ANALYSIS OF CIVILIAN LABOR COSTS WITHIN THE DEPARTMENT OF THE NAVY

by

Paul A. Llano

June 2017

Thesis Advisor: Robert Eger III
Co-Advisor: Eddine Dahel

Approved for public release. Distribution is unlimited.
Civilian labor costs rose 2.2 percent in the 12-month period ending in December 2016, according to a January 2017 Bureau of Labor Statistics cost index. Changes in labor costs can affect the financial stability of not only private corporations but also government organizations, such as the Department of the Navy (DoN). Both private and public employers must compete in the same market for skilled professionals.

Understanding how civilian labor costs change is of particular importance to the DoN, considering that the service is a manpower-intensive organization limited by congressionally enacted restraints that affect the service’s budgets. By conducting a statistical analysis of recent historical data, creating basic models, and projecting those models for the near future, this report provides a macro-level overview of the Navy’s civilian labor costs so that Navy leadership can make better-informed decisions on the expenditure of limited funds.
ANALYSIS OF CIVILIAN LABOR COSTS WITHIN THE DEPARTMENT OF THE NAVY

Paul A. Llano
Lieutenant Commander, United States Navy
B.S., United States Naval Academy 2005

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

from the

NAVAL POSTGRADUATE SCHOOL
June 2017

Approved by: Robert J. Eger III
Thesis Advisor

Eddine Dahel
Co-Advisor

Donald Summers
Academic Associate
Graduate School of Business and Public Policy
ABSTRACT

Civilian labor costs rose 2.2 percent in the 12-month period ending in December 2016, according to a January 2017 Bureau of Labor Statistics cost index. Changes in labor costs can affect the financial stability of not only private corporations but also government organizations, such as the Department of the Navy (DoN). Both private and public employers must compete in the same market for skilled professionals.

Understanding how civilian labor costs change is of particular importance to the DoN, considering that the service is a manpower-intensive organization limited by congressionally enacted restraints that affect the service’s budgets. By conducting a statistical analysis of recent historical data, creating basic models, and projecting those models for the near future, this report provides a macro-level overview of the Navy’s civilian labor costs so that Navy leadership can make better-informed decisions on the expenditure of limited funds.
# TABLE OF CONTENTS

## I. INTRODUCTION

A. PURPOSE ......................................................................................................................... 1
B. RESEARCH OBJECTIVES ................................................................................................. 1

## II. BACKGROUND ............................................................................................................. 3

A. FULL TIME EQUIVALENTS ............................................................................................... 3
B. HIRE TYPES ..................................................................................................................... 3
   1. Senior Executive Service (SES) ....................................................................................... 3
   2. General Schedule ........................................................................................................... 3
   3. Wage Grade ................................................................................................................... 4
   4. Foreign National Direct ................................................................................................. 4
   5. Foreign National Indirect ............................................................................................ 4
   6. National Security Personnel System ........................................................................... 4
   7. Demonstration Project ................................................................................................. 4
   8. Civilian Mariners ........................................................................................................... 5
C. APPROPRIATIONS .......................................................................................................... 5
   1. Operations and Maintenance ......................................................................................... 5
   2. Research, Development, Test, and Evaluation, Navy (RDTEN) .................................... 5
   3. Navy Working Capital Funds ......................................................................................... 6
   4. Military Construction, Navy and Marine Corps ......................................................... 6
   5. Base Realignment and Closure .................................................................................... 6
   6. Family Housing, Navy (Operations) (FHOPS) ............................................................ 6
   7. Budget Submitting Office (BSO) .................................................................................. 6

## III. LITERATURE REVIEW .................................................................................................. 7

A. DESCRIPTIVE STATISTICS ............................................................................................ 7
   1. Measures of Association between Two Variables ....................................................... 7
B. LINEAR REGRESSION ...................................................................................................... 9
   1. Independent versus Dependent Variables .................................................................... 10
   2. Coefficient of Determination ....................................................................................... 10
   3. Multiple Regression ...................................................................................................... 10
C. REGRESSION VALIDATION ............................................................................................ 11
   1. F-Statistic ...................................................................................................................... 11
   2. Probability (p) Value .................................................................................................... 12
   3. Multicollinearity .......................................................................................................... 12
APPENDIX B. FTE TRENDS OF INDIVIDUAL BUDGET SUBMITTING OFFICES .........................................................................................................................59

APPENDIX C. MULTIPLE REGRESSION MODEL DATA FOR ESTIMATING TOTAL EXPENDITURES BASED ON A SELECT NUMBER OF HIRE TYPES ..................................................................................................................61

APPENDIX D. MULTIPLE REGRESSION MODEL DATA FOR ESTIMATING TOTAL DEPARTMENT OF THE NAVY FULL TIME EQUIVALENTS BASED ON A SELECT NUMBER OF HIRE TYPES ........69

APPENDIX E. LINEAR AND MULTIPLE REGRESSION EQUATIONS FOR BSOS .................................................................................................................................77

LIST OF REFERENCES .................................................................................................................................................................................................83

INITIAL DISTRIBUTION LIST .........................................................................................................................................................................................85
LIST OF FIGURES

Figure 1. Changes of DoN Civilian FTEs and Expenditures, 2007–2016. ..........15
Figure 2. Difference between Predictions with and without NSPS Hire Type. ....17
Figure 3. 2007 Breakdown of Civilian FTEs by Hire Types. ..............................19
Figure 4. 2007 Total Civilian Labor Cost Breakdown....................................21
Figure 5. 2007 Breakdown of Civilians FTEs by BSO ..................................22
Figure 6. 2007 Breakdown of Civilians by Appropriation...............................23
Figure 7. 2016 Breakdown of Civilian FTEs by Hire Types. ...........................24
Figure 8. Comparison in the Growth of Basic Compensation and Benefits, 2006–2017 .............................................................26
Figure 9. Changes in Benefit Expense per FTE, 2007–2016. ..........................27
Figure 10. 2016 Total Civilian Labor Cost Breakdown..................................28
Figure 11. 2016 Breakdown of Civilian FTEs by BSO. ..................................29
Figure 12. Growth of Four Largest BSOs, 2007–2016. .................................29
Figure 13. 2007 Breakdown of Civilians by Appropriation............................30
Figure 14. Growth in the Cost per FTE, 2007–2016 .....................................32
Figure 15. Changes of DoN Civilian FTEs and Expenditures, 2007–2016. .........35
Figure 16. Changes in Expenditures with Changes in Total Number of FTEs, 2007–2016 .................................................................37
Figure 17. Projected DoN Expenditures When Predicting Changes in FTEs, 2018–2028 .................................................................39
Figure 18. Changes in Total FTEs and Expenditures, 2007–2028, Accounting for BSO Trends .........................................................40
Figure 19. Changes in Total Expenditures, 2007–2028, Using Multiple Regression and Select Hire Types to Project Expenditures ...............42
Figure 20. Changes in Total Expenditures and FTEs, 2007–2028, Using Multiple Regression and Select Hire Types to Project Total FTEs. ........43
Figure 21. Changes in DoN Total FTEs and Expenditures, 2007–2028, Adjusting for Trends in the Different Hire Types of Each BSO. ............44
Figure 22. Total FTEs and Expenditures, 2018–2028, Adjusting for Trends in the Different Hire Types of Each BSO. .............................................45
Figure 23. Change in Cost per FTE 2007–2028..............................................................46
Figure 24. Change in Benefit Expense per FTE 2007–2028...........................................47
Figure 25. Change in Basic Compensation per FTE 2007–2028........................................47
Figure 26. Changes in DoN AA FTEs 2007–2016 ..........................................................55
Figure 27. Changes in DoN Civilian Mariner FTEs 2007–2016. ......................................55
Figure 28. Changes in DoN DP FTEs 2007–2016. ..........................................................56
Figure 29. Changes in DoN FND FTEs 2007–2016. ..........................................................56
Figure 30. Changes in DoN FNI FTEs 2007–2016............................................................57
Figure 31. Changes in DoN GS FTEs 2007–2016. ............................................................57
Figure 32. Changes in DoN SES FTEs 2007–2016. ...........................................................58
Figure 33. Changes in DoN WG FTEs 2007–2016............................................................58
Figure 34. First Attempt for Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types. .................................61
Figure 35. Second Attempt for Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types. .................................62
Figure 36. Third Attempt for Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types. .................................63
Figure 37. Fourth Attempt for Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types. .................................64
Figure 38. Fifth Attempt for Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types. .................................65
Figure 39. Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types ......................................................................66
Figure 40. First Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types .........................................................69
Figure 41. Second Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types .......................................................... 70

Figure 42. Third Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types .......................................................... 71

Figure 43. Fourth Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types .......................................................... 72

Figure 44. Fifth Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types .......................................................... 73

Figure 45. Sixth Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types .......................................................... 74

Figure 46. Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types .................................................................................. 75
LIST OF TABLES

Table 1. Dollars per FTE and Man-Hour in 2007 ........................................20
Table 2. Dollars per FTE and Man-Hour in 2016 ........................................25
Table 3. Historical Data and Expenditure Projection Based on Multiple Regression of Individual Hire Types. .........................................................67
Table 4. Historical Data and Expenditure Projection Based on Multiple Regression of Individual Hire Types. .........................................................76
<table>
<thead>
<tr>
<th>AcqDemo</th>
<th>Acquisition Demonstration</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPN</td>
<td>Appropriation</td>
</tr>
<tr>
<td>BLS</td>
<td>Bureau of Labor Statistics</td>
</tr>
<tr>
<td>BRAC</td>
<td>Base Realignment and Closure</td>
</tr>
<tr>
<td>BSO</td>
<td>Budget Submitting Office</td>
</tr>
<tr>
<td>CIVPERS</td>
<td>Civilian Personnel</td>
</tr>
<tr>
<td>CR</td>
<td>Continuing Resolution</td>
</tr>
<tr>
<td>CY</td>
<td>Constant Year</td>
</tr>
<tr>
<td>DOD</td>
<td>Department of Defense</td>
</tr>
<tr>
<td>DoN</td>
<td>Department of the Navy</td>
</tr>
<tr>
<td>DP</td>
<td>Demonstration Project</td>
</tr>
<tr>
<td>ES</td>
<td>End Strength</td>
</tr>
<tr>
<td>FMB</td>
<td>Office of Financial Management and Budget</td>
</tr>
<tr>
<td>FTE</td>
<td>Full Time Equivalents</td>
</tr>
<tr>
<td>FY</td>
<td>Fiscal Year</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GS</td>
<td>General Schedule</td>
</tr>
<tr>
<td>JIC</td>
<td>Joint Inflation Calculator</td>
</tr>
<tr>
<td>MSC</td>
<td>Military Sealift Command</td>
</tr>
<tr>
<td>NAVSEA</td>
<td>Naval Sea Systems Command</td>
</tr>
<tr>
<td>NCCA</td>
<td>Naval Center for Cost Analysis</td>
</tr>
<tr>
<td>NSPS</td>
<td>National Security Personnel System</td>
</tr>
<tr>
<td>NWCF</td>
<td>Navy Working Capital Fund</td>
</tr>
<tr>
<td>OCHR</td>
<td>Office of Civilian Human Resources</td>
</tr>
<tr>
<td>OMN</td>
<td>Operations and Maintenance (Navy)</td>
</tr>
<tr>
<td>OMNR</td>
<td>Operations and Maintenance (Navy Reserve)</td>
</tr>
<tr>
<td>OMMC</td>
<td>Operations and Maintenance (Marine Corps)</td>
</tr>
<tr>
<td>OMMCR</td>
<td>Operations and Maintenance (Marine Corps Reserve)</td>
</tr>
<tr>
<td>OSD</td>
<td>Office of the Secretary of Defense</td>
</tr>
<tr>
<td>PACFLT</td>
<td>U.S. Pacific Fleet</td>
</tr>
</tbody>
</table>

xvii
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB</td>
<td>President’s Budget</td>
</tr>
<tr>
<td>R²</td>
<td>Coefficient of Determination</td>
</tr>
<tr>
<td>RDTEN</td>
<td>Research, Development, &amp; Evaluation (Navy)</td>
</tr>
<tr>
<td>SES</td>
<td>Senior Executive Service</td>
</tr>
<tr>
<td>TY</td>
<td>Then Year</td>
</tr>
<tr>
<td>USFF</td>
<td>U.S. Fleet Forces</td>
</tr>
<tr>
<td>USN</td>
<td>United States Navy</td>
</tr>
<tr>
<td>USMC</td>
<td>United States Marine Corps</td>
</tr>
</tbody>
</table>
ACKNOWLEDGMENTS

There are too many people to thank for the assistance they provided and not enough space to name them all. I would like to thank Mr. Christopher Greaver, from FMB-423, who provided me with the thesis topic and helped me access the data that I used. I also want to thank my thesis advisor, Dr. Robert Eger, who in class taught me many things, but the thing that I remember most is that “people are expensive.” Without his help and guidance, I would have been lost trying to complete this project. I am also grateful to my co-advisor, Dr. Eddine Dahel, from whom I learned that even though statistics are numbers that can be warped to support any message, calculating these numbers is not that scary.

I would remiss if I did not acknowledge my family, friends, and classmates, who provided me the much-needed moral support and grounding. Last, but certainly not least, I thank my lovely wife, Nancy. During my career, she has endured prolonged separations for deployments or other duties, and at NPS, she had to deal with my extended absences so I could be with my mistress, “this thesis.”
I. INTRODUCTION

A. PURPOSE

According to data from the United States Bureau of Labor Statistics (BLS), the cost of labor across all U.S. sectors increased 2.3 percent on average from 2006 to 2016,\(^1\) outpacing increases in inflation and gross domestic product (GDP) (Bureau of Labor Statistics, 2017). Increases in the cost of labor are not unique to the private sector, as public entities such as the Department of the Navy (DoN) must draw talented professionals from this labor pool. Two other issues affect the DoN. First, the Navy is a manpower-intensive requiring fleet support both in port and deployed, which means labor costs comprise a large portion of its budget. Second, as with other public entities, the DoN has faced decreased funding as fiscal constraints have increased, lowering the amount of appropriations allotted.

In fiscal year (FY) 2007, the DoN employed 187,461 full-time equivalents (FTEs) (Department of the Navy, 2017). In the FY 2017 budget request, the DoN asked for appropriations to support 203,317 civilian FTEs, a 7 percent increase (Department of the Navy, 2016). With increasing global commitments requiring an increase in the number of civilian FTEs needed as well as a fiscally constrained environment that limits Department of Defense (DOD) funding, it is imperative to understand how civilian labor costs will affect future budgets to allow informed decisions to be made on expenditures.

B. RESEARCH OBJECTIVES

This thesis includes a macro-level statistical analysis of ten years of recent historical data on the DoN’s civilian labor force to identify the largest cost drivers. This report evaluates the civilian labor trends in the DoN as a whole and then further analyzes the DoN civilian labor force according to the Budget Submitting Office (BSO), and Appropriations (APPN), and by the Hire Type.

