NBER Working Paper Series

AN EVALUATION OF THE ROLE OF FACTOR MARKETS AND INTENSITIES IN THE SOCIAL SECURITY CRISIS: A PROGRESS REPORT

John B. Shoven
Stanford University

Working Paper No. 216

CENTER FOR ECONOMIC ANALYSIS OF HUMAN BEHAVIOR
AND SOCIAL INSTITUTIONS

National Bureau of Economic Research, Inc.
204 Junipero Serra Boulevard, Stanford, CA 94305

November 1977

This research was supported by a contract with NBER from the Office of Income Security Policy, Department of Health, Education, and Welfare (No. HEW-100-76-0170).

ABSTRACT

This paper begins to evaluate some of the complicated set of economic adjustments which are going to occur as the uneven population age structure of the U.S. matures. It argues that in the 2012-2035 "crunch" years for the social security system not only will workers be scarce relative to retirees, but they will also be scarce relative to capital. This fact will tend to raise the wage-rentals ratio and partially alleviate the problems of a a retirement plan supported by taxes on labor income. On the other hand, during this period the large number of elderly persons will be attempting to dis-save by selling their assets to the relatively few younger, accumulating families. Such an imbalance will be equilibrated only by depressed asset prices. The conclusion, thus, is that the problems of the social security system may be partially alleviated by factor price adjustments, while private funded pension plans will have a problem of their own, namely lower than anticipated liquidation values.

John B. Shoven

An Evaluation of the Role of Factor Markets and Intensities in the Social Security Crisis: A Progress Report

I. Discussion of the Issues

Some of the major problems the United States faces with respect to its social security system are well known to economists. The largest issues seem to be (1) the squeeze on the program which can be foreseen due to the post World War II birth patterns, (2) the effect of the unfunded "pay-as-you-go" nature of the social retirement plan on savings and, hence, eventually on the size of the capital stock, (3) the effect the system has on retirement age and therefore the size of the non-productive adult population, and (4) the indexation of the program for inflation. This paper will focus on the first of these matters, but perhaps some brief discussion of the others is appropriate. The second, the savings effect of the unfunded character of the program, is far from resolved and needs more empirical investigation. Some of the most important work done to date on this matter would include Feldstein [1974, 1976a, 1976b] and Barro [1977]. The third problem, the effect on retirement, was analyzed by Boskin [1977a] in a recently published work which concludes that the combined income effect and the implicit tax rate which the social security system imposes on workers after age 62 (and, particularly, after age 65) affects retirement decisions markedly. The fourth and final issue listed, that concerning the double indexing for inflation, has received some attention in the literature and could become a very large problem in the next 20 or more years, However, it now looks as if Congress will correct for the faulty price level adjustments in the pay-out and pay-in formulas

As stated, this paper concentrates on the problems created by the age structure of the U.S. population and addresses an aspect of these issues which has received surprisingly little attention from economists. The most fundamental problem of the social security system is often summarized with the following logic. The social security system is basically a transfer of real income from the working population to the retired population at any point in time. If the ratio of workers to retired populations or more correctly payers to recipients remained constant, then the benefits per retired worker could grow at the same rate as the real labor income of the working population without raising the fraction of the workers' income which he is forced to "contribute" (i.e. his social security taxes).

Naturally, as the system began operation there was a very high ratio of payers to recipients, and this ratio would have inevitably declined as the program matured. The problem we now face is not only this "phasing in" phenomenon (which is continuing because the program has been continually made larger and more comprehensive over the past thirty years), but also the problems created by the post war birth patterns, the increased longevity of the population, and the trend towards earlier retirement. The broad facts regarding birth statistics are, of course, well known. The U.S. population grew very slowly during the depression and World War II (increasing only 7.2 percent between the 1940 and 1930 censuses, for example), increased rapidly from 1947 to 1960 (the U.S. population was up 18.5 percent in 1960 over 1950) after which the rate of growth has slowed continuously. The population is now increasing at a rate similar to that during the Great Depression.

This irregular pattern of births makes for an unstable age structure. Today the ratio of the working population to the retired population is approximately 3.2. This number may actually increase between 1995 and 2010, but will sharply fall when the 1947-1960 baby boom begins to retire in approximately 2012. Obviously, the behavior of this important ratio in the crucial period 2012 to 2035 depends on several unknowns including future birth rates, labor force participation rates, and the prevalent retirement age at that time. However, it has been estimated that the number of workers per retiree will decline to close to 2.0 by 2030 (Blechman, Gramlich, and Hartmann [1975]). Such a dramatic fall in this critical parameter, from 3.2 to 2.0, would imply that either the workers in 2012-2035 will have to "contribute" a significantly larger fraction of their earnings to the then retired population (with a possible negative impact on labor force participation) or the retirees will have to accept a smaller fraction of labor earnings than they themselves provided previous retired generations. Since the social security system is widely perceived as a pension plan rather than the more accurate depiction as an intergenerational transfer scheme, people have come to consider their retirement benefits as close to a contractual committment by the government. Therefore, neither of the two solutions to the demographic squeeze of 2012-2035, sharply higher tax rates or reduced generosity of benefits, is viewed favorably.

The model that people commonly have in mind when they focus on this ratio of the retired to working population is the Samuelson consumption loan model, Samuelson [1958]. At the most inituitive level, this model equates social security to an intergenerational chain letter. We can imagine the working generation at any point in time transferring some fraction of its product to the previous generation then retired. It does so with the expectation that the following generation will likewise share its product when the current working population retires. As long as total labor product per retiree is growing steadily (or at least as expected) and the plan is continued, no individual's expectations are disappointed. The generation retired at the time the system is inaugurated enjoy a windfall gain and each generation thereafter is "repaid" for its contributions by the payments of the following generation.

One of the major problems that social security is now thought to face is that total labor income per retiree will fall dramatically in the period 2012-2035. The question this study will begin to address is whether or not the magnitude of that fall will be as great as commonly supposed. A not-so-logical leap has always been made from the behavior of the ratio of workers to retired people to the projected labor income per retiree. This leap violates the most elementary of economic principles, namely that scarce items, including factors of production, command a high price in a competitive market.

There is no doubt that in addition to being scarce relative to retirees, workers will be scarce relative to capital in the squeeze period of concern, 2012-2035. The increase in the capital-labor ratio which will occur as the large baby boom population leaves the labor force will increase the relative price of labor. The extent to which this occurs and hence alleviates some of the pressure on the social security system is the area I am investigating. The framework for the investigation is described in this paper as well as some preliminary illustrative results. The main point of investigation, to repeat, is the extent to which the labor income per retiree will fall less than the ratio of workers to retiree. The latter parameter has frequently been referred to in describing the demographic pattern problem of social security, but it is the former number which is more relevant in evaluating the extent of the crisis.

