related costs in Worksheet S-3 are represented by lines 13, 14 and 18. Line 13, for example, stands for the Core Wage-Related Costs, which include:

- Retirement Costs: 401(k) Employer Contributions, Tax Sheltered Annuity (TSA) Employer Contribution, Qualified and Non-Qualified Pension Plan Cost, and Prior Year Pension Service Cost.

- Plan Administrative Costs (Paid to External Organization): 401(k)/TSA Plan Administration Fees; Legal/Accounting/Management Fees-Pension Plan, and Employee Managed Care Program Administration Fees.

- Health and Insurance Costs: Health Insurance (Purchased or Self-Funded), Prescription Drug Plan, Dental, Hearing and Vision Plans, Life Insurance, Accident Insurance, Disability Insurance, Long-Term Care Insurance, Workers' Compensation Insurance, and Retiree Health Care Costs.

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[26] These data can be found in the Public Use Files S-3 Wage and Occupational Mix Data in the CMS website: http://www.cms.hhs.gov.

- Taxes: FICA (Social Security and Medicare Taxes), Unemployment Insurance, and State or Federal Unemployment Taxes.

- Other: Executive Deferred Compensation, Day Care Cost and Allowances, and Tuition Reimbursement.

Line 14, refers to wage-related costs that are considered an exception to the list of core costs,[27] and line 18 refers to the wage-related costs (core and other costs) of Part A Physicians.

Using this calculation, we can compare index values that include benefits information to index values that do not. First we examine the change in total compensation when benefits are included in the wage calculation. To look at this difference we analyze the distribution of percent increases in compensation when wages and benefits are combined. Table C.1 in the appendix presents these results.

While we expect that wage values will increase once benefits are accounted for, the effects of including benefits in a hospital wage index are harder to predict. Using the current Medicare wage index methodology, an increase or decrease in index values depends on how this value changes in a particular area relative to the change in the national average hourly wage, inclusive of benefits. Hospitals located in areas where the average hourly wage (plus benefits) increases are larger than the national average wage (plus benefits) increases will see their index values increase. Likewise, hospitals in areas where the increase in the average compensation is smaller than the national increase experience a fall in their index values.

Because benefit shares vary geographically, we expect that some areas will see their values increase while others will see their values decrease. To measure the percent change in wage index values we subtract the index without benefits from the index with benefits, and divide this difference by the index without benefits. The distribution of

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[27] For a wage-related cost to be considered an exception, it must meet all of the following criteria: the cost is not listed on Exhibit 7, Part I of Form CMS-339; the wage-related cost has not been furnished for the convenience of the provider; the wage-related cost is a fringe benefit as defined by the Internal Revenue Service, and, where required, has been reported as wages to IRS; and, the total cost of the particular wage-related cost for employees whose services are paid under IPPS exceeds 1 percent of total salaries after the direct excluded salaries are removed.

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these percent differences is reported in Tables 3.2 and 3.3 below. Herein we report the relative changes in index values with and without benefits at two different levels of detail. First we present this information at the wage area level (Table 3.2) and then at the hospital level (Table 3.3). Summary statistics for both indices can be found in the appendix in Table C.2.

Table 3.2: Distribution of Percentage Change in Wage Index Values by Wage Area, from Medicare Wage Index without Benefits to Medicare Wage Index with Benefits

	Number	Percent
Between -10% and -5%	4	0.94%
Between -5% and -1%	131	30.68%
Between -1% and 0%	51	11.94%
Between 0% and 1%	56	13.11%
Between 1% and 5%	145	33.96%
Between 5% and 10%	32	7.49%
Greater than 10%	8	1.87%
Total	427	100.00%

Table 3.3: Distribution of Percentage Change in Wage Index Values by Provider, from Medicare Wage Index without Benefits to Medicare Wage Index with Benefits

	Number	Percent
Between -10% and -5%	37	1.09%
Between -5% and -1%	1,243	36.52%
Between -1% and 0%	525	15.42%
Between 0% and 1%	505	14.84%
Between 1% and 5%	934	27.44%
Between 5% and 10%	144	4.23%
Greater than 10%	16	0.47%
Total	3,404	100.00%

Although Table 3.2 shows that a larger percentage of wage areas experience an increase in index values when the index includes benefits (i.e., roughly 56% of differences are positive), at the provider level (see Table 3.3) the opposite is true: a larger number of providers actually experience a decrease in their index values when benefits information is included in the index (i.e., about 53% of differences are negative). This means that for a larger share of providers the percentage increase in the average hourly

wages of the hospital was lower than the percentage increase in the national average hourly wage.

The fact that the percentage of areas with increases is higher than the percentage of hospitals with increases suggests that the minority of areas that experienced decreases contain a relatively large number of hospitals. We know that the number of hospitals in urban areas is higher then in rural areas. When we compare benefit shares of rural and urban hospitals we see that rural hospitals tend to have higher benefit shares than urban hospitals on average, and this difference is statistically significant (Table 3.1). For differences in index values by type of region, see appendix Table C.3. The analysis above shows that incorporating benefits has a real impact on index values; however, this impact is not geographically uniform and depends on the geographic variation of benefit shares relative to the national average.

The effect of benefits on the wage index is not particular to the Medicare wage index. MedPAC also finds that incorporating benefits into the wage index impacts the values of the BLS wage index.[28] Acumen considered the following comparisons: (1) MedPAC's hospital wage index versus the Medicare Pre-Reclassification Index, and (2) MedPAC's compensation index versus the Medicare-Pre-Reclassification Index. Acumen found that a higher percentage of hospitals have positive increases when adopting MedPAC's hospital wage index than when adopting MedPAC's compensation index. This finding is consistent with the results presented in Table 3.3 and suggests that adjusting the BLS hospital wage index with Worksheet A will result in a higher number of hospitals experiencing decreases in their index values. Thus, adjusting either the BLS or Medicare hospital wage indices for benefits leads to increases in index values for some hospitals, and decreases in index values for others.[29]

Accounting for benefit costs in a hospital wage index is important given that benefits represent a significant portion of total labor costs and vary geographically. As

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[28] Please see "An alternative method to compute the wage index" in Section 6 of Report to the Congress: Promoting Greater Efficiency in Medicare. Medicare Payment Advisory Commission, June 2007, Page 134.

[29] For additional details, please see Acumen's Impact Analysis for the 2009 Final Rule in http://www.acumenllc.com/reports/cms/RevisedImpactAnalysisfor2009FinalRule.pdf.

shown above, taking benefit costs into account in a hospital wage index has a significant impact on the index values. As a result, choosing a consistent and reliable source of benefits data is relevant. The following sections describe the different sources of benefits data used in the Medicare hospital wage index and the MedPAC hospital compensation index and their possible advantages and disadvantages.

3.2   Benefit Costs in Hospital Wage Indices Constructed from Medicare and BLS Data

The existing Medicare hospital wage index and MedPAC compensation index incorporate benefit costs differently. In contrast to the Medicare hospital wage index, the BLS wage index does not directly take benefit costs into account. To construct the BLS hospital wage index, MedPAC uses average hourly wage data by occupation from the BLS's OES program. Data from the OES, however, do not include benefit costs. To account for benefit costs in constructing the BLS hospital compensation index, MedPAC constructs a benefit adjustment factor using data from Worksheet A of the hospital cost reports. Worksheet A data include information on hospitals' wage and benefit costs. The benefits data in Worksheet A include, but are not limited to the employers' share of the Federal Insurance Contributions Act tax (which includes Social Security and Medicare taxes), pension costs, unemployment insurance, health insurance, and 401k contributions by employers, among other wage related costs. When creating its compensation index, MedPAC substitutes Worksheet S-3 data for hospitals with apparently unreliable Worksheet A data. MedPAC deemed data "unreliable" if the reported benefit costs as a share of wage costs are greater than 35 percent or less than 15 percent. In a separate analysis of benefit shares we find that the number of hospitals with Worksheet A data that are deemed "unreliable", i.e., with shares greater than 35 percent or less than 15 percent, is substantial – approximately 35 percent.

3.2.1.   Differences in Sources of Benefits Data

As discussed above, the existing Medicare hospital wage index already incorporates benefits data from Worksheet S-3 of the Medicare hospital cost reports, while the proposed BLS compensation index uses benefits data from Worksheet A to

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adjust for the lack of benefit cost information in the OES data. These sources of benefit costs information differ in important ways.

One major difference between Worksheet S-3 and Worksheet A is the way in which benefit costs are reported. Worksheet A does not report total benefit costs either in a single field or a series of fields that could be summed to obtain the total benefit costs. The only field on Worksheet A that may contain benefit costs for some hospitals is column 2, line 5 (the benefits cost center line). However, hospitals are not instructed to consolidate all benefit costs in this field. Unlike Worksheet S-3, Worksheet A lacks an established set of guidelines and supervision. Medicare cost report principles allow providers discretion in recoding benefits on Worksheet A to coincide with the provider's accounting and record keeping system, which was sufficient to support the original use of the cost report for cost-based reimbursement. However, provider discretion makes the data less reliable for applications such as the wage index.

A second difference is that Worksheet A allows (but does not require) the "reclassification" of benefit costs from other cost centers to the benefits cost center (line 5). However, as currently configured, there is a single column for all reclassifications. Reclassified items in column 2 (such as benefit costs) are not identified separately from the reclassified wages in column 1. Therefore, it is not possible with the current Worksheet A to reliably identify benefit costs.

Another difference between these sources of information is the review process used to verify the data. Worksheet S-3 wage data undergo an eight month review and correction process and several iterations from the initial unaudited release to the finalized version which is used to construct the wage index. From the initial October release of the preliminary data, hospitals have 2 months to request revisions. Medicare's administrative contractors then complete desk reviews and transmit revised data to CMS by February. Also in February, CMS subjects the wage data to additional edits before releasing *revised* wage index and occupational mix files as public use files. Hospitals then have the opportunity to submit requests and supporting documentation for corrections of errors or revisions in response to intermediary adjustments. Corrected or revised data are then resubmitted to CMS and, in late April, after additional editing, the data are sent back to

Medicare's administrative contractors to undergo a final verification. Hospitals can request corrections until June. Then *final* wage index data are released on the CMS website in May, where hospitals have one month to verify and again submit correction requests. In August, at the end of this process, the Final Rule data set is publicly released. There is no reason to think that this lengthy review process would be eliminated by substituting Worksheet A for Worksheet S-3 data.

Revisions aside, recall that Worksheet S-3 still suffers from the fact that benefits data come exclusively from hospitals. Thus, the weight of each hospital's cost report numbers is relatively high in areas where only a small number of hospitals are present. This implies that any errors made on cost reports are translated to all the hospitals in the wage area.

In the next section, we analyze the differences between the data reported on these worksheets. We specifically examine the benefits that MedPAC incorporates into their compensation index. We look first at the distribution of benefit costs of Worksheets A and S-3, then consider the distribution of the difference between benefit costs of Worksheets A and S-3 and report the number of hospitals that experience "large" and "small" differences between these two Worksheets.

3.2.2. *Analysis of Worksheet A and Worksheet S-3 Benefits Data*

We report two sets of analyses in order to assess differences between the benefits data collected in Worksheet A and in Worksheet S-3. In the first one, we compare the benefit costs reported in Worksheet A with those reported in Worksheet S-3 at the hospital level. In the second one, we determine which types of hospitals had relatively large discrepancies between the benefit cost information reported in Worksheet A and that reported in Worksheet S-3.

Acumen's main findings of the differences between the information reported by hospitals on Worksheet A and on Worksheet S-3 are the following:

- The benefit data reported in Worksheet A do not closely correspond to the data reported in Worksheet S-3 for the large majority of hospitals.

- In particular, more than 51% of hospitals report benefits in Worksheet A that differ by more than 25% (both larger than and smaller than) from reported values in Worksheet S-3 for the same hospital.

We turn now to the empirical analysis. In order to construct the benefits for Worksheet S-3, Acumen used Part II column 3 ("Adjusted Salaries") lines 13, 14, and 18 ("Wage-related costs (core)", "Wage-related costs (other)", and "Physician Part A" respectively).[30] As mentioned previously, we use Worksheet S-3 data provided by CMS for fiscal years 2006-8 which has undergone review. The benefit information for Worksheet A comes from a single field: column 2 line 5.[31]

Acumen analyzed hospital cost reports from IPPS hospitals that had benefit data in both Worksheets A and S-3 for each of three fiscal years: 3,733 hospitals in FY2002, 3,443 in FY2003 and 3,372 in FY2004. Hospital cost reports for these three years were used to construct the Medicare hospital wage indices for FY2006, FY2007, and FY2008 respectively. We analyzed these data separately for each year, and with the data pooled for the three years. The results were very similar for each separate year. To simplify the presentation, we present the results of the analysis using pooled data.

We examine reporting discrepancies between the two worksheets by calculating the ratio of benefits reported on Worksheet A to benefits reported in S-3 (i.e., Benefits(A)/Benefits(S-3)). If the cost reported by a hospital in Worksheet A is the same as the cost reported in Worksheet S-3, the ratio of these costs will equal one. Below in Figure 3.1, we plot the distribution of this ratio of benefit costs using the pooled data from 2006-8. This results in a sample with a total of 10,548 ratios from Worksheet A and S-3 information. Individual years exhibit similar frequency distributions.

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[30] See previous section (section 3.1.1) of this analysis for a detailed explanation of lines 13, 14 and 18.
[31] We dropped from our analysis providers with negative Worksheet A benefit values (26 in 2002, 25 in 2003, 27 in 2004), and outliers which were influencing the mean of the univariate analyses (i.e., providers with a ratio of Benefits A/Benefits (S-3) larger or equal to 10. We found 3 providers in 2006, 2 in 2007, and 1 in 2008).

Figure 3.1: Distribution of Benefit Costs Reported in Worksheet A to Benefit Costs Reported in Worksheet S-3
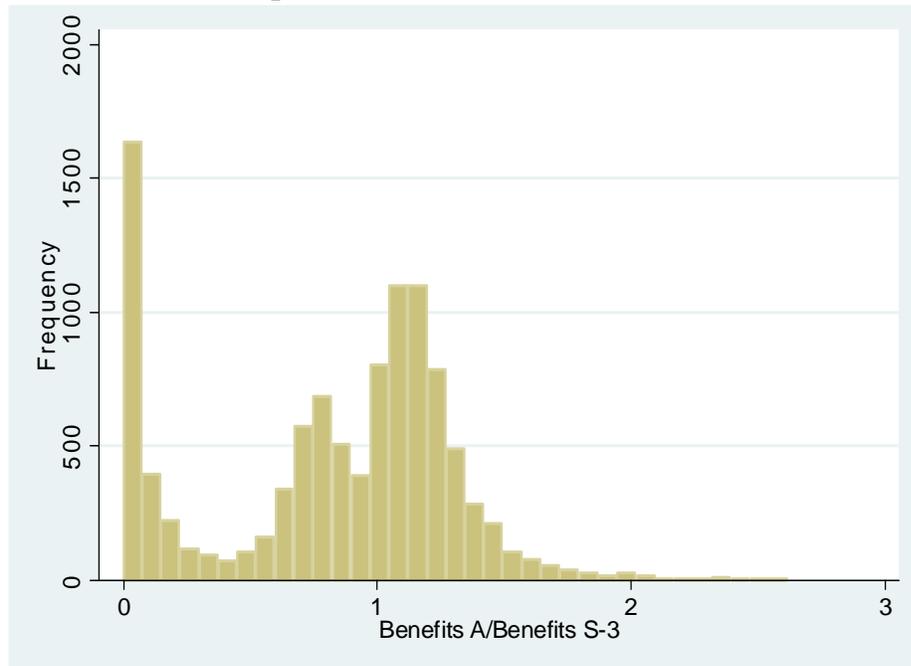
Figure 3.1 clearly shows that hospitals frequently do not report identical information on the cost of providing benefits on both worksheets. In fact, there are often substantial differences between these reports of benefit costs.