\(^1\) This information was obtained by creating a customizable search of the Employment Cost Index (NAICS) data base on the BLS website: https://www.bls.gov/ect/
After highlighting the largest cost drivers, the information is used to create basic models to project how these costs will change if all factors remain the same. These models serve to highlight how these costs may affect future DoN expenditures.

The purpose of highlighting these increases and creating projections is to provide Navy leaders with information on civilian labor force costs to allow them to make decisions about the allocation, programming, and budgeting of limited funds with the most information possible on the subject. This thesis does not advocate for certain programs, specific cost reduction strategies, or investment strategies, rather it serves only to highlight the general issues.
II. BACKGROUND

A. FULL TIME EQUIVALENTS

There are two ways of counting civilian personnel in the employ of the DoN: End Strength (ES) and FTE. ES counts the physical bodies performing work for the DoN, so one person working, regardless of fulltime or part-time status, counts as one ES. FTE counts the number of hours worked based on the assumption that one individual works 40 hours a week for 52 weeks. Thus, one FTE is 2,080 man-hours. Whether a worker is part-time or full-time does not affect the total number of FTEs. For example, one worker can work part time and thus count as .5 FTE since they only performed 1,040 hours of work. Another part-time worker can then work the remaining 1,040 hours. Even though two different people performed work, only one FTE is recorded. If ES had been used to determine civilian labor numbers then it would have provided an inflated number of labors while costs remained the same. This would mean that the labor would appear relatively inexpensive when compared to the total number of ES civilians.

B. HIRE TYPES

FTEs are classified in multiple ways as hire types.

1. Senior Executive Service (SES)

These individuals are the most senior civilian leaders directly beneath Presidential appointees. They act as the senior civilian leadership of the federal workforce (Office of Personnel Management, n.d.).

2. General Schedule

This hire type covers the majority of civilian employees in the DoN. General Schedule (GS) employees are paid on a scale that ranges from GS-1, the lowest paygrade, to GS-15, the highest paygrade. In addition, each of these paygrades has 10 steps, which incrementally increase the employee’s salary based on numerous characteristics such as performance and tenure while they remain in the GS level appropriate for their position. (Office of Personnel Management, n.d.)
3. **Wage Grade**

This hire type is used to employ civilians working in positions that are normally considered blue collar, skilled trade labor and craftsman, and are paid hourly (Office of Personnel Management, n.d.).

4. **Foreign National Direct**

Foreign Nationals directly employed and funded by the U.S. government are considered Foreign National, Direct Hires.

5. **Foreign National Indirect**

Foreign Nationals directly employed by foreign governments that work for the U.S. government are considered Foreign National, Indirect Hires. These hires are funded based on the specific agreements reached by the foreign and U.S. governments.

6. **National Security Personnel System**

The National Security Personnel System (NSPS) is a personnel system that was created in the National Defense Authorization Act (NDAA) for FY04 to give the DOD more flexibility in compensating, rewarding, and promoting individuals (Stewart, 2005). This was accomplished through “pay bands,” which were flexible pay scales. However, the system was criticized for being too subjective and the NDAA for FY10 repealed this hire type. Beginning in 2010, the civilians classified as NSPS were re-designated as other hire types (National Security Personnel System, 2010). Information about this hire type was used in this report because it was still a valid personnel system until 2010.

7. **Demonstration Project**

The National Defense Authorization Act (NDAA) for FY96 created the framework for reform of the civilian labor force that specifically dealt with acquisitions. This effort began in 1999 and was designed to improve the DOD acquisition civilian labor force by creating a better personnel system than was currently in use (Department of Defense Civilian Acquisition Workforce Personnel Demonstration Project, n.d.).
Demonstration project hire types are FTEs that are part of trial programs such as the Acquisition Demonstration (AcqDemo) FTEs, which do not fit into the other hire types.

8. **Civilian Mariners**

These hire types are civilian mariners employed by the federal government to operate U.S.-owned ships with the Military Sealift Command (MSC) to support all of the Armed Services but primarily support of the Navy operations (Military Sealift Command, n.d.).

C. **APPROPRIATIONS**

Appropriations are acts of Congress that provide legal authority for the specific outlay of funds in support of specific areas of endeavor (Musell, 2009, p. 14). Funds allocated for one appropriation are to be used solely in for that appropriation unless Congress has granted authority to move funds from one appropriation to another. As a result, specific types of funding are called appropriations in budgets (Schick, 2000, p. 186).

1. **Operations and Maintenance**

The general title of operations and maintenance actually covers four different appropriations: Operations and Maintenance, Navy (OMN), Operations and Maintenance, Navy Reserve (OMNR), Operations and Maintenance, Marine Corps (OMMC), and Operations and Maintenance, Marine Corps Reserve (OMMCR). Costs budgeted in this appropriation are considered an expense and used to support active operations (Department of Defense, 2011, p. D1).

2. **Research, Development, Test, and Evaluation, Navy (RDTEN)**

Funds outlayed for this appropriation are earmarked to support research and development efforts for the U.S. Navy and Marine Corps (Department of the Navy, 2016, p. 5–1). Costs budgeted in this appropriation can be considered an expense or investment. Since this report focuses on labor these funds are considered an expense (Department of Defense, 2011, p. D1).
3. **Navy Working Capital Funds**

The Navy Working Capital Fund (NWCF) is a revolving fund that finances certain activities, such as shipyards and depots, which are support operational units. This fund strives to break even over a budget cycle in order to provide services for the lowest cost possible (Department of the Navy, 2016, p. 7–1).

4. **Military Construction, Navy and Marine Corps**

Funds outlayed as Military Construction, Navy and Marine Corps (MCN) appropriation are earmarked to support the construction of United States Navy and Marine Corps facilities (Department of the Navy, 2016, p. 6–1). Costs budgeted in this appropriation can be considered an expense or investment but, since this report focuses on labor, it will be considered an expense (Department of Defense, 2011, p. D1).

5. **Base Realignment and Closure**

Funds outlayed in this appropriation are earmarked to support the Base Realignment and Closure (BRAC) efforts of U.S. Navy and Marine Corps facilities. Costs budgeted in this appropriation can be considered an expense or investment, but since the report focuses on labor, these funds will be considered an expense (Department of Defense, 2011, p. D1).

6. **Family Housing, Navy (Operations) (FHOPS)**

This appropriation is used to operate, maintain, and oversee the U.S. Navy’s family housing (Department of the Navy, 2016, p. 6–2). Costs budgeted in this appropriation can be considered an expense or investment (Department of Defense, 2011, p. D1). Like the previous APPNs, the labor costs will be considered an expense.

7. **Budget Submitting Office (BSO)**

A BSO is a subunit in the DoN that is responsible for submitting budget materials, reviewing work performed, and ensuring documentation is correct (Department of Defense, 2011, p. 81607).
III. LITERATURE REVIEW

As of the writing of this report, the author was able to locate seven reports written by the RAND Corporation and the Government Accountability Office (GAO) that specifically addressed the civilian workforce and related expenditures in the DoN and DOD. These reports focused on the efficiencies of military to civilian conversions of personnel, the optimal mix between civilians, contractors, and active duty personnel, as well as how to best compensate these civilians. However, these reports did not address how recent events such as sequestration, growth and reduction in the DOD budget, or other external factors affect the civilian labor force and expenditures. As a result, this literature review focuses on the research done into the different statistical methods used to develop models and create projections that can be used to estimate how much the civilian labor force will cost the DoN in the near future with the assumption that current external factors affecting the DoN budget remain in place.

A. DESCRIPTIVE STATISTICS

Descriptive statistics is the use of collected data points, which are then summarized into an easily understandable format for the end user in the form of graphs or tables. This data can then be used to identify historical trends or to create a projection for consumers of that information (Anderson, Sweeney, & Williams, 2010, p. 14). This data should be presented to convey the information in a simple and understandable format (Anderson, et al., 2010, p. 89).

1. Measures of Association between Two Variables

Variables can interact with each other in many ways. In order to conduct a thorough statistical analysis, it is important to understand the relationship different variables have with each other as well as how strong that relationship is. Covariance and Correlation Coefficient are two methods that can be used to interpret the nature and strength of a relationship between variables.
a. **Covariance**

Covariance \( (s_{xy}) \) is the measure of the linear association between two variables and is calculated in the following manner for samples (Anderson, et al., 2010, p. 149):

\[
s_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{n - 1}
\]

where

\( n \) = the sample size,

\( x_i \) and \( y_i \) = location of a data point on the x and y-axis, and

\( \bar{x} \) and \( \bar{y} \) = the average values of all x and y values.

Simply put, a positive covariance means that as one variable grows or shrinks, there is a similar reaction in the other variable. If there is a negative covariance, then the reaction of one variable is the opposite of the other (Anderson, et al., 2010, p. 151). It should be noted that a covariance of 0 does not mean that the two variables are independent of each other (i.e., statistically independent), but it could mean that the data has some type of dependency that is not easily identified (Newbold, 1995, p. 151). A limitation of covariance is that it is dependent on the units of measurement used by both variables. Thus, this reports comparison of FTEs, expenditures, and hire types would be difficult to accomplish using covariance.

b. **Correlation Coefficient**

Correlation Coefficient \( (r_{xy}) \) is similar to covariance in that it is another measure of the linear relationship between two variables but differs in that the difference in units does not affect the result. Values of the correlation coefficient can range from -1 to 1 with -1 indicating a perfect negative linear relationship and 1 indicating a perfect positive linear relationship. As the values approach 0, the weaker the linear relationship between the two variables is (Anderson, et al., 2010, p. 155). There may be a positive or negative relationship between two variables but that does not imply that one variable caused the
other, only that they are related in some fashion. The Correlation Coefficient for samples is calculated in the following manner (Anderson, et al., 2010, p. 151):

\[ r_{xy} = \frac{s_{xy}}{s_x s_y} \]

where

\[ s_{xy} = \text{the sample covariance}, \]
\[ s_x = \text{sample standard deviation of } x, \] and
\[ s_y = \text{sample standard deviation of } y. \]

B. LINEAR REGRESSION

Regression analysis is a statistical procedure that is used to create an equation to explain how variables are related to each other. Simple Linear regression identifies how one variable, the dependent variable, behaves with a change in the independent variable (Anderson, et al., 2010, p. 530). More variables require the use of multiple regression models, which also increase the complexity of the model (Mendenhall & Sincich, 1996, p. 173).

A simple linear regression model is normally depicted as (Anderson, et al., 2010, p. 534):

\[ \hat{y} = b_0 + b_1(x) \]

where

\[ \hat{y} = \text{is the estimate of the dependent variable based on the independent variable,} \]
\[ b_0 = \text{where the trendline will intercept the y-axis if the independent variable is 0,} \]
\[ b_1 = \text{the slope of the trendline, and} \]
\[ x = \text{the independent variable that is being manipulated to understand the movement of the dependent variable.} \]
1. **Independent versus Dependent Variables**

   Simple linear regression analysis only takes two variables into account. The independent variable, typically depicted on the x-axis, affects the dependent variable, normally depicted on the y-axis (Mendenhall & Sincich, 1996, p. 93). For example, this model will measure how much y will increase or decrease when x increases or decreases. In this report, the dependent variable is normally depicted as a DoN expenditure, while the independent variable is the number of FTEs by appropriation, BSO, or hire type.

2. **Coefficient of Determination**

   The coefficient of determination, abbreviated as $R^2$ in Microsoft Excel®, is a way to measure how well the regression equation fits the historical data that the equation was derived from (Anderson, et al., 2010, p. 545). $R^2$ values range from 0 to 1 with 0 meaning that the derived equation does not accurately model the data, and 1, which means the model derived will perfectly fit all provided data points and is thus the equation is a stronger model. $R^2$ is calculated in the following manner (Anderson, et al., 2010, p. 548):

   $$ R^2 = \frac{SSR}{SST} = \frac{\sum(\hat{y}_i - \bar{y})^2}{\sum(y_i - \bar{y})^2} $$

   where

   SSR is the Sum of Squares due to Regression and SST, is the Total Sum of Squares.

3. **Multiple Regression**

   Simple linear regression is useful in understanding the relationships between two variables, but a single independent variable may not be the sole manipulator of the dependent variable. In order to understand how multiple variables can affect the dependent variable multiple regression analysis is needed (Anderson, et al., 2010, p. 613). A generic equation for samples looks like (Anderson, et al., 2010, p. 614):

   $$ \hat{y} = b_0 + b_1 x_1 + b_2 x_2 + \cdots + b_p x_p $$

   where
\[ \hat{y} = \text{the estimate of the dependent variable based on the independent variables} \]
\[ x_1, x_2, \ldots, x_p. \]

For the purpose of this report, equations developed using this method will allow the use of multiple variables, such as the different hire types or appropriations, to be used in the determination of the DoN expenditures for civilian labor.

\textbf{a. Adjusted } R^2 \textbf{ }

The coefficient of determination \( R^2 \) is useful in simple linear regressions when there is only one independent variable. However, when additional independent variables are used in multiple regression analysis, the \( R^2 \) value will either remain the same or increase. Adjusted \( R^2 \) accounts for this increase and is thus a better tool to evaluate equations created using multiple regression. Similar to \( R^2 \), the higher the Adjusted \( R^2 \), the more the derived model will mimic the historical data from which it was calculated.

\textbf{C. REGRESSION VALIDATION }

Regression analysis uses historical data to develop equations that attempt to best explain how a dependent variable will behave based on changes to one or more independent variables. These models, based on historical data, may then be used to predict future results, but only if the model is defendable.

\textbf{1. F-Statistic }

When analyzing simple linear regressions, \( R^2 \) is a useful tool in understanding how well the calculated equation reflects the collected historical data. Adjusted \( R^2 \) is used in the same way but for multiple regression analysis. Even though these are useful to evaluate models, the preferred method is to evaluate the significance of the \( F \)-statistic that is presented in Excel’s regression readout. A lower value means that the probability that the regression was derived by chance is greatly reduced. A higher value calls into question the validity of the derived model (Mislick & Nussbaum, 2015, p. 138).
2. **Probability (p) Value**

The *p*-value is used when evaluating the different independent variables to determine how statistically significant they are to the model. A smaller *p*-value means that the probability that chance or randomness generated the values is low (Anderson, et al., 2010, p. 411). For this report, a confidence level of 90 percent has been adopted. Thus, $\alpha$ is 0.10 and any *p*-values above $\alpha$ will be removed from the model.

3. **Multicollinearity**

In this report, the independent variables may not be truly independent as there could be connections between the different variables. For example, a dramatic increase in GS FTEs may necessitate the hiring of an SES FTE in order to manage the new hires. Thus, GS and SES personnel are tied to each other. Multicollinearity is the test to determine the degree of independence these variables have from each other through the use of Excel’s correlation function (Anderson, et al., 2010, p. 633). For the purpose of this report, values less than or equal to 0.3 are considered to be sufficiently independent from each other so as to not corrupt the model. Values 0.31 to 0.7 are in an area where multicollinearity may be present but may not adversely affect the results. Values 0.71 and above are considered highly suspect as the variables may be too dependent on each other (Mislick & Nussbaum, 2015, p. 159).

