

## SOME EMPIRICAL EVIDENCE ON GOVERNMENT PURCHASE MULTIPLIERS \*

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A multiplier effect of state and local government purchases is found when estimating a vector autoregression of components of GNP. Military purchases, on the other hand, are only slightly expansionary in the very short term. Government purchases account for a substantial part of the variance of GNP.

### 1. Introduction

The effect of government purchases on real output has been extensively considered in the macroeconomic literature. Keynesian analysis has focused on studying its influence through aggregate demand, and has concluded that, no matter what the composition of the government expenditures is, there is a multiplier effect. The estimation of large scale economic models has provided the empirical support, although the conclusion has been repeatedly questioned. If government-provided goods and services are regarded as close substitutes for private consumption goods, then, as Bailey (1971) has pointed out, the multiplier effect vanishes. Barro (1981), provides empirical evidence that the effect on real output of temporary changes (defense purchases related to wars) is bigger than the effect of permanent changes (military as well as non-military, and state and local) but does not find a multiplier effect, although in the case of temporary changes a multiplier slightly bigger than one would also be consistent with the data.

In the search for evidence for or against the existence of a multiplier effect of government purchases, not much emphasis has been placed on the distinction of government purchases by the source and type of expenditure. This paper focuses on that distinction by breaking down government purchases into three components: federal military, federal non-military, and state and local purchases. If there is no multiplier effect of government purchases, to treat all government purchases together when undertaking data analysis imposes an unreasonable restriction on the estimated model. If, on the contrary, there is a unique multiplier effect of all components of government purchases, then the data analysis that includes several components separately should provide evidence to confirm its existence.

To address this question a nine-dimensional vector autoregression<sup>1</sup> of real GNP components, three of them being government purchases, is fitted to the U.S. postwar quarterly data. The nine

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<sup>1</sup> A detailed description of the VAR technique can be found in Sims (1980).

components of the vector sum up to GNP, which enters in the system as an identity. The main results can be summarized as follows:

- Government purchase innovations account for a substantial part of the variance of GNP, with state and local purchases increasing their percentage of explanation as the number of steps ahead increases.
- The response of GNP to an innovation in state and local purchases is positive, persistent and much larger than the response of state and local purchases to themselves. This expansionary effect is not observed in the response of GNP to an innovation in military purchases, which is smaller than the response of military purchases to themselves.

## 2. Estimation results

The estimated model has the form:

$$Y(t) = C + \sum_{s=1}^m A_s Y(t-s) + u(t), \quad (1)$$

where  $Y$  is a  $n \times 1$  vector of components of GNP,  $C$  is a  $n \times 1$  vector of constant terms, and  $A_s$  is a  $n \times 1$  matrix of coefficients for  $s = 1$  to  $m$ . The  $n \times 1$  vector of residuals  $u$  is identified by the property that  $u(t)$  is uncorrelated with  $Y(s)$  for  $s < t$ .

We interpret the results of our estimation by looking at its moving average form, that is, the impulse response functions. The moving average coefficients that we consider are those of a transformed system where the residuals are contemporaneously uncorrelated. The transformation is not unique but, if the transformation matrix is lower triangular with positive elements on the diagonal then, for a given order of the variables there is only one transformation.

The results we present correspond to the estimation of a system of nine components of GNP: durable consumption (DC), nondurable consumption (NDC), residential investment (IR), change in business inventories (INV), net exports (NX), federal government military purchases (GM), federal government non-military purchases (GNM), state and local government purchases (GL), and investment in producer durables and non-residential structures (I). The system is estimated with a constant term and five lags for the period 1948.2 to 1983.2<sup>2</sup>. The orthogonalization has been done in the order that the variables are listed. Although the contemporaneous correlations of the residuals are non-zero, for most variables, and in particular for the three types of government purchases, the correlations are small (see table 1).

Table 2 presents the decomposition of the  $k$ -step ahead prediction error for GNP, where  $k$  varies from 1 to 25. The percentage of GNP variance accounted for by innovations in total government purchases is as high as 38% for some periods. The percentage accounted for by state and local purchases increases with the number of periods and, for lags exceeding 12 periods (3 years), state and local purchases represents the greatest contributor to variations in GNP. This result suggests that government purchases are important to explain GNP and, furthermore, that state and local purchases have a long run effect on real output. The impulse response analysis that follows, supports this observation.