The implications of an aging population and the eventual bulge in retirements are more extensive than discussed above. Indeed, the age structure of the population has an important effect not only on the size of the labor force and retired population, but also on the savings rate and, hence, on the growth rate of the capital stock. People save and dissave for various reasons, partially to meet certain target expenditures such as college educations for children and a down payment on a house, and they also respond to the incentives offered savers in terms of a real rate of return. This latter elasticity (that of saving with respect to the real rate of return) has often been assumed to be zero, but recent empirical work, Boskin[1977b], estimates it at 0.4 which has major implications regarding tax policy, provision for retirement, and the effect of the demographic factors we are discussing on relative factor prices.

In this discussion of the correct formulation of a savings function it must be noted that retirement is the dominant target for which purchasing power is stored. A very simple model would have each household saving during their earning years, building up a stock of wealth, which they then dissave during retirement. With a steadily growing population there is always more savings generated for retirement by the working population than dissaving by the retired, thus freeing new funds for additions to the capital stock. However, if population growth ceases, no net funds are provided as the retired population simply sells the existing capital stock to the younger, accumulating households.

In the period roughly defined by 1995 to 2012 one can imagine a high rate of national savings and gradual increase in the capital stock available per worker. This is because of the fact that the relatively small number of persons born between 1930 and 1945 will be retiring and dissaving while the far more numerous members of the baby boom could be expected to be saving for their forthcoming retirements. The situation will reverse itself around 2012 when this group actually begins to retire, although what will happen to capital per worker is less than obvious since the growth of both the numerator and the denominator will slow markedly. It is my opinion that this K/L parameter will be at a historical high around 2012 to 2020 and it will either gradually fall or slow its rise after that.

Many of the above statements may seem overly qualified, but that is because many simultaneous factors are at work as the age structure of the U.S. changes. For instance, as the baby boom generation saves for retirement they might be expected to drive the price of capital goods up and the rate of return to capital down. This would affect the income of capital owners, the prices of all commodities, all demand patterns, etc. The only model which can attempt to capture the final outcome of these adjustments would be a general equilibrium model specifically designed to include all interactive effects in a consistent manner.

II. The Model

The model which will be used to address the impact of the changing age structure on factor incomes and the social security system will be a slightly modified version of one being assembled for tax policy evaluation at the U.S. Treasury. This model is a complete general equilibrium discription of the economy along the lines of Debreu [1959] and Arrow and Hahn [1971] except that taxation and government expenditure have been incorporated. The model is solved by computer using alogrithms similar to those designed by Scarf [1973]. The computer programs are now available in user-oriented interactive form. In the model 19 producer good industries, 16 consumer goods, and 12 consumer types (classified by income range) are identified. The model incorporates not only conventional consumer and producer behavior, but also savings and investment activity, foreign trade activity, and government purchase policies. The complete U.S. tax system is modelled - federal personal and corporate income taxes, state and local income and sales taxes, the social security system, corporate franchise taxes, and property taxes. An outline of the model is shown in Table 1.

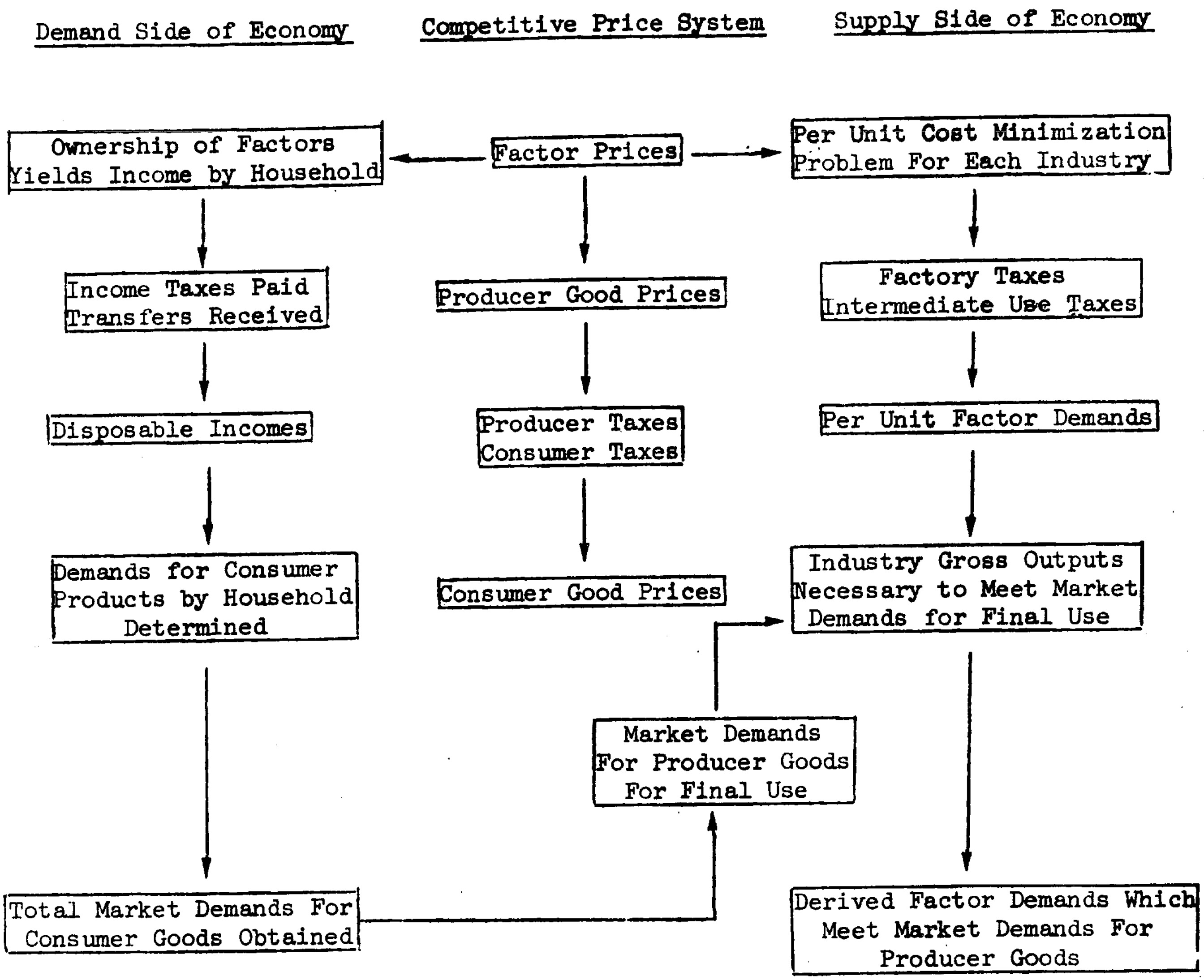
Each of the 19 industries produces a single output (termed a producer good) from a combination of primary factor inputs (capital and labor services) and the outputs of the other industries. The industrial classification used in the model is shown in Table 2, which also contains a listing of the 16 consumer goods considered. The model contains a medium degree of detail, but can easily be collapsed to a higher level of aggregation for the study of some questions.

