Changing the Taxable Maximum: Effect on Social Security Taxes by Industry and Firm Size

by Louis Esposito, David Podoff, and Aaron J. Prero*

During debate on the 1977 Social Security Amendments, it was suggested that the impact on firms of a change in the maximum taxable amount under the social security program would in part depend on the size of the firm. This study analyzes the relationship between increases in employer payroll-tax liability and both firm size and industry group. The authors conclude that there are substantial firm-size and industry effects on the increases in employer payroll-tax liability resulting from the 1977 amendments, with the largest firms experiencing, on the average, increases about three percentage points higher than those for the smaller firms. If the taxable maximum were changed (either doubled or removed) from the base established by the 1977 amendments, the industry effect would again be substantial, although there would be little or no firm-size effect.

The social security payroll tax is levied on wages up to a certain maximum each year. Beginning in 1974, the maximum taxable amount has been automatically increased each year by the estimated annual change in average wages in covered employment. The purpose of this automatic adjustment mechanism is to keep the taxable maximum at the same relative position in the wage distribution. The 1977 Amendments to the Social Security Act raised the relative position of the taxable maximum for years after 1978. For the years 1979-81, the taxable maximum is not determined by the automatic adjustment mechanism but is specified in the 1977 amendments. In 1981, for example, the taxable maximum will be $29,700, compared with $21,900, the figure that would have been in effect in 1981 if the automatic adjustment mechanism based on 1977 estimates were in effect.[1] Beginning in 1982, the maximum will again be automatically adjusted. During debate on the 1977 amendments, it was suggested that the impact on firms would in part depend on the size of the firm. This article analyzes the relationship between increases in employer-tax liability caused by changes in the social security taxable maximum and both firm size and industry group.[2]

When the taxable maximum is changed, the percentage increase in employer payroll-tax liability is determined by the percentage and distribution of earnings above the former taxable maximum. The earnings distribution for a given industry is primarily determined by the capital intensity, both physical and human, of the industry. Since capital intensities differ among industries, the distribution of earnings will differ as well. Other factors, such as differences in the market power of industries, may also account for differences in the distribution of earnings among industries. Since earn-

* Podoff is the acting director of and Prero is an economist in the Division of Supplemental Security Studies, Office of Research and Statistics, Office of Policy, Social Security Administration. Esposito is an associate professor of economics at the University of Massachusetts, Boston. Most of Esposito's work on this article was done in ORS while he was on leave from the university. The authors wish to thank Adah D. Enis of ORS for her assistance.

[1] The 1977 Amendments to the Social Security Act (Public Law 95-216) legislated changes in the taxable maximum for 1979, 1980, and 1981. This analysis is based on the legislation when fully implemented, that is, this article uses the taxable maximum legislated for 1981 as the basis for estimating the impact of changes in the taxable maximum.

[2] This analysis does not shed any light on or imply anything about the incidence of the employer's part of the social security payroll tax. Estimates have been made of the initial (or impact) increase in employer payroll-tax liability (by industry and firm size) resulting from changes in the taxable maximum. The final (or effective) increase will depend on the extent to which firms can pass (or shift) the tax forward to consumers in the form of higher prices or backward to workers in the form of lower wages. This analysis could be extended (in the context of an input-output model) to test various shifting assumptions by looking at the adjustments in prices and wages in various industries in response to changes in the "employer" payroll tax.

ings distributions differ among industries, the increase in employer payroll-tax liability can also be expected to vary among industries.

Although the relationship between the percentage increases in employer payroll-tax liability and industry is fairly straightforward and obvious, the relationship between increases in employer payroll-tax liability and firm size is not so obvious. A relationship between the latter two factors will exist if, within a given industry, the distribution of earnings differs according to the size of the firm. The distribution of earnings according to firm size may differ for several reasons. First, capital intensities may differ by firm size. For example, the use of an available capital-intensive technology may be economically feasible only for relatively large firms. Second, within a given industry, the extent of unionization may differ according to firm size. Large firms may be unionized; small firms may not. Third, within a given industry, the market power of firms may differ by firm size, with the largest firms possessing the greatest market power. All these factors suggest that the proportion of workers with earnings above the taxable maximum may increase with firm size. Thus, if there is a relationship between the percentage increases in employer payroll-tax liability and firm size, that relationship can be expected to be positive, that is, the larger the size of the firm the greater the increase in employer payroll-tax liability as a result of a given change in the taxable maximum.

