LONG-TERM IMPACTS OF MILITARY
DRAWDOWN ON INDUSTRIAL BASE

THESIS

Anton H. Martyn, Captain, USAF

AFIT-ENS-MS-16-M-115

DEPARTMENT OF THE AIR FORCE
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Wright-Patterson Air Force Base, Ohio

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THESIS

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Anton H. Martyn, BA

Captain, USAF

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Abstract

Since World War II, competition in the defense industry has fallen by over 90 percent. Over half of contracts currently executed by the United States Navy and Air Force are awarded without any competition. With the recent defense budget cuts, and an extended period of reduced defense spending ahead, more of which is going to sustainment and overhead than ever before, each year prime contractors are fighting over an even smaller piece of the procurement pie, which could have a deleterious effect on national security if these contractors go out of business or further consolidate through mergers. This study used data from the Federal Procurement Data System and the Securities Exchange Commission to track 13 of the DoD's top 100 contractors from 2010 through 2015 to determine if a relationship exists between this reduced procurement spending and the financials indicators of the tracked companies. Three of the six models developed showed a relationship between procurement spending and financial indicators at the .05 significance level: those of Price-to-Earnings ratio, revenue, and revenue growth. The results of this study give cause for concern about the ever condensing defense industry and suggest that increased care be taken to ensure that the existing base of contractors be cultivated though strategic management of procurement funding.

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I. Introduction

Problem Statement

The United States is reliant on defense contractors to provide complements to organic production. The large capital investments and long development cycles involved in this economic sector provide significant barriers to entry for new companies, and the limited customer base makes companies particularly susceptible to fluctuations in demand. As Department of Defense (DoD) funding for procurement decreases, companies in this industry could be forced to consolidate or exit the market, reducing competition and reducing the market capacity to produce materials and equipment. This would have a deleterious effect on the ability of the United States to wage war in future armed conflicts.

Historically, reduced procurement budgets have generally resulted in consolidation of the defense sector through mergers and to a lesser extent diversification of defense contractors into consumer sectors or exit from the defense sector by contractors. During recapitalization periods, the defense sector has not historically expanded to counteract this consolidation. As a result, the defense sector goes into this latest military drawdown in an already concentrated state, reducing the ability of defense contractors to maintain solvency through mergers. While more companies are attempting to diversify, crossover between the defense and consumer sectors remains limited. Therefore, the potential exists for defense contractors to exit the defense sector during

this drawdown period, reducing production capability available when the next recapitalization occurs.

This research examines the degree to which a prolonged military drawdown can impact the profitability and financial health of defense contractors providing support capabilities to the United States Air Force (USAF). As we continue to deal with budget cuts for the foreseeable future, and an accelerated pace of change in the defense industry, a study of the long-term impact to the financial health of these companies is needed sooner, rather than later, in order to determine how significant these cuts are to national defense, and whether additional funding need be budgeted to maintain current capabilities. (Lynn 2014)

Research Questions

The key research questions answered by this research include:

1. Are large prime contractor revenues and profit margins related to procurement spending?
2. Will a reduction in sales for large prime contractors due to a military drawdown impact the financial ratios of these companies?

Hypotheses

The critical hypotheses that were tested by this research include:

1. Revenues of large prime contractors are related to defense procurement spending.
2. Decreases in procurement spending negatively impact the financial ratios of large prime contractors.

Research Focus

This study covers, specifically, large defense prime contractors, i.e. contractors that contract directly with the US government and who may or may not then subcontract to smaller companies. The relationship between procurement spending and the financial indicators of these large prime contractors was examined to determine whether there remains cause for concern with regard to the health of the defense industrial base.

Methodology

Financial records were collected for each of 13 companies identified by the Federal Procurement Data System's (FPDS) Top 100 Contractors Report which met all other selection criteria. Their revenues, profits, and financial ratios were collected and a regression model was developed to determine the relationship between these performance measures and DoD procurement spending.

Assumptions/Limitations

Due to the concentrated nature of the defense industry, the sample size for examining a correlation and subsequent impact of a decreased procurement budgets on contractor revenues is small. As a result, individual contracts can compose a disproportionately large amount of revenue, and therefore the proposed model is subjected to a large amount of variability. Additionally, while overall trends in the economy are accounted for through the use price indexes and exchange rates, many cost drivers vary on a company by company basis, and lack of expertise on each of the companies in question, as well as time constraints, preclude analyzing each company for

cost drivers unrelated to the federal budgetary process. Likewise, the uncertainty present in predicting future federal budget allocations presents a significant likelihood of actual future procurement falling outside of modeled parameters. Finally, the five year time period over which the observations are taken is relatively short, making projections for any particular company difficult, and reducing the model's ability to account for auto-regression. For these reasons, this study's results are intended to serve as a baseline indicator of financial risk to defense contractors in general, to determine general levels of financial health within the defense industrial base. Less emphasis is placed on predicting actual impacts to any specific contractor.

An additional limitation of this study is that dollar figures are not adjusted to a baseline year. While this should not heavily impact the model due to fact that most performance measures are ratios and therefore not impacted by variable inflation, the measure of revenue is susceptible to inflation. This is in part mitigated by the heavy reliance on same year procurement spending to determine projected revenues. Compensation for autocorrelation remained impacted, as inflation causes the relationship between revenues in different years to vary over time; however, due to the timeline for data collection being limited to six years, compensation for autocorrelation over long time lags is not being explored.

Implications

Identifying the impact of government procurement spending on future weapon system development and current weapon system sustainment capability provides decision-makers a better indicator of whether current budget cuts created through reduced

procurement can be maintained without negatively impacting businesses which are key to our national defense strategies. Chiefly, maintaining a healthy defense industrial base contributes to retaining a necessary surge capacity in the event of hostilities and encourages competition, resulting in lower peace-time sustainment costs.

Surge Capacity

Multiple times in the history of the United States, our manufacturing capacity has been subverted from consumer production to war materiel production. While this was effective when technological requirements of our military equipment were relatively mundane, as systems become more advanced, more specialized, and more reliant on computer networks, it becomes more difficult to subvert consumer production to war materiel production. Additionally, there is less crossover between consumer and defense markets, as demonstrated by the fact that defense contractors find it difficult to diversify into consumer markets. It is reasonable to believe that converting the production of companies in the consumer market to war production would be just as difficult.

It is for this reason that the United States industrial base of active defense contractors needs to be maintained in a state which is capable of surging production capacity to full-scale war levels.

Peace-time Costs

In consumer markets, it is well understood that competition is important to keeping prices down, both because it encourages cost reducing measures by manufacturers, and because a company with a monopoly can keep prices above the equilibrium price to maximize profit. If contractors are unable to maintain solvency

during a military drawdown and are forced to consolidate through mergers, the amount of competition in the defense industry subsequently decreases. Even when multiple prime contractors exist, they often sub-contract with many of the same companies. Our defense industrial base has already become so tightly woven that contractors effectively operate as either oligopolies or monopolies.

Already, half of all contracts across the Navy and Air Force are uncontested. (Lynn, 2014) With the lack of competition, and the fact that many DoD contracts are priced using the cost-plus method, there's little incentive for contractors without competition to keep costs down. Even for contracts not priced out using cost-plus, the government has an incentive to keep its prime contractors in business, especially if there aren't other suitable substitutes, so any costs eventually get passed on to the government.

The DoD is not the sole player in realizing national defense objectives, and factoring the performance of other key players into strategic planning can ensure the DoD retains access to leading-edge technologies for weapon system development and sustainment now and in the future.

II. Literature Review

Background

This literature review examines past and current studies on the impact on the industrial base of a previous military drawdown following the Cold War and collapse of the Soviet Union, and the current drawdown. It explores the coping strategies used by companies of the time and those companies which have persisted through today.

The examination of previous studies focused on the consolidation and diversification strategies of contractors following military drawdowns and the success of those strategies. Studies regarding the current military drawdown were examined more for the concerns they express and to determine what data is currently available and/or has already been considered.

Cold War Drawdown

At the conclusion of the Cold War, much of the need for military weapons development was curtailed. As a result, the money budgeted to defense procurement was reduced by 65 percent between 1985 and 1999, and prime contractors turned to other operations to replace this lost revenue. (Bell 1999)

Sable discusses two primary methods of such revenue recoupment, diversification into non-military markets and consolidation through mergers. When neither of these options were used, the most likely scenario was downsizing. Sable concludes that military contractors were unsuccessful at breaking into civilian markets, and that the primary effective means of survival was downsizing. (Sable 1993)

Instead of focusing on structural changes to an organization, Bitzinger differentiates adjustment strategies based on intent. He mentions five broad options, leaving the defense sector, holding out and preserving core capabilities, diversifying, non-military government expansion, and foreign markets. He explains that the options a contractor is most likely to use is heavily dependent on the level of dependency to defense contracts. In doing so, he breaks contractors down into several groups: low-dependency defense contractors, defense primes, and smaller firms. (Bitzinger 1994)

Low-dependency defense contractors are those which are already highly diversified and only rely on defense contracts for a small portion of their revenue. They are most easily able to weather a downturn in procurement spending, and may continue to operate a defense portion of their business for the later opportunities it affords. That said, they are also the most likely to exit the defense sector if money becomes too tight. Defense primes, on the other hand, possess little non-defense business, and are most likely to weather droughts in procurement, as diversification becomes the bigger financial risk. Bitzinger suggests that it's these contractors, like Lockheed, Northrop, and Raytheon, who will receive preferential treatment in funding decisions when money is tight. The third group, smaller firms, has the same vulnerability to changing procurement funding that defense primes do, but are less able to diversify, downsize, or cut costs. Those which do not provide a niche defense capability are most likely to suffer during a downturn. (Bitzinger 1994)

Despite Bitzinger's assertion that small to medium sized companies were most at risk, the majority of research from the Cold War drawdown was on prime contractors,

due in large part to mergers. The number of mergers between prime contractors in the 1990s caused concern as competition for contracts declined. A study by Bell for the Air War College explored these mergers and increased vertical integration among prime contractors. His data showed that the defense industry had become extremely concentrated in certain sectors. "Looking back to the end of World War II, the US had 26 aircraft, 16 tank, 22 missile and 36 ship and submarine manufacturers . . . [by 1996] the US possessed only two contractors who produced bomber aircraft, four who produced fighter aircraft, one tank contractor, one strategic missile contractor and two expendable launch vehicle contractors," (Bell 1999) This equates to a more than 90 percent decrease in competition among these types of defense contractors. Bell's work called for additional studies to determine the impact of this consolidation on competition.

Ray explored the potential for Civil-Military Integration via three different methods: conversion, diversification, and dual-use science and technology. He stressed the differences between commercial and defense markets, and found that of the three proposed methods, only dual-use research and development was a viable way to expand the Defense Industrial Base. In executing this strategy, he recommended that such integration occur in the earliest stages of acquisition programs, and pointed out that the greatest barriers to execution are in regulatory requirements. (Ray 1998)

Current Drawdown

The current drawdown came in the form of sequestration, a blunt instrument of funding reduction called for by the 2011 Budget Control Act. This drawdown is fundamentally different from the one experienced at the end of the Cold War. There are

still technologically advanced threats to consider, and as shown by the studies conducted in the 1990s, we no longer have room for horizontal consolidation of prime contractors.