The use of primary factors by each industry is described by a separate C.E.S. or Cobb-Douglas production function. The model embodies a capability for preselection of functional form in addition to selection of parameter values. The intermediate use of products by industries is described by a conventional fixed coefficient input-output matrix. The matrix is derived from published 1970 input-output data for the United States.

Within the personal sector, twelve consumer groups defined by their family gross of tax income as reported in the 1973 Consumer Expenditure Survey Data published by the United States Department of Labor have been identified. The number of groups are restricted in order to keep the model of manageable size, but more consumer groupings could be considered by the approach. Besides income, additional characteristics, such as family size, age or marital status of household heads, and regional location, and working/retired status could be examined.

Table 1

Diagram of the Model Structure



Competitive Equilibrium

1. Demands equal supplies for all goods and factors.
2. Zero profits (net of taxes) prevail in all industries.
3. Tax receipts equal total government expenditures.

Table 2

Classification of Industries and Consumer Goods

Industries

1. Agriculture, Forestry, and Fisheries
2. Mining
3. Crude Petroleum and Gas
4. Contract Construction
5. Food and Tobacco
6. Textiles, Apparel, Leather products
7. Paper and Printing
8. Petroleum Refining
9. Chemicals and Rubber
10. Lumber, Furniture, Stone
11. Metals, Machinery, miscellaneous manufacturing
12. Transportation equipment
13. Motor Vehicles
14. Transportation, Communications, and Utilities
15. Trade
16. Finance and Insurance
17. Real Estate
18. Services
19. Government Enterprises

Consumer Goods

1. Food
2. Alcoholic Beverages
3. Tobacco
4. Utilities
5. Housing
6. Furnishings
7. Appliances
8. Clothing and Jewelry
9. Transportation
10. Motor Vehicles, Tires, and Auto Repair
11. Services
12. Financial Services
13. Reading, Recreation, misc.
14. Nondurable-nonfood household items
15. Gasoline and other fuels
16. Savings

Consumer demands are assumed to be generated by a process of utility maximization subject to a budget constraint. Any one of the family of conventional functional forms (Cobb-Douglas, L.E.S., C.E.S.) can be used for this purpose and the computer programs developed allow preselection. From the demands for consumer goods the derived demands for producer goods may be generated and these are used in the solution of the model.

Consumer goods are linked to producer goods through a transition matrix termed the 'G' matrix. An element g_{ij} of this matrix is the amount of producer good i needed to produce one unit of consumer good j. For all of the (non-savings) consumer goods, the producer goods 'retail and wholesale trade' and 'transportation' are needed for their production. Savings are treated in the model as a separate consumer good which enters demand functions. It is assumed that savings earns a rate of return given by the current price of capital services corrected for changes in the price of capital goods.

In addition to the personal sector consumer groups there are three special classifications of demand patterns for investment activity, government purchases, and foreign trade.

Investment activity is modeled via the transition matrix relating producer to consumer goods. Consumer savings made on the basis of the anticipated rate of return on capital are converted into derived demands for producer capital goods by type as appearing in the model. This treatment assumes an equality between savings and investment.

Government purchases are derived from a Cobb-Douglas demand function defined over producer goods which holds expenditure shares constant across these items. Government real expenditures are assumed to equal tax receipts plus government net borrowings less transfers since the general equilibrium approach requires that the government budget must be balanced.

The foreign trade sector is treated simply so as to close the model. The net value of exports less imports for each producer good is assumed to be constant. This enables calculation of the net quantity transactions at any given vector of producer prices and transformation from domestic demands to market demands. The constancy in value terms allows for a zero trade balance to be maintained at any set of prices if it holds initially. This treatment of foreign trade is unsuitable for a detailed analysis of tariff policy, but meets our objective of a manageable model for analysis of domestic impacts of demographic patterns, social security, and taxation policy.

At this stage the model is still static, but a dynamic extension is currently being developed. This extended model will distinguish two groups of consumer classes; household which are in the labor force and those which are receiving social security. The income of the latter groups is naturally capital and transfer intensive. The economy will be modelled for the fourteen years 1973, 1978, 1983, ..., 2033, 2038. Savings behavior of each group will depend on its income, the rate of return offered, and its work/retirement status. The savings decisions of one period, together with the depreciation patterns, determine next period's capital endowment both for the economy and for each consumer group. The relative population of the retired consumer groups to those which are working depends on birth statistics, some of which have already materialized, others of which must be projected. For the present time, both tastes and technology are assumed constant, so the real dynamic nature of the economy results from capital accumulation (which depends partially on the taxation of capital income) and the shifting of the relative size of the working and retired populations.

III. Parameterization and Data

One criticism of the general equilibirum approach to economic analysis is frequently the difficulty in obtaining the required data and parameter estimates. While there is some validity to this objection, one has little choice but to attempt to capture the important interactive effects of a large policy change (or change in the population age structure). Simply assuming that large numbers of cross elasticities are zero, for example, is hardly a satisfactory way to alleviate the empirical difficulties of specifying a fundamentally general equilibrium situation.

The broad approach to the parameterization of the model we will use for social security evaluation uses the concept of a benchmark equilibrium data set. Parameters are chosen such that this data set is replicated by the model as an equilibrium solution. The technique involves the use of a number of detailed data sets which require adjustments to make them mutually consistent in the sense that they satisfy the equilibrium conditions of the general equilibrium model. Several adjustments must be performed to transform the basic data into this form.

Once arranged in this form, the basic data are used to generate parameters for the behavioral equations of the model. This involves a prior step of decomposing the equilibrium observations on transactions in value terms into separate observations on equilibrium prices and quantities. For this purpose Harberger (1959, 1962, 1966) is followed by defining otherwise unobservable physical units of both factors and goods as those amounts which can be sold for $1 at the observed equilibrium. Thus, the benchmark equilibrium data set can be separated into price and quantity observations; all benchmark equilibrium market prices are unity and all benchmark equilibrium quantities are those given by the data in value terms.

From the quantity and price observations and the assumption of agent optimization it is possible to infer behavioral equation parameter values which are consistent with the equilibrium data set. For instance, if we assume a given industry has a Cobb-Douglas production function and cost minimizes, the factor employments observed in that industry are the direct outcome of solving the cost minimization problem at prices of unity. This uniquely determines the weighting parameters of the Cobb-Douglas functions. Similarly on the demand side, if a given consumer has a Cobb-Douglas utility function his commodity purchases at equilibrium prices of unity imply unique values for the utility function exponents. Other equilibrium conditions are used to determine remaining parameters; for example, the zero profit conditions by industry are used to generate the normalization constant in each industry's production function.

