NBER WORKING PAPER SERIES

HOW MUCH EQUITY DOES THE GOVERNMENT HOLD?

Alan J. Auerbach

Working Paper 10291
http://www.nber.org/papers/w10291

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 2004

This paper was presented at the 2004 Meetings of the American Economic Association. I am grateful to Kristy Piccinini for research assistance, the Robert D. Burch Center for financial support, and Kent Smetters and Julie Collins for comments. The views expressed herein are those of the authors and not necessarily those of the National Bureau of Economic Research.

How Much Equity Does the Government Hold?
Alan J. Auerbach
NBER Working Paper No. 10291
February 2004
JEL No. H20, G12

ABSTRACT

A central point in the recent debate about Social Security in the United States has been the extent to which the federal government should take significant positions in the equity market. But, as this paper shows, the government already has a much more significant, if implicit position in the U.S. equity market through its claim to future tax revenues. Using estimates of the sensitivity of federal tax revenues to stock market returns, I calculate the implicit equity position of the federal government, defined as the equity position that would be as sensitive to the stock market as the present value of federal revenues. Although standard errors are large, point estimates indicate that the implicit federal equity position exceeds the size of the stock market itself, a result that is consistent with the fact that revenues from all sources, not just taxes on corporate source income, are responsive to stock market returns.

Alan J. Auerbach
Department of Economics
549 Evans Hall, #3880
University of California, Berkeley
Berkeley, CA 94720-3880
and NBER
auerbach@econ.berkeley.edu

A central point in the recent debate about Social Security in the United States has been the extent to which the federal government should take significant positions in the equity market. During the Clinton administration, for example, a Social Security advisory council presented three proposals to improve the system's financial stability (U.S. Social Security Administration, 1997), one of which would have involved shifting a portion of the OASDI trust fund into corporate equity. Opponents argued that government ownership of equity would endanger the capital market and that the use of risky investments to sustain future benefits would implicitly commit the government to raise taxes on future workers if investment yields fell short of expectations.

But, as this paper shows, the government already has a much more significant, if implicit position in the U.S. equity market through its claim to future tax revenues. There are differences, of course, between implicit and explicit equity ownership. For example, an income tax does not apply selectively to particular companies or carry voting rights. But these differences can be overstated; a government may meddle in the equity market, but it may also change tax rules.

To get a sense of how large government's implicit equity claim might be, consider a proportional tax, τ, on all capital income. The government's right to this fraction of all capital income gives it $\tau/(1-\tau)$ of the income stream received by private owners of capital. If all such capital is held via the stock market, then government would have an implicit equity stake equal to $\tau/(1-\tau)$ of stock market value. A tax rate of 25 percent, for example, would make the government's equity claim one-third of the private stock market value. This simple calculation, though, likely understates the government's implicit claim. Much of the government's tax revenue comes from labor income or capital income outside the publicly traded sector, each stream likely correlated with corporate sector returns. Thus, the government's claim could be several times the size of the stock market. For example, if all income shocks were perfectly correlated, half of all capital income were received from sources other than the stock market, and labor income were three times the size of capital income, then stock market income would equal 1/6 of all income subject to the income taxation, so that a 25 percent income tax would provide an implicit equity claim equal to twice (6 x .25/.75) the explicit value of the stock market.

Measuring the Government's Equity Position

Before calculating this implicit equity position, one must confront some theoretical issues. First, the tax structure itself is subject to change, and this leads to an ambiguity in defining the implicit equity position at any given time. For example, suppose that the government must raise a fixed amount of revenue each year that does not vary with economic circumstances, and uses an income tax to raise this revenue. As income fluctuates, government offsets the change in revenue that would result by raising the income tax rate when income declines and lowering the tax rate when income falls. Is it appropriate in this case to say that government's revenue stream is deterministic and free of risk? If we seek to understand the risk characteristics associated with the tax *structure*, rather than with observed tax revenues, we should hold the tax structure constant in performing the calculation.

Second, as there is no market for a right to tax revenues, how can we estimate the government's implicit equity claim, under a given tax structure? This is the heart of the exercise performed below. Taking the government's overall "asset position" as the present value of its current and future revenues, we ask how this present value is affected by a contemporaneous change in the stock market. We then ask how large a share of private equity the government would have to hold in order for its wealth to change by the same amount, and define this to be the government's implicit equity position. This definition of government's equity position relates to risk, not value, telling us how much equity would have the same volatility as the government's position. This need not equal the present value of the government's revenue stream. The two measures would coincide if government revenues were some proportion of corporate revenues (as in the first example above), but this will not be the case more generally. Given our interest in the government's risk exposure, the risk-based measure seems more appropriate.

