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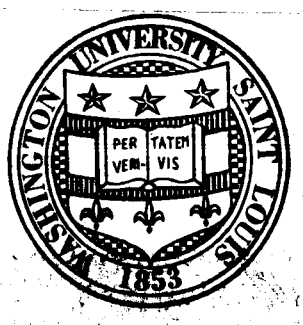

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EMPLOYMENT IMPACTS OF DEFENSE EXPENDITURES AND OBLIGATIONS

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1. Introduction

The importance of accurately specifying the impacts of military procurement in models of the economy is apparent. One of the potentially most important applications of such models is to generate the responses of the economy to changes in procurement activity and to evaluate the effects of alternative courses of government action designed to reduce the economic hardships associated with large and rapid changes in military procurement. An inaccurate specification of equations describing the impacts of government actions may seriously mislead planners in devising appropriate offsetting policies. For example, if the major changes in defense employment occur at the order-letting stage, rather than the expenditure or final delivery stage, as several models suggest, necessary modifications in fiscal and monetary policy may be delayed about a year.

From another point of view the empirical work contained in this paper is an attempt to include instrumental variables, variables which can be directly controlled by policy makers, in models designed to describe the behavior of the economy, as stressed by Orcutt, [15]. It will be pointed out that several of the existing models of the economy do not include the appropriate instrumental

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variables, making it difficult to consider alternative courses of action. In fact, the whole area of effects of government spending has not been studied extensively.[1]

For the purpose of analyzing the employment impacts of military expenditures and obligations, the paper proceeds as follows: 1) A brief review of the process by which a procurement action moves from the budget stage to the delivery and final payments stage is presented. Based on this process, implications are drawn about the appropriate variables to be entered into equations describing the impacts on employment of procurement actions. 2) Several existing models of the economy, those with fairly well-developed government sectors, are examined in the light of 1) to see if they accurately reflect the process. 3) Empirical work is presented which attempts to estimate the employment impacts of the process in two important defense industries. A concluding section summarizes the paper and points out some important data and research needs.

2. The Military Procurement Process and Some Implications

The discussion which follows briefly reviews the military procurement process and indicates the implications of this process for empirical research designed to estimate the economic effects of procurement actions.[2]

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[1] The following comment makes the point well: "When we began our work we expected that our main job would be to study very closely the detailed timing relations implicit in already established quantitative measures of the effectiveness of monetary and fiscal policy. We soon realized that no such foundation of established quantitative knowledge existed about (1) the working of the money and credit mechanism or (2) a large portion of the mechanism through which fiscal policy works. We found ourselves in the trying position of searching for a needle in a haystack, when no evidence had ever been produced that the haystack contained a needle in the first place." (1, P.1)

[2] More detailed analysis of this process may be found in [10], [16], and [23].

The process normally begins with the submission of the President's Budget in January, on which Congressional hearings are held. Later in the year appropriations bills are passed, providing the Department of Defense with authority to spend. During the year the Defense Department incurs obligations; in the case of procurement, these are generally in the form of contracts with private industry. To complete the process, expenditures are made as the finished products are delivered.

To measure impacts on output, employment, or income, which stages in the procurement process are crucial? Subject to several qualifications discussed below it appears that the contract-letting, or obligations, stage is most significant. At this stage the contractor adjusts employment, output, income payments as he takes steps to fill the order. As production is undertaken inventories are increased; these are reflected in GNP.[3] Eventually, the product is completed and payment is received by the firm. An important implication of this description, for the case in which production and delivery requires some time, is that the employment and income effects are felt prior to the expenditure--in some cases many months prior.

As indications that these lead times are significant, it might be noted that 27.8% of the 1960 total of procurement and RDTE was negotiated in the category: "Technical or specialized supplier requiring substantial initial investment or extended period of preparation for manufacture." [20, p.23]

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[3] Conceptually, for national income accounting purposes, work in progress, on which progress payments have or have not been paid, should be included in inventories. Unfortunately, company accounting practices make it difficult for the national income accountants to do this, since funds expended on such inventories are often reflected in accounts receivable, rather than in inventories. On the government side of the accounting, however, the amount called "government purchases of goods and services" is on a delivery basis. Progress payments paid during production do not appear as purchases until final delivery is made, at which time the total expended on the contract is recorded as purchases. The foregoing refers to equipment contracts; construction contracts are treated somewhat differently.

Other evidence is reported by Weidenbaum, [23, p. 11], who points out that the lag between ordering and production for rifles, destroyers, transport planes, bombers, and jet planes is two or more years. Empirical work of Ando and Brown [2] supports the view that obligations affect output. Their contribution will be discussed more fully below.

