Journal of Public Economics 30 (1986) 109–116. North-Holland

UNCERTAIN PARAMETER VALUES AND THE CHOICE AMONG POLICY OPTIONS

Don FULLERTON

Deputy Assistant Secretary for Tax Analysis, U.S. Treasury Department, Washington, DC 20220, USA

Andrew B. LYON*

Joint Committee on Taxation, U.S. Congress, Washington, DC 20515, USA

Received May 1984, revised version received October 1985

We use a tax policy example to show how debate on the value of an elasticity parameter translates into a debate about policy choices. To construct this example, suppose that the choice among four particular tax reform options is based on a single measure of efficiency gain. For each reform, we show how the size of this gain depends upon the elasticity of saving with respect to the net rate of return. Moreover, within quite narrow and reasonable bounds for the elasticity parameter, we find regions in which each of three different tax reforms turns out to dominate the others.

1. Introduction

The optimal tax literature provides valuable rules for designing tax reform to minimize the cost of distortions in economic choices. Yet the theory alone does not provide guidance on whether, for example, current tax rates on capital or labor are too high or too low relative to the optimum rates. Without appropriate estimates of the underlying economic parameters, the best direction for tax reform is ambiguous.

In this paper we use a tax policy example to illustrate and investigate the more general problem of using uncertain parameter values in models to evaluate policy alternatives. We show in this example how debate on the value of an elasticity parameter translates into a debate about policy choices. To construct this example, we suppose that the choice among four particular

*This paper was written while both authors were at Princeton University. We wish to thank Charles L. Ballard, Yolanda K. Henderson, John B. Shoven, Charles Stuart, and John Whalley for help with this research and for useful suggestions. Financial assistance was provided by the Treasury Department's Office of Tax Analysis and the National Science Foundation under grant SES 8025404. The research reported here is part of the NBER's research program in Taxation and project in Government Budget. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research, the U.S. Treasury Department, or the Joint Committee on Taxation.

tax reform options is based on a single measure of efficiency gain. Not surprisingly, perhaps, we can show how the size of this gain depends upon the elasticity of saving with respect to the net rate of return. In this example, however, the saving elasticity affects not just the size of the welfare gain but the very choice among reforms. Within quite narrow and reasonable bounds for the elasticity parameter, we find regions in which each of three different tax reforms turn out to dominate the others.

In the sections that follow we briefly discuss the importance of the saving elasticity in determining intertemporal welfare effects of taxes on income from capital; empirical estimates of this elasticity; the interaction of intertemporal distortions with intersectoral and labor/leisure distortions; and the results of simulating four potential tax reforms in a general equilibrium model that accounts for these considerations.

2. Taxation and saving

Taxes on income from capital raise the price of future consumption and thus distort intertemporal choices. In the partial equilibrium model of Feldstein (1978), the welfare cost is a quadratic function of t, the additional tax on future consumption, and a linear function of ε, the compensated elasticity of demand for future consumption with respect to the price of future consumption. This compensated quantity elasticity bears a linear relationship to η, the elasticity of saving with respect to the net rate of return.[1] As a consequence, in this partial equilibrium model the welfare cost is a linear function of η. This linearity breaks down in a general equilibrium model with large taxes, government spending, multiple consumers, and other second best considerations. In general, the welfare cost may be written as $W(\eta, t)$.

We use a large general equilibrium model below to calculate the welfare gains from each of four tax reforms, and we show how these gains depend on the assumed value of η. One might like to report that quantitative results depend upon parameters such as the saving elasticity, but that qualitative results do not. Here, however, we show that if the reforms are compared on the basis of welfare gains, their relative positions also depend on η.

As a secondary objective, we also discuss how uncertainty in the elasticity estimate affects the expected value of the welfare gain. When the elasticity

[1]The linear relationship between ε and η may be derived using two important points from Feldstein (1978). First, η reflects a change in saving, the expenditure on future consumption. If this expenditure is to remain constant (the case where $\eta = 0$), then quantity must adjust to offset any change in price. Since quantity changes affect welfare, a zero saving elasticity may be associated with a substantially nonzero welfare cost from taxes on income from capital. Second, η is usually measured as an uncompensated elasticity while distortions depend critically on the compensated elasticity. We choose to frame our discussion in terms of the well documented saving elasticity, but we always convert each value of η to a corresponding value of ε before calculations in the model.

parameter is measured with error, policy recommendations should be based on $\mathrm{E}[W(\eta, t)]$, where E is the expectations operator. Instead, analysts typically estimate $W[\mathrm{E}(\eta), t]$ in order to employ a single estimated value for the elasticity parameter. This short cut is perfectly valid in the partial equilibrium model where W is a linear function of η, so $\mathrm{E}[W(\eta, t)] = W[\mathrm{E}(\eta), t]$. Many general equilibrium studies continue to use $\mathrm{E}(\eta)$ to evaluate large tax changes, however, including the study by Fullerton, Shoven and Whalley (1983). We investigate the size of this error by using the same model to plot W as a function of the saving elasticity. If this relationship is nearly linear, then the effect of the error is small.