<sup>2</sup> We use U.S. quarterly data from the Citibase data tape, from 1947.1 to 1983.2. All variables have been deflated by their own implicit price deflator (1972 base) except for federal military and federal non-military purchases, that were deflated by the price deflator for federal government purchases.

Table 1  
Contemporaneous correlations of the residuals.

	DC	NDC	IR	INV	NX	GM	GNM	GL	I
DC	1.00	0.30	0.44	-0.05	-0.24	-0.06	-0.06	0.27	0.56
NDC	0.30	1.00	0.26	-0.15	-0.15	0.06	-0.19	0.07	0.24
IR	0.44	0.26	1.00	0.06	-0.17	0.05	-0.13	0.12	0.39
INV	-0.05	-0.15	0.06	1.00	-0.13	0.13	-0.09	-0.01	0.22
NX	-0.24	-0.15	-0.17	-0.13	1.00	0.05	-0.005	-0.07	-0.13
GM	-0.06	0.06	0.05	0.13	0.05	1.00	-0.29	0.01	0.06
GNM	-0.06	-0.19	-0.13	-0.09	-0.005	-0.29	1.00	0.03	-0.19
GL	0.27	0.07	0.12	-0.01	-0.07	-0.01	0.03	1.00	0.13
I	0.56	0.24	0.39	0.22	-0.13	0.06	-0.19	0.13	1.00

It is interesting to note that a high percentage of the variance of government purchase components is accounted for by their own innovations. This fact is particularly true for military purchases, which suggests that other components of GNP do not help much in predicting military expenditures. To confirm this believe, a Granger causally prior test for each of the nine components of GNP was performed. The results are presented in table 3. The government variables, one by one and as a block, were the only ones for which the null hypothesis (all coefficients outside the block are zero) could not be rejected.

Table 2  
Percentage of  $k$ -step ahead forecast error variance in GNP accounted for by each innovation.

$k$	DC	NDC	IR	INV	NX	GM	GNM	GL	I
1	33.03	4.83	7.50	35.57	7.26	3.88	3.16	0.99	3.75
2	27.05	16.01	19.14	21.42	3.51	6.16	1.33	2.35	3.01
3	21.26	18.86	26.09	13.18	2.01	9.60	1.06	5.14	2.77
4	16.01	20.89	27.74	10.07	2.98	12.60	1.56	5.88	2.23
5	13.44	23.57	27.50	8.05	3.53	13.68	1.48	5.85	2.88
6	11.83	23.01	26.26	7.57	3.46	13.67	2.34	7.18	4.67
7	10.63	21.52	25.01	6.93	3.41	12.74	4.00	9.58	6.15
8	9.57	19.73	23.38	6.49	3.57	11.56	5.53	12.31	7.83
9	9.03	18.24	21.83	6.45	3.41	10.64	6.69	14.07	9.61
10	8.85	17.05	20.51	6.57	3.32	9.95	7.85	15.51	10.37
11	8.79	16.11	19.39	7.46	3.18	9.40	8.39	16.75	10.49
12	8.70	15.36	18.49	8.83	3.04	8.97	8.27	17.82	10.48
13	8.81	14.69	17.71	10.32	2.91	8.59	8.03	18.80	10.14
14	8.88	14.04	16.98	11.79	2.79	8.20	7.78	19.82	9.69
15	8.95	13.48	16.33	12.99	2.73	7.85	7.51	20.82	9.32
16	9.07	12.99	15.76	13.59	2.83	7.56	7.24	21.83	9.11
17	9.21	12.51	15.17	13.79	3.01	7.29	6.99	22.96	9.05
18	9.30	12.03	14.56	13.82	3.33	7.08	6.75	24.05	9.05
19	9.37	11.53	14.03	13.67	3.84	6.97	6.56	24.96	9.04
20	9.45	10.98	13.64	13.33	4.48	6.68	6.44	25.65	9.02
21	9.42	10.37	13.51	12.91	5.19	7.10	6.40	26.16	8.92
22	9.31	9.75	13.75	12.43	5.87	7.35	6.39	26.45	8.68
23	9.14	9.12	14.32	11.91	6.42	7.70	6.48	26.55	8.34
24	8.92	8.51	15.16	11.40	6.76	8.12	6.66	26.53	7.90
25	8.66	7.94	16.18	10.94	6.92	8.60	6.90	26.44	7.40

Table 3  
Granger causally prior test.

