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Structural Growth in Labor Costs: Evidence from the Employment Cost Index

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Abstract

Wage growth forecasting is a necessary part of forensic economics. In this paper, we present a time series methodology to test whether wage and compensation growth in the United States varies by industry and occupation. If growth varies, then the common use of "all-worker" net discount or wage growth rates would not be accurate for every forensic economic case. Using the Employment Cost Index, we find that total compensation, wage, and benefit growth in some, but not all, industries and occupations has been significantly different from that of the wage growth of all workers. That finding may concern the forensic economist who needs to construct a variety of net discount or wage growth rates. As an alternative to constructing multiple forecasts, this paper provides estimated industry and occupational specific differentials from the growth in all workers' wages.

I. Introduction

Wage growth forecasting is a necessary part of forensic economics. In this paper, we present a time series methodology to test whether wage and compensation growth in the United States varies by industry and occupation. If growth varies, then the common use of "all-worker" net discount or wage growth rates would not be accurate for every forensic economic case. Using the Employment Cost Index, we find that total compensation, wage, and benefit growth in some, but not all, industries and occupations has been significantly different from that of the wage growth of all workers. That finding may concern the forensic economist who needs to construct a variety of net discount or wage growth rates. As an alternative to constructing multiple forecasts, this paper provides estimated industry and occupational specific differentials from the growth in all-workers' wages. Armed with the differentials and one net discount or growth rate forecast based on all-workers' wage growth, the forensic economist can adjust the all-worker forecast to a specific industry or occupation. The paper discusses the issue of wage growth variation and provides a time series method to measure it. The data and empirical results are presented along with example applications.

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II. The Issue of Wage Growth Variation

Industries and occupations utilize technology and laborer skills differently which creates variation in the growth of its laborers' wages (Bronars and Famulari, 1997). Reasons for an industry or occupation exhibiting growth in labor costs unique to it include:

- differing utilization of technology in the particular industry or occupation that changes its marginal productivity of labor relative to the entire economy;
- changes in the demand for the product produced by the specific industry or occupation relative to all other products which change relative price (and thus marginal revenue) to the entire economy; or,
- relative price changes of inputs used in the production of the product may change the growth in labor costs in the industry or occupation relative to the entire economy.

Historical wage growth differences is a frequent topic in the general economic literature with many studies focusing on the widening gap of wages by worker skill level (Juhn, et al., 1993; Autor, et al., 2008).

While specific industry and occupation wage growth measures are tracked, the macroeconomic variable of all-workers' wage growth receives the most attention as a forecasted variable. Within forensic economics, the wage growth of all workers is an important variable[1] and many forensic economists use forecasts of all-worker wage growth produced by private firms or government agencies.[2] Despite that forensic economic casework spans the gamut of workers by industry and occupation, only a few forensic economic studies such as those by Pelaez (1991) and Payne, et al., (1999) have given attention to wage growth disparity (those two studies give net discount rates for a handful of industries but they did not test for variation in net discount rates by industry). Trends in wage growth disparity should be accounted for because, absent cases involving children, most forensic evaluations call for wage growth forecasts over near periods of time in which the observed variations of wage growth across industry and occupation are likely to persist.[3]

III. Measuring Wage Growth Variation

Assume that the wages in any industry or occupation (subscript i) at time t is represented by W_{it} and that the wages of all workers at time t is repre-

[1]The phrase "net discount rate" appears in 102 past *Journal of Forensic Economics* articles. The concept of net discount rates based on "all-worker" wage growth is a common enough statistic that it leads the questioning in the Survey of Forensic Economists paper series (Slesnick et al., 2013).

[2]For example, it is common to see forensic economists using the all-worker wage growth estimates of the Social Security Administration.

[3]In 2012, the median age of all employed persons was 42.3 years Bureau of Labor Statistics data published from the *Current Population Survey* (http://www.bls.gov/cps/occupation_age.htm). The worklife expectancy of 42-year-olds ranges from 16 to 26 years based upon gender and education (Skoog, et al., 2011). .

sented as W_{At}. Define the period-to-period ratio in the wages in a chosen industry or occupation to that of all workers as

$$R_{it} = \frac{W_{it}}{W_{At}} \tag{1}$$

The period-to-period growth rate in R_{it} can be written as

$$G_{it} = \frac{R_{it}}{R_{it-1}} - 1\,. \tag{2}$$

Conversely, G_{it} can also be thought of as a link between the period-to-period changes in W_{it} and W_{At} as

$$\frac{W_{it}}{W_{it-1}} = (1+G_{it})\frac{W_{At}}{W_{At-1}} = \frac{W_{At}}{W_{At-1}} + G_{it}\frac{W_{At}}{W_{At-1}} \tag{3}$$

If the growth differential series G_i is stationary and non-zero, there is a constant mechanism separating the wage growth in the particular industry or occupation from that of all workers. Econometrically, we have to (1) determine the stationarity of G_i, and (2) test whether G_i is statistically different from zero.