3. Empirical estimates of the saving elasticity

An increase in the net rate of return lowers the price of future consumption. The compensated quantity demanded must rise, but the percentage increase may exceed or fall short of the percentage decrease in price. Expenditure on future consumption (saving) may rise or fall, so the sign of η is ambiguous.

Empirical estimates of η have hardly narrowed the range of plausible values. 'Denison's Law' states that η is zero, following Denison's (1958) observation that saving as a fraction of income in the United States has been a historical constant. Econometric estimates by Boskin (1978) suggest that η is significantly positive. Using eight different regressions, Boskin finds values for η that range from 0.2 to 0.6, but that cluster between 0.3 and 0.4. Howrey and Hymans (1978) use Boskin's data but find that estimates of η are sensitive to (1) the measure of expected inflation, (2) the sample period, (3) the definition of saving, and (4) the interest rate variable chosen for the regression. They cannot reject the hypothesis that η is zero.

More recently, Summers (1981) builds a model in which lifetime consumption plans depend upon intertemporal substitution in utility, time until retirement and death, the rate of time preference, rates of growth, and the rate of return to saving. The model is then solved for the saving elasticity. Plausible values for these other parameters imply values for η from 1.5 to 3.0, a range much higher than those of the econometric estimates described above. Finally, Starrett (1982) and Evans (1983) show how amendments to Summers' model could widen these bounds still further, but they argue for values of η that are lower than those found by Summers.

4. Efficiency analysis with several distortions

For each different value of η, we use a computational model in the tradition of Harberger (1962, 1966) to measure the welfare gains from four separate tax reform proposals.[2] Our model includes 19 different industries, each with a constant elasticity of substitution (CES) production function defined over capital, labor, and the outputs of other industries. Capital is homogeneous and mobile, and it faces an ad valorem rate of tax in each industry that reflects corporate taxes, property taxes, and personal taxes. Differing rates of tax create distortions in the allocation of capital among industries, so efficiency can be enhanced by any reform that tends to remove tax rate disparities. In fact, for a fixed stock of capital in one period, any common rate of tax on all uses of capital is nondistorting.

Each of 12 different income classes has an endowment of labor and capital, and is assigned a nested CES utility function defined over future consumption, present consumption, and leisure. The model allows the user to specify any value for the wage elasticity of labor supply and any value for the interest elasticity of saving. It then calculates parameters for the 12 utility functions such that utility maximization behavior is consistent with those elasticities. Government uses revenues in a balanced budget to purchase industry outputs, to make transfer payments, and to subsidize government enterprises. A trade sector closes the model.

Total saving in each period is used to augment the capital stock in successive periods. We choose an exogenous rate of growth for effective labor units, such that a simulation with unchanged tax rules provides a sequence of equilibria that lies on a steady state growth path. A simulation with an alternative tax rule provides a sequence of equilibria that approaches a different steady state growth path, with a different capital/labor ratio for the economy. Intertemporal and other distortions are then measured by comparing the discounted stream of consumption from each sequence. Aggregate welfare differences are defined by the present value of equivalent variations, in 1973 dollars.[3]

When tax rules are altered for a simulation, we scale all personal income tax rates up or down in order to keep the government's budget balanced at the same level of real expenditures and transfer payments. Any change in an industry's tax on capital thus affects intersectoral distortions through the dispersion of tax rates by industry, intertemporal distortions through the overall average rate of tax on capital, and labor/leisure distortions through the personal taxes required to maintain real revenue yields. As a conse-

[2]For further description of the general equilibrium model used in this paper the reader is referred to Fullerton, Shoven and Whalley (1983), and Ballard, Fullerton, Shoven and Whalley (1985).