A study released by the RAND institute in 2013 focusing on the Air Industrial Base (AIB) emphasizes that while there was no competition to U.S. power at the end of the Cold War, there is now a technologically advanced threat in the Pacific theater. Moreover, in their report, Arena, Graser and DeLuca show that funding which could normally be allocated to procurement is tied up in ongoing operations and a more aggressive posture, contributing to high expenditures in operations and maintenance (O&M) which are near record highs despite a declining budget. (Arena 2013)

Despite a decrease in overall procurement funding, there has not yet been a round of consolidation like in post-Cold War drawdown. This is in part due to the fact that procurement expenditures in key areas such as the AIB have remained steady, and according to Arena, Graser, and DeLuca's work, will continue to remain steady through the end of the decade. However, this only explains some sectors of the defense industry. Lynn, former U.S. Deputy Secretary of Defense, argues for a different explanation, claiming that there is little opportunity for further consolidation. He states that more than half of contracts awarded by the Navy and Air Force in 2012 were awarded without any competition at all. While Lynn uses this to imply that we no longer get the value for our taxpayer money we once commanded, there are additional implications in the coping strategies still available to prime contractors with no consolidation options. (Lynn 2014)

Scope of the Problem

In the currently concentrated defense industry, without opportunity for consolidation, and in light of historically poor track records for diversifying into civilian sectors, what options are left to prime contractors? As Sable stated, baring consolidation, downsizing is the most common effective strategy. It is also clear that certain sectors of the defense industry, such as the AIB, are not seeing reductions in funding commensurate with overall budget cuts from sequestration. While insufficient research has been conducted to determine which sectors are more negatively impacted, it logically follows that if sectors such as the AIB are not experiencing reductions in revenues, while total revenue across the industry is falling, that some sectors will experience disproportionately lower revenues as a result of the drawdown. In the event that these sectors are also sectors in which there is only one prime contractor, there is a risk of losing procurement capacity for a surge or production capability entirely if there are no available substitutes and the prime contractor goes out of business.

Following the drawdown at the end of the Cold War, Chatman conducted a quantitative study on the solvency, efficiency, and profitability of selected defense industry contractors using financial ratios. While Chatman's study found solvency of defense contractors following the drawdown to be generally positive, with 22 of the 28 sample companies showing improving current ratios and 17 of 28 showing improving debt to equity ratios over the period of the drawdown, the defense industry showed poorer solvency conditions than industry averages. (Chatman 1995)

While results for profitability were poorer in absolute terms, with only 12 and 13 of 28 firms maintaining return on assets or return on investment, respectively, over the same period, these figures were still better than the industry average over the same period. It is unclear, however, how much of this is attributed to consolidation, as several of the firms listed in the study had conducted mergers, a strategy already identified as suspect in this current drawdown. Based on these results, solvency may be an area needing particular study in the current drawdown. (Chatman 1995)

Theoretical Model

Chatman's quantitative model provides a clear set of metrics which can be used to evaluate defense contractors based on industry accepted measures of solvency. While Chatman's work was broad in scope, a more focused study could also examine the mathematical relationship between these metrics and the defense procurement budget. Such a focus would necessitate careful selection of the sample firms and independent variables, based on risk factors identified in past research.

Bitzinger provides insight into one such independent variable. His discussion of dependency on defense contracts highlights the importance of revenue streams in a heterogeneous defense industry. Where previous research focused almost entirely on large prime contractors in the AIB, this study examined corporations of varying dependency. This can be accounted for determining the percentage of revenue that each company obtains from the government. (Bitzinger 1994)

Hooker and Knetter identify two other important variables in their research, which also establishes a basis for the impact of procurement spending on the economy as a

whole, as reflected in employment rates. While not focusing on the performance of individual companies, employment is an important indicator in business performance, and the use of the producer price index (PPI) for crude oil and the trade weighted average exchange index for the US dollar should translate to other performance indicators. (Hooker and Knetter 1997)

Hypotheses

Previous research offers unclear results regarding correlation between procurement funding and financial indicators. Hooker and Knetter's research showed that large decreases in state military procurement, a drop of more than $100 per capita, had a disproportionately large impact on employment growth rates, while smaller negative changes in procurement and large positive changes in procurement did not produce statistically significant results. (Hooker and Knetter 1997)

By contrast, Chatman's research showed mixed results. His data showed that while defense firms were generally less solvent than the overall U.S. manufacturing industry, those companies which were most dependent on defense contracts were more solvent, though less profitable, than those companies which were only loosely dependent on defense contracts. (Chatman 1995) In addition, the literature review conducted in the RAND study by Arena et al. was contradictory. Depending on the segment of the defense sector being examined, and the definition used for what constitutes a competitive industrial base, the data seems to suggest that the AIB is at the same time stable and atrophying. (Arena 2013) It is this uncertainty among previous studies that necessitates a more quantitative approach through the use of regression analysis.

III. Methodology

Methodology

Regression analysis was the primary methodology employed. Specifically, the relationship between prime contractor financial indicators and procurement funding was examined. The purpose of using regression analysis is to determine what impact the decrease in procurement funding may have had on contractor financial indicators.

Contractor Selection

Before the regression analysis was conducted, however, an initial selection of companies of interest was conducted. For the initial companies' selection, a list was pulled from the Federal Procurement Data System's (FPDS) Top 100 Contractors Report, specifically, the Top 100 Contractors for the DoD. From this list, only corporations which were publicly traded American companies were considered. Additionally, companies whose primary products were commodities for which there are a large number of customers, such as oil and fuels, were excluded. Furthermore, as the RAND Corporation had already conducted a study on the AIB, these companies were also excluded.

The remaining list of companies of interest was further pared down to companies for which financial data was available for at least the last five years. Several companies were later excluded due to mergers which occurred during the period of the study, and others were excluded as subsidiaries of a larger corporation in the study.

Data Sources

After the 13 companies of interest were selected, their financial records for the past six years were obtained from the U.S. Securities and Exchange Commission (SEC), which keeps electronic records for all publically traded American companies. Specifically, the 10-K annual reports from FY 2009 through FY2014 were used. Selected financial data, consolidated statements of income, and consolidated balance sheets were pulled from these annual reports. From these data tables, values were transcribed or calculated for percentage of revenues from the government, annual revenues, revenue growth over previous year, annual profits, profit margin, percent change in annual profit over previous year, and the following ratios: current ratio, price-to-earnings ratio, debt-to-equity ratio, and diluted earnings per share (EPS). The historical stock prices of each company were also obtained via Scottrade historical records. Note that only five years' worth of observations were made, the sixth year of reports were collected for the purposes of providing lag variables and year-over-year percentage changes in revenue.

Procurement spending data was obtained for the same time period from the Office of Management and Budget historical tables, namely, table 5.1, "Budget Authority by Function and Subfunction: 1976-2020" to determine the total budget allocated to appropriations. Only procurement funds for national defense were considered. Future projected procurement spending was based on these same figures, plus the restrictions on budget growth placed by the 2011 Budget Control Act. To account for fiscal years which did not match up with the federal fiscal year, the procurement amount associated with

each K-10 statement was the weighted average of the previous and current fiscal year's procurement budget, weighted based on number of month in each fiscal year covered by the statement timeline.

Two additional factors were considered based on previous studies: oil prices and exchange rates. Oil prices are used due to its contribution as a cost driver through influence of oil prices on logistics costs. An exchange index is likewise used to account for exchange rate fluctuations on the cost of foreign outsourcing, services, or raw materials.

Oil prices were captured using the 12-month rolling average of the PPI for crude oil, as maintained by the Bureau of Labor Statistics, at the end of the fiscal years for which each company's K-10's were filed. Exchange rates were captured using the Trade Weighted U.S. Dollar Index: Major Currencies exchange rate (TWEX), as provided by the Federal Reserve Economic Data. Again, the values used for regression analysis were the 12-month rolling averages.

Tools and Format

Statistical analysis was conducted in JMP. Six dependent variables were examined: D/E, Price-to-Earnings (P/E) ratio, CR, profit margin, revenue, and year-over-year revenue growth. For all variables, a regression analysis was conducted with an alpha value of 0.05 as a cut off, though models displaying an alpha value of over .05 but under 0.1 were also considered, provided the total cumulative p-value between all variables in the model remained below 0.1. The independent variables of interest are percent of revenue received from the government, the 12-month weighted average

defense procurement funding, the 12-month rolling average PPI for Crude Oil, and the 12-month rolling average TWEX. Of these, the primary independent variable of interest is U.S defense procurement spending. A time lag variable was also included for several of the dependent variables to account for the highly company-specific nature of performance figures, and each model also included a time lag variable for procurement if significant, to account for the delayed impact of procurement decisions due to contract implementation timelines. The reason for employing multiple models is two-fold; first, the short length of time over which data was collected resulted in only a few data points for each company, which presents issues with regard to degrees of freedom for extensive multivariate models. Additionally, many of the variables, both independent and dependent, have the potential for multicollinearity, and the use of multiple models kept this to a minimum. To that end, all final models had VIF scores under 5 for all independent variables.

Of note, for the financial ratio P/E, the data was inversely transformed, as small relative profits cause large positive values of P/E, where a relatively large profit typically causes small values of P/E, and likewise for losses; an inverse transformation keeps the data relevant over the full range of values. Lower (non-negative) P/E ratios generally indicate a stock market perception of higher risk or lower earnings growth potential, but can also indicate improved financial performance when compared to historical performance. Negative P/E ratios are not traditionally used to evaluate company performance, however, they were calculated and retained for the purposes of the model to

preserve any statistical relationship. As a result, the interpretations provided by this model are not applicable when P/E ratios are negative.

Scope of Interest

This methodology identifies the relationship between key economic indicators for the set of sample companies and defense procurement spending. These economic indicators are accepted measures of financial performance, and while not definitive, do provide insight into the risk of each company going out of business during a military drawdown. While other more qualitative methodologies may capture more company-specific nuances of solvency and company viability that cannot be examined through this quantitative study, as qualitative data on companies can be difficult beyond the resources of this study to capture, this study focused on annual reports to provide a more industry generalized look.

IV. Results

Overview

Of the six dependent variables examined, three showed a relationship with procurement at the 0.05 significance level: D/E, revenue, and revenue growth, with p-values of 0.0057, 0.0196, and 0.0117 respectively. One additional dependent variable showed a relationship with procurement at the 0.1 significance level, however, this was only evident when a variable for 1-year lag in procurement was also included, and these two variables together had a combined p-value of over 0.1. In all cases except the revenue model, procurement without any applied transformation showed the lowest p-values. In the revenue model, the logarithmic transformation of procurement spending offered the lowest p-value.

While a temporal variable, TWEX, PPI for Crude Oil, and percent of revenue received from the government were also considered as independent variables, and in some cases showed a relationship with the dependent variables singly or in groups, in no case were they statistically significant when paired with procurement or any of its transformations.

Debt to Equity Ratio

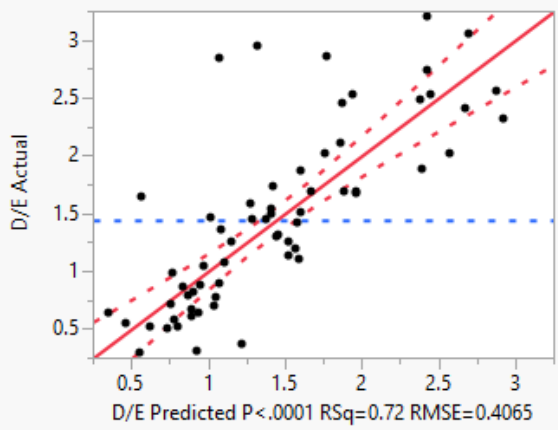
The final model for regression of D/E included the independent variables of procurement, procurement lagged by one year, and D/E lagged by one year. This yielded an r-square of 0.72, due primarily to the strong correlation with D/E 1-year lag. The p-values for procurement and the procurement 1-year lag were 0.0575 and 0.0835,

respectively. While this suggests a potential relationship between procurement spending and contractor D/E ratio, it was not significant to an alpha of 0.05. Of note, the data shows that any potential relationship between procurement or procurement 1-year lag and D/E are likely opposite each other, meaning the D/E ratio may be related to changes in procurement, not actual procurement levels themselves.

