How shifting occupational composition has affected the real average wage

OES data from 2002–2007 reveal that an overall shift in employment towards occupations with lower mean wages hindered growth in the U.S. real average wage and that wage growth was concentrated in higher paying occupations; the data also show a shift in employment from the middle-paying occupations to the highest and lowest paying occupations

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Between November 2002 and May 2007, the cross-occupational average hourly wage in the United States increased by $2.46, from $17.10 to $19.56, or by about 14 percent, according to the Occupational Employment Statistics (OES) program. Adjusting the 2002 figure to May 2007 dollars[1] shows the real average hourly wage increased from $19.48 to $19.56, approximately a .41-percent increase.

There have been numerous studies and programs devoted to understanding this recent slow growth in the Real Average Wage (RAW). Many studies attribute slow wage growth to the increasing cost of employee benefits and health insurance—a phenomenon that results in employees' wages becoming a smaller part of their total compensation.[2] Other studies have analyzed how wage growth relates to income or wage inequality.[3] This article seeks to contribute towards an understanding of RAW growth by quantifying how changes in the occupational composition of U.S. employment have affected the average wage.

This article analyzes occupational wage and employment data from the OES program to understand how changes in occupations' wages and changes in occupations' levels of employment each have contributed to growth in the U.S. RAW. Overall wage growth could stem from increases in the mean wages of particular occupations, from a shift in employment towards occupations with higher wages, or from a combination of the two factors. This article's analysis of OES data from November 2002 to May 2007 finds that a shift in employment towards lower paying occupations hindered U.S. RAW growth, that increases in the real mean wages of individual occupations was the only factor that caused growth in the U.S. RAW, and that most of the average wage growth was due to increases in the wages of the highest paying occupations. This analysis also finds a shift in employment towards the highest paying and lowest paying occupations and away from middle-paying occupations. This article will show which occupations experienced growth and which experienced decline in real mean wages or in share of employment, and how these changes influenced the U.S. RAW. It will also reveal patterns of lower and higher paying occupations and of education and training categories, and give a brief analysis of changes in the average wages of U.S. States.

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Methods

The OES program estimates national employment and wages by occupation and provides a

data set for understanding changes in the average wage over the medium term. The OES program surveys 1.2 million business establishments, using 3 years of data collected in six semiannual panels to produce estimates for over 800 occupations.[4] Because of the survey methods employed, it can be difficult to use the data for time-series analysis, but this study mostly overcomes the issue because it compares wage and employment data 4½ years apart and analyzes cross-industry wage and employment estimates that have been retabulated on the basis of a common coding system.[5] However, between November 2002 and May 2007, OES implemented refinements in occupational coding procedures that have caused some management workers to be moved from one occupation to another. Therefore, some results of this analysis may have been affected by this worker classification change and must be interpreted cautiously.

Change in the U.S. average wage may be due to changes in the mean wages of individual occupations or to shifts in employment among higher and lower paying occupations. An occupation's share of national employment is the percent of total jobs in the Nation for which the occupation accounts. This article uses a "shift-share analysis" of OES data to quantify the effect of changes in mean wages and the effect of changes in employment share on the U.S. RAW from November 2002 to May 2007.[6] OES data previously have been employed to examine the role of occupational composition, or the assortment of shares of national employment held by occupations, in the average wage differentials of U.S. States for one point in time.[7] In this article, change in the U.S. RAW over time is analyzed in a similar fashion, by decomposing the components of the change.

To calculate the U.S. RAW, each occupation's mean wage is multiplied by its share of national employment and then the products are summed. Change in the U.S. RAW from time t to time t+1 is found by subtracting the U.S. RAW at time t from the U.S. RAW at time t+1. Just as the U.S. RAW is influenced by the two factors of occupational mean wages and occupational composition, change in the U.S. RAW is influenced by the two factors of changes in occupational real mean wages and change in occupational composition. The decomposition of U.S. RAW change into these two factors, expressed in words and in mathematical notation, is

Change in U.S. RAW = National Wage Component + National Employment Component + National Residual Component

$$\overline{w}_{t+1} - \overline{w}_t = \sum_{j=1}^{J} \left(\frac{N_j}{N}\right)_t \Delta\overline{w}_j + \sum_{j=1}^{J} \overline{w}_{jt} \Delta\left(\frac{N_j}{N}\right) + \sum_{j=1}^{J} \Delta\overline{w}_j \Delta\left(\frac{N_j}{N}\right)$$

where

$j = \{1, 2, ..., J\}$ index occupations
Δ = Change from November 2002 to May 2007
$\overline{w}$ = U.S. real average wage (in May 2007 dollars)
$\overline{w}_j$ = Occupational real average wage (in May 2007 dollars)
N = National employment; N_j = Occupational employment
t = November 2002; t+1 = May 2007

Table 1 shows the results and constituents of this analysis for the sum of all occupations and for major occupational groups (obtained by summing the results of all occupations within each group), and includes mean wages (in May 2007 dollars) and national employment shares in November 2002 and May 2007. Table 2 shows the results and constituents of this analysis for selected occupations.

The contribution of changes in the mean wages of occupations to the change in the U.S. RAW, represented by the first term in the aforementioned equation, is called the "wage component." The wage component of an occupation is found by holding the occupation's share of national employment constant while considering only the change in the mean wage of the occupation. The wage component is measured by multiplying the change in mean wage from November 2002 (in May 2007 dollars) to May 2007 by the occupation's share of November 2002 national employment.