Several additional features of the defense industry and the procurement process complicate the above description. First, defense firms often submit proposals to the Defense Department describing projects which might be of interest to the Department. While a certain amount of this type of work is likely to be going on all the time, greater activity may take place in response to information from the Department of Defense regarding its views on national security needs. Information is made available to the defense industries in various ways, including speeches by officials in the Department and amounts requested in the Budget message. Though the former is fairly difficult to quantify, the Budget is readily available. Also, to the extent that the Department has unobligated appropriations in various accounts, information on the possibility of future obligations is passed on to the industry. Second, if off-the-shelf items are supplied, the effect of the government orders depends on firms' inventory policies and positions. If they were overstocked, for example, there may be few effects on employment and output until inventories are further reduced. In specialized defense firms this is probably not very important. Third, in many contracts the typical procedure is for the firm to bill the government as production takes place. These progress payments are made although no delivery takes place. In the past several years changes in progress payments have occurred which are of some importance: the percentage of costs paid monthly has been changed from 100% to 80% and then back to 100%. Peck and Scherer suggest that the ability of defense firms to operate is affected by their access

to working capital, so that amounts received from the government might have an independent affect. [16, p. 162-3]. Fourth, it is likely that firms do not respond completely to new contracts of a month-to-month basis, due perhaps to the high costs of rapid employment change.

These considerations suggest that a model designed to predict the impacts of changes in government procurement actions on employment should include among the independent variables:

1. "Announcement" effects, specifically, budget plans and unobligated appropriations.
2. Expenditures, to allow for the importance of working capital.
3. Obligations, to measure the direct impact of contract letting. Several lags will be incorporated to capture the possibility that firms do not respond fully on a month-to-month basis.

Additional variables are needed to capture the effects of two other variables: price changes and changes in the amount of subcontracting. Since the empirical work will relate money amounts of expenditures and obligations to employment, changes in the price level will weaken the relationship. In a period of rising prices, for example, the same amount of obligations would lead to a smaller amount of employment.

Changes in the amount of subcontracting are important because the Department of Defense budget categories and the SIC employment categories do not cover the same industries. This problem is described more fully in the Appendix to this section; briefly, Department of Defense budget categories are concerned with end items, such as aircraft or ships, while the SIC data are keyed to the major product class of individual establishments. The tendency for more electronics equipment to be included in ships is reflected in the Department of Defense data in the "ships" account, while in the employment data, it is reflected in the electronics category. This factor should operate negatively

on employment: a given amount of dollars obligated for ships will lead to less employment in shipbuilding establishments, the more electronic equipment is included in the ship.[4] I attempt to allow for these affects by another variable:

4. Polynomial in time, to allow for trends in subcontracting and price changes.

The use of a trend variable will, of course, pick up other smoothly changing omitted variables. In the present study, changes in the amount of procurement purchased from foreign sources may be one such variable.

Finally, although I suspect that much of the seasonal variation in the monthly employment series is due to the seasonality in the obligations series, conventional holiday periods and climatic conditions may be significant. These are allowed for by a set of variables:

5. Set of seasonal dummy variables, with January omitted.

Employment will be measured by 1) total workers, 2) production workers, 3) production workers times average weekly hours. These all reflect different types of adjustments. It is anticipated that the man-hours variable will be most sensitive to changes in obligations, since adjusting the length of the work week is generally the fastest way to increase output. The number of production workers should be more sensitive to obligations than total workers, since the latter includes a large component of managerial and research people, who may be more insulated from changes in productions. To the extent, however, that research personnel are involved, the "announcement" variables may exert a greater impact on total workers than on production workers.

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[4] The effects of price changes and changes in subcontracting are discussed by Hitch in [7, p. 694].

3. Review of Previous Empirical Work

The discussion of the previous section leads to the conclusion that the structure of the government procurement process is such that the prime effects on employment and output will be felt some after the order or obligations stage, with secondary effects operating through expenditures and announcements. With that in mind, some empirical work in which government purchases of goods plays an important role will be examined; this work includes four large scale models of the economy and two papers which emphasize the importance of obligations.[5]

Two other models were examined, but will not be reported in detail since their government sectors are not greatly elaborated. These include the Wharton School Quarterly Economic Model, [9], and T. C. Liu's Quarterly Model, [11]. In the Klein model, government purchases appears only in the identity for GNP. Other possible routes through which defense procurement could flow are through new orders and unfilled orders. New orders, however, are a function of recent sales and price changes, which does not explicity allow for a change in government procurement action. New orders, along with the rate of capacity operations, determines unfilled orders. Again, there is little scope for changes in defense spending.

In Liu's model, the relevant variable, government purchases of goods and services, appears (after eliminating an identity) in the equation determining the change in nonfarm business inventories. Its coefficient is positive, but not significant. The description of the government spending process suggests

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[5] Several other large-scale models of the economy are currently being constructed. The Brookings-SSRC model, [9], is close to completion, although important revisions are still being undertaken at this time. Two others, Wisconsin's SSRI [14] and the NPA's PARM, [13] have not, to my knowledge, elaborated a government expenditures sector.

that the coefficient be negative, since purchases would tend to decrease inventories. However, since service items, which may have fairly short lags between order and delivery, are included, and since there are problems in estimating inventories, the relationship may have been obscured.

I next consider four large-scale models and two other studies which are directly concerned with the impacts of the procurement process.