Response D/E

Whole Model

Actual by Predicted Plot



Summary of Fit

RSquare	0.719057
RSquare Adj	0.703449
Root Mean Square Error	0.40649
Mean of Response	1.440251
Observations (or Sum Wgts)	58

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	22.836954	7.61232	46.0700
Error	54	8.922625	0.16523	Prob > F
C. Total	57	31.759579		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF
Intercept	0.1563819	0.487403	0.32	0.7496	.
DE Lag	0.9103276	0.077854	11.69	<.0001*	1.0243276
Procurement	1.3755e-5	7.086e-6	1.94	0.0575	4.0158552
Pro Lag 1 yr	-1.261e-5	7.15e-6	-1.76	0.0835	3.9677954

Figure 1: Debt-to-Equity Ratio Model

Several data points were excluded from this test based on circumstances beyond the scope of this study. For the year of 2010, OshKosh Corporation was excluded due to a one billion dollar impairment of goodwill the year prior to the study, which led to a significant adjustment in equity. As a one-year D/E lag was essential to the model, this could not be reconciled. Booz Allen Hamilton was excluded from the model entirely due to a $1 billion dividend payout mid-study which increased their D/E ratio nearly ten-fold. Finally, for the year 2010, AAR Corporation was excluded due to a lack of historical D/E ratio data for use in the lag variable.

When validating the model, it initially fails the test for normality, but passes when the two outliers are excluded from the data set with a Shapiro-Wilk p-value of 0.25. Examining the Cook's D Influence reveals that no points are overly influential in the model, with the highest value being approximately 0.19. The model also passes a breusch-pagan test for constant variance with a p-value of 0.18. Finally, when the data is aligned sequentially by date of financial statement, a durbin-watson test yields a value of 0.23, indicating no auto-correlation among the residuals.

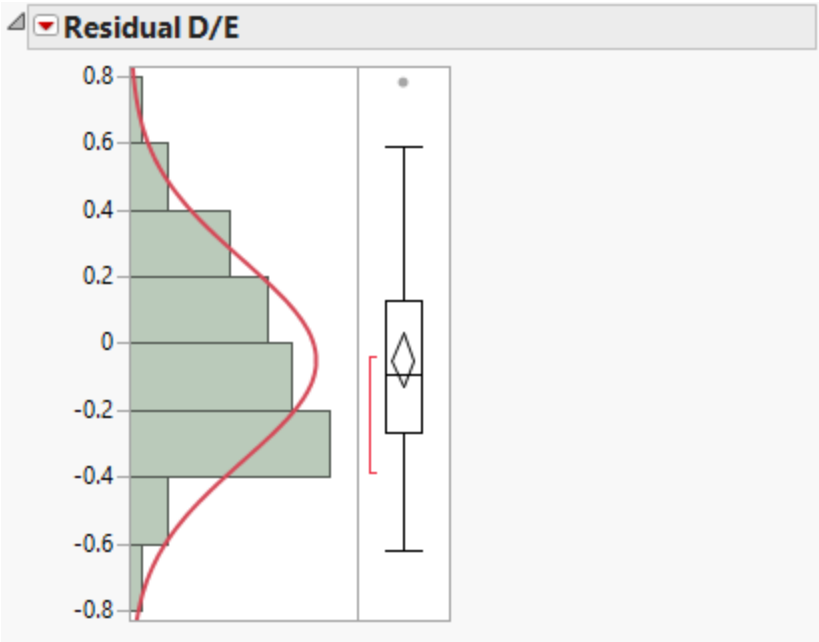


Figure 2: Debt-to-Equity Ratio Residuals Histogram

Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.973548	0.2542

Figure 3: Debt-to-Equity Ratio Shapiro-Wilk Test

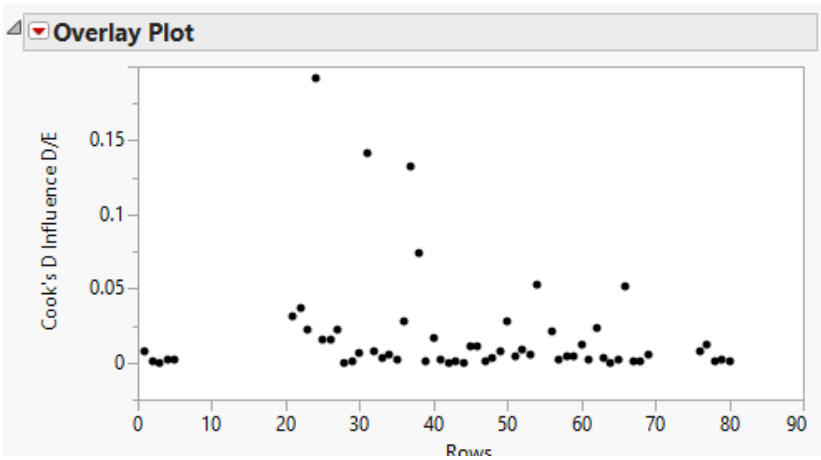


Figure 4: Debt-to-Equity Ratio Cook's D Influence

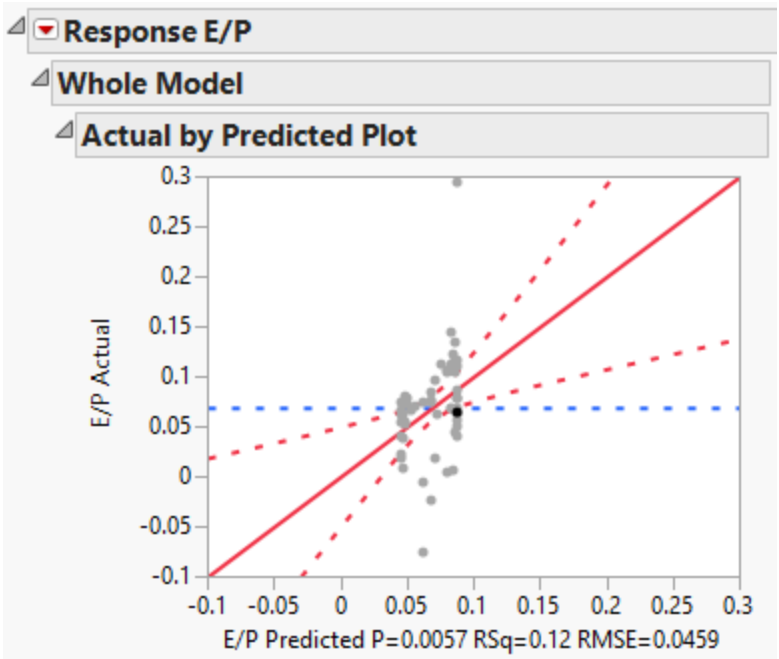
Durbin-Watson

Durbin-Watson	Number of Obs.	AutoCorrelation	Prob<DW
1.8712752	58	0.0619	0.2298

Figure 5: Debt-to-Equity Ratio Durbin-Watson Test

Price-to-Earnings Ratio

Procurement was the only independent variable shown to have a relationship with P/E at the 0.05 level of significance, with a p-value of 0.0057. As mentioned previously, P/E data was inversely transformed to more accurately depict a continuous relationship of perceived financial performance. The data shows that higher procurement levels are related to lower P/E ratios to an r-square of 0.12.



Response E/P

Whole Model

Actual by Predicted Plot

Summary of Fit

RSquare	0.124286
RSquare Adj	0.109188
Root Mean Square Error	0.045939
Mean of Response	0.068973
Observations (or Sum Wgts)	60

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.01737245	0.017372	8.2317
Error	58	0.12240529	0.002110	Prob > F
C. Total	59	0.13977774		0.0057*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.064464	0.046885	-1.37	0.1744
Procurement	1.1219e-6	3.91e-7	2.87	0.0057*

Figure 6: Price-to-Earnings Ratio Model

In this model, the data from Computer Sciences Corporation was excluded due to a large adjustment in costs of services reported during the time period studied, in

response to an SEC audit and allegations of tax fraud. This drastic change in P/E could not be reconciled with data prior to the adjustment. Additionally, there was a significant outlier, the 2010 data for Oshkosh Corporation had a residual that was 4.5 standard deviations out, and a Cook's D Influence of 0.41. This is likely due to nearly half of its revenue in that year coming from a single DoD contract, an abnormally large contract for the company. The data point was retained, as removing it did not have an impact on the results with regard to this study, though it did change the p-value of the model from 0.0057 to 0.0091, and significantly changed the equation coefficients of the model. Additionally, as mentioned previously, data points which had negative values were retained to preserve statistical relationships even though these would not be used to evaluate a company's financial performance. Even then, removing these negative data points from the model did not significantly alter the results, procurement still had a p-value of 0.0043

When validating the model, it initially fails a test for normality; however, when several potential outliers are excluded, it passes both normality and constant variance, with p-values for the Shapiro-Wilk and Breusch-Pagen tests of 0.1 and 0.63, respectively. A Durbin-Watson test for autocorrelation returns a p-value of 0.74, indicating no autocorrelation.

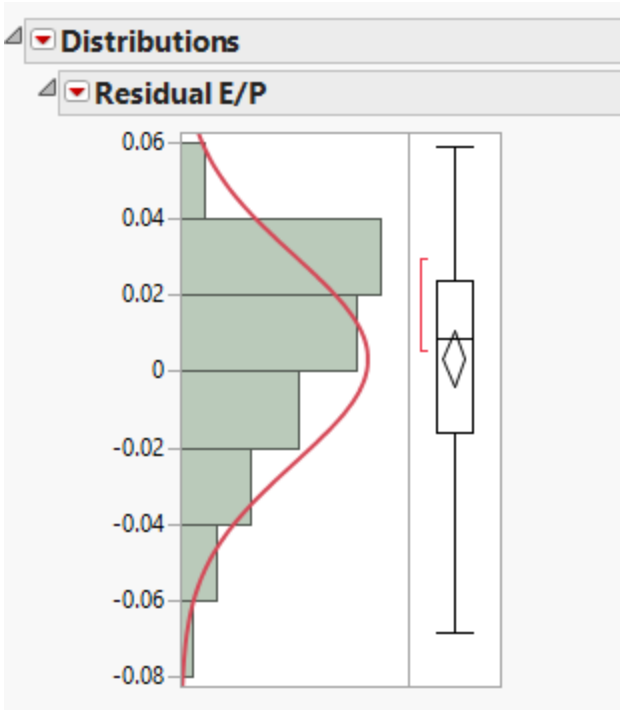


Figure 7: Price-to-Earnings Residuals Histogram

Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.964494	0.1036

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Figure 8: Price-to-Earnings Shapiro-Wilk Test

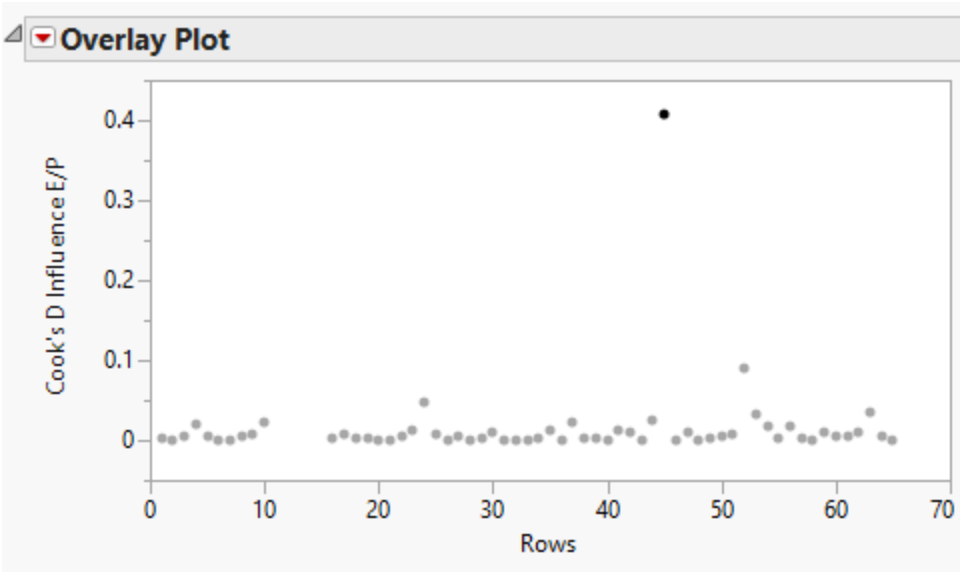


Figure 9: Price-to-Earnings Cook's D Influence

Durbin-Watson

Durbin-Watson	Number of Obs.	AutoCorrelation	Prob<DW
2.1982746	60	-0.1034	0.7385

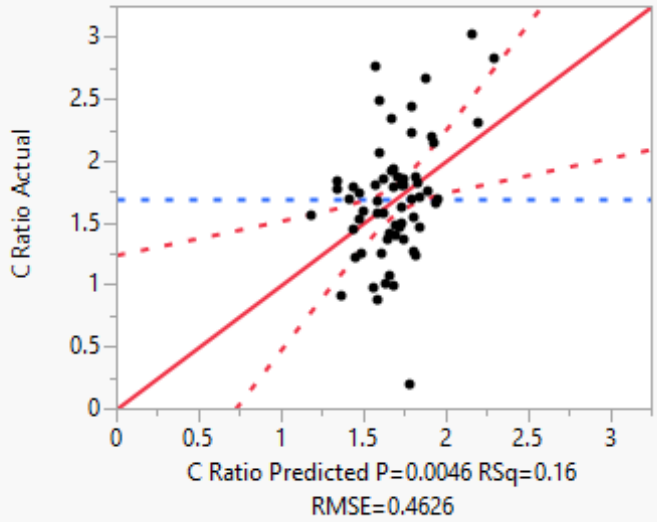
Figure 10: Price-to-Earnings Durbin-Watson Test