A positive wage component indicates that the mean wage of an occupation or group of occupations increased, while a negative result indicates that the mean wage decreased. For example, as seen in table 2, the occupation of accountants and auditors has a wage component of 1 cent, found by multiplying the occupation's real mean wage increase of $1.23 by its November 2002 employment share of .70 percent. The national wage component is found by summing all occupations' wage components. A positive national wage component indicates that occupational mean wages grew overall, whereas a negative result indicates mean wages declined overall.

The contribution of changes in occupational composition to the change in the U.S. RAW, represented by the second term in the above equation, is called the "employment component." The employment component of an occupation is found by multiplying the occupation's change in employment share by its November 2002 mean wage (in May 2007 dollars). In other words, an occupation's

Table 1. Mean hourly wage, employment share, and components of change in the U.S. real average wage, by occupational group, Nov. 2002–May 2007

Occupational group	2002 mean wage, in May 2007 dollars	2007 mean wage	Change in real mean wage[1]	2002 employment share	2007 employment share	Change in employment share[1]	Wage component	Employment component	Residual component	Total of three components[1]	Employment effect
Total, all occupations	$19.48	$19.56	$0.08	100.0	100.0	—	$0.22	$–0.11	$–0.03	$0.08	$–0.11
Management occupations[2]	43.19	46.27	3.08	5.56	4.47	–1.09	.20	–.49	–.04	–.33	–.28
Business and financial operations occupations	29.20	30.07	.87	3.74	4.48	.74	.02	.22	.00	.25	.08
Computer and mathematical science occupations	33.75	34.71	.96	2.17	2.38	.20	.01	.08	.00	.09	.04
Architecture and engineering occupations	31.77	33.11	1.34	1.89	1.85	–.04	.02	–.01	.00	.01	.00
Life, physical, and social science occupations	28.69	29.79	1.11	.85	.93	.09	.01	.03	.00	.04	.01
Community and social services occupations	18.96	19.49	.53	1.24	1.33	.10	.01	.02	.00	.03	.00
Legal occupations	42.35	42.53	.18	.73	.74	.01	.00	.01	.00	.01	.01
Education, training, and library occupations	22.01	22.41	.40	6.09	6.19	.10	.01	.03	.00	.05	.01
Arts, design, entertainment, sports, and media occupations	22.81	23.27	.46	1.18	1.31	.13	.00	.03	.00	.04	.01
Healthcare practitioner and technical occupations	29.75	31.28	1.53	4.87	5.12	.25	.06	.08	.01	.15	.03
Healthcare support occupations	12.27	12.31	.03	2.49	2.70	.21	.00	.02	.00	.03	–.02
Protective service occupations	18.25	18.84	.58	2.35	2.30	–.05	.02	– .01	.00	.00	.00
Food preparation and serving related occupations	9.40	9.34	–.06	7.89	8.39	.50	.00	.04	.00	.04	–.05
Building and grounds cleaning and maintenance occupations	11.44	11.33	–.11	3.34	3.28	–.06	.00	–.01	.00	–.01	.00
Personal care and service occupations	11.70	11.53	–.17	2.29	2.49	.20	.00	.02	.00	.02	–.02
Sales and related occupations	16.76	16.94	.18	10.46	10.67	.21	.02	.04	.00	.05	.00
Office and administrative support occupations	15.28	15.00	–.28	17.84	17.32	–.52	–.04	–.09	.00	–.13	.01
Farming, fishing, and forestry occupations	11.05	10.89	–.16	.35	.33	–.02	.00	.00	.00	.00	.00
Construction and extraction occupations	19.93	19.53	–.40	4.80	4.99	.19	–.02	.04	.00	.02	.00
Installation, maintenance, and repair occupations	19.59	19.20	–.39	4.09	4.01	–.08	–.02	–.02	.00	–.03	.00
Production occupations	15.43	15.05	–.38	8.41	7.55	–.86	–.03	–.13	.00	–.16	.04
Transportation and material moving occupations	14.93	14.75	–.18	7.37	7.17	–.20	–.02	–.02	.00	–.04	.02

[1] Numbers may not add precisely because of rounding.

[2] The results for management occupations should be interpreted with caution because they may be affected by refinements in occupational coding procedures.

mean wage is held constant and only the change in an occupation's employment share is taken into account. A positive employment component indicates that the employment share of an occupation or group of occupations increased, while a negative result indicates that its employment share declined. For example, as seen in table 1, the employment component of the production occupational group is –13 cents, found by multiplying the pro-

Table 2. Mean hourly wage, employment share, and components of change in the U.S. real average wage, for selected occupations, Nov. 2002–May 2007

