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**AN ACTUARIAL MODEL FOR ANALYZING THE SOCIAL  
SECURITY MONEY'S-WORTH QUESTION**

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**ABSTRACT**

Over the past few years many state and local governments and nonprofit organizations have examined the question of whether they should terminate social security coverage for their employees. One of the first steps in addressing this issue is to answer the social security "money's-worth" question: Does social security provide a fair return on dollars contributed? This paper describes an actuarial model that was developed to answer this question with reference to a two-wage-earner family. Illustrative examples of the output from the model are presented based upon the "official" set of projections contained in the 1982 OASDI and HI trustees' reports ([7], [8]).

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**INTRODUCTION**

One of the first steps in analyzing whether an organization should withdraw from the social security system is to answer the question: On average, will the employees of the organization receive a fair return on their dollars contributed to social security? This is the money's-worth question. If analysis shows that most employees will not receive their money's worth, then it is appropriate to address the question: How much will it cost to replace the benefits provided by the social security system?

Most actuarial models designed to answer the money's-worth question have not considered the situation of two married wage-earners both covered by social security. Most models have considered only the retirement benefits provided by the system or, at most, the "cash benefits" (retirement, disability, and death benefits).

The model described in this paper examines the question from both the one-wage-earner and the two-wage-earner points of view. In the latter case, it considers the *additional* benefits provided by the second worker's taxes. The model considers not only cash benefits, but also incorporates a proxy to the benefits provided by the hospital insurance portion of the medicare program.

The results of any actuarial model are sensitive to the methods and assumptions utilized. Every effort must be made to select assumptions (particularly economic forecasts) that will not bias the result. In this paper, the initial assumptions used are the Alternative II-B assumptions contained in the 1982 OASDI trustees' report [7] for cash benefits, and the Alternative II-B assumptions in the 1982 HI trustees' report [8] for hospital insurance benefits. These assumptions have the advantage of being up-to-date as well as unbiased (i.e., not selected by either the organization examining the withdrawal issue or the actuary performing the analysis). Alternative calculations are frequently developed based on assumptions thought to be more appropriate to the employees of a particular organization. The Alternative II-B assumptions are described in Appendix III.

An important assumption that underlies any money's-worth projection is whether or not the system itself will be changed. This is particularly important here since, under the Alternative II-B assumptions, both OASDI and HI are out of balance (i.e., future benefits are greater than future tax receipts). The model presented herein does not anticipate any future benefit or tax changes. If the model shows that the typical employee will not receive his or her money's worth from social security, then it is more than likely that any future changes in the system would not reverse this relationship (benefits will have to be reduced or taxes increased for the system to become balanced). On the other hand, if the typical employee will receive his or her money's worth from the system, then the fact that the system is out of balance clouds the issue. The attitude of the organization and its employees toward the system will come into play.

#### TAXES

Appendix II contains the tax rates utilized in the model. No attempt is made to project larger tax rates than are currently contained in the law. The wages to which the tax rate applies are limited to the taxable wage base, which is estimated from the assumption as to future increases in average wages in covered employment.

Only the employee tax rate is compared with the value of future benefits. However, the results can be easily adjusted to use the combined employee-employer taxes by doubling the present value of future taxes.

#### BENEFITS

The model takes into account the major benefits provided under social security: retirement, disability, death, and medicare. It does not consider "special" benefits such as those payable to aged parents, lump-sum death benefits, or benefit losses due to divorce or remarriage.

In order to accommodate the use of assumptions that vary by duration, the model develops "benefit streams," which assign to each future year a specific benefit weighted by the appropriate probability of receipt. The benefits are modified to take into account any age-related adjustment factors contained in the social security system as well as to reflect increases in the Consumer Price Index. The benefits are discounted using the assumed interest rate. Appendix I contains the formulas used to develop the four types of benefits considered in the model. These formulas reflect the "carve out" of benefits payable to a worker based upon the spouse's earnings record, where applicable (this concept is discussed in more detail later in the paper).

To assign a value to future medicare benefits, the model determines the present value of future premiums required to purchase such coverage from the social security system. Although this approach is not feasible for disabled individuals under age 65, it is appropriate as a proxy to future hospital insurance benefits.

#### ACTUARIAL ASSUMPTIONS

The results obtained from this model are highly influenced by the actuarial assumptions used. Because of the nature of the money's-worth question, primary considerations in the selection of assumptions are that they be objective and relevant.

Objectivity means that the assumptions should stand up to scrutiny by anyone reviewing the results. They should not be chosen to bias the results either way.

Relevance means that it is not enough for the assumptions to be appropriate in the "aggregate," as ERISA requires under its pension-funding rules. Because the results will frequently be distributed to the employees involved, and because these individuals cannot be expected to understand the offsetting effects of implicit assumptions, each assumption by itself must appear reasonable to a layman.

#### *Economic Assumptions*

The economic assumptions used are most often subject to scrutiny. In order to satisfy the conditions of objectivity and relevance, the economic assumptions first applied are usually those used in the 1982 OASDI trustees' report [7] (Alternative II-B). As the "official" assumptions, and as those most frequently quoted, they pass the objectivity test. They also satisfy the relevance criterion since, based on recent levels of inflation and interest rates, the assumptions over the next decade are quite believable.

To be compatible with this set of assumptions, the average HI monthly premium rate increases were developed from the intermediate set of assumptions in the 1982 HI trustees' report [8] (Alternative II-B). As a first step in developing the projections, the monthly health insurance premium rate effective on July 1 was determined for each year from 1981 through 2006. The rate applicable during the first six months of a calendar year was averaged with the rate applicable during the last half of the calendar year, and the corresponding increase in the average HI monthly premium rate was determined.