Differences in hospitals' reports of their benefit costs across worksheets are widespread. Table 3.4 below illustrates this fact. Over 51 percent (about 51.27%) of hospitals' reports of benefits in Worksheet A differ by more than 25% (larger and smaller) than reported benefits in Worksheet S-3 of the same hospital.

Table 3.4: Percent Differences in Benefit Costs Worksheet A versus Worksheet S-3

	Number	Percent
Less than -75%	2,298	21.79%
Between -50% and -75%	302	2.85%
Between -50% and -25%	1,135	10.76%
Between -25 and -5%	1,457	13.81%
Between -5% and -1%	216	2.05%
Between -1% and 1%	254	2.41%
Between 1% and 5%	474	4.49%
Between 5% and 25%	2,739	25.97%
Between 25% and 50%	1,216	11.53%
Between 50% and 75%	259	2.46%
Greater than 75%	198	1.88%
Total	10,548	100.00%

Note: The percent difference is the Worksheet A benefits less the Worksheet S-3 benefits as a percentage of the Worksheet S-3 benefits

There are hospitals with higher benefits and hospitals with lower benefits reported in Worksheet A relative to Worksheet S-3. A larger fraction of hospitals have extreme negative comparisons (lower benefits reported in Worksheet A) than extreme positive comparisons (higher benefits reported in A). Over 24 percent of hospitals reported benefits on Worksheet A that were more than 50 percent smaller than what they reported on Worksheet S-3 and an additional 10 percent reported benefit to wage ratios on Worksheet A that were between 25 percent and 50 percent smaller than what they reported on Worksheet S-3. At the same time, over 15 percent of hospitals reported benefit to wage ratios that were 25 percent or greater in Worksheet A than in Worksheet S-3.

We also examine discrepancies between Worksheet A and S-3 benefits with regard to the following hospital characteristics: geographic location, urban/rural setting, size (measured by number of beds), and teaching status (See Appendix Table C.4 for more details). There are significant differences between the information reported in Worksheet A and in Worksheet S-3 for all types of hospitals (rural and urban hospitals, hospitals in all regions of the country, hospitals of all sizes, and both teaching and non-teaching hospitals). In particular, hospitals in the Northeast / Mid Atlantic region and rural hospitals tend to report higher values for the benefit costs on Worksheet A relative

to Worksheet S-3. Meanwhile, hospitals in the West region, urban hospitals, teaching hospitals, and 'larger' hospitals (100 + beds) tend to report lower values for the benefit costs on Worksheet A than on Worksheet S-3. We used a regression analysis to better understand the independent correlations between these attributes. The results of the regression confirmed the relationships described in the tables. Details can be found in Appendix Table C.5.

3.3 Potential Alternative Sources of Benefit Cost Data: The ECEC

In this section we discuss the advantages of having both wage and benefits data collected from a single agency, compare benefit cost data from an alternative source, the ECEC series from BLS, with the benefit cost data from hospitals' cost reports, and describe how these data could be used to adjust the BLS wage index to account for regional variation in benefit costs. Finally, we describe some ideas that could be implemented in the future to overcome the limited geographical detail provided by the ECEC data. The main findings of this section are the following:

- There are advantages in having a single agency collect data on both wages and benefits. It is the opinion of Acumen that the BLS is best suited to be this agency.

- The ECEC provides estimates for benefit costs as a fraction of wages for all industries for 9 Census regions (more detailed geographic estimates and geographic estimates for the hospital industry are not available).[32] These estimates could be used to adjust the BLS wage index for the cost of providing benefits.

- Geographic variation in benefit costs as a fraction of wages for the hospital industry could be obtained by CMS's working with BLS to expand the size of the NCS or by employing imputation methods.

Even though benefit cost information from Worksheet S-3 could be used to adjust the BLS index, Acumen believes there are substantial disadvantages from combining BLS wage and Worksheet S-3 benefits data. First, collecting only benefits data in

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[32] In order to discuss regional variation we examine benefit to compensation ratios in this section.

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Worksheet S-3 would not significantly reduce the burden and cost of data collection for CMS. Second, if only benefit information were collected in Worksheet S-3, it would not be possible to verify consistency between wages and benefits. Third, as discussed in more detail below, CMS and BLS define wages and benefits differently, and CMS would need to change its definition of benefits to be consistent with BLS wage data.

Furthermore, there would be a real advantage in using BLS data for both wages and benefits. The BLS OES data is collected by the State Workforce Agencies (SWAs), which administer the unemployment insurance program. Establishments in both the BLS NCS and the OES are selected from lists maintained by the SWAs for unemployment insurance purposes. This connection between the unemployment insurance program and the two BLS surveys is likely to increase the accuracy and reliability of the wage and benefit data.

Benefits data available from the NCS offer an alternative, though limited, source of benefit cost data. The National Compensation Index is used to construct the Employer Costs for Employee Compensation (ECEC) series. Collected on a quarterly basis, the survey includes information about wages, salaries, and benefits costs by industry groups (including the hospital industry), by occupation group, and by nine geographic divisions. Although the wages series began in 1975, the benefits data were collected starting in 1981.

According to the latest data available in the ECEC, nationwide, benefit costs as a fraction of compensation costs in the hospital industry were 31.4 % in September 2008. There is sufficient detail about the sources of benefit costs in the ECEC to allow a direct comparison to the benefit data reported in Worksheet S-3. The benefits included in the ECEC data are:

- Paid leave: vacations, holidays, sick leave, and personal leave.

- Supplemental pay: premium pay for work in addition to the regular work schedule (such as overtime, weekends and holidays), shift differentials, and nonproduction bonuses (such as referral bonuses and attendance bonuses).

- Insurance benefits: life, health, short-term disability, and long-term disability.

- Retirement and savings benefits: defined benefit and defined contribution plans, and,

- Legally required benefits: Social Security and Medicare (FICA taxes), federal and state unemployment insurance, and workers' compensation.

The benefit costs that appear in the ECEC but not in Worksheet S-3 include paid leave and supplemental pay. These items are included in Salaries in Worksheet S-3. If we adjust benefit data to accord more closely with calculations performed by CMS (i.e., if we subtract both paid leave and supplemental pay from total benefits), this share is 19.7%, which is very similar to the average share reported by all IPPS hospitals, 18.9% (see Table 3.1).[33] Additionally, the relative importance of each of the benefit components with respect to total compensation for the year 2008, according to ECEC, is as follows: 8.8% corresponds to insurance benefits; legally required benefits, including Social Security and Medicare (FICA taxes), unemployment insurance, and workers' compensation, accounts for 7.3% of total compensation; paid leave accounts for 8.6%; retirement and savings benefits for 3.5%; and, supplemental pay accounts for 3.2%.

The paid leave and supplemental pay categories amount to almost 12% of total compensation. These two represent around 37% of total benefit costs, and as mentioned before these are not considered wage-related costs, but rather are counted as Salaries in Worksheet S-3.

Relative to the ECEC, hospitals report similar benefit costs as a fraction of total compensation in Worksheet S-3. However, we do not have the full distribution of ECEC's benefit shares, so these results are partial.

Unfortunately, the ECEC currently does not provide estimates of benefit and wage costs for the hospital industry at the regional level (or at a more detailed geographic level). However, so long as benefit costs as a fraction of total compensation vary

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[33] Raw figures come from http://www.bls.gov/news.release/pdf/ecec_12102008.pdf.

regionally in the hospital industry to the same extent that they vary regionally for all industries, one could use regional estimates of benefit and total wage costs for all industries to adjust the wage index. In particular, one would make the following adjustment to construct a compensation index from the BLS wage index:

$$I_{ij}^c = I_{ij}^w \times \left[1 + \left(\frac{B_j}{C_j}\right)\right] \Big/ \left[1 + \left(\frac{B_N}{C_N}\right)\right],$$

where:

I_{ij}^C is the compensation index for wage area i in region j,

I_{ij}^W is the wage index for wage area i in region j,

$\dfrac{B_j}{C_j}$ is the ratio of benefit costs to total compensation in region j, and

$\dfrac{B_N}{C_N}$ is the ratio of benefit costs to total compensation nationally.

Table 3.5 presents an estimate of the benefit costs including insurance and pension benefits, paid leave and supplemental pay, retirement and savings, as well as of the employer's share of payroll taxes, as a fraction of total compensation, for each of the nine Census regions in September 2008.[34,35] One can observe that the benefit shares for workers in all industries vary by region.

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[34] The numbers for this table can be found at http://www.bls.gov/ro7/ro7ecec.htm.

[35] Payroll taxes here refer to Social Security and Medicare (FICA taxes), federal and state unemployment insurance, and workers' compensation.

Table 3.5: Benefit Costs as a Share of Total Compensation, by Region: ECEC

Region	ECEC
New England	0.286
Mid Atlantic	0.309
South Atlantic	0.280
East South Central	0.287
West South Central	0.276
East North Central	0.304
West North Central	0.294
Mountain	0.282
Pacific	0.296

If the geographic variation in benefit shares for the hospital industry is the same as for all industries, one could use the benefit shares in Table 3.5 to adjust the BLS wage index. However, if the geographical variation in benefit shares for the hospital industry is different from that for all industries, then an alternative method to adjust the BLS wage index is needed.

One potential solution would be for CMS to work with BLS to expand the NCS to collect more benefit information for a larger sample of workers in the hospital industry. With a larger sample, estimates of benefit shares for the hospital industry could be constructed for each Census region.

A second potential solution would be to impute benefit shares for the hospital industry for each Census region. This imputation could be conducted by estimating the association between hospital and wage area characteristics and benefit shares. Table C.6 in the appendix reports the results of a linear regression that estimates the relationship between several hospital and wage area characteristics and the benefit to total compensation share estimated using Worksheet S-3 data. Consistent with the results observed in Table 3.1 above, we can see that hospitals in urban areas have lower benefit shares than hospitals in rural areas. Likewise, hospitals that are located in the South have lower benefit shares than hospitals located elsewhere. Hospital characteristics such as number of beds and teaching status do not have a statistically significant association with benefit shares.

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The purpose of presenting the regression results in Table C.6 is to demonstrate one way to identify hospital and geographic characteristics that are associated with benefit shares which could be used to impute the ECEC data, or to help in the design of a survey of hospitals that contains significant variation in both geography and hospital traits.

3.4 Conclusion

The aim of a hospital wage index is to capture as accurately as possible geographic variation in total labor costs. Benefit costs represent a significant part of total labor costs. Thus, accounting for benefits in a hospital wage index is important. With regional variation in benefit costs the inclusion of benefits in a wage index will not result in a uniform increase in index values. Some hospitals will experience increases in their index values, while others will experience decreases. While benefits costs may increase the total cost of labor, the direction of change in the index value depends upon the size of the change in index values in an area relative to the size of the national average change.

Given the significance of benefit costs, the source of benefit data is relevant to any discussion about the construction of a wage index. The benefit cost information reported by hospitals in Worksheet A of the hospital cost report is not consistent or reliable. There are both large numbers of hospitals that report low values and large numbers of hospitals that report high values of benefit costs in Worksheet A relative to Worksheet S-3.

Because of these deficiencies in Worksheet A data, Acumen believes that there is little justification for using Worksheet A data in place of Worksheet S-3 data. MedPAC was able to use Worksheet A data only by using Worksheet S-3 data for those hospitals with poor quality Worksheet A information. Unless the quality of the cost reports in Worksheet A can be substantially improved, we do not believe these data should be used.

BLS data on benefits, collected in the NCS and currently published as part of the BLS's Employer Costs for Employee Compensation (ECEC) series, should be considered for use as part of a compensation index. One advantage of these data source is that it is independent of Medicare reimbursements. This is in contrast to the current system in

which the costs reported by hospitals, especially in areas with few hospitals, can have a significant impact on index values.

In addition, having only one agency collect both benefit and wage data would lessen the cost incurred with the continued submission and review of Worksheet S-3 data, and would also increase consistency in the data. Given the accuracy of the wage data reported to BLS (with the OES survey being partially administered by SWAs, which are in charge of unemployment insurance programs), the BLS is a natural candidate to be that agency. Therefore, while the data available at present are limited, CMS should work with BLS to determine the feasibility of expanding the geographic detail of the BLS compensation data to become a viable source of benefits data for the hospital wage index.

It will be important to capture the geographic variation in benefits (and wages) in order to allow for compensation indices that accurately reflect the cost of labor in different areas. This variation in both wages and benefits likely reflects both the different costs of labor, but as well the different mix of labor that hospitals employ. Taking account of the occupational mix has been challenging in the past. CMS aggregates its hospital level data, thereby averaging over the details of each hospital's labor choices. It addresses this issue in the index through the use of a specific weighting strategy. MedPAC suggests an alternative weighting strategy. We examine these weighting mechanisms and their impact on the wage index in the following section.

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The following analysis examines the impact of using fixed national weights and cross-industry wages to construct the wage index using BLS data. The analysis is based on summary statistics that BLS produced from special tabulations of OES data. This task also reviews the OMA used by CMS. The major findings of this section are as follows:

- Acumen believes that the use of national fixed occupation weights in the construction of the BLS wage index is not overly restrictive. Acumen analyzed the impact of changing the geographic basis of the weights from the nation to the state and found that a less restrictive set of occupation weights calculated for each state yields virtually identical BLS wage index values for almost all wage areas.

- MedPAC's choice of 30 occupations used to construct the fixed weights and the BLS wage index is reasonable. However, this specific set of occupations was not chosen using a clear predetermined rule. To rectify this, Acumen selected the 62 most prevalent four-digit hospital occupations, which account for approximately the same share of total wages as MedPAC's 30 occupations, to construct the fixed weights and the BLS wage index. Acumen believes this issue is important because wage index values are modestly sensitive to this choice. Roughly 14 percent of wage areas experience a 2 percent or greater change in their wage index values when a different, but equally reasonable, set of occupations are used to construct the index.

- Both the use of a national fixed weight index and the use of the OMA could, in principle, properly adjust for geographic differences in the occupational mix. The OMA does make a modest difference. Almost 24 percent of wage areas have their index values adjusted by 2 percent or more as a result of the OMA. However, it is the opinion of Acumen that fixed weights are a better method of adjusting for geographic differences in occupational mix than the OMA. This is because the OMA is applied just to "nursing" employees, which represent only 40 percent of hospital employment.