Occupation title	2002 mean wage, in May 2007 dollars	2007 mean wage	Change in real mean wage[1]	2002 employment share	2007 employment share	Change in employment share[1]	Wage component	Employment component	Residual component	Total of components[1]	Employment effect
Total, all occupations	$19.48	$19.56	0.08	100.0	100.0	—	0.22	–0.11	$–0.03	$0.08	$–0.11
Selected occupations with large positive wage components (sorted by wage component)[2]											
Registered nurses	27.29	30.04	2.74	1.76	1.84	.08	.05	.02	.00	.07	.01
Pharmacists	41.15	47.58	6.43	.17	.19	.02	.01	.01	.00	.02	.00
Sales representatives, wholesale and manufacturing, except technical and scientific products	28.00	28.94	.94	1.08	1.12	.04	.01	.01	.00	.02	.00
Accountants and auditors	29.15	30.37	1.23	.70	.83	.13	.01	.04	.00	.05	.01
First-line supervisors/managers of non-retail sales workers	35.19	37.58	2.39	.26	.21	–.05	.01	–.02	.00	–.01	–.01
Sales representatives, wholesale and manufacturing, technical and scientific products	34.75	36.76	2.01	.29	.30	.01	.01	.00	.00	.01	.00
Licensed practical and licensed vocational nurses	17.69	18.72	1.03	.54	.54	–.01	.01	.00	.00	.00	.00
Waiters and waitresses	8.64	8.93	.29	1.64	1.75	.12	.00	.01	.00	.02	–.01
Computer software engineers, systems software	41.53	43.65	2.12	.20	.26	.06	.00	.02	.00	.03	.01
Executive secretaries and administrative assistants	19.19	19.57	.38	1.10	1.13	.03	.00	.00	.00	.01	.00
Selected occupations with large negative wage components (sorted by wage component)[2]											
Office clerks, general	12.89	12.48	–.41	2.24	2.22	–.02	–.01	.00	.00	–.01	.00
Truck drivers, heavy and tractor-trailer	18.81	18.06	–.76	1.19	1.26	.07	–.01	.01	.00	.00	.00
Stock clerks and order fillers	11.63	10.93	–.71	1.26	1.35	.09	–.01	.01	.00	.00	–.01
Cashiers	9.14	8.84	–.30	2.65	2.64	–.01	–.01	.00	.00	–.01	.00
Customer service representatives	15.46	14.93	–.54	1.45	1.63	.18	–.01	.03	.00	.02	–.01
Team assemblers	13.53	12.72	–.81	.89	.87	–.02	–.01	.00	.00	–.01	.00
Securities, commodities, and financial services sales agents	46.94	43.49	–3.44	.20	.20	.00	–.01	.00	.00	–.01	.00
Secretaries, except legal, medical, and executive	14.45	14.04	–.42	1.41	1.36	–.04	–.01	–.01	.00	–.01	.00
Computer support specialists	23.18	21.78	–1.40	.38	.39	.02	–.01	.00	.00	.00	.00
Construction laborers	15.64	14.88	–.76	.65	.78	.13	.00	.02	.00	.01	–.01

See footnotes at end of table.

Table 2. Continued—Mean hourly wage, employment share, and components of change in the U.S. real average wage, for selected occupations, Nov. 2002–May 2007

Occupation title	2002 mean wage, in May 2007 dollars	2007 mean wage	Change in real mean wage[1]	2002 employment share	2007 employment share	Change in employment share[1]	Wage component	Employment component	Residual component	Total of components[1]	Employment effect
Selected occupations with large positive employment effects (sorted by employment effect)[2]											
Computer software engineers, applications	40.41	41.18	0.77	0.28	0.37	0.09	0.00	0.04	0.00	0.04	0.02
Computer software engineers, systems software	41.53	43.65	2.12	.20	.26	.06	.00	.02	.00	.03	.01
Accountants and auditors	29.15	30.37	1.23	.70	.83	.13	.01	.04	.00	.05	.01
Packers and packagers, hand	9.94	9.77	–.17	.73	.59	–.13	.00	–.01	.00	–.01	.01
Management analysts	38.42	38.68	.26	.31	.37	.06	.00	.02	.00	.03	.01
Market research analysts	33.00	32.20	–.80	.10	.16	.07	.00	.02	.00	.02	.01
Personal financial advisors	42.96	42.89	–.07	.06	.10	.04	.00	.02	.00	.02	.01
Loan officers	28.56	30.10	1.54	.17	.27	.09	.00	.03	.00	.03	.01
Network systems and data communications analysts	33.62	34.02	.41	.10	.16	.06	.00	.02	.00	.02	.01
Financial analysts	36.79	39.28	2.50	.13	.17	.04	.00	.02	.00	.02	.01
Selected occupations with large negative employment effects (sorted by employment effect)[2]											
Combined food preparation and serving workers, including fast food	8.30	8.03	–.27	1.57	1.94	.37	.00	.03	.00	.03	–.04
Retail salespersons	11.91	11.79	–.12	3.05	3.30	.24	.00	.03	.00	.03	–.02
Home health aides	10.43	10.03	–.40	.45	.62	.17	.00	.02	.00	.02	–.02
Waiters and waitresses	8.64	8.93	.29	1.64	1.75	.12	.00	.01	.00	.02	–.01
Computer programmers	34.88	34.62	–.26	.36	.29	–.06	.00	–.02	.00	–.02	–.01
Personal and home care aides	9.20	9.11	–.09	.35	.44	.09	.00	.01	.00	.01	–.01
Cooks, restaurant	10.87	10.56	–.31	.56	.65	.09	.00	.01	.00	.01	–.01
First–line supervisors/ managers of non–retail sales workers	35.19	37.58	2.39	.26	.21	–.05	.01	–.02	.00	–.01	–.01
Stock clerks and order fillers	11.63	10.93	–.71	1.26	1.35	.09	–.01	.01	.00	.00	–.01
Customer service representatives	15.46	14.93	–.54	1.45	1.63	.18	–.01	.03	.00	.02	–.01

[1] Numbers may not add precisely because of rounding.

[2] Management occupations and residual occupations are not included.

duction group's November 2002 mean wage (in May 2007 dollars) of $15.43 by its employment share decline of .86 percentage point. A higher paying occupation will have an employment component of a greater degree than a lower paying occupation with the same change in employment share. The national employment component is found by summing all occupations' employment components. A positive national employment component indicates that higher paying occupations gained employment share relative to lower paying occupations, while a negative result indicates lower paying occupations gained employment share.

The final component of change in the U.S. RAW is the residual component, which captures the part of the

change in the RAW that is not attributable solely to either the employment component or the wage component. The residual component is less meaningful to this study than the wage and employment components, because it is small and does not represent either the change in occupational composition alone or the changes in occupations' wages alone.