DC	$\chi^2(40) = 79.05435$	$\alpha = 0.00022779$
NDC	$\chi^2(40) = 58.50408$	$\alpha = 0.02955134$
IR	$\chi^2(40) = 76.3177$	$\alpha = 0.00047163$
INV	$\chi^2(40) = 71.47354$	$\alpha = 0.00162048$
NX	$\chi^2(40) = 64.16757$	$\alpha = 0.009002165$
GM	$\chi^2(40) = 40.965$	$\alpha = 0.42797$
GNM	$\chi^2(40) = 42.39684$	$\alpha = 0.368035$
GL	$\chi^2(40) = 43.13858$	$\alpha = 0.33860$
I	$\chi^2(40) = 72.44183$	$\alpha = 0.0012735$
GM,GNM,GL	$\chi^2(90) = 97.192$	$\alpha = 0.2837085$

Figs. 1 to 3 present the impulse responses of GNP to shocks in federal military, state and local and federal non-military purchases. They also plot the response of each government purchase component to its own shock. It is remarkable how different the pattern of responses is for the case of military purchases and for that of state and local purchases. In the case of federal non-military purchases, it is hard to arrive at conclusions as the coefficients are not significantly different from zero for most lags.

The response of GNP to a shock in state and local purchases is significantly different from zero for most periods, persistent, and higher than the response of the GNP component to its own shock. The GNP response to military purchases is initially positive and significantly different from zero for the first four quarters. It declines after one year and becomes negative after about three years, although it is not significantly different from zero. The military purchase response to its own shock is positive, persistent, and highly significant for many periods; also it is higher than the GNP response for all lags except third and fourth.

The ratio 'GNP response/response to own innovation' can be considered as a measure of the (expansive) effect of changes in government purchases on the level of real output. We could think

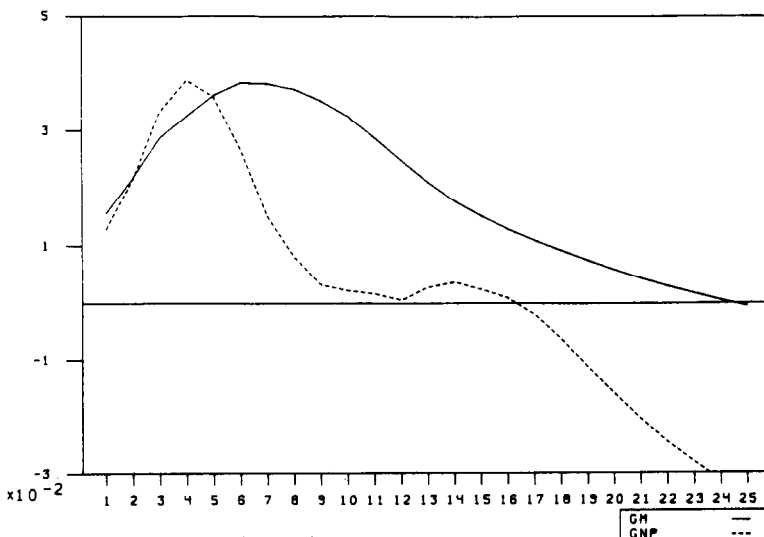


Fig. 1. Response to GM innovation.