The Use of Fixed Weights and Cross-Industry Wages in Constructing a Wage Index from BLS Data

A central feature of the BLS wage index is that it adjusts for differences in occupational mix across geographic areas. The BLS wage index is a fixed-weight (Laspeyres) index where the weights are chosen to represent the distribution of occupations within the hospital industry nationally. The use of national fixed weights means that a hospital that chooses to use a relatively more skilled (and more expensive) workforce will not necessarily receive higher wage index values. Wage index values are determined solely by the relative cost of employing hospital workers of the same occupation across geographic areas.

The BLS hospital wage index relates the average hourly wages by occupation (excluding benefits) weighted by the national hospital occupation shares in a wage area to national average hourly wages also weighted by the national hospital occupation shares. This index can be expressed as,

$$Index_j = \frac{\sum_i s_{iN} \times w_{ij}}{\sum_i s_{iN} \times w_{iN}} \tag{1}$$

where $Index_j$ is the national fixed weight index, w_{ij} is the average hourly compensation level in occupation i in all industries in wage area j, w_{iN} is the average hourly compensation level in occupation i in all industries nationally, and s_{iN} are the nation-wide share of hospital employment in each occupation, i. Wage areas are MSAs and state-rural residual areas.

The 30 occupations and occupational groupings chosen by MedPAC to construct the fixed-occupation weights are among the most prevalent occupations in the hospital industry nationally.

There are three issues related to the construction of this index that we will assess in this section. The first is whether the use of national occupation weights is overly restrictive relative to occupation weights based on smaller geographic regions. The second is the selection of the set of occupations from which one constructs the fixed occupation weights. The third is an assessment of the merits of the OMA as a solution to

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geographic variation in occupational mix, both relative to making no adjustment and relative to the use of a national fixed weight index.

In the following section, we discuss each of these issues in turn.

4.1 The Use of National Fixed Weights in Constructing a Wage Index from BLS Data

The use of a fixed weight index is a natural way to address differences in occupational mix across geographic wage areas. A hospital's choice of occupational mix may result in the Medicare wage index suffering from the problem of endogeneity. By endogeneity, we mean changes in the index that are associated with the index itself. Two problems with the Medicare wage index fall under this heading. First is the problem of circularity, where hospitals that choose to pay relatively high wages get higher index values, which in turn allows them to pay higher wages. Similarly, the opposite occurs when hospitals start with relatively low wages. Second is the problem of occupational mix. As with the circularity problem, in the absence of an adjustment for occupational mix, hospitals with relatively higher proportions of skilled staff receive higher index values.[36]

To address the problem of circularity, the BLS wage index is constructed to reflect geographic variation in the price of labor as opposed to geographic variation in labor expenses. We previously discussed the merits of a geographic price index relative to a geographic expense index in Section 2.3.

Of course, it is possible that due to state-mandated staffing requirements or other regional factors, the use of national fixed weights based on employment shares is overly restrictive. If so, then the use of regional or state-level fixed weights based on employment shares at the region or state level would still account for "local" choices yet be flexible enough to allow for regional variation in staffing considerations that are unrelated to the hospital index.

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[36] CMS has recently introduced additional data collection to address the occupational mix of nurses and other hospital staff that are combined together in the average wage reported by the hospital. We discuss this further refinement of the OMA in Section 4.3.

In order to assess the impact of using national fixed weights as opposed to state-level fixed weights, we calculate the following modified BLS wage index:

$$Index_j^M = \frac{\sum_i s_{iS} \times w_{ij}}{\sum_i s_{iS} \times w_{iN}} \qquad (3)$$

where $Index_j^M$ is the state-level fixed weight index, w_{ij} is the average hourly compensation level in occupation i in all industries in wage area j, w_{iN} is the average hourly compensation level in occupation i in all industries nationally, and s_{iS} are a set of state-wide hospital employment shares for each occupation, i.[37] Wage areas are once again MSAs and state-rural residual areas.

4.2 Sensitivity of the Wage Index from BLS Data to the Choice of Weights

The 30 occupations and occupational groupings chosen by MedPAC to construct the fixed-occupation weights are among the most prevalent occupations in the hospital industry, nationally, and are listed along with their hospital industry employment and wage shares in the appendix in Table A.1. The employment shares for each occupation are calculated as the fraction of all workers in the hospital industry nationally who are also in that occupation. The national wage shares are calculated as the percentage of wages that each hospital occupation accounts for relative to the total wage share of all hospital occupations.

Acumen could not determine any predetermined rule that would lead one to select these 30 occupations, some of which are aggregates of smaller occupations. Exactly how these thirty occupations were chosen and how some occupations were aggregated into occupational groups is not clear. To test whether the BLS wage index is sensitive to the choice of weights, Acumen created an alternative set of fixed occupation weights and reconstructed the BLS wage index using these alternative weights.

The predetermined rule we use to select the group of occupations to include for this alternative BLS wage index is the following. We choose the 62 most prevalent four-

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[37]The analysis completed by Acumen was based on summary statistics that BLS produced from OES data.

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digit occupations in the hospital industry, where prevalence is determined by wage share. We do not aggregate any occupations into occupational groups. Unlike MedPAC, we elect not to aggregate any occupations into larger categories because we cannot see how this aggregation can be conducted in a non-discretionary manner. We believe that MedPAC's choice of 30 occupations, which accounts for 84.3% of total wages, is reasonable. Thus, we choose 62 occupations because this number yields approximately the same total wage share (85.9%) as MedPAC's occupations. These 62 occupations and their hospital industry employment and wage shares are listed in Table D.1.

4.3 Medicare's Occupational Mix Adjustment

The MedPAC (2007) report recommended the use of a fixed weight index as a way to adjust for differences in occupational mix across wage areas. Previously, based on a MedPAC recommendation, Congress mandated in the Medicare, Medicaid, and State Children's Health Insurance Program Benefits Improvement and Protection Act (BIPA) of 2000 that CMS use the OMA to adjust the Medicare wage index for geographic differences in occupational mix.[38] However, the OMA is applied only to the nursing "class" of occupations.

The OMA works in the following way. It considers five subcategories of nurses within the occupational class, "nursing." These are Registered Nurses/Management (RNs Management), RNs Staff, Licensed Practical Nurses (LPNs), Nursing Aides, and Medical Assistants.[39]

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[38]Please see RTI International Report, "Potential Refinements to Medicare's Wage Indexes for Hospitals and Other Sectors", prepared for MedPAC, June 2007.

[39] The occupational categories and definitions included in the OMA survey derive directly from the BLS, 2001 Occupational Employment Statistics survey. The BLS standard occupational categories (SOCs) for these occupations are the following: Registered Nurses (RNs, SOC 29-1111), Licensed Practical Nurses (LPNs, SOC 29-2061), Surgical Technologists (SOC 29-2055), Nursing Aides, Orderlies, & Attendants (SOC 31-1012), and Medical Assistants (SOC 31_9092). For more detail on the OMA, please see "2007-2008 Hospital Form CMS-10079 OM Survey Instructions and Definitions", which can be downloaded from the CMS website http://www.cms.hhs.gov/AcuteInpatientPPS/WIFN/.

The hospital-specific occupational mix adjusted average hourly wage is calculated by:

$$\frac{\alpha \times Salaries_n + Salaries_o}{Hours}, \tag{4}$$

where

$$\alpha = \frac{w^N_n}{\sum\limits_{j=1}^{5} w^N_j \times s_j}, \tag{5}$$

and

α is the "adjustment factor",

$Salaries_n$ is the hospital's total wage bill for nurses,

$Salaries_o$ is the hospital's total wage bill for staff other than nurses,

$Hours$ is the total number of hours worked by hospital employees,

w^N_n is the average hourly wage for nurses nationally (estimated from BLS data),

w^N_j is the average hourly wage (estimated from BLS data) for nurses' subcategory j, (which are RNs/ Management, RNs/Staff, LPNs, Nursing Aides, and Medical Assistants), and

s_j is the ratio of subcategory j's total hours for that hospital to nurses' total hours for that hospital.

Notice the difference between the adjusted average hourly wage (equation 4) to the hospital's unadjusted average hourly wage, which is given by:

$$\frac{Salaries}{Hours}, \tag{6}$$

where *Salaries* is the hospital's total wage bill.

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In principle, the OMA would provide the same adjustment for occupational mix differences as the MedPAC fixed weight index. In practice, however, there are several limitations to the OMA relative to the use of a national fixed weight index.

To illustrate how the OMA adjusts for occupational mix differences and how the OMA and a fixed weight index are, in principle, equivalent, consider the following example (see Table 4.1). Suppose there are five hospital occupations. Consider a local area that uses a more highly skilled (and more expensive) occupational mix than is used nationally. For example, the employment share locally for the most expensive labor (Occupation 1) is 40% while it is only 20% nationally. Each occupation is 50% more expensive in the local area than it is nationally (see Local Hourly Wage and National Hourly Wage columns). So a geographic wage index that reflects differences in the cost of labor should yield an index value for the local area that is 1.5. If we were to use the ratio of local hourly wages to national hourly wages (as the unadjusted Medicare wage index does), we would instead get an index value of 1.95 (i.e., $39/$20). This difference reflects the bias from the endogenous choice of occupational mix.

Table 4.1: Example: OMA versus Fixed-Weight Index Approach for Adjusting for Occupational Mix Differences

Occupation	Local Hours Share	National Hours Share (National Fixed Weight)	Local Hourly Wage	National Hourly Wage
1	40%	20%	$60	$40
2	20%	20%	$30	$20
3	20%	20%	$30	$20
4	10%	20%	$15	$10
5	10%	20%	$15	$10
Average			$39	$20

Fixed Weight Index Method				
Occupation	Local Hourly Wages * National Fixed Weight	National Hourly Wages * National Fixed Weight		Fixed Weight Index Value
1	$12	$8		
2	$6	$4		
3	$6	$4		
4	$3	$2		
5	$3	$2		
Sum	$30	$20		1.5

OMA Method				
Occupation	Local Hours Share * National Hourly Wages	Local Hourly Wage	National Hourly Wage	OMA Index Value
1	$16	$60	$40	
2	$4	$30	$20	
3	$4	$30	$20	
4	$1	$15	$10	
5	$1	$15	$10	
Sum	$26	$39	$20	1.5

The fixed weight method of adjusting for occupational mix is to use the national hour's shares as fixed weights in constructing each area's wage index. Using these weights yields an adjusted hourly wage of $30, which compared with the national hourly wage of $20 yields a wage index value of 1.5.

The OMA method is to calculate an adjustment factor, which is the ratio of national hourly wages to the weighted average of national hourly wages. Here the local hours shares are the weights. This adjustment factor in this example is 0.77 (i.e.,

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$20/$26). The adjustment factor is then applied to the local average hourly wage, $39,
yielding a local adjusted hourly wage of $30. Comparing this adjusted wage with the
national hourly wage of $20 also yields an index value of 1.5.

Thus, in this example, the two methods yield identical index values. However,
this is not always the case. Suppose the OMA is applied only to the last three
occupations. In this case, the OMA method would yield an index of 1.6.[40] Because the
occupational mix differs at the local level relative to the nation as a whole, some sort of
adjustment needs to be made to the Medicare wage index. Without an adjustment the
Medicare wage index would yield incorrect values.

While in principle the OMA and the fixed weight methods could both properly
adjust for geographic differences in occupational mix, there are important practical
differences between the methods that favor the fixed weight approach. These differences
are:

- The Medicare adjustment applies only to nursing employees, which represents
  only 40% of hospitals' total employment nationally.

- The data from which the OMA is constructed are reported only by IPPS hospitals,
  leaving open the possibility of circularity in the wage index.

Even though the OMA is not perfect, it is important to know whether the OMA
adjustments are worth doing. To assess whether the OMA has an impact on wage index
values, we compare FY2009 Medicare hospital wage indices with and without the OMA.

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[40] We arrive at this result in the following way: the ratio of adjusted wages to national wages for the last
three occupations is once again equal to 1.5, which is obtained by dividing the average National Hourly
Wage for occupations 3, 4, and 5 (i.e., $13.32) by the weighted average of National Hourly Wages for
occupations 3, 4, and 5 where the weights are the local hours shares (i.e., $15). We then multiply the
adjustment factor (0.888) by the local average hourly wage of the last 3 occupations (i.e., 0.888 x $22.50 =
$20). The ratio of this number to the average National Hourly wage is 1.5 (=20/13.32). The ratio of
unadjusted wages to national wages for the first two occupations is 1.667. Since the first two occupations
represent 60 percent of local employment and the last three represent 40 percent of local employment, the
wage index is 1.6 (1.6 = .6*1.667 + .4 * 1.5).

4.4 Analysis

In this section, we report the results of Acumen's analysis of the issues surrounding the use of fixed weights in the construction of the BLS wage index. The main findings of this analysis are the following:

- The BLS wage index is not very sensitive to the use of state level occupational weights relative to the use of fixed national weights. The difference in index values when comparing the BLS wage index constructed with fixed national weights with the BLS wage index constructed with state level weights is minor.

- The BLS wage index is moderately sensitive to the choice of occupations used in its construction. Thus, a clear set of rules for including occupations in the BLS wage index is necessary. Acumen believes that choosing the top 62 4-digit occupations with the largest wage shares in the hospital industry is a good alternative to MedPAC's choice of occupations and occupation groups.

- The OMA used by CMS does take geographical differences in occupational mix into account. However, given that this adjustment is based upon less than half of all hospital employees, fixed weights are a better method of adjusting for geographic differences in the occupational mix than the OMA.

4.4.1. *The Use of National Fixed Weights*

Using state fixed weights as opposed to using national fixed weights has a negligible impact on wage index values (see Table 4.2). For each MSA wage area and BLS-defined balance of state areas (i.e., the counties in the State that are not in MSAs), the percent difference between the BLS national fixed weight index value and the BLS state fixed weight index value was calculated.[41] The percent difference between these two index values is less than 1 percent for more than 93 percent of wage areas and

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[41] This analysis was based on summary statistics that BLS produced from special tabulations of May 2007 OES estimates. CMS uses a single balance of state area (defined as the counties in a state that are not in MSAs) for each state. BLS data has multiple balance of state (BOS) areas per state and did not aggregate them for this analysis.

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balance of state areas. Only 2.3 percent of MSAs and 1 percent of balance of state areas experience differences greater than 2 percent in their index values.

Table 4.2: Percent Changes, BLS Wage Index Constructed with National Fixed Weights to BLS Wage Index Constructed with State Fixed Weights

Percent Difference	MSAs		Balance of State Areas	
	Number	Percent	Number	Percent
Less than 1%	369	93.18%	160	93.57%
Between 1% and 2%	18	4.55%	9	5.26%
Between 2% and 3%	1	0.25%	0	0.00%
Between 3% and 4%	1	0.25%	0	0.00%
Between 4% and 5%	4	1.01%	1	0.58%
Between 5% and 6%	3	0.76%	1	0.58%
Total	396	100.00%	171	100.00%

Note: The number of MSAs is counted separately from the number of BOS areas. These are based on May 2007 OES wage estimates. It includes several BOS areas per state because the single BOS area is not a standard OES product. Data for Dover, DE and three areas in Puerto Rico are not included in the counts.

4.4.2. *Sensitivity of the Wage Index from BLS Data to the Choice of Weights*

The BLS wage index is surprisingly sensitive to the choice of occupations that comprise the wage index.[42] Roughly 14 percent of wage areas have differences in their wage index values of greater than plus or minus 2 percent depending upon which set of occupations are used to construct the index (see Table 4.3).