A. University of Michigan Research Seminar in Quantitative Economics Econometric Model

One of the few econometric models to take into account institutional factors of the government procurement process is the model, based on annual data, developed at the University of Michigan, [17]. The equation explaining the change in durable goods inventory is a function of the difference between federal military purchases in the following and the current year, as well as other variables. The variable enters positively and significantly into the equation. The rationale for including this variable is that production of this component of inventory "...appears in the national accounts as goods in process, and exerts a strong impact on the economy long before delivery of the finished product materializes as government expenditure." [P. 115].

This model is thus seen to have recognized the importance of accurately specifying lead and lag structure. It is, however, inadequate from other viewpoints: 1) The level of aggregation is quite high, making it impossible to obtain impacts on specific industries. 2) The use of annual data makes it impossible to study intrayearly movements which may be of some interest. 3) The use of federal military purchases from private industry includes purchases of items which are not classified in the durable goods industry. Nevertheless, the importance of this variable in the inventory equation is an indication of

the gains to be realized from an appropriate specification of the lead and lag structure of the process.

B. Duesenberry-Eckstein-Fromm: Model of the United States Economy During Recession

In their very interesting paper, [4], Professors Duesenberry, Eckstein, and Fromm recognize the importance of the order effect, particularly in the explanation of inventory changes. In constructing the order series, however, they assume that the lag between orders and purchases in one-quarter. They nevertheless are able to state that the "...stimulus of government actions worked through orders as much as through actual expenditures." It would be interesting to explore the consequences of a more realistic specification of the lag between obligations and purchases.

C. Fromm: "Inventories, Business Cycles, and Stabilization"

In a paper preferred for the Joint Economic Committee, [6], Gary Fromm states, "...fluctuations in government orders and expenditures coupled with their resulting impact on, and the independent variation of, private business investment appear to bear the principal responsibility for recent stability difficulties in the U. S. economy." [37].

Although he presents some data to support this view, government orders do not explicitly appear, in the econometric model of the economy presented in a later section of the paper. They are included, however, in the change in unfilled orders variable, which enters the inventory change equation. There would appear to be some difficulty, though, since the unfilled orders variable is essentially determined by lagged values of itself and current and lagged final sales of goods. Thus, government orders are present only to the extent they appear as initial conditions in the unfilled orders equation, and to the extent they appear in the final sales of goods, which enters with a lag of two

periods. The following is the inventory equation:

$$\Delta I_t = -29.4345 + .4601\ S^G_t - .7314\ I_{t-1} + .1658 \left[111.3945 \right.$$

$$\left. - .3878\ S^G_{t-1} + .5229\ \Delta S^G_{t-2} - .5545\ O_{t-2} + .8099\ O_{t-2} \right]$$

where I is inventories, S is final sales of goods, and O is unfilled orders. The term in brackets is the equation for ΔO_{t-1} [PP. 71, 73]

Change in inventories is thus determined by current sales and sales lagged one, two, and three periods. In the case of government purchases, we would expect inventories to be related to sales with a lead, as in the Michigan model.

D. Lovell: Factors Determining Manufacturing Inventory Investment

A paper which explicitly considers government obligations is that of Michael Lovell, in [12]. Based on quarterly data from 1954 through 1960, he obtains the following inventory change equation:

$$H_t = -4.01 - .0683\ H_t - +.184\ X_t + .0298\ \Delta X_t - .0158$$

$$\Delta\ U_t + .0112\ U_t - .295\ E_t + .124\ O_{bt},$$

where H is inventories of durable goods, X is sales of durable goods, U is unfilled orders, E is defense expenditures, and O_b is defense obligations. [P. 132] Defense obligations are seen to enter positively; they are also statistically significant. Unfortunately, Lovell did not report on longer lags.

E. Ando-Brown: Commission on Money and Credit Study

The study most closely related to the present is the paper by Ando and Brown for the CMC, [2]. They report that "the relationship between expenditures on aircrafts and current output is small. The current and two preceding months of expenditure did have coefficients that were statistically significant, and there may be some evidence that advance payments to contractors are of some significance to aircraft output." [P. 144] The relationship between lagged obligations and output, on a quarterly basis, resulted in the following

equation:

$$P_t = \underset{(.0077)}{.0063\ O_t} + \underset{(.0076)}{.0002\ O_{t-1}} + \underset{(.0068)}{.0107\ O_{t-2}} + \underset{(.0067)}{.0130\ O_{t-3}}$$

where P_t Quarterly average of Federal Reserve Board Index of Production in period t; O_t = Quarterly obligations in period t. [P. 144] The second and third quarter preceding that for which output is to be explained were considered significant, so that a lag of nearly a year between obligations and output exists. Further experiments on longer lags were not very satisfactory.