[3]Though the model provides some distributional results, consumer groups are differentiated by current income rather than by lifetime earnings. Because individuals move through several current income groups during their lifetimes, a change for any one group is a poor indicator of lifetime welfare. Finally, because capital is homogeneous and mobile in this model, no individuals suffer immediate capital gains or losses as the result of tax reform.

quence, the model is fully capable of second-best efficiency analysis in a world where nondistorting taxes are generally unavailable.[4]

5. Tax reform simulations

To demonstrate the relationships discussed above, we select four particular tax reforms that are currently under consideration by at least some economists and policymakers.[5]

(1) Tax imputed rents. Homeowners earn a return to their investment that currently escapes both corporate and personal taxation. This reform raises the low rate of tax on capital in the housing industry, reduces the dispersion of rates, and provides an intersectoral efficiency gain. By raising more revenue, the government can also reduce the personal income tax distortions in labor/leisure choices. By raising the overall rate of tax on capital, however, this reform implies intertemporal losses that increase in importance with the saving elasticity. Fig. 1 shows that gains outweigh losses for all values of η between zero and 0.6, but that the net gain falls from $256 billion to $126 billion across this range of elasticity values. Because intertemporal losses are small for low η, this reform dominates the others for $\eta<0.18$.

(2) Index capital gains. In the current system, taxes are paid on 40 percent of real capital gains as well as on inflationary increases in share prices and other asset values.[6] This reform removes inflationary gains from the tax base and reduces the overall taxation of income from capital. It thus provides intertemporal gains that increase with η. It changes industry tax rates differentially and has an ambiguous impact on intersectoral distortions, but the revenue loss requires additional distorting personal taxes on labor. Fig. 1 shows how the net gain increases from $18 billion to $185 billion, but this reform by itself never dominates all the others.

(3) Integrate income taxes. Since industries differ in the degree to which firms are incorporated, separate corporate taxes raise effective rates in some industries more than others. This reform eliminates the separate corporate tax system, but collects personal tax on retained as well as distributed profits of corporations. It lowers the highest rates of tax on capital and thus provides both intersectoral and intertemporal gains. Fig. 1 shows how these gains outweigh additional distortions in the labor/leisure choice, with net gains rising from $122 to $393 billion as η is increased from zero to 0.6.

[4]The comparative advantages of alternative tax reforms depend on a large set of modelling choices and behavioral parameters. The uncompensated labor supply elasticity is set to 0.15 in this paper, while the elasticity of substitution between labor and capital in production is chosen for each industry from estimates in the literature.

[5]Many other alternatives or combinations of these alternatives could be evaluated in this model, but these four reforms by themselves best illustrate how the saving elasticity can affect not just the size of the welfare gain but the very choice among reforms.

[6]The model assumes a constant 7 percent rate of inflation.

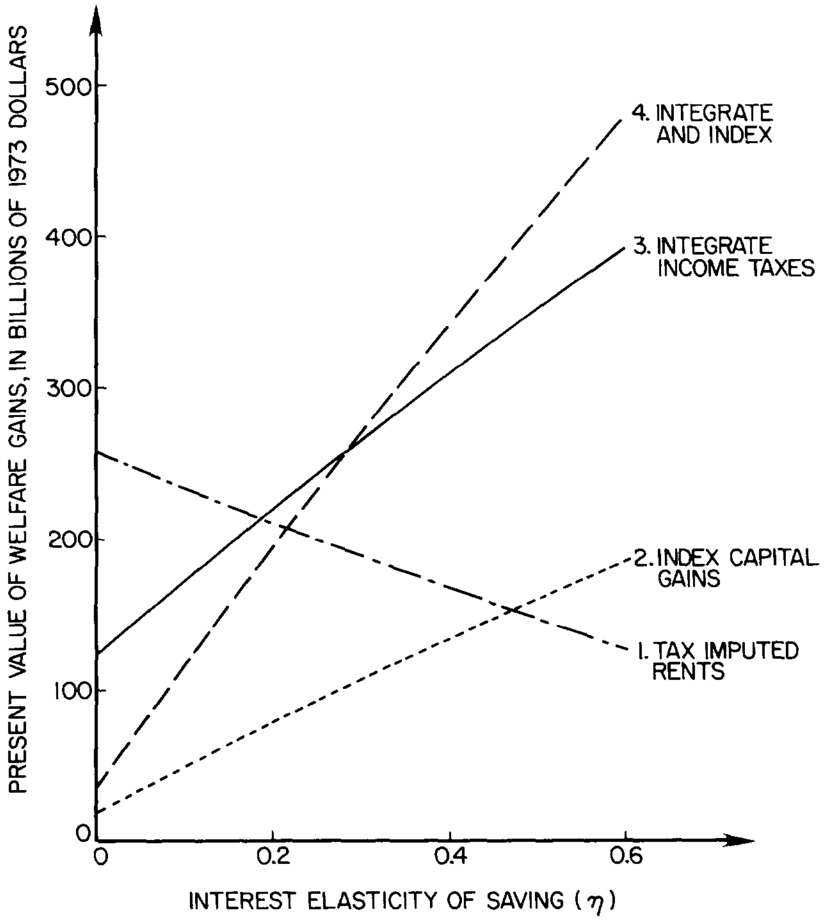

Fig. 1. Welfare gains (W) from four tax reforms, as functions of the saving elasticity (η).

