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A Reexamination of the Effect of Rapid Military Spending on Inflation

Farrokh Nourzad
Marquette University, farrokh.nourzad@marquette.edu

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A REEXAMINATION OF THE EFFECT OF RAPID MILITARY SPENDING ON INFLATION

Farrokh Nourzad*
Marquette University

Abstract

The hypothesis that rapid defense buildups contribute to inflation recently has been rejected by Donald F. Vitaliano. In this paper, it is argued that this result is misleading, given that it is obtained under the implausible assumption of constancy of the expected real rate of interest. The hypothesis is reexamined using a well-known measure of the expected inflation rate, and it is found that growth of defense spending has a statistically significant positive effect on the rate of price inflation.

I. INTRODUCTION

Economists increasingly have become interested in the economic consequences of military spending. Most early analysis took place in the 1970s [5, 7, 9, and 11]. The acceleration of defense expenditures in the 1980s has led to significant additional research in this area [2, 3, 4, 10, 12, and 13]; a variety of propositions has been offered and subjected to empirical tests. A popular contention that recently has been tested by Vitaliano [13] is that defense spending has a discernible influence on the rate of inflation. His results indicate that "there appears to be no perceptible impact on the rate of price inflation separably attributable to defense spending" [13].

This paper argues that this conclusion is reached using an empirical model that is misspecified. A remedy for this problem is offered, and the resulting model is used to reexamine the defense spending-inflation hypothesis. The results indicate that there is a statistically significant positive relation from the growth rate of defense spending to the rate of inflation.

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II. BACKGROUND

The effect of defense spending on the general price level can be transmitted through changes in aggregate demand and/or aggregate supply. On the demand side, rapid defense buildups contribute to acceleration of nominal demand growth that will affect inflation adversely if not offset by tax increases or monetary growth reductions. In this respect, the demand side effect of increased defense spending is no different from that of other government expenditures [12].

On the supply side, expansive defense outlays can contribute to inflation if they are confronted with supply inelasticities or capacity limitations in the narrow-based defense industry [2, 12]. Further, to the extent that the defense industry and the market for skilled labor on which it relies are characterized by monopolistic and/or monopsonistic pricing practices, defense buildups bring price increases in these markets that spread to the rest of the economy, as well as entering the price index directly [13]. Thus, for given demand pressure and inflation expectations, defense spending has a potential supply side effect on the rate of price inflation similar to the effect of the oil price shocks of the 1970s [2].

It should be noted that what matters is the speed of increase in defense expenditures, not the level of these outlays [12]. A related factor is the timing of the planned buildups with respect to the space of time over which the objectives of the buildups are to be realized and whether this coincides with a period when the defense industry is operating at or near full capacity.

The defense spending-inflation rate hypothesis has been tested by Vitaliano using Gordon's [6] model of inflation. Vitaliano measures the inflation rate, p, in terms of the quarterly rate of change of the GNP deflator, specifies demand pressure as the natural logarithm of the ratio of actual to natural unemployment rate, $\ln(u/u^*)$, and captures supply shocks, S, using a dummy variable for the 1973 to 1974 OPEC oil price increase. In his analysis, Vitaliano assumes a constant expected real rate of interest, r^e, and uses the average of the nominal yield on three and five year U.S. government bonds, i, as a proxy for the expected inflation rate, p^e.

To this model, Vitaliano adds alternative measures of defense spending, D, as separate explanatory variables. The specific measures he uses are the quarterly rate of growth of nominal defense spending, GRD, the ratio of nominal defense spending to nominal GNP, D/GNP, and the growth rate of this ratio, GRDGNP. Thus, Vitaliano's model is [13]:

$$(1)\quad p = a_0 + a_1 p^e + a_2 \ln(u/u^*) + a_3 S + a_4 D + e,$$

where $p^e = i$, and e is the random disturbance term.

A priori, a_1 is expected to be unity since an increase in p^e represents an upward shift in the short-run Phillips curve along a vertical long-run Phillips curve, increasing p proportionately. Further, a_2 is expected to be negative because an increase in u relative to u* represents a reduction in nominal demand growth, reducing p. On the other hand, a_3 is expected to be positive because an unfavorable supply shock shifts the short-run Phillips curve up, increasing p. Finally, because Vitaliano assumes a constant expected real rate of interest, it is omitted from the model and left to the intercept term. Thus, a_0 is expected to equal the negative of r^e.