The sums of the three components for each occupation or occupational group are the figures in the "total of components" column of tables 1 and 2. The sum of all three components of all occupations is equal to the change in the U.S. RAW. In addition to decomposing U.S. RAW change into its three components, this article also seeks to show how the change in each occupation's mean wage and the change in its employment share have affected the U.S. RAW. The effect of the change in an occupation's mean wage on the U.S. RAW is captured through its wage component. Occupations whose real mean wages have increased will have positive wage components and increase the U.S. RAW, while occupations whose real mean wages have declined will have negative wage components and decrease the U.S. RAW. For example, accountants and auditors' real mean wage increase of $1.23 would have increased the U.S. RAW by 1 cent were employment shares to have remained constant, as seen in table 2.

Whereas the wage component indicates the effect that the change in an occupation's mean wage has on the U.S. RAW, the employment component does not indicate the effect that the change in an occupation's employment share has on the U.S. RAW. For example, a below-average paying occupation with a decline in employment share will have a negative employment component, but this decline in employment share will actually increase the U.S. RAW. There is, however, a calculation that can determine the effect that the change in one occupation's employment share has on the U.S. RAW, and the result of this calculation is referred to as the "employment effect." The employment effect takes into account both the change in an occupation's share of employment and the difference between the occupation's mean wage and the national mean wage. The overall employment effect of a group or category of occupations is calculated by summing the employment effects of all the occupations within that group or category. The national employment effect—that is, the employment effect of all occupations taken together—is found by summing the employment effects of all occupations in the United States, and it is equal to the national employment component. The occupational employment effect is shown in tables 1 and 2, and its equation is

$$E_j = \Delta S_j * \left(\overline{w}_{jt} - \overline{w_t}\right)$$

where

j = {1, 2,...J} index occupations
$\underline{E}$ = Occupational employment effect
$\underline{w}$ = U.S. real average wage (in May 2007 dollars)
$\overline{w}_j$ = Occupational real average wage (in May 2007 dollars)
ΔS = Change in occupational employment share
t = November 2002

A positive employment effect indicates that the change in an occupation's employment share was a factor pushing the U.S. average wage upward. An occupation with a below-average mean wage and a decline in employment share will have a positive employment effect, as will an occupation with an above-average mean wage and an increase in employment share. Similarly, a negative employment effect indicates that the change in an occupation's employment share was a factor pushing the U.S. average wage downward. A negative employment effect is a result of either an occupation with a below-average mean wage gaining employment share or an occupation with an above-average mean wage losing employment share. For example, computer programmers' above-average November 2002 wage of $34.88 and their loss of .06 percentage point in employment share from November 2002 to May 2007 resulted in an employment effect of –1 cent on the U.S. RAW.

Results

The U.S real average wage increase of 8 cents was the combined result of a –11 cent employment component, indicating an employment shift toward lower paying jobs; a 22 cent wage component, indicating that the mean wages of occupations increased overall; and a –3 cent residual component.

The national wage component. The national wage component was 22 cents, indicating the U.S. RAW would have increased by 22 cents, or 1.1 percent, if the employment shares of occupations had remained constant. The national wage component more than offset the national employment component of –11 cents, and it alone propelled the U.S. RAW to positive growth. So, while the mean wages of occupations increased overall, growth in the U.S. RAW was hindered because lower paying occupations gained employment share relative to higher paying occupations.

The positive wage component indicates either that a majority of employment was in occupations with mean wage growth or that those occupations with mean wage growth had a greater degree of change in wage than did occupations whose mean wages declined. In fact, in November 2002 only about 41 percent of employment was in occupations whose mean wage was to grow through May 2007, and the remaining 59 percent was in occupations whose mean wage was to decrease or remain unchanged during the same period. Therefore, the positive wage component was driven by occupations with growth in the mean wage having a greater degree of change than occupations with a decline in the mean wage.

The influences of occupational wage components. Overall, about 51 percent of occupations, making up about 41 percent of employment, had positive wage components. The wage components of occupations depend on their employment shares in November 2002 and on the change in their mean wage from November 2002 to May 2007. An occupation with a higher employment share or greater growth in the mean wage will have a larger wage component. Conversely, an occupation with a lower employment share or lesser wage growth will have a smaller wage component. Those occupations with the largest wage components are generally higher paying and are mostly from the management, computer and mathematical science, healthcare practitioner and technical, and sales and related groups. As seen in table 2, registered nurses had one of the highest wage components, 5 cents, because the occupation had both strong real mean wage growth of $2.74 and a high November 2002 employment share of 1.76 percent. General office clerks, heavy and tractor-trailer truck drivers, and stock clerks and order fillers all had some of the most negative wage components, at –1 cent each, because of the occupations' high employment shares coupled with declines in their real mean wages. The management occupational group and the healthcare practitioner and technical occupational group had the largest wage components of all occupational groups, as shown in table 1. Production occupations and office and administrative support occupations had the most negative wage components.

The national employment component. The shifting occupational composition of the United States would have decreased the RAW by 11 cents, or .6 percent, had occupational mean wages remained constant. In other words, if the mean wages of all occupations had remained unchanged, changes in the distribution of employment among occupations would have decreased the U.S. RAW by 11 cents. This negative employment component indicates that lower paying occupations gained employment share relative to higher paying occupations. In other words, lower paying occupations had faster employment growth than higher paying occupations, accounting for a greater share of total employment in May 2007 than in November 2002. Because the national employment component aggregates the employment components of all occupations, it signifies a trend that takes all occupations into account and does not necessarily indicate that only the lowest paying occupations gained employment share or that only the highest paying occupations lost employment share. Occupations that gained and lost employment share will be further explored later in this article.

