

lead to less employment in shipbuilding establishments, the more electronic equipment is included in the ship.⁴ An attempt is made to allow for these effects by including 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 number of workers, (2) number production workers, and (3) number of production workers times average weekly hours worked. 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 production. To the extent, however, that research personnel are involved, the "announcement" variables may exert a greater impact on total workers than on production workers.

III. 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 primary effects on employment and output will be felt some time 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 upon in detail since their government sectors are not greatly elaborated. These include the Wharton School Quarterly Economic Model [Klein, 8], and T. C. Liu's Quarterly Model [11]. In the Klein model, government purchases appear 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 do not explicitly allow for a change in government procurement action. New orders, along with the rate of capacity operations, determine unfilled orders. Again, there is little scope for changes in defense spending.

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

⁵ Several other large-scale models of the economy are currently being constructed. The Brookings-Social Science Research Council model, [9], is close to completion, although important revisions are still being undertaken at this time. Two others, Wisconsin's Social Systems Research Institute [14] and the National Planning Association's Program Analysis for Resource Management, [13] have not, to my knowledge, elaborated a government expenditures sector.