Vitaliano estimates several versions of this model that differ with respect to the specification of the defense spending variable and the lag assumed by the demand pressure and/or growth of defense spending (no lags versus a two quarter lag). His results indicate that defense spending has no statistically significant effect on the rate of inflation.

The most troublesome aspect of Vitaliano's work is his use of the nominal rate of interest as a proxy for the expected inflation rate. This causes an error-in-variable bias (i.e., bias due to misspecification of explanatory variables) if the expected real rate is not constant.[1] In this case, ordinary least squares (OLS) estimators will be biased and inconsistent, and

[1]Note that the primary problem is not whether r^e has a homoskedastic variance, but whether it has a nonzero variance. The former problem is not usually expected in time series samples.

the classical test of hypothesis produces misleading results[2]. Even if the model did not suffer from this problem, the estimates still would be biased and inconsistent due to the simultaneous equation bias that results from the interaction between inflation and the nominal interest rate.

It is hard to believe that the expected real rate of interest has been constant over more than two decades of structural change, especially in the 1970s. It is true that in the 1960s both nominal interest rates and inflation expectations were generally stable. But in the 1970s, while nominal interest rates remained relatively stable, inflation expectations became volatile. In the 1980s, this pattern has been reversed; nominal interest rates have become volatile and inflation expectations have reached relative stability.

In order to examine the behavior of the real component of the measure of the nominal interest rate used by Vitaliano, one has to estimate the expected rate of inflation. For this purpose, an approach suggested by Barro [1] and Gordon [6] [3] is used. According to the estimates over the sample period, the hypothesis that the variance of the expected real rate is not different from zero cannot be accepted. Further, separate tests of equality of means and variances of the expected real rate before and after the first quarter of 1970 indicate that neither hypotheses can be accepted. These observations lead to the conclusion that the expected real rate of interest has not been constant over the sample period, and therefore a reexamination of the defense spending -inflation rate hypothesis is warranted.

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[2]Vitaliano [13] clearly is aware of the problems associated with a nonconstant expected real rate of interest. He chooses to use the nominal rate of interest as a proxy for expected inflation because "...regressing the inflation rate on past values of itself poses serious serial correlation problems that could produce inconsistent and biased estimators..." As indicated below (footnote 4), this problem can be avoided if one uses an estimation procedure suggested by Barro [1] and Gordon [6].

[3]This rate was estimated using a second order Almon polynomial with and without right endpoint constraint and a purely distributed-lag model. Following Gordon [6], in each case a dummy variable was included for the Nixon wage-price controls but then used its estimated coefficient to add the effect of the controls to the predicted values of the regressand. The maximum length of lag was kept at twenty quarters as suggested by Gordon. The results were generally consistent across all three specifications; in no case could the hypothesis of zero variance of the expected real rate be accepted.

III. THE MILITARY SPENDING-INFLATION HYPOTHESIS REEXAMINED

This section incorporates the measure of the expected inflation rate into Gordon's model, and the defense spending-inflation hypothesis is reexamined.[4] In order to facilitate comparisons with the results reported by Vitaliano, all other variables are specified as he did, using the same notations, data sources, and sample period of all seven equations he uses are estimated.[5] The results are reported in Table I.

The results are analyzed by first considering the determinants of inflation suggested by Gordon. In all seven equations, the parameter estimate of the expected inflation rate has the expected positive sign and is statistically significantly different from zero. Further, in no equation is this estimate statistically significantly different from unity (in decimal terms), thus satisfying the restriction imposed on it by the underlying theory.

Turning to the demand pressure variable, it is observed that in all equations the parameter estimate of this variable has the expected negative sign and is statistically significant. This is different from Vitaliano's results; in his first six equations this important variable is insignificant at the conventional levels. Regarding the supply shock variable, the results indicate that in all equations it is positive and statistically significant, as suggested by theory.

The defense spending variable is considered next. First, observe that any contemporaneous measure of defense spending that is specified in growth form is positive and statistically significant at least at the ten per-

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[4] A conceptual and an econometric feature of the approach used for estimating the expected real rate should be pointed out. Conceptually, it is based on the notion that expectations are formed rationally, but with imperfect information [1]. Econometrically, this approach has an advantage for a model of inflation in that the resulting anticipated inflation rate acts as an instrumental variable upon entering the model. As a result, there is no reason to believe that this measure is correlated with the error term of the model, so that its use need not yield biased and inconsistent parameter estimates.