The Ando-Brown paper thus presents important evidence on two of the effects which might be considered important from the discussion of the government spending process and the nature of the defense industries. It is concluded that lagged obligations explain output better than do expenditures, but that recent expenditures have some effect on output, pointing to the possible importance of the industry's dependence on the government for working capital. Their conclusions are summarized in the following statement:

"Even variations in rates of procurement of defense items take a considerable period before they register themselves in output. Output appears to be more sensitive to contract awards than to actual expenditure in the aircraft component of defense expenditure, the only one we examined. Aircraft contracts, for example, change output by only 20 percent of the contract by the end of six months, 55 percent by the end of three quarters, and are nearly fully reflected in output change by the end of a year. This particular case, however, can be attributed to excess capacity in the industry. New products could be initiated only after lengthly periods of research and would be expected to have lags of considerably greater length." [P. 11]

The main differences between Ando-Brown and the statistical results to be reported upon in the following section are the following:

1. The absence of variables representing "announcement" effects in the Ando-Brown paper. These may significantly affect the timing of changes in output and employment.

2. The use of output rather than employment data. It might be noted that the Federal Reserve reports that the monthly output series for the aircraft industry is based on man-hours, with an adjustment for value of output. [3, P. 5-9]. To the extent that our polynomial trend reflects price changes, results are comparable.

3. The correspondence between Department of Defense Budget categories and SIC categories. Ando-Brown relate Budget Aircraft to SIC aircraft, while the present study, because of the fact that much of the country's missile production takes place in establishments classified as aircraft, attempts to adjust for this.

4. Ando-Brown work with the period 1954-59, while the present study incorporates 1955-63.

G. Summary

The preceding discussion of several large-scale models of the U.S. economy indicated that by and large these models do not appear to have accurately portrayed the government sector with respect to purchases of military goods. In general, the equations developed to explain inventories, orders, and unfilled orders are better suited for industries in which sales are made from inventories, and the adjustment mechanism operates through attempts to control inventories. This is not the case for large amounts of military procurement, however. Many of these items are made to order, and a long time occurs between orders and purchases. If military procurement were a small or unchanging portion of government purchases, inaccurate equations perhaps would not be crucial. But some of the important uses of these models have to do with the time path of the economy as changes in these procurement actions occur. An accurate description of the process is thus especially necessary if econometric models are to be helpful in evaluating alternative courses of action which would tend to offset major changes in procurement.

The discussion also showed that when obligations were explicitly included they emerged as an important explanatory variable. The empirical work discussed in the following section bears this out for the aerospace industry expenditures and presents some new evidence on the importance of the "announcement" effect.

4. Statistical Results

The previous sections have argued that models designed to analyze the effects on employment of military procurement should incorporate announcement variables and new orders to obtain more accurate predictions of the time path of employment. It has also been pointed out that many of the existing large-scale econometric models of the economy have not done so, and that the small amount of empirical work which has recognized the role of new orders has discovered it to be an important variable. In this section empirical work for two groups of budget categories will be reported. Specifically, expenditures and obligations for the aircraft-missiles-astronautics budget categories (hereafter aerospace group), will be related to employment in SIC 372 and 19, aircraft and parts, and ordnance and accessories, respectively; and budget category "Ships" will be associated with SIC 3731, shipbuilding and repairing. A more detailed description of the data may be found in the Appendix.

Tables 1, 2, and 3 contain the results for the aerospace industry of multiple regression analyses for three dependent variables: total employment, production worker employment, and production workers times average weekly hours. Employment figures are in thousands of employees; man-hours are in thousands; and all dollar numbers are in millions. The results are broadly similar and are discussed in the following paragraphs.

1. Seasonal and time variables: Generally the seasonal variables are not significant individually, which lends support to the hypothesis that observed seasonality in the employment series is better explained by the seasonality in the obligations series than a constant seasonal pattern. An F test performed on the group of seasonal dummy variables for the total worker regression proved to be insignificant at the 5% level. Both time and time squared are highly significant; the coefficient of time is negative and that of time squared, positive. Over the range of in this study, however, the negative effect predominates and the net effect of time is negative, although at a decreasing rate. In view of the earlier discussion of the likely effects of price changes and subcontracting patterns, this negative effect was expected.

2. Expenditures and Obligations: The three sets of regression coefficients reveal that current expenditures and obligations are not significant explanatory variables of employment, but that lagged obligations are all positive, all greater than their standard errors, and 9 out of 12 coefficients in each regression are statistically significant. The fact that expenditures were not significant casts some doubt on the hypothesis that the industry is dependent upon the government for its working capital needs, but the importance of obligations is strongly reinforced. Contrary to the findings of Ando and Brown, the effects of obligations are felt almost immediately (the first lagged value is significant) and effects are fairly well spread out over the year, with a rather sharp drop between the eleventh and twelfth coefficient.