Table 4.3: Percent Changes, BLS Wage Index Based on MedPAC's 30 Occupations and Occupational Groups to BLS Wage Index Based on the Top 62 Occupations

	Number of Wage Areas	Percent
Less than -2%	25	5.88%
Between -2% and -1%	50	11.76%
Between -1% and 0%	141	33.18%
Between 0% and 1%	114	26.82%
Between 1% and 2%	61	14.35%
Greater than 2%	34	8.00%
Total	425	100.00%

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[42] These results were calculated by Acumen using publicly available OES data from May 2005.

The two indices are otherwise similar, having nearly identical means and standard deviations (see Table 4.4).[43]

Table 4.4: BLS Wage Index Based on MedPAC's 30 Occupations versus BLS Wage Index Based on the Top 62 Occupations

	N	Mean	Median	Min	Max	St Dev
BLS Index MedPAC 30	425	0.961	0.939	0.783	1.467	0.1059
BLS Index Top 62	425	0.962	0.939	0.790	1.459	0.1060
Percent Change Distribution, BLS MedPAC 30 to BLS Top 62	425	0.10%	-0.03%	-6.07%	5.37%	1.46%

Although the sensitivity of the wage index to the choice of the occupation set is modest, Acumen believes that it is large enough that any arbitrariness in the choice of occupations needs to be avoided. Thus, a clear, well-justified and predetermined rule for choosing occupations is needed. The rule used by Acumen – the 62 4-digit occupations with the largest wage shares in the hospital industry – is a good alternative. MedPAC's list of occupations, while reasonable, could not be generated by a clear predetermined rule.

4.4.3. Medicare's Occupational Mix Adjustment

The occupational mix adjustment implemented by CMS has a modest impact on wage index values for a substantial number of wage areas—almost 24 percent of wage areas have an adjustment to their wage index values of more than plus or minus 2 percent (see Table 4.5). The adjustment, as expected, slightly reduces the dispersion of index values across wage areas (see Table 4.6).

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[43] The indices were adjusted, so that if weighted by hospital discharges their mean would equal 1. The same applies to the CMS indices presented in Table 4.6.

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Table 4.5: Percent Changes, Medicare Wage Index (Unadjusted) to Medicare Wage Index (with Occupational Mix Adjustment)

	Number	Percent
Less than -2%	37	8.71%
Between -2% and -1%	76	17.88%
Between -1% and 0%	98	23.06%
Between 0% and 1%	91	21.41%
Between 1% and 2%	60	14.12%
Greater than 2%	63	14.82%
Total	425	100.00%

Table 4.6: Medicare Wage Index Values, with and without Occupational Mix Adjustment

	N	Mean	Median	Min	Max	St Dev
No Occupational Mix Adj.	425	0.969	0.940	0.709	1.675	0.146
With Occupational Mix Adj.	425	0.970	0.942	0.715	1.630	0.140
Percent Change Distribution, Unadjusted Index to Index with Occupational Mix Adj.	425	0.19%	0.01%	-5.27%	6.51%	1.82%

The impacts of the OMA exist despite the fact that the adjustment is only applied to nursing occupations – which represent 40% of hospital employment. Because the OMA is only applied to a subset of hospital workers, it is the opinion of Acumen that fixed weights are a better method of adjusting for geographic differences in occupational mix than the OMA as we discussed in Section 4.3. However, while the OMA can only adjust for geographic differences in occupational mix, it is both a step in the right direction and has an impact that is large enough to justify its application.

4.5 Conclusion

In this section we demonstrate that the use of national fixed occupation weights in the construction of the BLS wage index is not overly restrictive. A less restrictive set of occupation weights calculated for each state yields virtually identical BLS wage index values for almost all wage areas.

The above analyses also suggest that the BLS wage index is moderately sensitive to the choice of occupations used in its construction. Thus, a clear set of rules for including occupations in the BLS wage index is necessary.

In addition, the analyses show that the use of a national fixed weight index and the use of the OMA can, in principle, properly adjust for geographic differences in the occupational mix. However, for the reasons stated above, it is the opinion of Acumen that fixed weights are a better method of adjusting for geographic differences in occupational mix than the OMA.

5 YEAR TO YEAR VOLATILITY IN THE MEDICARE AND BLS WAGE DATA

In this section we explore the extent of volatility in the Medicare and BLS wage indices. We discuss why volatility in a geographic wage index could be an indication that the index imprecisely measures temporal changes in the underlying cost of labor. We also consider two possible reasons for the presence of volatility in the Medicare wage index: the absence of a method of smoothing wage information over time and the small number of hospitals reporting in some wage areas, as well as the changes in the number of hospitals reporting in a wage area.[44]

The order of this section is as follows. We first present an economic framework for considering wage index volatility (in Section 5.1). In Section 5.2, we discuss the data sources we use to measure volatility, present three methods for measuring volatility, and report the results of our analysis. In Section 5.3, we explore two potential causes of volatility in the Medicare wage index, first, by demonstrating the effect of moving to a two-year rolling average would have on the volatility of the Medicare wage index and, second, by estimating the association between the number of hospitals and change in the number of hospitals in a wage area on the volatility of the Medicare and BLS wage indices. In the final section (Section 5.4) we highlight the main findings of the report and present our conclusions.

The major findings of this section are:

- The volatility of a wage index can either capture the underlying variance in costs, or it may reflect measurement error in the data. If an index exhibits "too much" volatility there are methods available to address this issue. One possibility is to average the index over time. However, reducing volatility by taking averages of

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[44] Smoothing here refers to a process that extracts the information from a wage series and mutes the effects of "noise" or measurement error. One possible example of a smoothing procedure is called a rolling average.

index values across years may introduce another source of inaccuracy; it may involve the use of less timely data.

- As a result of analyzing several years of data Acumen found that the BLS wage index is less volatile than the Medicare wage index.

- The number of hospitals in a wage area and changes in the number of hospitals in a wage area are related to the volatility of the Medicare wage index. The use of a two-year rolling average of index values would be a reasonable approach to reducing the annual volatility of the Medicare wage index.

5.1 An Economic Framework for Considering Wage Index Volatility

In this section, we explain why volatility in a geographic wage index can be an indicator for how well it measures underlying labor cost differences across wage areas. We also discuss how one possible approach to reducing volatility – taking multi-year averages of wage index values – can exacerbate the problem that stems from using four year lagged data to measure current labor costs.

5.1.1. Accuracy in Measuring Underlying Labor Costs

Ideally, a hospital wage index accurately measures two dimensions of labor prices differences: (i) in any single year, the index should measure geographic differences in *relative* labor prices across wage areas (i.e. relative to the national average wages) and, (ii) from year to year, the index should capture changes in *relative* labor prices in any single wage area. The more closely the index measures the underlying labor costs, the better the index; thus some level of volatility may reflect movements in prices in the labor market and should be captured by the index. But volatility is not always related to actual changes in prices. It could be caused by the manner in which the wage data used to construct the index is collected. Sources of volatility unrelated to prices that move the index diminish its accuracy. We examine these issues below.

Economic theory suggests that the price of obtaining labor in a local labor market is determined by a number of factors, including the total number of firms seeking to hire

workers in an area, the number of qualified workers who live in an area, and the amount of experience or training required for the job to name a few.[45] While these factors can change from year to year, leading to year-to-year changes in wage levels these changes may occur relatively slowly. Further, though large changes can occur, they do so rather infrequently. That is, given that the determinants of labor prices are unlikely to change to a large degree very often, we do not expect that there will be large and frequent year-to-year changes in the underlying labor costs of a wage area relative to those of other wage areas. For example, a worker cannot immediately become a nurse when nurses' salaries are relatively high as becoming a nurse requires several years of training. It is true that for a labor area in which labor prices change frequently or rapidly an accurate wage index would appear to be volatile. For example, if a new hospital were to open in a market with a small number of hospitals, we may observe real changes in the price of hiring labor even in the short term. However, because underlying costs for hospital labor likely change slowly or infrequently, volatility in this type of wage index is generally believed to reflect measurement error in the calculation of labor prices.

5.1.2. *Tradeoff between Volatility and Relevance*

One way to reduce excess volatility in a measure is to take multi-year averages of that measure. If the volatility is the result of data with "enough" measurement error which varies from year to year for reasons unrelated to underlying labor costs, this averaging will tend to mitigate the effects of this measurement error.

While averaging over time may reduce volatility, this reduction may come at the cost of timeliness. If labor prices were to increase suddenly in an area, this increase would initially be only partially reflected in the change in a wage index constructed from multi-year averages of the data. The use of multi-year averages involves a trade-off between different sources of inaccuracy: one due to the volatility associated with measurement error in the data, and the other due to the use of data that no longer accurately reflects costs in the market.

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[45] See Rogerson, Richard, Robert Shimer and Randall Wright "Search-Theoretic Models of the Labor Market: A Survey" in Journal of Economic Literature , Vol.XLIII (December 2005), p.959-988, for example.

5.2 Volatility in the Wage Indices Constructed from Medicare and BLS Data

In this section, we describe how we construct the Medicare and BLS wage indices, including the sources of data we use. We then present three methods of measuring volatility in a wage index, discuss the relative strengths and weaknesses of each measure, and present our calculations of the extent of volatility in the Medicare and BLS wage indices.

5.2.1. Data Sources

In order to measure the volatility in the Medicare and BLS wage indices, we construct each index from the underlying wage data. We generate index values for a number of years so that we have observations of the index over time.

To construct the BLS wage index, we use publicly available data from the BLS's OES. As in previous sections, we follow the MedPAC method for constructing this index with the following exceptions: we do not smooth index values across contiguous wage areas, and we do not adjust the wage index values at the county level. We refer to this pre-smoothing version of the MedPAC hospital wage index as the "BLS hospital wage index." To examine the volatility of the index, we use three years of OES data: 2002, 2003, and 2004. These years roughly correspond to the years of data used to construct the FY2006, FY2007, and FY2008 Medicare wage indices, as described below.

Each year of estimated wages in the OES is based on data collected from establishments in six semiannual panels for three consecutive years. Every six months, a new panel of establishments is added, and the oldest panel is dropped. The three years of employment data are benchmarked to represent the total employment for the reference period using the ECI.[46] The use of data collected over three years to estimate occupational wages at the wage area level requires averaging over time. This may dampen the responsiveness of the index to short-term changes in labor prices.

To construct the Medicare hospital wage index, we use hospital cost report data from Worksheet S-3 and follow the method used by CMS to construct its index with the

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[46] The use of the Employment Cost Index (ECI) assumes that occupational wages in a wage area change at the same rate as the national change in the ECI wage component for the occupational group.

following exceptions: we do not adjust any of the Medicare wage area indices for occupational mix, and we do not impose any reclassifications or readjustments to wage index values. The Medicare wage index for any given fiscal year is based on hospital cost reports from four years prior. For example, the FY 2008 Medicare wage index was constructed from hospital cost reports from FY 2004.

For the analysis of volatility, we use four years of hospital cost report data (2001, 2002, 2003, and 2004) and construct the Medicare wage index for fiscal years 2005 through 2008.

The number of wage areas represented by the BLS and Medicare indices differs. We can construct the BLS indices for 364 wage areas and the Medicare indices for 423 or more areas, depending on the year. [47] This difference exists because the CMS uses hospital-based wage data to construct the wage area index and then locates the hospitals in a CBSA (Core Based Statistical Area) using the current CBSA classification (i.e. the CBSA classification for the years 2005, 2006, 2007 and 2008). We are unable to use the same CBSA classification when constructing the BLS wage area indices. The BLS classification differs because the public wage data available from BLS-OES is provided at the MSA level (not at the hospital level) and the MSA composition changed in the year 2005. [48] Thus, for the BLS indices, we use the MSA classification used from 2002-2004, which includes fewer MSAs than the current classification. [49]

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[47] We observe different number of wage areas in each of the CMS indices between years 2005 and 2008. This creates differences in the number of observations included in the analysis from year to year. Specifically, we observe 423 wage areas in the 2005 index, 425 wage areas in the 2006 and 2007 indices, and 427 wage areas in the 2008 index. When we analyze the annual change in index values we observe: 422 areas in the comparison of FY2005 and FY2006 indices; and 424 areas in the FY2006 and FY2007 and FY2007 and FY2008 comparisons, respectively. This gives us a total of 1270 annual changes. We also find that 420 wage areas have values for all four indices, 4 wage areas have index values for three of the four indices, and two areas have index values for two of the indices.

[48] In May 2005, the OES survey began using metropolitan area definitions based on new standards and the results of the Census 2000. Prior to 2005, OES had data for 334 metropolitan areas. As of 2006, OES has data for 584 metropolitan areas, including 375 metropolitan statistical areas (MSAs) and 34 metropolitan divisions which make up 11 of the MSAs.

[49] We also did not include BLS OES occupational wage estimates collected before 2002 given that in the year 2002, the OES survey switched from the Standard Industrial Classification (SIC) system to the North American Industry Classification System (NAICS). Thus, the change in industry classification (2002) and the change in geographic classification (2005) in the OES survey allowed us only to compare 2002-2004 estimates.

5.2.2. Methods

Section 5.1.1 described the two dimensions of *relative* labor price differences that an ideal hospital wage index would measure, where the first dimension captures changes across wage areas in a given year. In practice, consideration of volatility across wage areas within a year is related to the idea of smoothing wage values across contiguous wage areas. However, we will address the issue of smoothing in our next report. This report focuses on the second dimension of labor prices: year-to-year differences in labor prices in any single wage area. We test this by measuring the extent of volatility in the Medicare and BLS wage indices, using three different measures of volatility. In the remainder of Section 5.2, we discuss the relative strengths and weaknesses of each measure and then present their results.

The first measure of volatility is the percentage of wage areas that experience large year-to-year increases or decreases in their wage index values. Identifying the frequency of large changes is important. Volatility, regardless of whether it stems from the way an index is constructed, data measurement issues, or real changes in the cost of labor, will be a greater challenge for hospitals in wage areas that experience the largest swings in wage index values.

One advantage of this metric is that it is simple to understand. But this "large change" measure also has two drawbacks. First, it only uses information on the existence of a large change, not the frequency and size of all changes. Second, defining a "large change" is necessarily subjective. We chose thresholds of 1%, 5% and 10%. These cutoff points were selected because while a large annual change in hospitals' index values likely has an important effect on hospitals' payments and budget planning, it is not clear at what threshold these changes begin to represent a challenge for hospitals. As we discuss below, our conclusions as to whether there are differences between the Medicare and BLS wage indices in the frequency of large changes depends somewhat on the choice of threshold.

The second measure we use is the standard deviation of these year-to-year percent changes. This measure of volatility provides an overall picture of volatility that allows us to examine the full range of differences across all hospitals. This measure has an

advantage over the "large change" measure because it incorporates changes of all sizes, not just information about the presence of a "large change." However, this measure treats increases and decreases in index values from one year to the next identically. Another drawback is that the measure does not lend itself to easy interpretation.

