NBER WORKING PAPER SERIES

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Working Paper No. 5009

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 1995

This paper was prepared for the January, 1995 AEA meetings. This paper is part of NBER's research program in Public Economics. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

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ABSTRACT

Some economists have argued that the disincentive effects of marginal tax rate increases in the 1980s caused revenue to rise by less than had been anticipated. To evaluate the hypothesis, this paper considers OMB revenue forecasts and forecast errors for the period 1982-93. If the revenue gains from tax increases, and the revenue losses from tax cuts, were overstated because of inadequate allowance for behavioral responses, then the forecast errors should be negatively related to the initial revenue estimates of the impact of policy changes.

For excise taxes and corporate income taxes, the results suggest that the systematic overprediction of revenues during the period can be explained in part by an underestimate of behavioral responses to taxation.

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Tax Projections and the Budget: Lessons from the 1980s

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Economists trying to explain the current U.S. fiscal crisis have looked back at the tax changes of the 1980s and early 1990s in search of an explanation. Some have argued that the disincentive effects of marginal tax rate increases caused revenue to rise by less than had been anticipated. As I showed in a recent paper (Auerbach 1994), revenue forecast errors accounted for only a portion of the major budget forecasting problem during the 1980s. Still, understanding the causes of these errors can shed light on the continuing controversy over the behavioral effects of taxation, which will take on greater importance as the United States recognizes the need to weigh further tax increases against other deficit-reducing measures.

My earlier paper presented some initial findings, based on an analysis of the Congressional Budget Office's (CBO's) aggregate revenue forecast errors. Had the revenue gains from tax increases, and the revenue losses from tax cuts, been systematically overestimated, the forecast errors should have been negatively related to the revenue estimates. The logic is straightforward. The estimated change in revenue from a tax change Δt is $\Delta t \times b \times (1-\eta^*)$, where b is the initial tax base and η^* is the assumed elasticity of this tax base with respect to tax rate changes. If the true elasticity is η, then the actual revenue change will be $\Delta t \times b \times (1-\eta)$. The forecast error resulting from the use of the wrong elasticity will be $\Delta t \times b \times (\eta^*-\eta)$, which equals $(\eta^*-\eta)/(1-\eta)$ times the initial revenue estimate. Hence, the regression coefficient of actual revenue on the initial forecast provides an estimate of the gap between the true and assumed elasticities. While negative, the coefficient of revenue estimates was small and statistically insignificant.

This paper takes another look at the causes of revenue forecast errors using a different source of data that is more disaggregated than the CBO data and provides a better measure of policy changes. While the results presented below should still be considered preliminary, they suggest that behavioral responses may have contributed to the period's revenue forecasting errors.

I. Data and Methodology

Like the CBO, the Office of Management and Budget (OMB) prepares annual budget forecasts and estimates the effects of policy changes, publishing these in the annual budget for the upcoming fiscal year. For many years, the budget document has also contained a table analyzing the revenue forecast errors for the most recently completed fiscal year, based on the forecasts originally made in *that* fiscal year's budget. For example, the 1995 budget (published in early February, 1994) compared actual revenues for fiscal year 1993 (which ended on September 30, 1993) to those originally forecast in the 1993 budget, published in February, 1992. Thus, for each fiscal year, the error covers a period of about 20 months that begins about eight months earlier.

As with the CBO data analyzed in my earlier paper, these forecast errors are divided into three mutually exclusive components, labelled *policy*, *economic*, and *technical*. Policy errors indicate the extent to which revenues deviated from their initial forecast because of an inaccurate prediction of the policies followed. Economic errors are those attributed to inaccurate forecasts of macroeconomic variables, such as GDP, interest rates and inflation. Technical errors are the residual forecast errors that OMB attributes neither to policy changes nor macroeconomic performance.

The analysis below focuses on these technical errors, for they might arise, in part, as a result of unexpected behavioral responses. Even after adjustment for errors in predicting aggregate output or expenditures (which might also relate to tax-induced behavior), tax-induced shifts in the composition of income, say, away from corporate profits or capital gains, or in the composition of expenditures, away from commodities facing higher excise taxes, would induce revenue forecast errors, were these behavioral responses not built into initial revenue forecasts. Both OMB and CBO do build *some* behavioral responses into their forecasts; the controversy is about whether these predicted responses are large enough.

The OMB data also are disaggregated into eight revenue categories. This is an advantage in searching for evidence of behavioral responses. Legislation may include changes that offset each other in the aggregate. For example, the Tax Reform Act of 1986 raised corporate taxes but lowered individual taxes. Also, some revenue sources, notably excise taxes, are too small for their behavioral effects easily to be discerned in the response of total revenues.