Current Ratio

For the CR model, CR lag of one year was used as a variable, in addition to procurement, due to it being the only significant variable with regard to CR. Note that both with and without this independent variable in the model, procurement was not significant, with a p-value of 0.24 in the final model. A logarithmic transformation and 1-year lag for procurement were attempted as well, but these did not yield any different results.

Response C Ratio

Actual by Predicted Plot



Summary of Fit

RSquare	0.161483
RSquare Adj	0.13399
Root Mean Square Error	0.462648
Mean of Response	1.691588
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	2.514460	1.25723	5.8737
Error	61	13.056639	0.21404	Prob > F
C. Total	63	15.571099		0.0046*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1.558054	0.493027	3.16	0.0025*
CR Lag	0.3965091	0.120993	3.28	0.0017*
Procurement	-4.581e-6	3.839e-6	-1.19	0.2374

Figure 11: Current Ratio Model

Only one data point was excluded from the final model, the 2010 data for AAR Corporation. It was excluded due to no historical current ratio available. The model also

passed tests for normality, constant variance, and autocorrelation without the exclusion of any further data points. The p-values for Shapiro-Wilk, Durbin-Watson, and Breusch-Pagan tests were 0.20, 0.37, and 0.59, respectively. No points were overly influential in the model, and the highest Cooks D value observed was approximately 0.17.

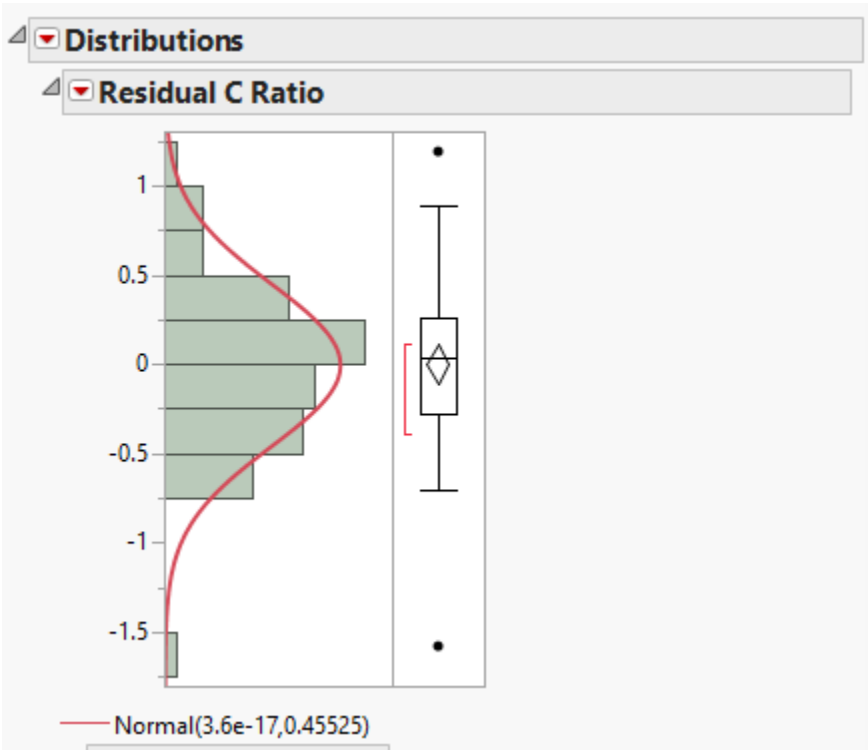


Figure 12: Current Ratio Residuals Histogram

Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.974434	0.2049

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Figure 13: Current Ratio Shapiro-Wilk Test

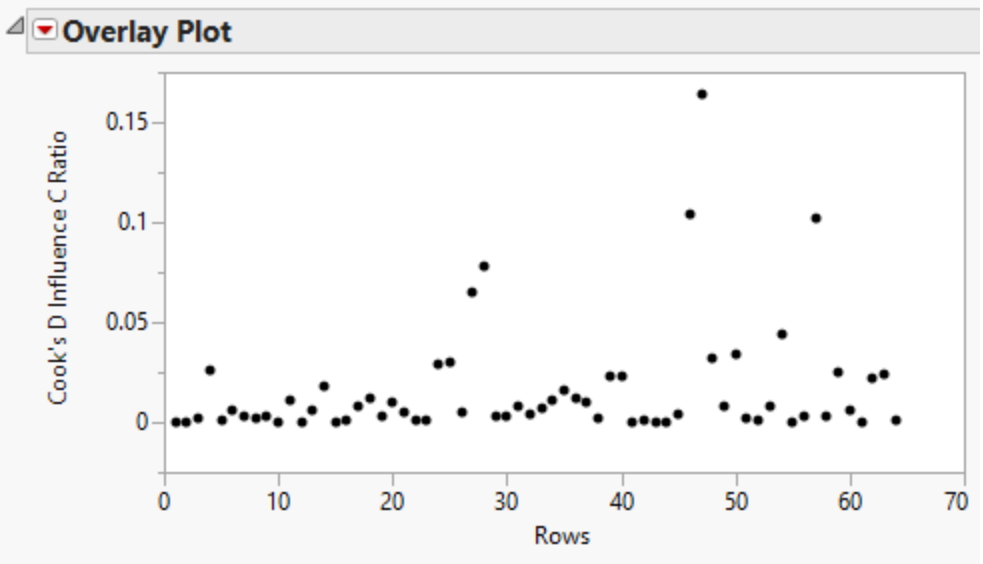


Figure 14: Current Ratio Cook's D Influence

Durbin-Watson

Durbin-Watson	Number of Obs.	AutoCorrelation	Prob<DW
1.9446869	64	0.0237	0.3697

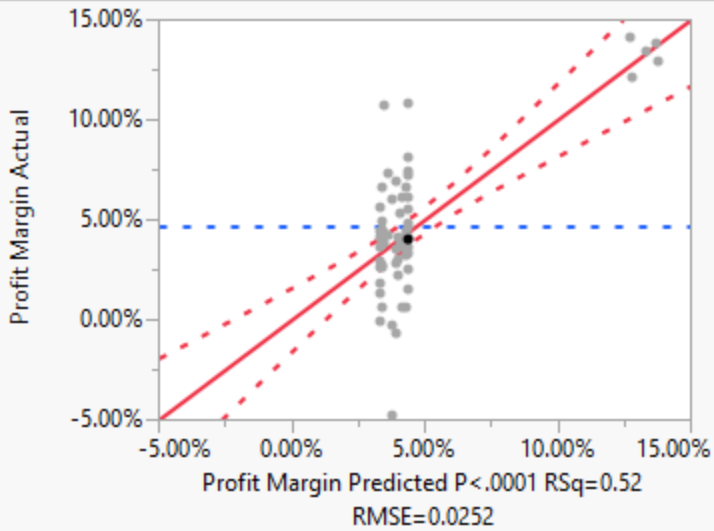
Figure 15: Current Ratio Durbin-Watson Test

Profit Margin

The profit margin model includes a cohort variable in addition to procurement. No variables aside from this cohort were found to be significant. The cohort consisted of all the data from Rockwell Collins. This communications company experienced consistent profit margins much higher than the other companies in the study, and accounted for 50 percent of the observed variability. Procurement was not significant, with a p-value of 0.19. Attempting to use logarithmic transformations or a time lag for procurement did not change the results of the model.

Response Profit Margin

Actual by Predicted Plot



Summary of Fit

RSquare	0.5212
RSquare Adj	0.50524
Root Mean Square Error	0.025156
Mean of Response	0.0467
Observations (or Sum Wgts)	63

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.04133254	0.020666	32.6567
Error	60	0.03797006	0.000633	Prob > F
C. Total	62	0.07930260		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.0059902	0.025163	0.24	0.8126
Procurement	2.805e-7	2.102e-7	1.33	0.1870
Cohort (company 8)	0.0939758	0.011732	8.01	<.0001*

Figure 16: Profit Margin Model

Computer Sciences Corporation data was excluded for year 2010 and 2011 because of large cost of sales adjustments as a result of the SEC investigation mentioned previously.

The model's residuals are normal after excluding two outliers which were more than three standard deviations out, with a resulting p-value for the Shapiro-Wilk test of 0.29. The model subsequently passes tests for constant variance and autocorrelation with p-values of 0.46 and 0.31, respectively. No data points were overly influential, and the highest Cooks D value was 0.1.

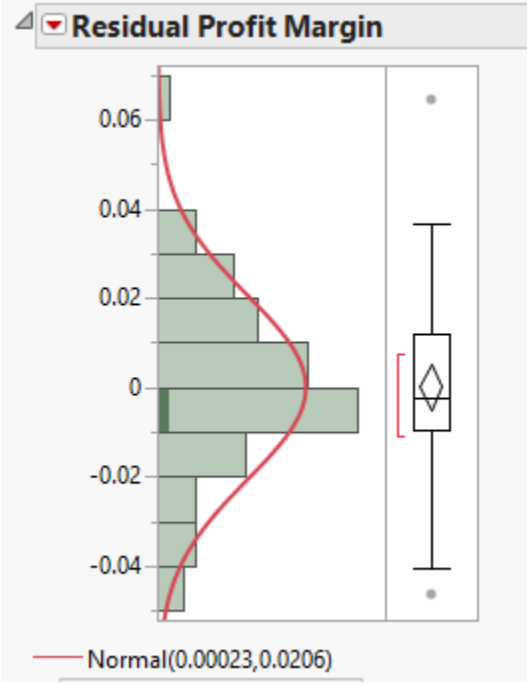


Figure 17: Profit Margin Residuals Histogram

Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.976384	0.2852

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Figure 18: Profit Margin Shapiro-Wilk Test