The influences of occupational employment effects. Whereas the national employment component has documented the shift in employment share from higher paying to lower paying occupations, the employment effect of an occupation shows precisely the degree and direction that the occupation's change in employment share has had on the U.S. RAW. Overall, 42 percent of occupations, making up 46 percent of employment, had a negative or zero employment effect on the U.S. RAW. For example, the occupation of combined food preparation and serving workers, including fast food, has one of the most negative employment effects, –4 cents, on the U.S. RAW because this below-average paying occupation increased in employment share from 1.57 percent to 1.94 percent. Major occupational groups that had negative employment effects on the U.S. RAW include the healthcare support, food preparation and serving related, and personal care and service occupational groups.

Still, most occupations had positive employment effects on the U.S. RAW. Many of those occupations with the greatest positive employment effects were from the business and financial operations group or computer and mathematical science group, as many of these above-average-paying occupations gained employment share. For example, the occupation of computer software engineers, applications had a positive employment effect of 2 cents on the U.S. RAW, as this high-paying occupation increased in employment share from .28 to .37 percent.

Grouping occupations by mean wage. Besides identifying how each occupation's mean wage and change in employment share affected the U.S. RAW, broader trends in the U.S. labor market can be understood through grouping occupations on the basis of mean wage. Doing so will illus-

Table 3. Employment shares and components of change in the U.S. real average wage, by pay category, Nov. 2002–May 2007

Category of occupations or percentage summary	Pay categories (organized by mean hourly wage)				All occupations
	Lowest paying	Lower paying	Average paying	Highest paying	
	Below $11.80	$11.80 to $15.67	$15.68 to $24.11	Above $24.11	
All occupations					
Employment share, Nov. '02, in percent	24.86	24.41	25.49	25.24	100.00
Employment share, May '07, in percent	25.46	23.67	25.29	25.57	100.00
Percentage point change in employment share, Nov. '02–May '07	.60	–.74	–.20	.33	.00
Total wage component	–.03	–.06	–.04	.35	.22
Total employment component	.05	–.10	–.03	–.03	–.11
Total residual component	.00	.00	.00	–.03	–.03
Total of three components	.02	–.16	–.08	.30	.08
Employment effect	–.06	.04	.01	–.09	–.11
Occupations whose mean wage increased Nov. '02–May '07					
Employment share, Nov. '02, in percent	6.73	5.10	9.66	19.55	41.03
Employment share, May '07, in percent	6.63	4.80	9.57	19.83	40.81
Percentage point change in employment share, Nov. '02–May '07	–.10	–.30	–.09	.28	–.22
Occupations whose mean wage declined or remained the same Nov. '02–May '07					
Employment share, Nov. '02, in percent	18.13	19.31	15.84	5.69	58.97
Employment share, May '07, in percent	18.83	18.88	15.73	5.75	59.18
Percentage point change in employment share, Nov. '02–May '07	.71	–.44	–.11	.06	.22
Percentage summaries					
Percent of pay category's Nov. '02 employment that was in occupations whose mean wage increased Nov. '02–May '07	27.08	20.88	37.88	77.45	
Percent of pay category's Nov. '02 employment that was in occupations whose mean wage declined or remained the same Nov. '02–May '07	72.92	79.12	62.12	22.55	
Percent of Nov. '02 employment in occupations whose mean wage increased that comes from this pay group	16.41	12.42	23.54	47.63	
Percent of Nov. '02 employment in occupations whose mean wage declined or remained the same that comes from this pay category	30.74	32.75	26.86	9.65	

trate how occupations with higher and lower mean wages experienced changes in mean wage and employment as a group, and how these changes influenced the U.S. RAW. Table 3 distributes occupations into four categories that had roughly equal shares of the Nation's employment in 2002. The categories vary by their 2002 mean wages, and they are labeled as follows: "highest paying" (mean wage over $24.11); "average paying" (mean wage of $15.68 to $24.11), a range within which the U.S. RAW of $19.48 falls; "lower paying" (mean wage of $11.80 to $15.67); and "lowest paying" (mean wage below $11.80). Table 3 also presents employment shares in November 2002 and May 2007, employment components, wage components, residual components, and employment effects for each of

Table 4. The number of occupations in the major occupational groups whose mean hourly wages are in each of 4 pay categories, Nov. 2002

Occupational group	Total	Mean wage below $11.80	Mean wage of $11.80 to $15.67	Mean wage of $15.68 to $24.11	Mean wage above $24.11
All occupations	762	76	150	285	251
Management occupations	30	0	0	4	26
Business and financial operations occupations	28	0	0	4	24
Computer and mathematical science occupations	16	0	0	2	14
Architecture and engineering occupations	34	0	0	9	25
Life, physical, and social science occupations	39	0	0	10	29
Community and social services occupations	14	0	2	11	1
Legal occupations	9	0	0	4	5
Education, training, and library occupations	58	1	3	9	45
Arts, design, entertainment, sports, and media occupations	37	1	3	20	13
Healthcare practitioner and technical occupations	46	0	7	12	27
Healthcare support occupations	15	4	8	3	0
Protective service occupations	20	2	3	9	6
Food preparation and serving related occupations	16	14	1	1	0
Building and grounds cleaning and maintenance occupations	9	3	4	2	0
Personal care and service occupations	33	17	9	6	1
Sales and related occupations	21	3	6	4	8
Office and administrative support occupations	55	6	21	28	0
Farming, fishing, and forestry occupations	13	4	4	5	0
Construction and extraction occupations	58	0	13	42	3
Installation, maintenance, and repair occupations	51	1	10	35	5
Production occupations	110	13	47	43	7
Transportation and material moving occupations	50	7	9	22	12

the four categories of pay.