If multicollinearity is suspected, it is necessary to run the regressions both with and without the suspected variables. If both equations produce similar results, within 30 percent, then the multicollinearity does not present an issue and both equations are valid. However, if the tests are greater than 30 percent, then it is best to develop another model.
IV. METHODOLOGY

A. DATA SELECTION

Data on the civilian labor force and DoN expenditures was provided by FMB-423, Civilian Resources Division. Although defense spending has changed in various ways over the last century, the most recent ten years were particularly tumultuous period with numerous events that will most likely continue to shape budgets in the near future (Department of the Navy, 2017). Passage of the Budget Control Act in 2011 created the threat of sequestrations, frequent continuing resolutions (CRs) have impacted the predictability of federal budgets, and multiple other fiscal restraints have been added to defenses budgets, all of which are encompassed in the previous ten years. The use of data from additional years would only dilute the effects of these events by smoothing out the trends.

Since this report seeks to project the near-term future costs, where these external factors might still shape expenditures, it was important to ensure the effects are reflected as much as possible in future projections.

B. DATA PREPARATION

1. Normalization

The data provided by FMB-423 was in Then Year Dollars (TY$) and needed to be adjusted for inflation to provide dollar figures in Constant Year (CY$) amounts. To adjust TY dollars into CY dollars, the Naval Center for Cost Analysis (NCCA) was used. NCCA captures the inflation values for past, present, and future budgets and has created the Joint Inflation Calculator (JIC), which allows normalization of data. By taking the original data and then adjusting for inflation to a common year, in this report FY 2017, constant (or real) dollar values adjust for the change in purchasing power of the dollar over time, allowing a comparison of dollar values from one year to another. The result of the constant dollar transformation is an accurate comparison of the growth in expenses due to cost growth and not as a result of inflation.
2. **Data Organization**

The original data was then divided in three ways:

- By Hire Type to better see the trends in the workforce and pay systems
- By Appropriation to better see which appropriations were growing in both expenditures and FTEs
- By BSO to see which organizations were growing in expenditures and FTEs

In each of these three categories, the data was further subdivided into years to allow a more detailed analysis of the trends. After subdividing the data, the individual amounts were totaled in order to create a denominator to use in the calculation of percentages.

To understand the changes in the Civilian Labor Force, 2007 was used as the base year from which all changes would be measured. This information was presented first and then the changes up to 2016 were discussed to show how FTE numbers and expenditures changed over the period. Initially, 2017 data was to be used as the final year. However, the data was collected in January of 2017 and subsequent changes to the DOD budget and changes in funding for FY17 made this data highly suspect.

3. **Simple Linear Regression Creation and Validation**

After reorganizing the data and making initial calculations, Excel’s line chart function was used to visually represent the data in an easily digestible form, similar to the graphs seen in Figure 1. Excel’s regression function was then used to create the simple linear equations to create a model that mimics the growth of data from 2007 to 2016.
The simple linear model was then validated by looking at the $R^2$ value. Any values less than 0.75 meant that the regression equation created did not accurately model the historical data and could not be used as a defendable model to predict trends in the future. Even though the $R^2$ values of 0.59 for expenditures and 0.13 for FTEs mean the developed equation is not defendable, it does highlight that, on average, the expenditures for civilian labor are growing at a faster rate than the civilian workforce. In some cases, the simple linear regression equation could not be used so more detailed multiple regression models would be necessary.

4. Multiple Regression Model Creation and Validation

Although the total number of FTEs is the primary driver of total expense, the different FTEs grew at different rates indicating that a multiple regression model that took into account the changes in the different hire types may produce a more accurate model.
An initial model was developed using total expense as the dependent variable and the total number of the different hire types as the independent variables. The resulting model was a poor fit as the Significant $F$-value of 0.34 and the $p$-values\(^3\) for each of the independent variables was above the predetermined $\alpha$ of .10, although model fit, as determined by the adjusted $R^2$, was 0.76. With so many independent variables, it was necessary to ensure that the independent variables had sufficient independence from each other. Using Excel’s correlation function, there were variables that were highly correlated with each other but no logical reason could be discerned for this outcome. Since there was no logical reason for this result, the values remained in the equation.

One issue that did come from initial analysis was that the NSPS hire type skewed the results even though the NSPS hire type was discontinued and would not play a factor in future expenditures. In order to correct for that discrepancy, subsequent models were created without the NSPS hire type included in the regression. Figure 2 demonstrates how much the inclusion of the NSPS data could skew a future prediction of growth with the burgundy line predicting future growth using NSPS data and the blue line showing predictions after the NSPS hire type was removed as an independent variable.

---

\(^3\) $p$-Values for each of the independent variables ranged from 0.442 to 0.947
Data from 2007 to 2017 was derived from the information in the OP08 database maintained by the Department of the Navy. Values from 2018 to 2028 are projections. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 2. Difference between Predictions with and without NSPS Hire Type.

The regression created by using the growth of different FTEs in the DoN was not defendable due to the multiple independent variables having large p values as well as the Significant-F result of the regression equation. Since this approach would not produce defendable results, it was necessary develop a different method for predicting DoN labor costs with respect to personnel.

The first subdivision of the Navy is into the individual BSOs. These individual BSOs expanded and contracted at different rates. Organizations like BSO 60, U.S. Fleet Forces (USFF), and BSO 70, U.S. Pacific Fleet (PACFLT), experienced explosive growth while others like BSO 18, The Bureau of Medicine, contracted. Not only did the individual BSOs expand and contract at various rates, the increase or decrease of the individual hire types within the BSOs themselves varied dramatically with some hiring more DP FTEs and other hiring more GS FTEs.

In order to better capture these trends, it was necessary to create simple linear regressions of each hire type in individual BSOs and then create a projected growth of each BSO. Then the totals of each BSO were combined to create a total DoN growth
projection. This updated projection almost exactly matched the first model but did provide more insight into the behaviors of the different BSOs and the trends of hire types in the subunits.
V. CALCULATION OF CIVILIAN LABOR COSTS

A. CIVILIAN LABOR FORCE OVERVIEW IN 2007

In 2007, the DoN employed 187,641 civilian FTEs at a cost of $18,917,892,000\(^4\) (FY17$). This figure means that the DoN paid an average of $100,916.42 per FTE, or $48.52 per man-hour.\(^5\)

1. Civilian Labor Breakdown by Hire Type

In 2007, 51 percent of the DoN FTEs were General Schedule (GS), at a total expense of $10,147,380,000, approximately 53.64 percent of all DoN expenditures on civilian labor (Figure 3). Wage Grade (WG) civilians were the second largest group of FTEs, at 18.41 percent at a cost of $3,045,514,000, 16.10 percent of all civilian labor expenditures.

Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 3. 2007 Breakdown of Civilian FTEs by Hire Types.

---

\(^4\) Unless specified, all dollar values have been normalized to FY 2017 values.

\(^5\) Since 2007 was not a leap year, the amount of man-hours per FTE was calculated at 2,080.
Even though GS and WG were the most numerous hire types requiring the most funds, they were not the most expensive hire types per FTE. SES, were the most expensive FTE, costing an average of $222,033.17 per FTE, or $106.75 per man-hour (Table 1). Even though this amount is 120 percent more than the DoN average of $100,916.42, the SES hire type was only a total of 327 FTEs and accounted for 0.17 percent of all FTEs in 2007.

Table 1. Dollars per FTE and Man-Hour in 2007.

<table>
<thead>
<tr>
<th>Hire Type</th>
<th>Dollars per FTE</th>
<th>Cost per Man-Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Executive Service</td>
<td>$222,033.17</td>
<td>$106.75</td>
</tr>
<tr>
<td>General Schedule</td>
<td>$106,630.45</td>
<td>$51.26</td>
</tr>
<tr>
<td>NSPS</td>
<td>$122,631.00</td>
<td>$58.96</td>
</tr>
<tr>
<td>Demonstration Project</td>
<td>$136,323.99</td>
<td>$65.54</td>
</tr>
<tr>
<td>Administrative Action</td>
<td>$174,232.32</td>
<td>$83.77</td>
</tr>
<tr>
<td>Wage Grade</td>
<td>$88,265.52</td>
<td>$42.44</td>
</tr>
<tr>
<td>Civilian Mariners</td>
<td>$79,733.85</td>
<td>$38.33</td>
</tr>
<tr>
<td>Foreign National Direct</td>
<td>$51,286.95</td>
<td>$24.66</td>
</tr>
<tr>
<td>Foreign National Indirect</td>
<td>$11,045.72</td>
<td>$5.31</td>
</tr>
</tbody>
</table>

The above table shows the average cost per FTE and per Man-Hour for each hire type in 2007. Adapted from C. Greaver, non-archived email, January 27, 2017.

2. Civilian Labor Compensation Breakdown

In terms of Civilian Labor Compensation, the majority of funds, 68.83 percent of all labor costs, were expended providing Basic Government Accountability Office Compensation to the civilians as seen in Figure 4. The second largest component, at 19.97 percent of all labor costs, was the payment of benefits. Overtime was third largest single category at 4.63 percent of all compensation costs and was most prevalent in the NWCF appropriations.
Figure 4. 2007 Total Civilian Labor Cost Breakdown.

Other expenditures was actually larger than overtime at 6.57 percent but this category is actually a combination of all the other payments made to the various items such as awards, pay pool, Permanent Change of Station (PCS), voluntary separation, and early retirement, which themselves are a very small percentage individually, 1.8 percent or less.

3. Civilian Labor Force Break Down by BSO

The previous two sections discussed the composition of the civilian labor force and the structure of their compensation. One item to note is that the civilian labor force of the individual BSOs changed in the 2007–2016 period and understanding the changes will help provide understanding to the changes in the DoN Civilian Labor Force.

In 2007, 12.08 percent of DoN FTEs were in Naval Sea Systems Command (NAVSEA), BSO 24, and 11.84 percent were in Naval Air Systems Command (NAVAIR), BSO 19. These two BSOs accounted for 15.61 percent and 13.53 percent, respectively, of total DoN civilian labor expenditures in 2007. However, BSOs 24 and 19 did not spend, on average, the most per FTE as BSO 14, Chief of Naval Research, and
BSO 39, Space and Naval Warfare Systems cost $139,047.85 and $133,764.07 per FTE, respectively (Figure 5).

Figure 5. 2007 Breakdown of Civilians FTEs by BSO.

The reason for the increased expense of an FTE in BSO 14 and BSO 39 when compared to NAVSEA and NAVAIR is that the first two BSOs employed more of the relatively expensive NSPS and DP hire types whereas the other BSOs mainly employed the less expensive GS hire type.

4. Civilian Labor Force Break Down by APPN

The final way to evaluate the composition of the Civilian Labor Force is to see how the FTEs are divided among the different APPN categories, as displayed in Figure 6.
In 2007, 49.93 percent of the civilian personnel fell under the appropriation labeled as Operations and Maintenance, Navy (OMN). The cost of the OMN civilians is $9,249,369,000, or 48.89 percent of total labor costs. The majority of the FTEs employed in OMN, 60.59 percent, were GS with the second largest hire type in OMN was WG FTEs at 19.27 percent. While the GS FTE is more expensive than the DoN average of $100,916.42 per FTE, it was only slightly so (Table 1). WG FTEs were less expensive than the DoN average.

The Navy Working Capital Fund (NWCF) was the second largest appropriation at 41.49 percent of total labor costs at $7,849,958,000 but only 38.36 percent of the Navy’s civilian FTEs. The GS FTE was also the most numerous hire type in the NWCF appropriation at 35.19 percent of the labor force. The second largest hire type was the more expensive DP hire type at 28.84 percent of the NWCF APPN labor force. The next two largest hire types were the WG FTEs at 19.19 percent and Civilian Mariners at 9.31 percent.
B. CHANGES IN THE CIVILIAN LABOR FORCE FROM 2007 TO 2016

In 2016, the DoN employed 201,581 civilian FTEs at a cost of $22,552,748,000. This figure means that the DoN paid an average of $111,879.34 per FTE, or $53.58 per man-hour. Compared to 2007, this means that the number of FTEs grew 7.53 percent while the total expenditures on labor grew by 19.21 percent. During this period, the cost per FTE grew 10.86 percent. As shown in Figure 1, the DoN saw changes in the number of civilian FTEs employed and the total amount spent for civilian labor during the period 2007–2016.

1. Changes in Civilian Labor by Hire Type

In 2016, 51.69 percent of the DoN FTEs were GS, a total expense of $12,357,657,000, approximately 52.76 percent of all DoN expenditures on civilian labor (Figure 7). Demonstration Project (DP) increased from 11.56 percent of the civilian labor force to 19.31 percent of the labor force to become the second largest hire type. This is a notable change in the composition of the civilian labor force considering that DP FTEs are an expensive hire type at $146,444.39 per FTE, or $70.14 per man-hour (Table 2).

![Figure 7](image)

Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 7. 2016 Breakdown of Civilian FTEs by Hire Types.

---

6 Unlike 2007, 2016 was a leap year so the amount of man-hours per FTE was calculated at 2,088.
Wage Grade (WG) civilians shrunk to 17.81 percent of the labor force to become the third largest group of FTEs.

Table 2. Dollars per FTE and Man-Hour in 2016.

<table>
<thead>
<tr>
<th>Hire Type</th>
<th>Dollars per FTE</th>
<th>Cost per Man-Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Executive Service</td>
<td>$238,908.11</td>
<td>$114.42</td>
</tr>
<tr>
<td>General Schedule</td>
<td>$118,609.22</td>
<td>$56.81</td>
</tr>
<tr>
<td>Demonstration Project</td>
<td>$146,444.39</td>
<td>$70.14</td>
</tr>
<tr>
<td>Administrative Action</td>
<td>$172,950.76</td>
<td>$82.83</td>
</tr>
<tr>
<td>Wage Grade</td>
<td>$89,487.29</td>
<td>$42.86</td>
</tr>
<tr>
<td>Civilian Mariners</td>
<td>$103,263.61</td>
<td>$49.46</td>
</tr>
<tr>
<td>Foreign National Direct</td>
<td>$54,522.92</td>
<td>$26.11</td>
</tr>
<tr>
<td>Foreign National Indirect</td>
<td>$13,975.78</td>
<td>$6.69</td>
</tr>
</tbody>
</table>

The table shows the average cost per FTE and per man-hour for each hire type in 2016. Adapted from C. Greaver, non-archived email, January 27, 2017

Appendix A shows the changes in the number of the different civilian FTEs in the DoN from 2007 to 2016. In this period, the NSPS hire type was discontinued and there were decreases in the two relatively inexpensive Foreign National Hire Types, when compared to the average cost for a DoN civilian FTE. On average, all other hire types in the DoN saw growth with the largest growth in terms of numbers, 17,254, and rate, 79.60 percent, being DP FTEs.