Let X_t be the level of government revenue in year t, and define $x_t = \ln(X_t / X_{t-1})$ as the proportional change in X_t from year t-1 to year t. Let r_t be the proportional stock market return over the same period, also defined using logarithms. To purge the calculated revenue change of tax law changes in response to contemporaneous stock market returns, let $\bar{x}_t = \ln({}_{t-1}X_t / X_{t-1})$ be the change in revenue between years t-1 and t that would have occurred had the year t-1 tax law applied in both years. To determine the impact of the stock market on government revenues at date t, we specify the equation,

$$\bar{x}_t = \alpha + \beta_1 \bar{x}_{t-1} + \ldots + \beta_m \bar{x}_{t-m} + \gamma_0 r_t + \gamma_1 r_{t-1} + \ldots + \gamma_n r_{t-n} + \varepsilon_t \tag{1}$$

where m and n are the number of lags for revenue growth and stock market returns, respectively.[1]

The lag structure of expression (1) permits a flexible impact of current changes in the stock market on future levels of revenue. This makes sense given the various channels through which the market affects revenue (which we do not attempt to distinguish). For example, we might expect capital gains tax collections to surge for a number of years after an initial shock to the market, because of delays in realizations; to the extent that revenue shocks are associated with anticipated changes in profits, revenues needn't immediately reflect the rise in the market.

Using the coefficients from (1), one can estimate the impact of a stock market shock at date t on revenue growth from date t onward.[2] Letting a_s be the impact on $\bar{x}_{t+s}$ of a unit shock to

[1] If revenue and the value of the stock market were cointegrated, then it would be appropriate to include an error correction term in (1) to represent the long-run relationship between the two variables. However, various tests indicated that the variables were not cointegrated.

the return r_t after s periods, we have (for lag structure $(m,n) = (1,1)$, which turns out to be a preferred specification using annual data):

(2) $$a_0 = \gamma_0\,;\;\; a_1 = \gamma_1 + \beta_1 a_0\,;\;\; a_s = \beta_1 a_{s\text{-}1}\;,\; \forall\; s > 1,$$

which we may use to calculate the cumulative effect, b_s, on the logarithm of revenues at date s+t,

(3) $$b_0 = a_0\,;\;\; b_s = a_s + b_{s\text{-}1}\;,\; \forall\; s > 0.$$

We would expect the terms a_s to converge to zero after a time, and the terms b_s to converge to some constant value, representing the long-run percentage increase in revenues resulting from a one-time unit increase in the stock market. As a one-time shock to r_t represents a permanent increase in asset prices, there is no reason for this long-run value of b to be zero. For example, a one-time increase in the level of productivity ought to have a permanent effect on revenue.

The terms b_s provide estimates of the impact on revenues at each date $s \geq t$ of a stock market shock at t. Let ρ be the appropriate real government discount rate[3]. The present value change in revenue associated with a unit increase in r_t is then:

(4) $$b_0 X_t + b_1 X_{t+1}/(1+\rho) + b_2 X_{t+2}/(1+\rho)^2 + \ldots,$$

where X_{t+s} is the baseline level of revenue in period t+s. If we assume that baseline revenue grows at a constant real rate, g, then expression (4) becomes

(5) $$b_0\, X_t + b_1 X_t(1+g)/(1+\rho) + b_2 X_t(1+g)^2/(1+\rho)^2 + \ldots$$

$$= \quad X_t\,[b_0 + b_1(1+g)/(1+\rho) + b_2\,(1+g)^2/(1+\rho)^2 + \ldots],$$

so that the present value impact relative to current revenue X_t is, simply:

(6) $$\theta = [b_0 + b_1\,(1+g)/(1+\rho) + b_2\,(1+g)^2/(1+\rho)^2 + \ldots].$$

---

[2] This calculation assumes that a stock market shock at date t has no direct impact on stock market returns at subsequent dates.

[3] For simplicity, the discount rate is assumed here to be constant.

With this variable calculated, we are now in a position to determine the government's implicit equity share. A unit increase in the stock market at date t increases the present value of revenues by θX_t. The same increase raises the value of the stock market as a whole by V_t, where V_t is the market's capitalized value. Thus, the increase in the government's revenues has the same present value as it would if the government received no tax revenues at all, but held a fraction $\theta X_t/V_t$ of the stock market, or stock valued at θX_t.