The analysis above suggests that the increase in a particular firm's payroll-tax liability as a result of a change in the taxable maximum will depend on the industry in which the firm is located and the size of the firm. This article first presents estimates, based on the 1-percent Continuous Work History Sample, by industry and firm size of the percentage increase in employer payroll-tax liability resulting from (1) the increase in the taxable maximum traceable to the 1977 amendments, (2) doubling the taxable maximum from the base established by the amendments, and (3) removing the taxable maximum from the base established by the amendments. Second, it analyzes the nature of the relationship between industry and firm size and the percentage increase in employer payroll-tax liability resulting from changes in the taxable maximum.

The first section presents estimates of the percentage increase in employer payroll-tax liability by industry and firm size resulting from the various changes in the taxable maximum. The second section presents and discusses these changes by industry, that is, aggregated across all firm sizes; the third section presents and discusses these changes by firm size, that is, aggregated across all industries. In the fourth section an analysis of the industry and firm size effects on the percentage increases in employer payroll-tax liability is presented. The fifth section presents the summary and conclusions.

Estimates of Increases in Tax Liability

Table 1 presents estimates of the percentage increases in employer payroll-tax liability by industry category and firm size for 1981.[3] It includes the estimated increases in tax liability resulting from increasing the taxable maximum in 1981 from $21,900 to $29,700 (the change brought about by the 1977 Amendments to the Social Security Act) and the estimated increases resulting from doubling and removing the taxable maximum from the base established by the 1977 amendments.[4]

Estimates are presented for 20 industry groups (including "unknown" industry) and 18 firm-size classes (including one for "unclassified and unknown" size). The first column in the table aggregates across all firm-size classes and presents the percentage increase in employer payroll-tax liability by industry group. (Industries are listed in order of magnitude of the change caused by the 1977 amendments.) The first row in the table aggregates across all industry groups and presents the percentage increase in employer payroll-tax liability by firm-size class.[5] Each cell above the percentage increase in payroll-tax liability records the number of employees employed by firms of that size in that industry at any time during the year.[6]

The data used to estimate the percentage increase in employer payroll-tax liability by industry and firm size are from the 1974 Annual Employee-Employer File, which is a 1-percent sample of all employees covered by the social security program.[7] The file includes informa-

[3] The estimates do not include annually reported payroll taxes for agricultural workers. Few such workers reach the maximum with a single employer.

[4] The estimates are based on 1974 data and consequently use the 1974 taxable maximum of $13,200 as a starting point. A legislated increase in the 1981 taxable maximum to $29,700 from its projected level of $21,900 is roughly proportional to an increase in the 1974 taxable maximum from $13,200 to $18,000. Similarly, the estimates of the impact of doubling and removing the maximum are based on a 1974 hypothetical maximum of $18,000. It should also be noted that $21,900 is a 1977 projection of the 1981 taxable maximum made before passage of the 1977 amendments. Under the intermediate assumptions used in the **1979 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds,** it was estimated that the 1981 taxable maximum in the absence of the 1977 amendments would have been $22,200. For this analysis the projected impact at the time the legislative change was made is the relevant comparison. Thus, the simulations here are based on the change from $21,900 to $29,700.

[5] The total increases shown in the first row and column of table 1 are not simple averages of the figures presented for the industry groups according to firm size. They are, in essence, weighted averages of the figures for industry/firm size where the weights are total wages in the respective industry/firm size.

[6] Workers with more than one job are counted separately in each of their jobs.

[7] If a worker is engaged by more than one employer in the same year, the taxable maximum applies to his total wages for the purpose of the employee tax but it applies separately to his wages from each employer for the purpose of the employer tax. The estimates reflect the increases in employer-tax liability only, and therefore earnings up to the taxable maximum are subject to taxation for each employer of multi-employer workers.

tion on the employer's industry and was augmented with data on the number of workers employed by each firm during a single pay period in March 1974. It is these latter data that are used to define firm size.[8]

Although the Social Security Administration does not have records of wages exceeding the taxable maximum, the Annual Employee-Employer File includes an estimate of total wages for workers whose wages amounted to more than the maximum. The estimate is made by extrapolating wages recorded during the calendar quarters preceding the one in which the maximum was reached. This procedure is possible because, until 1978, wages were reported quarterly. If a worker earned the maximum in the first quarter, earnings of $93,200, for a man, and $91,500, for a woman, are assumed for 1974.