This technique produced a declining sequence of increases with the rate in the year 2004 equal to 8.3 percent. To extend the table further, two choices are available. First, an ultimate rate of 8 percent can be projected beginning in the year 2005. While this would produce a smooth transition to the ultimate rate, it would imply that health care costs will forever be in excess of the increase in wages. This is not a totally unreasonable assumption, considering that historically hospital costs have risen faster than either wages or inflation. Table 1 compares historical increases in hospital costs with increases in average wages and inflation. Another method, which may seem more reasonable, would be to assume that hospital cost increases eventually will be the same as increases in average

TABLE 1  
HISTORICAL INCREASES IN HOSPITAL COSTS

Calendar Year	Average Wages	CPI	Aggregate Inpatient Hospital Costs
1956-65.....	3.7%	1.6%	10.4%
1966.....	5.7	3.0	11.7
1967.....	5.5	2.8	18.6
1968.....	6.4	4.2	16.5
1969.....	6.7	5.4	18.4
1970.....	4.9	5.9	16.8
1971.....	4.9	4.3	13.7
1972.....	7.3	3.3	13.5
1973.....	6.9	6.2	10.1
1974.....	7.4	11.0	14.5
1975.....	6.6	9.1	18.7
1976.....	8.2	5.8	15.7
1977.....	8.0	6.5	13.6
1978.....	8.2	7.6	12.7
1979.....	8.8	11.1	12.7
1980.....	8.6	13.5	16.6

SOURCE.—Table A1 in the 1982 HI trustees' report [8].

wages. This assumption would result in a sharp discontinuity in the year 2005, but would be more reasonable in the eyes of some individuals. The illustrations contained in this paper were prepared under the assumption that increases in average hospital insurance premium rates would level off at 8 percent per year, remaining higher than the increases in both wages and the Consumer Price Index.

In practice, complete past salary histories are usually secured from the social security administration for individuals aged 35 and older. Where possible, records of past quarters of coverage are also obtained. Future increases in pay are usually assumed to be in line with the increases in average wages in covered employment, and all individuals are assumed to have unbroken work records in the future. Note that in the examples included in this paper, pre-1982 earnings trends were assumed to follow the past trends in average covered wages.

#### *Noneconomic Assumptions*

A standard table is used by the model in forecasting mortality rates for healthy individuals (the UP-1984 Table [1]). This table is adjusted to be sex-distinct. For disabled individuals, mortality rates are taken from the tables used by the PBGC to value benefits for individuals in receipt of social security disability benefits. This information originally comes from the Social Security Administration, so its use is appropriate. Zero mortality is assumed for children in the valuation of family benefits.

Disability incidence rates are taken from the most recent actuarial study on the subject. This study was published in 1980 and deals with experience of disabled workers during the period 1974–78 [6]. Incidence rates are based on the 1977 calendar year of entitlement. These disability incidence rates may be considered high since the experience under the disability portion of the social security system has been improving over the past few years. However, the disability incidence rate prior to 1980 was generally high. The disability incidence rate has been below 4.0 awards per thousand insured workers in only four years—1964, 1980, 1981, and 1982.

No recoveries from disability are assumed; the only terminations of disability are due to death.

Expenses of administration are disregarded in the analysis. To simplify the calculations, workers are assumed to retire at age 65 with spouses retiring at the first age eligible, but not before the worker.

#### WORKER CHARACTERISTICS

The actuarial model has been developed to handle three distinct types of family units in arriving at the present value of future benefits.

*Single Worker*

The first and simplest case is the analysis for an individual who is unmarried. An unmarried individual is assumed to have no children. Although this may not be reasonable considering the increase in the divorce rate over the past few years, it does simplify the calculations. For a single worker, retirement benefits, disability benefits, and medicare benefits are valued.

*Married Worker with a Nonworking Spouse*

The next analysis is for a married worker with a nonworking spouse and two or fewer children. Retirement benefits, disability benefits, death benefits, and medicare benefits are all valued.

*Married Worker with Working Spouse*

This actuarial model, unlike most traditional analyses, considers the benefits payable to a worker after reflecting the fact that a working spouse covered by social security will also provide benefits to the worker. The "marginal" benefits over and above those attributable to an individual based on the spouse's earnings record are compared to the present value of the worker's social security taxes. For hospitals considering withdrawal from the social security system, because of their typical work force (heavy percentage of females belonging to a two-wage-earner family), this refinement is of utmost importance. The statement is frequently made that a two-wage-earner family will generally receive their money's-worth in relation to the *sum* of their contributions because each earner will receive at least the benefits payable to an unmarried worker. However, this view ignores the fact that it is possible to take advantage of the social adequacy principles of the system in certain situations.

Because of the complexities involved, benefits payable to the worker based upon the spouse's earnings record are recognized only in the most valuable areas. The areas not measured do not make up a significant part of the total present value of future benefits.

In the retirement area, full recognition is made of the benefits payable to the spouse based on the worker's earnings record, the benefits payable to the worker based on the spouse's earnings record, and the death benefits payable to the worker based on the spouse's earnings record. Chart 1 illustrates the mechanism used in the model for assigning retirement benefits to a worker and spouse when both of them qualify for social security retirement benefits at age 65 on their own earnings records.

In the first case, the worker's social security taxes will earn an additional \$250 in retirement benefits for the worker, since, even if the worker was not covered by the system, based on the spouse's earnings record the worker would have a benefit of \$150 per month. Since the benefit the spouse earns on his or her own earnings record is higher than the spouse's benefit provided by the worker's earnings record, the spouse's benefit provided by the worker is of no value. The only benefit that would be included in the money's-worth analysis would be a \$250 retirement benefit to the worker.

In the second case, the worker's retirement benefit as well as the spouse's benefit based on the worker's earnings record are both of no value since the spouse would provide his or her own benefit as well as a spouse's benefit in excess of anything that would be generated from the worker's earnings record. There is no future return in retirement benefits on social security taxes paid by the worker.

In the third case, the worker provides an additional \$350 in retirement benefits based on his or her own earnings record, as well as an additional \$100 of benefits to the spouse. Thus, a total of \$450 in monthly retirement benefits would be valued and compared to the worker's social security taxes.

The approach illustrated above simply carves out of the total family benefits the benefits payable based on the spouse's earnings record. The adjusted benefits then represent the marginal benefits the worker will receive as a result of his or her social security taxes over and above what would be provided the family on the basis of the spouse's earnings record.

CHART 1

	WORKER (SUBJECT OF ANALYSIS)		SPOUSE	
	$RB_t(w)$	$RB_t(w)^{spouse}$	$RB_t(s)$	$RB_t(s)^{spouse}$
Case 1:				
Basic benefits .....	\$400	\$200	\$300	\$150
Marginal benefits .....	250	0	.....	.....
Case 2:				
Basic benefits .....	200	100	400	200
Marginal benefits .....	0	0		
Case 3:				
Basic benefits .....	400	200	100	50
Marginal benefits .....	350	100		

NOTES —  $RB_t(w)$  = retirement benefit payable in year  $t$  to worker based on own earnings record;  $RB_t(s)$  = retirement benefit payable in year  $t$  to spouse based on own earnings record;  $RB_t(w)^{spouse}$  = retirement benefit payable in year  $t$  to spouse from worker's earnings record;  $RB_t(s)^{spouse}$  = retirement benefit payable in year  $t$  to worker from spouse's earnings record.

