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IMPACT OF POLITICAL-ECONOMY VARIABLES ON COST GROWTH IN MILITARY WEAPON SYSTEM CONTRACTS

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ABSTRACT. For decades, cost growth in major military weapon system programs has been problematic. The result is a multitude of studies documenting internally focused causes of Department of Defense (DoD) acquisition cost growth and a spawning of acquisition reforms that have provided little relief to the problem. The missing components of these prior analyses are the larger economic and political factors that contribute to cost growth. This study analyzes cost growth in major DoD development and procurement contracts through a holistic political-economy construct including the effect of the political party of the President and Congress, and the liberal-conservative record of the Armed Services Committees. These political-economy constructs in both development contracts and procurement contracts are found to be more robust.

INTRODUCTION

Cost growth in military weapon systems has been an object of concern and area of active public policy for over thirty years. Despite numerous acquisition reform legislations aimed at the development and procurement processes, cost growth has not subsided (Arena et al, 2006). Indeed, in their most recent report, GAO (2013) finds cost growth of $74.4 billion from the previous year.

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Compounding the issue, in the wake of the Great Recession, proposed austerity measures have intensified the pressure on DoD acquisition programs. Therefore, it is not surprising that cost growth garners significant attention in both public policy actions and interest from researchers.

Understanding the factors that affect cost growth in military weapon system contracts is a necessary first step to providing a solution. Previous research (Drezner et al, 1993; Jarvaise et al, 1996; Swank et al, 2000; Porter et al, 2009; Gansler, 2010) focus on internal linkages to cost growth: funding stability, requirements definition, program management, cost estimation error, and technology readiness are common strands in this literature. Other past research efforts focus on the effects of a specific acquisition reform initiative on cost growth (Searle, 1997; Christensen et al, 1999; Smirnoff and Hicks, 2008). These previous research efforts neglect the public choice literature[1] and must be considered incomplete from a political-economy perspective. Adding to the problem, many of the previous research efforts aggregate the data to Service or OSD level analysis, obscuring the underlying interactions.

Filling the void necessitates an analysis of cost growth in military weapon systems through an integrated political-economy construct at the individual weapon system level. Traditional explanations from the literature on cost growth must be combined with economic and political variables to construct a fully specified model. This paper models the approach through a thorough examination of individual Acquisition Category I (ACAT I) Air Force, Army, and Navy contracts from 2000-2008. Specifically, individual econometric models are developed for the Research and Development (R&D) and procurement phases of individual acquisition programs. This program phase delineation accounts for the unique characteristics of the program's life cycle. In addition, utilizing econometric techniques allows for a complete statistical analysis that incorporates all the hypothesized factors that affect cost growth.

Prior to econometric modeling, several issues are addressed. First, a complete understanding of the cost growth concept is provided. Cost growth denotes different meanings to different audiences, necessitating an explicit definition for this analysis. Following this, an analysis of the existing literature on cost growth is examined. Revealing the findings of previous studies provides insight

into traditional explanations for cost growth and simultaneously allows the unveiling of holes in previous efforts. Econometric models, undergirded by the public choice literature, are then designed to fill those voids.

LITERATURE REVIEW

Understanding Cost Growth

The term cost growth is utilized by different entities for assorted purposes. Therefore, it is imperative to understand who the research is conducted for, the sources of data, and the methodology employed in calculating the cost growth statistic. An accurate assessment of the current state of the cost growth literature is only possible after these distinctions are specified.

Calcutt (1993) states there are three main sources of cost growth research: GAO, IDA, and RAND Corp. Differences between the three sources begin with the intended audience. The GAO conducts their research primarily in support of Congressional interests. Reports are typically provided to the House Armed Services Committee (HASC) and Senate Armed Services Committee (SASC) along with subcommittees on defense appropriations. Thus, the GAO acts as a monitoring and reporting mechanism for legislators in an attempt to overcome principal-agent problems.

GAO primarily relies upon Selected Acquisition Reports (SARs) to conduct data analysis. SARs are an annual DoD publication prepared in conjunction with the President‘s Budget that summarize the latest estimates of cost, schedule and technical status of major weapon systems. Hough (1992) analyzes limitations to using SAR data in cost growth calculations. Three of these limitations deserve increased attention. First, SAR data is highly aggregated. Calculations done at this summary level can be problematic. In particular, the confidence level from the cumulative distribution function associated with the cost estimates is not provided. Second, the cost estimates include future budget year values which are not necessarily consistent with any particular cost estimate (Bolten et al, 2008). Third, GAO calculations do not adjust for quantity changes over the life of the program. Because the GAO methodology for calculating cost growth is a simple ratio of the current estimate to the development

estimate[2], each of the three data limitations must be understood when interpreting their cost growth results.