If more complex functional forms are used, additional parameter values must be provided before the same procedure can be used. In the C.E.S. case, an extraneous estimate of the elasticity of substitution is necessary for each industry or consumer. While there are procedures for crudely choosing among these (such as examining implied point estimates of the price elasticity of market demand functions at the benchmark equilibrium) the degree of arbitrariness in choosing any particular set of elasticities should not be ignored. It should be added, however, that this difficulty is not a shortcoming of this approach alone. It is exactly these elasticity margins which any model must specify in order to address the class of issues analyzed by these techniques.

The complexity of the model makes it impossible to estimate without a large number of identifying restrictions on parameter values. In the face of this identification problem, a procedure which might suggest itself is to use extraneous econometric estimates of individual parameters of the model. Such a procedure would search the literature for estimates of production functions and demand functions for use in the model. However, the implementation of this procedure faces a basic methodological difficulty. If extraneous parameter values are adopted, there is no test of the overall performance of the model. It is quite possible, for instance, that the chosen combination of parameters will yield an equilibrium which bears little relation to what is known to occur from statistical evidence. Because of this it is more appropriate to use the equilibrium solution concept as an identifying restriction for the model.

The procedures advocated here also have a number of practical advantages. First, they enable direct use of national accounts data, avoiding the difficulty of providing definitions of units in physical form. This means that, with the more complex functional forms, we are able to use extraneous parameter estimates for unit free elasticity parameters and avoid the problem of a conversion between units used in our model and extraneous estimation procedures. A further point is that extraneous estimates are surprisingly sparce, often inconclusive, and usually presented for classifications other than those with which we will work.

A complete general equilibrium benchmark data set has been assembled for 1973. The data include labor income, social security taxes, and other labor taxes by industry; capital income and taxes by industry; an input-output table for the 19 production sectors in the model; government receipt and expenditure information; investment and foreign trade statistics, and consumer factor incomes, transfer payments, income taxes, and expenditure patterns. A schematic outline of all of the necessary data is shown in Table 3. The data set is described in Fullerton, Shoven, and Whalley [1977] and is most completely presented in the 31 Tables of Shoven and Whalley [1977]. The primary source for this data is the National Income Accounts, but information has also been obtained from the Treasury Department, Internal Revenue Service, Commerce Department, Labor Department and other sources. When data is collected from so many diverse sources adjustments must be made so that the equilibrium conditions of the model are satisfied. Total market demand for each commodity must equal the amount produced, zero economic profits net of tax must be made by each

Table 3

Outline of the Interrelation between Data Sets for the Model

Production Side				Demand Side	
Input-Output Accounts 19×19	Intermediate Demands for Commodities	Final Demand for Products Comprising 1) Personal Consumption 2) Investment Expenditures 3) Government Expenditures 4) Exports less Imports for Final Use	⟹	Personal Consumption Expenditures on the Producer Good Classification	"G" Transition Matrix Linking Producer and Consumer Good Classifications 19×16
Intermediate Usage by Industry					Personal Consumption Expenditures on the Consumer Good Classification Gross of Consumer Expenditure Taxes
Valued Added by Industry Comprising 1) Cost of Capital Services 2) Cost of Labor Services 3) Factor Taxes Paid				Incomes of Consumer Groups Comprising 1) Capital Type Income 2) Labor Type Income 3) Transfers Received 4) Less Income Taxes	Expenditures on Products Consumer Groups 12×16

industry, disposable incomes must equal expenditures for each household, payments to factors by industry must equal the corresponding income receipts by source and by households, the government's budget must be balanced by its receipts, and zero balance (after allowing for capital transactions) should prevail in terms of the value of foreign trade. A diagram showing the various consistency conditions which must be met by a benchmark equilibrium is shown in Table 4. In order to achieve these conditions we have used the RAS method of data matrix adjustment described in Bacharach [1971].

A fraction of the primary data for the benchmark equilibrium is contained in the following eight tables, numbered 5 through 12. The reader interested in sources, definitions, and a complete, consistent set should contact the author.