3. Announcement effects: The coefficients of the unobligated appropriations and the budget variables are stantistically significant in two of the three regressions, and positive, though not significant, in the third. These variables appear to exert more effect on total workers than on production workers, both in terms of the magnitude of regression coefficients and standardized regression coefficients (β's). Since total workers include managerial and research people whose employment may depend less on

Table 1

Aerospace Industries--Regression Analysis

Dependent Variable: Total workers[a]

Independent Variable[b]	Coefficient	Standard Error	Beta	Partial Correlation
Seasonal Dummies:				
February	.6556	25.84	.0031	.0030
March	21.1127	27.28	.1006	.0909
April	10.0475	21.25	.0478	.0556
May	11.8130	27.41	.0563	.0507
June	43.2230	31.50	.2058	.1596
July	24.1764	26.11	.1215	.1085
August	35.9255	33.91	.1804	.1239
September	60.3828	33.88	.3034	.2056
October	62.7813	33.69	.3154	.2145
November	65.4592	39.51	.3289	.1916
December	88.8696*	41.55	.4465	.2444
t	-8.9091*	.9671	-4.6461	-.7355
t^2	.0459*	.0061	2.8220	.6611
Current Expenditures	.0054	.0112	.1114	.0573
Obligations--Current	- .0037	.0103	- .0836	-.0452
1 month lag	.0323*	.0104	.3253	.3434
2 month lag	.0275*	.0104	.2794	.2985
3 month lag	.0210*	.0107	.2111	.2262
4 month lag	.0271*	.0108	.2730	.2850
5 month lag	.0303*	.0108	.3076	.3148
6 month lag	.0305*	.0106	.3144	.3221
7 month lag	.0159	.0106	.1608	.1752
8 month lag	.0185	.0106	.1876	.2019
9 month lag	.0223*	.0103	.2262	.2466
10 month lag	.0306*	.0104	.3096	.3264
11 month lag	.0348*	.0105	.3529	.3649
12 month lag	.0168	.0091	.1759	.2120
Unobligated Appropriations	.0071*	.0029	.5031	.2775
Budget	.0081*	.0029	.9044	.3091
Intercept	805.8519			
R^2	.7347			
Standard error of estimate	34.6737			
Degrees of Freedom	72			
Durbin-Watson statistic	.3068			

a. In thousands
b. All money amounts are in millions of dollars.

* Significant at the 5 percent level.

Table 2

Aerospace Industries--Regression Analysis

Dependent Variable: Production Workers.

Independent Variable[b]	Coefficient	Standard Error	Beta	Partial Correlation
Seasonal Dummies:				
February	- .2856	18.93	- .0100	-.0178
March	.1060	19.98	.0369	.0624
April	.2955	15.56	.0103	.0224
May	.1698	20.07	.0059	.0100
June	.2422	23.07	.0844	.1228
July	.6452	19.12	.0237	.0397
August	.1562	24.83	.0574	.0739
September	.3679	24.81	.1352	.1722
October	.4207	24.67	.1546	.1970
November	.4307	28.94	.1583	.1728
December	.6097	30.43	.2241	.2298
t	-8.2397*	.7083	-3.1437	-.8079
t^2	.0346*	.0045	1.5590	.6725
Current Expenditures	.0040	.0082	.0600	.0575
Obligations--Current	- .0023	.0075	- .0379	-.0360
1 month lag	.0240*	.0076	.1769	.3479
2 month lag	.0205*	.0076	.1525	.3036
3 month lag	.0149	.0078	.1097	.2197
4 month lag	.0191*	.0079	.1409	.2754
5 month lag	.0218*	.0079	.1619	.3098
6 month lag	.0213*	.0077	.1605	.3084
7 month lag	.0094	.0077	.0696	.1423
8 month lag	.0119	.0078	.0880	.1776
9 month lag	.0158*	.0076	.1175	.2394
10 month lag	.0222*	.0076	.1643	.3235
11 month lag	.0267*	.0077	.1978	.3794
12 month lag	.0131*	.0067	.1005	.2254
Unobligated Appropriations	.0046*	.0021	.2416	.2506
Budget	.0056*	.0022	.4572	.2932
Intercept	568.0707			
R^2	.9238			
Standard error of estimate	25.3485			
Degrees of Freedom	72			
Durbin-Watson statistic	.3501			

a. In thousands
b. All money amounts are in millions of dollars.

* Significant at the 5 percent level.

Table 3

Aerospace Industries--Regression Analysis

Dependent Variable: Production worker monthly man-hours

Independent Variable[b]	Coefficient	Standard Error	Beta	Partial Correlation
Seasonal Dummies:				
February	-117.4075	780.3	- .0097	-.0177
March	167.2887	823.7	.0138	.0239
April	-256.6500	641.7	- .0212	-.0471
May	-347.5373	827.5	- .0287	-.0494
June	147.2898	951.2	.0122	.0182
July	-797.1213	788.5	- .0695	-.1183
August	-127.6783	1024.0	- .0111	-.0147
September	687.8603	1023.0	.0600	.0790
October	807.6806	1017.0	.0704	.0932
November	894.8415	1193.0	.0780	.0881
December	153.0373	1254.0	.1334	.1423
t	-356.9214*	29.2	-3.2292	-.8215
t^2	1.6258*	.1852	1.7354	.7190
Current Expenditures	- .0001	.3378	- .0389	-.0382
Obligations--Current	.0002	.3100	.0601	.0583
1 month lag	1.0772*	.3140	.1884	.3748
2 month lag	.9303*	.3134	.1637	.3302
3 month lag	.6327*	.3220	.1103	.2256
4 month lag	.7840*	.3245	.1369	.2739
5 month lag	.8744*	.3248	.1541	.3024
6 month lag	.9448*	.3193	.1688	.3293
7 month lag	.5929	.3190	.1037	.2140
8 month lag	.6790*	.3197	.1193	.2429
9 month lag	.7571*	.3122	.1331	.2748
10 month lag	.8686*	.3148	.1527	.3092
11 month lag	.9021*	.3161	.1586	.3188
12 month lag	.4546	.2760	.0824	.1905
Unobligated Appropriations	.0845	.0872	.1043	.1135
Budget	.1353	.0889	.2615	.1766
Intercept	25,279.4280			
R^2	.9272			
Standard error of estimate	1,045.1086			
Degrees of Freedom	72			
Durbin-Watson statistic	.3708			