Both the first and second measures examine only year-to-year changes. This does not make the best use of the data over a longer time frame. We have three years of data from which to construct BLS wage indices and four years of data from which to construct Medicare wage indices. In any given year we could observe anomalous cost changes; looking over a longer time frame helps to distinguish one-time changes from volatility in a wage index. Our third measure is a measure of how volatile a wage area's index values are over all the years of available data. In particular, for each wage area we calculate the standard deviation of wage index values over the three or four year period. We then determine what fraction of wage areas have "large" standard deviations, much in the way we did for our first measure. This measure, unlike the first two we considered, uses all the available years of data to determine volatility. It does, however, share some of the disadvantages of the earlier measures. Like the first measure, it introduces subjectivity in the need to define a threshold for a "large" standard deviation; and like the second measure, the standard deviation treats increases and decreases identically.

While the three measures each emphasize a slightly different aspect of volatility, taken together, these measures suggest that the Medicare wage index is more volatile than the BLS wage index.

5.2.3. *Results: Wage Areas with Large Year-to-Year Changes in Index Values*

The percentage of areas that experience large year-to-year fluctuations in their Medicare and BLS wage index values, over multiple years, is presented in Figure 5.1.

Using FY 2005 though FY 2008 Medicare wage index values, we are able to calculate 1270 one-year percent changes in these Medicare wage index values.[50]

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[50] This number represents the sum of the total wage areas we observe in each annual comparison of the indices. In the comparison of FY2005 and FY2006 indices we observe 422 areas; in the comparison of FY2006 and FY2007, and FY2007 and FY2008 indices we observe 424 wage areas, respectively. This gives us a total of 1270 annual changes.

Similarly using OES data from 2002 to 2004 for 364 wage areas, we calculate 728 one-year percent changes in the BLS wage index values (2 per wage area).

Over the four-year period from 2005-2008, wage areas experienced one-year changes in their Medicare wage index values of more than 5 percent or less than -5 percent less than 10 percent of the time. Decreases and increases of more than 10 percent were rare (occurring only 0.55% and 0.47% of the time). Decreases of between 5% and 10% were also relatively infrequent (occurring 3.78% of the time) as were increases of between 5% and 10% (which occurred 3.86% of the time). Smaller changes of between 1% and 5% were relatively frequent; decreases of this size occurred 30.63% of the time and increases of this size occurred 25.91% of the time.

The frequencies of changes in the BLS wage index of between 5% and 10% or of more than 10% do not differ from those of changes in the Medicare wage index. Over the three-year period from 2002-2004, wage areas experienced one-year changes in their BLS wage index values of greater than 5 percent or less than -5 percent less than 6 percent of the time. Very large declines (of 10% or greater) in BLS wage index values were also very rare (occurring only once, or 0.14% of the time). Increases in BLS wage index values of more than 10 percent were also atypical (occurring 0.41% of the time). Decreases of between 5% and 10% occurred 2.20% of the time and increases of between 5% and 10% occurred 3.43% of the time.[51]

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[51] To estimate these numbers we use the Medicare wage area indices from FY2005, FY2006, FY2007 and FY2008, which are constructed from 2001, 2002, 2003, and 2004 Worksheet S-3 wage data and are not adjusted for occupational mix. We construct BLS wage indices from OES data from 2002, 2003, and 2004 following MedPAC (2007) with the exception that we do not smooth across contiguous wage areas and do not adjust wage index at the county level.

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Figure 5.1: Percentage of Wage Areas with One-Year Changes in Wage Index Values
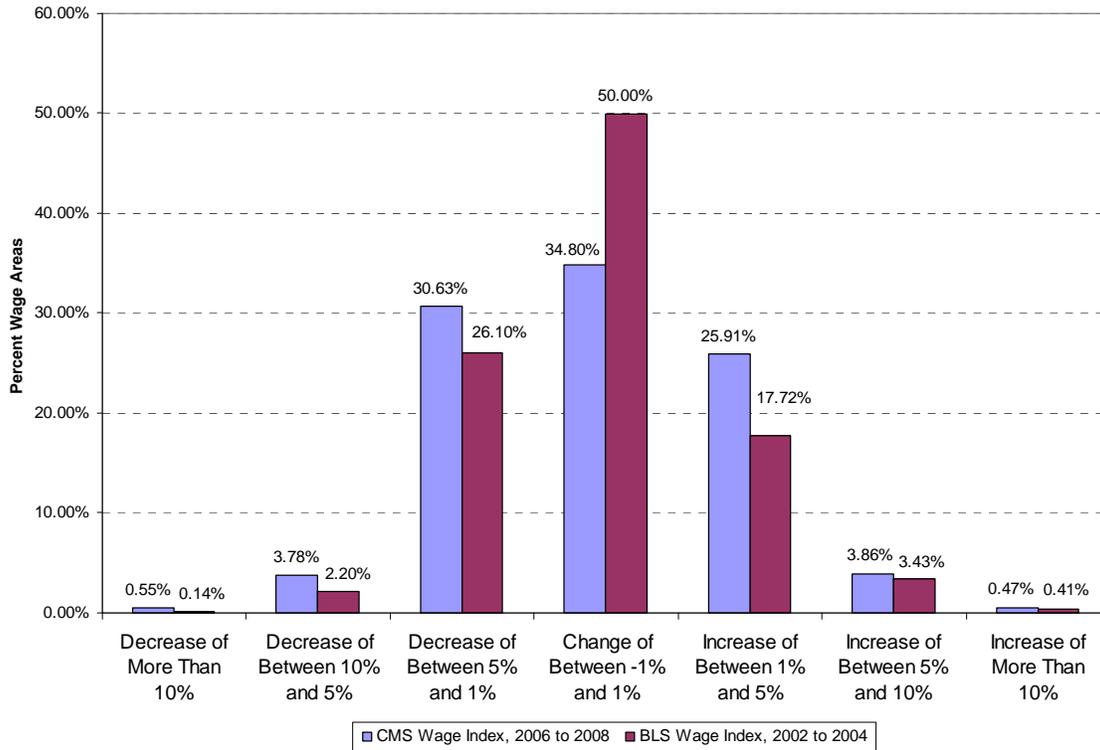
There is no statistically meaningful difference between the frequency of large changes in the Medicare and BLS wage indices when we use thresholds of either 5% or 10%.[52] That is, the frequency of large changes in the Medicare and BLS wage index values (defined by these threshold values) are roughly equal.

In contrast to relatively large changes, there are noticeable and statistically meaningful differences in the frequencies of changes in the range of 1% and 5% between the Medicare and BLS wage indices. 30.63% of wage areas experienced one-year decreases in their Medicare wage index values of between 1% and 5% while only 26.10% of wage areas had such decreases in their BLS wage index values. 25.91% of wage areas

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[52] Based on a Yate's chi-squared test at a 10 percent level (Yates, F. (1934). "Contingency table involving small numbers and the chi-squared test." Journal of the Royal Statistical Society (Supplement) 1: 217-235). The test statistic has the following form: $\chi^2 = \sum \frac{\left(\left|O_i - E_i\right| - 0.5\right)^2}{E_i}$, where O_i is the observed frequency in category i and E_i is the expected frequency. The value of the test statistic using only the 5% and 10% thresholds is 1.34 (with 3 degrees of freedom).

had increases of between 1% and 5% in their Medicare wage index values while only 17.72% had such increases in their BLS wage index values. These differences in the frequency of changes smaller than 5% are large enough so that a comparison of the distributions (shown in Figure 5.1) is statistically meaningful.[53]

Thus, based on this "large change" measure of volatility, we find that wage areas are not more likely to experience large year-to-year changes in their Medicare wage index values than in their BLS wage index values if we focus on changes greater than 5%. Wage areas are, however, more likely to experience changes in their Medicare wage index than in their BLS wage index if we consider changes smaller than 5%.

The focus of our analysis is on wage areas, not hospitals. Since some wage areas have a large number of hospitals while other contain only a few hospitals, the distributions of volatility by hospitals looks somewhat different than the distribution of volatility by wages areas. We have 10,942 observations on hospitals from the 1270 wage area observations for which we have Medicare wage index data and have 7,182 observations on hospitals from the 728 wage areas for which we have BLS wage index data (see Table 5.1).

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[53] Based on a Yate's chi-squared test at a 5 percent level, the value of the test statistic for the frequencies reported in Figure 5.1 is 47.04 (with 6 degrees of freedom).

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Table 5.1: Percentage of Hospitals with One-Year Changes in Wage Index Values

	Medicare Wage Index 2005 to 2008		BLS Wage Index 2002 to 2004	
	Number of Providers	Percentage	Number of Providers	Percentage
Decrease of More Than 10%	17	0.16%	2	0.03%
Decrease of Between 10% and 5%	184	1.68%	38	0.53%
Decrease of Between 5% and 1%	2928	26.76%	1786	24.87%
Change of Between -1% and 1%	5487	50.15%	4355	60.64%
Increase of Between 1% and 5%	2097	19.16%	918	12.78%
Increase of Between 5% and 10%	195	1.78%	72	1.00%
Decrease of More Than 10%	34	0.31%	12	0.15%
Total Number of Providers	10942	100.00%	7182	100.00%

Note: These differences in the distributions of wage index volatility for hospitals are statistically meaningful whether we consider only large one-year changes (of 5% or 10%) or whether we consider smaller changes in the range of 1% and 5% as well. [54]

5.2.4. Results: Standard Deviation of Year-to-Year Changes in Index Values

Calculating the fraction of wage areas that experience large changes in their wage index values focuses attention on the tails of the distribution. We also may be interested in year-to-year changes in index values of any size and, therefore, consider another measure: the standard deviation of year-to-year changes in the index values. This measure quantifies the extent to which increases and decreases are relatively more frequent. In particular, the standard deviation measures how disperse a distribution is around its mean. In the case examined below, an index having a larger standard deviation implies that wage areas are relatively more likely to experience larger increases and decreases in index values from one year to the next.

Table 5.2 reports the average one-year percent change in wage index values and the standard deviation of the one-year percent changes for the Medicare and BLS wage indices. As we did earlier, we calculate one-year percent changes in the Medicare wage index for each of the 424 wage areas for which we have Medicare wage index values for the following years, 2005 to 2006, 2006 to 2007, and 2007 to 2008.[55] We also calculate

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[54] Based on a Yate's chi-squared test at a 5 percent level. The value of the test statistic for the frequencies reported in Table 5.1 is 271.38 (with 6 degrees of freedom).
[55] Again, we observe different number of wage areas across these years with Medicare wage index values.

one-year percent changes for the 364 wage areas for which we have BLS wage index values for the years 2002 to 2003 and 2003 to 2004.

The standard deviation of the distribution of one-year percent changes in the Medicare wage index is 3.33%, while that for the BLS wage index is 2.44%. These values are statistically different from one another at a 1% significance level. Based on this second measure of volatility, the Medicare wage index is more volatile than the BLS wage index.

Table 5.2: Summary Statistics for One-Year Percent Changes in Medicare and BLS Wage Index Values

	Annual Percentage Change in Wage Index Values	
	Medicare Wage Index, 2005 to 2008	BLS Wage Index, 2002 to 2004
Mean	-0.17%	-0.05%
Standard Deviation	3.03%	2.44%
Number of Wage Areas Across All Years	1270	728

Note: We use the Medicare wage area indices from FY2005, FY2006, FY2007 and FY2008, which are constructed from 2001, 2002, 2003, and 2004 Worksheet S-3 wage data and are not adjusted for occupational mix. We construct BLS wage indices from OES data from 2002, 2003, and 2004 following MedPAC (2007) with the exception that we do not smooth across contiguous wage areas and do not adjust wage index at the county level. The number of observations represents the number of wage areas multiplied by the number of one-year changes we are able to calculate.

Taken together, the first two measures of volatility identify important information about the relative differences between the two indices. These results suggest that while wage areas are equally likely to experience large changes in their Medicare and BLS wage index values (as discussed in the previous sub-section), they experience small- and medium-sized changes in their Medicare wage index values more frequently.

5.2.5. *Results: Wage Areas with Large Standard Deviations in their Wage Index Values over a Three or Four Year Period*

Both of the previous two measures of volatility are based on one-year changes. Because for a single wage area a one-year percent change cannot distinguish between a one-time change in wage index values and more persistent fluctuations in wage index

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values over time, we consider a third measure: the standard deviation of a wage area's index values over multiple years.

For each wage area, j, we calculate the standard deviation of its Medicare wage index values over time as:

$$SD_j^{CMS} = \sqrt{\frac{1}{3} \sum_{t=2005}^{2008} \left(I_{jt}^{CMS} - \bar{I}_j^{\;CMS} \right)^2}$$

where SD_j^{CMS} is the standard deviation of the Medicare wage index for area j, I_{jt}^{CMS} is the Medicare wage index for area j in year t, and $\bar{I}_j^{\;CMS}$ is the mean Medicare wage index for area j.

and the standard deviation in its BLS wage index values as:

$$SD_j^{BLS} = \sqrt{\frac{1}{2} \sum_{t=2002}^{2004} \left(I_{jt}^{BLS} - \bar{I}_j^{\;BLS} \right)^2}$$

where SD_j^{BLS} is the standard deviation of the BLS wage index for area j, I_{jt}^{BLS} is the BLS wage index value for area j in year t, and $\bar{I}_j^{\;BLS}$ is the mean BLS wage index value for area j.