RAND and IDA, on the other hand, perform their cost growth research primarily for the Department of Defense. Their research focuses on the causes of cost growth rather than on monitoring and reporting findings to Congress. Additionally, although RAND and IDA primarily utilize SAR data for their calculations, there are several differences. For example, their metric for cost growth is called the Cost Growth Factor (CGF). The CGF normalizes the data to a common base year and adjusts for quantity changes (Calcutt, 1993). It further breaks down the data to development and procurement stages of the program's life cycle. These differences must be understood when interpreting RAND and IDA cost growth results.

This paper avoids many of the pitfalls of the SAR data by utilizing cost data from the Defense Acquisition Executive Summary (DAES) database. The DAES database is maintained by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OUSD (AT&L)). DAES data contains monthly submission on cost and schedule status as provided in Contractor Performance Reports (CPRs). The reliability of the CPR data is assured through contractor compliance with the Earned Value Management System (EVMS) (Christensen and Templin, 2000). The Defense Contract Management Agency (DCMA) oversees compliance of the EVMS.

The EVMS is an integrated management system that encompasses a wide range of functions. The subcomponents of the EVMS germane to this analysis involve the tracking of budgets to work packages and subsequent calculation of cost variance. To accomplish this, the EVMS develops an integrated baseline by time-phasing budget resources for defined work. As work is performed and measured against the baseline, the corresponding budget value is earned. From this earned value metric, cost and schedule variances can be determined and analyzed (Defense Contract Management Agency, 2006).

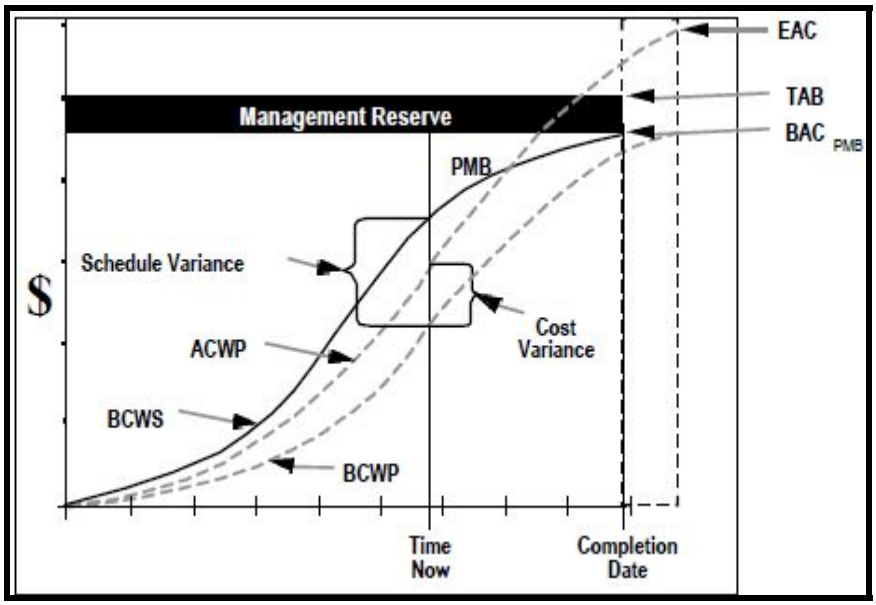
Two components undergird the earned value cost variance calculation. The first component is the Budgeted Cost of Work Performed (BCWP). The BCWP is also known as the "earned value". It is the sum of the performance budgets for all work scheduled to be accomplished within a given time period (Defense Contract

Management Agency, 2006). The second component is the Actual Cost of Work Performed (ACWP). These are the costs actually incurred in accomplishing work performed in a given time period. See Figure 1.

As Figure 1 demonstrates, the cost variance calculation is the difference between the ACWP and BCWP. This methodology for collecting earned value data and calculating cost variance is standardized across the DoD. All major capital acquisition programs with contract values greater than $50 million are required to collect and report EVM data (Defense Contract Management Agency, 2006). Thus, this effort capitalizes on the valuable DAES EVM data to conduct program level analysis of cost variance in military weapon systems.

In summary, it is imperative to understand the definition of cost growth when interpreting cost growth studies. The methodology and data sources employed vary with the intended audience and purposes of the study. While SAR data analysis is the most common,

FIGURE 1
Cost Variance Calculation with EVM (DAU, 2012)



it has many pitfalls. This effort avoids many of those pitfalls by conducting a **lower level analysis with earned value data from the DAES database.**

Causes of Cost Growth and Acquisition Reforms

What are the factors that cause cost growth in military weapon system acquisitions? Several researchers have attempted to answer this question. Table 1 summarizes their findings.