2. Changes in Civilian Labor Compensation

From 2007 to 2016, the DoN increased spending on Civilian Labor by $3.6 Billion. Most of the increase in civilian labor costs went into Basic Compensation, which grew 18.12 percent from 2007. However, it should be noted that expenditures for benefits grew 40.14 percent during the same period.

Figure 8 serves to show the difference in the growth rates between Basic Compensation and Benefits costs from 2007 to 2016. The regressions\(^7\) depicted on the

\(^7\) The equation for the trend line for Total Basic Compensation Expenditures is \(y=233,486x+10,000,000\) with a \(R^2\) of 0.59 and \(y=158,055x+4,000,000\) with a \(R^2\) of 0.88 for Total Benefits Expenditures.
graph closely follow the actual data and demonstrate how much more rapidly the cost of benefits is growing when compared to the growth of Basic Compensation.

![Graph showing growth of Basic Compensation and Benefits](image)

Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 8. Comparison in the Growth of Basic Compensation and Benefits, 2006–2017.

Figure 9 shows that, in terms of benefits expense per FTE, the average expense grew over $6,000 from $20,153.55 in 2007 to $26,265.23 in 2016, an average of 3 percent per year.\(^8\)

\(^8\) The regression equation for Benefit Expense per FTE is \(y=695.94x+19,374\) with a \(R^2\) of 0.995
When looking at total civilian compensation expenditures, benefit expenses grew from 19.97 percent to 23.48 percent of all labor costs (Figure 10). In 2007, the DoN spent, for the average FTE, $69,463.16 on Basic Compensation and $20,153.55 on Benefits. In 2016, the DoN spent $77,247.79 in basic compensation for the average FTE and $26,484.36 on benefits expense.
3. Changes in the Civilian Labor Force by BSO

In 2016, the largest BSOs were NAVSEA, BSO 24, and NAVAIR, BSO 19 with 13.08 percent and 12.65 percent, respectively, of the civilian FTEs (Figure 12). Notably USFF, and PACFLT, grew to 12.41 percent and 12.23 percent of the civilian labor force (Figure 11). These four BSOs contained 50.37 percent of all DoN civilian FTEs and accounted for 51.39 percent of all civilian labor expenditures. Figure 12 serves to highlight the rapid growth of FTEs in USFF and PACFLT when compared to NAVSEA and NAVAIR.

Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 10. 2016 Total Civilian Labor Cost Breakdown.
Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 11. 2016 Breakdown of Civilian FTEs by BSO.

Figure 12. Growth of Four Largest BSOs, 2007–2016.

In this period, USFF added 6,701 GS FTEs and 4,100 WG FTEs. PACFLT added 4,383 GS and 3,319 WG FTEs. In terms of cost per FTE, the average GS FTE is
approximately $6,000 more expensive than the average DoN FTE and WG FTEs are approximately $23,000 cheaper (Table 2).

4. Civilian Labor Force Break Down by APPN

In 2016, three appropriations, OMN, OMMC, and the NWCF comprised 98.58 percent of all civilian FTEs (Figure 13). Since 2007, the largest increases in civilian FTEs were found in two appropriations: the Navy Working Capital Fund (NWCF) with the addition of 5,908 FTEs growing from 29.08 percent to 30.73 percent of all DoN civilian FTEs. Operations and Maintenance, Navy and Marine Corps grew 3,843 and 3,619 FTEs, respectively. The majority of these FTE increases were in the GS and DP hires in the NAVAIR and NAVSEA BSOs. In terms of average cost per FTE, the appropriation category with the largest increase was RDTEN with a 42.42 percent increase since 2007 despite shrinking from 1,520 FTEs to 1,027; a cut of 493 FTEs.

Figure 13. 2007 Breakdown of Civilians by Appropriation.

One explanation for this increase in expenditures in the RDTEN Appropriation can be the 23.12 percent increase in spending by BSO 14, the 16.98 percent increase by
BSO 18, and BSO 41, which in 2007 had not funded any civilian FTEs but in 2016 accounted for 25.62 percent of funding.

Another explanation can be the increase in the use of DP FTE’s by BSO 14, which accounted for 46.81 percent of expenditures whereas in 2007 BSO 14 did not fund any DP personnel. DP personnel cost, on average, $146,444.39 per FTE, which is over $30,000 more per year than the average DoN FTE.

5. Changes in the Cost per FTE

Using the data provided by FMB-423, the average cost per FTE can be calculated by dividing the total expenditures by the number of FTEs to come up with the amount required to purchase one FTE. In 2007, to support one FTE for the year cost the DoN $100,916.42. In 2016, the cost to support one FTE rose by $12,009.77 to $112,926.19; an 11.90 percent increase. Using this information, it can be estimated that the DoN can expect to see an increase in the cost of an average DoN FTE by 1.07 percent per year (Figure 14).

The cost per FTE growth can be attributed to the reduction in number of relatively inexpensive FTEs, such as Indirect Foreign Hires, and the addition of more expensive hire types such as GS and DP FTEs. When constructing the linear trendline, the correlation coefficient, $R^2$, is 0.94 percent, which strongly suggests this is a viable equation that can be used to project the growth in the cost per FTE in the near future.

---

9 The equation for the trendline is $Cost \text{ per FTE} = 1,346.4x + 105,626$ where $x$ is the year (2007 = 1, 2008=2, etc.)
C.

CIVILIAN LABOR CHANGES SUMMARIZED

Figure 14 serves to highlight that the cost per average FTE has increased at a steady rate from 2007 to 2016. During that same period, civilian basic compensation saw a modest increase of 11 percent and remains the dominant portion of civilian labor expenses. In the same timeframe, expenditures on benefits for the typical FTE grew three times faster than basic compensation to become a larger portion of overall compensation.

Changes were seen in the different BSOs with some BSOs, like Bureau of Medicine, showing a decrease in personnel and associated costs due to organizational changes. In contrast, USFF and PACFLT saw growth that put them almost on par, in terms of number of FTEs, with the two largest BSOs, NAVAIR and NAVSEA. At the end of 2016, NAVAIR, NAVSEA, USFF, and PACFLT were the four largest BSOs in the DoN and this trend will most likely continue as BSO 33, Military Sea Lift Command, with over 8,000 FTEs, is incorporated into USFF.

With few exceptions, each of the hire types saw some growth. The most growth in terms of numbers and rate of growth was seen in the more expensive DP hire type followed by GS FTEs. Some of the changes in the different hire types can be explained

Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 14. Growth in the Cost per FTE, 2007–2016.
by the transfer of personnel previously under the NSPS designation to other systems but the changes in the number of FTEs in the DoN and in the individual BSOs varied over the period. These variations in the number of FTEs will make it difficult to create any meaningful predictions in future years.
THIS PAGE INTENTIONALLY LEFT BLANK
VI. PROJECTION OF FUTURE CIVILIAN LABOR COSTS

A. MODELING THE CHANGES IN THE DON

1. Linear Regression Models for the DoN

Figure 15 shows the historical data with the solid blue line representing the growth of DoN expenditures on civilian labor and the solid red line representing the number of DoN FTEs, measured on the right y-axis. The dashed blue and red lines are visual representations of the linear regression equations that Excel has created for the expenditures and FTEs respectively. The regression equations and associated $R^2$ values are

\[
\text{Total Expenditures} = 360,072x + 20,000,000 \quad R^2: 0.589
\]

\[
\text{Total FTEs} = 1,093.9x + 194,585 \quad R^2: 0.134
\]

where $x$ is the year for which the FTE or expenditure is to be calculated using sequential values (i.e., $x = 1$ for 2007, $x = 2$ for 2008, ..., $x = 12$ for 2018, etc.)

Figure 15. Changes of DoN Civilian FTEs and Expenditures, 2007–2016.
Once the regression calculations are complete, it is necessary to evaluate the strength of the linear models by evaluating their associated $R^2$ values. $R^2$ values show how closely regression equations model the historical data from which they are derived. Ranging from zero to one, the higher the $R^2$ value, the closer the derived equation will model the historical data. The lower the $R^2$ value, the less the derived equation models the historical data.

The regression equation for total expenditures from Figure 15 explains 59 percent of the variation of the historical data, but the regression model for FTEs has very poor explanatory power with an $R^2$ of 0.13. Since the $R^2$ values for both regression equations are below 75 percent, they would be unacceptable to use for creating projections due to the large variations seen. Even though the equations cannot be used for creating a defendable projection of expenditures or FTEs, they can be useful for evaluating general trends.

In Figure 15, the independent variable was time and the dependent variables were expenditures and total number of FTEs. Since time is usually a poor independent variable, another approach to finding total expenditures is to make FTEs the independent variable. In this manner, it is possible to see how total expenditures will change following a change in the total number of FTEs. To test this proposition, the total number of FTEs replaced time on the x-axis and total expenditures remained on the y-axis as the dependent variable (Figure 16).
Figure 16. Changes in Expenditures with Changes in Total Number of FTEs, 2007–2016.

Figure 16 is a scatter plot diagram where the total number of FTEs is the independent variable on the x-axis and total expenditures is the dependent variable on the y-axis. Each year of the historical period is placed as a point on the graph and then the following regression equation and associated $R^2$ value was derived:

\[
\text{Total Expenditures} = 135.43 \times \text{Total Number of FTEs} - 6,000,000 \quad R^2: 0.746
\]

Rounded up to 0.75, the equation’s $R^2$ value means that the derived equation closely matches the historical data. Since the $R^2$ value is equal to the predetermined threshold, it means that the equation can be defended as a method for determining a future total expenditure based on the total number of civilian FTEs.

Even though a defendable model for calculating total DoN expenditures is possible, Figure 15 shows that linear regression would not be accurate enough to determine the total number of DoN civilian FTEs.
Instead of trying to calculate the total number of DoN civilian FTEs using one regression, an alternative approach was undertaken where linear regressions were derived for each of the hire types. It was postulated that in this manner, it would be possible to create defendable regressions that could be combined to create a total DoN FTE estimation. Changes in different hire types were evaluated from 2007–2016 and regression equations were derived using Excel (Appendix A). The regression equations and their associated $R^2$ values are

- **Total AA FTEs** = $34.758x + 1051.3$  \( R^2: 0.61 \)

- **Total Civilian Mariner FTEs** = $145.78x + 6787.5$  \( R^2: 0.7 \)

- **Total DP FTEs** = $2822.8x + 13985$  \( R^2: 0.8 \)

- **Total FND FTEs** = $-85.376x + 2864.7$  \( R^2: 0.8 \)

- **Total FNI FTEs** = $27.164x + 11141$  \( R^2: 0.04 \)

- **Total GS FTEs** = $3845.3x + 72555$  \( R^2: 0.33 \)

- **Total SES FTEs** = $1.8182x + 351.2$  \( R^2: 0.04 \)

- **Total WG FTEs** = $57.036x + 34152$  \( R^2: 0.06 \)

where $x$ is the year for which the FTE is to be calculated using sequential values (i.e., $x = 1$ for 2007, $x = 2$ for 2008, …, $x = 12$ for 2018, etc.)

Using the above equations for each hire type, combining the individual results to create a total number of FTEs, and then inserting the combined total into the equation for total expenditures that was previously derived, resulted in the projection shown in Figure 17.
Data from 2007 to 2017 was derived from the information in the OP08 database maintained by the Department of the Navy. Values from 2018 to 2028 are projections. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 17. Projected DoN Expenditures When Predicting Changes in FTEs, 2018–2028.

Figure 17 represents the growth of DoN expenditures on civilian labor after projecting the changes in each of the DoN FTE hire types. If the factors and trends that shaped the historical data remain true, the DoN can expect to spend a total of $277,290,505,000 on civilian labor in the period 2018–2028. Even though this projection is an improvement over the first attempt to calculate total expenditures, the independent variable is derived using eight linear regressions, of which only two have a defendable $R^2$.

A linear regression model of the total number of DoN FTEs as well as a second attempt which combined the regression models of each hire type both proved inadequate to develop a suitable model for projecting future DoN expenditures on civilian labor. A third avenue to attack this issue was to evaluate the changes in FTEs of the individual BSOs to create defendable projections, which could then be combined to create a total number of FTEs. After calculating a total number of FTEs an estimation of total expenditures can be developed using the equation derived from Figure 16 (Figure 18).
Data from 2007 to 2017 was derived from the information in the OP08 database maintained by the Department of the Navy. Values from 2018 to 2028 are projections. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 18. Changes in Total FTEs and Expenditures, 2007–2028, Accounting for BSO Trends.

Figure 18 shows the projected number of FTEs and total expenditures when accounting for FTE trends in the individual BSOs (Appendix B). Using this information, the DoN is projected to add an additional 27,541 FTEs from 2018 to 2028 and spend a total of $261,686,602,000 over the same period.

Even though this third attempt is better than the previous models for calculating total expenditures based on FTEs, it is still not a defendable projection. Of the 20 BSO regressions created to develop the total FTE projection, only nine had $R^2$ values that passed the predetermined threshold of 0.75. Due to the variability in FTE projections, another method of projecting the total number of FTEs must be developed.

A final method involved using linear regression models to predict the growth of the individual hire types in each BSO and then combine those results to create a projection of total FTEs in the BSO. All the BSO totals were then combined to create a total DoN FTE number that was then inputted into the expenditure equation derived from Figure 15 to project total expenditures. This approach proved unfruitful because of the
107 regressions created for each hire type in the individual BSOs, only 18 equations had defendable $R^2$ values. Because only 16 percent of the regression equations could be used to calculate total expenditures, this method was not pursued as the previous attempt had 45 percent of the regressions being viable.

Using linear regressions or combining linear regressions did not provide defendable projections but using multiple regression models may allow the creation of models that only use the previously derived defendable equations to create projections.

2. **Multiple Regression Models for the DoN**

Since simple linear regression models could not produce a defendable projection of DoN FTEs, it was postulated that using multiple regression techniques to derive expenditures and FTEs would create projections that could withstand scrutiny.

The first attempt at creating a defendable model using multiple regression involved using the individual DoN FTE hire types as the independent variables and expenditures as the dependent variable. All current hire types were initially used and the FTE with the highest $p$-value was removed. This process was repeated 6 times until the following equation was derived:

$$
Total \ DoN \ Civilian \ Labor \ Expenditures \ (FY17K$) = - 19,674,410.69 + (9455.82 \times AA \ FTEs) + (957.6 \times FNI \ FTEs) + (538.31 \times WG \ FTEs).
$$

With an Adjusted $R^2$ of 0.84, which indicates that the derived equation accounts for 84 percent of the variation seen in the data and a Significant $F$ 0.003, the model can be used to estimate DoN total expenditures if given projections for the AA, FNI, and WG hire types. These independent variables projections were achieved by using the linear regressions derived in Appendix A and the test for multicollinearity showed that the independent variables were fairly independent from each other with values less than 0.20. Appendix C outlines the process by which the preceding equation was derived as well as the resulting data that was used to populate Figure 19.