Table 4

Microeconomic Data Set Modifications to Produce Overall Consistency

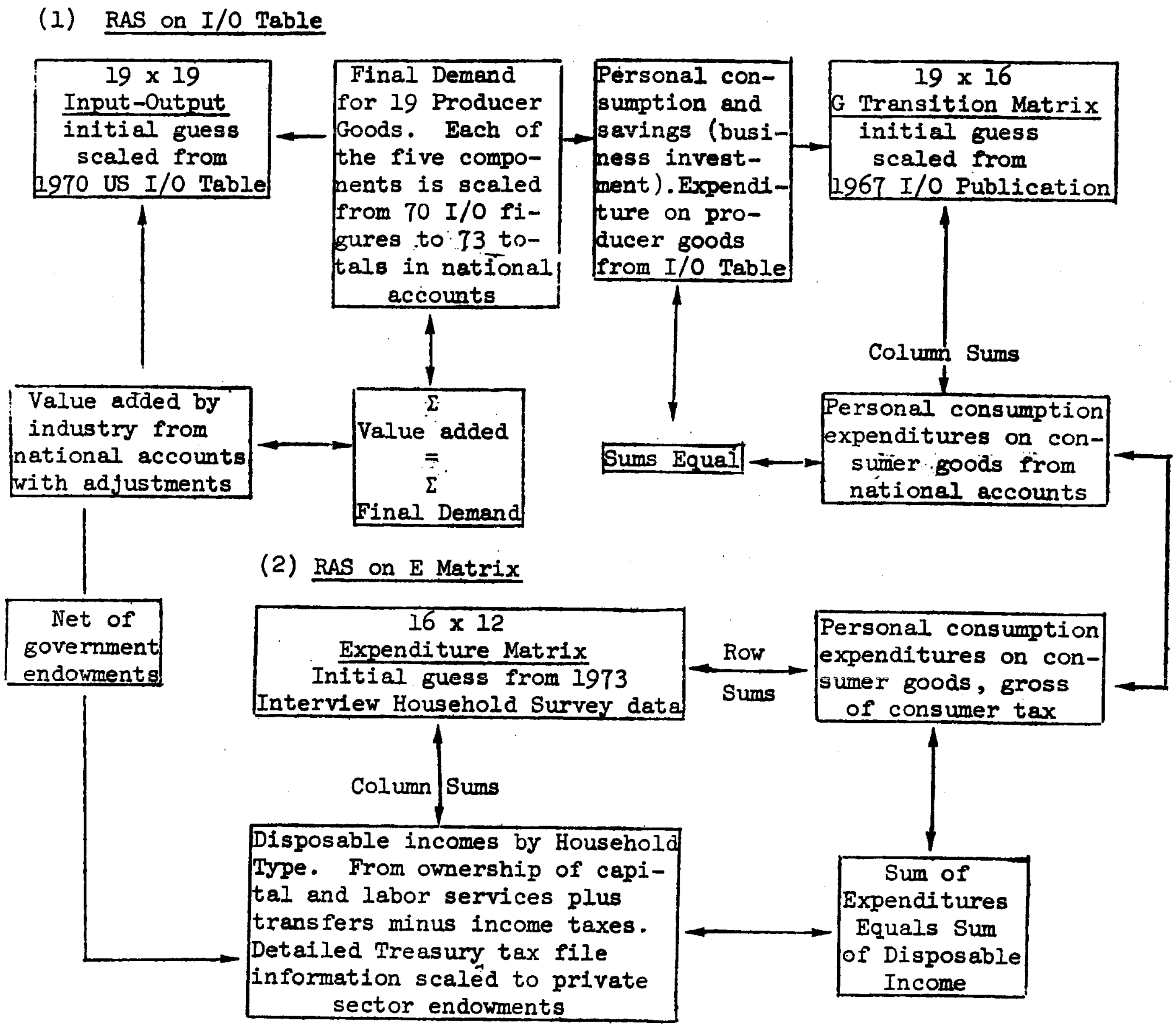


Table 5

Labor Income, Tax, and Effective Rates by Industry in the U. S. for 1973*

	(1) Labor Income Net of Tax	(2) Tax on Labor	(3) Effective Tax Rate (2)÷(1)
All Industries	643,040	64,997	.1011
Ag., For., Fish.	16,257	1,141	.0702
Mining	4,718	464	.0983
Crude Petr. Gas	3,415	308	.0902
Construction	50,908	5,308	.1043
Food, Tobacco	16,964	1,859	.1096
Textiles, App., Lea.	17,447	2,268	.1300
Paper, Printing	18,996	1,948	.1025
Petrol. Refin.	2,834	239	.0843
Chem., Rubber	19,387	1,957	.1009
Lumber, Furn. Stone	17,419	1,930	.1108
Metals, Machinery	87,996	9,167	.1042
Transp. Equip.	13,738	1,393	.1014
Motor Vehicles	15,064	1,358	.0901
Trans., Comm., Util.	59,086	6,188	.1047
Trade	130,239	13,745	.1055
Finance, Insurance	32,839	3,161	.0963
Real Estate	7,782	827	.1063
Services	112,785	10,179	.0903
Govt. Enterprises	15,166	1,557	.1027

*All figures are in millions of dollars. Component detail is available upon request.

Table 6

Capital Income Components by Industry in the U.S. for 1973*

	(1) Corporate Profits After Tax with IVA	(2) Capital Consumption Adjustment	(3) Return to Noncorporate Capital	(4) Net Rents Paid	(5) Net Interest Paid	(6) Total Capital Income
All Industries	45,633	8,221	33,541	21,237	65,530	181,973
Ag., For., Fish.	523	4/	22,865	4,067	3,323	30,778
Mining	840 2/	-	37	80	179	1,136
Crude Petr. and Gas	2,446 2/	-	561	304	59	3,370
Construction	500	-	0	75	448	1,023
Food, Tobacco	335	572	0	64	846	1,817
Textiles, App., Lea.	428 1/	138	0	49	471	1,086
Paper, Printing	2,376	-96	0	242	199	2,721
Petrol. Refin.	3,583	3,578	0	640	481	8,282
Chem., Rubber	3,172	132	0	71	535	3,910
Lumber, Furn., Stone	3,115 2/	512	0	181	421	4,229
Metals, Machinery	5,527	2,144	0	427	2,303	10,401
Trans. Equip.	-91 1/	61	0	22	176	168
Motor Vehicles	2,785	1,180	0	30	852	4,847
Trans., Comm., Util.	4,292	-	0	357	8,606	13,255
Trade	7,198	-	367	898	1,258	9,721
Finance, Insurance	6,843 3/	-	809	188	0	7,840
Real Estate	88 1/	4/	0	13,013	43,731	56,832
Services	1,673	-	8,902	529	1,642	12,746
Govt. Enterprises	-	-	-	-	-	7,811 5/

*All in millions of dollars. 1/ Averaged over 71,72,73. 2/ Includes depletion. 3/ Includes FRB earnings. 4/ CCA already included. 5/ Imputed.

Table 7

Capital Taxes by Industry in the U.S. for 1973 1/

	(1) Corporate Income Tax	(2) Corporate Franchise Tax	(3) Adjusted Property Tax	(4) Total Tax on Capital	(5) Capital Income Net of Tax	(6) Effective Tax Rate (4)÷(5)
All Industries	48,702	1,161	46,033	95,896	181,973	.5270
Ag., For., Fish	309	10	2,420	2,739	30,778	.0890
Mining	237	8	273	518	1,136	.4560
Crude Petr., and Gas	194	4	804	1,002	3,370	.2973
Construction	1,012	18	334	1,364	1,023	1.3333
Food, Tobacco	2,585	45	617	3,247	1,817	1.7870
Textiles, App. Lea.	1,221	23	264	1,508	1,086	1.3886
Paper, Printing	2,125	31	479	2,635	2,721	.9684
Petrol. Refin.	1,282	92	256	1,630	8,282	.1968
Chem., Rubber	3,573	44	574	4,191	3,910	1.0719
Lumber, Furn., Stone	1,647	28	422	2,097	4,229	.4959
Metals, Machinery	8,094	138	1,979	10,211	10,401	.9817
Transp. Equip.	536	7	542	1,085	168	6.4583
Motor Vehicles	2,974	19	276	3,269	4,847	.6744
Trans., Comm., Util.	4,007	319	5,313	9,639	13,255	.7272
Trade	7,513	125	3,252	10,890	9,721	1.1203
Finance, Insurance	9,457 2/	178	968	10,603	7,840	1.3524
Real Estate	700	47	25,354	26,101	56,832	.4593
Services	1,236	25	1,906	3,167	12,746	.2485
Govt. Enterprises	0	0	0	0	7,811	.0000

1/ In millions of dollars. 2/ Includes FRB payments to the Treasury.

Table 8

United States Interindustry Transactions, 1973
(In Millions of Dollars at Producers' Prices)