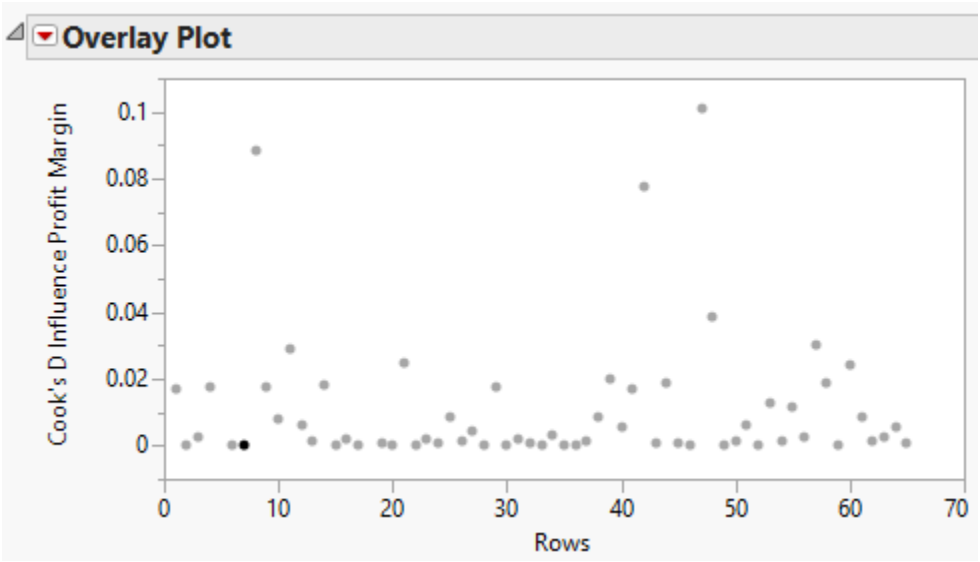


Figure 19: Profit Margin Cook's D Influence

Durbin-Watson

Durbin-Watson	Number of Obs.	AutoCorrelation	Prob<DW
2.0039178	63	-0.0130	0.4576

Figure 20: Profit Margin Durbin-Watson Test

Revenue

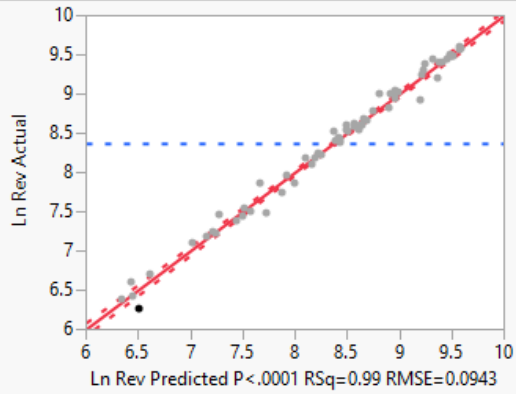
The model for revenue includes a variable for revenue with a one year lag. This variable accounts for nearly 99 percent of the variability, and its inclusion is necessary to

identify if any other variables are significant with regard to procurement and revenue. Prior to inclusion of the lag variable, the data indicated that the percentage of revenues derived from government contracts was negatively related to revenues, but this likely only shows that larger companies which compete for government contracts also do business in the commercial sector. Under this model, procurement could not be linked to revenues. The final model including the revenue lag variable does, however, indicate a relationship between procurement and revenues with a p-value of 0.02.

Fit Group

Response Ln Rev

Actual by Predicted Plot



Summary of Fit

RSquare	0.989597
RSquare Adj	0.989256
Root Mean Square Error	0.094307
Mean of Response	8.36784
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	51.608897	25.8044	2901.415
Error	61	0.542519	0.0089	Prob > F
C. Total	63	52.151416		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Std Beta
Intercept	-2.295756	1.073321	-2.14	0.0365*	0
Ln Rev 1 yr Lag	0.9718814	0.012766	76.13	<.0001*	0.996336
Ln(Pro)	0.2177358	0.090866	2.40	0.0196*	0.031359

Figure 21: Profit Margin Model

After building the initial model for revenues, the revenue from Oshkosh 2010 had a Cook's D Influence value of over 0.6. Further examination revealed that the revenue for this year was abnormally high due to a single $4.5 billion dollar contract with the DoD for 7,500 M-ATVs, making up nearly half of the company's entire revenue. This was an abnormally large contract for the company and not indicative of more general procurement spending trends, so that data point was subsequently excluded from final model. Additionally, early models displayed heteroscedasticity, likely due to the variability of revenue increasing as revenue gets higher. To compensate for this, the final model uses logarithmic transformations.

After transforming both revenue and procurement values logarithmically, the data passed the tests for normality, constant variance, and autocorrelation. The p-values for Shapiro-Wilk, Durbin Watson, and Breusch-Pagen tests are 0.21, 0.66, and 0.1, respectively. No points were overly influential, and the highest Cooks D value detected was approximately 0.29.

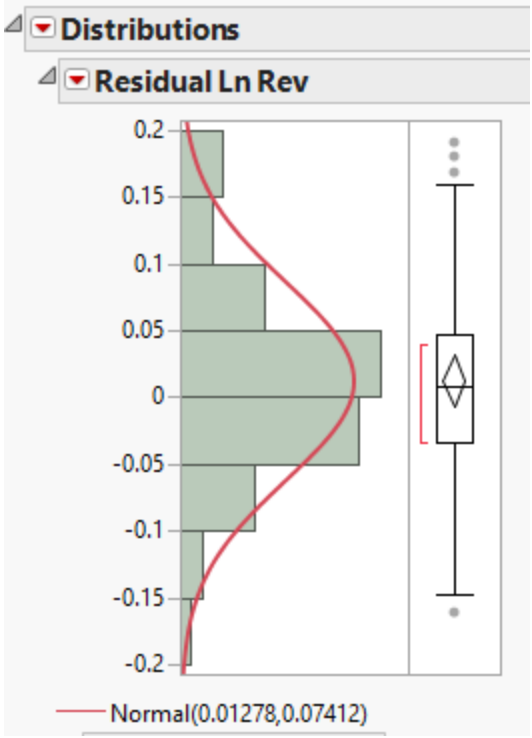


Figure 22: Profit Margin Residuals Histogram

Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.973810	0.2146

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Figure 23: Profit Margin Shapiro-Wilk Test

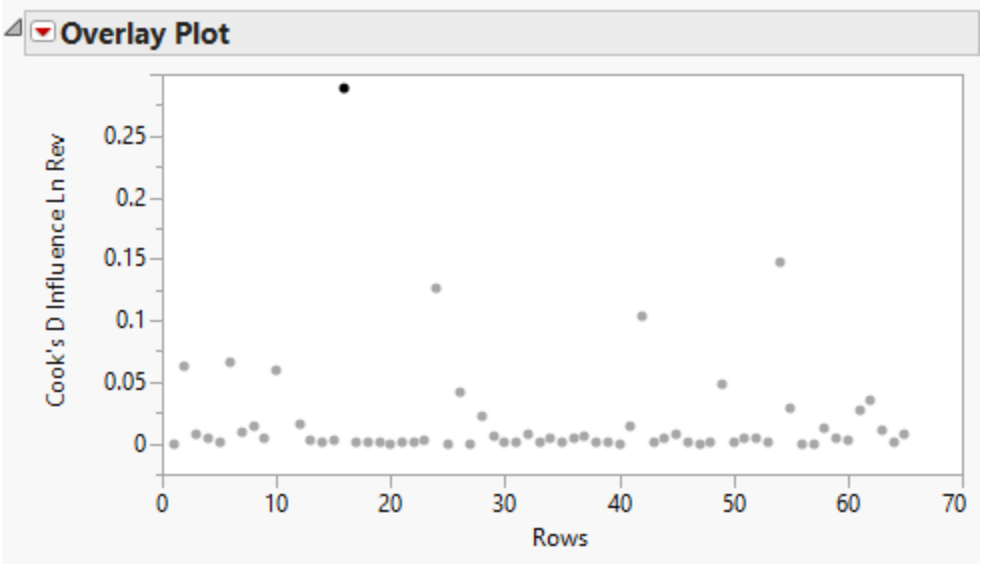


Figure 24: Profit Margin Cook's D Influence

Durbin-Watson

Durbin-Watson	Number of Obs.	AutoCorrelation	Prob<DW
2.1334403	64	-0.0708	0.6605

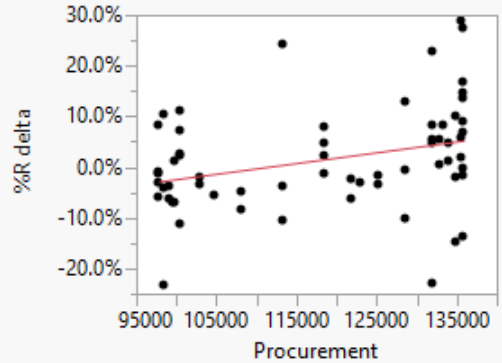
Figure 25: Profit Margin Durbin-Watson Test

Revenue Growth

Several independent variables were shown to be significant with regard to revenue growth, however, none of these were overwhelmingly significant, and none were significant singly or in any combination when paired with procurement. As a result, the final model included only procurement as an independent variable. The model did find a relationship between procurement and revenue growth, at a p-value of 0.01. This relationship describes approximately 10 percent of the variability in the data.

Response %R delta

Regression Plot



Summary of Fit

RSquare	0.098472
RSquare Adj	0.083931
Root Mean Square Error	0.098437
Mean of Response	0.016875
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.06562035	0.065620	6.7721
Error	62	0.60076757	0.009690	Prob > F
C. Total	63	0.66638792		0.0116*

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack Of Fit	23	0.15772942	0.006858	0.6037
Pure Error	39	0.44303814	0.011360	Prob > F
Total Error	62	0.60076757		0.8997
				Max RSq
				0.3352

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.235228	0.097654	-2.41	0.0190*
Procurement	2.1224e-6	8.156e-7	2.60	0.0116*

Figure 26: Revenue Growth Model

Like revenue, the revenue growth model excludes the data from Oshkosh 2010. No other data points were excluded, and the data passed the tests for normality, constant

variance, and autocorrelation. The p-values for Shapiro-Wilk, Durbin Watson, and Breusch-Pagen tests are 0.06, 0.77, and 0.08, respectively. No points were overly influential, and the highest Cooks D value detected was approximately 0.11.

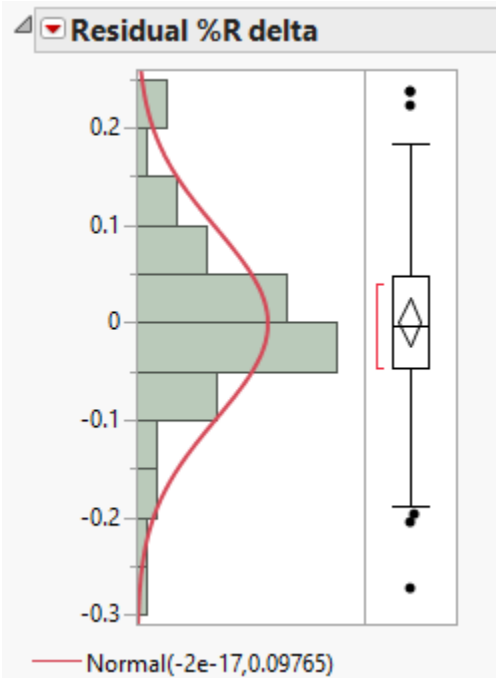


Figure 27: Revenue Growth Residuals Histogram

Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.964197	0.0602

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Figure 28: Revenue Growth Shapiro-Wilk Test

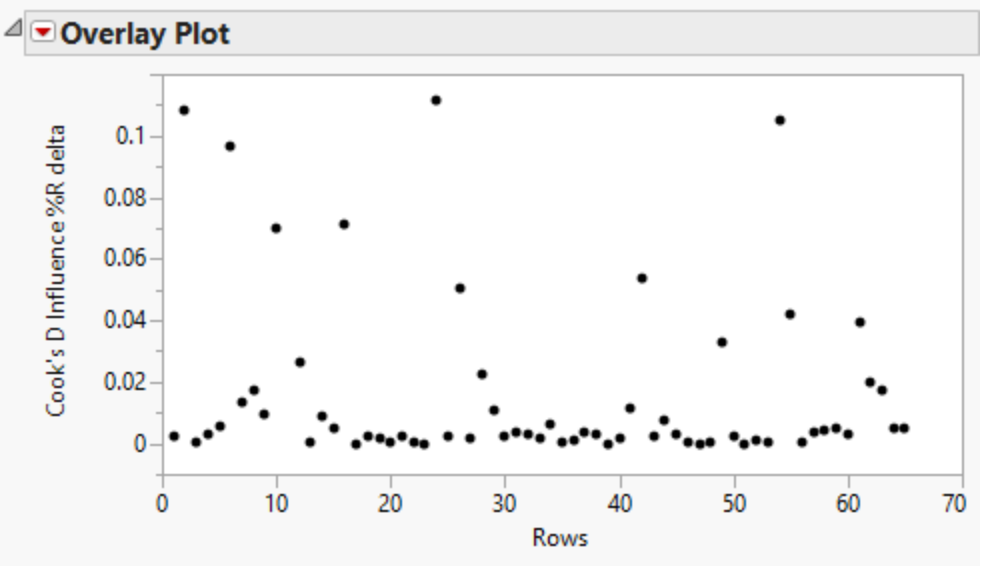


Figure 29: Revenue Growth Cook's D Influence

Durbin-Watson

Durbin-Watson	Number of Obs.	AutoCorrelation	Prob<DW
2.2202871	64	-0.1129	0.7757

Figure 30: Revenue Growth Durbin-Watson Test

V. Conclusions and Implications

Summary

The purpose of this study was to determine the relationship between procurement spending and the financial indicators of prime contractors. Using data from the FPDS and SEC, a statistical analysis was performed on 13 of the DoDs top 100 prime contractors over the course of five years to determine if a relationship exists between procurement spending and the financial indicators of D/E, P/E, CR, profit margin, revenue, and revenue growth. Of these indicators, P/E, revenue, and revenue growth were shown to be related to procurement spending at the 0.05 significance level.