---

10 $p$-values for AA, FNI, and WG were 0.00, 0.10, and 0.10 respectively.
Data from 2007 to 2017 was derived from the information in the OP08 database maintained by the Department of the Navy. Values from 2018 to 2028 are projections. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 19. Changes in Total Expenditures, 2007–2028, Using Multiple Regression and Select Hire Types to Project Expenditures.

Figure 19 is comparable to the projections made in Figures 17 and 18, however, none of the regressions used to project the independent variables met the predetermined threshold of 0.75. Since the estimations of AA, FNI, and WG FTEs would not withstand scrutiny due to their poor correlation coefficients, a second effort was made to derive a valid projection of FTEs using the different hire types as independent variables. It was hypothesized that by using multiple regression techniques to derive the equation for total FTEs, the strongest independent variables would be used. The resulting projection for total DoN FTEs would then be placed into the linear regression model for total expenditures based on FTEs created in Figure 16.

A process similar to developing the preceding equation was undertaken and after 7 iterations, the following equation was the result:

\[
\text{Total DoN FTEs} = 97,700.01 + (0.263 \times GS FTEs) + (216.734 \times SES FTEs).
\]

Appendix D outlines the process to create the regression as well as the resulting estimations. With an Adjusted \( R^2 \) of only 0.58, which was lower than the previous
multiple regression model, and a slightly higher Significant $F$ of 0.021; the model is not the best for projecting total FTEs. Additionally, there is the issue that the projections used to determine the independent variables of SES and GS FTEs have poor correlation coefficients that were 0.3 or less. Figure 20 is a visual representation of the information found in Appendix D.

![Figure 20: Changes in Total Expenditures and FTEs, 2007–2028, Using Multiple Regression and Select Hire Types to Project Total FTEs.](image)

Data from 2007 to 2017 was derived from the information in the OP08 database maintained by the Department of the Navy. Values from 2018 to 2028 are projections. Adapted from C. Greaver, non-archived email, January 27, 2017.

Attempts at creating multiple regression with the number of FTEs as independent variables failed to produce defendable results because information encompassed shifts in the entire DoN and was not detailed enough.

3. **Multiple Regression Models for each BSO to Calculate DoN Labor Costs**

A final attempt to create defendable projections for DoN FTEs and expenditures was undertaken by applying multiple regression techniques at a lower level, the
individual BSOs. The results were then combined to produce total DoN values for FTEs and expenditures.

Appendix E outlines the final attempt to model the changes of each BSO by creating a multiple regression model based on the different hire types in each BSO.\textsuperscript{11} The result of combining these results can be seen in Figure 21 and Table 3.

Data from 2007 to 2017 was derived from the information in the OP08 database maintained by the Department of the Navy. Values from 2018 to 2028 are projections. Adapted from C. Greaver, non-archived email, January 27, 2017.

**Figure 21.** Changes in DoN Total FTEs and Expenditures, 2007–2028, Adjusting for Trends in the Different Hire Types of Each BSO.

\textsuperscript{11} Excel data was summarized due to the large volume.
Figure 22. Total FTEs and Expenditures, 2018–2028, Adjusting for Trends in the Different Hire Types of Each BSO.

<table>
<thead>
<tr>
<th></th>
<th>FTEs</th>
<th>Expenditures (FY17K$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>218,422</td>
<td>24,929,427</td>
</tr>
<tr>
<td>2019</td>
<td>225,561</td>
<td>25,436,580</td>
</tr>
<tr>
<td>2020</td>
<td>233,697</td>
<td>25,943,734</td>
</tr>
<tr>
<td>2021</td>
<td>241,838</td>
<td>26,450,887</td>
</tr>
<tr>
<td>2022</td>
<td>250,024</td>
<td>27,000,570</td>
</tr>
<tr>
<td>2023</td>
<td>258,210</td>
<td>27,559,196</td>
</tr>
<tr>
<td>2024</td>
<td>266,397</td>
<td>28,116,042</td>
</tr>
<tr>
<td>2025</td>
<td>274,584</td>
<td>28,672,888</td>
</tr>
<tr>
<td>2026</td>
<td>282,771</td>
<td>29,229,734</td>
</tr>
<tr>
<td>2027</td>
<td>290,957</td>
<td>29,786,581</td>
</tr>
<tr>
<td>2028</td>
<td>299,146</td>
<td>30,343,105</td>
</tr>
</tbody>
</table>

Adapted from C. Greaver, non-archived email, January 27, 2017.

Even with the use of multiple regression models and checks for multicollinearity, of the 58 regression models for the independent variables, only 13 regression models (22 percent), were defensible.

Attempts to project future DoN expenditures and number of FTEs using regression equations failed to produce defensible results because the historical information was not detailed enough. It is possible to create regressions that meet the predetermined thresholds to calculate expenditures and total FTEs, however the regressions created to project the number of FTEs by hire type would not stand up to scrutiny.

B. MODELING CHANGES IN EXPENDITURES

It may not be possible to create defensible predictions on the growth of DoN FTEs and associated expenditures, but it is possible to predict the changes in civilian compensation. Figure 14 shows that the amount spent for the average FTE grew at a predictable rate. Figure 22 shows the projected growth in the cost per FTE in the period 2018–2028.
With an $R^2$ value of 0.91, the regression model closely mirrors the historical data and can be used as a reliable model to predict future changes in the Cost per FTE. This growth will be primarily driven by the rapid increase in benefits expense as seen in Figure 8. Assuming that the rate\(^{12}\) of growth in benefits expense continues, the benefit expense per FTE will increase to $33,988.74 by 2028 (Figure 23). Basic Compensation per FTE also grew at a steady rate meaning that it is possible to predict future growth\(^{13}\) (Figure 24).

Data from 2007 to 2017 was derived from the information in the OP08 database maintained by the Department of the Navy. Values from 2018 to 2028 are projections. Adapted from C. Greaver, non-archived email, January 27, 2017.

**Figure 23.** Change in Cost per FTE 2007–2028.

---

\(^{12}\) The equation for the trendline is $\text{Benefit Expense per FTE (FY17$)} = 695.94x+19374$ where $x$ is the year ($2007 = 1$, $2008=2$, etc.). The associated $R^2$ value is .995

\(^{13}\) The equation for the trendline is $\text{Basic Compensation per FTE (FY17$)} = 841.01x+69308$ where $x$ is the year ($2007 = 1$, $2008=2$, etc.). The associated $R^2$ value is .96
Data from 2007 to 2017 was derived from the information in the OP08 database maintained by the Department of the Navy. Values from 2018 to 2028 are projections. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 24. Change in Benefit Expense per FTE 2007–2028.

Figure 25. Change in Basic Compensation per FTE 2007–2028.
C. SUMMARY

1. Modeling Labor Costs and FTEs

Figure 15 was an initial attempt to model the changes in the DoN civilian labor force and associated expenditures. The poor $R^2$ values meant that the derived models were unsuitable for creating projections but could highlight an important trend: that the expenditures on civilian labor would grow at a faster rate than the size of the civilian labor force. This trend was previously discussed in Figure 14 (Chapter V) where the cost per FTE grew 11.9 percent from 2007 to 2016.

Since time was proven to be an ineffective independent variable, the second attempt to model costs was made by placing the number of FTEs as the independent variable. Figure 16 provided a defensible model that could be used to predict costs based on the total number of FTEs.

With a defensible model for costs, the goal now became developing a method to estimate the number of FTEs. Figure 15 had shown that it was not possible to model civilian FTE numbers as whole so each individual hire type was modeled. After the individual hire types were modeled, the results were combined to create a DoN total. This effort also proved inadequate because only two of the five hire types had $R^2$ values that were suitable.

After creating and testing the initial models, it became evident that it would be necessary to further subdivide the information to create a useable model. A third attempt was undertaken by modeling the growth of FTEs in the individual BSOs to create a total DoN number. Besides possibly providing more accurate models by taking into account the trends of the individual BSOs, this method also assisted in the analysis of changes in the different subunits. This method resulted in 20 regressions to create a total number of FTEs, however, only nine met or surpassed the $R^2$ threshold of 0.75.

Since modeling the BSO would not be viable, another attempt was undertaken by modeling the different hire types in each BSO. This effort also proved fruitless as a smaller percent of the regressions met the $R^2$ threshold. Even though it was not possible
to adequately estimate the total number of FTEs using simple linear regression, it was postulated that it may be possible to create models using multiple regression techniques.

The first attempt with multiple regression involved creating a regression that estimated total expenditures using the different hire types as the independent variables (Appendix C). The derived equation was shown that it could be used to predict expenditures based on the using select hire type projections, however, the models used to derive the equations had poor correlation coefficients, which made them unsuitable.

A second attempt at multiple regression was made, this time by estimating the total number of FTEs by using the different hire type as independent variables. If a total number of FTEs could be determined, then the result could be inserted into the expenditures equation derived from Figure 16. This line of effort produced an equation that was not as strong as the previous multiple regression equation. Additionally, projecting the independent variables relied on using equations with correlation coefficients that did not meet the predetermined level of 0.75.

A final attempt at multiple regression was done at the BSO level. Appendix E shows the regression equations used, but estimation of the number of FTEs still proved elusive and as a result the effort did not produce defensible results.

The primary reason all efforts to project total expenditures and FTEs for the upcoming ten years failed is because there is no defendable way to estimate the number of FTEs based on the information provided. There was too much variation in the numbers of the FTEs to create a defendable regression model. More detailed information on the number of FTEs at levels below the BSO would be necessary to create the defendable models.

2. **Modeling Changes in Civilian Labor Compensation**

Even though it was not possible to adequately predict the change in DoN expenditures because of the variability of the number of FTEs, the composition of civilian compensation was very easy to model. The predictable growth of Cost per FTE allowed for an estimation of $131,480 per average FTE in 2028. This growth will be
primarily driven by increases in basic compensation, which will remain the largest component of civilian labor costs. Benefit expense will continue to grow at a rapid rate becoming over a quarter of civilian compensation by 2028.
VII. CONCLUSIONS AND RECOMMENDATIONS

The period from 2007 to 2017, has seen tumultuous swings in defense appropriations. The Budget Control Act, the Affordable Care Act, Sequestration, and numerous continuing resolutions have affected the DoN budgets during this time period. In addition to these pressures on the DoN budget, labor market pressures have increased the cost of civilian labor in during same period. Given the current political landscape, these pressures will most likely remain in place for the near future while labor expenses will continue to rise increasing the costs of employing civilian FTEs. This analysis was undertaken in order to provide Navy leadership with as much information as possible on the civilian labor force and the trends seen from 2007 to 2016 in order to allow better-informed decisions when allocating scare economic resources.

A. SUMMARY AND CONCLUSIONS

Historical data was collected from 2007 to 2017 for analysis. To allow for an accurate comparison, the dollar values were normalized to FY17 values. Chapter V sought to highlight the changes in the DoN civilian labor force and associated expenditures over this time period. This analysis proved problematic as the DoN had sizeable shifts in the total number of FTEs over this period, which made creating regressions with an acceptable correlation coefficient difficult. A more detailed analysis of the individual BSOs was also difficult as some, like BUMED, decreased dramatically while others saw sizeable shifts year to year in FTEs and expenditures that could not be easily explained. Other organizations, like NAVAIR, NAVSEA, USFF, and PACFLT grew at consistent and predictable rates.

In contrast to the number of FTEs and their associated expenditures, the composition of civilian compensation changed at predictable rates during this period. The average cost per DoN FTE grew 11.9 percent over this period, primarily driven by the rapid increase in benefit expense and a more gradual growth in basic compensation.

Chapter VI sought to take the previously identified trends and create models that could be used to project their effects into the near future. Calculating future
estimations of the size and expense of the DoN civilian labor force proved to be impossible given the information provided. Using linear regression as well as multiple regression, it was possible to create models that estimated future expense given the number of FTEs. However, predicting the number of FTEs in the DoN and even in the individual BSOs proved impossible due to the variations seen in the number of FTEs.

There was variation in the total number of FTEs and in the different hire types over the historical period being analyzed. Coupled with the requirement for $p$-values equal to or less than to 0.10 as well as $R^2$ values equal to or above 0.75, very few regressions were defendable. More historic data points could have alleviated this issue but that would have minimized the effects that recent events had on the DoN civilian labor force that were of interest. A future analysis of these issues should find more detailed data from each of the BSOs, which can be used to create accurate projections of the number of FTEs.

Even though the projections created in Chapter VI should be treated with a level of skepticism. Because of the previously discussed reasons, they do indicate some noteworthy trends. First, the DoN can expect to spend approximately $270-$300 billion over the next ten years to pay for civilian labor. The second trend that the projections imply is that the cost of labor will continue to rise at a much faster rate than the number of civilians employed by the DoN. Third, NAVAIR, NAVSEA, USFF, and PACFLT will remain the largest BSOs, accounting for over 50 percent of civilians and expenditures in the DoN. Lastly, most of the growth in the BSOs will occur in the Operations and Maintenance as well as the NWCF appropriations.

In contrast to the efforts to calculate FTEs and expenditures, predicting changes in civilian compensation was relatively simple. Due to their predictable nature, it was easy to see that the average cost per DoN FTE would continue its annual one percent growth. Basic compensation would continue to grow at approximately one percent per year while benefits expense would grow, on average three percent per year.
B. RECOMMENDATIONS FOR FURTHER STUDY

This report was able to analyze historical data and highlight some noticeable trends that will have and will continue to affect the DoN civilian labor force and associated expenditures. However, more research can be done to further understand the civilian labor force and costs associated with employing civilians to manage expenditures in a time of fiscal constraint.

The first recommended area of study would be to understand the composition of the benefits expense. Considering that this one expense has grown, at a steady rate, 40 percent in the last ten years, it is important to understand why and what specific portion of the benefits expense is driving the growth. Increases in health care costs as well as the effects of changes in healthcare legislation on benefits expenditures should be investigated to understand their effects.

A second recommended area of study would be to conduct a cost-benefit analysis on the number and functions of the DP hire type in the different BSOs. Tremendous growth of the DP hire type has occurred mainly in the Operations and Maintenance as well as the NWCF appropriations and these FTEs tend to be more expensive than the average DoN FTE.

A third area of additional study would be on the return on investment of the additional hires in USFF and PACFLT to see if the additional FTEs have increased the effectiveness of those organizations, or if they could best be served by another, less expensive hire type or contract labor.

A final area for additional study would be an evaluation of the civilian labor force to identify opportunities for contract personnel to provide those services vice direct hires by the DoN.
APPENDIX A. DON-WIDE CHANGES IN HIRE TYPES, 2007–2016

Figure 26. Changes in DoN AA FTEs 2007–2016

Figure 27. Changes in DoN Civilian Mariner FTEs 2007–2016.
Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 28. Changes in DoN DP FTEs 2007–2016.

Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 29. Changes in DoN FND FTEs 2007–2016.
Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 30. Changes in DoN FNI FTEs 2007–2016.

Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 31. Changes in DoN GS FTEs 2007–2016.
Figure 32. Changes in DoN SES FTEs 2007–2016.

Figure 33. Changes in DoN WG FTEs 2007–2016.
APPENDIX B. FTE TRENDS OF INDIVIDUAL BUDGET SUBMITTING OFFICES

\[ BSO\ 11\ FTEs = -178.44x + 3148.2 \quad R^2: 0.79 \]
\[ BSO\ 12\ FTEs = -13.388x + 4764.7 \quad R^2: 0.05 \]
\[ BSO\ 14\ FTEs = 17.285x + 2707.1 \quad R^2: 0.46 \]
\[ BSO\ 15\ FTEs = -51.412x + 1727.3 \quad R^2: 0.26 \]
\[ BSO\ 18\ FTEs = -1525.4x + 17434 \quad R^2: 0.61 \]
\[ BSO\ 19\ FTEs = 332.65x + 21930 \quad R^2: 0.85 \]
\[ BSO\ 22\ FTEs = 326.22x + 6272.4 \quad R^2: 0.72 \]
\[ BSO\ 23\ FTEs = -118.11x + 8137.4 \quad R^2: 0.55 \]
\[ BSO\ 24\ FTEs = 466.16x + 22232 \quad R^2: 0.87 \]
\[ BSO\ 25\ FTEs = 172.53x + 15988 \quad R^2: 0.16 \]
\[ BSO\ 27\ FTEs = 394.01x + 19668 \quad R^2: 0.49 \]
\[ BSO\ 30\ FTEs = 34.661x + 782.07 \quad R^2: 0.9 \]
\[ BSO\ 33\ FTEs = 151.76x + 7747.9 \quad R^2: 0.76 \]
\[ BSO\ 39\ FTEs = 262.61x + 6931.7 \quad R^2: 0.97 \]
\[ BSO\ 41\ FTEs = -63.6x + 826.8 \quad R^2: 0.80 \]
\[ BSO\ 52\ FTEs = -493x + 18894 \quad R^2: 0.69 \]
\[ BSO\ 60\ FTEs = 742.24x + 17054 \quad R^2: 0.95 \]
\[ BSO\ 70\ FTEs = 700.36x + 16798 \quad R^2: 0.94 \]
\[ BSO\ 72\ FTEs = 4.982x + 405 \quad R^2: 0.26 \]
\[ BSO\ 74\ FTEs = 21.242x + 220.87 \quad R^2: 0.01 \]

where \( x \) is the year for which the FTE is to be calculated using sequential values (i.e., \( x = 1 \) for 2007, \( x = 2 \) for 2008, \ldots, \( x = 12 \) for 2018, etc.)
APPENDIX C. MULTIPLE REGRESSION MODEL DATA FOR ESTIMATING TOTAL EXPENDITURES BASED ON A SELECT NUMBER OF HIRE TYPES

Initial Excel Regression Data to Calculate Total DoN Expenditures for Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total LBR” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. The highlighted value is the largest p-value and the associated independent variable was removed on subsequent attempts. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 34. First Attempt for Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types.

### Year Total LBR AA CIV MAR DP FND FNI GS SES WG
<table>
<thead>
<tr>
<th>Year</th>
<th>Total LBR</th>
<th>AA</th>
<th>CIV MAR</th>
<th>DP</th>
<th>FND</th>
<th>FNI</th>
<th>GS</th>
<th>SES</th>
<th>WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>18917892</td>
<td>1057</td>
<td>6721</td>
<td>21676</td>
<td>2842</td>
<td>11247</td>
<td>95164</td>
<td>327</td>
<td>34504</td>
</tr>
<tr>
<td>2008</td>
<td>19451728</td>
<td>1060</td>
<td>7118</td>
<td>18382</td>
<td>2669</td>
<td>11277</td>
<td>71633</td>
<td>338</td>
<td>34182</td>
</tr>
<tr>
<td>2009</td>
<td>20331010</td>
<td>1053</td>
<td>6899</td>
<td>17578</td>
<td>2459</td>
<td>11218</td>
<td>59841</td>
<td>353</td>
<td>34509</td>
</tr>
<tr>
<td>2010</td>
<td>21487374</td>
<td>1294</td>
<td>7303</td>
<td>18366</td>
<td>2624</td>
<td>10872</td>
<td>66476</td>
<td>429</td>
<td>34006</td>
</tr>
<tr>
<td>2011</td>
<td>22985995</td>
<td>1283</td>
<td>7118</td>
<td>18182</td>
<td>2669</td>
<td>11277</td>
<td>71633</td>
<td>338</td>
<td>34182</td>
</tr>
<tr>
<td>2012</td>
<td>23734799</td>
<td>1368</td>
<td>8048</td>
<td>18366</td>
<td>2624</td>
<td>11519</td>
<td>12204</td>
<td>345</td>
<td>34008</td>
</tr>
<tr>
<td>2013</td>
<td>24348343</td>
<td>1379</td>
<td>7971</td>
<td>17578</td>
<td>2459</td>
<td>11218</td>
<td>59841</td>
<td>353</td>
<td>34509</td>
</tr>
<tr>
<td>2014</td>
<td>22552748</td>
<td>1344</td>
<td>7783</td>
<td>18366</td>
<td>2624</td>
<td>11519</td>
<td>12204</td>
<td>345</td>
<td>34008</td>
</tr>
</tbody>
</table>

### SUMMARY OUTPUT

Run 1 for total expenditures

<table>
<thead>
<tr>
<th>Regression Statistics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.986689478</td>
</tr>
<tr>
<td>R Square</td>
<td>0.973556125</td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.762005128</td>
</tr>
<tr>
<td>Standard Error</td>
<td>693265.6694</td>
</tr>
<tr>
<td>Observations</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ANOVA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>df</td>
<td>SS</td>
</tr>
<tr>
<td>Regression</td>
<td>8</td>
</tr>
<tr>
<td>Residual</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
<th>Lower 90.0%</th>
<th>Upper 90.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-98696146.4</td>
<td>89036475</td>
<td>-1.10849</td>
<td>0.467272</td>
<td>-1.03E+09</td>
<td>1.03E+09</td>
<td>-6.6E+08</td>
</tr>
<tr>
<td>AA</td>
<td>36639.35029</td>
<td>38235.03</td>
<td>0.958267</td>
<td>0.513565</td>
<td>-449183</td>
<td>522461.5</td>
<td>-204767</td>
</tr>
<tr>
<td>CIV MAR</td>
<td>-288.6645041</td>
<td>3478.15</td>
<td>-0.08299</td>
<td>0.947285</td>
<td>-44482.7</td>
<td>43905.42</td>
<td>-22248.8</td>
</tr>
<tr>
<td>DP</td>
<td>-244.5295948</td>
<td>223.4624</td>
<td>-1.09428</td>
<td>0.471361</td>
<td>-3083.89</td>
<td>2594.829</td>
<td>-1655.42</td>
</tr>
<tr>
<td>FND</td>
<td>692.8786687</td>
<td>2047.58</td>
<td>0.338389</td>
<td>0.792275</td>
<td>-25327.4</td>
<td>26709.87</td>
<td>-13235</td>
</tr>
<tr>
<td>FNI</td>
<td>3594.157988</td>
<td>4078.14</td>
<td>-0.883122</td>
<td>0.404069</td>
<td>-48223.6</td>
<td>55411.91</td>
<td>-23154.2</td>
</tr>
<tr>
<td>GS</td>
<td>-57.48771893</td>
<td>79.1129</td>
<td>-0.72665</td>
<td>0.599954</td>
<td>-1062.71</td>
<td>947.7371</td>
<td>-556.987</td>
</tr>
<tr>
<td>SES</td>
<td>-57797.6215</td>
<td>74000.0</td>
<td>-0.13486</td>
<td>0.511921</td>
<td>-1001871</td>
<td>886276</td>
<td>-520911</td>
</tr>
<tr>
<td>WG</td>
<td>1974.223279</td>
<td>1041.278</td>
<td>1.290285</td>
<td>0.249707</td>
<td>-8388.4</td>
<td>12338.85</td>
<td>-4388.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Correlation Matrix</th>
<th>AA</th>
<th>CIV MAR</th>
<th>DP</th>
<th>FND</th>
<th>FNI</th>
<th>GS</th>
<th>SES</th>
<th>WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>1</td>
<td>0.864968872</td>
<td>1</td>
<td>0.77080671</td>
<td>0.889335</td>
<td>1</td>
<td>0.654517783</td>
<td>0.758247</td>
</tr>
<tr>
<td>CIV MAR</td>
<td>0.864968872</td>
<td>1</td>
<td>0.77080671</td>
<td>0.889335</td>
<td>1</td>
<td>0.654517783</td>
<td>0.758247</td>
<td>0.854179</td>
</tr>
<tr>
<td>DP</td>
<td>0.77080671</td>
<td>0.889335</td>
<td>1</td>
<td>0.654517783</td>
<td>0.758247</td>
<td>0.854179</td>
<td>0.408766</td>
<td>0.235615</td>
</tr>
<tr>
<td>FND</td>
<td>0.654517783</td>
<td>0.758247</td>
<td>0.854179</td>
<td>1</td>
<td>0.639007325</td>
<td>-0.705833</td>
<td>-0.752277</td>
<td>1</td>
</tr>
<tr>
<td>FNI</td>
<td>0.758247</td>
<td>0.854179</td>
<td>0.408766</td>
<td>0.235615</td>
<td>-0.705833</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS</td>
<td>0.854179</td>
<td>0.408766</td>
<td>0.235615</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>0.408766</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WG</td>
<td>0.235615</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

61
Excel Regression Data to Calculate Total DoN Expenditures for Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total LBR” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. The highlighted value is the largest p-value and the associated independent variable was removed on subsequent attempts. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 35. Second Attempt for Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types..
Excel Regression Data to Calculate Total DoN Expenditures for Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with "Total LBR" being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. The highlighted value is the largest p-value and the associated independent variable was removed on subsequent attempts. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 36. Third Attempt for Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types.
Excel Regression Data to Calculate Total DoN Expenditures for Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total LBR” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. The highlighted value is the largest p-value and the associated independent variable was removed on subsequent attempts. Adapted from C. Greaver, non-archived email, January 27, 2017

Figure 37. Fourth Attempt for Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types.
Excel Regression Data to Calculate Total DoN Expenditures for Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total LBR” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. The highlighted value is the largest p-value and the associated independent variable was removed on subsequent attempts. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 38. Fifth Attempt for Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types.
Excel Regression Data to Calculate Total DoN Expenditures for Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total LBR” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 39. Multiple Regression Equation that Projects Total Expenditures based on FTE Hire Types.
Table 3. **Historical Data and Expenditure Projection Based on Multiple Regression of Individual Hire Types.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total LBR</th>
<th>AA</th>
<th>FNI</th>
<th>WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>18917892</td>
<td>1057</td>
<td>11247</td>
<td>34504</td>
</tr>
<tr>
<td>2008</td>
<td>19451728</td>
<td>1060</td>
<td>11277</td>
<td>34182</td>
</tr>
<tr>
<td>2009</td>
<td>20331010</td>
<td>1053</td>
<td>11218</td>
<td>34509</td>
</tr>
<tr>
<td>2010</td>
<td>21487374</td>
<td>1294</td>
<td>10872</td>
<td>34006</td>
</tr>
<tr>
<td>2011</td>
<td>22985995</td>
<td>1283</td>
<td>11615</td>
<td>34796</td>
</tr>
<tr>
<td>2012</td>
<td>22722854</td>
<td>1351</td>
<td>11196</td>
<td>34896</td>
</tr>
<tr>
<td>2013</td>
<td>22373479</td>
<td>1368</td>
<td>11159</td>
<td>34008</td>
</tr>
<tr>
<td>2014</td>
<td>21434834</td>
<td>1379</td>
<td>11005</td>
<td>33212</td>
</tr>
<tr>
<td>2015</td>
<td>22135134</td>
<td>1236</td>
<td>12275</td>
<td>34648</td>
</tr>
<tr>
<td>2016</td>
<td>22552748</td>
<td>1344</td>
<td>11038</td>
<td>35896</td>
</tr>
<tr>
<td>2017</td>
<td>22505822</td>
<td>1344</td>
<td>11038</td>
<td>35896</td>
</tr>
<tr>
<td>2018</td>
<td>23558800</td>
<td>1434</td>
<td>11440</td>
<td>34779</td>
</tr>
<tr>
<td>2019</td>
<td>23944181</td>
<td>1468</td>
<td>11467</td>
<td>34836</td>
</tr>
<tr>
<td>2020</td>
<td>24329562</td>
<td>1503</td>
<td>11494</td>
<td>34893</td>
</tr>
<tr>
<td>2021</td>
<td>24714943</td>
<td>1538</td>
<td>11521</td>
<td>34951</td>
</tr>
<tr>
<td>2022</td>
<td>25100324</td>
<td>1573</td>
<td>11548</td>
<td>35008</td>
</tr>
<tr>
<td>2023</td>
<td>25485705</td>
<td>1607</td>
<td>11576</td>
<td>35065</td>
</tr>
<tr>
<td>2024</td>
<td>25871086</td>
<td>1642</td>
<td>11603</td>
<td>35122</td>
</tr>
<tr>
<td>2025</td>
<td>26256467</td>
<td>1677</td>
<td>11630</td>
<td>35179</td>
</tr>
<tr>
<td>2026</td>
<td>26641848</td>
<td>1712</td>
<td>11657</td>
<td>35236</td>
</tr>
<tr>
<td>2027</td>
<td>27027229</td>
<td>1746</td>
<td>11684</td>
<td>35293</td>
</tr>
<tr>
<td>2028</td>
<td>27412610</td>
<td>1781</td>
<td>11711</td>
<td>35350</td>
</tr>
</tbody>
</table>

Adapted from C. Greaver, non-archived email, January 27, 2017.
## APPENDIX D. MULTIPLE REGRESSION MODEL DATA FOR ESTIMATING TOTAL DEPARTMENT OF THE NAVY FULL TIME EQUIVALENTS BASED ON A SELECT NUMBER OF HIRE TYPES