Since so many hospital employees are female secondary wage earners with a spouse covered under the social security system, this type of analysis is quite important.

In addition to the retirement benefit offset, the model also offsets benefits payable to the worker from the death of a spouse.

In the disability area, no benefit offsets are considered. This limits the analysis, but because of the relative insignificance of disability benefits, this simplification does not materially distort the results. With respect to death benefits, the only offset that takes place deals with the retirement benefit payable to the spouse based on his or her own earnings record. In the medicare area, full recognition is made of the fact that the worker can qualify for a benefit based on the spouse's earnings record when the spouse retires. Again, because of the significant value of medicare benefits, this refinement is essential.

#### EXAMPLES

In April of 1978, Orlo R. Nichols and Richard G. Schreitmueller of the Office of the Actuary of the Social Security Administration published an actuarial note entitled "Some Comparisons of the Value of Worker's Social Security Taxes and Benefits" [3]. The paper presented the results of their money's-worth actuarial model for a large number of hypothetical workers, both newly covered in 1978 and already covered. For each worker, a "worker's future value ratio," defined as the present value of OASDI benefits to be gained divided by the present value of OASDI taxes to be paid, was calculated. Components of the basic figures were set forth to illustrate the details of the methodology used, along with the relative values of the various categories of benefits. These included future benefits derived from past covered employment and benefits to be gained from future covered employment.

These results are herein compared with the calculations of the model described in this paper but based on updated median earnings and maximum earnings figures, and with the calculations prepared as of January 1, 1982. Tables 2 and 3 illustrate the comparison. Note that married workers are assumed to have two children (25 and 27 years younger) who will remain eligible for child's benefits until age 16 in the 1982 calculations and until age 22 in the 1978 calculations. Even though children may continue to receive benefits until age 18 (or age 19 if in high school), to simplify the calculations child's benefits are not considered after the spouse's benefit ceases.

There are differences in calculation techniques which should be recognized when comparing results:

1. The 1978 calculations utilize only the OASDI tax rates, while the 1982 calculations include the HI tax rates.
2. The 1978 calculations do not include any hospital insurance (medicare) benefits, while the 1982 calculations do include these benefits.
3. The 1978 calculations include lump-sum death benefits, while the 1982 calculations do not.
4. The 1978 calculations include the death benefits payable to a surviving spouse after retirement with the value of old-age benefits, while the 1982 calculations include the surviving spouse benefits with the other death benefits.

One interesting observation to be drawn from Table 2 is that in all cases the most valuable benefits are those for hospital insurance. Because the current tax structure cannot support projected future hospital insurance benefits under the assumptions utilized in the analysis, all but one of these workers will receive back not only their own taxes but also those paid on their behalf by their employer. The lone exception is for an unmarried male worker with earnings always at the taxable wage base. Similar results were obtained when the lower 5½ percent hospital insurance premium rate increase assumption after 2004 was substituted for the 8.0 percent rate.

Table 3 indicates the relationship between benefits and social security taxes for an illustrative worker who already has "earned" a significant amount of the eventual social security benefits that he and his family will receive. In these cases, adding in the medicare benefits again illustrates their significant value. But upon withdrawal from the system, most of the medicare benefits would already be "vested," and the additional hospital insurance taxes would not purchase much in additional benefits. The future value ratios are uniformly lower than those developed in 1978.

To illustrate the two-wage-earner family situation, the examples were modified to replace the nonworking spouse with a spouse earning the same salary. The results are shown in Tables 4 and 5.

A comparison of the results illustrated on Tables 2 and 4 is striking. In all cases the worker with a working spouse covered by social security has a future value ratio less than 2.00, indicating that coverage under the social security system will not provide a return equal to the combined employee-employer taxes. The examples in Table 2 show that the married workers in a one-earner family can expect to receive much more than the combined employee-employer taxes (the ratios range from 3.34 to 8.39).

**TABLE 2**  
**ONE-WAGE-EARNER SITUATIONS**  
(Dollar figures are present values at January 1, 1978 and 1982)

	WORKER BECOMING COVERED AT AGE 22				WORKER BECOMING COVERED AT AGE 42			
	Median Earnings		Maximum Earnings		Median Earnings		Maximum Earnings	
	1982 \$15,000	1978 \$9,654	1982 \$32,400	1978 \$17,700	1982 \$15,000	1978 \$9,654	1982 \$32,400	1978 \$17,700
	Male Worker							
Worker's taxes .....	\$ 35,429	\$19,557	\$ 76,527	\$ 49,439	\$ 19,040	\$10,701	\$ 41,127	\$26,726
Benefits payable to unmarried worker:								
Old-age .....	30,413	20,856	43,067	34,635	28,295	19,652	43,962	35,105
Disability .....	14,443	6,648	20,482	11,003	7,320	3,076	11,686	5,302
Medicare .....	51,735	.....	51,735	.....	36,417	.....	36,417	.....
Total .....	\$ 96,591	\$27,504	\$115,284	\$ 45,638	\$ 72,032	\$22,728	\$ 92,065	\$40,407
Worker's future value ratio .....	2.73	1.41	1.51	.92	3.78	2.12	2.24	.151
Additional benefits payable to dependents of married worker:								
Old-age .....	\$ 10,507	\$25,084	\$ 14,878	\$ 41,658	\$ 10,019	\$22,611	\$ 15,566	\$40,390
Disability .....	1,917	1,313	2,722	1,924	1,454	21	2,330	44
Death .....	29,333	8,708	41,587	14,477	21,078	6,145	33,257	10,946
Medicare .....	81,420	.....	81,420	.....	55,105	.....	55,105	.....
Total .....	\$123,177	\$35,105	\$140,607	\$ 58,059	\$ 87,656	\$28,777	\$106,258	\$51,380
Total benefits payable to married worker and dependents:								
Total .....	\$219,768	\$62,609	\$255,891	\$103,697	\$159,688	\$51,505	\$198,323	\$91,787
Worker's future value ratio .....	6.20	3.20	3.34	2.10	8.39	4.81	4.82	3.43