Conclusions

A great deal of variability existed in the data set, due to the budget process and the heterogeneous nature of defense contractors. Being from a variety of different disciplines, varying sizes, and degrees of reliance on government contracts for revenue, each company had different D/E ratios they were comfortable maintaining and different degrees of cost efficiency, resulting in vastly different baseline performance between companies, which was beyond the scope of this study. As a result, even in the cases where financial indicators were determined to be related to procurement spending, only a small amount of the total variability in the data set could be attributed to procurement. Nevertheless, procurement spending was found to be related to half of the financial indicators examined.

Negative Indicators

This data in this study does not support a relationship between procurement spending and D/E ratios, current ratios, or profit margins. These financial indicators were very polarized by company, and only significant events, such as large dividend payments, balance sheet adjustments, or unexpectedly large one-time contracts had much impact on these indicators. This suggests that the current prime contractor base has reached a point of equilibrium where cost drivers and individual company characteristics are greater indicators of financial success in these areas than procurement spending.

Of the six indicators studied, these three are the mostly closely related to solvency and financial risk. That they showed no relationship with procurement spending should ease fears that the defense industrial base will continue to shrink. While this study does not examine reductions in procurement spending an order of magnitude larger than those now in effect, the current market appears well equipped to absorb the reductions implemented by the 2011 Budget Control Act.

Positive Indicators

There does remain some cause for concern regarding procurement spending and the performance of prime contractors. The data did suggest that the other three indicators studied are related to procurement spending, and the results were significant more than just statistically. Revenue growth over the examined period for the companies studied averaged only 1.7 percent, compared to a 3.7 percent average annual growth rate in GDP over the same period. (U.S Bureau of Economic Analysis 2016) Furthermore, the data suggests that procurement levels in the leaner years of the study corresponded to negative

revenue growth despite opportunities in non-defense related markets being available to many of the companies studied.

P/E ratios were also shown to have a relationship with revenue, and this was the indicator for which procurement explained the most variability within the model, 12 percent. Interestingly, this relationship was opposite of what was expected. As procurement spending increased, P/E ratios fell. Lower P/E ratios are generally linked to lower investor confidence in growth potential or a higher level of perceived risk, and this does not seem to logically follow as a result of increased procurement spending. One possible explanation for this is that investor response to changing procurement spending may be lagged, and due to data limitations, it was not possible to introduce a lag variable in this particular model. It is also possible that share prices were suppressed in spite of positive performance measures due to the anticipated negative impact of the 2011 Budget Control Act. Unfortunately, share prices are as volatile as investor perceptions and not necessarily directly related to performance indicators.

As would be expected from the existence of a relationship between procurement spending and revenue growth, there was also a relationship between procurement spending and annual revenue, though this was initially obscured by the fact that nearly 99 percent of variability in revenues across the data set was explained by the previous year's revenue. Revenue was significant at an alpha of 0.05, but very little additional variability was explained by its inclusion in the model. This suggests that at this point previous performance is the single best predictor of contractor financial performance, and like the

indicators which showed no relationship to procurement, that the defense industrial base has reached a point of equilibrium.

Managerial Implications

While there is clearly a relationship between procurement spending and some indicators of financial performance, it is unlikely that the Budget Act of 2011 will have a negative impact on the defense industrial base. Revenues of defense contractors may be impacted by declining procurement spending, as expected, but other more comprehensive performance indicators show no relationship with procurement spending in this data set.

Maintaining a competitive environment for defense contractors is important to keeping peace-time costs low and ensuring that adequate surge capacity exists in the event of a mobilization, and previous research has already expressed concern about the state of the defense industrial base with regard to lack of competition. This study, however, indicates by a lack of relationship between procurement spending and D/E ratio, current ratio, or profit margin that the current procurement cuts should be insufficient on their own to drive further mergers or negatively impact prime contractors' bottom line. As a result, if current market conditions are considered acceptable for the national defense strategy, it is unlikely that the ongoing Budget Act of 2011 or procurement spending cuts of a similar nature will negatively change that outlook.

This study also contained several examples of revenues increasing by upwards of 25 percent in a single year, and even 84 percent in one case. This would seem to indicate that the prime contractors included in this study are able to increase capacity to cover a

surge in operations even with the lower overall procurement spending levels experienced during this time period.

While some mergers and acquisitions were observed among the top 100 DoD contractors over the course of the study, there were also multiple divestitures, where assets were sold off so contractors could focus on their core competencies. It should be noted, however, that in these cases, no production capabilities were lost, they only changed ownership. In light of this, current efforts to maintain a competitive defense industrial base using the congressionally limited funding available should be sufficient to maintain a surge capacity for wartime operations.

Future Research

This study covers companies from a list of the top 100 DoD contractors. As a result, while it represents those companies receiving the most government money as a result of defense contracts, and subsequently the area where spending could be most substantially curtailed, it does not cover those companies which are most at risk, smaller privately owned companies with a high reliance on government contracts. Future research could use case studies to focus on these smaller privately owned companies providing niche products for the DoD.

Additional research should also be conducted on other factors beyond procurement spending which might impact defense contractors. This study showed that while revenues of the sample population were related to procurement spending, their other financial indicators were not. A better understanding of cost drivers for this population will likely provide insight into overall financial performance. Additionally,

there were several companies, specifically those large companies with only a small percentage of revenue coming from government contracts, which earned that revenue specifically through subsidiaries. It might be worthwhile to compare parent companies' overall performance to the performance of their defense subsidiaries.

Finally, this study included data from a relatively short span of time, and as a result, much of the variability in the data was the result of company-specific drivers. A focus on a select group of contractors over a longer time interval may reveal additional relationships and allow projection of financial indicators into the future.

Appendix A: List of Sample Companies

1. L-3 Communications Holdings Inc.
2. Booz Allen Hamilton Holding Corporation
3. Computer Sciences Corporation
4. CACI International Inc.
5. Harris Corporation
6. Rockwell Collins Inc.
7. Jacobs Engineering Group Inc.
8. Mantech International Corporation
9. Oshkosh Corporation
10. Cubic Corporation
11. Great Lakes Dredge & Dock Corporation
12. AAR Corporation
13. AECOM Technology Corporation

Appendix B: List of Examined Independent Variables

Time Period – Numeric by month, starting with filing month of first K-10 statement

%Gov – Percentage of revenue obtained from the government

Sqrt %Gov – Square root of [%Gov]

%Gov Sq – [%Gov] squared

Cat I – [%Gov] of over 75%

Cat II – [%Gov] of between 25% and 75%

Year – Calendar year over which the majority of the K-10 filling elapsed

PPI - Crude – Rolling 12-month average Producer Price Index for Crude Oil

Exch – Rolling 12-month average US Trade Weighted Exchange Index

Procurement – Weighted average of annual procurement spending

Ln(Pro) – Natural log of [Procurement]

Pro Lag 1 – One-year lag variable for [Procurement]

Ln(Pro Lag 1) – Natural lop of [Pro Lag 1]

PE Lag – One-year lag variable for Price-to-Earnings Ratio

DE Lag – One-year lag variable for Debt-to-Equity Ratio

CR Lag – One-year lag variable for Current Ratio

Revenue Lag – One-year lag variable for Revenue

Ln(Rev) Lag – One-year lag variable for [Ln(Rev)]