We then calculate the distribution over wage areas of these standard deviations for both the Medicare and BLS wage indices. In particular, we determine how frequently the standard deviation falls into various value ranges (less than 0.01, between 0.01 and 0.025, between 0.025 and 0.05, and greater than 0.05). These bin values were chosen to span the distribution of this volatility measure. These distributions are shown in Figure 5.2.[56]

We can see in Figure 5.2 that these distributions differ and, moreover, a statistical test based on the frequencies reported indicates that these distributions are statistically

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[56] We calculate the standard deviation for any wage area that has Medicare wage index values for two or more years across the 2005 to 2008 period. In total we observe 426 wage areas with a standard deviation. From these 426 areas, we observe 420 wage areas with index values across the four years (complete info on all four indices); 4 wage areas that have information on three of the four indices (one of these wage areas is missing the 2008 index value, the other three are missing the 2005 index values), and 2 wage areas that have index values only for 2 of the four indices (one is missing the 2005 and 2006 values and the other the 2007 and 2008 values).

different from one another.[57] In particular, wage areas are more likely to have very small (less than 0.01) standard deviations of their BLS wage index values than of their Medicare wage index values. Wage areas are also more likely to have larger standard deviations of their Medicare wage index values than of their BLS wage index values. A difference in these distributions indicates that there is greater volatility in the Medicare wage index than in the BLS wage index. [58]

Figure 5.2: Distribution of Standard Deviations of Wage Index Values by Wage Area

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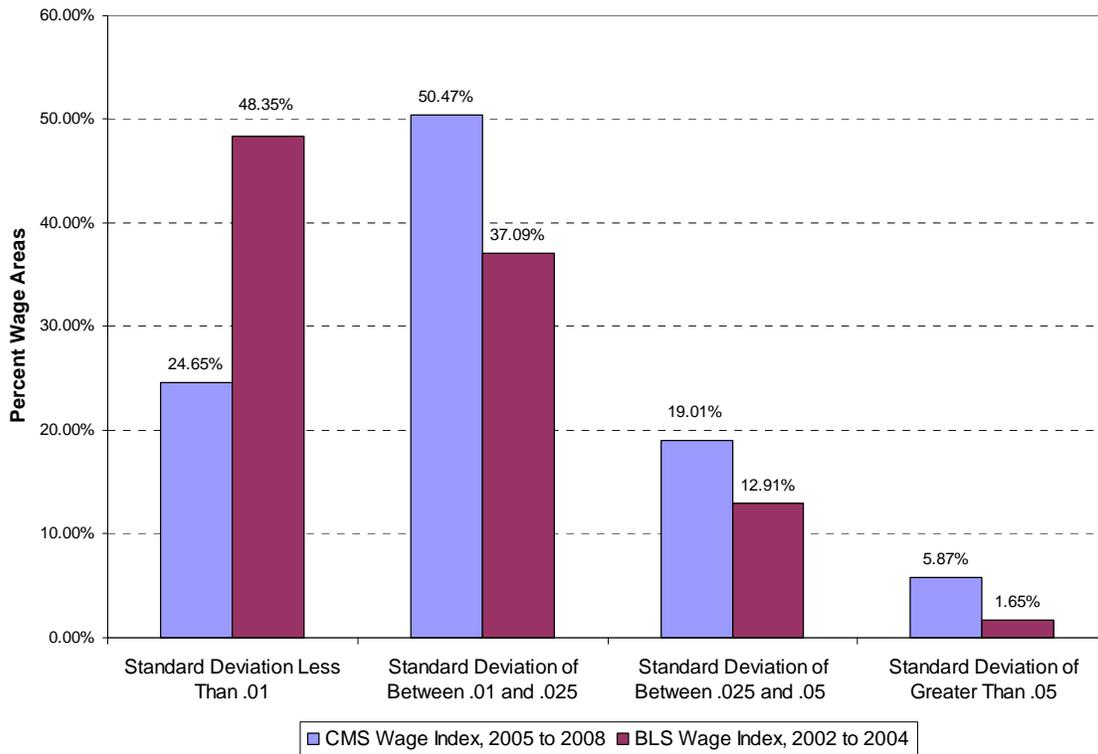
[57] This is based on a Yate's chi-squared test which had a test statistic of 128.01 with 3 degrees of freedom.
[58] While we want to use as much accessible data as possible to calculate the distributions shown in Figure 5.2, the small numbers in denominator of the standard deviation formula, along with the different numbers of years available for the Medicare and BLS data, could potentially skew the results shown in Figure 5.2. To address this, Tables E.1 and E.2 in the Appendix show a Distribution of Standard Deviations of Wage Index Values using only 3 years for the Medicare wage index,(removing the FY2005 data). These tables also show that the BLS wage index is less volatile than the Medicare wage index, though to a lesser degree.

5.2.6. Summary of Volatility Results

The BLS wage index is less volatile than the Medicare wage index according to our three measures of volatility. In particular,

- The frequency of one-year changes in wage index values in the range of 1% to 5% is greater in the Medicare wage index than in the BLS wage index.

- The standard deviation of one-year percent changes in wage index values is smaller for the BLS wage index that for the Medicare wage index. This result indicates that wage areas are less likely to experience smaller changes, in their BLS wage index values from one year to the next than in their Medicare wage index values.

- Looking at volatility over 3 years (in the case of the BLS wage index) or 4 years (in the case of the Medicare wage index), fewer wage areas have volatility in their BLS wage index than in their Medicare wage index, as measured by the standard deviation in wage index values over time.

However,

- There is no statistically meaningful difference between the frequency of large one-year changes (greater than 10% or between 5% and 10%) in wage index values between the Medicare and BLS wage indices.

- Although we find statistically significant results, it is important to remember that we analyze changes in the Medicare and BLS wage indices over a limited time frame.

5.3 Two Potential Causes of Volatility in the Medicare Wage Index

The relatively lower volatility in the BLS wage index may stem from differences in the way the OES data, from which we construct the BLS wage index, and Medicare data are collected. The BLS wage index is based on the wages of workers in hospital-related occupations from firms in all industries while the Medicare data are from hospital wages only. This difference in the source of the data may affect volatility in two ways. First, using a larger sample of workers from a more diverse set of jobs may mitigate

volatility if this larger sample of wages better reflects underlying labor costs. Second, wage areas with relatively few hospitals may be more susceptible to measurement error in the data and may experience relatively large year-to-year swings in index values (see below).

Another difference between the data sets is that the OES data are collected over a three year period and adjusted to reflect current year wage levels using the ECI. In this way, the OES data are essentially already averaged over multiple years. By contrast, the Medicare data are from a single fiscal year.[59]

These data differences suggest that we explore two potential causes of volatility in the Medicare wage index. The first is the extent to which volatility in Medicare wage index is reduced if we were to use a two-year rolling average of index values as the wage index. The second is to determine the extent to which volatility in the Medicare wage index is related to the number of hospitals in a wage area and to changes in the number of hospitals in a wage area.

5.3.1. *The Effect of Using a 2-Year Rolling Average Medicare Wage Index on Volatility*

What is the effect of using a two-year rolling average of the current Medicare wage index on volatility? The BLS wage index is calculated from the OES data, which is collected over a three year period. Thus, at least one reason for the BLS wage index's relatively lower level of volatility is that it is in essence already a three-year rolling average. As there are additional differences between the underlying data sources (which we discussed in Section 2 of this report), it is important to directly determine how much volatility would be reduced by using a two-year rolling average of the Medicare wage index.

To construct the two-year rolling average, we adjust prior years of the Medicare data to reflect the most recent year's wage levels using the ECI. We then compare the

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[59] A third difference is that wages in the Medicare data include benefits while wages in the OES data do not. The underlying labor compensation inclusive of benefits may be more volatile than labor costs based on cash wages alone. We are unable to explore the effects of the differential treatment of benefits on the volatility of the wage index in this report.

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volatility in the one-year Medicare wage index with the volatility in the two-year Medicare wage index using the three measures discussed in the previous section (i.e., the percentage of wage areas that experience large year-to-year increases or decreases in their wage index values, the standard deviation of these year-to-year percent changes, and the standard deviation of wage index values over time for each wage area).

The effect of using a two-year rolling index on the first measure of volatility, the percentage of wage areas with one-year percent changes, is shown in Table 5.3. It shows that moving to a two-year rolling average of index values would make the distribution of yearly changes less disperse. In particular, large changes (of greater than 10% or of between 5% and 10%) would become less frequent, and increases of between 1% and 5% would become less frequent. Decreases of between 1% and 5% would become more frequent as would the frequency of changes between -1% and 1%. The average one-year percent change would be, by construction, unaffected by the use of a two-year rolling average. Based on a Yate's chi-squared test, these distributions differ statistically at a 5-percent significance level.[60]

Table 5.3: Distribution of Changes in Medicare Wage Area Index Values: Single-Year Indices and Two-Year Rolling Average Indices

	One-Year Medicare Index		Two-Year Medicare Rolling Index	
	Number of Areas	**Percent**	**Number of Areas**	**Percent**
Decrease of More Than 10%	7	0.55%	1	0.12%
Decrease of Between 10% and 5%	48	3.78%	17	2.01%
Decrease of Between 5% and 1%	389	30.63%	284	33.57%
Change of Between -1% and 1%	442	34.80%	357	42.20%
Increase of Between 1% and 5%	329	25.91%	167	19.74%
Increase of Between 5% and 10%	49	3.86%	17	2.01%
Increase of More Than 10%	6	0.47%	3	0.35%
Total Wage Areas	1,270	100.00%	846	100.00%

Note: We use the Medicare wage area indices from FY2005, FY2006, FY2007 and FY2008, which are constructed from 2001, 2002, 2003, and 2004 Worksheet S-3 wage data and are not adjusted for occupational mix. The number of observations represents the total number of wage areas for which are able to construct the one-year and two-year Medicare rolling indices.

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[60] The test statistic is 27.54 with 6 degrees of freedom.

Once again, while the focus of our analysis is on wage areas, not hospitals, it is useful to examine the distribution of changes in Medicare wage index values for providers because some wage areas have a large number of hospitals while other contain only a few hospitals (see Table 5.4).

Table 5.4: Distribution of Changes in Medicare Hospital Index Values: Single-Year Indices and Two-Year Rolling Average Indices

	One-Year Medicare Wage Index		Two-Year Medicare Rolling Index	
	Number of Providers	Percentage	Number of Providers	Percentage
Decrease of More Than 10%	17	0.16%	2	0.03%
Decrease of Between 10% and 5%	184	1.68%	58	0.81%
Decrease of Between 5% and 1%	2,928	26.76%	1,667	23.27%
Change of Between -1% and 1%	5,487	50.15%	4,180	58.34%
Increase of Between 1% and 5%	2,097	19.16%	1,157	16.15%
Increase of Between 5% and 10%	195	1.78%	78	1.09%
Increase of More Than 10%	34	0.31%	23	0.32%
Total Number of Providers	10,942	100.00%	7,165	100.00%

Table 5.4 shows that moving to a two-year rolling average of index values would also make the provider-level distribution of yearly changes less disperse. Based on a Yate's chi-squared test, these distributions differ statistically at a 5-percent significance level.[61]

We also calculated the effect of using a two-year rolling average on the standard deviation of the distribution of one-year percentage changes. As described above, the standard deviation measures which index is relatively more likely to experience larger increases and decreases in index values from one year to the next.

Using a two-year rolling average leads the standard deviation of the one-year percent distribution to fall from 3.03% to 2.46%. The difference between these numbers is statistically meaningful at the 5% significance level.

The effect of using a two-year rolling average on the volatility of the Medicare wage index using our third measure – the distribution of the standard deviation of each

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[61] The Yate's chi-squared test statistic is 139.62 with 6 degrees of freedom.

wage area's wage index values (over 3 or 4 years) for both the one-year and two-year Medicare indices – is shown in Table 5.5.

A greater percentage of wage areas have large standard deviations in their one-year Medicare wage index values than in their two-year Medicare wage index values. Moreover, these distributions statistically differ from one another at the 1% significance level.[62]

Table 5.5: Distribution of Standard Deviations of Wage Index Values by Wage Area

	One-Year Medicare Index		Two-Year Medicare Rolling Index	
	Number of Areas	Percent	Number of Areas	Percent
Standard Deviation Less Than .01	105	24.65%	162	38.30%
Standard Deviation of Between .01 and .025	215	50.47%	192	45.39%
Standard Deviation of Between .025 and .05	81	19.01%	55	13.00%
Standard Deviation of Greater Than .05	25	5.87%	14	3.31%
Total Number of Wage Areas	426	100.00%	423	100.00%

A move to a two-year rolling average would reduce the amount of volatility in the Medicare wage index. In particular,

- The frequency of one-year changes of 10% or greater and of between 5% and 10% is diminished in the use of a two-year rolling average of Medicare wage index values.

- The standard deviation of one-year percent changes in wage index values is smaller for the two-year rolling average Medicare wage index.

- Looking at volatility over 3 years (in the case of a Medicare two-year rolling average wage index) or 4 years (in the case of a Medicare one-year wage index), fewer wage areas experience volatility in a Medicare two-year rolling average wage index.

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[62] The Yate's chi-squared test statistic is 124.85 with 3 degrees of freedom.

- However, as we discussed in Section 5.1.2., there is a potential tradeoff between increasing the accuracy of a wage index by reducing its volatility and reducing its accuracy through the use of less timely data.

- This tradeoff is the reason why Acumen did not consider constructing and analyzing a three-year rolling average wage index from the Medicare wage index values. A Medicare 3-year wage index would entail using hospital cost data from 2002 (along with data from 2003 and 2004) as a part of the FY2008 wage index. In our opinion, the increase in the time lag from using cost data that are six years out of date likely outweighs the benefits from using an additional year in constructing the rolling-average index.

5.3.2. Is Volatility Associated with the Number of Hospitals or Changes in the Number of Hospitals?

A possible explanation for the fact that the Medicare wage index exhibits a greater amount of volatility than the BLS wage index is that it is calculated from hospitals' cost reports and many wage areas have few hospitals. Because each wage observation in the Medicare data comes from a single employer, wage areas that contain a small number of hospitals will have relatively few observations. These areas may produce index values that are sensitive to relatively small changes in costs and will also likely be sensitive to the entry or exit of hospitals. If the Medicare wage index is more volatile than the BLS wage index when fewer hospitals exist in an wage area or when the number of hospitals in an MSA changes, this will demonstrate that at least some of the additional volatility found in the Medicare wage index is rooted in the data.

To test this proposition, we estimate the extent to which volatility in both the Medicare and BLS wage indices are associated with the number of hospitals in a wage area and with changes in the number of hospitals in a wage area.

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We estimate the following regression model. We regress the absolute value of the one-year percent change in wage index values[63] on the number of hospitals in a wage area (N) and the annual change in the number of hospitals in a wage area (ΔN). [64] We also include year dummies to capture macroeconomic trends in labor prices. Specifically, the model is:

$$\left| \frac{I_{j,t}^{CMS} - I_{j,t-1}^{CMS}}{I_{j,t-1}^{CMS}} \right| = \alpha + \beta_1 N_j + \beta_2 \Delta N_j + \varepsilon_j,$$

where I^{CMS}_{jt} is the Medicare wage index value for wage area j in year t.

The parameter estimates from the regression model are presented in Table 5.6. These estimates show that both the number of hospitals in a wage area and changes in the number of hospitals in a wage area affect volatility in the Medicare wage index. They also show that the number of hospitals in a wage area also affects volatility in the BLS wage index, but to a lesser degree than in the Medicare wage index, and that changes in the number of hospitals in a wage area do not affect volatility in the BLS wage index.

As seen in Table 5.6, the number of hospitals in a wage area is negatively related to the amount of volatility in the Medicare wage index. That is, areas with more providers have less volatility than areas with fewer providers. This is consistent with concerns that wage areas that host small numbers of hospitals may be subject to more volatility in index values from year to year than wage areas that include larger numbers of hospitals.

The percent change in the number of providers also influences the measure of volatility. It is positively related to volatility. Areas that experience large percent changes in their number of providers (due to hospital entry and exit) also exhibit slightly larger amounts of volatility.

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[63] We analyze the effects of the number of hospitals (N) and the annual change in the number of hospitals on the *absolute* value of the one-year percent change in wage index values because there is no expectation that either the number of or the change in the number of hospitals will lead to positive or negative changes in wage index values.

[64] We log the variable number of hospitals given that we believe it has a non-linear relationship with the absolute value of one-year percent change in wage index values.

As with the Medicare wage index, the number of hospitals is negatively related to the amount of volatility in the BLS wage index. Even though the BLS wage index is constructed from occupational wages from all industries, not just the hospital industry, there likely are relatively few observations in wage areas with relatively few hospitals, which also would lead to estimates that are measured with error.

Unlike with the Medicare wage index, the percent change in the number of providers is unrelated to measured volatility in the BLS wage index. This lack of a relationship between changes in the number of hospitals in a wage area and the amount of volatility in the BLS wage index helps confirm that some of the additional volatility found in the Medicare wage index stems from the data used to construct the index.