TABLE 2—Continued  
 ONE-WAGE-EARNER SITUATIONS  
 (Dollar figures are present values at January 1, 1978 and 1982)

	WORKER BECOMING COVERED AT AGE 22				WORKER BECOMING COVERED AT AGE 42			
	Median Earnings		Maximum Earnings		Median Earnings		Maximum Earnings	
	1982 \$15,000	1978 \$9,654	1982 \$32,400	1978 \$17,700	1982 \$15,000	1978 \$9,654	1982 \$32,400	1978 \$17,700
	Female Worker							
Worker's taxes .....	\$ 36,436	\$20,421	\$ 78,702	\$ 51,654	\$ 19,879	\$11,249	\$ 42,939	\$28,129
Benefits payable to unmarried worker:								
Old-age .....	43,381	32,187	61,430	53,453	39,849	29,466	61,912	52,636
Disability .....	14,939	6,713	21,188	11,138	7,507	3,039	11,980	5,226
Medicare .....	75,379	.....	75,379	.....	53,056	.....	53,056	.....
Total .....	\$133,699	\$38,900	\$157,997	\$ 64,591	\$100,412	\$32,505	\$126,948	\$57,862
Worker's future value ratio	3.67	1.91	2.01	1.25	5.05	2.89	2.96	2.06

TABLE 3  
ONE-WAGE-EARNER SITUATIONS  
(Dollar figures are present values at January 1, 1978 and 1982)

	MALE WORKER AGED 42 WITH 20 YEARS COVERAGE			
	Median Earnings		Maximum Earnings	
	1982 \$15,000	1978 \$9,654	1982 \$32,400	1978 \$17,700
Worker's taxes .....	\$ 19,040	\$10,701	\$ 41,127	\$26,726
Benefits payable to unmarried worker:				
If coverage continues:				
Old-age .....	37,252	25,770	50,046	39,580
Disability .....	13,971	5,609	18,116	8,051
Medicare .....	37,510		37,510	
Total .....	\$ 88,733	\$31,379	\$105,672	\$47,631
If coverage terminates:				
Old-age .....	\$ 26,010	\$17,605	\$ 31,555	\$21,950
Disability .....	5,614	1,106	6,795	1,440
Medicare .....	35,122		35,122	
Total .....	\$ 66,746	\$18,711	\$ 73,472	\$23,390
Benefits to be gained by future coverage .....	\$ 21,987	\$12,668	\$ 32,200	\$24,241
Worker's future value ratio .....	1.15	1.18	.78	.91
Additional benefits payable to dependents of married worker:				
If coverage continues:				
Old-age .....	\$ 13,190	\$29,650	\$ 17,719	\$45,538
Disability .....	2,336	293	3,062	329
Death .....	33,574	10,223	44,199	14,959
Medicare .....	58,801		58,801	
Total .....	\$107,901	\$40,166	\$123,781	\$60,826
If coverage terminates:				
Old-age .....	\$ 9,210	\$20,256	\$ 11,173	\$25,255
Disability .....	1,252	293	1,519	320
Death .....	24,660	8,065	29,942	10,256
Medicare .....	58,801		58,801	
Total .....	\$ 93,923	\$28,614	\$101,435	\$35,831
Benefits to be gained by future coverage .....	\$ 13,978	\$11,552	\$ 22,345	\$24,995
Total benefits payable to married worker and dependents to be gained by future coverage:				
Total .....	\$ 35,965	\$24,220	\$ 54,545	\$49,236
Worker's future value ratio .....	1.89	2.26	1.33	1.84

The results from Tables 3 and 5 are more compatible. This is because after twenty years of coverage under the social security system, the workers in both situations have already earned most of their eventual social security benefits.

Nichols and Schreitmueller conclude in their paper [3] that with few exceptions a two-wage-earner family will generally receive their money's-worth in relation to their contributions, because each earner will receive at least the benefits payable to an unmarried worker. While this may be true, the *marginal* benefits to be gained by coverage for the second earner will not be worth the combined employee-employer taxes. This has been a primary motivation behind the significant increase in withdrawal activity over the past few years.

## CONCLUSION

This paper has presented a detailed explanation of the operation of an actuarial model designed to answer the social security money's-worth question. The intent was not to answer the question for any particular

TABLE 4  
TWO-WAGE-EARNER SITUATIONS  
(Dollar figures are present values at January 1, 1982)

	WORKER BECOMING COVERED AT AGE 22. WORKER/SPOUSE EARNINGS		WORKER BECOMING COVERED AT AGE 42. WORKER/SPOUSE EARNINGS	
	\$15,000	\$32,400	\$15,000	\$32,400
	Male Worker			
Worker's taxes .....	\$35,429	\$76,527	\$19,040	\$41,127
Marginal benefits payable:				
Old-age .....	10,617	17,327	8,137	15,379
Disability .....	16,360	23,204	8,774	14,016
Death .....	19,564	29,201	11,696	18,681
Medicare .....	5,670	5,670	2,135	2,135
Total .....	\$52,211	\$75,402	\$30,742	\$50,211
Worker's future value ratio .....	1.47	.99	1.61	1.22
	Female Worker			
Worker's taxes .....	\$36,436	\$78,702	\$19,879	\$42,939
Marginal benefits payable:				
Old-age .....	11,859	20,126	8,973	16,958
Disability .....	16,842	23,889	8,852	14,134
Death .....	10,393	15,571	5,898	9,417
Medicare .....	5,499	5,499	1,982	1,982
Total .....	\$44,593	\$65,085	\$25,705	\$42,491
Worker's future value ratio .....	1.22	.83	1.29	.99

case, but rather to point out the considerations involved in analyzing the question. The model expands upon traditional calculations by partially taking into account benefits payable to a worker based on a spouse's earnings record in a two-wage-earner family, and by including a proxy for the hospital insurance benefits payable under the medicare program.