Studying the time series properties of the growth in medical care costs, Bowles and Lewis (2000) commented on the importance of stationarity in a forecasted time series. A covariance stationary series has a time invariant mean and variance such that the series fluctuates around a constant long-term mean. The unbiased forecast of a stationary series is its long-term mean. The forensic economic literature has devoted much attention to the stationarity of the net discount rate—if the net discount rate is not stationary, then its use produces biased forecasts. If G_i is stationary and the all-worker net discount rate is stationary, then G_i can be subtracted from the all-worker net discount rate forecast to produce a viable net discount rate forecast for the particular industry or occupation *i*.

An accepted test for determining the stationarity of a growth series is the Phillips-Perron test. The Phillips-Perron test is an augmented Dickey-Fuller test that recognizes autocorrelation and heteroscedasticity in the disturbance. The Phillips-Perron test for a single mean in G_i is determined from the autoregressive model

$$G_{it} = \alpha + \rho G_{i(t-1)} + u_{it} \tag{4}$$

where α is the constant, ρ is the coefficient on the lagged growth differential value, and u_{it} is the disturbance. Since first order autocorrelation might be expected in G_i, to get an unbiased estimate of the single mean growth, the disturbance adds a first order autocorrelation parameter so u_t is specified as

$$u_{it} = \varepsilon_{it} - \varphi_1 u_{i(t-1)} \text{ and } \varepsilon_{it} : N\left(0, \sigma_i^2\right). \tag{5}$$

The autoregressive model is estimated using the Yule-Walker method which first estimates the parameters with generalized least squares, then φ_1 with ordinary least squares, and then using φ_1 the parameters are re-estimated with generalized least squares. The generalized least squares approach corrects for the heteroscedasticity in the variance of the time series observations. Using the standard error of the estimated mean, we perform a *t*-test to discover whether the mean growth differential statistic for each industry and occupation selected is significantly different from zero.

IV. Data

In order to find the historical differential growth in labor costs, we utilize the Employment Cost Index ("ECI").[4] The Employment Cost Index is a principal federal economic indicator[5] published by the Bureau of Labor Statistics and it is based on the change in the average straight-time hourly cost of labor, free from the influence of employment shifts among occupations and industries. Detailed information on ECI concepts, coverage, and methods can be found in the BLS Handbook of Methods, Chapter 8, "National Compensation Measures."[6] In 2006, the ECI underwent revision which left many industries and occupations without data before 2001. For our analysis, we utilized all of the so-called "continuity ECI indexes" that span back as early as September 1975[7] along with the remaining top-level industry ECI series that begin in 2001. The data are current through December 2013. By industry and occupation, we use the three ECI measures of labor costs: total compensation, wages and salaries, and benefits.[8] The ECI series utilized are those that are seasonally adjusted.[9] The denominator in each industry or occupation *i* from equation (1) is the ECI for the wages and salaries of all private industry workers.

In Figure 1, we show an example incremental growth data series as the total compensation ECI for private industry office and administrative support occupations. The solid line represents *R*, the simple ratio of the office and administrative support occupation total compensation ECI divided by the all-worker wage and salary ECI. If the office and administrative support occupation total compensation ECI grew over time at approximately the same annual rate as the all-worker wage and salary ECI, the solid line would be relatively

[4]The methodology could be used in the same manner with other wage time series data.
[5]For information on principal federal economic indicators, see OMB Statistical Policy Directive No. 3, found December 27, 2013 on the Internet at http://www.bea.gov/about/pdf/federalregister09251985.pdf.
[6]As of June 4, 2013 on the Internet at http://www.bls.gov/opub/hom/pdf/homch8.pdf
[7]For a listing of these ECI's, see "Employment Cost Index Historical Listing–Volume V accessed on the Internet December 27, 2013 at http://www.bls.gov/web/eci/ecicois.pdf.
[8]The sum of wages and salaries and benefits equals total compensation.
[9]A separate analysis using not seasonally-adjusted data achieved nearly identical results.

flat around the value of 100 across all time periods.[10] In this example, the solid line R is not flat but increasing showing that office and administrative support occupation total compensation growth has historically outpaced all-worker wage and salary growth. The black dashed line shows G, the quarter-to-quarter growth in the solid line incremental growth index. Our econometric task will be to discover whether G is stationary and significantly different from zero. Because the total compensation G for office and administrative support occupation is relatively flat (or non-trending), a visual appraisal suggests stationarity. While the mean value of G looks positive, it is hard to visually predict whether the variance of G keeps its mean value statistically different from zero—a t-test will produce that significance value.