The percentage increase in employer payroll-tax liability resulting from increasing the taxable maximum from $21,900 to $29,700 in 1981 (because of the 1977 amendments) is estimated by increasing the 1974 taxable maximum from $13,200 to $18,000, that is, by applying the proportional increase in the taxable maximum in 1981 to the taxable maximum in 1974. The same "proportionality" procedure is used to obtain the estimates of the increases resulting from doubling or removing the taxable maximum from the base established by the 1977 amendments. Although the data used are for 1974, the estimates will apply in any year to the extent that the relative distribution of wages has not changed among industries or firms of different sizes.

Impact of Changes in Taxable Maximum by Industry

The first column in table 1, which aggregates across firm sizes, is shown separately (except for "unknown" industry) in table 2 for convenience. The numbers in parentheses show the rank of the magnitude of the effect of each change in the maximum taxable amount.

The estimated percentage increase in employer payroll-tax liability for all industries resulting from the 1977 amendments is 6.3 percent. Estimates for individual industry groups range from a low of 1.3 percent for the military-reserves group to a high of 9.1 percent for the transportation, communications, and utilities group. If the taxable maximum were doubled from the base established by the 1977 amendments, the increase in employer payroll-tax liability for all industries would be 4.9 percent. The smallest increase would be for the military-reserves group (0.4 percent) and the largest would be for the professional private services group (10.2 percent). If the taxable maximum were removed from the base established by the 1977 amendments the increase in employer payroll-tax liability would be 7.8 percent. Again, the smallest increase would be for the military-reserves group (0.4 percent) and the largest would be for the professional private services group (21.2 percent).

A comparison of the industry ranking of the percentage increase in employer payroll-tax liability resulting from doubling the taxable maximum with that resulting from removing it shows them to be quite similar. On the other hand, a comparison of the industry ranking resulting from the 1977 amendments with that resulting from either doubling or removing the taxable maximum shows that for several industry groups a significant difference in ranking is evident. For example, the transportation, communications, and utilities category ranks first as a result of the 1977 amendments and tenth as a result of removing the taxable maximum. The professional private services category ranks sixth as a result of the 1977 amendments and first as a result of removing the taxable maximum.

In general, the industry groups with both the smallest and largest increases in payroll-tax liability are service industries. The industry groups engaged in the production of goods—durable manufacturing, nondurable manufacturing, and construction, for example—tend to be located near the middle of the distribution.

It appears that the impact of changing the taxable maximum on employer contributions differs significantly by industry. As stated earlier, these differences reflect variations in the distribution of wages among industries.

It is not surprising that industry groups such as the military, government, and retail trade experience the smallest increases in payroll-tax liability. These industries employ a relatively large number of low-wage workers and therefore only a small proportion of their payroll is above the taxable maximum. On the other hand, industries such as professional private services, wholesale trade, and finance, insurance, and real estate, which employ a relatively large number of high-wage workers, generally experience the largest increases in employer payroll-tax liability.[9]

Caution should be used in interpreting the industry estimates presented in table 2. Differences between the estimates should not be interpreted as resulting solely from differences in the nature of the industries involved. Such an interpretation is possible only if (1) no relationship exists between firm size and the percentage increase in employer payroll-tax liability or (2) a

[8] For a more detailed discussion of the data base and its limitations as well as the industry group definitions, see the technical note at the end of this article.

[9] Since the industry groups used in this analysis are rather broad, they may contain individual industries with significantly different proportions of payroll above the taxable maximum. For example, the industry group of transportation, communications, and utilities combines industries that may have significantly different earnings distributions with respect to the taxable maximum. Broad industry groups were used to make the tabulation and presentation of the data manageable.