The studies from Table 1 emphasize bureaucratic processes, practices, techniques and oversight. While many individual factors are identified, two stand out. The first is funding instability. A majority of the studies identified program instability due to funding changes as a primary causal factor for cost growth. The second factor that repeatedly appears is inaccurate cost estimates. The recurrent nature of these two factors commands special attention for any model that wants to investigate cost growth and is therefore incorporated into this analysis.

TABLES 1
Causes of Cost Growth Studies

Study	Findings
Singer (1982)	Cost growth most likely to occur in development phase. Funding instability and bidding-in cause cost
Drezner, Jarvaise, Hess, Hough and Norton (1993)	No silver bullet for cost growth. Program size and maturity affect cost growth.
Tyson, Harmon, Utech (1994)	Tactical Missile and Aircraft cost growth factors: poor cost estimates, program instability, concurrency, technical changes.
Czelusniak and Rodgers (1997)	Funding instability due to contingency operations cause cost growth.

TABLES 1 (Continued)
Causes of Cost Growth Studies

Study	Findings
McNutt (1998)	Increased cycle time, funding instability and complex acquisition processes increase cost growth.
McNicol (2004)	Unrealistic cost estimates and lack of enforcement/penalty result in cost growth.
Smirnoff and Hicks (2008)	Funding instability, unexpected inflation, and war cause procurement cost growth.
Bolton, Leonard, Arena, Younossi and Sollinger (2008)	Cost growth dominated by DoD decisions (requirements growth, quantity change, schedule changes). Cost estimation and unanticipated inflation also have impact on cost growth.
Porter et al (2009)	Weakness in program oversight and poor initial program definition and cost estimates cause cost growth.
Selected Acquisition Reports (Annual)	Categories of cost growth: requirements definition, cost estimating, program management, technical, contracting, budgetary.

Logically, the internally focused factors identified in Table 1 have an impact on cost growth. These are significant insights and deserve due diligence. Their importance should not be minimized. However, there are significant voids in these internally bureaucratic focused studies. The political-economy construct is overlooked, rendering the analysis incomplete. These studies omit the larger economic factors that may contribute to cost growth. Similarly, they exclude the political influences that may affect cost growth. Developing a fully specified model that includes all of these factors is the next step needed to advance the research.

A second strand of literature focuses on the effects of acquisition reform initiatives on cost growth in military weapon systems (See Table 2).

TABLE 2
Acquisition Reform Study Findings

Study	Reform	Findings
Gates (1989)	Packard Commission	Qualitative assessment that Packard Commission is unsuccessful in meeting stated goals.
Garcia et al (1997)	DAWIA	DAWIA has enhanced the quality, expertise and professionalism of acquisition workforce, but work remains.
Christensen, Searle, and Vickery (1999)	Packard Commission	Cost growth worsened after the Packard Commission was implemented.
Lorell and Graser (2001)	Multitude	No evidence for military aircraft cost models to be modified due to acquisition reforms, as no cost savings was found.
Holbrook (2003)	FASA	Cost performance unchanged pre and post FASA implementation.
Abate (2004)	FASA	Missile systems cost growth increased after FASA implementation.
Phillips (2004)	FASA	Aircraft cost growth unchanged by FASA.
Hanks et al (2005)	Multitude	Interviews with Army personnel find reform initiatives benefits have not been realized.
Smirnoff and Hicks (2008)	Multitude	Research and Development contracts unaffected by acquisition reforms. Production contracts cost growth decreased with acquisition reform implementation.

Table 2 demonstrates that as a whole, the effect of acquisition reform legislation on cost growth has not transpired as envisioned. Most studies find that reforms have exacerbated the cost growth or had no effect. The limited nature of these studies, however, makes drawing conclusions premature. Several of these studies conducted simple univariate hypothesis tests of mean cost growth pre and post reform implementation. The singular study that did incorporate a more sophisticated econometric analysis made the same political-economy omissions as the studies of table 1. Therefore, the effects of acquisition reform legislation require further analysis. Analyzing the effects of each individual reform is beyond the scope of this effort. However, those reforms that are predominate for the time period examined here are included as part of the fully specified econometric model.

METHODS

Data and Model

DoD acquisition programs have considerable variation in size. Programs are designated as Acquisition Category (ACAT) I, II, or III based on RDT&E and Procurement dollar thresholds (Department of Defense, 2008). DAES reporting occurs for Major Defense Acquisition Programs (MDAP), which fall under the ACAT I designation. Due to the large dollar value, these programs are likely to generate the most interest from bureaucrats, legislators and defense industry companies. This makes a holistic political-economy analysis of these programs especially fruitful.