	1	2	3	4	5	6	7	8	9
1.	45327.244100	0.000000	0.000000	381.924400	34720.698800	1524.927000	0.000000	0.000000	176.424400
2.	294.161500	1756.658400	0.000000	1375.462000	75.004400	35.758500	244.641600	137.562600	1262.619400
3.	0.000000	1.349200	522.310600	0.000000	0.000000	0.000000	0.000000	19643.377800	82.945800
4.	1198.961700	186.189600	652.302700	50.745200	381.360400	155.722500	402.558400	750.979500	649.083800
5.	8358.244000	0.000000	0.000000	0.000000	20018.780000	321.826500	198.043200	67.377600	1107.260600
6.	454.428800	48.571200	7.026600	413.974000	177.475200	26840.791500	525.526400	5.614800	1618.101400
7.	330.678100	40.476000	2.342200	417.980200	3810.434800	696.714000	17242.702400	280.740000	2439.659800
8.	2393.866000	188.888000	48.015100	3257.040600	266.212800	80.745000	287.356800	3169.554600	3212.504000
9.	5443.002100	495.156400	283.406200	3648.312800	1922.648000	5710.978500	2876.156800	1313.863200	24720.481600
10.	267.788400	275.236800	125.307700	19379.324800	1521.216000	230.700000	2047.740800	112.296000	913.720400
11.	1359.229000	1158.962800	1196.864200	32273.947200	3736.486800	1216.942500	1918.300800	547.443000	4837.188400
12.	48.688800	4.047600	0.000000	1.335400	0.000000	2.307000	7.766400	0.000000	113.227600
13.	34.497900	9.444400	0.000000	5.341600	5.282000	3.460500	0.000000	5.614800	55.297200
14.	4055.371300	837.853200	477.808800	4820.794000	4646.047200	1664.500500	3103.971200	3366.072600	4511.908200
15.	7003.072400	313.014400	269.353000	13609.061400	4535.125200	2296.618500	2148.704000	572.709600	3072.944400
16.	1704.136700	230.713200	185.033800	1211.207800	547.215200	370.273500	445.273600	613.416900	588.520200
17.	6246.367300	778.488400	3748.691100	1091.021800	1018.369600	821.292000	1988.198400	1174.896900	2409.378000
18.	4335.331900	562.616400	539.877100	9429.259400	5361.230000	1474.173000	3030.190400	1504.766400	7529.635400
19.	24.344400	12.142800	9.368800	114.844400	127.824400	125.731500	472.456000	32.285100	157.992000

	10	11	12	13	14	15	16	17	18	19
1.	2016.220800	30.541700	0.000000	0.000000	191.893000	189.193800	0.000000	3927.439000	836.201200	-9.193100
2.	1696.209600	6134.898000	8.586400	32.854000	1893.785400	14.759800	2.454200	173.522600	30.479600	291.552600
3.	0.000000	0.000000	0.000000	0.000000	4311.637200	0.000000	0.000000	340.422200	0.000000	0.000000
4.	440.203200	1460.690000	133.089200	216.836400	5440.497400	968.779600	225.786400	13247.324600	2503.302800	3295.069700
5.	19.531200	103.576200	0.000000	0.000000	305.705400	1458.536600	0.000000	474.206800	6168.806000	-35.459100
6.	1048.675200	1138.010300	150.262000	1301.018400	273.943800	462.921000	0.000000	152.329000	866.680800	42.025600
7.	1274.035200	7166.676300	129.869300	179.054300	412.900800	3031.126200	976.771600	333.799200	15873.245600	115.570400
8.	395.131200	956.088000	129.869300	134.701400	3942.408600	2050.270400	127.618400	1173.595600	1172.802000	211.441300
9.	2325.715200	7580.981100	708.378000	2076.372800	861.533400	2129.436600	22.087800	1004.046800	4915.166800	308.625500
10.	11237.952000	3979.716300	916.598200	997.118900	89.991200	784.953000	0.000000	196.040800	661.274800	11.819700
11.	4050.470400	117358.474100	9730.537800	19600.696400	2826.782400	3936.841200	941.185700	2348.515800	11212.517200	177.295500
12.	63.100800	2232.199900	7913.440900	124.845200	1181.796200	413.274400	0.000000	200.014600	72.886000	5.253200
13.	40.564800	2052.933400	375.655000	20969.065500	132.340000	131.496400	0.000000	239.752600	2150.799600	23.639400
14.	3888.211200	10878.156900	936.990900	1894.033100	25605.143200	9259.761800	2246.820100	3112.810000	22239.506400	4189.427000
15.	2238.576000	11643.027200	1274.007100	1887.462300	3567.886400	5929.414200	954.683800	2809.476600	7613.274000	253.466900
16.	515.323200	2058.245000	166.361500	282.544400	2440.349600	5007.597600	16179.313500	7290.598400	2979.049600	521.380100
17.	895.430400	4534.778500	514.110700	359.751300	3434.223000	14327.740400	2940.131600	6295.823800	12373.392400	580.478600
18.	1927.579200	11735.980200	1630.342700	2667.744800	8226.254400	21505.028600	7923.384700	6756.784600	23183.048800	1184.596600
19.	75.120000	359.860900	52.591700	91.991200	11894.719200	4272.291200	1454.113500	2220.029600	2228.986400	43.338900

Table 9

Components of Final Demand, Estimates by Industry for 1973*

	Personal Consumption Expenditures (1)	General Government Expenditures (2)	Gross Private Fixed Capital Formation (3)	Net Inventory Change (4)	Exports (5)	Imports (6)
All Industries	827,525.0	119,764	202,092.0	18,787	84,598.8	84,598.8
Ag., For., Fish.	10,194.9	-1,526	0.0	3,248	10,313.2	4,707.3
Mining.	266.3	217	0.0	1,421	1,253.3	1,221.5
Crude Petr. & Gas	0.0	0	0.0	410	103.1	5,190.6
Construction	0.0	45,690	115,132.0	-773	0.0	0.0
Food & Tobacco	105,701.8	1,522	0.0	-1,044	6,831.7	5,690.4
Textiles, App., Lea.	36,571.4	669	163.9	-652	3,475.3	5,741.5
Paper & Printing	9,656.8	2,178	0.0	116	1,405.6	2,170.0
Petr. Refining	16,673.5	1,501	0.0	-16	556.7	3,139.8
Chem. & Rubber	17,795.8	4,141	38.6	1,243	6,259.0	3,509.5
Lumber, Furn., Stone	8,154.0	927	2,508.2	849	1,700.9	2,760.9
Metals, Mach. & Misc.	29,956.9	14,117	42,279.4	10,644	27,499.4	25,250.3
Transp. Equip.	3,045.0	16,103	8,478.8	-3,189	4,653.3	1,084.2
Motor Vehicles	21,643.9	2,503	16,154.6	-1,877	6,080.0	10,238.9
Trans., Comm. Util.	57,192.2	9,961	3,493.1	682	8,662.3	11,584.3
Trade	191,084.4	2,121	10,040.2	7,959	0.0	0.0
Finance & Insurance	57,997.9**	884	21.3	0	0.0	0.0
Real Estate	122,201.5	1,783	3,419.9	0	0.0	0.0
Services	135,514.7	16,154	0.0	-234	5,805.0	2,309.6
Govt. Ent.	3,873.8	818	0.0	0	0.0	0.0

*All levels are in millions of 1973 dollars.
**Includes imputed service charge payments.

