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NOMINAL GNP GROWTH AND ADJUSTED RESERVE GROWTH: NONNESTED TESTS OF THE ST.LOUIS AND BOARD MEASURES

Joseph H. Haslag*
Federal Reserve Bank of Dallas

and

Scott E. Hein*
Texas Tech University

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In a recent exchange, Friedman (1988) and McCallum (1988) took opposite positions on the viability of nominal GNP targeting with a monetary base instrument. Friedman questioned the appropriateness of a monetary base instrument and, when he specified a nominal GNP growth equation with reserve growth as an explanatory variable, he found that there was no significant statistical association between the two variables. McCallum, however, re-estimated the nominal GNP growth equation using a different measure of reserve growth and found evidence consistent with the hypothesis that changes in reserve growth temporally precede changes in nominal GNP growth. Friedman used the total reserves series calculated by the Board of Governors, whereas McCallum used a measure of adjusted total reserves calculated by the Federal Reserve Bank of St. Louis.1/ The disparate results, and hence, the opposing positions, apparently center on which reserve measure is used.2/

In light of the exchange between Friedman and McCallum, the natural question is: Which result does one believe? If the Board of Governor's reserve measure is the correct one, then Friedman's conclusion seems warranted. If, on the other hand, the Federal Reserve Bank of St. Louis reserve measure is the correct one, then McCallum's recommendation deserves further consideration. A priori, there seems little reason to reject one measure out of hand. The two respective Federal Reserve System institutions adjust the total reserves aggregate for changes in reserve requirements and seasonal variation through different procedures. There does not appear to be a reason to prefer one measure over the other. But, the evidence suggests that the measure chosen may lead to diametrically opposite policy conclusions.

The purpose of this paper is to compare the two total reserve measures in terms of their abilities to explain nominal GNP growth. The comparison involves a specification test. If the specification test indicates that the two specifications are not statistically different from each other, then the choice regarding which reserve aggregate to use when targeting nominal GNP seems arbitrary. In this case, the evidence supporting a reserve or base targeting procedure must be considered less favorable. The test for nonnested specifications used here was developed by Davidson and MacKinnon (1981).

II. The Model

Following Friedman and McCallum, two separate reduced-form equations relating nominal GNP growth to reserve growth are estimated. The primary difference between each specification is that a different reserve measure is used. One uses the Board of Governors measure. The other uses the St. Louis measure. The general form of the model is given by

$$(1) \quad Y_t = \alpha_0 + \sum_{i=1}^{n_1} \alpha_i Y_{t-i} + \sum_{i=1}^{n_2} \beta_i R_{t-i} + \sum_{i=1}^{n_3} \lambda_i FG_{t-i} + \epsilon_t,$$

where Y denotes nominal GNP growth rate; R, the adjusted reserve growth rate (either the Board or St. Louis); FG is the high-employment federal budget surplus growth rate; and, ϵ, a residual term.

Equation (1) differs slightly from the model specification adopted by Friedman and McCallum. First, neither Friedman nor McCallum accounted for the potential effects of fiscal policy. As equation (1) shows, the high-employment federal budget surplus is included. Second, equation (1) permits a very general lag structure for each of the separate explanatory variables. Thornton and Batten (1985) provide evidence which suggests that policy conclusions can be sensitive to the lag-length choice. Friedman and McCallum use one-quarter lags on both nominal GNP growth and reserve growth, without providing much support for this particular specification. The final prediction error (FPE) criterion developed by Akaike (1969) is used here to determine the number of lags of each variable included in the specification.3/

III. Empirical Results

Table 1 reports the estimation of the model given by (1) for both reserve measures using quarterly data from 1959I to 1989II.4/ The FPE criterion indicates that one lagged value each of nominal GNP growth, adjusted reserve growth and high-employment surplus growth should be included in the specification. Moreover, the Breusch-Godfrey test is consistent with the hypothesis that the residuals are not autocorrelated. The general specifications estimated by Friedman and McCallum appear to be supported by the data.5/

