Research & Planning
Wyoming DOE

Employment Change and Impacts on Workplace Fatalities in Wyoming

August 2010

Wyoming Department of Employment

Research & Planning

Employment Change and Impacts on Workplace Fatalities in Wyoming

Wyoming Department of Employment
Gary W. Child, Director

Research & Planning
Tom Gallagher, Manager

Prepared by:
Patrick Manning

Edited by:
Phil Ellsworth
Michael Moore

Submitted for Publication August 2010

Department of Employment Nondiscrimination Statement

The Department of Employment does not discriminate on the basis of race, color, religion, national origin, sex, age, or disability. It is our intention that all individuals seeking services from our agency be given equal opportunity and that eligibility decisions be based upon applicable statutes, rules, and regulations.

Employment Change and Impacts on Workplace Fatalities in Wyoming

*by: **Patrick Manning, Principal Economist***

Our research spans the 18-year period from 1992 to 2009. It shows that employment changes in Wyoming are directly related to changes in the number of workplace fatalities; for example, as total employment increases or decreases, so does the number of workplace fatalities.

Various satistical techniques yield similar results. One method used in this research shows that a 1% increase in employment is associated with an increase of 2.7 fatalities. Using another method produced similar results, as a 1% increase in employment was directly associated with an increase of 2.4 fatalities.

For those intersted in more thorough statistical analysis on this subject, see pages 4 and 5.

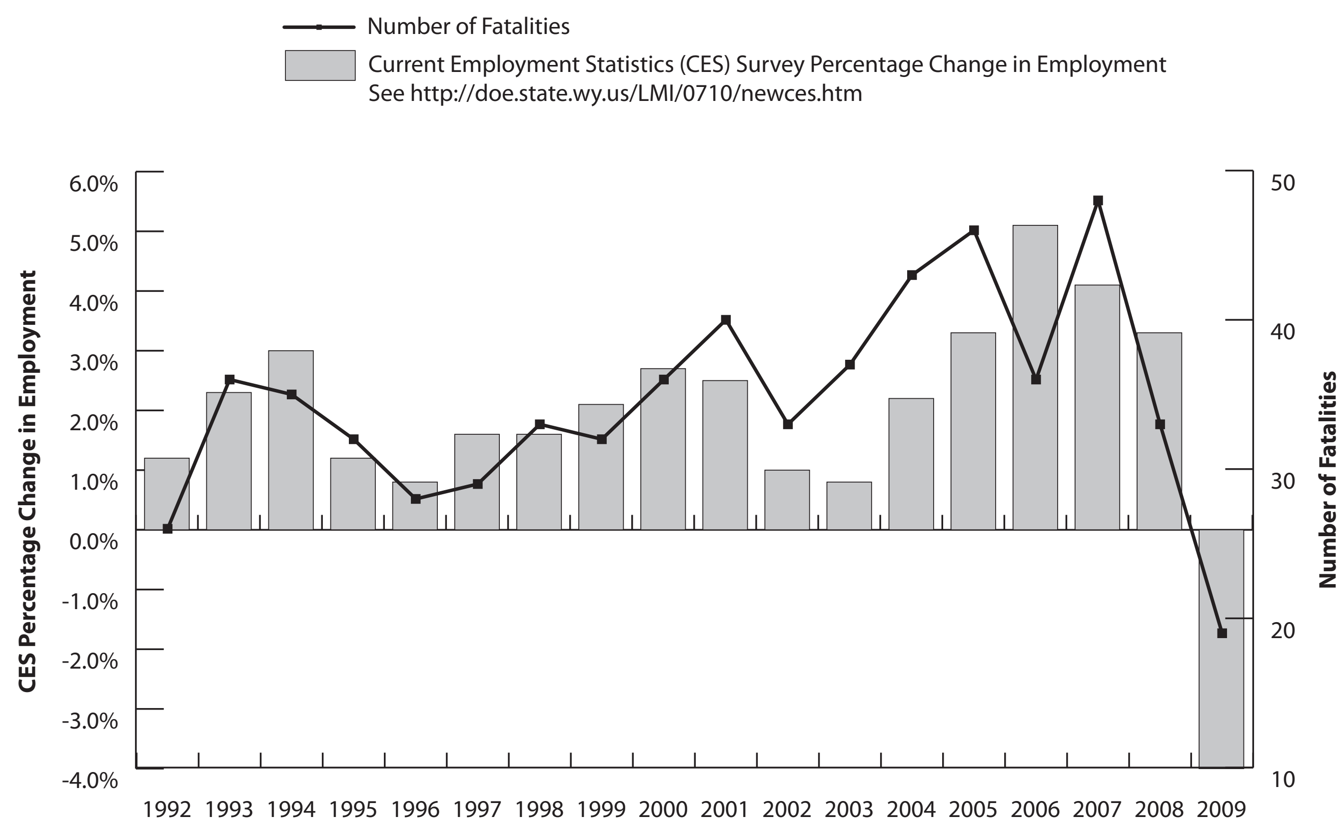

Figure: **Percentage Change in Employment and Number of Fatalities per Year, 1992-2009**

Methodology and Statistics

Introduction

This study examined the relationship of changes in overall employment by place of work on the number of workplace fatalities. The hypothesis is that greater exposure (number of people employed, total hours worked, hours worked per person, etc.) is associated with the number of fatalities. By analogy, as the amount of traffic through an intersection increases, the number of potential accidents increases.