Table 10

Labor Income and Income Taxes*

	Wages & Salaries (1)	63.33% of Partnership Income (2)	Labor Income (1) + (2) (3)	Capital Income (4)	Total Income (3) + (4) (5)	Federal Income Tax (6)	S&L Income Tax (7)	Total Tax (6) + (7) (8)	Rate of Tax (8)÷(5) (9)	Average Marginal Tax Rate (10)
0-3,000	686.5	-22.17	664.33	399.06	1,063.39	6	0	6	.0056	.0100
3-4,000	1,640.2	2.53	1,642.73	701.85	2,344.58	74	1	75	.0320	.0608
4-5,000	2,586.0	0	2,586.00	743.52	3,329.52	158	3	161	.0484	.1019
5-6,000	3,459.2	2.53	3,461.73	892.07	4,353.80	257	6	263	.0604	.1228
6-7,000	4,370.6	7.60	4,378.20	988.14	5,366.34	365	13	378	.0704	.1346
7-8,000	5,529.0	19.00	5,548.00	1,049.92	6,597.92	516	24	540	.0818	.1570
8-10,000	6,925.9	8.23	6,934.13	1,082.15	8,016.28	709	47	756	.0943	.1813
10-12,000	8,739.0	19.00	8,758.00	1,369.22	10,127.22	962	90	1,052	.1039	.2078
12-15,000	11,169.5	41.17	11,210.67	1,506.57	12,717.24	1,330	143	1,473	.1158	.2215
15-20,000	14,294.3	51.30	14,345.60	2,016.70	16,362.30	1,951	270	2,221	.1357	.2618
20-25,000	17,443.5	136.18	17,579.68	3,101.84	20,681.52	2,829	449	3,278	.1585	.2897
25,000+	22,549.7	1,234.48	23,784.18	12,806.37	36,590.55	8,049	1,303	9,352	.2556	.4067
Total	6,794.4	74.74	6,869.14			1,057	139	1,196		

*In 1973 dollars per year, per individual.

Table 11

Average Government Transfers*

	Unemployment Compensation (1)	Welfare Receipts (2)	Government Employee Pension (3)	Workman's Compensation (4)	Veterans' Benefits (5)	Social Security (6)	Ins. Value of Medicare (7)	Ins. Value of Medicaid (8)	Ins. Value of Veteran Benefits (9)	Value of Food Stamp Bonus (10)	Total (11)
0-3,000	15	74	5	4	11	268	67	65	8	20	537
3-4,000	38	237	29	10	59	844	164	161	38	51	1,631
4-5,000	47	236	48	14	69	805	160	139	37	51	1,606
5-6,000	61	165	73	18	55	810	157	92	29	41	1,501
6-7,000	65	157	110	31	80	748	133	76	34	36	1,470
7-8,000	63	95	109	47	81	585	97	61	31	28	1,197
8-10,000	69	49	153	53	81	547	89	35	28	16	1,120
10-12,000	64	26	196	56	86	475	83	23	30	9	1,048
12-15,000	58	10	208	68	85	341	60	14	31	6	881
15-20,000	57	12	300	69	99	301	55	10	33	5	941
20-25,000	46	3	510	81	103	303	58	7	37	3	1,151
25,000+	41	4	1,005	80	112	358	76	5	32	2	1,715
Total	45	81	172	37	64	467	91	56	26	21	1,060

*In 1973 dollars per year, per individual.

Table 12

Matrix of Expenditures on Consumer Goods by Households

Household Groups

Consumer Goods

	1	2	3	4	5	6
1.	766.80	1034.90	1153.10	1292.80	1336.30	1400.70
2.	22.48	37.00	44.88	50.68	56.24	67.60
3.	68.41	78.58	85.63	92.46	108.39	115.66
4.	271.60	340.40	388.10	407.40	448.20	442.80
5.	1094.23	1323.34	1353.06	1439.94	1480.34	1540.81
6.	72.97	112.32	131.92	131.56	157.80	183.19
7.	52.29	71.85	85.75	96.96	110.62	143.16
8.	142.90	218.90	241.00	303.40	321.60	368.40
9.	47.14	65.83	68.63	69.41	59.29	79.75
10.	288.80	419.80	470.10	502.60	768.90	804.90
11.	406.50	483.72	590.04	669.44	709.92	780.88
12.	191.19	289.06	404.61	400.24	471.25	497.38
13.	102.30	150.90	147.50	200.60	204.80	255.50
14.	135.46	165.10	188.24	219.96	235.56	243.62
15.	151.20	194.10	251.90	264.60	316.00	372.00
16.	-18.74	64.58	106.87	174.20	239.35	309.86

	7	8	9	10	11	12
1.	1592.90	1804.00	1972.70	2373.50	2764.90	3311.40
2.	67.77	89.66	82.53	115.82	124.93	199.44
3.	135.05	146.13	151.04	170.22	166.72	153.12
4.	483.30	534.80	591.20	671.90	738.40	891.20
5.	1697.56	1872.23	1989.17	2430.00	2885.93	3663.97
6.	232.52	237.19	294.53	425.47	545.61	770.44
7.	155.14	164.49	195.37	216.44	248.34	270.96
8.	419.60	506.00	562.40	743.10	934.90	1366.00
9.	84.82	91.68	77.15	102.75	140.88	304.84
10.	880.10	1195.30	1317.00	1564.80	1891.40	2373.20
11.	854.30	903.64	1059.10	1367.96	1802.96	3362.58
12.	546.15	568.11	714.66	774.28	1021.09	1749.67
13.	322.10	395.10	471.50	651.30	915.10	1193.20
14.	260.00	303.42	345.54	398.44	452.14	505.44
15.	411.40	474.20	556.50	626.80	714.40	767.10
16.	419.54	596.77	835.96	1203.55	1670.55	4980.27

IV. Application to Social Security

Applying this model to social security is relatively straightforward. The eventual plan will involve the two sub-populations, workers and retired, and incorporate the population dynamics implied by U.S. birth patterns. For the present example I have simply examined the sensitivity of the real wage rate to the aggregate capital-labor ratio where each of the nineteen industries has a different elasticity of factor substitution. The source of the "best guess" industrial elasticity parameters is a recent survey article by Caddy [1976] which includes most published estimates. The demand functionsfor this illustrative run have been kept extremely simple, each being of the Cobb-Douglas, constant expenditure share variety.

Given that the complete dynamic program is not yet available, the experiment of this section simply examines what the effect would have been of reducing the total labor force in 1973 by 37.5 percent. Hueristically this corresponds to the 3.2 to 2.0 move in workers per retiree discussed earlier, but of course a more complete analysis must be done on the projected patterns of both the capital/worker and workers/retiree ratios.