Table 4 displays the occupational makeup of each pay category. The highest paying category consists mainly of management; business and financial operations; computer and mathematical science; life, physical, and social science; architecture and engineering; healthcare practitioner and technical; and education, training, and library occupations. However, some occupations from other groups also are included, such as power plant operators from the production group. The average-paying category consists of occupations from every occupational group. Still, accounting for most of this category of pay are occupations in the office and administrative support; arts, design, entertainment, sports, and media; construction and extraction; installation, maintenance, and repair; production; and transportation and material moving occupational groups. Most occupations within the lower paying category are in the office and administrative support; production; and construction and extraction occupational groups. The lowest paying category contains many occupations from the personal care and service; food preparation and serving related; and production occupational groups.

Wage components by pay category. Analyzing the wage components of each category of pay as a whole illustrates how mean wage growth varied by category. When the wage components of occupations within each category are summed, only the highest paying category has a positive wage component, while the three other pay categories have negative wage components. When occupations are analyzed in the context of these four categories, only the highest paying category would have increased the U.S. RAW—by 35 cents—from November 2002 to May 2007 had employment shares remained constant during that period. The lower paying category has the most negative wage component, –6 cents, while the lowest paying category has a wage component of –3 cents and the average-paying category has a wage component of –4 cents. Breaking out occupations into these pay categories shows that the category of highest paying occupations is the largest factor in creating a positive national positive wage component of 22 cents.

The highest paying category's wage component of 35 cents indicates either that occupations whose mean wage increased make up the majority of employment in this category or that those occupations whose mean wage grew had a greater degree of wage change than did those whose mean wage declined or remained unchanged. The analysis shows that in fact about 77 percent of November 2002 employment in this category was in occupations with growth in the mean wage.

For each of the other three pay categories, all of which have negative wage components, the majority of employment was in occupations with declines in the mean wage. About 62 percent of November 2002 employment within the average-paying category, 79 percent of employment from that time within the lower paying category, and 73 percent of employment from that time within the lowest paying category was in occupations with a decline in the mean wage or an unchanged mean wage from November 2002 to May 2007. Thus, most employment in the average-, lower, and lowest paying categories was in occupations with decline or no growth in mean wages, whereas the majority of employment in the highest paying category was in occupations whose mean wage increased.

Employment share by pay category. One can see from the negative national employment component that lower paying occupations gained employment share overall, but breaking out occupations into pay categories reveals that there also was an employment shift from the middle two pay categories to the lowest and highest paying categories. The lowest paying category had the largest increase in employment share, .60 percentage point, while the highest paying category increased employment share by about half that (.33 percentage point). The average-paying category lost .20 percentage point of its share of employment, and the lower paying category lost the greatest employment share, with a decrease of .74 percentage point. This same "polarization" of the U.S. labor market was studied by David H. Autor, Lawrence F. Katz, and Melissa S. Kearney in the 1990s; they found "employment polarizing into high-wage and low-wage jobs at the expense of traditional middle-skill jobs."[8]

Employment components and employment effects by pay category. Analyzing the overall employment effect of each category of pay reveals how shifts in employment share have influenced the U.S. RAW. The lowest paying category's gain of .60 percentage point in employment share resulted in an employment effect of –6 cents on the RAW. Still, the employment component of the category is positive, at 5 cents, showing that within the lowest paying category, occupations with higher mean wages gained employment share. Meanwhile, the lower paying category lost .74 percentage point of employment share, causing a positive employment effect of 4 cents on the U.S. RAW. Within the lower paying category, however, employment share shifted away from higher paying occupations, evidenced by the category's employment component of –10 cents. The average-paying category had an employment effect of about 1 cent on the U.S. RAW, although its employment component of –3 cents indicates that among the occupations within the category, employment share shifted slightly towards lower paying occupations. Because the highest paying category contains many management occupations, the results of this analysis for the highest paying category should be interpreted with caution.

Examination of employment trends within the four pay categories shows that the negative national employment component is explained by the trend of an overall shift in employment towards the lowest paying category. There was also a shift in employment towards occupations with lower mean wages within two or three of the pay categories.

Grouping occupations by change in mean wage. In addition to grouping occupations on the basis of their November 2002 mean wage, another way to allow hidden patterns to emerge is to separate occupations into those with growth in the mean wage and those with a decline in the mean wage or an unchanged mean wage. Table 3 displays employment components, wage components, and changes in employment share for occupations whose mean wage increased from November 2002 to May 2007 and for occupations whose mean wage decreased or remained unchanged during the same period. As described earlier, in November 2002 only about 41 percent of employment was in occupations whose mean wage increased during the 4½-year period, and the remaining 59 percent was in occupations whose mean wage declined or remain unchanged during that time. The highest paying category accounted for about 48 percent of the November 2002 employment of occupations whose mean wage was to grow through May 2007. So, not only was most employment in the highest paying category in occupations that experienced growth in the mean wage, as discussed earlier, but the highest paying category accounted for almost half of employment among occupations whose mean wage increased. The average-paying category made up about 24 percent of employment in occupations whose mean wage increased, and the remaining 29 percent came from the

lower paying and lowest paying categories.

Among occupations for which the mean wage declined or remained the same from November 2002 to May 2007, the lowest and lower paying categories made up 63 percent of November 2002 employment. The average-paying category made up 27 percent of employment among the same occupations, and the highest paying category accounted for the remaining 10 percent. This finding further explains the strong positive wage components of the highest paying category and the negative wage components of the three other categories.