Data

Given the form in which revenue data are available, we work with annual data for fiscal years, with the stock market returns measured over the same period. The main data source for government revenues is various publications of the Congressional Budget Office. To calculate period t revenues under period t-1's tax law, ${}_{t-1}X_t$, we subtract from actual revenues in period t the CBO estimates during year t of the cumulative impact of legislation on revenues in that fiscal year.[4] In cases where components of revenue, such as individual income tax receipts, are being considered, the standard CBO publications must occasionally be supplemented by other materials describing the components of tax legislation, although breakdowns are generally available except where the legislative effects on revenue are quite small.[5] Unfortunately, complete estimates of the impact of legislation on current-year revenues are available only going back to fiscal year 1985, which leaves us with relatively short time series. Thus, we also consider estimates of equation (1) using the actual growth in revenues, x_t, rather than the constant-law growth in revenues, $\bar{x}_t$, which allows estimation over a much longer sample period.

[4] CBO's periodic updates break down revenue changes among "technical", "economic" and "legislative" factors. Our correction subtracts all current-year legislative changes.

[5] Details of how these corrections are computed are available upon request.

Fiscal year stock returns are based on the value weighted total (NYSE, AMEX, and NASDAQ) market, from the CRSP Indices database. Revenues and stock returns are deflated with the GDP deflator; the estimated equation relates real revenue growth to real stock returns.

Results

Table 1 presents estimates of equation (1), using actual revenue growth, for fiscal years 1949-2002, for both total federal revenue and its major components.[6] The number of lags for the model was chosen using the Schwarz Bayesian Information Criterion, although similar results followed from the use of alternative criteria.[7] The estimates suggest that total revenues rise immediately in response to a stock market shock, and then continue to rise more rapidly, with the impact converging rapidly to about .22 percent of revenue for each one-time, percentage point stock market increase. The estimated sensitivity is greater for personal income taxes, at .35 percent of revenue, and largest for corporate income taxes, with an implied long-run response of just over .4 percent per percent increase. For all other categories of taxes, the sensitivity is quite small.

The bottom part of Table 1 presents estimates of θ, based on expression (6), for an assumed real growth rate of 3 percent and alternative real discount rates of 3.5, 6, and 9 percent, respectively. Also included for each estimate are 95-percent confidence intervals.[8] Recall that θ, multiplied by the level of revenue, provides an estimate of the implicit equity holdings associated with this particular revenue source. The estimates of θ are consistent with the long-run annual responses just discussed. They are also very sensitive to the choice of discount rate, particularly

[6] The starting date was chosen to exclude World War II from the data, and to accommodate sufficient revenue lags in choosing the appropriate specification.

[7] For all but the Social Insurance equation, the (1,1) specification was found to be optimal. For that equation, the (3,1) specification was found to be slightly better, but I present the (similar) results for the (1,1) specification to preserve comparability with other estimates.

[8] These intervals are calculated by taking 1000 random draws from the estimated joint distribution of the parameter estimates.

at low levels of the discount rate. This is a consequence of the fact that the estimated impact on revenue is permanent, so that θ becomes very large as the discount rate converges to the growth rate. For the intermediate discount rate assumption of $\rho = .06$, the estimate for total revenues is 7.5, meaning that a 1-percent shock to the stock market raises the present value of revenue by 7.5 percent of current revenue. Based on the nonfinancial corporate sector's 2002 equity value of about $7.8 trillion (Federal Reserve Board, 2003, Table B.102) and fiscal year 2002 federal revenues of $1.9 trillion, this implies a federal implicit equity holding of 1.8 times the entire value of the stock market! Even though the corporate income tax is estimated to be the most responsive to stock prices, it accounts for only about 15 percent of the government's implicit equity because it is such a small share of federal revenue.

As discussed above, point estimates of this magnitude are plausible. On the other hand, the 95 percent confidence intervals are quite broad. For example, the lower bound of the interval for all revenues is just under 50 percent of equity, compared to the point estimate of 180 percent. However, even half of the stock market is quite large in comparison to the shares commonly discussed in the context of trust fund investment. By comparison, the total combined OASDI trust fund at the end of 2002 was roughly $1.4 trillion, or about 18 percent the size of the stock market, and proposals have generally been to invest only a fraction of the trust fund in equity, representing perhaps 5 percent of the total stock market's capitalization.

The preceding calculations are all based on estimates of the responsiveness of actual revenue to the stock market. As discussed above, one might wish to adjust revenue changes to exclude the effects of contemporaneous legislation, to measure the responsiveness of tax revenue inherent in the tax rules themselves. Given the short time period for which such adjusted revenue data are available, it is difficult to obtain robust estimates of the equation (1). We do not attempt to determine the number of lags of revenue and stock returns to be included in the estimated equations, but simply use the specification generally preferred for the previous estimates, (m,n) = (1,1). The resulting values of θ (for a real discount rate of $\rho = .06$) implied by these estimates, along with 95-percent confidence intervals, are displayed in Table 2. To see the importance of the adjustment to revenue, the table presents estimates based on unadjusted revenue data (comparable to those figures presented in Table 1) as well.