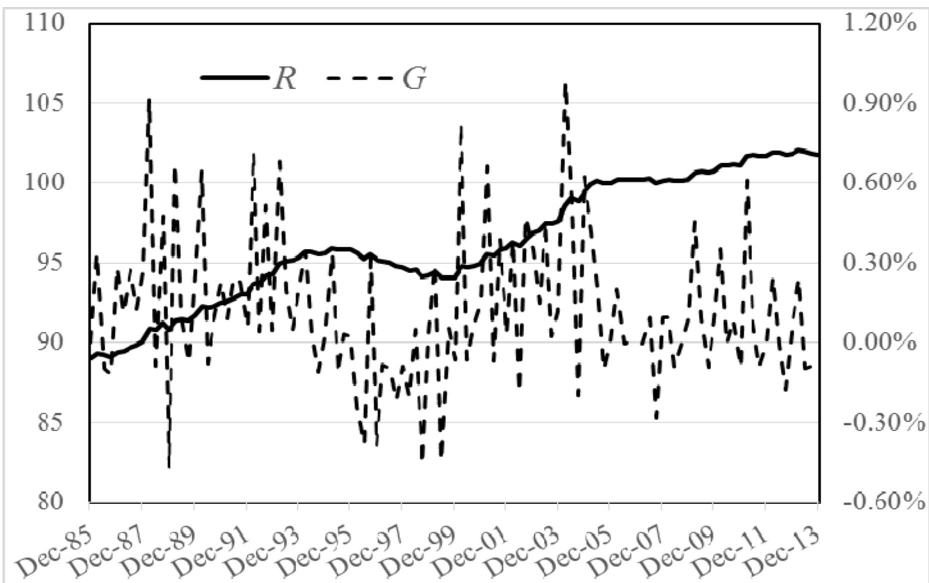

Figure 1. Growth in the total compensation paid to office administrative support workers relative to the wages and salaries paid to all workers

V. Results

In Table 1, we show the estimation results of mean growth differentials by industry and occupation for total compensation, wages and salaries, and benefits. The name of the industry or occupation is shown in the first column and the second column contains the series analysis start date. All of the Phillips-Perron test statistics were significant at the 99% confidence level supporting stationarity in all of the G_i wage growth series.[11] The estimates of G_i, the

[10]Within the context of examining the "flatness" of the time series ratio of two wage indexes, if the ratio is "flat" then one index series could be described as having "mean reverting" tendencies to the other index series.

[11]This article's electronic supplemental materials at the *Journal of Forensic Economics* Internet site contains a table showing the Phillips-Perron and Durbin-Watson test statistics.

mean annual growth in the particular ECI which is in excess of the all-worker wage and salary ECI growth is presented along with the level of statistical significance of the growth being different from 0% (** represents 99% confidence that the annual growth is significantly different from 0% and * represents 95% confidence). If an annual growth differential is not statistically significant from 0%, then the growth in the wages and salaries of all workers is a suitable indicator of the particular labor cost growth for that industry or occupation. If the growth differential is significantly different from zero, the growth differential can be used to adjust an all-worker net discount rate or wage growth level forecast to fit the empirical characteristics of the particular industry or occupation.

Table 1
Growth differentials in total compensation, wages and salaries, and benefits relative to the wages and salaries paid to all workers

Industry & Occupation	Starting Date	Total Compensation		Wages & Salaries		Benefits†	
Private Industry							
All workers	1984Q1	0.24%	**			0.85%	**
Management, business, and financial	1985Q4	0.41%	**	0.30%	*		
Professional and related	1985Q4	0.40%	**	0.16%			
Sales and related	1986Q1	0.15%		0.04%			
Office and administrative support	1985Q4	0.48%	**	0.17%	**		
Service occupations	1984Q1	0.06%		−0.24%	*	0.93%	**
Goods-producing industries	1984Q1	0.14%		−0.17%	**	0.78%	
Construction	1985Q1	0.05%		−0.36%	**		
Manufacturing	1984Q1	0.17%		−0.13%	*	0.78%	
Service-providing industries	1984Q1	0.30%	**	0.09%		0.89%	**
Transportation and warehousing	1985Q1	−0.06%		−0.51%	**		
Utilities	1987Q4	0.76%	**	0.17%			
Financial activities	1985Q1	0.55%	*	0.35%			
Education services	1988Q4	0.65%	*	0.32%			
Junior colleges, colleges, and universities	1988Q4	0.63%	*	0.26%			
Hospitals	1986Q2	0.73%	**	0.48%	*		
Nursing care facilities	1992Q2	0.23%		0.21%			
State & Local Government							
All workers	1984Q1	0.55%	*	0.17%		1.14%	**
Professional and related	1989Q2	0.21%		−0.07%			
Office and administrative support	1989Q2	0.41%	*	−0.15%			
Service occupations	1984Q1	0.74%	**	0.25%			
Education services	1989Q1	0.20%		−0.10%			
Schools	1984Q1	0.55%		0.24%			
Elementary and secondary schools	1984Q1	0.55%		0.24%			
Hospitals	1988Q1	0.49%	*	0.20%			
Public administration	1984Q1	0.57%	**	0.07%			