Table 1.—Number of workers in covered employment and estimated percentage increase in employer payroll-tax liability, by industry group and size of firm

[Numbers in thousands]

Industry	Size of firm (number of employees)										
	Total	1-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49
Total											
Number of workers	140,764	10,006	8,984	6,213	4,781	3,822	3,091	2,753	2,343	2,129	1,870
Percentage increase due to:											
1977 amendments	6.3	3.9	6.3	5.8	5.7	5.9	6.1	6.0	5.5	5.7	5.9
Doubling taxable maximum	4.9	5.3	7.0	6.5	6.0	6.0	6.2	5.3	5.3	5.2	5.7
Removing taxable maximum	7.8	10.5	12.8	12.5	11.1	10.5	10.4	9.2	9.7	8.7	10.4
Transportation, communications, and utilities											
Number of workers	7,072	307	434	300	208	171	132	112	96	88	84
Percentage increase due to:											
1977 amendments	9.1	3.6	7.0	6.7	4.3	5.1	7.2	5.6	5.3	6.2	7.5
Doubling taxable maximum	4.5	3.4	3.6	3.7	2.3	3.0	5.6	3.4	5.1	3.2	5.4
Removing taxable maximum	6.0	5.7	4.2	5.0	3.1	4.0	10.6	5.9	11.4	4.9	8.8
Wholesale trade											
Number of workers	7,926	504	879	596	456	365	294	243	212	188	157
Percentage increase due to:											
1977 amendments	8.7	8.0	11.9	7.2	7.4	7.0	7.1	7.8	7.1	6.7	7.0
Doubling taxable maximum	9.1	12.0	12.3	9.6	8.8	8.1	8.5	9.3	9.7	7.7	9.4
Removing taxable maximum	15.1	21.3	19.2	17.6	16.6	15.8	13.6	18.8	17.6	14.4	15.0
Mining											
Number of workers	1,185	49	50	42	37	32	26	26	21	24	18
Percentage increase due to:											
1977 amendments	7.8	8.5	5.3	5.1	7.0	9.6	3.4	8.2	5.5	8.6	9.2
Doubling taxable maximum	5.1	8.9	7.5	4.7	5.0	7.8	.5	9.4	3.4	7.9	5.8
Removing taxable maximum	6.7	10.1	10.1	7.8	6.0	15.9	.5	11.8	3.4	7.9	12.7
Construction											
Number of workers	11,073	1,183	1,114	784	619	504	390	360	285	251	218
Percentage increase due to:											
1977 amendments	7.6	3.6	5.2	7.0	7.2	7.6	8.4	8.4	8.0	8.4	8.9
Doubling taxable maximum	4.8	2.7	3.4	4.2	4.0	4.5	4.7	5.6	4.0	4.3	5.1
Removing taxable maximum	6.9	4.6	5.1	6.7	5.5	6.7	7.2	8.0	6.8	5.6	9.8
Durable manufacturing											
Number of workers	17,532	345	410	385	345	304	286	292	219	208	188
Percentage increase due to:											
1977 amendments	7.5	4.9	5.3	6.2	6.7	6.5	6.6	6.5	5.6	5.2	5.8
Doubling taxable maximum	4.5	3.3	4.6	6.2	6.5	5.6	5.8	3.8	6.0	4.1	5.4
Removing taxable maximum	6.6	5.0	7.2	9.9	10.8	9.2	8.5	5.2	10.3	9.5	9.7
Professional private services											
Number of workers	10,920	1,276	970	579	424	312	259	228	200	182	180
Percentage increase due to:											
1977 amendments	6.8	5.7	8.0	9.1	8.0	8.2	7.6	6.6	6.0	6.9	6.0
Doubling taxable maximum	10.2	12.8	17.5	16.8	12.6	12.3	10.9	9.0	8.4	9.8	7.4
Removing taxable maximum	21.2	31.6	43.7	42.6	30.6	26.0	18.0	15.7	20.2	19.0	13.3
Finance, insurance, and real estate											
Number of workers	7,015	704	469	300	220	164	137	123	106	94	86
Percentage increase due to:											
1977 amendments	6.8	4.8	6.4	6.5	6.9	6.7	6.9	6.4	7.2	6.9	5.1
Doubling taxable maximum	7.7	6.5	8.9	9.3	8.9	8.1	9.7	7.0	8.1	8.1	7.2
Removing taxable maximum	13.5	11.2	15.3	14.6	16.9	13.6	14.0	10.7	12.1	12.1	10.9
Nondurable manufacturing											
Number of workers	14,487	250	334	313	284	274	250	237	241	208	179
Percentage increase due to:											
1977 amendments	6.0	5.4	5.9	5.9	5.1	5.2	6.2	4.8	5.0	4.8	4.4
Doubling taxable maximum	4.8	5.3	5.4	7.1	6.1	6.5	7.4	4.8	4.9	5.4	5.4
Removing taxable maximum	8.0	10.5	9.0	11.5	10.2	11.1	11.3	9.0	10.1	6.7	11.8
Nonprofit educational services											
Number of workers	1,182	29	24	30	33	28	31	25	20	21	19
Percentage increase due to:											
1977 amendments	6.0	10.7	1.3	0	.3	.4	.5	1.1	1.4	.7	3.1
Doubling taxable maximum	4.9	9.2	.4	0	0	0	.1	.9	0	0	3.2
Removing taxable maximum	5.7	17.5	.4	0	0	0	.1	.9	0	0	3.2
Government educational services											
Number of workers	4,982	15	20	14	15	18	19	26	26	25	29
Percentage increase due to:											
1977 amendments	5.9	4.3	1.9	.5	1.4	1.9	2.3	1.5	.6	1.1	1.1
Doubling taxable maximum	3.5	1.0	.1	0	1.5	3.3	1.3	1.0	0	0	0
Removing taxable maximum	3.6	1.0	.1	0	1.5	3.3	1.3	1.0	0	0	0