<table>
<thead>
<tr>
<th>Year</th>
<th>Total FTEs</th>
<th>AA</th>
<th>CIV MAR</th>
<th>DP</th>
<th>FND</th>
<th>FNI</th>
<th>GS</th>
<th>SES</th>
<th>WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>187461</td>
<td>1057</td>
<td>6721</td>
<td>21676</td>
<td>2842</td>
<td>11247</td>
<td>95164</td>
<td>327</td>
<td>34004</td>
</tr>
<tr>
<td>2008</td>
<td>188994</td>
<td>1060</td>
<td>7118</td>
<td>18182</td>
<td>2669</td>
<td>11277</td>
<td>71613</td>
<td>338</td>
<td>34182</td>
</tr>
<tr>
<td>2009</td>
<td>197213</td>
<td>1053</td>
<td>6889</td>
<td>17578</td>
<td>2459</td>
<td>11218</td>
<td>59841</td>
<td>353</td>
<td>34509</td>
</tr>
<tr>
<td>2010</td>
<td>206136</td>
<td>1294</td>
<td>7830</td>
<td>18366</td>
<td>2624</td>
<td>10872</td>
<td>66476</td>
<td>429</td>
<td>34006</td>
</tr>
<tr>
<td>2011</td>
<td>212267</td>
<td>1283</td>
<td>7899</td>
<td>28932</td>
<td>2411</td>
<td>11615</td>
<td>109117</td>
<td>377</td>
<td>34796</td>
</tr>
<tr>
<td>2012</td>
<td>212557</td>
<td>1351</td>
<td>8072</td>
<td>37176</td>
<td>2347</td>
<td>11196</td>
<td>117094</td>
<td>363</td>
<td>34896</td>
</tr>
<tr>
<td>2013</td>
<td>207696</td>
<td>1368</td>
<td>80465</td>
<td>38246</td>
<td>2491</td>
<td>11359</td>
<td>112004</td>
<td>345</td>
<td>34008</td>
</tr>
<tr>
<td>2014</td>
<td>193290</td>
<td>1379</td>
<td>7971</td>
<td>37177</td>
<td>1934</td>
<td>11005</td>
<td>100272</td>
<td>340</td>
<td>32312</td>
</tr>
<tr>
<td>2015</td>
<td>198642</td>
<td>1236</td>
<td>8079</td>
<td>38839</td>
<td>2152</td>
<td>12275</td>
<td>101053</td>
<td>360</td>
<td>34648</td>
</tr>
<tr>
<td>2016</td>
<td>203581</td>
<td>1344</td>
<td>7783</td>
<td>38930</td>
<td>2022</td>
<td>11038</td>
<td>104188</td>
<td>380</td>
<td>83896</td>
</tr>
</tbody>
</table>

### SUMMARY OUTPUT

Run 1 for total FTEs

### ANOVA

<table>
<thead>
<tr>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>Significance F</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>6.41E+08</td>
<td>8011472</td>
<td>0.81171387</td>
<td>0.700728</td>
</tr>
</tbody>
</table>

Initial Excel Regression Data to Calculate Total DoN Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total FTEs” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. The highlighted value is the largest p-value and the associated independent variable was removed on subsequent attempts. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 40. First Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types.
Excel Regression Data to Calculate Total DoN Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total FTEs” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. The highlighted value is the largest $p$-value and the associated independent variable was removed on subsequent attempts. Adapted from C. Greaver, non-archived email, January 27, 2017.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total FTEs</th>
<th>AA</th>
<th>DP</th>
<th>FND</th>
<th>FNI</th>
<th>GS</th>
<th>SES</th>
<th>WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>187461</td>
<td>1057</td>
<td>21676</td>
<td>2842</td>
<td>11247</td>
<td>95164</td>
<td>327</td>
<td>34504</td>
</tr>
<tr>
<td>2008</td>
<td>188994</td>
<td>1060</td>
<td>18182</td>
<td>2669</td>
<td>11277</td>
<td>71633</td>
<td>338</td>
<td>34182</td>
</tr>
<tr>
<td>2009</td>
<td>197213</td>
<td>1053</td>
<td>17578</td>
<td>2459</td>
<td>11359</td>
<td>59841</td>
<td>353</td>
<td>34509</td>
</tr>
<tr>
<td>2010</td>
<td>206136</td>
<td>1294</td>
<td>18366</td>
<td>2624</td>
<td>11224</td>
<td>57996</td>
<td>345</td>
<td>34006</td>
</tr>
<tr>
<td>2011</td>
<td>212557</td>
<td>1351</td>
<td>37176</td>
<td>2347</td>
<td>11076</td>
<td>117094</td>
<td>377</td>
<td>34896</td>
</tr>
<tr>
<td>2012</td>
<td>212557</td>
<td>1351</td>
<td>28932</td>
<td>2411</td>
<td>11204</td>
<td>109117</td>
<td>363</td>
<td>34796</td>
</tr>
<tr>
<td>2013</td>
<td>207869</td>
<td>1368</td>
<td>38246</td>
<td>2491</td>
<td>11204</td>
<td>109117</td>
<td>363</td>
<td>34684</td>
</tr>
<tr>
<td>2014</td>
<td>201581</td>
<td>1344</td>
<td>38930</td>
<td>2491</td>
<td>11204</td>
<td>109117</td>
<td>363</td>
<td>34684</td>
</tr>
</tbody>
</table>

**SUMMARY OUTPUT** Run 2 for total FTEs

**Regression Statistics**

<table>
<thead>
<tr>
<th>Multiple R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Standard Error</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.929037681</td>
<td>0.863111014</td>
<td>0.383999561</td>
<td>7114.934692</td>
<td>10</td>
</tr>
</tbody>
</table>

**ANOVA**

<table>
<thead>
<tr>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>Significance F</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>6.38E+08</td>
<td>91195192</td>
<td>1.80148274</td>
<td>0.402644</td>
</tr>
<tr>
<td>2</td>
<td>1.01E+08</td>
<td>50622296</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>7.4E+08</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Coefficients**

<table>
<thead>
<tr>
<th>Intercept</th>
<th>AA</th>
<th>DP</th>
<th>FND</th>
<th>FNI</th>
<th>GS</th>
<th>SES</th>
<th>WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>-744543.264</td>
<td>281.1332663</td>
<td>-2.15519342</td>
<td>18.55261875</td>
<td>24.85366182</td>
<td>-0.42912622</td>
<td>-453.564178</td>
<td>15.6223866</td>
</tr>
</tbody>
</table>

**t Stat**

<table>
<thead>
<tr>
<th>Intercept</th>
<th>AA</th>
<th>DP</th>
<th>FND</th>
<th>FNI</th>
<th>GS</th>
<th>SES</th>
<th>WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.38696</td>
<td>1.613244</td>
<td>-1.33069</td>
<td>0.960253</td>
<td>1.500401</td>
<td>-0.78426</td>
<td>-0.20051</td>
<td>1.47388</td>
</tr>
</tbody>
</table>

**P-value**

<table>
<thead>
<tr>
<th>Intercept</th>
<th>AA</th>
<th>DP</th>
<th>FND</th>
<th>FNI</th>
<th>GS</th>
<th>SES</th>
<th>WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.29980574</td>
<td>0.24803002</td>
<td>0.31472777</td>
<td>0.4825497</td>
<td>0.40148274</td>
<td>0.51502601</td>
<td>0.40273268</td>
<td>0.27843833</td>
</tr>
</tbody>
</table>

**Lower 95%**

<table>
<thead>
<tr>
<th>Intercept</th>
<th>AA</th>
<th>DP</th>
<th>FND</th>
<th>FNI</th>
<th>GS</th>
<th>SES</th>
<th>WG</th>
</tr>
</thead>
</table>

**Upper 90.0%**

<table>
<thead>
<tr>
<th>Intercept</th>
<th>AA</th>
<th>DP</th>
<th>FND</th>
<th>FNI</th>
<th>GS</th>
<th>SES</th>
<th>WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>822952.4</td>
<td>789.9869</td>
<td>4.81343</td>
<td>101.682</td>
<td>37.8631</td>
<td>7.8426</td>
<td>22.77</td>
<td>15.328</td>
</tr>
</tbody>
</table>

Figure 41. Second Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types.
Excel Regression Data to Calculate Total DoN Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total FTEs” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. The highlighted value is the largest p-value and the associated independent variable was removed on subsequent attempts. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 42. Third Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total FTEs</th>
<th>AA</th>
<th>DP</th>
<th>FNI</th>
<th>GS</th>
<th>SES</th>
<th>WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>187461</td>
<td>1057</td>
<td>21676</td>
<td>11247</td>
<td>95164</td>
<td>327</td>
<td>34504</td>
</tr>
<tr>
<td>2008</td>
<td>188994</td>
<td>1060</td>
<td>18182</td>
<td>11277</td>
<td>71633</td>
<td>338</td>
<td>34182</td>
</tr>
<tr>
<td>2009</td>
<td>197213</td>
<td>1053</td>
<td>17578</td>
<td>11218</td>
<td>100272</td>
<td>353</td>
<td>34008</td>
</tr>
<tr>
<td>2010</td>
<td>206136</td>
<td>1294</td>
<td>18366</td>
<td>11059</td>
<td>101053</td>
<td>363</td>
<td>34648</td>
</tr>
<tr>
<td>2011</td>
<td>212267</td>
<td>1283</td>
<td>28932</td>
<td>11615</td>
<td>112204</td>
<td>377</td>
<td>34796</td>
</tr>
<tr>
<td>2012</td>
<td>212557</td>
<td>1351</td>
<td>37177</td>
<td>11105</td>
<td>109117</td>
<td>340</td>
<td>33212</td>
</tr>
<tr>
<td>2013</td>
<td>207869</td>
<td>1368</td>
<td>38246</td>
<td>11159</td>
<td>100272</td>
<td>345</td>
<td>34008</td>
</tr>
<tr>
<td>2014</td>
<td>212557</td>
<td>1351</td>
<td>37177</td>
<td>11105</td>
<td>109117</td>
<td>340</td>
<td>33212</td>
</tr>
<tr>
<td>2015</td>
<td>201581</td>
<td>1344</td>
<td>38930</td>
<td>11038</td>
<td>104188</td>
<td>380</td>
<td>35896</td>
</tr>
</tbody>
</table>

Summary Output

Regression Statistics

<table>
<thead>
<tr>
<th>Regression Statistics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.894426797</td>
</tr>
<tr>
<td>R Square</td>
<td>0.799999296</td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.399997888</td>
</tr>
<tr>
<td>Standard Error</td>
<td>7021.93487</td>
</tr>
<tr>
<td>Observations</td>
<td>10</td>
</tr>
</tbody>
</table>

ANOVA

<table>
<thead>
<tr>
<th>ANOVA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>df</td>
<td>SS</td>
</tr>
<tr>
<td>Regression</td>
<td>6</td>
</tr>
<tr>
<td>Residual</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
</tr>
</tbody>
</table>

Coefficients

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
<th>Lower 90.0%</th>
<th>Upper 90.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-473407.86</td>
<td>450590.6</td>
<td>-1.05064</td>
<td>0.37058887</td>
<td>-1907388</td>
<td>960572.5</td>
<td>-1533811</td>
</tr>
<tr>
<td>AA</td>
<td>204.3978572</td>
<td>152.8393</td>
<td>1.337339</td>
<td>0.27346673</td>
<td>-282.005</td>
<td>690.8006</td>
<td>-155.288</td>
</tr>
<tr>
<td>DP</td>
<td>-2.22600564</td>
<td>1.596783</td>
<td>-1.39406</td>
<td>0.2571108</td>
<td>-7.30768</td>
<td>2.85671</td>
<td>-5.98382</td>
</tr>
<tr>
<td>FNI</td>
<td>18.50916162</td>
<td>14.9914</td>
<td>1.234652</td>
<td>0.30484874</td>
<td>-29.2002</td>
<td>66.2185</td>
<td>-16.7711</td>
</tr>
<tr>
<td>GS</td>
<td>-0.05310138</td>
<td>0.377179</td>
<td>-0.14079</td>
<td>0.896382</td>
<td>-1.25345</td>
<td>1.147251</td>
<td>-0.94074</td>
</tr>
<tr>
<td>SES</td>
<td>-272.808121</td>
<td>382.2992</td>
<td>-0.7136</td>
<td>0.52698094</td>
<td>-1489.45</td>
<td>943.8385</td>
<td>-1172.5</td>
</tr>
<tr>
<td>WG</td>
<td>11.03347307</td>
<td>9.33739</td>
<td>1.181644</td>
<td>0.2245378</td>
<td>-18.6823</td>
<td>40.74921</td>
<td>-10.9408</td>
</tr>
</tbody>
</table>

Figure 42. Third Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types.
Excel Regression Data to Calculate Total DoN Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total FTEs” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. The highlighted value is the largest p-value and the associated independent variable was removed on subsequent attempts. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 43. Fourth Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types.
Excel Regression Data to Calculate Total DoN Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total FTEs” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. The highlighted value is the largest p-value and the associated independent variable was removed on subsequent attempts. Adapted from C. Greaver, non-archived email, January 27, 2017.

**Figure 44.** Fifth Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types.
Excel Regression Data to Calculate Total DoN Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total FTEs” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. The highlighted value is the largest $p$-value and the associated independent variable was removed on subsequent attempts. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 45. Sixth Attempt for Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types.
Excel Regression Data to Calculate Total DoN Civilian FTEs based on the number of each hire type in the DoN. The top graph is the inputs with “Total FTEs” being the dependent variable and the different hire types being the independent variables. ANOVA data follows the input table and the bottom table is used to determine the independence between the different variables. Adapted from C. Greaver, non-archived email, January 27, 2017.