Table 5.6: Absolute Annual Percent Change in Medicare and BLS Wage Index Values (OLS)

Coefficient	Absolute Percentage Change, Medicare Wage Index	Absolute Percentage Change, BLS Wage Index
Number of Providers in MSA (Log)	-0.00479***	-0.00456***
	(0.000551)	(0.000605)
Absolute % Change in No. of Providers	0.0105***	0.00353
	(0.00398)	(0.00756)
Dummy Year Change 2005 to 2006	0.00319**	--
	(0.00144)	
Dummy Year Change 2006 to 2007	-0.000206	-0.00736***
	(0.00144)	(0.00137)
Constant	0.0269***	0.0275***
	(0.00132)	(0.00137)
Observations	1270	728
R-squared	0.0644	0.1092
*** p<0.01, ** p<0.05, * p<0.1		

Note: Standard Errors in Parentheses

The magnitude of the relationship between the amount of volatility in a wage area and the number of hospitals in that area and the change in the number of hospitals in that area is shown in Table 5.7.

For the Medicare wage index, we estimate the amount of volatility (as measured by the absolute value of the one-year percent change) of wage areas with only one hospital to be 2.86% while that for wage areas with 22 hospitals is 1.37%. (10% of wage areas have only 1 hospital and 10% of wage areas have 22 hospitals or more.) Similarly,

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we estimate that wage areas with no change in their number of hospitals have an expected absolute value of the one-year percentage change of 2.06% while that for wage areas with a 25 percent change in their number of hospitals is 2.33% (50 percent of wage areas have no change in their number of hospitals while 10% of wage areas have a 25 percent or greater change in their number of hospitals).

Table 5.7: Expected Annual Absolute Percentage Change in Medicare Wage Index Values

Condition	Expected Value of Annual Absolute Percentage Change
Effects of the number of hospitals in a wage area	
1 Hospital (10th Percentile)	2.86%
4 Hospitals (50th Percentile)	2.20%
22 Hospitals (90th Percentile)	1.37%
Effects of changes in the number of hospitals in a wage area	
0% Change (50th Percentile)*	2.06%
25% Change (90th Percentile)	2.33%

* Note: There is 0% change for all values below the 50th percentile

Table 5.8 shows that the BLS wage index demonstrates less volatility than the Medicare wage index for wage areas with few numbers of hospitals. The amount of volatility of wage areas with only one hospital is 2.38% while that for wage areas with 22 hospitals is 0.99%. As seen in the regression analysis in table 5.6, the absolute change in the number of hospitals has no effect on the amount of volatility of the BLS wage index values.

Table 5.8: Expected Annual Absolute Percentage Change, BLS Wage Index Values

Condition	Expected Value of Annual Absolute Percentage Change
Effects of the number of hospitals in a wage area	
1 Hospital	2.38%
4 Hospitals	1.76%
22 Hospitals	0.99%

Because volatility is greater in wage areas with fewer hospitals, it is helpful to know the distribution of the number of hospitals in a wage area. Tables 5.9 and 5.10

show these distributions for the wage areas for which we observe Medicare and BLS wage index values respectively.[65]

Table 5.9: Distribution of Providers by Wage Area, Medicare Data

	Number of Areas	Percentage
1 or 2 Providers	420	33.07%
3 or 4 Providers	283	22.28%
Between 5 and 10 Providers	283	22.28%
Between 11 and 25 Providers	180	14.17%
More Than 25 Providers	103	8.19%
Total Number of Wage Areas	1,270	100.00%

Note: We observe Medicare wage index values in 1270 wage areas from 2005 to 2008.

Table 5.10: Distribution of Providers by Wage Area, BLS Data

	Number of Areas	Percentage
1 or 2 Providers	194	26.65%
3 or 4 Providers	164	22.53%
Between 5 and 10 Providers	169	23.21%
Between 11 and 25 Providers	123	16.90%
More Than 25 Providers	78	10.71%
Total Number of Wage Areas	728	100.00%

Note: We observe BLS wage index values in 728 wage areas.

5.4 Conclusion

In this report, we explore the extent of volatility in the Medicare and BLS hospital wage indices. We find that:

- The volatility of a wage index can either capture the underlying variance in costs, or it may reflect measurement error in the data. If an index exhibits "too much" volatility there are methods available to address this issue. One possibility is to average the index over time. However, reducing volatility by taking averages of index values across years may introduce another source of inaccuracy: the use of less timely data.

- The BLS wage index is less volatile than the Medicare wage index.

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[65] In order to see which areas experience the "smallest" and "largest" absolute changes in number of providers, we present in Appendix E the distribution of absolute changes in number of providers in a wage area by the number of hospitals in the area.

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- The number of hospitals in a wage area and the change in the number of hospitals in a wage area are associated with the volatility of the Medicare wage index. Using a two-year rolling average of Medicare wage index values can reduce the amount of volatility in the Medicare wage index.

Whether the relatively higher volatility in the Medicare wage index means it is also relatively less accurate depends whether the inaccuracy that is likely related to volatility is larger than the inaccuracy that is likely related to using less timely wage data. That is, the Medicare wage index could be volatile for reasons unrelated to changes in underlying labor prices or, the BLS wage index could be relatively sluggish in responding to sudden changes in labor prices.

Both the Medicare and BLS wage indices are measures of the cost of labor in wage areas. They differ in terms of their volatility because the sources of wage data from which they are constructed differ in a large number of ways. The relatively higher levels of volatility in the Medicare wage index do appear to be related to its not being constructed from multiple years of wage data and to its being calculated from a small number of observations in some wage areas. However, it is important to remember that the two differences identified in this report may not be the only ones leading to higher volatility in the Medicare wage index. Other differences in the data sources used to construct the indices may also contribute to the relative volatility of the Medicare wage index.

6 CONCLUSION

With this analysis we have weighed the advantages and disadvantages of using either the current Medicare wage data or the BLS wage data for the construction of a hospital wage index. In the sections above, we present an in-depth investigation of the content of each data source by: examining the consequences of including or excluding different sets of workers, aggregating or disaggregating different levels of information, analyzing the importance of including benefit cost information in the index, evaluating the advantages and drawbacks of different approaches to measuring the occupational mix of hospitals, and assessing possible sources of year to year volatility and the remedies for it.

Based on our assessment of these advantages and disadvantages, Acumen recommends that the BLS data be used to construct a hospital compensation index. This source of wage information is more accurate and reliable for the construction of the compensation index.

There are a number of benefits from using BLS data to construct the hospital wage index. First, the BLS data include information from establishments other than hospitals, so that the vast majority of wage areas are likely to have more observations from which to build an index. This increased number of observations helps lower the year to year volatility in the index. As seen in this report, relative to the Medicare data, the BLS data present lower year to year volatility. Second, a measure of labor costs that is based on a broader set of industries, especially in small geographic areas, is more likely to be reflective of labor costs than of staffing decisions among a potentially small number of hospitals. Moreover, the BLS method to adjust for geographic differences in occupational mix is a better option than Medicare's OMA. Third, there is less geographic dispersion in wage index values in the BLS data relative to Medicare data.

As described above, the analyses presented in this report show that the use of BLS data addresses some of the specific concerns with the current index identified by MedPAC, such as, distinguishing the differences in labor costs across wage areas from

differences in the occupational mixes within hospitals, and limiting the annual volatility in the index.

Nonetheless, there are a number of challenges involved with using BLS data that need to be acknowledged. First, in addition to the above mentioned advantages of using data from establishments from outside of the hospital industry to measure labor costs, there is a potential disadvantage from using data from these establishments. If there are both differences across industries in the wages paid to workers in specific occupations and if there are geographic differences in these inter-industry wage differentials, the use of data from establishments from outside of the hospital industry could lead to some measurement error in the BLS hospital wage index.

Analyses presented in this report suggest that a BLS wage index constructed using wage data exclusively from hospitals as opposed to wage information from all industries can affect wage index values. While it is possible that these differences arise because BLS occupational data is less reliably measured for a single industry, it is also possible that they indicate geographic differences in inter-industry wage differentials.

Second, the BLS wage index is calculated in such a way that is could be sensitive to geographic differences in the fraction of workers that are part time versus full time. This potential sensitivity is the result of the manner in which average hourly wages are calculated in the underlying BLS survey as opposed to the method used to construct the BLS wage index. As a result, it is difficult to correct for this limitation in the BLS data. While Acumen's analysis suggests that this potential sensitivity to the fraction of workers that are part time in an area is likely to be small, it remains a limitation of the BLS data.

Third, the BLS data do not include self-employed or contract workers. As a result, the BLS wage index could be sensitive to geographic differences in the fraction of workers that are self-employed or contract workers. While Acumen's analysis again suggests that this sensitivity is likely to be small, it is another limitation of the BLS data. And, finally, in order to adjust the BLS wage index for geographic variation in benefit costs, an expansion of the geographic detail in the BLS benefits data is necessary.

Overall and despite these limitations, Acumen believes that the methods recommended by MedPAC for constructing the hospital compensation index represent an

improvement over existing methods and that the BLS data should be adopted so that the MedPAC approach can be implemented.

This report focused primarily on the comparison of two data sources used to construct a hospital wage index. In a forthcoming report, Acumen will consider additional MedPAC recommendations for the hospital wage index, and will address issues related to the methodology of constructing a wage index, such as, ways to define wage areas as well as methods to smooth wage index values across contiguous wage areas.

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Table A.1: Wage and Employment Shares within the Hospital Industry by Occupation (MedPAC 30)

Occupation	Share of Wages	Share of Employment
Registered nurses	35.73%	27.16%
Office and administrative support occupations	9.90%	15.20%
Healthcare support occupations	7.48%	13.17%
Management occupations	6.42%	3.45%
Licensed practical and licensed vocational nurses	2.83%	3.57%
Radiologic technologists and technicians	2.26%	2.11%
Medical and clinical laboratory technologists	2.05%	1.85%
Pharmacists	2.04%	1.03%
Building and grounds cleaning and maintenance occupations	1.82%	3.71%
Respiratory therapists	1.54%	1.47%
Food preparation and serving related occupations	1.44%	2.90%
Physical therapists	1.38%	0.96%
Medical and clinical laboratory technicians	0.96%	1.23%
Surgical technologists	0.92%	1.14%
Medical records and health information technicians	0.83%	1.21%
Occupational therapists	0.70%	0.52%
Diagnostic medical sonographers	0.61%	0.49%
Pharmacy technicians	0.60%	0.93%
Protective service occupations	0.58%	0.88%
Health technologists and technicians, all other	0.58%	0.67%
Cardiovascular technologists and technicians	0.57%	0.62%
Psychiatric technicians	0.51%	0.75%
Emergency medical technicians and paramedics	0.49%	0.73%
Dietitians and nutritionists	0.37%	0.35%
Speech-language pathologists	0.33%	0.24%
Respiratory therapy technicians	0.33%	0.37%
Nuclear medicine technologists	0.32%	0.24%
Radiation therapists	0.28%	0.20%
Personal care and service occupations	0.26%	0.47%
Dietetic technicians	0.14%	0.23%

Table A.2: Summary Statistics for Regression Variables

	Dependent Variable		Independent Variables			
	Difference between BLS and Medicare Wage Index (Medicare-OES)	**Absolute Difference between BLS and Medicare Indices**	**% Hospital Workers working in Hospitals**	**% Hospital Workers working part-time**	**% Self Employed Hospital Workers**	**Number of Hospitals in MSAs**
Maximum	0.444	0.444	61.61%	48.56%	16.72%	89
Median	-0.001	0.035	39.82%	22.50%	3.95%	4
Minimum	-0.189	0.000	12.79%	6.58%	1.51%	1
Mean	0.009	0.050	39.58%	22.77%	4.35%	8.39
Standard Deviation	0.072	0.053	6.73%	6.90%	1.91%	12.11
Number of Areas	416	416	416	416	416	416

Note: We restrict our observations to the areas that had information on all of the independent variables (i.e. to the areas that had full ACS information and were included in the regression analysis). If we did not make this restriction, we would find a higher number of observations in the distribution of the two dependent variables.

Table A.3: OLS Model: Difference between Medicare and BLS Indices

	Model 1 Difference	Model 2 Absolute Difference
Share of hospital workers	0.00042	0.00024
	(0.00056)	(0.00038)
Share of part-time workers	0.00172***	0.0019***
	(0.00060)	(0.00045)
Share of self-employed workers	0.00393*	0.00387***
	(0.00244)	(0.00147)
Number of Hospitals (Dummy =1 if hosp >5)	-0.0124*	-0.01133**
	(0.0068)	(0.00496)
Constant	-0.0591**	-0.0156
	(0.0296)	(0.0209)
Observations	416	416
R-squared	0.046	0.095
*** p<0.01, ** p<0.05, * p<0.1		

Note: Standard Errors in Parentheses

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Table A.4: Ordered Probit: Probability of Negative and Positive Difference between Medicare and BLS Indices

	Model 4.1 Ordered Difference
Share of hospital workers	-0.0026
	(0.0088)
Share of part-time workers	0.0212**
	(0.0082)
Share of self-employed workers	0.0298
	(0.0349)
Number of Hospitals (Dum =1 if hosp >5)	-0.2473**
	(0.1080)
_cut1	-0.2688
	(0.4416)
_cut2	0.4745
	(0.4418)
_cut3	1.1093**
	(0.4432)
Observations	416
Pseudo R-squared	0.012
*** p<0.01, ** p<0.05, * p<0.1	

Note: Standard Errors in Parentheses

The dependent variable takes the values of 0, 1, 2, and, 3, where

0 represents negative differences that are smaller than -0.033026 (the 25th percentile).

1 represents negative differences that range from -0.033026 to 0 (approximately the 50th percentile).

2 represents positive differences that range from 0 to 0.03720 (75th percentile),

and,

3 represents positive differences larger than 0.03720.

Note: _cut1, _cut2, and _cut3 are the coefficients of the *thresholds* or *cut points* of the latent variable y* that ranges from -∞ to ∞ that is related to our discrete ordered dependent variable (in this case, our dependent variable is the negative and positive differences in index values and takes the values of 0, 1, 2, and 3). The location of these cut points tell us the probabilities of each of the discrete outcomes of our dependent variable after a normal transformation. For a detailed explanation of ordered probit models see Long, Scott, *Regression Models for Categorical and Limited Dependent Variables*, SAGE Publications 1997.

APPENDIX B: THE EFFECT OF ADJUSTING BLS DATA

How could one adjust the BLS data to correct for its weighting part-time and full-time workers equally when calculating average hourly wages and for not collecting data from self-employed workers? Using data from the ACS on occupation-level information on the fraction of workers that are part-time in each wage area, the ratio of annual hours of work for part-time worker to annual hours of work for full-time workers, and the difference between the average hourly wages paid to full-time and part-time workers, one could adjust the BLS data to make it comparable to the Medicare method for calculating average hourly wages. Using occupational-level data from the ACS on the fraction of workers that are self-employed in each wage area and on the difference between the average hourly wages paid to employees and to self-employed workers, one could adjust the BLS data (which does not collect data on self-employed workers) to make it comparable to the Medicare data (which does).

The adjustment to the BLS data to make it more comparable to the Medicare data in how it treats part-time workers is:

$$a_{ij} = PT_{ij} \times \left(\frac{hours_i^{PT}}{hours_i^{FT}} \right) \times \left(w_i^{FT} - w_i^{PT} \right),$$

Where a_{ij} is the additive adjustment factor for occupation i in wage area j, PT_{ij} is the fraction of workers in occupation i in wage area j that are part-time, $hours_i^{PT}$ is the annual hours of work for part-time workers in occupation i, $hours_i^{FT}$ is the annual hours of work for full-time workers in occupation i, w_i^{PT} is the average hourly wage paid to part-time workers in occupation i, and w_i^{FT} is the average hourly wage paid to full-time workers in occupation i.