Econometric models are developed for both the development and procurement phases of the military program from 2000-2008. Unbalanced panel models are constructed for both phases. An unbalanced panel model is necessary because each weapon system panel is not active over the entire period of analysis. In total, over 485 data points from Air Force, Army, and Navy ACAT I programs are analyzed.

Dependent Variable

The dependent variable in the model is the cost variance percentage for an individual ACAT I weapon system contract. The

cost variance is calculated as the percentage difference between actual and planned costs through a utilization of DAES EVM data.

Independent Variables

Independent variables selection starts with the internally focused variables from the literature review. Additional variables that capture broader economic influences, special interests, and political influence are added to complete the holistic political-economy model. All of the independent variables are normalized to real dollars. See Table 3 for a list of the independent variables and their ex ante anticipated sign. A discussion of each variable follows.

TABLE 3
Independent Variables

Independent Variable	Category	Anticipated Sign
Defense Dollars Spent in State	Economic	+
Defense Employment in State	Economic	+
% Real Change GDP	Economic	-
% Real Change Defense	Acquisition Program	-
Cost Estimation Error	Acquisition Program	-
Number of Lobbyists	Special Interest	+
Campaign Contributions to Representatives	Special Interest	+
Total Defense Company Cont.	Special Interest	+
Average ADA Rating – HASC	Ideology	-
Average ADA Rating – SASC	Ideology	-
Democratic Control of House	Govt.	-
Democratic Control of Senate	Govt.	-
Democratic Control of	Govt.	-
Acquisition Reform Legislation	Acquisition Reform	+
Time of War	Other	+

Economic Variables

Three traditional economic variables are included in the model: percentage real change in GDP, defense spending in individual states where acquisition programs are performed, and DoD employment in

individual states where acquisition programs are performed. DoD employment and defense spending are expected to be positively correlated with cost variance. Undergirding the positive correlations is the modeling of individuals as rational agents with standard *homo economicus* assumptions. DoD employment levels and defense contract spending indicate a level of general support for defense programs in a given state. The more important defense is to the population of the state, the more tolerant it is to deviations in defense contracts. Percentage real change in GDP, however, is negatively correlated with cost growth. A growing economy results in more dollars available for defense spending. Higher confidence levels are therefore selected in cost estimates which reduces cost growth.

Acquisition Program Variables

As discussed earlier, previous research efforts find two recurring explanations for cost growth: funding instability and inaccurate cost estimates. These variables are both included in the econometric models. The first variable, funding instability, is modeled as the percentage real change in defense budgets. The development model utilizes the percentage real change in the RDT&E appropriation while the procurement model utilizes the procurement appropriations. The funding instability variable is expected to be negatively correlated with cost growth. The second variable, cost estimation error is modeled through inflation errors. Every weapon system cost estimate incorporates inflation predictions for current and future years. The estimation error variable is calculated as the forecasted inflation less the actual inflation in the year the money is used. Estimation error is expected to be negatively correlated with cost growth. The greater the forecasted inflation in relation to the actual inflation realized, the smaller the cost overrun.

Special Interest Variables

Three variables capture the effects of special interests: lobbyists, campaign contributions to representatives, and individual defense company contributions. All three are expected to be positively correlated with cost growth. The first variable captures the number of lobbyists hired by the prime contractor for each acquisition program. Lobbying efforts are an attempt to obtain or maintain a privilege. The larger the lobbying effort, the more likely large cost growth is

tolerated. The second variable captures campaign contributions by the defense industry to legislators in the House of Representatives from the state in which the individual acquisition program contract work is performed. The third variable narrows the data down to the specific defense industry company associated with the specific acquisition program. This variable records the total dollars each of these companies contributed to Congress as a whole. The expectation is that cost growth increases as more money is provided to legislators.

Ideology Variables

The public choice literature details the importance and influence of committees. The Armed Services Committees in the House and Senate are the most important to defense issues. Americans for Democratic Action (ADA) provide a measure of the voting record for individual legislators. Higher ADA ratings denote a more liberal voting record. Given the historical relationship of liberal legislators being less supportive of defense, it is expected that higher ADA ratings are negatively correlated with cost growth. However, for the period encompassed in this study, Republican legislators displayed a propensity to spend at a rate more traditionally associated with Democratic ideology. At the same time, Democrats were more likely to support defense due to the wars in Afghanistan, Iraq and the larger global war on terror. Given these factors, ADA ratings may not have as great an impact as normally expected. Additionally, as argued by Niskanen (1971), defense committees in particular may not be as powerful as other committees due to the asymmetric information the defense bureaucracy possesses. The model incorporates ideology through two variables: average HASC ADA rating and average SASC ADA rating.