In the analysis below, I study the forecasts of aggregate revenues as well as individual and corporate income taxes and excise taxes, which together account for about 60 percent of all revenues. Since 1980, each of these revenue sources has undergone legislative changes to which significant behavioral responses have been attributed. The 1981 and 1986 acts reduced marginal tax rates on most sources of individual income, and some analyses of the 1981 changes (Lawrence Lindsey 1987) and the 1986 changes (Daniel Feenberg and James Poterba 1993, Martin Feldstein 1993) have argued that these marginal tax rate reductions led to a substantial increase in taxable individual income. Other changes, notably the 1986 increase in capital gains taxes, worked in the opposite direction.

The 1981 act also cut corporate taxes sharply, but these reductions were largely undone by subsequent legislation, notably the 1986 act, which eliminated the investment tax credit and left the corporate tax rate above the top individual marginal tax rate. Some authors (e.g., Roger Gordon and Jeffrey Mackie-Mason, 1990, and Myron Scholes and Mark Wolfson, 1992) have concluded that the 1986 changes led to variety of behavioral responses that reduced corporate tax collections, including higher debt-equity ratios and a shift toward noncorporate business organization. These changes provide one explanation for the unexpectedly low corporate tax receipts in the years after 1986 (Poterba, 1992).

Several major changes in excise taxes occurred during the period, including the enactment of the Crude Oil Windfall Profit Tax in 1980 and the introduction of a 10 percent tax (above a threshold) on certain luxury goods in 1990. While there has been little scientific analysis of the behavioral impact of these luxury taxes, the dire reports of lost business and employment coming from affected industries hastened their repeal in 1993.

The equations to be estimated take the basic form:

$$E_{it} = \alpha_i + \beta_i \times {}_{t-1}P_{it} + \epsilon_{it} \qquad (1)$$

where E_{it} is the technical forecast error for revenue type i and fiscal year t and ${}_{t-1}P_{it}$ is an estimate of the change in revenues in year t resulting from policy changes during year t-1. Thus, the equation assumes that behavior responds to the previous year's policy changes. If the estimated revenue effects of these policy changes account inadequately for offsetting taxpayer behavior, then they should be associated with forecast errors of the opposite sign ($\beta < 0$). In terms of the notation used above, the actual behavioral elasticity will be a weighted average of the assumed elasticity and 1,

$$\eta = (-\beta)\times 1 + (1-(-\beta))\times\eta^{*} \qquad (2)$$

How to represent the policy changes ${}_{t-1}P_{it}$ is not straightforward, even for a simple model in which projected revenue changes provide a reasonable proxy for the marginal tax rate changes influencing current behavior. In my previous work based on CBO data, I used the revenue forecast errors attributed to policy changes to represent changes in tax rules and hence incentives. However, these policy forecast revisions simply indicate the extent to which policies deviate from original baseline forecasts. Had a baseline forecast incorporated a major change that ultimately did take place, there would be no estimated revenue effect of policy.

Fortunately, the OMB data offer an alternative. Each annual OMB budget document provides, at the same level of disaggregation as the forecast error breakdown, the estimated revenue effects, projected for the current fiscal year and several future fiscal years, of major legislation enacted in the just-completed calendar year. For example, the 1995 budget reported the effects of legislation enacted in calendar year 1993 on revenues in fiscal years 1994-1999. Hence, for each fiscal year, we may combine the information from recent budgets to obtain estimates of the revenue effects of recent legislation.

Even this measure based on actual legislation has its own pitfalls. If the legislation simply extends current tax rules (as was the case for some of the income tax provisions of the 1993 act), then changes in law needn't correspond to changes in tax rules. However, the major legislation of the period typically did change tax rules. One should also keep in mind that such a simple revenue-based measure of tax rule changes will not account for all the changes in the current tax structure relevant to taxpayer behavior, such as the degree of tax progressivity, the extent to which the changes in tax provisions were anticipated, and how the changes altered expectations regarding future tax rates. Hence, it provides a noisy, although not obviously biased, signal of behavioral incentives.

II. Results

Table 1 presents summary statistics for the technical forecast errors, expressed as a share of their respective revenues. Total revenues (conditional on changes attributable to macroeconomic factors and policy developments) were slightly overforecast for the period as a whole, while individual income taxes, which account for nearly half of all federal revenues, were slightly underpredicted. However, both corporate income taxes and excise taxes were substantially overpredicted.[1]

The volatility of prediction errors also varies across sources of revenue, with the relatively minor volatility of aggregate errors giving little indication of how erratic the forecasts of particular types of revenue were. Corporate tax prediction errors were the most erratic, having a standard deviation of nearly 9 percent.

Table 2 presents regression results with these four series as dependent variables, based equation (1), with the policy variables also expressed as a share of revenue. Recall that these policy variables give the estimated effect on the current fiscal year's revenue of earlier *calendar* years' legislation. Because fiscal years and calendar years overlap, I include the policy variables from both the most recent calendar year and the one preceding it, each of which includes part of the most recent fiscal year before the current one.