The adjustment to the BLS data, which does not collect data on self-employed workers, to make it more comparable to the Medicare data, which does collect data on self-employed workers, is:

$$b_{ij} = SE_{ij} \times \left(w_i^E - w_i^{SE} \right),$$

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Where b_{ij} is the additive adjustment factor for occupation i in wage area j, SE_{ij} is the fraction of workers in occupation i in wage area j that are self-employed, w^{SE}_i is the average hourly wage paid to self-employed workers in occupation i, and w^E_i is the average hourly wage paid to employees in occupation i.

Acumen used data from the Bureau of the Census's American Community Survey (ACS) to calculate adjustment factors for self-employment and for part-time workers.[66] These adjustment factors were then applied to the BLS wage index and the adjusted indices were compared, by wage area, with the Medicare wage index. The results of these comparisons are presented in Table B.1.

Table B.1: Distributions of "Large" and "Small" Percent Change when Moving from Medicare Wage Index (Occupational Mix Adjusted) to BLS Indices (Adjusted and Non-Adjusted)

	Wage Areas	Medicare to Unadjusted BLS	Wage Areas	Medicare to Part-Time Adjusted BLS	Wage Areas	Medicare to Self-Employed Adjusted BLS
Less than -10%	33	7.93%	34	8.17%	35	8.41%
Between -10% and -5%	57	13.70%	52	12.50%	63	15.14%
Between -5% and -1%	84	20.19%	85	20.43%	84	20.19%
Between -1% and 1%	72	17.31%	77	18.51%	71	17.07%
Between 1% and 5%	92	22.12%	89	21.39%	94	22.60%
Between 5% and 10%	59	14.18%	60	14.42%	53	12.74%
Greater than 10%	19	4.57%	19	4.57%	16	3.85%
Total	416	100.00%	416	100.00%	416	100.00%

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[66] Given that the ACS data on hourly wages had several extreme observations that were affecting the estimations of the adjustment factors, we decided to clean the data and delete the top and bottom 3% of the observations.

Table B.1 shows that the percentage difference between the Medicare wage index and the BLS wage index changes very little if we adjust for self-employment or for part-time workers. The percentage of hospitals that would see decreases or increases of greater than 5% in their index values when adopting the unadjusted BLS wage index or the part-time adjusted BLS wage index is fairly constant across these two indices (approximately 21% of hospitals would experience decreases greater than 5%, and about 19% of hospitals would experience increases greater than 5% if adopting either the unadjusted or the part-time adjusted BLS indices). The percent of hospitals with decreases in their index values greater than 5% increases slightly if hospitals were to adopt the self-employed adjusted BLS wage index (approximately 23%). However, the distribution of changes remains fairly similar to the one observed if the unadjusted or part-time adjusted BLS indices were adopted. The fact that adjusting the BLS wage index for part-time and self-employed workers has practically a very small effect on the differences between the Medicare and BLS wage index values, suggests that adjusting the BLS-OES wage data for these two factors is not necessary.

Moreover, regardless of whether one compares the Medicare wage index to either of the BLS adjusted indices, it is still the case that on average a move from the Medicare to the BLS wage index results in a positive percent change in index values, and that the BLS wage indexes varies less across wage areas than the Medicare wage index (see table B.2). These results are still consistent with the results in section 2.3.

Table B.2: Summary Statistics of Adjusted and Non-Adjusted Hospital Wage Indices

	N	Mean	Median	Min	Max	Std
Medicare Wage Index, Adjusted for Occupational Mix	416	1.00	0.97	0.71	1.63	0.15
BLS Wage Index, Unadjusted	416	1.00	0.98	0.78	1.47	0.12
BLS Wage Index, Part-time Adjusted	416	1.00	0.99	0.78	1.47	0.12
BLS Wage Index, Self-Employed Adjusted	416	1.00	0.98	0.77	1.48	0.13

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APPENDIX C: SUPPLEMENTARY DATA FOR SECTION 3

Table C.1: Percentage Increase in Compensation by Provider, when Including Benefits

	Number	Percent
Less than 10% increase	14	0.41%
Between 10% and 20% increase	1,076	31.61%
Between 20% and 30% increase	1,877	55.14%
Between 30% and 40% increase	377	11.08%
Greater than 40% increase	60	1.76%
Total	3,404	100.00%

Table C.2: Summary Statistics, Medicare Wage Index (Weighted by Discharges), with and without Benefits, by Wage Area

	N	Mean	Median	Min	Max	St Dev
With benefits	427	1.000	0.975	0.514	1.672	0.154
Without benefits	427	1.000	0.974	0.536	1.622	0.153

Table C.3: Percent Change in Provider Index Values Moving from Medicare, no Benefits to Medicare with Benefits

	N	Mean	Median	Min	Max	St. Dev.
Rural Hospitals	974	1.44%	0.88%	-3.48%	11.55%	2.38%
Urban Hospitals	2,430	-0.35%	-0.87%	-7.65%	19.79%	2.98%

Table C.4: Percent Differences in Benefit Costs between Worksheet A and Worksheet S-3, by Hospital Characteristic

Hospital Characteristics	N Hospitals	Mean	Median	St. Dev
All Hospitals	3,372	-16.70%	-2.59%	50.19%
Urban/Rural:				
Urban	2,417	-21.75%	-11.38%	49.60%
Rural	955	-3.94%	8.59%	49.44%
Region:				
Northeast/Mid Atlantic	549	0.90%	9.22%	39.99%
South	1,346	-17.11%	-7.22%	47.30%
Midwest	749	-12.95%	0.00%	52.74%
West	593	-34.38%	-24.47%	53.87%
Number of Beds:				
0-99	1,170	-8.35%	3.96%	53.79%
100-199	1,007	-17.98%	-10.11%	46.63%
200-299	497	-18.57%	-6.74%	45.92%
300-499	401	-26.75%	-17.32%	46.68%
500+	162	-29.55%	-17.09%	49.99%
Teaching Status:				
Non-teaching	2,224	-12.98%	0.23%	49.49%
<100 Residents	780	-21.25%	-12.05%	49.14%
100+ Residents	233	-30.75%	-17.32%	51.89%

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Table C.5: Linear Regression Analysis: Percent Difference in Benefits from Worksheets S-3 to Worksheet A : (A-S-3)/S-3*100

Coefficient	Percentage Difference
Urban (relative to Rural)	-12.80***
	(2.178)
Bed Size (Relative to Less than 100 Beds)	
100-199	-5.962***
	(2.231)
200-299	-2.874
	(2.904)
300-499	-6.590**
	(3.333)
500+	-5.175
	(5.048)
Region (Relative to South)	
Northeast - Mid Atlantic	24.970***
	(2.522)
Midwest	6.898***
	(2.223)
West	-13.995***
	(2.394)
Teaching Status (Relative to No Teaching)	
100+ residents	-18.56***
	(4.273)
<100 residents	-5.326**
	(2.281)
Constant	-4.511**
	(1.838)
Observations	3,237
R-squared	0.0857

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table C.6: Linear Regression Analysis: Benefit to Total Compensation Ratio Worksheet S-3

Coefficient	Percentage Difference
Urban (relative to Rural)	-0.0154***
	(0.0022)
Bed Size (Relative to Less than 100 Beds)	
100-199	-0.0023
	(0.0022)
200-299	-0.0001
	(0.0030)
300-499	0.0018
	(0.0033)
500+	-0.0018
	(0.0050)
Region (Relative to South)	
Northeast - Mid Atlantic	0.0252***
	(0.0025)
Midwest	0.0206***
	(0.0022)
West	0.011***
	(0.0024)
Teaching Status (Relative to No Teaching)	
100+ residents	0.0037
	(0.0042)
<100 residents	-0.0022
	(0.0022)
Constant	0.190***
	(0.00181)
Observations	3,233
R-squared	0.0591

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Table D.1: Wage and Employment Shares within the Hospital Industry by Occupation (Acumen's Top 62)

Occupation	Share of Wages	Share of Employment
Registered nurses	35.73%	27.16%
Nursing aides, orderlies, and attendants	4.04%	7.69%
Medical and health services managers	3.21%	1.77%
Licensed practical and licensed vocational nurses	2.83%	3.57%
Radiologic technologists and technicians	2.26%	2.11%
Medical and clinical laboratory technologists	2.05%	1.85%
Pharmacists	2.04%	1.03%
Respiratory therapists	1.54%	1.47%
Physical therapists	1.38%	0.96%
Office clerks, general	1.38%	2.35%
Medical secretaries	1.12%	1.78%
Maids and housekeeping cleaners	1.07%	2.32%
Medical and clinical laboratory technicians	0.96%	1.23%
Interviewers, except eligibility and loan	0.93%	1.56%
Surgical technologists	0.92%	1.14%
Secretaries, except legal, medical, and executive	0.88%	1.35%
Healthcare support workers, all other	0.86%	1.43%
First-line supervisors/managers of office and administrative support workers	0.86%	0.85%
Medical records and health information technicians	0.83%	1.21%
General and operations managers	0.75%	0.38%
Medical and public health social workers	0.74%	0.69%
Executive secretaries and administrative assistants	0.72%	0.87%
Occupational therapists	0.70%	0.52%
Diagnostic medical sonographers	0.61%	0.49%
Pharmacy technicians	0.60%	0.93%
Health diagnosing and treating practitioners, all other	0.60%	0.46%
Medical assistants	0.59%	0.97%
Health technologists and technicians, all other	0.58%	0.67%
Cardiovascular technologists and technicians	0.57%	0.62%
Janitors and cleaners, except maids and housekeeping cleaners	0.56%	1.13%
Maintenance and repair workers, general	0.55%	0.74%
Billing and posting clerks and machine operators	0.55%	0.85%
Medical transcriptionists	0.54%	0.78%
Psychiatric technicians	0.51%	0.75%
Emergency medical technicians and paramedics	0.49%	0.73%
Receptionists and information clerks	0.48%	0.86%
Business operations specialists, all other	0.47%	0.40%
Security guards	0.47%	0.76%
Managers, all other	0.47%	0.28%
Bookkeeping, accounting, and auditing clerks	0.44%	0.64%

Occupation	Share of Wages	Share of Employment
Physician assistants	0.44%	0.27%
Chief executives	0.40%	0.12%
Food preparation workers	0.38%	0.82%
Dietitians and nutritionists	0.37%	0.35%
Administrative services managers	0.37%	0.23%
Healthcare practitioners and technical workers, all other	0.35%	0.38%
Computer systems analysts	0.35%	0.25%
Financial managers	0.35%	0.17%
Cooks, institution and cafeteria	0.34%	0.64%
Food servers, non-restaurant	0.33%	0.72%
Speech-language pathologists	0.33%	0.24%
Accountants and auditors	0.33%	0.29%
Respiratory therapy technicians	0.33%	0.37%
Customer service representatives	0.33%	0.51%
Mental health and substance abuse social workers	0.33%	0.36%
Nuclear medicine technologists	0.32%	0.24%
Medical equipment preparers	0.32%	0.54%
Physical therapist assistants	0.32%	0.36%
Psychiatric aides	0.30%	0.53%
Stock clerks and order fillers	0.30%	0.51%
Radiation therapists	0.28%	0.20%
Bill and account collectors	0.28%	0.43%

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APPENDIX E: SUPPLEMENTARY DATA FOR SECTION 5

Table E.1: Summary Statistics for One-Year Percent Changes in Medicare and BLS Wage Index Values (3 Year Analysis)

	Annual Percentage Change in Wage Index Values	
	Medicare Wage Index, 2006 to 2008	**BLS Wage Index, 2002 to 2004**
Mean	-0.23%	-0.05%
Standard Deviation	2.81%	2.44%
Number of Wage Areas Across All Years	848	728

Note: We use the Medicare wage area indices from FY2006, FY2007 and FY2008, which are constructed from 2002, 2003, and 2004 Worksheet S-3 wage data and are not adjusted for occupational mix. We construct BLS wage indices from OES data from 2002, 2003, and 2004 following MedPAC (2007) with the exception that we do not smooth across contiguous wage areas and do not adjust wage index at the county level. The number of observations represents the number of wage areas multiplied by the number of one-year changes we are able to calculate.

Table E.2: Distribution of Standard Deviations of Wage Index Values by Wage Area (3 Year Analysis)

	Medicare Wage Index 2006 to 2008		BLS Wage Index 2002 to 2004	
	Number of Areas	**Percent**	**Number of Areas**	**Percent**
Standard deviation less than .01	148	34.82%	176	48.35%
Standard deviation of between .01 and .025	187	44.00%	135	37.09%
Standard deviation of between .025 and .05	74	17.41%	47	12.91%
Standard deviation of greater than .05	16	3.76%	6	1.65%
Total number of observations	425	100.00%	364	100.00%

Note: We use the Medicare wage area indices from FY2006, FY2007 and FY2008, which are constructed from 2002, 2003, and 2004 Worksheet S-3 wage data and are not adjusted for occupational mix. We construct BLS wage indices from OES data from 2002, 2003, and 2004 following MedPAC (2007) with the exception that we do not smooth across contiguous wage areas and do not adjust wage index at the county level. The number of observations represents the total number of wage areas for which we have multiple years of wage index values.

Table E.3: Distribution of Absolute Changes in Providers per Wage Area

Distribution of Changes in Providers	Frequency	Percent
All Wage Areas		
0% change in providers	872	68.66%
Between 0% and 15% change in providers	193	15.20%
Between 15% and 30% change in providers	109	8.58%
Greater than 30% change in providers	96	7.56%
Total	1,270	100.00%

Table E.4: Distribution of Absolute Change in Providers per Wage Area, by Number of Providers

Distribution of Changes in Providers	Frequency	Percent
Wage Areas Containing 1 or 2 Providers		
0% change in providers	382	90.95%
Between 0% and 15% change in providers	0	0.00%
Between 15% and 30% change in providers	0	0.00%
Greater than 30% change in providers	38	9.05%
Total	420	100.00%
Wage Areas Containing 3 or 4 Providers		
0% change in providers	220	77.74%
Between 0% and 15% change in providers	0	0.00%
Between 15% and 30% change in providers	24	8.48%
Greater than 30% change in providers	39	13.78%
Total	283	100.00%
Wage Areas Containing between 5 and 10 Providers		
0% change in providers	170	60.07%
Between 0% and 15% change in providers	48	16.96%
Between 15% and 30% change in providers	53	18.73%
Greater than 30% change in providers	12	4.24%
Total	283	100.00%
Wage Areas Containing between 11 and 25 Providers		
0% change in providers	74	41.11%
Between 0% and 15% change in providers	83	46.11%
Between 15% and 30% change in providers	20	11.11%
Greater than 30% change in providers	3	1.67%
Total	180	100.00%
Wage Areas Containing More than 25 Providers		
0% change in providers	26	25.00%
Between 0% and 15% change in providers	62	59.62%
Between 15% and 30% change in providers	12	11.54%
Greater than 30% change in providers	4	3.85%
Total	104	100.00%