Governmental Interrelationship Variables

Related to the ideology variables discussed above is the control of government variables. Republican and Democratic platforms place different importance on military matters. Republicans typically emphasize national defense as a top priority for government, while Democrats are less supportive. Thus, which party has majority control of the government (and the resulting interrelationships during split government) are important.

Three dummy variables are included in the model: control of the House, Senate, and Presidency. Each variable is coded a "one" during years of Democratic control. Given this coding structure, it is expected that the government control variables are negatively correlated with cost growth.

Other

The last two variables capture the influence of acquisition reform legislation and times of war. Most acquisition reforms, including the Nunn-McCurdy legislation, state that their goal is cost reduction. However, the literature review revealed that acquisition reforms have exacerbated cost growth. Therefore, in contrast to the stated goals of the legislation, it is anticipated that acquisition reforms are positively correlated with cost growth.

A time of war dummy variable recognizes the Global War on Terror (GWOT). This variable is coded a "one" for the years 2002-2008. The year 2002 is included as the first year since any military operations that would materially affect acquisition programs would not have been realized until 2002 (despite combat operations beginning in October 2001). This war variable is expected to be positively correlated with cost growth.

RESULTS

Development Model Results

Several diagnostics are addressed before the development model result is finalized. First, multicollinearity in the independent variables is examined. An iterative process of scatter plot and correlation matrix evaluations resulted in the *defense employment in state* variable being removed. Second, the Hausman specification test revealed that the model should incorporate random effects rather than fixed effects. Random effects modeling allows for time invariant variables to be added as independent variables in the model. Dummy variables for the Air Force, Army, Navy and DoD are therefore added to the model. Third, the dependent variable is tested to determine if it is stationary. A Fisher-type unit root test based on the augmented Dickey-Fuller test was run. It determined that the dependent variable is stationary. Fourth, the Breusch and Pagan Lagrangian multiplier test for random effects was run. This test is

designed to determine if a pooled model rather than a random effects model should be used. The null hypothesis of the test is that the variance of the groups is zero. The test revealed that the random effects model is the appropriate technique for this data.

Testing for autocorrelation and heteroskedasticity are the two final tests of the development model. Wooldridge (2002) developed an autocorrelation test for panel-level data. The null hypothesis states there is no first-order autocorrelation. Conducting the test on the development model data confirmed the null hypothesis. Autocorrelation is not a problem in this model. Similarly, the assumption of constant variance, or homoskedasticity, is tested. A modified Wald statistic for groupwise heteroskedasticity in the residuals is calculated. The test reveals that heteroskedasticity is present. To correct for this, robust standard errors are utilized in the model (Torres-Reyna, 2010).

With the development model now fully specified, two individual models are run. The first model includes those variables hypothesized in the literature review as traditional explanations of acquisition program cost growth plus the economic variables. The second model builds upon the first, adding the special interests, ideology, governmental and acquisition reform variables. The intent of the second model is to determine whether taking a more holistic political-economy construct provides better explanatory power. See Table 4.

Table 4 demonstrates that the political-economy model is a better fit. With a fully specified model, acquisition program variables are significant predictors. Specifically, the model confirms previous studies findings that funding instability is correlated with cost variance. The dollar impact is not trivial. In fiscal year 2010, a ten percent cut in research and development would have predicted an additional 709 million dollars of cost growth. In contrast, the cost estimation error variable did not have predictive power. This finding is contrary to earlier studies that detailed it as a causal factor.

The broader economic variables also have predictive power for cost variance. Focusing on real GDP, a one-percent increase in GDP results in a one percent decrease in cost variance. Similarly, state defense spending is found to be positively correlated with cost

variance. However, this result must be interpreted with caution as it is only significant at the 0.15 level.

TABLE 4
Development Model Regression Results

	Model 1 - Economic & Acquisition Program Variables			Model 2 – Full Political-Economy Model		
Independent Variable	Coef.	Robust Std. Err.	Co-rrect Sign	Coef.	Robust Std. Err.	Correct Sign
Defense Dollars Spent in State	8.60e-06	.0000207	Yes	.0000623*	.0000413	Yes
% Real Change GDP	-.3767352	.3704036	Yes	-1.00214***	.5041977	Yes
% Real Change Defense Budget	-.096154**	.0550608	Yes	-.090222**	.0530044	Yes
Cost Estimation Error	-.5239638	.8805028	Yes	-1.858466	2.222214	Yes
Number of Lobbyists				.0109954	.0121584	Yes
Campaign Contr. to Reps.				-7.78e-07	2.40e-06	No
Total Defense Company Contr.				-9.68e-07	1.59e-06	No
Average ADA Rating - HASC				.0260971	.1597899	No
Average ADA Rating - SASC				-.2595239	.2280141	Yes
Democratic Control of House				3.112591	2.350945	No
Democratic Control of Senate				-.808109	1.338646	Yes
Democratic Control of Presidency				-2.48766*	1.585342	Yes
Acquisition Reform Legislation				3.225456	2.53631	Yes
Time of War				-2.854923***	.9089218	No
R^2	0.0417			0.0838		
***=0.05 sig. **=0.10 sig. *=0.15 sig.	Chi-square test p-value:	0.6069		Chi-square test p-value:	0.0013	