TABLE 5  
TWO-WAGE-EARNER SITUATIONS  
(Dollar figures are present values at January 1, 1982)

	WORKER AGED 42 WITH 20 YEARS COVERAGE. WORKER/SPOUSE EARNINGS	
	\$15,000	\$32,400
	Male Worker	
Worker's taxes .....	\$19,040	\$41,127
Marginal benefits payable:		
If coverage continues:		
Old-age .....	15,102	20,636
Disability .....	16,307	21,178
Death .....	22,430	29,448
Medicare .....	2,925	2,925
Total .....	\$56,764	\$74,187
If coverage terminates:		
Old-age .....	\$ 6,519	\$ 6,593
Disability .....	6,866	8,314
Death .....	16,036	19,479
Medicare .....	537	537
Total .....	\$29,958	\$34,923
Benefits to be gained by future coverage .....	\$26,806	\$39,264
Worker's future value ratio .....	1.41	.95
	Female Worker	
Worker's taxes .....	\$19,879	\$42,939
Marginal benefits payable:		
If coverage continues:		
Old-age .....	17,298	23,739
Disability .....	16,802	21,791
Death .....	11,542	15,158
Medicare .....	2,807	2,807
Total .....	\$48,449	\$63,495
If coverage terminates:		
Old-age .....	\$ 7,188	\$ 7,270
Disability .....	8,055	9,754
Death .....	8,235	10,005
Medicare .....	570	570
Total .....	\$24,048	\$27,599
Benefits to be gained by future coverage .....	\$24,401	\$35,896
Worker's future value ratio .....	1.23	.84

Although the possibility of withdrawing from the social security system will become a moot question if the recommendations of the Report of the National Commission on Social Security Reform [4] are adopted, the money's-worth question will always be of interest to individuals covered by the program.

APPENDIX I  
BENEFIT FORMULAS

1. Retirement Benefits

- $x_1$  = Worker's current age;
- $x_2$  = Spouse's current age;
- $t_1$  = Worker's age in year  $t$ ;
- $t_2$  = Spouse's age in year  $t$ ;
- $l^a$  = Entry from active life table;

$RB_t(w)$  = Retirement benefit payable in year  $t$  to worker based on own earnings record;

$RB_t(s)$  = Retirement benefit payable in year  $t$  to spouse based on own earnings record;

$RB_t(w)^{spouse}$  = Retirement benefit payable in year  $t$  to spouse from worker's earnings record;

$RB_t(s)^{spouse}$  = Retirement benefit payable in year  $t$  to worker from spouse's earnings record;

$DB_t(s)$  = Death benefit payable in year  $t$  to worker from spouse's earnings record if spouse died in year  $s$ .

Single worker: benefit valued during year  $t$  is

$$\frac{l_{t_1}^a}{l_{x_1}^a} RB_t(w).$$

Married worker: benefit valued during year  $t$  is

$$\frac{l_{t_1}^a}{l_{x_1}^a} \left( \frac{l_{t_2}^a}{l_{x_2}^a} \{ [RB_t(w) - RB_t(s)^{spouse}] + [RB_t(w)^{spouse} - RB_t(s)] \} + \sum_{s_2}^{t_2-1} \frac{d_{s_2}^a}{l_{x_2}^a} [RB_t(w) - DB_t(s)] \right).$$

NOTES

1. Worker retires at age 65; spouse retires at first eligible age, but not before worker.

2. Benefits payable based on the spouse's earnings record as a result of the spouse becoming disabled are not considered.

3. Benefit adjustments to reflect age when payments began and increases in the Consumer Price Index are not explicitly shown but are part of the symbol *RB* or *DB*.

4. No worker's benefit is reduced to a negative value after offsetting by the spouse's benefit.

## 2. Disability Benefits

$x_1$  = Worker's current age;

$x_2$  = Spouse's current age;

$y_1$  = Worker's age in year of disability ( $s$ ) before age 65;

$t_1$  = Worker's age in year  $t$ ;

$t_2$  = Spouse's age in year  $t$ ;

$l^a$  = Entry from active life table;

$l^i$  = Entry from disabled life table;

$IB_i^?(w)$  = Disability benefit payable in year  $t$  based on worker's earnings record if disability occurred in year  $s$ .

If there is at least one child under age 16, benefit valued during year  $t$  is

$$\frac{i_{y_1}}{l_{x_1}^a} \frac{l_{t_1+1}^i}{l_{y_1}^i} IB_i^?(w) \left\{ 1 + 0.5 \left[ \left( \begin{array}{c} \text{number of children} \\ \text{under age 16} \end{array} \right) + \frac{l_{t_2}^a}{l_{x_2}^a} \right] \right\}.$$

If there are no children under age 16 and  $t_2 \geq 62$ , benefit valued during year  $t$  is

$$\frac{i_{y_1}}{l_{x_1}^a} \frac{l_{t_1+1}^i}{l_{y_1}^i} IB_i^?(w) \left[ 1 + \frac{l_{t_2}^a}{l_{x_2}^a} \left( \begin{array}{c} \text{spouse's} \\ \text{reduction} \\ \text{factor} \end{array} \right) \right].$$

## NOTES

1. Spouse draws benefit at first eligible age.

2. Benefits payable based on the spouse's earnings record as a result of the spouse retiring, becoming disabled, or dying are not considered.

3. Benefit adjustments to reflect increases in the Consumer Price Index are not explicitly shown but are part of the symbol *IB*.

4. Mortality rates for children are not used, and no benefits after age 16 are considered.

5. No recoveries from disability are assumed.

6. Maximum family benefit limitation is automatically checked, and appropriate reductions are made.

### 3. Death Benefits

$x_1$  = Worker's current age;

$x_2$  = Spouse's current age;

$y_1$  = Worker's age in year of death ( $s$ );

$t_2$  = Spouse's age in year  $t$ ;

$l^a$  = Entry from active life table;

$l^i$  = Entry from disabled life table;

$DB_i^?(w)$  = Death benefit payable in year  $t$  based on worker's earnings record if death occurred in year  $s$ ;

$RB_t(s)$  = Retirement benefit payable in year  $t$  to spouse based on own earnings record.

