

COMMENT AND EXTENSIONS

The model we have formulated is meant to demonstrate the possibility of formulation of our social security planning problem as a linear program. Except for introduction of the social adequacy constraints (4.5), we have aimed at keeping the model as simple and as analogous to the calculus model as possible. In this development we have suppressed many possible elaborations. We now list a few of the possible modifications and refinements that can be added to the linear programming model.

1. The tax rates may be varied between cohorts in the same year. This would lead to an expanded set of variables $r(t, x)$ ($t=1 \dots T$; $x=1 \dots g$). It appears likely that such expansion of the set of variables would entail additional constraints limiting the variability of social security tax rates. It also appears likely that allowing a more varied tax rate structure would reduce violation of the other constraints. It is also possible, and possibly desirable, to constrain the variability of tax rates over time in a model in which the tax rate only varies with time.

2. The solvency constraint can (and should) be relaxed to permit temporary surpluses and deficits. This can be accomplished easily within the linear programming framework.

3. The equity relation can be expressed in a variety of forms. For example, the retirement benefit can be related to average income, average income over the last k years in the work force, or average income over the k years of highest wages. Linear programming will accommodate all these possibilities.

We believe, however, that relating benefits to total interest-weighted payments has several advantages in addition to those cited in section III. It permits straightforward comparison of social security with other means of providing for retirement income, and it permits the development of simple relations between the social security interest rate and natural economic and demographic parameters.

A related use of the linear programming model is to analyze and compare various benefit formulas (such as, for example, those mentioned above) with the interest-weighted contributions under various assumptions as to the growth of wages and the work force.

4. It is possible to include constraints establishing an upper limit on the total individual contribution to the social security system and/or an upper limit on the social security tax rate.

5. The model might be expanded to include detailed representation and control of the process of providing annuity income to the retired population.

6. In case it were possible to satisfy all constraints, our objective function would not be a useful means of achieving a best schedule of rates and benefits. This difficulty can be resolved by expanding the objective function to include nonzero (and normally negative) c_i coefficients corresponding to the slack variables, $s_i(t)$, ($i=2, 3$; $t=1, \dots, T$).

These coefficients could also be meaningfully introduced into the objective function in cases where some artificial variables are positive in an optimal solution. For example, it might be socially desirable to have a larger terminal obligation 0 (T) than that permitted by (4.10).