Interestingly, the inclusion of political variables takes a model without predictive power (model 1) and generates a much better model (model 2). Although individual special interest and ideology variables do not contain statistically significant predictive power, inclusion of them in the model is of paramount importance to the overall model's predictive power. Additionally, the control of government is found to be important. Specifically, democratic control of the Presidency is predicted to decrease cost variance by 2.4%. However, this finding is only statistically significant at the 0.15 level and must be interpreted with caution.

Two other points merit attention. First, it is important to note that the acquisition reform variable is not statistically significant. Although this finding does not statistically support the hypothesis that acquisition reform legislation exacerbates cost variance, the positive sign on the coefficient lends support to the idea that the legislation is not helping mitigate cost growth. Second, the war variable has a large impact on cost variance, decreasing it by 2.8 percent. However, the war variable's sign is contrary to the anticipated sign. One explanation for the negative sign may be that in times of war the importance of the capability the acquisition program provides overrides the politician's desire for peace-time "pork". Attention to the program is more focused. Importance is placed on matching skill-sets to ensure the best program manager available is employed on a given program. The emphasis becomes fielding capability as quickly as possible at the least cost.

Procurement Model Results

The procurement model analysis takes the same approach as the development model. Model 1 incorporates only the traditional explanatory variables from the literature review. Model 2 builds upon model 1 to incorporate the holistic political-economy approach. See Table 5.

As shown in Table 5, the fit of Model 2 is superior to model 1. Focusing on model 2, there are several important results. First, consistent with the development model results, the percent change in real GDP is statistically significant in the procurement model. The dollar impacts are large. A one percent increase in real GDP results in a decrease of 774 million dollars in procurement contracts cost

TABLE 5
Procurement Model Regression Results

	Model 1 - Economic & Acquisition Program Variables			Model 2 – Full Political-Economy Model		
Independent Variable	Coef.	Robust Std. Err.	Correct Sign	Coef.	Robust Std. Err.	Correct Sign
Defense Dollars Spent in State	0.0000239	0.000062	Yes	.0000956	.000106	Yes
% Real Change GDP	.3634551	.5700904	No	-.7208959**	.4261971	Yes
% Real Change Defense Budget	-.0614089	.0598547	Yes	.007599	.1194411	No
Cost Estimation Error	.4323063	1.136835	No	-.6734779	1.989863	Yes
Number of Lobbyists				-.0262632**	.014518	No
Campaign Contr. to Reps.				5.97e-08	4.64e-06	Yes
Total Defense Company Contr.				9.74e-07	2.43e-06	Yes
Average ADA Rating - HASC				-.1858894	.2845781	Yes
Average ADA Rating - SASC				-.166343	.267636	Yes
Democratic Control of Senate				2.398442	3.791914	No
Democratic Control of Presidency				3.736365	3.928055	No
Acquisition Reform Legislation				2.848931**	1.65156	Yes
R^2	0.1836			0.2912		
***=0.05 sig. **=0.10 sig. *=0.15 sig.	Chi-square test p-value:	0.0679		Chi-square test p-value:	0.0000	

growth. Second, the internal acquisition program variables described as causal factors in previous research are not found to be significant in this fully specified political-economy model. This highlights a potential pitfall in utilizing a solely internally focused model. Third, the effects of acquisition reforms are found to be consistent with the hypothesis. Acquisition reforms are found to be *positively* correlated, exacerbating cost variance. Fourth, special interests, in the form of lobbyists are found to be statistically significant. However, the sign is contrary to the expectation. An increase in the number of lobbyists is correlated with a *decrease* in cost variance. Perhaps communication can explain this contrarian result. More lobbyists equate to increased lines of communication. This increased feedback mechanism may result in less cost growth. Supporting this view are economists, such as Milton Friedman, who until very late in his career viewed interest groups as providers of information rather than as policy lobbyists. Another possibility is that lobbyists inflate the planned costs, so that cost variance is mitigated. Lastly, the committee results are consistent with the development model findings.

CONCLUSION

Cost growth in DoD acquisition programs remains a problem. Understanding the factors that influence cost growth is a necessary first step in mitigating the issue. While previous efforts have been undertaken to analyze cost growth, the highly aggregated data and narrow focus provide incomplete understanding. This research highlights that a holistic political-economy model can bridge that gap.