The stochastic terms of the estimated equations also require further consideration. Each observation is a forecast error over the twenty-month period beginning eight months before the fiscal year being evaluated. Hence, successive observations overlap for an eight-month period. Given this, we should expect successive error terms ϵ_{it} to be correlated, even if the underlying disturbances themselves were serially uncorrelated across fiscal years. Each observation's error should have an MA(1) structure:

$$\epsilon_t = \nu_t + \phi \nu_{t-1} \qquad (3)$$

where ν_t is the component of the disturbance arising during the fiscal year itself. The parameter ϕ, which should be positive, is the moving average term reported in Table 2.

The table provides a number of interesting results. First, the moving average term is positive, as expected, for each of the equations. Second, disaggregation by revenue source helps considerably. While the adjusted R^2 is just .08 for revenues as a whole, and near zero for individual income tax collections, it exceeds .4 for both corporate taxes and excise taxes.

In each equation, the once-lagged policy variable has a negative coefficient, as one would predict if behavioral effects were understated. (The twice-lagged variable has a significant impact only in the equation for excise taxes.) However, while the coefficients are similar across equations, they are significantly different from zero only for corporate and excise taxes. This may reflect the greater level of aggregation of individual and total revenues rather than a greater behavioral sensitivity to corporate and excise tax changes. The intuition is that, whereas policy-induced changes in excise taxes all involve increase or decreases in some rate of commodity taxation, policy changes in the individual income tax can affect very different types of behavior (e.g., labor supply, capital gains realizations, charitable contributions, etc.) and might or might not involve changes in marginal tax rates.

Another interesting aspect of these results involves the constant terms, which represent the average overprediction of revenues that remain unexplained. The forecast errors in the aggregate and for individual income taxes have sample averages close to zero, to begin with. In the behavioral equations, the constants are even smaller in absolute value and quite insignificant. Perhaps of greater interest, the much larger mean sample error of -.034 for excise taxes virtually disappears once the behavioral effects are incorporated; for excise taxes, behavioral effects explain the overprediction of revenues during the period. For corporate taxes, the constant remains significant, although only about two-thirds the size of the sample mean. In other words, this simple behavioral model accounts for about one-third of the period's very large average overprediction of corporate revenues.

Sensitivity analysis of these results does not alter the findings in any important way. Omitting the second-lagged policy variable reduces the remaining coefficient's size in the excise tax equation to -.24 (reducing the adjusted R^2 to .28) but raises the coefficient in the corporate tax equation to -.54 (and the adjusted R^2 to .52), with both still statistically significant, while leaving the other equations' coefficients insignificant.

One might expect lagged policy variables from other sources to matter. For example, the overprediction of corporate taxes after 1986 has been tied not only to increases in corporate taxes but also reductions in individual income taxes. Lagged corporate tax changes do enter with the predicted positive sign in the individual income tax equation, raising the adjusted R^2 to .29, but all coefficients remain insignificant; lagged individual income tax changes enter the corporate tax equation insignificantly and with the wrong sign. Estimating the three disaggregate equations together, using the technique of seemingly unrelated regressions[2], also does not affect any variable's significance or insignificance.

III. Conclusions

This paper's results offer tentative support for the argument that the overly optimistic revenue forecasts of the 1980s resulted, at least in part, from an inadequate allowance for taxpayer behavioral responses. However, the methodology requires greater refinement before more precise conclusions can be drawn.

Table 1

Technical Forecast Errors, by Source of Revenue, 1982-1993
(Relative to Revenue)

Tax Category	Total Revenues	Individual Income Tax	Corporate Income Tax	Excise Tax
Mean	-.006	.004	-.067	-.034
Standard Deviation	.019	.033	.089	.041

Source: OMB

Table 2

Explaining Technical Forecast Errors
(by Source of Revenue, 1982-1993)

Tax Category:	Total Revenues	Individual Income Tax	Corporate Income Tax	Excise Tax
Independent Variable				
Constant	-.004 (-0.75)	-.000 (-0.02)	-.045 (-2.04)	-.004 (-0.31)
Policy Term, t-1	-.268 (-1.03)	-.276 (-0.81)	-.456 (-2.19)	-.301 (-2.73)
Policy Term, t-2	.002 (0.02)	-.122 (-0.96)	.132 (0.98)	-.082 (-2.15)
Moving Average Term	.632 (2.24)	.499 (1.64)	.923 (12.86)	.251 (0.70)
$\bar{R}^2$	.083	.017	.403	.417

Source: OMB

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Endnotes

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1. For each revenue source, the average economic forecast error was negative more than twice as large in absolute value than the average technical forecast error. The technical and economic errors combined for the corporate tax averaged over 23 percent of revenue!

2. The argument for doing so is that the contemporaneous forecast errors are undoubtedly driven by similar unobserved factors, so that the stochastic disturbances of the three equations should be correlated. The sample correlations of the dependent variables themselves are .19 (corporate-excise), .47 (individual-excise) and -.19 (corporate-individual).