[5] While Vitaliano [13] uses the data from the second edition of Gordon's text, this work uses the data reported in the third edition. Although there are some differences between the two series, they appear to be too minor to affect the results presented here.

TABLE I
Quarterly Estimates of Inflation Equations
1955:1 to 1979:2
(t-ratios in Parentheses)

Independent Variables	1	2	3	4	5	6	7
GRD	0.00035 (2.58)	0.00038 (2.87)					
GRD_{-2}				-0.00002 (-0.12)	0.00001 (0.07)		
DGNP							-0.17 (-1.06)
GRDGNP			0.0002 (1.58)			0.0002 (1.61)	
ln(u/u*)	-0.0145 (-2.77)		-0.0152 (-2.87)	-0.0163 (-2.99)			-0.0188 (-3.13)
$\ln(u/u^*)_{-2}$		-0.0140 (-2.75)			-0.0144 (-2.66)	-0.0135 (-2.55)	
p^e	0.0098 (17.00)	0.0096 (16.99)	0.0100 (17.18)	0.0099 (16.58)	0.0097 (16.26)	0.0097 (16.82)	0.0090 (8.50)
S	0.0174 (4.13)	0.0175 (4.13)	0.0171 (4.00)	0.0169 (3.83)	0.0173 (3.85)	0.0173 (3.97)	0.0162 (3.61)
Constant	-0.0042 (-1.43)	-0.0034 (-1.19)	-0.0027 (-0.93)	-0.0032 (-1.08)	-0.0020 (-0.68)	-0.0016 (-0.54)	1.28 (0.84)
$\bar{R}^2$	0.77	0.77	0.75	0.75	0.74	0.75	0.75
F Statistic	69.42	69.39	65.11	62.52	60.99	63.64	63.55
Rho	-0.22 (-2.04)	-0.22 (-1.97)	-0.24 (-2.18)	-0.24 (-2.19)	-0.22 (-2.03)	-0.22 (-2.03)	-0.21 (-1.87)
D-W Statistic	2.01	2.01	2.02	2.03	2.03	2.01	2.02

Notes:

1) All equations were estimated using Cochrane-Orcutt first order autoregressive procedure with maximum likelihood estimate of Rho.
2) All estimates are expressed in decimal terms.
3. All quarterly growth rates have been annualized.

cent level using a one-tailed test (equations 1, 2, 3, and 6). In particular, regardless of the specification of the demand pressure variable (no lags versus a two quarter lag), the contemporaneous growth rate of nominal defense spending (GRD) is positive and significant at the five percent level or better (equations 1 and 2).[6] In equations 3 and 6, however, the growth rate of the ratio of nominal defense expenditure to nominal GNP (GRDGNP), while positive, is significant only at the ten percent level. This variable is never significant in Vitaliano's model.

According to equations 4 and 5, the two quarter lagged value of the growth rate of defense spending has no statistically significant impact on the inflation rate. Other lag structures for this variable yielded similar insignificant results. This, coupled with the fact that the contemporaneous growth rate of nominal defense expenditures has a positive and significant coefficient, implies that rapid defense buildups exert only a transitory effect upon the inflation rate.

According to equation 7, the ratio of nominal defense expenditures to nominal GNP is negative, but not statistically significant at reasonable levels. This represents another dissimilarity between the present results and those reported by Vitaliano, given that he finds this variable to be significant at the ten percent level. In any case, this variable is not crucial for the hypothesis since, as noted above, what matters is the rapidity of defense spending.[7]

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[6] An anonymous referee pointed out that the proper way of expressing the defense spending variable, GRD, is to measure it in real terms. Vitaliano does not address this issue. Equations 1, 2, 4, and 5 were reestimated using the quarterly growth rate of real defense expenditures. In equations 1 and 2, this variable turned out to be positive and statistically significant at the ten and five percent levels, respectively, using a one-tailed test. As expected, the parameter estimate of this variable was smaller than that of the corresponding variable measured in nominal terms. Further, in equations 4 and 5, as in the case of nominal defense expenditures, the two quarter lagged growth rate of real defense expenditures was not statistically significant.