If death occurs while active and  $y_1 < 65$  and there is at least one child under age 16, benefit valued during year  $t$  is

$$\frac{d_{y_1}^a}{l_{x_1}^a} DB_i^?(w) \left\{ 0.75 \left[ \left( \text{number of children under age 16} \right) + \frac{l_{t_2}^a}{l_{x_2}^a} \right] \right\}.$$

If death occurs while active and  $y_1 < 65$ , there are no children under age 16, and  $t_2 \geq 60$ , benefit valued during year  $t$  is

$$\frac{d_{y_1}^a}{l_{x_1}^a} DB_i^?(w) \frac{l_{t_2}^a}{l_{x_2}^a} \left( \begin{array}{l} \text{spouse's} \\ \text{reduction} \\ \text{factor} \end{array} \right).$$

If death occurs while disabled and there is at least one child under age 16, benefit valued during year  $t$  is

$$\frac{d_{y_1}^i}{l_{x_1}^i} DB_i^?(w) \left\{ 0.75 \left[ \left( \text{number of children under age 16} \right) + \frac{l_{t_2}^a}{l_{x_2}^a} \right] \right\}.$$

If death occurs while disabled, there are no children under age 16, and  $t_2 \geq 60$ , benefit valued during year  $t$  is

$$\frac{d_{y_1}^i}{l_{x_1}^i} DB_i^?(w) \frac{l_{t_2}^a}{l_{x_2}^a} \left( \begin{array}{l} \text{spouse's} \\ \text{reduction} \\ \text{factor} \end{array} \right).$$

If death occurs when  $y_1 \geq 65$ , benefit valued during year  $t$  is

$$\frac{d_{y_1}^a}{l_{x_1}^a} \frac{l_{t_2}^a}{l_{x_2}^a} [DB_i^?(w) - RB_t(s)].$$

## NOTES

1. Spouse draws benefit at first eligible age.
2. Benefits payable based on the spouse's earnings record as a result of the spouse retiring (if death of the worker occurs before age 65 or while the worker is disabled), becoming disabled, or dying are not considered.
3. Benefit adjustments to reflect age when payments began and increases in the Consumer Price Index are not explicitly shown but are part of the symbols *DB* and *RB*.
4. Mortality rates for children are not used, and no benefits after age 16 are considered.
5. Maximum family benefit limitation is automatically checked, and appropriate reductions are made.
6. No benefit is reduced to a negative value after offsetting by the spouse's benefit.
7. No lump-sum death benefits are considered.

4. *Medicare Benefits*

- $x_1$  = Worker's current age;  
 $x_2$  = Spouse's current age;  
 $y_1$  = Worker's age in year of disability or death (*s*) before age 65;  
 $t_1$  = Worker's age in year *t*;  
 $t_2$  = Spouse's age in year *t*;  
 $l^a$  = Entry from active life table;  
 $l^i$  = Entry from disabled life table;

$MP_t$  = Medicare premium payable in year *t*.

Disabled participant when  $t_1 \geq y_1 + 2$ : benefit valued during year *t* is

$$\frac{i_{y_1} l_{t_1}^i}{l_{x_1}^a l_{y_1}^i} MP_t.$$

Disabled participant's spouse when  $t_2 \geq 65$ : benefit valued during year *t* is

$$\frac{i_{y_1} l_{t_1}^i l_{t_2}^a}{l_{x_1}^a l_{y_1}^i l_{x_2}^a} MP_t.$$

Deceased participant's spouse when  $t_2 \geq 65$ : benefit valued during year *t* is

$$\left( \frac{d_{y_1}^a}{l_{x_1}^a} + \frac{d_{y_1}^i}{l_{x_1}^i} \right) \frac{l_{t_2}^a}{l_{x_2}^a} MP_t.$$

Retired participant with spouse not eligible for a benefit on own earnings record when  $t_2 \geq 65$ : benefit valued during year is

$$\frac{l_{65}^a}{l_{x_1}^a} \left( \frac{l_{t_1}^a}{l_{65}^a} + \frac{l_{t_2}^a}{l_{x_2}^a} \right) MP_r.$$

Retired single participant:

$$\frac{l_{65}^a}{l_{x_1}^a} \frac{l_{t_1}^a}{l_{65}^a} MP_r.$$

NOTES

1. Premium adjustments to reflect increases in average hospital costs are not explicitly shown but are part of the symbol  $MP$ .
2. No recoveries from disability are considered.
3. Benefits payable based on the spouse's earnings record as a result of the spouse becoming disabled or dying are not considered.

APPENDIX II

TAXES

EQUAL EMPLOYEE/EMPLOYER TAX RATE

Calendar Year	OASDI	HI	Total
1982 .....	5.4%	1.3 %	6.7 %
1983 .....	5.4	1.3	6.7
1984 .....	5.4	1.3	6.7
1985 .....	5.7	1.35	7.05
1986 .....	5.7	1.45	7.15
1987 .....	5.7	1.45	7.15
1988 .....	5.7	1.45	7.15
1989 .....	5.7	1.45	7.15
1990 and later.....	6.2	1.45	7.65

APPENDIX III

ACTUARIAL ASSUMPTIONS

1. *Economic Assumptions*

The annual percentage increase in average wages in covered employment, the Consumer Price Index, and the annual interest rate are taken from the 1982 OASDI trustees' report [7] intermediate set of economic assumptions (Alternative II-B). The average HI monthly premium rates

are based on the 1982 HI trustees' report [8] intermediate set of economic assumptions (Alternative II-B) up to 2005. Beginning in 2006 the rates are projected at a constant 8 percent.

CALENDAR YEAR	ANNUAL PERCENTAGE INCREASE IN			ANNUAL INTEREST RATE
	Average Wages in Covered Employment	Consumer Price Index	Average HI Monthly Premium Rate	
1982	6.6%	6.9%	21.3%	13.0%
1983	8.1	7.9	14.7	11.4
1984	8.1	7.4	14.2	9.3
1985	6.9	6.6	14.6	8.0
1986	6.8	5.8	13.3	7.1
1987	6.6	5.5	12.2	6.8
1988	6.6	5.3	11.3	6.6
1989	6.4	4.9	11.5	6.5
1990	6.0	4.5	11.4	6.4
1991	5.7	4.1	10.8	6.2
1992	5.5	4.0	10.5	6.1
1993	5.5	4.0	10.1	6.1
1994	5.5	4.0	10.0	6.1
1995	5.5	4.0	9.6	6.1
1996	5.5	4.0	9.2	6.1
1997	5.5	4.0	9.1	6.1
1998	5.5	4.0	9.0	6.1
1999	5.5	4.0	9.0	6.1
2000	5.5	4.0	8.7	6.1
2001	5.5	4.0	8.4	6.1
2002	5.5	4.0	8.3	6.1
2003	5.5	4.0	8.2	6.1
2004	5.5	4.0	8.3	6.1
2005 and later	5.5	4.0	8.0	6.1

## 2. Noneconomic Assumptions

Mortality rates for healthy individuals are taken from the UP-1984 Table [1], unadjusted for males and set back five years for females.