Cohort (8) – Rockwell Collins = 1; all others = 0

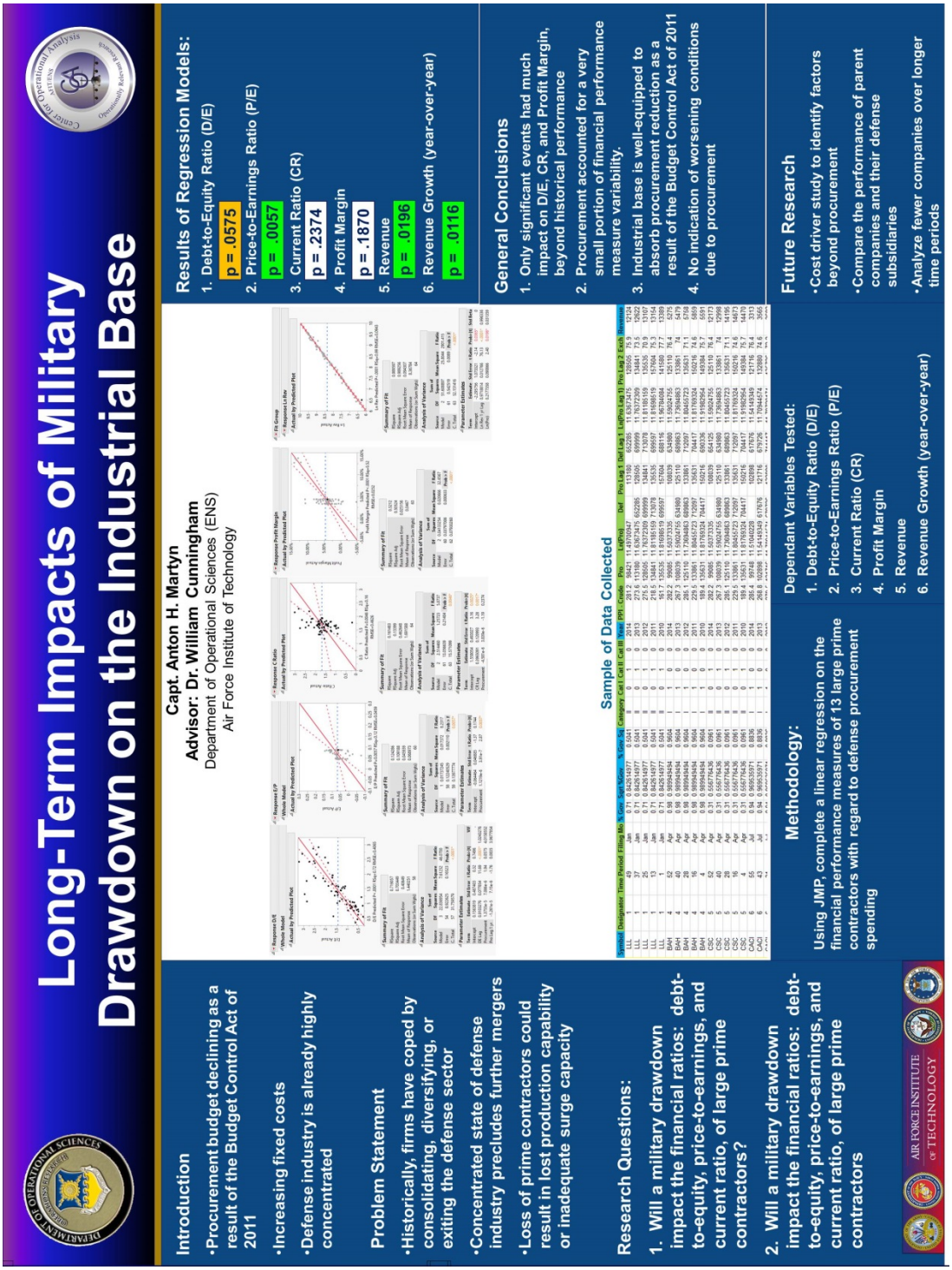
Appendix C: JMP Dataset

	Designator	Filing Mo	% Gov	Sqrt % Gov	% Gov Sq	Category	Year	PPI - Crude	Procurement	Ln(Pro)	Pro Lag 1 yr	Exch	Revenue
1	1	Jan	0.71	0.842614977	0.5041	II	2014	281.2	98421	11.49700947	113180	75.9	12124
2	1	Jan	0.71	0.842614977	0.5041	II	2013	273.6	113180	11.63673475	128505	73.5	12622
3	1	Jan	0.71	0.842614977	0.5041	II	2012	275.5	128505	11.76372309	134841	70.9	13107
4	1	Jan	0.71	0.842614977	0.5041	II	2011	218.5	134841	11.81185159	135535	75.3	13154
5	1	Jan	0.71	0.842614977	0.5041	II	2010	161.7	135535	11.81698519	157604	77.7	13389
6	4	Apr	0.98	0.989949494	0.9604	I	2014	282.2	99085	11.50373335	108039	76.4	5275
7	4	Apr	0.98	0.989949494	0.9604	I	2013	267.3	108039	11.59024755	125110	74	5479
8	4	Apr	0.98	0.989949494	0.9604	I	2012	285.1	125110	11.73694863	133861	71.1	5758
9	4	Apr	0.98	0.989949494	0.9604	I	2011	229.5	133861	11.80455723	135631	74.6	5859
10	4	Apr	0.98	0.989949494	0.9604	I	2010	189.4	135631	11.81769324	150216	75.7	5591
11	5	Apr	0.31	0.556776436	0.0961	II	2014	282.2	99085	11.50373335	108039	76.4	12173
12	5	Apr	0.31	0.556776436	0.0961	II	2013	267.3	108039	11.59024755	125110	74	12998
13	5	Apr	0.31	0.556776436	0.0961	II	2012	285.1	125110	11.73694863	133861	71.1	14195
14	5	Apr	0.31	0.556776436	0.0961	II	2011	229.5	133861	11.80455723	135631	74.6	14673
15	5	Apr	0.31	0.556776436	0.0961	II	2010	189.4	135631	11.81769324	150216	75.7	14470
16	6	Jul	0.94	0.969535971	0.8836	I	2014	285.4	99748	11.51040228	102898	76.4	3313
17	6	Jul	0.94	0.969535971	0.8836	I	2013	268.8	102898	11.54149349	121716	74.6	3565
18	6	Jul	0.94	0.969535971	0.8836	I	2012	279.5	121716	11.70944574	132880	72.2	3682
19	6	Jul	0.94	0.969535971	0.8836	I	2011	249	132880	11.79720174	135726	72.6	3774
20	6	Jul	0.94	0.969535971	0.8836	I	2010	203.2	135726	11.81839343	142827	75.2	3578
21	7	Jul	0.93	0.964365076	0.8649	I	2014	285.4	99748	11.51040228	102898	76.4	5083
22	7	Jul	0.93	0.964365076	0.8649	I	2013	268.8	102898	11.54149349	121716	74.6	5012
23	7	Jul	0.93	0.964365076	0.8649	I	2012	279.5	121716	11.70944574	132880	72.2	5112
24	7	Jul	0.93	0.964365076	0.8649	I	2011	249	132880	11.79720174	135726	72.6	5451
25	7	Jul	0.93	0.964365076	0.8649	I	2010	203.2	135726	11.81839343	142827	75.2	5418
26	8	Oct	0.3	0.547722558	0.09	II	2014	276.7	100412	11.517037	97757	76.7	4979
27	8	Oct	0.3	0.547722558	0.09	II	2013	278	97757	11.49024009	118321	75.3	4474
28	8	Oct	0.3	0.547722558	0.09	II	2012	279.8	118321	11.68115655	131899	73.3	4531
29	8	Oct	0.3	0.547722558	0.09	II	2011	263.3	131899	11.78979176	135822	71	4593
30	8	Oct	0.3	0.547722558	0.09	II	2010	210.7	135822	11.81910048	135439	75.3	4358
31	9	Oct	0.18	0.424264069	0.0324	III	2014	276.7	100412	11.517037	97757	76.7	12695
32	9	Oct	0.18	0.424264069	0.0324	III	2013	278	97757	11.49024009	118321	75.3	11818
33	9	Oct	0.18	0.424264069	0.0324	III	2012	279.8	118321	11.68115655	131899	73.3	10894
34	9	Oct	0.18	0.424264069	0.0324	III	2011	263.3	131899	11.78979176	135822	71	10382
35	9	Oct	0.18	0.424264069	0.0324	III	2010	210.7	135822	11.81910048	135439	75.3	9916
36	10	Jan	0.99	0.994987437	0.9801	I	2014	281.2	98421	11.49700947	113180	75.9	1774
37	10	Jan	0.99	0.994987437	0.9801	I	2013	273.6	113180	11.63673475	128505	73.5	2310
38	10	Jan	0.99	0.994987437	0.9801	I	2012	275.5	128505	11.76372309	134841	70.9	2582
39	10	Jan	0.99	0.994987437	0.9801	I	2011	218.5	134841	11.81185159	135535	75.3	2870
40	10	Jan	0.99	0.994987437	0.9801	I	2010	161.7	135535	11.81698519	157604	77.7	2604
41	11	Oct	0.24	0.489897949	0.0576	III	2014	276.7	100412	11.517037	97757	76.7	6808
42	11	Oct	0.24	0.489897949	0.0576	III	2013	278	97757	11.49024009	118321	75.3	7665
43	11	Oct	0.24	0.489897949	0.0576	III	2012	279.8	118321	11.68115655	131899	73.3	8141
44	11	Oct	0.24	0.489897949	0.0576	III	2011	263.3	131899	11.78979176	135822	71	7539
45	11	Oct	0.24	0.489897949	0.0576	III	2010	210.7	135822	11.81910048	135439	75.3	9772
46	12	Oct	0.63	0.793725393	0.3969	II	2014	276.7	100412	11.517037	97757	76.7	1398
47	12	Oct	0.63	0.793725393	0.3969	II	2013	278	97757	11.49024009	118321	75.3	1361
48	12	Oct	0.63	0.793725393	0.3969	II	2012	279.8	118321	11.68115655	131899	73.3	1404
49	12	Oct	0.63	0.793725393	0.3969	II	2011	263.3	131899	11.78979176	135822	71	1302
50	12	Oct	0.63	0.793725393	0.3969	II	2010	210.7	135822	11.81910048	135439	75.3	1201
51	13	Jan	0.7	0.836660027	0.49	II	2014	281.2	98421	11.49700947	113180	75.9	806.8
52	13	Jan	0.7	0.836660027	0.49	II	2013	273.6	113180	11.63673475	128505	73.5	731.4
53	13	Jan	0.7	0.836660027	0.49	II	2012	275.5	128505	11.76372309	134841	70.9	588.4
54	13	Jan	0.7	0.836660027	0.49	II	2011	218.5	134841	11.81185159	135535	75.3	520.1
55	13	Jan	0.7	0.836660027	0.49	II	2010	161.7	135535	11.81698519	157604	77.7	609
56	14	Jun	0.31	0.556776436	0.0961	II	2014	284.1	99527	11.50818424	104612	76.4	1594
57	14	Jun	0.31	0.556776436	0.0961	II	2013	265.8	104612	11.55801355	122847	74.5	1709
58	14	Jun	0.31	0.556776436	0.0961	II	2012	282.5	122847	11.71869496	133207	71.8	1807
59	14	Jun	0.31	0.556776436	0.0961	II	2011	243.1	133207	11.79965959	135694	73.3	1866
60	14	Jun	0.31	0.5567764	0.0961	II	2010	201.8	135694	11.81815763	145290	75	1724
61	16	Oct	0.15	0.387298335	0.0225	III	2014	276.7	100412	11.517037	97757	76.7	8357
62	16	Oct	0.15	0.387298335	0.0225	III	2013	278	97757	11.49024009	118321	75.3	8153
63	16	Oct	0.15	0.387298335	0.0225	III	2012	279.8	118321	11.68115655	131899	73.3	8218
64	16	Oct	0.15	0.387298335	0.0225	III	2011	263.3	131899	11.78979176	135822	71	8037
65	16	Oct	0.15	0.387298335	0.0225	III	2010	210.7	135822	11.81910048	135439	75.3	6546