Figure 46. Multiple Regression Equation that Projects Total DoN FTEs based on Hire Types.
Table 4. Historical Data and Expenditure Projection Based on Multiple Regression of Individual Hire Types.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total FTEs</th>
<th>GS</th>
<th>SES</th>
<th>Total LBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>187461</td>
<td>95164</td>
<td>327</td>
<td>18917892</td>
</tr>
<tr>
<td>2008</td>
<td>188994</td>
<td>71633</td>
<td>338</td>
<td>19451728</td>
</tr>
<tr>
<td>2009</td>
<td>197213</td>
<td>59841</td>
<td>353</td>
<td>20331010</td>
</tr>
<tr>
<td>2010</td>
<td>206136</td>
<td>66476</td>
<td>429</td>
<td>21487374</td>
</tr>
<tr>
<td>2011</td>
<td>212267</td>
<td>109117</td>
<td>377</td>
<td>22985995</td>
</tr>
<tr>
<td>2012</td>
<td>212557</td>
<td>117094</td>
<td>363</td>
<td>22722854</td>
</tr>
<tr>
<td>2013</td>
<td>207869</td>
<td>112204</td>
<td>345</td>
<td>22373479</td>
</tr>
<tr>
<td>2014</td>
<td>193290</td>
<td>100272</td>
<td>340</td>
<td>21434834</td>
</tr>
<tr>
<td>2015</td>
<td>198642</td>
<td>101053</td>
<td>360</td>
<td>22135134</td>
</tr>
<tr>
<td>2016</td>
<td>201581</td>
<td>104188</td>
<td>380</td>
<td>22552748</td>
</tr>
<tr>
<td>2017</td>
<td>203317</td>
<td>104188</td>
<td>380</td>
<td>22505822</td>
</tr>
<tr>
<td>2018</td>
<td>208324</td>
<td>114853</td>
<td>371</td>
<td>22213370</td>
</tr>
<tr>
<td>2019</td>
<td>209729</td>
<td>118699</td>
<td>373</td>
<td>22403548</td>
</tr>
<tr>
<td>2020</td>
<td>211133</td>
<td>122544</td>
<td>375</td>
<td>22593725</td>
</tr>
<tr>
<td>2021</td>
<td>212537</td>
<td>126389</td>
<td>377</td>
<td>22783902</td>
</tr>
<tr>
<td>2022</td>
<td>213941</td>
<td>130235</td>
<td>378</td>
<td>22974080</td>
</tr>
<tr>
<td>2023</td>
<td>215346</td>
<td>134080</td>
<td>380</td>
<td>23164257</td>
</tr>
<tr>
<td>2024</td>
<td>216750</td>
<td>137925</td>
<td>382</td>
<td>23354435</td>
</tr>
<tr>
<td>2025</td>
<td>218154</td>
<td>141770</td>
<td>384</td>
<td>23544612</td>
</tr>
<tr>
<td>2026</td>
<td>219558</td>
<td>145616</td>
<td>386</td>
<td>23734789</td>
</tr>
<tr>
<td>2027</td>
<td>220963</td>
<td>149461</td>
<td>388</td>
<td>23924967</td>
</tr>
<tr>
<td>2028</td>
<td>222367</td>
<td>153306</td>
<td>389</td>
<td>24115144</td>
</tr>
</tbody>
</table>

Adapted from C. Greaver, non-archived email, January 27, 2017.
APPENDIX E. LINEAR AND MULTIPLE REGRESSION EQUATIONS FOR BSOS

BSO 11: Director, Field Support Activity (FSA), Adj $R^2$: 0.622, Significant $F$: 0.032

Civilian Labor Expenditures (FY17K$) = -53688.26 + (5314.55 * SES FTEs) + (94.75 * GS FTEs) + (796.31 * WG FTEs)

\[
SES\ FTEs = -0.77 \times (number\ of\ years) + 30.73 \quad R^2: 0.047, \ p-value: 0.068
\]

\[
GS\ FTEs = 104.87 \times (number\ of\ years) + 627.93 \quad R^2: 0.183, \ p-value: 0.053
\]

\[
WG\ FTEs = -23.4 \times (number\ of\ years) + 211.8 \quad R^2: 0.568, \ p-value: 0.007
\]

BSO 12: Assistant for Administration (DONAA), Adj $R^2$: 0.844, Significant $F$: 0.002

Civilian Labor Expenditures (FY17K$) = 549084.68 + (3840.7 * SES FTEs) + (5.3 * GS FTEs) + (-17643.15 * FN Indirect FTEs)

\[
SES\ FTEs = -0.5091 \times (number\ of\ years) + 74.4 \quad R^2: 0.071, \ p-value: 0.003
\]

\[
GS\ FTEs = 521.86 \times (number\ of\ years) + 67.47 \quad R^2: 0.534, \ p-value: 0.055
\]

\[
FN\ Indirect = -0.2061 \times (number\ of\ years) + 11.53 \quad R^2: 0.283, \ p-value: 0.005
\]

BSO 14: Chief of Naval Research (ONR), Adj $R^2$: 0.964, Significant $F$: 3.84E-6

Civilian Labor Expenditures (FY17K$) = 159821.449 + (222.2094 * SES FTEs) + (67.5343 * DP FTEs)

\[
SES\ FTEs = 0.212 \times (number\ of\ years) + 39.733 \quad R^2: 0.073, \ p-value: 0.002
\]

\[
DP\ FTEs = 78.182 \times (number\ of\ years) + 2044.2 \quad R^2: 0.787, \ p-value: 1.83E-6
\]

BSO 15: Naval Intelligence Activity (NIA), Adj $R^2$: 0.388, Significant $F$: 0.032

Civilian Labor Expenditures (FY17K$) = 472238.293 + (22528.639 * SES FTEs)
\[ SES \text{ FTEs} = 1.933(\text{number of years}) + 10.067 \quad R^2: 0.517, \text{p-value: 0.032} \]

BSO 18: Bureau of Medicine and Surgery (BUMED), Adj \( R^2: 0.991, \text{Significant } F: 2.724 \times 10^{-8} \)

Civilian Labor Expenditures (FY17K$) = 43284.12 + (288641.922 \times SES FTEs) + (723.805 \times WG FTEs)

\[ SES \text{ FTEs} = -0.158(\text{number of years}) + 2.067 \quad R^2: 0.27, \text{p-value: 2.473 \times 10^{-5}} \]

\[ WG \text{ FTEs} = -100.78(\text{number of years}) + 1045.9 \quad R^2: 0.774, \text{p-value: 3.544 \times 10^{-5}} \]

BSO 19: Naval Air Systems Command (NAVAIR), Adj \( R^2: 0.846, \text{Significant } F: 0.001 \)

Civilian Labor Expenditures (FY17K$) = -3230440.39 + (-371.62 \times WG FTEs) + (76688.05 \times FNI FTEs)

\[ WG \text{ FTEs} = -115.92(\text{number of years}) + 5887.7 \quad R^2: 0.707, \text{p-value: 0.001} \]

\[ FNI \text{ FTEs} = 0.279(\text{number of years}) + 103.67 \quad R^2: 0.272, \text{p-value: 0.004} \]

BSO 22: Chief of Naval Personnel (BUPERS), Adj \( R^2: 0.971, \text{Significant } F: 1.567 \times 10^{-5} \)

Civilian Labor Expenditures (FY17K$) = 620711.105 + (-370.887 \times AA FTEs) + (2435.509 \times WG FTEs) + (2867.541 \times FND FTEs)

\[ AA \text{ FTEs} = 74(\text{number of years}) + 631.6 \quad R^2: 0.646, \text{p-value: 0.113} \]

\[ WG \text{ FTEs} = 18.121(\text{number of years}) + 84.733 \quad R^2: 0.469, \text{p-value: 0.007} \]

\[ FNI \text{ FTEs} = 2.849(\text{number of years}) - 9.267 \quad R^2: 0.641, \text{p-value: 0.01} \]

BSO 23: Naval Supply Systems Command (NAVSUP), Adj \( R^2: 0.864, \text{Significant } F: 0.0 \)

Civilian Labor Expenditures (FY17K$) = 483114.1 + (14806.421 \times SES FTEs) + (106.137 \times WG FTEs)

\[ SES \text{ FTEs} = -0.097(\text{number of years}) + 7.533 \quad R^2: 0.065, \text{p-value: 0.004} \]
WG FTEs = -35.552(number of years)+903.33  \( R^2: 0.598, p\)-value: 0.007

BSO 24: Naval Sea Systems Command (NAVSEA), Adj \( R^2: 0.999, \) Significant \( F: 3.4E^{-17} \)

Civilian Labor Expenditures (FY17K$) = -849556.491+(10362.316*SES FTEs)+(40.789*GS FTEs)+(179.295*DP FTEs)+(52461.42*AA FTEs)

\[
\begin{align*}
SES FTEs &= -0.667(number of years)+62.067  \quad R^2: 0.2127, p\text{-value: 0.007} \\
GS FTEs &= 516.22(number of years)+6084.7  \quad R^2: 0.7615, p\text{-value: 0.006} \\
DP FTEs &= 379.54(number of years)+11973  \quad R^2: 0.8869, p\text{-value: 8.37E^{-5}} \\
AA FTEs &= 0.2121(number of years)+12.933  \quad R^2: 0.538, p\text{-value: 0.014}
\end{align*}
\]

BSO 25: Naval Facilities Engineering Command (NAVAC), Adj \( R^2: 0.802, \) Significant \( F: 0.005 \)

Civilian Labor Expenditures (FY17K$) = -1338971+(41.926*GS FTEs)+(204.929*WG FTEs)+(875.457*FNI FTEs)

\[
\begin{align*}
GS FTEs &= 445.02(number of years)+6366.5  \quad R^2: 0.43, p\text{-value: 0.013} \\
WG FTEs &= -13.176(number of years)+4848.1  \quad R^2: 0.036, p\text{-value: 0.139} \\
FNI FTEs &= 8.497(number of years)+1861.3  \quad R^2: 0.061, p\text{-value: 0.008}
\end{align*}
\]

BSO 27: Commandant of the Marine Corps (CMC), Adj \( R^2: 0.987, \) Significant \( F: 1.7E^{-5} \)

Civilian Labor Expenditures (FY17K$) = -131278+(7.212*GS FTEs)+(10850.5*AA FTEs)+(297.35*WG FTEs)+(80.147*FNI FTEs)

\[
\begin{align*}
GS FTEs &= 777.81(number of years)+6561.9  \quad R^2: 0.547, p\text{-value: 0.199} \\
AA FTEs &= 7.1818(number of years)+0.6  \quad R^2: 0.8, p\text{-value: 1.3E^{-5}} \\
WG FTEs &= -100.59(number of years)+4739.3  \quad R^2: 0.693, p\text{-value: 0.001} \\
FNI FTEs &= 77.018(number of years)+3140  \quad R^2: 0.252, p\text{-value: 0.022}
\end{align*}
\]
BSO 30: Strategic Systems Program (SSP), Adj $R^2$: 0.951, Significant $F$: 7.5E$^{-5}$

*Civilian Labor Expenditures (FY17K$) = 49907.7+(6010.22*SES FTEs)+(22.701*GS FTEs)+(49.881*DP FTEs)*

\[ SES \text{ FTEs} = 0.418(\text{number of years}) + 7.4 \quad R^2: 0.718, \quad p\text{-value}: 0.006 \]
\[ GS \text{ FTEs} = 78.164(\text{number of years}) + 184.8 \quad R^2: 0.469, \quad p\text{-value}: 0.008 \]
\[ DP \text{ FTEs} = 33.812(\text{number of years}) - 119.67 \quad R^2: 0.442, \quad p\text{-value}: 0.003 \]

BSO 33: Military Sealift Command (MSC), Adj $R^2$: 0.761, Significant $F$: 0.003

*Civilian Labor Expenditures (FY17K$) = 322379+(55642.1*SES FTEs)+(147.237*GS FTEs)*

\[ SES \text{ FTEs} = 0.152(\text{number of years}) + 4.667 \quad R^2: 0.421, \quad p\text{-value}: 0.007 \]
\[ GS \text{ FTEs} = 44.709(\text{number of years}) + 634.4 \quad R^2: 0.514, \quad p\text{-value}: 0.031 \]

BSO 39: Space and Naval Warfare Systems Command (SPAWAR), Adj $R^2$: 0.65, Significant $F$: 0.025

*Civilian Labor Expenditures (FY17K$) = -3082626+(61941.5*SES FTEs)+(125381*AA FTEs)+(184407*FNI FTEs)*

\[ SES \text{ FTEs} = 0.327(\text{number of years}) + 18.2 \quad R^2: 0.442, \quad p\text{-value}: 0.016 \]
\[ AA \text{ FTEs} = .1515(\text{number of years}) - 0.133 \quad R^2: 0.234, \quad p\text{-value}: 0.023 \]
\[ FNI \text{ FTEs} = -0.024(\text{number of years}) + 15.933 \quad R^2: 0.03, \quad p\text{-value}: 0.099 \]
BSO 41: Naval Systems Management Activity (NSMA), Adj $R^2$: -0.034, Significant $F$: .471

Civilian Labor Expenditures (FY17K$) = 77626.5+(30587.3*SES FTEs)+(-59.682*GS FTEs)

$SES FTEs = -0.006(number of years)+0.133 \quad R^2: 0.003, p-value: 0.291$

$GS FTEs = 17.63(number of years)+136.13 \quad R^2: 0.111, p-value: 0.3$

BSO 52: Naval Installations Command (CNIC), Adj $R^2$: 0.873, Significant $F$: 0.001

Civilian Labor Expenditures (FY17K$) = 276685+(35.475*GS FTEs)+(1727.06*WG FTEs)+(-231.538*FND FTEs)

$GS FTEs = 115.78(number of years)+10383 \quad R^2: 0.025, p-value: 0.001$

$WG FTEs = -21.897(number of years)+717.93 \quad R^2: 0.829, p-value: 0.001$

$FND FTEs = -57.17(number of years)+1284.1 \quad R^2: 0.622, p-value: 0.043$

BSO 60: U.S. Fleet Forces (USFF), Adj $R^2$: 0.995, Significant $F$: 0.004

Civilian Labor Expenditures (FY17K$) = -736271+(45.728*GS FTEs)+(-109.643*DP FTEs)+(61697.1*AA FTEs)+(285.143*WG FTEs)+(69415.1*CIVMAR FTEs)+(5174.68*FND FTEs)+(-3003.86*FNI FTEs)

$GS FTEs = 943.44(number of years)+5921.4 \quad R^2: 0.759, p-value: 0.077$

$DP FTEs = -10812(number of years)+219.07 \quad R^2: 0.034, p-value: 0.172$

$AA FTEs = 0.03(number of years)-0.067 \quad R^2: 0.084, p-value: 0.129$

$WG FTEs = 213.99(number of years)+7028.5 \quad R^2: 0.903, p-value: 0.01$

$CIVMAR FTEs = 0.588(number of years)-0.933 \quad R^2: 0.79, p-value: 0.073$

$FND FTEs = 6.2(number of years)+117.6 \quad R^2: 0.43, p-value: 0.049$

$FNI FTEs = 4.473(number of years)+171.2 \quad R^2: 0.287, p-value: 0.131$
BSO 70: Pacific Fleet (PACFLT), Adj $R^2$: 0.994, Significant $F$: $2E^6$

_Civilian Labor Expenditures (FY17K$) = 561864 + (53.05*GS FTEs) + (8668.69*DP FTEs) + (138.98*WG FTEs) + (-41175.8*FND FTEs)_

\[ GS FTEs = 627.53(number of years) + 4674.7 \quad R^2: 0.804, \ p-value: 0.0 \]
\[ DP FTEs = -0.485(number of years) + 7.067 \quad R^2: 0.027, \ p-value: 0.0 \]
\[ WG FTEs = 262.87(number of years) + 7903 \quad R^2: 0.802, \ p-value: 0.0 \]
\[ FND FTEs = -0.321(number of years) + 9.267 \quad R^2: 0.681, \ p-value: 0.003 \]

BSO 72: Navy Reserve Force (RESFOR), Adj $R^2$: 0.435, Significant $F$: 0.023

_Civilian Labor Expenditures (FY17K$) = 42308.6 + (-162.994*WG FTEs)_

\[ WG FTEs = -2.624(number of years) + 53.133 \quad R^2: 0.913, \ p-value: 0.023 \]

BSO 74: Special Warfare Command (SPECWAR), Adj $R^2$: 0.999, Significant $F$: $3.4E^{-17}$

_Civilian Labor Expenditures (FY17K$) = 10.9508 + (114.438*GS FTEs)_

\[ GS FTEs = 21.242(number of years) + 220.87 \quad R^2: 0.014, \ p-value: 3.4E^{-17} \]
LIST OF REFERENCES


83


INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center  
   Ft. Belvoir, Virginia  

2. Dudley Knox Library  
   Naval Postgraduate School  
   Monterey, California