I have chosen not to include the detailed results of this experiment, but rather offer to send them to the interested reader. The major conclusions are shown in Table 13, however. First, the relative price of labor rises considerably, approximately twenty percent relative to a price index using consumer demands as weights. The price of labor rises even more when compared to the return on capital. The wage-rental

Table 13

Effects of a 37.5 Percent Reduction in a Aggregate Labor Supply on Relative Industrial Prices (price of capital = 1.0)

Industries	Prices	Elasticity of Factor Substitution
1. Agriculture, Forestry, and Fisheries	1.345	0.676
2. Mining	1.568	1.000
3. Crude Petroleum and Gas	1.394	1.000
4. Contract Construction	1.675	1.000
5. Food and Tobacco	1.485	0.712
6. Textiles, Apparel, Leather products	1.631	0.903
7. Paper and Printing	1.595	0.903
8. Petroleum Refining	1.332	0.783
9. Chemicals and Rubber	1.553	0.960
10. Lumber, Furniture, Stone	1.571	0.912
11. Metals, Machinery, misc. manufacturing	1.630	0.737
12. Transportation equipment	1.690	0.816
13. Motor Vehicles	1.547	0.923
14. Transportation, Communications, and Utilities	1.553	1.000
15. Trade	1.646	1.000
16. Finance and Insurance	1.513	1.000
17. Real Estate	1.288	1.000
18. Services	1.637	1.000
19. Government Enterprises	1.535	1.000
Factors		
Labor services	1.825	
Capital services	1.000	
Net National Income	-27.8%	

Table 13 (contd)

Effects of a 37.5 Percent Reduction in a Aggregate Labor Supply on the Relative Price of Consumer Goods (price labor = 1)*

Consumer Goods	Prices
1. Food	0.841
2. Alcoholic Beverages	0.856
3. Tobacco	0.850
4. Utilities	0.851
5. Housing	0.713
6. Furnishings	0.889
7. Applicances	0.894
8. Clothing and Jewelry	0.897
9. Transportation	0.850
10. Motor Vehicles, Tires and Auto Repair	0.874
11. Services	0.894
12. Financial Services	0.829
13. Reading, Recretation, misc.	0.884
14. Nondurable-nonfood household items	0.878
15. Gasoline and other fuels	0.820

* These are goods prices in terms of hours of work. Before labor supply reduction units were normalized so that all prices equalled unity.

ratio increases from 1.0 to 1.82. As stated earlier, the gross output of the economy falls (but by 28% and not 37.5%), but this is accompanied by a major shift in the functional distribution of income in favor of labor and against capital. The real income of labor falls slightly less than half as much as the size of the labor force.

As one would expect the relative price of labor intensive products, such as services, rises while the price of capital intensive products, particularly housing, falls a great deal. These results are suggestive of what may occur in the period 2012 to 2035 when the members of the baby boom bulge in population are attempting to liquidate the assets they have accumulated for retirement.

It is premature to draw policy conclusions from this analysis, but certain likelihoods are already emerging from this work. It does seem that labor intensive goods will become more expensive and that the members of the populous post World War II generation are going to bear a burden for their massive numbers. Not only will they have a smaller labor income base available to them through social security (although here scarcity pricing may alleviate around one-half the problem), but they also may well be disappointed in the value of their privately accumulated assets at the time they want to liquidate them.

V. Conclusion

It is hardly appropriate to write a conclusion to a paper which is designed to open an area of research rather than to settle the issues. What has been done is to raise the point that a complicated set of economic adjustments are going to occur as the uneven population age structure of the U.S. matures. Our focus has been on the social security system and it has been argued that one cannot simply count workers and retirees to gain a useful picture of the problems the system faces, but one must take into account the large relative price changes which will occur.

What has been suggested is that not only will workers be scarce relative to retirees forty years from now during the "crunch" period, but they will also be scarce relative to capital. The relative price of labor will rise and, if the tax base of social security remains labor income, social security may be in somewhat better shape than is commonly supposed. However, the return on capital assets will be depressed, which may harm the retired generation.

A general equilibrium model has been developed for U.S. tax policy evaluation and it can be applied to the evaluation of these social security issues. The model has been briefly outlined and a dynamic extension has been discussed. A large portion of the research to date has been in gathering the necessary data to empirically specify this model. This task has been completed and a portion of the data has been presented in this paper.

An illustrative application of the model has been completed and is reported on in this paper. The primary result is that a 37.5 percent reduction in the 1973 work force would have resulted in an approximate 20 percent increase in the real wage. The service price of capital would have been lowered significantly resulting in a major adjustment in relative factor shares and in the prices of commodities depending on their factor intensities. Further work is anticipated in this research area, but these results do illustrate the large price adjustments which the changing factor proportions imply. The implications for social security of these factor price and share changes will prove to be very important.

Bibliography

Arrow, Kenneth J. and F. H. Hahn, [1971], General Competitive Analysis, San Francisco, Holden-Day, Inc.,

Bacharach, Michael, [1971], Bi-proportional Matrices and Input-Output Change, England: Cambridge University Press.

Barro, Robert [1977], "Social Security and Private Saving--Evidence from the U.S. Time Series," The University of Rochester, April.

Blechman, Barry M. and Edward M. Gramlich and Robert W. Hartmen [1975], Setting National Priorities: The 1976 Budget, Washington, D.C., The Brookings Institution.

Boskin, Michael J. [1977a], "Social Security and the Retirement Decision," Economic Inquiry, Vol. XV, January, pp. 1-25.

Boskin, Michael J. [1977b], "Taxation, Saving and the Rate of Interest," Journal of Political Economy, forthcoming.

Boskin, Michael J. [1977c], "Social Security: The Alternatives Before Us," in The Crisis in Social Security: Problems and Prospects, M. J. Boskin, ed., San Francisco, Institute for Contemporary Studies.

Caddy, E. [1976], "Empirical Estimation of the Elasticity of Substitution: A Review," Preliminary Working Paper Op-09, IMPACT Project, Industrial Assistance Commission, Melbourne, Australia, November.

Feldstein, Martin [1974], "Social Security, Induced Retirement and Aggregate Capital Accumulation," Journal of Political Economy, Vol. 82, No. 5, September/October, pp. 905-926.

Feldstein, Martin [1976a], "Social Security and Saving: The Extended Life Cycle Theory," American Economic Review, Vol. 66, No. 2, May, pp. 77-86.

Feldstein, Martin [1976b], "The Social Security Fund and National Capital Accumulation," Discussion Paper Number 505, Harvard University, Cambridge, Mass., October.

Fullerton, Don, John B. Shoven, and John Whalley [1977], "General Equilibrium Analysis of U.S. Taxation Policy," 1977 Compendium of Tax Research, U.S. Treasury Department.

Kurz, Mordecai, [1977], "Funding the Social Security System: Evaluation of the Issues," unpublished mimeo.

Samuelson, Paul A. [1958], "An Exact Consumption-Loan Model of Interest with or without the Social Contrivance of Money," Journal of Political Economy, LXVI, December, pp. 467-482.

Scarf, Herbert E. (with the collaboration of Terje Hansen) [1973], The Computation of Economic Equilibria. New Haven, Conn.: Yale University Press.

Shoven, John B., and John Whalley [1973], "General Equilibrium with Taxes: A Computational Procedure and an Existence Proof." Review of Economic Studies, 40, pp. 475-490.

Shoven, John B. and John Whalley [1977], "Complete Primary Data Set for A General Equilibrium Model of 1973 U.S. Economy, Consistency Procedures, and Extraneous Parameters," U.S. Treasury Department, unpublished paper.