	%R delta	Profit	Profit Margin	% P delta	EPS (D)	Stock $	% S delta	P/E	Equity	Debt	D/E	C Assets
1	-4%	677	6%	-11%	7.56	123.12	0.1085	16.28571429	5360	8476	1.581343284	4737
2	-4%	760	6%	-4%	8.24	111.07	0.463	13.47936893	6056	7951	1.312912814	4613
3	-0%	794	6%	-18%	8.03	75.92	0.1189	9.454545455	5539	8287	1.496118433	4571
4	-2%	970	7%	0%	9.03	67.85	-0.0959	7.513842746	6724	8784	1.306365259	6598
5	2%	967	7%	6%	8.25	75.05	-0.0611	9.096969697	6855	8596	1.253975201	5078
6	-4%	233	4%	0%	1.52	27.5	0.2393	18.09210526	186	2691	14.46774194	1163
7	-5%	232	4%	6%	1.54	22.19	0.7069	14.40909091	172	2769	16.09883721	1256
8	-2%	219	4%	-9%	1.45	13	-0.1114	8.965517241	227	2951	13	1424
9	5%	240	4%	182%	1.7	14.63	-0.116	8.605882353	1185	2130	1.797468354	1654
10	9%	85	2%	240%	0.66	16.55	0.1274	25.07575758	907	2117	2.334068357	1366
11	-6%	-8	-0%	-101%	-0.05	64.45	0.0891	-1289	2949	7252	2.459138691	4905
12	-8%	947	7%	25%	6.28	59.18	0.2632	9.423566879	3944	7445	1.887677485	5628
13	-3%	760	5%	-223%	4.89	46.85	0.6696	9.580777096	3160	8091	2.560443038	5673
14	1%	-616	-4%	-78%	-3.97	28.06	-0.4496	-7.068010076	2834	8355	2.948129852	4883
15	-0%	-2832	-20%	-694%	4.73	50.98	-0.0269	-2.78123	7560	8560	1.132275132	7557
16	-7%	126	4%	-7%	5.17	82.13	0.1905	15.88588008	1480	1777	1.200675676	676
17	-3%	135	4%	-11%	5.38	68.99	0.039	12.82342007	1359	2000	1.471670346	736
18	-2%	152	4%	-9%	6.35	66.4	0.1763	10.45669291	1208	1294	1.071192053	728
19	5%	167	4%	16%	5.96	56.45	-0.0445	9.47147651	1164	1224	1.051546392	686
20	14%	144	4%	35%	4.61	59.08	0.2565	12.81561822	1310	1011	0.771755725	782
21	1%	334	7%	-38%	3.11	82.94	0.2149	26.66881029	3402	9727	2.85920047	3524
22	-2%	535	11%	373%	4.95	68.27	0.1963	13.79191919	1825	3094	1.695342466	1991
23	-6%	113	2%	265%	1.01	57.07	0.3702	56.5049505	1561	3297	2.112107623	1948
24	1%	31	1%	-95%	0.26	41.65	0.0446	160.1923077	1946	3647	1.874100719	2600
25	15%	588	11%	5%	4.6	39.87	-0.1046	8.667391304	2512	3661	1.457404459	2217
26	11%	604	12%	-4%	4.52	84.15	0.2051	18.61725664	1889	5174	2.739015352	3204
27	-1%	632	14%	4%	4.56	69.83	0.3033	15.31359649	1623	3777	2.327171904	3094
28	-1%	609	13%	-4%	4.01	53.58	-0.0403	13.36159601	1264	4050	3.204113924	2787
29	5%	634	14%	13%	3.81	55.83	-0.0773	14.65354331	1528	3861	2.526832461	2889
30	-2%	561	13%	-6%	3.34	60.51	0.2011	18.11676647	1486	3578	2.407806191	2689
31	7%	328	3%	-22%	2.48	47.45	-0.2198	19.13306452	4506	3948	0.876165113	3892
32	8%	423	4%	12%	3.23	60.82	0.5761	18.82972136	4248	3026	0.712335217	4040
33	5%	379	3%	15%	2.94	38.59	-0.0054	13.12585034	3759	3080	0.819366853	3612
34	5%	331	3%	35%	2.6	38.8	0.0049	14.92307692	3323	2876	0.865482997	3180
35	-14%	246	2%	-39%	1.96	38.61	-0.087	19.69897959	2865	1819	0.634904014	2767
36	-23%	47	3%	-883%	1.27	32.53	0.1179	25.61417323	1155	333	0.288311688	419
37	-11%	-6	-0%	-106%	-0.17	29.1	0.1796	-171.1764706	1134	590	0.520282187	750
38	-10%	95	4%	-29%	2.57	24.67	-0.298	9.59922179	1165	677	0.58111588	745
39	10%	133	5%	6%	3.63	35.14	-0.1259	9.680440771	1089	671	0.616161616	688
40	29%	125	5%	12%	3.43	40.2	-0.1609	11.72011662	966	624	0.645962733	630
41	-11%	308	5%	-3%	3.61	44.76	-0.0595	12.39889197	1985	2602	1.310831234	2384
42	-6%	316	4%	37%	3.55	47.59	0.5874	13.4056338	2108	2658	1.260910816	2553
43	8%	230	3%	-16%	2.51	29.98	0.4372	11.94422311	1854	3094	1.668824164	2695
44	-23%	273	4%	-65%	2.99	20.86	-0.2931	6.976588629	1597	3230	2.022542267	2455
45	89%	790	8%	-172%	8.69	29.51	-0.056	3.395857307	1327	3382	2.548605878	2216
46	3%	69	5%	176%	2.59	48.24	-0.0811	18.62548263	783	412	0.526181354	765
47	-3%	25	2%	-74%	0.94	52.5	0.0758	55.85106383	717	393	0.548117155	743
48	8%	97	7%	13%	3.64	48.8	0.0357	13.40659341	677	337	0.497784343	701
49	8%	86	7%	18%	3.22	47.12	0.0815	14.63354037	579	387	0.668393782	676
50	17%	73	6%	14%	2.72	43.57	0.2553	16.01838235	513	358	0.69785575	680
51	10%	10.3	1%	-129%	0.17	7.77	0.0319	45.70588235	256	637	2.48828125	342
52	24%	-35	-5%	-1161%	-0.57	7.53	-0.1972	-13.21052632	242	611	2.524793388	361
53	13%	3.3	1%	-81%	0.04	9.38	0.4679	234.5	273	553	2.025641026	314
54	-15%	17.3	3%	-49%	0.28	6.39	-0.231	22.82142857	293	496	1.692832765	326
55	6%	33.7	6%	129%	0.57	8.31	0.4061	14.57894737	277	417	1.505415162	223
56	-7%	10.2	1%	-86%	0.24	31.87	0.1564	132.7916667	845	258	0.305325444	954
57	-5%	72.9	4%	33%	1.83	27.56	0.2539	15.06010929	1001	791	0.79020979	1111
58	-3%	55	3%	-19%	1.38	21.98	0.6306	15.92753623	920	828	0.9	1034
59	8%	67.7	4%	-3%	1.65	13.48	-0.5024	8.16969697	866	857	0.98960739	1063
60	28%	69.8	4%	57%	1.73	27.09	0.6183	15.65896	835	452	0.541317	914
61	3%	230	3%	-4%	2.33	32.55	0.0242	13.96995708	2272	3851	1.694982394	3434
62	-1%	239	3%	-505%	2.35	31.78	0.4802	13.52340426	2074	3592	1.731918997	3132
63	2%	-59	-1%	-121%	-0.52	21.47	0.0263	-41.28846154	2224	3440	1.54676259	3147
64	23%	276	3%	16%	2.33	20.92	-0.2109	8.978540773	2395	3394	1.417118998	2990
65	7%	237	4%	25%	2.05	26.51	0.0503	12.93170732	2138	3104	1.451824135	2946

	C Debt	C Ratio	Defense Funding	Cat I	Cat II	DE Lag	CR Lag	PE Lag	Time Period
1	2525	1.876039604	652285	0	1	1.312912814	1.80689385	13.47936893	49
2	2553	1.80689385	699999	0	1	1.496118433	1.760107817	9.454545455	37
3	2597	1.760107817	713078	0	1	1.306365259	2.344705046	7.513842746	25
4	2814	2.344705046	699597	0	1	1.253975201	1.858031467	9.096969697	13
5	2733	1.858031467	688116	0	1	1.233483483	2.04913522	10.50328515	1
6	849	1.369846879	634980	1	0	16.09883721	1.369683751	14.40909091	52
7	917	1.369683751	689863	1	0	13	1.475647668	8.965517241	40
8	965	1.475647668	712097	1	0	1.797468354	1.809628009	8.605882353	28
9	914	1.809628009	704417	1	0	2.334068357	1.577367206	25.07575758	16
10	866	1.577367206	690336	1	0	5.005882353	1.743002545	66.72727	4
11	3601	1.362121633	654125	0	1	1.887677485	1.625649913	9.423566879	52
12	3462	1.625649913	634980	0	1	2.560443038	1.693938489	9.580777096	40
13	3349	1.693938489	689863	0	1	2.948129852	1.076499118	-7.068010076	28
14	4536	1.076499118	712097	0	1	1.132275132	1.808760172	10.77801	16
15	4178	1.808760172	704417	0	1	1.528426552	2.043182921	9.922348	4
16	400	1.69	617676	1	0	1.471670346	1.739952719	12.82342007	55
17	423	1.739952719	679726	1	0	1.071192053	0.981132075	10.45669291	43
18	742	0.981132075	711117	1	0	1.051546392	1.41443299	9.47147651	31
19	485	1.41443299	709238	1	0	0.771755725	1.789473684	12.81561822	19
20	437	1.789473684	692556	1	0	0.913895993	1.278115502	•	7
21	2281	1.544936431	617676	1	0	1.695342466	1.785650224	13.79191919	55
22	1115	1.785650224	679726	1	0	2.112107623	1.501927525	56.5049505	43
23	1297	1.501927525	711117	1	0	1.874100719	1.838755304	160.1923077	31
24	1414	1.838755304	709238	1	0	1.457404459	0.994170404	8.667391304	19
25	2230	0.994170404	692556	1	0	1.166210046	1.905893536	•	7
26	2198	1.457688808	600371	0	1	2.327171904	1.561837456	15.31359649	58
27	1981	1.561837456	669589	0	1	3.204113924	0.197100424	13.36159601	46
28	14140	0.197100424	710136	0	1	2.526832461	1.932441472	14.65354331	34
29	1495	1.932441472	714058	0	1	2.407806191	1.851928375	18.11676647	22
30	1452	1.851928375	694776	0	1	2.586872587	1.738042678	•	10
31	2350	1.656170213	600371	0	0	0.712335217	2.139830508	18.82972136	58
32	1888	2.139830508	669589	0	0	0.819366853	2.067544362	13.12585034	46
33	1747	2.067544362	710136	0	0	0.865482997	1.466113416	14.92307692	34
34	2169	1.466113416	714058	0	0	0.634904014	2.233252623	19.69897959	22
35	1239	2.233252623	694776	0	0	0.683010262	2.174382716	•	10
36	333	1.258258258	652285	1	0	0.520282187	1.271186441	-171.1764706	49
37	590	1.271186441	699999	1	0	0.58111588	1.925064599	9.59922179	37
38	387	1.925064599	713078	1	0	0.616161616	1.773195876	9.680440771	25
39	388	1.773195876	699597	1	0	0.645962733	1.009615385	11.72011662	13
40	624	1.009615385	688116	1	0	0.346389229	1.756183746	•	1
41	1312	1.817073171	600371	0	0	1.260910816	1.848660391	13.4056338	58
42	1381	1.848660391	669589	0	0	1.668824164	1.580645161	11.94422311	46
43	1705	1.580645161	710136	0	0	2.022542267	1.450945626	6.976588629	34
44	1692	1.450945626	714058	0	0	2.548605878	1.222958057	3.395857307	22
45	1812	1.222958057	694776	0	0	8.240310078	1.291742013	•	10
46	270	2.833333333	600371	0	1	0.548117155	3.020325203	55.85106383	58
47	246	3.020325203	669589	0	1	0.497784343	2.66539924	13.40659341	46
48	263	2.66539924	710136	0	1	0.668393782	2.194805195	14.63354037	34
49	308	2.194805195	714058	0	1	0.69785575	2.437275986	16.01838235	22
50	279	2.437275986	694776	0	1	0.795724466	2.166666667	•	10
51	201	1.701492537	600371	0	1	2.524793388	1.860824742	-13.21052632	49
52	194	1.860824742	669589	0	1	2.025641026	1.688172043	234.5	37
53	186	1.688172043	710136	0	1	1.692832765	2.488549618	22.82142857	25
54	131	2.488549618	714058	0	1	1.505415162	1.676691729	14.57894737	13
55	133	1.676691729	694776	0	1	1.718367347	1.645390071	•	1
56	412	2.315533981	623444	0	1	0.79020979	2.763681592	15.06010929	54
57	402	2.763681592	683105	0	1	0.9	1.248792271	15.92753623	42
58	828	1.248792271	711443	0	1	0.98960739	1.240373396	8.16969697	30
59	857	1.240373396	707631	0	1	0.541317365	2.197115385	15.65895954	18
60	416	2.197115	•	0	1	•	•	•	6
61	2456	1.398208469	600371	0	0	1.731918997	1.524829601	13.52340426	58
62	2054	1.524829601	669589	0	0	1.54676259	0.914825581	-41.28846154	46
63	3440	0.914825581	710136	0	0	1.417118998	0.880966411	8.978540773	34
64	3394	0.880966411	714058	0	0	1.451824135	1.590712743	12.93170732	22
65	1852	1.590712743	694776	0	0	1.160205245	1.422607579	14.58959538	10

Appendix D: Quad Chart



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14. ABSTRACT
Since World War II, competition in the defense industry has fallen by over 90 percent. With the recent defense budget cuts, and reduced procurement spending, each year prime contractors fight over an shrinking piece of the procurement pie, with potential deleterious effects on national security if these contractors go out of business or further consolidate through mergers. This study used data from the Federal Procurement Data System and the Securities Exchange Commission to track 13 of the DoD's top 100 contractors from 2010 through 2015 to determine if a relationship exists between this reduced procurement spending and financial indicators of the tracked companies. Three of the six models developed showed a relationship between procurement spending and financial indicators at the .05 significance level: those of Price-to-Earnings ratio, revenue, and revenue growth. The results of this study show cause for further research to ensure that current strategic management of procurement funding will maintain a healthy defense industrial base.

15. SUBJECT TERMS
Defense Procurement; Prime Contractors; Defense Industrial Base; Financial Indicators

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