†The Employment Cost Index does not contain a benefits index for every industry or occupation.

For total compensation growth differentials, we utilized 17 private industry and occupations ECI series and nine state and local government series. All but one of the growth differentials were positive and 15 of the 26 were statistically significantly different from zero. At the top level for private industry, the annual growth differential between the total compensation paid to all workers and the wages and salaries paid to all workers is a stationary and statistically significant at 0.24%. This result means that when forecasting the sum of earnings and benefits, 0.24% should be subtracted[12] from an all-worker wage and salary net discount rate or added to a wage and salary growth level forecast. Assume that a chosen all-worker wage and salary based net discount rate is 2%. If the forensic economist is projecting earnings and benefits in a case and he or she believed that the all-worker classification is relevant to the case, then the appropriate total compensation net discount rate will subtract 0.24% from the 2% all-worker wage-based net discount rate. If a nominal all-worker wage and salary growth forecast is 3%, then the appropriate nominal all-worker compensation growth forecast will be calculated by adding 0.24% to the 3% all-worker wage and salary growth forecast. If a real, inflation-free all-worker wage and salary growth forecast is 0.75%, then the appropriate real, inflation-free all-worker compensation growth forecast will be calculated by adding 0.24% to the 0.75% all-worker wage and salary growth forecast. Looking down the list of private industry and occupation total compensation growth differentials, those that are statistically significantly different from 0% are in predominantly white-collar occupations or high-skilled industries.[13] Blue-collar occupations or low-skilled industries have not had growth in total compensation which is statistically significantly different from the growth in wages and salaries of all workers. This result suggests that when the forensic economist is evaluating the earnings and benefits of blue-collar type workers, the net discount rate or wage growth level forecast of all workers is suitable in computing present value. The growth differential for all state and local government workers' total compensation is over double that of the growth differential for all private industry workers (0.55% versus 0.24%).

When measuring the growth differentials using wages and salaries by industry and occupation, we found only three of the 26 industry and occupations had statistically significant positive growth differentials—white-collar oriented management, business, and financial; office and administrative support; and, hospitals). Significant and negative growth differentials were in blue-collar oriented service occupations, goods-producing industries, construction, manufacturing, and transportation and warehousing. As an example of using a negative growth differential, when determining the present value of the wage earnings of a construction worker, the forensic economist would add 0.36% to his or her all-worker wage and salary net discount rate (or subtract 0.36% from his or her all-worker wage and salary growth level forecast).

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[12]Geometric subtraction would be required. For example, to geometrically subtract a growth rate of 0.25% from a net discount rate of 2%, the calculation would be $(1-0.25\%)(1+2\%)-1=1.745\%$. To geometrically add a growth rate of 0.25% to a net discount rate of 2%, the calculation would be $(1+0.25\%)(1+2\%)-1=2.255\%$

[13]This is the same result found by Juhn, et al. (1993).

In all industries and occupations except goods-producing and manufacturing industries, the benefit growth differentials were positive and statistically significant. This result suggests that nearly always net discount rates or wage level growth forecasts based on the wages and salaries of all workers are not appropriate for computing the present value of total employment benefits.[14]

VI. Conclusion

Although it is an important part of forensic economics, wage growth by industry and occupation has received little attention in the literature. In this paper, using a time series methodology we found that the growth in labor costs in some industries and occupations varies from that of all-worker wage growth. Our finding suggests that the blanket use of all-worker net discount rates or growth level forecasts is not consistent with the wage growth found in many industries and occupations. In providing stationary, constant mean growth differentials, we show the additions or subtractions necessary to adjust all-worker net discount rates or growth level forecasts for use in specific industry and occupation forensic economic cases.

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[14]In a forensic economic case, some of the employer benefit costs might be mathematically linked to the employee wage rate as a constant percentage (e.g., a 3% of wages 401(k) contribution). When calculated alone, forecasting constant percentage benefits would be more suited to wage and salary growth as opposed to total benefit cost growth.