Specifically, the importance of broader economic variables (which was largely ignored in previous research) is demonstrated. Real GDP is found to be highly significant in both models while defense dollars spent in a given state is significant in the development model. Additionally, while previous research found that acquisition reforms did not materially reduce cost growth, the economic models employed here find they exacerbated cost growth. This is important as legislation, such as WSARA, is implemented and as future internally focused acquisition reforms are contemplated.

Finally, several important topics relevant to the public choice literature are unveiled. Defense committees are found to be correctly modeled through the Niskanen (1971, 1975) lens. The bureaucracy's asymmetric advantage is apparent through the

statistical insignificance of the HASC and SASC variables. Additionally, the importance of including special interest and other variables is shown. The holistic political-economy model (in the spirit of the public choice literature) obtained much better fits. This brings us to the current acquisition frontier. If we are to move the ball forward and understand the ramification for DoD procurement, future research efforts must capitalize on this finding and ensure their models incorporate this approach.

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NOTES

1. See Black (1948), Downs (1957), Buchanan and Tullock (1962), Olson (1965, 1982), and Tullock (1967) for seminal works in the pubic choice tradition. Additionally, see *Politics as Public Choice, The collected works of James M. Buchanan Vol. XIII* for a comprehensive volume on Buchanan's pubic choice theory.
2. SARs contain several types of cost estimates that are used to calculate cost growth. All GAO cost growth calculations begin with the "current" estimate. The current estimate is then compared to a SAR "baseline" estimate. Common practice is to designate the cost estimate when the program enters full-scale development (called the development estimate) as the baseline estimate. When development estimates are not available, GAO uses the "planning" estimate to compare to the current estimate.

REFERENCES

Abate, C. C. (2004). *An Analysis of Missile Systems Cost Growth and Implementation of Acquisition Reform Initiatives Using a Hybrid Adjusted Cost Growth Model.* MS Thesis, School of Engineering

and Management, Air Force Institute of Technology, Wright-Patterson AFB: OH.

Arena, M. V., Leonard, R. S., Murray, S. E., & Younossi, O. (2006). *Historical Cost Growth of Completed Weapon System Programs.* Santa Monica, CA: RAND Corporation.

Black, D. (1948). "On the Rationale of Group Decision-making." *The Journal of Political Economy*, *56*: 23-34.

Bolton, J. G., Leonard, R. S., Arena, M. V., Younossi, O., & Sollinger, J. M. (2008). *Sources of Weapon System Cost Growth.* Santa Monica, CA: RAND Corporation.

Buchanan, J. M. (2000). *Politics as Public Choice: The Collected Works of James M. Buchanan: Volume XIII*. Indianapolis, IN: Liberty Fund.

Buchanan, J. M., & Tullock, G. (1962). *The Calculus of Consent*. Ann Arbor: University of Michigan Press.

Calcutt, H. M. (1993). *Cost Growth in DoD Major Programs: A Historical Perspective.* (Executive Research Project.) Washington, DC: The Industrial College of the Armed Forces, Fort McNair, National Defense University.

Christensen, D. S., & Templin, C. (2000). "An Analysis of Management Reserve Budget on Defense Acquisition Contracts." *Acquisition Review Quarterly*: *7*(3): 191-208.

Christensen, D. S., Searle, D. A., & Vickery, C. (1999). "The Impact of the Packard Commission's Recommendations on Reducing Cost Overruns on Defense Acquisition Contracts." *Acquisition Review Quarterly*, *6*(3): 251-262.

Czelusniak D. P., & Rodgers, P. D. (1997). "The Kaminski Initiative." *Program Manager, 24*: 59-65.

Defense Acquisition University (DAU) (2012). *Earned Value Management Gold Card*, [On-line]. Available at https://acc.dau.mil/evm [Retrieved on February 5, 2012].

Defense Contract Management Agency (2006). *Department of Defense Earned Value Management Implementation Guide.* [On-line]. Available at http://guidebook.dcma.mil/79/EVMIG.doc [Retrieved on January 28, 2012].

Department of Defense (2008, December 8) *Operation of the Defense Acquisition System*. DoD Instruction 5000.2. Washington, DC: DTIC.

Downs, A. (1957). "*An Economic Theory of Democracy."* New York: Harper & Row.

Drezner, J. A, Jarvaise, J. M., Hess, R., Norton, D. M., & Hough, P. G. (1993). "*An Analysis of Weapon System Cost Growth."* Santa Monica, CA: RAND Corporation.