A final underlying trend behind the .41-percent growth of the RAW was faster overall growth in employment among occupations whose mean wage declined or did not change, in comparison with occupations whose mean wage increased. Overall, those occupations whose mean wage decreased or remained the same gained .22 percentage point of employment share. Most of the loss in employment share from occupations with growth in the mean wage came from the average-paying, lower paying and the lowest paying categories, which lost a combined .49 percentage point of employment share. The highest paying occupations with mean wage growth gained .28 percentage point of employment share. In contrast, the lowest paying occupations whose mean wage decreased or remained the same gained .71 percentage point of employment share; the lower paying and average-paying categories whose mean wage declined or stayed the same lost employment share. As mentioned earlier in this article, the lowest paying and highest paying categories were the two pay categories that gained employment share. Categorizing occupations by change in mean wage reveals that for the lowest paying category, most of the occupations that gained employment share were occupations with a decline or no change in the mean wage, and that for the highest paying category, most of the occupations that gained employment share were occupations whose mean wage increased.

Additional applications

There are many potential additional applications for this

Table 5. Employment shares, wage components, and employment effects for categories of education and training, Nov. 2002–May 2007

Education or training category	Number of occupations	Employment share, November 2002	Change in employment share	Wage component	Employment effect	Number of occupations by pay category			
						Mean wage below $11.80	Mean wage of $11.80 to $15.67	Mean wage of $15.68 to $24.11	Mean wage above $24.11
All categories	759	100.00	—	0.22	–0.11	76	150	283	250
First professional degree	16	1.09	0.09	–.01	.04	0	0	0	16
Doctoral degree	45	1.09	.07	.02	.01	0	0	1	44
Master's degree	29	1.13	.09	.01	.01	0	1	6	22
Bachelor's or higher degree, plus work experience[1]	33	5.03	–.77	.17	–.22	0	0	4	29
Bachelor's degree	103	11.48	.95	.06	.10	0	1	28	74
Associate degree	39	4.07	.12	.06	.01	0	2	25	12
Postsecondary vocational award	48	5.00	–.07	.01	.00	3	12	27	6
Work experience in a related occupation	47	8.92	–.34	.06	–.05	1	2	22	22
Long-term on-the-job training	86	6.47	.18	–.01	.00	2	15	51	18
Moderate-term on-the-job training	180	19.63	–.34	–.07	.04	13	62	98	7
Short-term on-the-job training	133	35.83	.03	–.07	–.04	57	55	21	0
Not classified[2]	3	.27							

[1] The results of this category should be interpreted with caution because they may be affected by refinements in occupational coding procedures.

[2] The occupations represented in these data were assigned to more than one category of education or training.

article's analysis of the effects of changing employment shares and of changing occupational composition on change in the U.S. RAW. Two applications that will be briefly explored in this section are patterns among education and training categories and an analysis of the average wages of U.S. States.

Education and training categories. Just as this article groups occupations on the basis of their mean wage to demonstrate trends among lower and higher paying occupations, it also groups occupations into education and training categories to reveal trends among occupations associated with greater or lesser education and training. The BLS Employment Projections program assigns each occupation to 1 of 11 education and training categories, which range from "short-term on-the-job training" to "first professional degree." The most common source(s) and level of education for workers in a given occupation serves as the basis for placing the occupation in a particular category. Table 5 displays the employment shares, wage components, and employment effects of these categories of occupations.

The wage components of the three on-the-job training categories are negative, and the wage components of most of the eight other education and training categories are positive. The moderate-term on-the-job training and short-term on-the-job training categories both have the most negative wage components, –7 cents, and the long-term on-the-job training category has a wage component of –1 cent. Occupations in the category of bachelor's or higher degree, plus work experience had the greatest overall wage component, 17 cents, even though these occupations made up only 5 percent of employment in November 2002. This shows that this category had the greatest increase in real average wage of all the education and training categories. The categories of bachelor's degree, associate degree, and work experience in a related occupation each had relatively high wage components of about 6 cents.

Regarding shifts in employment share among the education and training categories, those occupations in the category of bachelor's degree gained the most employment share, .95 percentage point. Other education and training categories that made slight gains in employment share are long-term on-the-job training, short-term on-the-job training, associate degree, master's degree, doctoral degree, and first professional degree. The categories of work experience in a related occupation and moderate-term on-the-job training each lost about .34 percentage point of employment share, and the category of postsecondary vocational award decreased in employment share by .07 percentage point. Autor, Katz, and Kearney, observed "more rapid employment growth in the bottom end of the

Table 6. Components of change in the real average hourly wages of U.S. States, Nov. 2002–May 2007