Table 1: **Descriptive Statistics**

Statistics	Fatalities	Total Employment	% Change in Employment
N observations	18		
Minimum	19.0	205.6	-4.0%
Maximum	48.0	298.2	5.1%
Mean	34.6	245.1	1.9%
Standard Deviation	7.0	28.3	1.9%

Methodology

This study examines annual fatalities from 1992-2009. Employment data are from the Current Employment Statistics Survey (CES). The wage information is from the Quarterly Census of Employment and Wages (QCEW). Some descriptive statistics of the relevant variables are shown in Table 1. A correlation matrix was produced containing the relevant variables.

In this analysis, the concept of exposure is measured by change in employment levels and change in the average wage in Wyoming. Change in the average wage serves as a proxy for the amount of time worked by place of work. It is important to note a distinction between measuring employment by place of work (as in this analysis) and measuring employment by place of residence. These two measurements can be substantially different in Wyoming. This is due to the fact that "Wyoming's workforce is different from most states because it is comprised of a core group of residents and adds or subtracts nonresidents to maintain staffing levels." The percentage of nonresidents in the Wyoming workforce has been as high as 22.7%. (Jones, 2010).

As a demonstration, an Ordinary Least Squares (OLS) regression model is provided and explained. As this study is comprised of count data (data that is discrete and non-negative), a more appropriate modeling technique using a Poisson distribution is shown. SAS® PROC REG, PROC GENMOD and PROC COUNTREG were used in the regression analysis (SAS). Several model specifications were tested for each modeling technique.

Results

The correlation matrix shown in Table 2 (see page 5) indicates a strong positive relationship between the dependent variable (fatalities) and the measure of change in employment of 0.73. The Figure on page 3 demonstrates this correlation. There is also a strong relationship with the percentage change in average wages. The OLS regression results are shown in Table 3 (see page 6). The best model was chosen by examining the R^2 (a statistical measure of how well the linear regression model fits the data), the adjusted R^2, and the significance of the independent variable(s). The best model contained the employment percentage change as the only independent variable. The R^2 indicates that the model explains 53% of the variation in fatalities over the time period analyzed. The effect of the employment percentage change variable is highly significant. The parameter estimate of 2.7 indicates that a 1% increase in employment is associated with an increase of 2.7 fatalities.

The Poisson regression results are shown in Table 4 (see page 7). The best model was selected based on the significance of the independent variable(s) as well as two information measures - Akaike's information criterion (AIC) and Schwarz's Bayesian information criterion (SBC) - which can be used to compare competing Poisson models. As was the case in the OLS modeling, the best Poisson model contained the CES employment percentage change as the only independent variable. The impact of the employment percentage change variable is highly significant. The impact of the parameter estimate of 0.088 is interpreted differently than the OLS model. Using the average number of fatalities across the time span of 34.6, the impact of a 1% increase in employment would be calculated as $e^{\ln(34.6) + 0.088} = 36.9$, which is an increase in fatalities of 2.4.

Possible Future Research

Further research could be conducted on more granular data (i.e. quarterly or monthly data as opposed to annual data). While this data is collected, it is not currently available for analysis. The number of observations in the dataset would greatly increase (i.e. from 18 annual to 72 quarterly to 216 monthly observations), therefore allowing for the production of more precise regression models.

References

Jones, S. (2009). Wyoming Workforce Characteristics: Nonresident Influences. *Wyoming Workforce Annual Report 2009*. Retrieved August 16, 2010, from http://doe.state.wy.us/LMI/annual_report_09.pdf

SAS Institute Inc. (2008). SAS/STAT 9.2 User's Guide. Cary, NC: SAS Institute Inc.

Table 2: **Correlation Matrix**

	Fatalities	Total Employment	Employment % Change	Average Wage	Average Wage % Change
Fatalities	1				
CES Total Employment	0.26	1			
CES Employment % Change	0.73	0.07	1		
Avg. Wage	0.20	0.99	0.02	1	
Avg. Wage % Change	0.63	0.41	0.84	0.37	1

Table 3: **Ordinary Least Squares Regression Model**

The REG Procedure

Model: MODEL1

Dependent Variable: Fatalities

Number of Observations Read: 18

Number of Observations Used: 18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	443.36005	443.36005	18.14	0.0006
Error	16	391.08440	24.44277		
Corrected Total	17	834.44444			

Root MSE	4.94396
Dependent Mean	34.55556
Coeff Var	14.30729
R-Square	0.5313
Adj R-Sq	0.5020

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t value	Pr > |t|
Intercept	1	29.27488	1.70155	17.20	<.0001
CES_emp_pct_chg	1	2.71581	0.63767	4.26	0.0006

Table 4: **Poisson Regression Results**

The COUNTREG Procedure

Model Fit Summary	
Dependent Variable	Fatalities
Number of Observations	18
Data Set	CFOI.COMPLETE
Model	Poisson
Log Likelihood	-53.76009
Maximum Absolute Gradient	5.7238E-7
Number of Iterations	2
Optimization Method	Newton-Raphson
AIC	111.52018
SBC	113.30092

Algorithm converged.

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Approx. Pr. > | t |
Intercept	1	3.360350	0.067135	50.05	<.0001
CES_emp_pct_chg	1	0.087592	0.024399	3.59	0.0003