Gansler, J. S. (2010). "The Effect of the Nunn-McCurdy Amendment on Unit Cost Growth of Defense Acquisition Projects." Naval Postgraduate School Acquisition Symposium, May 12, Monterey, California.

Garcia, A., Keyner, H., Robillard, T. J., & VanMullekom, M. (1997). "The Defense Acquisition Workforce Improvement Act: Five Years Later." *Acquisition Review Quarterly*, *4*(3): 295-314.

Gates, W. (1989). *Department of Defense Procurement Policy Reform: An Evolutionary Perspective.* Naval Postgraduate School, Monterey, CA.

Government Accountability Office (2013, February). "*High Risk Series: An Update.* (GAO-13-283). Washington, DC: Author.

Hanks, C. H., Axelband, E. I., Lindsay, S., Malik, M. R., & Steele, B. D. (2005). *Reexamining Military Acquisition Reform: Are We There Yet?* Santa Monica, CA: RAND Corporation.

Holbrook, M. A. (2003). *An Analysis of the Implementation of Acquisition Reform Initiatives and Cost Variance.* MS Thesis, School of Engineering and Management, Air Force Institute of Technology, Wright-Patterson AFB: OH.

Hough, P. G. (1992). *Pitfalls in Calculating Cost Growth from Selected Acquisition Reports.* Santa Monica, CA: RAND Corporation.

Jarvaise, J. M., Drezner, J. A., Norton, D. (1996). *Cost Growth Analysis Using Selected Acquisition Reports.* Santa Monica, CA: RAND Corporation.

Lorell, M., & Graser, J. C. (2001). "An Overview of Acquisition Reform Cost Savings Estimates." Santa Monica, CA: RAND Corporation.

McNicol, D. L. (2004). *Growth in the Costs of Major Defense Procurement Programs*. Alexandria, VA: Institute for Defense Analysis.

McNutt, R. (1998). *Reducing DoD Product Development Time: The Role of the Schedule Development Process.* Ph.D. Dissertation, Cambridge, MA: Massachusetts Institute of Technology.

Niskanen, W. A. (1971). *Bureaucracy and representative government*. Chicago, IL: Aldine Atherton.

Niskanen, W. A. (1975). "Bureaucrats and Politicians." *Journal of Law and Economics*, *18*: 617-643.

Olson, M. (1965). *The Logic of Collective Action: Pubic Goods and the Theory of Groups*. Cambridge, MA: Harvard University Press.

Olson, M. (1982). *The Rise and Decline of Nations: Economic Growth, Stagflation, and Social Rigidities*. New Haven, CT: Yale University Press.

Phillips, R. A. (2004). *An Analysis of Aircraft Weapon System Cost Growth and Implementation of Acquisition Reform Initiatives Using a Hybrid Adjusted Cost Growth Model.* MS Thesis. Wright-Patterson AFB, OH: School of Engineering and Management, Air Force Institute of Technology.

Porter, G., Gladstone, B., Gordon, C. V., Karvonides, N., Kneece, R. R., & Mandlebaum, J. (2009, December). *The Major Causes of Cost Growth in Defense Acquisition.* IDA P-4531, Alexandria, VA: Institute for Defense Analyses.

Searle, D.A. (1997). *The Impact of the Packard Commission's Recommendations on Reducing Cost Overruns in Major Defense Acquisition Programs.* MS Thesis, Wright-Patterson AFB, OH: Graduate Cost Analysis Masters Program, Air Force Institute of Technology.

Singer, N. M. (1982). *Cost Growth in Weapon Systems: Recent Experience and Possible Remedies.* Washington, DC: Congressional Budget Office.

Smirnoff, J. P., & Hicks, M. J. (2008). "The Impact of Economic Factors And Acquisition Reforms on The Cost of Defense Weapons Systems." *Review of Financial Economics*, *17* (1): 3-13.

Swank, W. J., Alfieri, P. A., Gailey III, C. K., & Reig, R. W. (2000). *Acquisition Trend Metrics in the Department of Defense* (Defense Acquisition University Technical Report TR 1-00). Alexandria, VA: DAU Press.

Torres-Reyna, O. (2010). *Panel Data Analysis, Fixed & Random Effects* (using Stata 10.X). New Haven, CT: Yale University [Online]. Available at http://dss.princeton.edu/training/.

Tullock, G. (1967). "The Welfare Costs of Tariffs, Monopolies, and Theft." *Western Economic Journal*, *5*: 224-232.

Tyson, K. W., Harmon, B. R., & Utech, D. M. (1994). "*Understanding Cost and Schedule Growth in Acquisition Programs.*" Alexandria, VA: Institute for Defense Analysis.

Wooldridge, J. M. (2002). "*Econometric Analysis of Cross Section and Panel Data*." Cambridge, MA: MIT Press.