State	Wage component	Employment component	Residual component	Total of three components[1]
Alabama	$0.05	$–0.13	$–0.02	$–0.10
Alaska	.11	–.03	–.13	–.04
Arizona	.19	–.18	–.12	–.11
Arkansas	.24	–.01	–.04	.19
California	.11	.32	–.05	.38
Colorado	.03	.03	.02	.08
Connecticut	–.31	.24	–.02	–.09
Delaware	1.00	–.29	–.28	.44
Florida	.60	–.21	–.16	.24
Georgia	–.32	.10	–.01	–.23
Hawaii	–.07	.21	–.03	.11
Idaho	–.01	.07	–.17	–.12
Illinois	1.24	–.31	–.16	.76
Indiana	–.12	–.25	–.02	–.38
Iowa	.30	–.17	–.12	.01
Kansas	–.17	–.09	–.02	–.28
Kentucky	–.19	.02	–.06	–.22
Louisiana	.18	–.24	–.05	–.12
Maine	.44	–.14	–.07	.24
Maryland	1.25	–.24	–.16	.85
Massachusetts	.78	.03	–.06	.75
Michigan	–.30	.04	.04	–.22
Minnesota	–.06	.24	–.02	.15
Mississippi	.49	–.04	–.06	.39
Missouri	.52	–.49	–.20	–.17
Montana	.42	–.29	–.10	.03
Nebraska	.37	–.36	–.13	–.12
Nevada	–.11	–.09	.05	–.15
New Hampshire	.55	.04	–.01	.58
New Jersey	.20	.29	–.05	.44
New Mexico	.73	–.51	.01	.23
New York	–.14	.34	.05	.25
North Carolina	.02	–.10	–.10	–.18
North Dakota	.81	–.09	–.18	.54
Ohio	.15	–.33	–.06	–.24
Oklahoma	–.25	.05	.02	–.18
Oregon	.00	.09	–.04	.05
Pennsylvania	.49	–.60	–.15	–.25
Rhode Island	.38	.26	–.09	.55
South Carolina	.12	–.20	–.11	–.18
South Dakota	.11	–.09	.00	.02
Tennessee	.00	–.13	–.02	–.15
Texas	.11	–.28	–.12	–.29
Utah	.16	–.02	.00	.14
Vermont	.18	.10	.05	.32
Virginia	1.18	–.19	–.04	.95
Washington	.32	–.04	.02	.30
Washington, DC	1.22	.29	.47	1.98
West Virginia	–.03	–.36	–.07	–.47
Wisconsin	.07	–.06	.02	.03
Wyoming	.33	.27	.00	.61

[1] Numbers may not add precisely because of rounding.

education distribution than in the middle" in the 1990s, but this article's findings from the 2000s indicate that the trend has changed.

Wage analysis by State. Just as OES data are used to analyze the U.S. RAW, they also can be used to analyze the components of changes in the average wages of U.S. States. The wage component, employment component, residual component, and total component for each State and the District of Columbia are shown in table 6. The patterns in employment and mean wages found at the national level also occur in most States. For example, the overall shift toward occupations with lower mean wages is found in 32 States. The States with the most negative employment components—that is, the most pronounced shift in employment toward occupations with lower mean wages—are Pennsylvania, New Mexico, Missouri, West Virginia, and Nebraska. The five places with the greatest positive employment components, or the most pronounced employment shift towards occupations with higher mean wages, are New York; California; New Jersey; Washington, DC; and Wyoming.

Most States have a positive wage component (35 States and the District of Columbia), but 15 States have negative occupational wage components, indicating that occupational mean wages declined overall in the State. The States with the most negative wage components are Georgia, with wage component of –32 cents; Connecticut, with wage component of –31 cents; and Michigan, with a wage component of –30 cents. The places with the greatest positive wage components are Maryland; Illinois; Washington, DC; and Virginia. Some States that have positive wage components still had a decline in the average wage—Pennsylvania being one example—because the negative employment component is greater in degree than the wage component. As seen in table 6, wage components and employment components differ greatly by State, with some States having an employment component and a wage component that are both negative, such as Kansas and Indiana, and some States having an employment component and wage component that are both positive, such as Vermont and California.

USING OES DATA TO UNDERSTAND COMPONENTS of U.S. real average wage growth from November 2002 to May 2007 reveals many trends in occupational mean wages and employment shares. The analysis revealed that the increase of 8 cents in the U.S. RAW could be decomposed into an employment component of –11 cents, a wage component of 22 cents, and a residual component of –3 cents. These components indicate that overall, the mean wages of individual occupations grew faster than is evident from the national average wage growth statistic because the national average wage was suppressed by occupations with lower mean wages gaining employment share. Another finding was that a majority of employment was in occupations that experienced a decline or no change in the mean wage, and the group of occupations whose mean wage decreased or remained the same made a slight gain in employment share; these two phenomena also hampered the growth of the U.S. RAW.

Grouping occupations by mean wage revealed that the lowest, lower, and average-paying categories of occupations each have overall negative wage components, indicating that taken together, occupations within each of these categories experienced a decline in their mean wage. An additional finding of this article was a shift in employment from the two middle-paying categories of occupations to the lowest and highest paying categories. The lowest paying category increased the most in employment share, .60 percentage point, and most of this gain was made by occupations whose mean wage decreased or did not change. The pay categories also revealed that the increase in the U.S. RAW is due mostly to growth in the mean wages of occupations in the highest paying category, which had a wage component of 35 cents and made up 48 percent of employment among occupations whose mean wage increased from November 2002 to May 2007. □

Notes

[1] The adjustment for inflation was made using the BLS Consumer Price Index for Urban Wage Earners and Clerical Workers.

[2] Katherine Baicker and Amitabh Chandra, "The Labor Market Effects Of Rising Health Insurance Premiums," *Journal of Labor Economics*, July 2006, pp. 609–34.

[3] John Jones, "What do OES data have to say about increasing wage inequality?" *Monthly Labor Review*, June 2009, pp. 39–49.

[4] OES statistics cover part-time and full-time wage and salary workers, and do not cover the self-employed, owners and partners in unincorporated firms, household workers, or unpaid family workers.

[5] The common coding system is the 2002 OES occupational coding structure.

[6] Mean wages for November 2002 have been adjusted for inflation to May 2007 dollars. All wages are discussed in terms of May 2007 dollars.

[7] Patrick Kilcoyne, "The Role of Occupational Composition in State Wage Differentials," *Occupational Employment and Wages*, May 2005, Bulletin 2585 (Bureau of Labor Statistics, May 2007).

[8] David H. Autor, Lawrence F. Katz, and Melissa S. Kearney, "The Polarization of the U.S. Labor Market," *American Economic Review,* May 2006, pp. 189–194.