a. In thousands
b. All money amounts are in millions of dollars.

* Significant at the 5 percent level.

actual production contracts than on the preparation of proposals to the defense department based on expectations about the amount of subsequent production contracts, this result is consistent with a priori expectations.

The R^2 are quite high, ranging from .73 to .93, and are highest for the production workers and the production man hours equations. The Durbin-Watson statistic appears to indicate some degree of positive serial correlation of the residuals, although the published tables do not contain entries for the number of independent variables used in these regressions.

Several other sets of regressions were tried with lack of success. The first used outstanding obligations, lagged up to six months, as independent variables. They were not statistically significant and yielded low R^2. Another set of regressions used the data for the shipbuilding industry to estimate models similar to those reported above. The results were quite disappointing, with statistically insignificant coefficients and low R^2. Much of the trouble is no doubt due to the large and changing civilian component in the employment.[6]

The importance of considering the effects of announcement and obligations variables on employment is illustrated in Table 4 and Figure 1. Three different models are used to generate the employment effects of the following postulated series of events: $1 billion is added to the budget and included in an appropriations bill passed in August; a contract for that amount is let in September, and delivery takes place the following September. Model I utilizes the coefficients from a model which includes announcement effects and obligations.

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[6]According to (18 p.23), the 1958 portion of military output (according to value of output) for shipbuilding and repairing industry was 61%. Further, Survey of Manufactures data reveals that the proportion of military shipbuilding has fluctuated from about thirty per cent to over fifty per cent.

Model II is based on a regression which contains the obligations variables, but not the announcement variables. Model III assumes that the entire employment effect takes place at the time of delivery as assumed in several of the econometric models discussed above.

Model I accounts for a greater total of employment than Model II and displays a rather different time pattern. By September, when the obligation is assumed to occur, the announcement variables have already generated 17% of the total employment. The percentage of employment accounted for by Model I remains above that accounted for by Model II for the whole period. Both Model I and II, of course, predict a time rather quite different from that suggested by Model III.

5. Conclusions

It will be convenient to consider the main conclusions of this study in four parts: empirical description of the military procurement process, implications for econometric models, data needs and availability, and directions for further research.

A. Empirical Description of the Military Procurement Process

Based on the description of the government spending process and the regressions for the aerospace industry, it is clear that an important role is played by the obligations variables. Beginning with a one-month lag they exert an important influence for a year. In addition, evidence has been presented to indicate that two proxies for announcement effects--budget and unobligated appropriations--have substantial impacts on employment.