Efficiency gains are larger than those of any other reform when η is between 0.18 and 0.29.

(4) *Integrate and index.* This reform combines those of (2) and (3) above, and it provides the greatest reduction of taxes on income from capital. With a zero saving elasticity, these intertemporal gains are relatively unimportant. The large shortfall in revenue, however, requires major increases in personal taxes that add to important labor/leisure distortions. Net gains are only \$34 billion, but these increase dramatically to \$481 billion as η increases to 0.6. For values of $\eta > 0.29$, intertemporal gains outweigh other losses by enough that this reform dominates all others. This curve in Fig. 1 is not the vertical sum of the curves from reforms (2) and (3), because the combined revenue

shortfall requires an increase in the personal tax rate that enters approximately quadratically in the cost of labor/leisure distortions.

Though not readily visible in fig. 1, the four curves are slightly nonlinear. The first curve is slightly convex and the other three are slightly concave. If the distribution of possible values for η is symmetric around 0.4, for example, these results indicate that the correct expected welfare gain from reducing taxes on capital is only slightly less than the welfare gain obtained with the use of $\eta = 0.4$ alone.[7]

6. Conclusion

In this paper we use a general equilibrium simulation model to rank four possible tax reforms on the basis of a measure of economic efficiency that includes the intersectoral allocation of capital, the intertemporal allocation of consumption, and the labor/leisure allocations of individuals. Not surprisingly, the welfare gain from each tax reform is a function of the saving elasticity assumed in the model, and we show the sensitivity. More disturbing, however, is that even within the relatively narrow region between zero and 0.6, we find values of the saving elasticity for which each of three different tax reforms is ranked highest.

One interpretation of this result is that until theorists such as Summers (1981), Starrett (1982), and Evans (1983) agree on a concept for the saving elasticity, and until econometricians such as Boskin (1978) and Howrey and Hymans (1978) agree on an estimate for the saving elasticity, those of us who use this parameter to simulate tax reforms cannot hope to provide unambiguous recommendations to policymakers. Furthermore, because the saving elasticity is only one of many uncertain parameters, econometric estimates may never be refined sufficiently to allow the ranking of policy options by a single criterion.

[7]Though it may be useful to know that general equilibrium welfare costs are practically linear in this parameter, this result is not general. Fullerton, Lyon and Rosen (1984) use a different model to show that welfare costs are a very nonlinear function of the assumed rate of inflation.

References

Ballard, Charles L., Don Fullerton, John B. Shoven and John Whalley, 1985, A general equilibrium model for tax policy evaluation (University of Chicago Press, Chicago).

Boskin, Michael J., 1978, Taxation, saving and the rate of interest, Journal of Political Economy 86, S3–S27.

Denison, Edward F., 1958, A note on private saving, Review of Economics and Statistics 40, 261–267.

Evans, Owen J., 1983, Tax policy, the interest elasticity of saving, and capital accumulation: Numerical analysis of theoretical models, American Economic Review 73, 398–410.

Feldstein, Martin, 1978, The welfare cost of capital income taxation, Journal of Political Economy 86, S29–S51.

Fullerton, Don, John B. Shoven and John Whalley, 1983, Replacing the U.S. income tax with a progressive consumption tax, Journal of Public Economics 20, 3–23.

Fullerton, Don, Andrew B. Lyon and Richard J. Rosen, 1984, Uncertainty, welfare cost, and the 'adaptability' of U.S. corporate taxes, Scandinavian Journal of Economics 86, 229–243.

Harberger, Arnold, C., 1962, The incidence of the corporation income tax, Journal of Political Economy 60, 215–240.

Harberger, Arnold C., 1966, Efficiency effects of taxes on income from capital, in: Marion Krzyaniak, ed., Effects of corporation income tax (Wayne State University Press, Detroit).

Howrey, E. Philip and Saul H. Hymans, 1978, The measurement and determination of loanable-funds saving, Brookings Papers on Economic Activity, 655–685.

Starrett, David A., 1982, Long run savings elasticities in the life cycle model, Factor Markets Workshop Research paper no. 24, Stanford University.

Summers, Lawrence H., 1981, Capital taxation and accumulation in a life cycle growth model, American Economic Review 71, 533–544.