[7] Vitaliano, who noted this fact, included this ratio in his model "because the national debate is cast in terms of the relative share of GNP devoted to defense," [13].

An interesting question that arises is whether the above findings would hold if the sample period were extended to include the 1980s, a period in which the inflation rate declined significantly even though defense spending accelerated. In order to examine this issue, all equations were reestimated over the period 1955:1 to 1983:2.[8] In addition to the dummy variable indicating the 1973 to 1974 OPEC oil price increase, S, (which is now denoted S_1,) a second dummy variable, S_2, representing the oil price supply shock of 1979 to 1980 that followed the revolution in Iran was included also. The results are reported in Table II.

As is evident from these results, the traditional determinants of inflation have the expected signs and are significant in all seven equations. It also is observed that, as before, the coefficient of the contemporaneous growth rate of nominal defense spending (equations 1 and 2) is positive and significant at the five percent level and has a magnitude similar to that in Table I. Further, the two quarter lagged value of this variable is insignificant (equations 4 and 5). All of these results are consistent with those reported in Table I. There are some differences, however, between the two sets of results with respect to the statistical significance of the ratio of defense expenditures to GNP and the growth rate of this variable. While this ratio remains negative, it is now significant (equation 7). The growth rate of this ratio, however, is no longer significant at any level (equations 4 and 5).

IV. CONCLUSION

The model used here and that employed by Vitaliano lead to different conclusions with respect to the effect of growth of defense expenditures on the inflation rate. The results reported in this paper indicate that rapid defense buildups have an adverse effect on the rate of price inflation that appears to be transitory.

Since all other factors are common between the two models, the difference in the conclusions is attributable to the different measures of the expected inflation rate. In view of the problems associated with using nominal interest rates as a proxy for the expected inflation rate, the results from the present model seem to be more reliable.

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[8]The longer sample period ends with the second quarter of 1983 due to the unavailability of data on the natural rate of unemployment used for constructing the demand-pressure variable.

TABLE II
Quarterly Estimates of Inflation Equations
1955:1 to 1983:2
(t-ratios in parentheses)

Independent Variables	1	2	3	4	5	6	7
GRD	0.0003 (2.25)	0.0003 (2.38)					
GRD_{-2}				-0.00004 (-0.32)	-0.00004 -(0.27)		
DGNP							-0.29 (-2.05)
GRDGNP			0.0001 (0.79)			0.00009 (0.69)	
$\ln(u/u^*)$	-0.0126 (-2.72)		-0.0125 (-2.68)	-0.0122 (-2.64)			-0.0166 (-3.23)
$\ln(u/u^*)_{-2}$		-0.0110 (-2.28)			-0.0099 (-2.04)	-0.0100 (-2.05)	
p^e	0.0096 (15.73)	0.0093 (15.37)	0.0098 (16.02)	0.0098 (15.73)	0.0095 (15.30)	0.0095 (15.58)	0.0084 (9.43)
S_1	0.0189 (4.25)	0.0195 (4.29)	0.0184 (4.11)	0.0179 (3.93)	0.0187 (4.00)	0.0192 (4.15)	0.0159 (3.44)
S_2	0.0109 (2.31)	0.0111 (2.28)	0.0120 (2.52)	0.0127 (2.72)	0.0131 (2.72)	0.0125 (2.54)	0.0113 (2.40)
Constant	-0.0030 (-0.99)	-0.0018 (-0.59)	-0.0019 (-0.64)	-0.0022 (-0.74)	-0.0009 (-0.28)	-0.0006 (-0.19)	0.0243 (1.85)
$\bar{R}^2$	0.76	0.75	0.75	0.75	0.74	0.74	0.76
F Statistic	62.91	61.36	59.28	58.86	56.89	57.21	62.17
Rho	-0.24 (-2.36)	-0.21 (-2.09)	-0.26 (-2.55)	-0.27 (-2.66)	-0.24 (-2.39)	-0.23 (-2.27)	-0.23 (-2.29)
D-W Statistic	2.04	2.02	2.06	2.07	2.05	2.04	2.06

Notes:

1) All equations were estimated using Cochrane-Orcutt first order autoregressive procedure with maximum likelihood estimate of Rho.
2) All estimates are expressed in decimal terms.
3) All quarterly growth rates have been annualized.

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