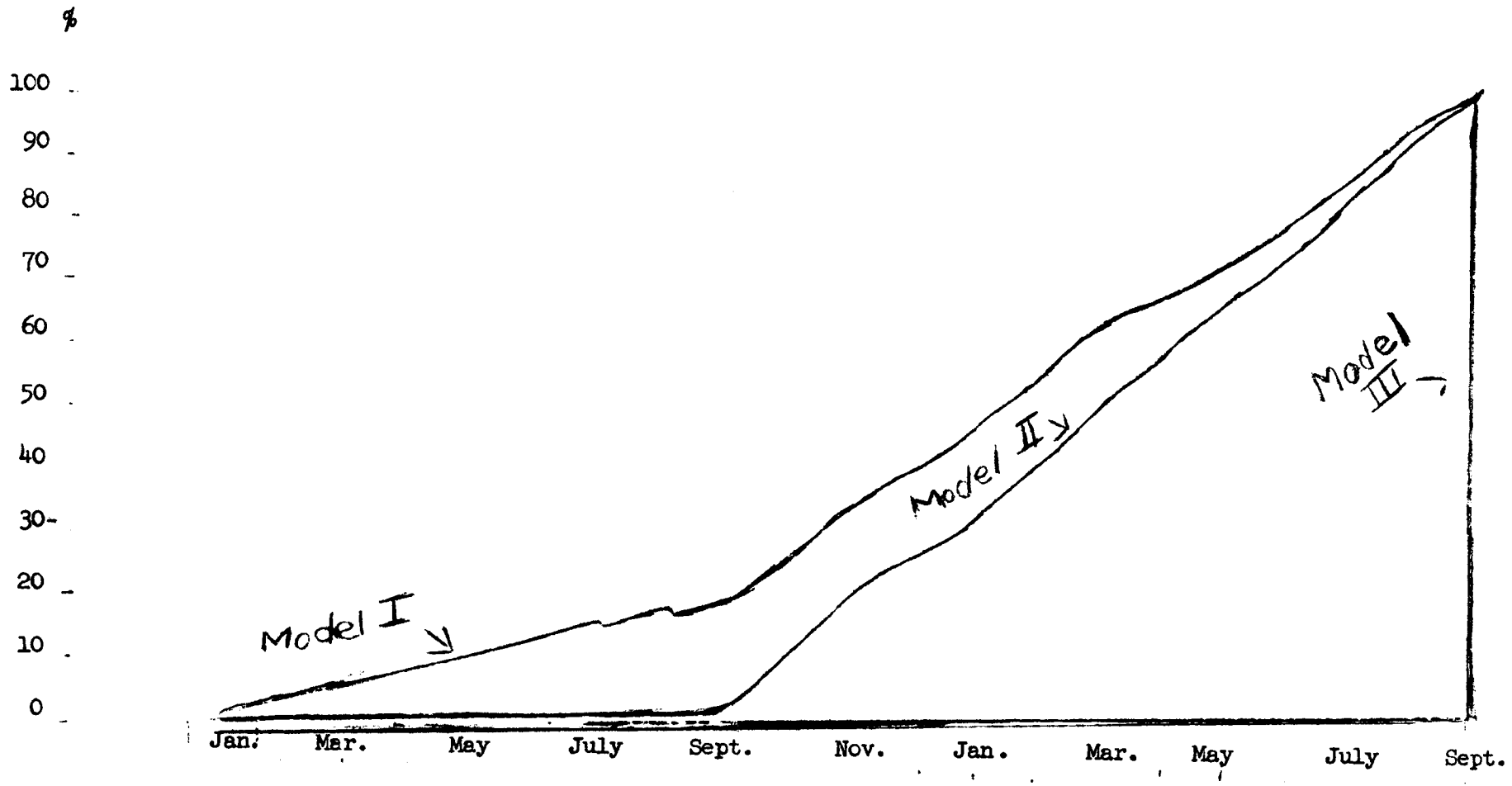
Time trend variables, acting as proxies for factors such as changes in the amount of employment in the SIC employment category associated with the

Employment Resulting from $1 Billion Increase in Budget,
Included in August Appropriation Bill, Obligation Incurred in September,
and Delivery Made in following September

	MODEL I			MODEL II			MODEL III
Month	Employment[a]	Cumulative Employment[a]	Cumulative Percent of Total Employment	Employment[a]	Cumulative Employment[a]	Cumulative Percent of Total Employment	Cumulative Percent of Total Employment
January	8,100	8,100	2.16%	0	0	0.00%	0
February	8,100	16,200	4.32	0	0	0.00	0
March	8,100	24,300	6.48	0	0	0.00	0
April	8,100	32,400	8.64	0	0	0.00	0
May	8,100	40,500	10.81	0	0	0.00	0
June	8,100	48,600	12.97	0	0	0.00	0
July	8,100	56,700	15.13	0	0	0.00	0
August	7,100	63,800	17.02	0	0	0.00	0
September	3,400	67,200	17.93	4,900	4,900	1.67	0
October	32,300	99,500	26.55	30,900	35,800	12.17	0
November	27,500	127,000	33.88	21,600	57,400	19.51	0
December	21,000	148,000	39.49	14,900	72,300	24.58	0
January	27,100	175,100	46.72	20,400	92,700	31.51	0
February	30,300	205,400	54.80	27,600	120,300	40.89	0
March	30,500	235,900	62.94	31,200	151,500	51.50	0
April	15,900	251,800	67.18	21,000	172,500	58.63	0
May	18,500	270,300	72.12	22,100	194,600	66.15	0
June	22,300	292,600	78.07	22,400	217,000	73.76	0
July	30,600	323,200	86.23	29,100	246,100	83.65	0
August	34,800	358,000	95.52	33,100	279,200	94.90	0
September	16,800	374,800	100.00%	15,000	294,200	100.00%	100.0%
Total	374,800			294,200			

a. Number of Employees

Cumulative Percentage Employment Resulting from $1 Billion Increase in Budget
Included in August Appropriation Bill, Obligation
Incurred in September, and Delivery
Made in Following September



corresponding budget category, proved to be highly significant. Seasonal dummies, however, were not significant. Expenditures were not a significant explanatory variable, contrast to the findings of Ando and Brown. Whether this was due to differences in industry correspondence, time period covered, or estimation of expenditures was not investigated.

Unfortunately, similar regressions for the ship industry resulted in unsatisfactory coefficients and low R^2. This result was attributed to the significant and varying non military demand in the industry. However, the fact that different results were obtained with the two industries also suggests that some degree of industry disaggregation should be employed to obtain more accurate estimates of employment impacts.

B. Implications for Econometric Models

The implications for existing and planned econometric models are clear: there are apparently important employment (and income) effects associated with announcements and obligations. Variables representing these effects should be included among the exogenous variables. Further, models which incorporate series on new or unfilled orders should recognize that part of these series--especially orders for military procurement--are exogenous to the system. They are under the control of the government, and should enter the model in such a way as to facilitate study of their impacts on variables of interest.