Mortality rates for disabled individuals are taken from tables used by the Pension Benefit Guaranty Corporation to value benefits for individuals in receipt of social security disability benefits for plans that terminated on or after September 2, 1974, and before December 1, 1980.

No mortality is assumed for children.

Disability rates of incidence are taken from Actuarial Study No. 81, "Experience of Disabled-Worker Benefits under OASDI, 1974-78" [6], and are based on a 1977 calendar year of entitlement.

No recovery rates are assumed.

Expenses of administration are disregarded.

Retirement is assumed at age 65 for a worker. Spouses retire at the first eligible age, but not before the worker.

CALENDAR AGE AT ENTITLEMENT	DISABILITY INCIDENCE RATES	
	Males	Females
Under 25 . . . . .	.0013	.0007
25-29 . . . . .	.0016	.0010
30-34 . . . . .	.0022	.0018
35-39 . . . . .	.0030	.0026
40-44 . . . . .	.0043	.0039
45-49 . . . . .	.0068	.0056
50-54 . . . . .	.0118	.0095
55-59 . . . . .	.0208	.0154
60-64 . . . . .	.0260	.0164

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## DISCUSSION OF PRECEDING PAPER

ROBERT F. LINK:

There are at least two reasons for interest in the social security money's-worth question. First, "money's-worth" may be a criterion in the design of social security (witness a recent Advisory Council proposal to increase benefits to assure that an unmarried, high-income person could expect money's-worth for his own FICA tax). Second, information on this subject may be useful to individuals or groups facing choices involving their future social security coverage.

This paper, which mainly addresses the second reason, is a useful addition to the literature. The authors define money's-worth as "a fair return for dollars contributed," using actuarial present values and thus taking applicable interest into account. This seems to be the correct approach.

These authors have used the employee tax as "dollars contributed." They and others who take this approach go on to say that those who prefer the total tax may easily multiply the ratios by two. I think that looking at only the employee tax is an incomplete view. I'd rather see the emphasis go toward the combined tax.

How about money's-worth for the whole system? Can cohorts of current contributors expect it? This question could be answered using Social Security Administration data. Even without doing calculations, there are reasons to expect a money's-worth shortfall.

This view is suggested by considering a stationary population model. Elaborate on the model to include stationary assumptions on some additional factors: age at entry into the labor force, age at retirement, levels of real income, and the provisions of the system itself. In this model, one sees that the benefits for a cohort are about equal to the taxes of the cohort. Without the inclusion of interest, there is a money's-worth shortfall.

What changes in this model might cause the benefits for a cohort to exceed the taxes of the cohort? The following are some possibilities:

1. System immaturity, such that some getting full benefits will not have a record of full taxes.
2. Benefit increases (a special form of system immaturity).
3. Sustained population growth.
4. Sustained growth in rates of real compensation.

This list assumes that other factors are of lesser strength and that inflation

hits both sides and cancels out. Also, it assumes that we count all sources of income to the system as contributions, that is, general revenue infusions.

There is little doubt that these factors have tilted the equation toward or beyond a collective money's-worth for past generations. Can collective money's-worth prevail in the future? Probably there is not much scope for future ad hoc benefit increases. Population and pay levels may have significant potential for long-term growth. But almost certainly, there will be times when the necessary conditions do not exist.

If approval of our system depends on the existence of a collective money's-worth state, we probably must withdraw our approval. This is a backward way of saying that such a criterion is not appropriate for the system as a whole (any more than it would be for income or other taxes). If we try to meet critics of our system on their own money's-worth ground, we deserve to lose the argument.

Entirely different money's-worth criteria should be applied to our kind of system. Do most of the funds get used for the stated purposes of the system? Is it efficient? We must answer yes. We are getting out what we put in. Is American society generally pleased with the results of this redistribution of purchasing power, in comparison with the expected results of any alternative system or no system? The opinion surveys seem to indicate more satisfaction than dissatisfaction, but there is no developed and examined alternative for comparison.

It would be pleasing to see some serious discussion of alternatives. The thoughts of A. Haeworth Robertson deserve study: "Not in the spirit of, 'This won't work for the following reasons.' Rather, 'How could we fix it so it *would* work?'" If we could, would it be worth considering?" Such study might lead to desirable changes. Or it might give us renewed confidence in what we have. Without such study, we can expect a continuation of quick fixes. The time for study is before there is an emergency.

HOWARD YOUNG:

I found this paper lacking in a couple of areas. Actuaries should be concerned more with improving the social security system than attacking it. Furthermore, an analysis should not be performed without concern for the social consequences.

As the authors anticipated in their final paragraph, the Social Security Act has been changed to treat employees of nonprofit organizations in the same manner as all others. Consequently, there seems to be less justification for the paper's premise now.

RICHARD G. SCHREITMUELLER AND ORLO R. NICHOLS:

This excellent paper discusses one of the more complex and interesting problems of recent years. Mr. Burianek and Ms. Reverman have set a good example for other consulting actuaries whose best work sometimes goes unpublished.

Since early 1983, tax-exempt nonprofit organizations and governmental employers have not been allowed to terminate social security coverage. Thus the money's-worth question analyzed in the paper is less pressing as the authors anticipated in their conclusion. There will be some ongoing interest among these governmental employers who are outside social security and can opt in.

Money's-worth questions of continuing interest to the general public involve benefit/tax comparison for workers already covered. This is true for the young especially but also the old, men and women, married and unmarried, and so forth. Some would say that comparisons of benefits versus taxes for such groups are totally irrelevant, because social security is a transfer program in which one's own taxes pay for someone else's current benefits. Despite this, because payroll taxes finance social security, we agree with the authors that money's-worth questions will always be of interest to individuals covered by the program.

Some students of social security argue that the public should not care about workers' benefits versus taxes. The fact is that many workers perceive payroll taxes as the price they pay for coverage. By paying taxes during their working years, they earn the right to get benefits later. No one likes to pay taxes, so naturally they care about getting benefits with a value at least equal to their taxes plus interest. Another public concern is whether any government program might be handled better by the private sector. This concern was evident long before the current conservative trend.

Benefit/tax comparisons under the present social security law are so complex that one can set up comparisons and assumptions to "prove" that just about any group either gains or loses. At times our political system seems to encourage a divide-and-conquer approach to forming public opinion, in which social security money's-worth comparisons may play a role in uniting diverse groups to support or oppose program features.