With the exception of the coefficients on the lagged values of the alternative reserve measures, the coefficient estimates are generally similar across the alternative specifications. Both coefficients on lagged nominal GNP growth are statistically different from zero and about 0.25, while both the coefficient estimates on the fiscal policy variable are similar in magnitude and are not significantly different from zero. The estimated coefficients on the lagged adjusted reserve measures, however, differ more substantially across specifications. The coefficient in the St. Louis specification is positive and statistically different from zero.6/ In contrast, the coefficient on the Board's adjusted reserve variable is not statistically different from zero. Consequently, we conclude that the growth in adjusted reserves, as measured by the Board, has no statistical association with nominal GNP growth. On the other hand, we find that variation in adjusted reserve growth, as measured by the Federal Reserve Bank of St. Louis, bears a temporally leading association with nominal GNP growth. Thus, the findings of Friedman and McCallum have survived the incorporation of fiscal policy variables and the possible addition of longer lag lengths on each of the explanatory variables.7/

But, can we reject one of these specifications in favor of the other? Given that (i) the St. Louis specification has greater explanatory power (adjusted R^2 of 0.09 vs. 0.06), and (ii) the St. Louis reserve measure is statistically associated with future movements in nominal GNP growth and the Board's measure is not, the data seemingly suggest that the St. Louis specification is superior. But, is the superiority statistically significant, or is the difference between the two relationships statistically indistinguishable?

To examine this question we performed the Davidson-MacKinnon J-test on the two alternative specifications. The test is designed to make pairwise comparisons of competing models. In the first case, we presume that the Board specification is the null hypothesis (that is, the Board reserve measure is presumed to be the monetary variable in the "true" model) and the St. Louis model is the alternative. In this case, the fitted values from the St. Louis specification are included as a separate explanatory variable in the Board specification. The results from estimating this "augmented" equation are given in the first column of Table 2. The only significant coefficient is that on the variable representing the fitted value from the St. Louis equation. The coefficient on the Board adjusted reserve variable is negative, but not different from zero at conventional levels. Under the null hypothesis that the Board reserve is the "true" model, the J-statistic equals 2.52, which indicates that the null hypothesis is rejected in favor of the alternative St. Louis specification.

Davidson and MacKinnon note that their test procedure is not necessarily symmetric and suggest reversing the null and alternative hypotheses. The null hypothesis in the second test presumes that the St. Louis specification is the "true" null model and that the model with the Board reserve measure is the alternative. The results for this test are reported in the second column in Table 2. In this case, the coefficient on the variable representing the fitted value from the Board model is negative, but not different from zero at conventional significance levels. The J-test statistic is equal to -1.36 which does not reject the null model in favor of the alternative.8/

In short, the specification test provides evidence that the model with the St. Louis reserve measure is statistically superior in explaining movements in nominal GNP behavior than the Board model.

IV. Conclusion

Evidence is presented that rejects the hypothesis that the Board adjusted reserve series is preferred to the St. Louis adjusted reserve series in terms of explaining nominal GNP growth. The hypothesis that the St. Louis measure is better than the Board measure, however, is not rejected. Thus, insofar as explaining nominal GNP growth is concerned, the results presented in this paper suggest that the St. Louis adjusted reserve series is superior to the Board adjusted reserve series. Consequently, the evidence supports McCallum's conclusion that the choice of the reserve measure used matters in evaluating monetary policy rules. Indeed, the conclusion regarding the merits of nominal GNP targeting using a reserve rule hinge on whether one uses the St. Louis measure or the Board's measure of adjusted total reserves.

FOOTNOTES

1. Officially, the Board's measure is called total reserves adjusted for changes in reserve requirements. Gilbert (1983) provides a thorough discussion of the differences between these two measures.

2. Friedman also estimated the equations with both the Board and St. Louis monetary base measures and found that the Board base measure does not "substantially affect McCallum's results." He interprets the evidence from this comparison as verification that changing from the Board measure to the St. Louis measure of the monetary base does not substantially alter the results of McCallum's simulation. Haslag and Hein (1989), however, provide evidence which suggests there is a statistical difference between the two measures in terms of their respective abilities to explain movements in nominal GNP growth.

3. Hsiao (1981) developed the multivariate approach for selecting lag length. Essentially, this procedure identifies an order for choosing the explanatory variables, as well as choosing the "optimal" lag-length.