C. Data Needs

A few changes would seem fairly inexpensive and quite useful; these include breaking up the "ordnance, vehicles and related equipment" category into individual categories and publishing expenditures data on a gross basis. The former would permit a closer correspondence between employment and budget categories; the latter would provide a better estimate of amounts paid to business.

It would also be desirable for other agencies of the government, particularly GSA, NASA and AEC to release similar information on monthly obligations, with care being taken that they are not also counted in the Department of Defense series when contracts are placed through the latter.

While on the subject of data, it might be noted that a study for the Joint Economic Committee entitled "A Federal Statistics Program for the 1960's" (19) does not include an improved series covering government obligations on its list of directions for improvement.

D. Further Research

Given the present data availability, I do not think that the procedure followed in this paper can be applied to other industries. If appropriate data should become available, such studies would be quite valuable. Another direction for research would be to complete the description of the spending process by constructing models which relate expenditures and government purchases to lagged obligations and other variables.

An important area for research, not touched upon in this paper, is the question of economic impacts on particular regions. It is hoped that the present study has contributed to this problem by pointing out the stage at which impacts are likely to occur. Again in the direction of disaggregation, more detail on the occupational mix of employment might be investigated. As noted above, there appears to be differences in the behavior of total employment and production worker employment. As longer series on research and development obligations become available, these differences might be useful for studying the dynamics of the demand for engineers and scientists.

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Appendix

The purpose of this appendix is to provide the sources of the data and the various adjustments made.

1. Industry Correspondence[1]

The following correspondence was establishes between the budget categories used by the Department of Defense and the Standard Industrial Classification used for the employment data:

Industry Name	Budget Categories[a]	Standard Industrial
	Aircraft	Aircraft and Parts (372)
Aircraft-Missiles	Missiles	Ordnance and Acessories (19)
Ships	Ships	Shipbuilding and Repairing (3731)

a. These Budget categories are the titles used in the most recent issues of the "Monthly Report on Status of Funds by Functional Title." Earlier years titles were somewhat different.

Work on Missiles is divided between the aircraft and parts industry and the ordnance and accessories industry. It was not possible to include the entire ordnance budget classification, since in most recent years ordnance has been part of "Ordnance, vehicles, and related equipment." Using this category would make it necessary to include the motor vehicles and parts industry employment category to pick up the vehicles component of the budget category, but this would involve including the civilian component of the industry as well. In this case, of course, the civilian component would dominate the data.

2. Employment, Hours, and Earnings

These data were obtained from "Employment and Earnings, 1909-1961" [21] and current issues of the same publication. The variables are not seasonally adjusted.

1. This correspondence was established with the aid of Professor M. L. Weidenbaum, and is based on Census work sheets for industry classification.

3. Budget

The budget amounts are taken from the United States Budget for various years. Generally, the correspondence between the DOD categories used in this study and the Budget categories is easily established. An exception is the case of the Army budget, which for several years uses the category "Ammunition and Guided Missiles." The portion included in missiles was taken to be the percentage of obligations for missiles and ammunition going to missiles for the year in question applied to the total budgeted amount for missiles and ammunition.

4. Expenditures, Obligations, Unobligated Balances, Unpaid Obligations

The main source for these variables is the Department of Defense monthly release, "Monthly Report on Status of Funds by Functional Title." Amounts taken are those for "Military Functions."

A. The amounts shown for expenditures are net of receipts from other government agencies (Mutual Defense, NASA, etc.) for whose account the Defense Department placed contracts.[1] In an effort to arrive at a gross expenditures amount, which more accurately reflects payments to industry, a correction was added to expenditures. This correction was obtained by taking, for each year, outstanding obligations at the beginning of the year plus current obligations minus net expenditures. The resulting figure is compared with outstanding obligations at the beginning of the next year, and the difference is assumed to be the amount by which gross expenditures have been misstated. One-twelfth of the difference is added to each month. This correction was not possible for procurement 1954 and R&D 1960.

1. Thanks to Mr. Sheldon Taylor of the Department of Defense for explaining the intricacies of their accounting procedures.

B. Obligations data are taken directly as published in the Status of Funds Report.

C. Status of Funds reports unobligated balances at the beginning of the year. This is diminished monthly by current obligations and then replenished by the annual appropriations. This latter amount is added in the month that the appropriations bill is reported out of the Joint Conference.[2] Appropriations are derived by deducting end of fiscal year uncommitted obligations from uncommitted obligations for the beginning of the next fiscal year. These estimates will include some minor accounting adjustments in addition to appropriations.

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2. Although the appropriations bills do not become law until signed by the President, I assume that the "announcement" effect operates at the time the bill is reported out of the Joint Conference for two reasons: first, the signing of the bill follows by a few days, so that it does not make very much difference; second, it is extremely unlikely that the bill will be vetoed, so that the bill's being reported out of the Joint Conference is tantamount to approval of the appropriations.