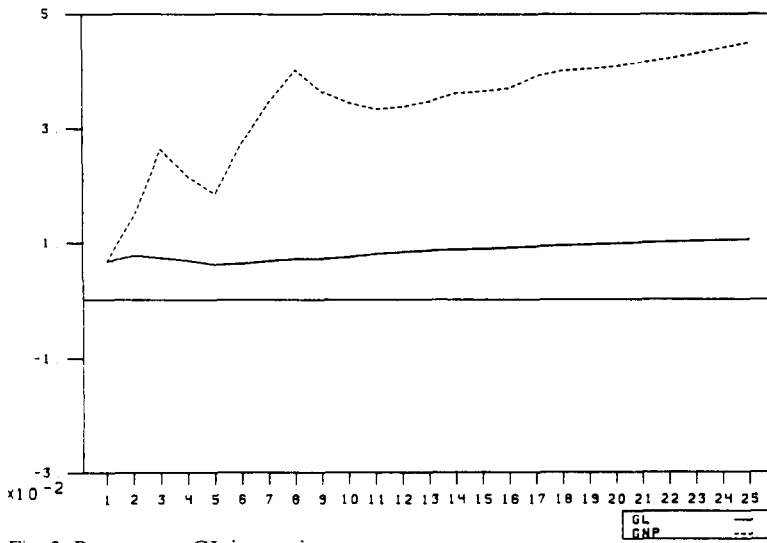


Fig. 2. Response to GL innovation.

of this ratio as a measure of the multiplier effect of expenditure, and compare its value for the different components of government purchases.

In the case of military purchases, the ratio is smaller than one for almost every period, and it is not even positive after three years. When looking at state and local purchases, the ratio is positive and bigger than one for all periods other than the first one. From this result we conclude that, while state and local purchases have a multiplier effect on output, an increase in military purchases does not tend to expand output.

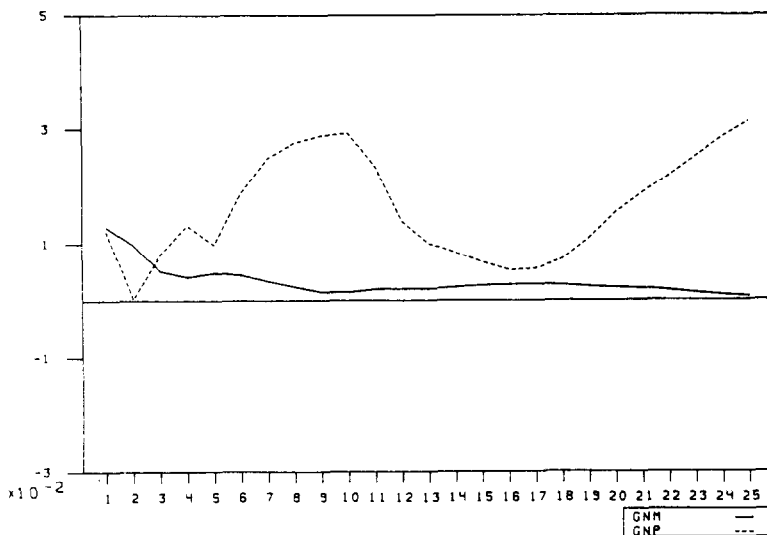


Fig. 3. Response to GNM innovation.

Several orderings have been tried, some with the government purchase component first, some with it last. Also, the position of military purchases relative to state and local purchases has been varied, but this had no noticeable effect. Placing government purchase components first in the ordering rather than at the end causes the percentage of variance of GNP explained by them to be higher in the first few periods, but has no significant effect on the later periods. The pattern of impulse responses is not affected by the ordering changes mentioned here.

Some other components of GNP are more sensitive to the ordering, as might be expected by looking at the correlation coefficients in table 1, although altering the relative order of the consumption and investment components does not change results regarding the dynamic interrelation between government purchases and GNP.

### 3. Conclusions

The analysis of postwar U.S. data for several components of GNP provides evidence that government purchases have a considerable impact in the determination of total output. This influence, though, varies depending on the type of government purchase considered. When analyzing the impulse responses of a system of nine variables with five lags, state and local government purchases are found to have an expansionary effect on total output, while federal military expenditures are not. These empirical results do not support the existence of a general multiplier for government purchases, but are consistent with the presence of a multiplier effect for non-military government purchases.

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