4. The growth rates are calculated as follows:

$$(x_t - x_{t-1}) / [(x_t + x_{t-1})/2],$$

where x_t denotes the explanatory variable. The St. Louis adjusted reserve series is calculated as the difference between adjusted monetary base and the currency component of M1 (i.e., currency in the hands of the public). The Board estimates seasonal factors separately for both currency in the hands of the public and total reserves. Consequently, the Board's total reserve series is used. The Federal Reserve Bank of St. Louis provided the adjusted monetary base data. Nominal GNP, the high-employment government budget surplus, the currency component of M1 and the Board's total reserve series adjusted for changes in reserve requirements are obtained from the Citibase data bank. All data are seasonally adjusted.

5. One lag on the fiscal policy variable is included (under the assumption that at least one lag is appropriate), but the coefficient on this variable is estimated to be not significantly different from zero. Omitting the fiscal policy measure from the specification does not alter the main conclusions of this paper.

6. The long-run elasticity of nominal GNP growth with respect to a one-percentage-point increase in adjusted reserves is estimated to be only 0.26 with the St. Louis adjusted reserve measure. This differs from the estimate of the long-run elasticity, which is equal to 0.67 when the St. Louis adjusted monetary base is used. The constrast is sharpened when we consider that long-run elasticity is not significantly different from one when the monetary base is specified, but is significantly <u>less</u> than one, but greater than zero when St. Louis adjusted reserves are specified. With the Board's adjusted reserve measure, the long-run elasticity of nominal GNP growth is equal to 0.14, and is not statistically different from zero. The long-run elasticities are

statistically different when the monetary base is used in the nominal GNP specification as compared to adjusted reserves. Thus, contrary to McCallum's claim, the empirical findings suggest that reserves and monetary base measures are different in terms of their respective abilities to explain nominal GNP growth.

7. A test to determine if the models are stable over the entire sample was also performed. Because of the reforms introduced in the Monetary Control Act of 1980, 1980I is identified as potential join point. The test statistics from the Chow test are equal to 0.55 and 0.87 for the models with St. Louis reserves and Board reserves, respectively. The evidence, therefore, suggests that both of the relationships are stable over the sample period.

8. Sawa (1978) presents an alternative methodology to compare nonnested specifications, which does not suffer from the potential asymmetries present in the Davidson-MacKinnon procedures. Sawa uses information criterion as a measure of the distance from the competing specifications and the "true" specification. Using the Bayes decision rule, the test amounts to which specification yields a lower value of the information criteria. As in the Davidson-MacKinnon procedure, the BIC is smaller for the specification with the St. Louis reserve measure than with the Board reserve measure (-740.76 vs. -735.81). Thus, the information criterion suggests that the specification with the St. Louis adjusted total reserves is superior.

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Table 1

Reduced-form Nominal GNP Equations
with the Two Adjusted Reserve Measures
(I/1959 - IV/1988)
Coefficient Estimate

Variable	Board Reserves	St.Louis Reserves
Intercept	0.665* (0.108)	0.606* (0.109)
Y_{t-1}	0.255* (0.090)	0.247* (0.088)
R_{t-1}	0.105 (0.073)	0.193* (0.076)
FG_{t-1}	0.0001 (0.001)	0.0002 (0.001)
Summary Statistics:		
$\bar{R}^2$	0.09	0.06
Breusch-Godfrey Test Statistic F= (includes 4 lagged values)	1.26	0.97

*Indicates statistical significance at the 5 percent level.
Standard error of the estimate in parentheses.

Table 2

Reduced-form Nominal GNP Equations
Used for Nonnested Test of Models
(I/1959 - IV/1988)
Null Hypothesis

Variable	Board Model	St. Louis Model
Intercept	-0.294 (0.401)	1.587* (0.726)
Y_{t-1}	-0.102 (0.175)	0.641* (0.283)
R_{t-1}	-0.153 (0.112)	0.293* (0.116)
FG_{t-1}	-0.00001 (0.001)	0.001 (0.001)
Y_{t-1}	1.514* (0.601)	-1.449 (1.064)
Summary Statistics:		
$\bar{R}^2$	0.107	0.107
Breusch-Godfrey Test Statistic (includes 4 lagged values)	1.58	1.58
J-Test	2.52	-1.36

*Indicates statistical significance at the 5 percent level.
Standard error of the estimate in parentheses.

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