Actuaries have generally behaved responsibly toward money's-worth studies, avoiding biased and misleading comparisons. Other analysts sometimes develop money's-worth figures to support ideological arguments. We do not live in an ideal world where facts sell themselves on their own merits. One challenge for actuaries regarding money's-worth is to remain objective in choosing methods and assumptions. Then we avoid bias in our own work

and gain the ability to speak fairly about the work of others. In that spirit, we can all learn from this paper.

An analysis under present law would have to consider two recent provisions: the income tax payable on part of social security cash benefits and the windfall provisions applicable to workers who receive pensions based on noncovered employment. The tax on benefits can best be treated as a benefit reduction for the people affected, provided that any comparison with an alternative program is done on an after-tax basis. This may complicate the analysis. The effect of the windfall provision is to scale back the first step of the benefit formula from the usual 90 percent to 40 percent, thus reducing the primary insurance amount for a typical noncovered worker by 50 percent of the first bend point. While this is the typical result, special transitional cases involve workers who (1) have substantial social-security-covered earnings over more than twenty-five years, (2) get only small pensions from their noncovered employment, or (3) reach the noncovered employer's retirement age before 1990. This windfall provision makes it less attractive for a public employer to remain outside social security.

One should be careful in raising the authors' question: "How much will it cost to replace the benefits provided by the social security system?" No alternative arrangement will fully replace the OASDI benefits, or the HI benefits, and to suggest otherwise would seem to raise expectations unduly.

It is gratifying to see the paper call the intermediate assumptions of the trustees report "up-to-date as well as unbiased (i.e., not selected by either the organization examining the withdrawal issue or the actuary performing the analysis)," and "quite believable" as to inflation and interest rates over the next decade. From our viewpoint as well, these assumptions appear unbiased for purposes of money's-worth comparisons because they were chosen by the trustees to analyze a more fundamental issue, the adequacy of financing. Because money's-worth comparisons are often a takeoff point for defending or attacking provisions of the existing program, a model devised mainly for the purpose of analyzing the money's-worth issue is suspect until proven otherwise.

The authors' model did not allow for any future benefit or tax changes. This although just before the 1983 amendments were enacted, the long-range income to the OASDI program was projected to cover only about 90 percent of the long-range benefits. As a practical matter, the authors had little choice but to assume continuation of the law in effect at the time. Accordingly, as the paper points out, the issue would be clouded if the typical employee stood to get his or her money's-worth from the program then in effect. Something obviously had to be changed, and either higher scheduled taxes or lower scheduled benefits would make the benefits appear less favorable relative to the taxes. A general principle can be stated. If under a given set

of assumptions the social security program is underfinanced, those assumptions will tend to show overly favorable benefit/tax comparisons which imply that the program will survive long enough to deliver those benefits in exchange for those taxes. This principle is recognized in the paper.

To estimate social security benefits to be earned in the future, each employee in the paper was assumed to have an unbroken work record with future pay following the projected national wage trend. This is normal practice for a pension benefit design study where emphasis is on the career employee and ancillary benefits can be analyzed separately. For social security comparisons, this assumption seems to assign no value to the disability-freeze and dropout-year provisions, thus understating the benefit/tax ratios somewhat. Similarly, nothing is included for administering the alternative set of benefits, although the payroll taxes cover social security administrative costs. On the other hand, there seems to be no turnover assumption and introducing one would make terminating social security coverage look more attractive. These are minor points which illustrate that even a sophisticated model will typically cut some corners compared to the Social Security Administration methods.

The authors did well to include an analysis of employees with working spouses and of medicare. This went beyond earlier published actuarial studies. The Social Security Administration practice has traditionally been to publish actuarial money's-worth studies quite conservatively, sticking to areas where the technology is well-developed, and remaining silent at times when the long-range financing is out of balance.

(AUTHORS' REVIEW OF DISCUSSION)

FRANK G. BURIANEK AND JUDITH M. REVERMAN:

We wish to thank each of the four discussants for their comments on our paper. They raised issues which should be considered in connection with any analysis of the social security money's-worth issue.

Mr. Link appropriately points out that there is more than one way to answer the money's-worth question. Each of these other viewpoints is worthy of study.

We hope that those responsible for the social security system will heed his advice and recognize that the most appropriate time for study of the system is when an emergency is not imminent. Perhaps now that the 1983 amendments have been adopted there will be a "window of opportunity" during which the basic design of the system can be examined and desirable changes can be enacted without the threat of impending default on benefit payments.

Mr. Young raises two particular criticisms of the paper. He first questions

whether actuaries should be engaged in this type of analysis. In response, we point out that if actuaries do not prepare this type of analysis, those less qualified will step in. The result will be less accurate analyses.

Mr. Young's second point is that the 1983 Social Security amendments have made this type of analysis irrelevant. While the amendments did remove the right of most employee groups to withdraw from the system, as long as we have a social security system based on payroll taxes, the money's-worth question will be with us. As Mr. Link points out in his discussion, the issue of money's-worth may be to some a criterion in evaluating the design or general merits of the social security system. Mr. Schreitmueller and Mr. Nichols also correctly point out that the money's-worth question will be of continuing interest to the general public—especially the young—in their own assessment of the worth of the system. We agree with their view that, whether or not the public should care about workers' benefits versus taxes, many workers do view payroll taxes as the price they pay for coverage. As proof, refer to the furor surrounding a statement made by President Reagan this past summer. Mr. Reagan said, "There is a possibility—well, probability—that many people, young people now paying in, will never be able to receive as much as they're paying." One need only note the flurry of responses generated to appreciate that the money's-worth question is still with us.

Finally, it was gratifying that Mr. Schreitmueller and Mr. Nichols took the time to comment on our paper since so much of our work was based on their earlier analyses. We agree with their specific comments on the methodology contained in our paper. The principal refinements in our approach to their earlier analyses described in the paper were to expand the calculations by including (1) the two-wage earner family, and (2) the benefits and costs of the medicare system. Subsequent to the time the paper was submitted for publication the 1983, social security amendments were adopted. We have redone the benefit illustrations in the paper to reflect the later retirement ages for younger workers and have updated the assumptions to those in the 1984 trustees' report. If any reader would like to see these results, contact either of us at our *Yearbook* addresses for copies.