This adjustment has virtually no impact for overall revenues, suggesting that which way we choose to measure the riskiness of the government's tax position may not be that important and that the more precise results obtained from the longer, unadjusted time series in Table 1 may suffice. For some disaggregated categories, particularly corporate tax revenues, the impact of the adjustment is larger. Somewhat surprisingly, the impact often is to reduce the implied sensitivity of revenue to the stock market. That is, the legislative terms being excluded by the adjustment augment the responsiveness of revenues to the stock market. If unexpected increases in revenues led to tax cuts, one would have expected the opposite effect. But these adjustments take into account only current-year revenue effects, which might behave differently, and the presence of a lagged dependent variable that is also adjusted makes the interpretation more difficult. Also, given the wide and overlapping confidence intervals for these estimates, it is probably wise not to make too much of these differences.

In general, the picture conveyed by the results in Table 2 is similar to that of Table 1. Social Insurance, Excise and Other Taxes have small and insignificant responses to the stock market, while personal income taxes are somewhat more responsive than total revenues, with both measures somewhat more responsive than in Table 1. The estimates for corporate income taxes are quite volatile and strongly influenced by the adjustment term, highlighting the difficulty of obtaining robust estimates from such a short sample, particularly for so volatile a series. Still, if one focuses on aggregate revenues, the results appear to confirm the findings from Table 1, that there is a wide range possible for the implicit equity position of the federal government, but with a lower bound that still represents a large fraction of privately held equity.

Conclusions

The federal government holds little equity directly, but the sensitivity of federal revenue to the stock market is quite large. In light of the empirical estimates presented here, it is important that policies to increase direct government investment in equities be evaluated taking into account the government's existing implicit equity position.

References

Federal Reserve Board. Flow of Funds Accounts for the United States. Washington, DC, March 6, 2003.

U.S. Social Security Administration. Findings and Recommendations of the 1994–96 Advisory Council on Social Security. Washington, D.C., January 7, 1997.

Table 1
Revenue Growth and Stock Market Returns (1949-2002)

Revenue:	Total	Personal Income	Social Insurance	Corporate Income	Excise	Other
Independent Variable:						
Constant	0.012	0.002	0.050	-0.021	0.006	0.032
	(0.011)	(0.014)	(0.012)	(0.025)	(0.016)	(0.014)
Revenue (-1)	0.181	0.279	0.129	0.027	0.030	-0.175
	(0.131)	(0.136)	(0.137)	(0.129)	(0.141)	(0.130)
Return	0.018	0.081	-0.009	0.033	-0.038	-0.021
	(0.043)	(0.055)	(0.038)	(0.106)	(0.069)	(0.055)
Return (-1)	0.162	0.173	0.065	0.360	0.038	0.173
	(0.043)	(0.054)	(0.038)	(0.108)	(0.071)	(0.057)
$\overline{R}^2$	0.188	0.179	0.013	0.132	-0.045	0.161
Real Discount Rate:			**Implied values of θ**			
3.5%	44.5	71.5	13.0	82.1	0.1	26.3
	(12.0, 2.0)	(24.3,147.7)	(-13.0, 1.9)	(18.3, 65.0)	(-43.8,46.2)	(-1.7, 57.5)
6%	7.5	12.1	2.2	13.9	0.0	4.4
	(2.0, 15.4)	(4.1, 24.6)	(-2.2, 7.1)	(3.0, 27.8)	(-7.5, 7.8)	(-0.3, 9.7)
9%	3.7	6.0	1.1	7.0	0.0	2.2
	(1.0, 7.6)	(2.0, 12.2)	(-1.2, 3.5)	(1.4, 13.9)	(-3.8, 3.9)	(-0.2, 4.96)

Table 2
Estimates of θ (1986-2002; $\rho = .06$)

Total	Pers. Income	Soc. Insurance	Corp. Income	Excise	Other
		Unadjusted			
11.3	18.1	2.8	17.8	-2.9	8.3
(6.9, 21.2)	(10.5, 39.7)	(-0.2, 9.0)	(2.5, 33.8)	(-22.0, 10.1)	(-0.2, 18.5)
		Adjusted			
11.3	16.0	2.9	1.5	2.3	7.0
(6.1, 24.9)	(9.3, 31.1)	(0.1, 8.5)	(-19.5, 20.1)	(-15.8, 22.3)	(-1.4, 16.9)