Table 1.—Number of workers in covered employment and estimated percentage increase in employer payroll-tax liability, by industry group and size of firm—**Continued**

[Numbers in thousands]

Industry	Size of firm (number of employees)							
	50-99	100-249	250-499	500-999	1,000-2,499	2,500-4,999	5,000 or more	Unclassified and unknown
Total								
Number of workers	12,034	14,027	9,528	8,844	9,576	5,153	22,898	12,712
Percentage increase due to:								
1977 amendments	6.0	5.7	5.5	5.7	6.0	6.3	8.4	4.4
Doubling taxable maximum	5.5	4.8	4.4	4.3	4.2	4.1	5.0	2.7
Removing taxable maximum	9.5	7.7	6.8	6.4	6.4	5.7	6.8	3.8
Transportation, communications, and utilities								
Number of workers	486	742	521	539	720	384	1,280	468
Percentage increase due to:								
1977 amendments	7.0	7.8	9.3	8.6	9.5	9.6	11.4	11.2
Doubling taxable maximum	4.3	3.3	4.5	3.8	4.2	3.4	5.8	5.4
Removing taxable maximum	6.5	4.2	6.7	5.0	5.7	4.1	7.2	7.1
Wholesale trade								
Number of workers	856	747	367	327	379	172	890	295
Percentage increase due to:								
1977 amendments	7.1	7.7	8.0	8.1	8.5	10.8	10.8	6.4
Doubling taxable maximum	8.4	8.1	8.8	7.6	8.1	9.1	8.1	6.5
Removing taxable maximum	16.5	13.5	14.1	11.5	12.0	15.2	11.4	10.6
Mining								
Number of workers	124	136	98	78	96	21	200	107
Percentage increase due to:								
1977 amendments	7.7	6.6	9.7	7.9	6.3	6.2	8.6	8.4
Doubling taxable maximum	5.8	4.6	6.6	5.1	3.7	3.2	4.5	5.0
Removing taxable maximum	7.0	6.1	8.8	6.9	3.9	6.4	6.3	5.1
Construction								
Number of workers	1,382	1,283	668	425	295	179	491	643
Percentage increase due to:								
1977 amendments	8.7	9.1	8.9	9.1	10.0	8.9	8.7	4.1
Doubling taxable maximum	4.7	6.2	5.9	6.9	7.5	6.3	5.6	2.6
Removing taxable maximum	7.3	9.7	7.4	8.0	10.9	8.2	5.8	3.0
Durable manufacturing								
Number of workers	1,353	1,964	1,301	1,200	1,438	855	5,586	851
Percentage increase due to:								
1977 amendments	5.7	5.3	4.9	5.6	5.9	6.0	9.8	5.7
Doubling taxable maximum	5.0	4.4	3.6	3.7	3.6	3.2	4.9	3.6
Removing taxable maximum	8.0	7.3	5.5	5.7	5.5	4.2	6.6	6.4
Professional private services								
Number workers	1,275	1,541	854	791	489	301	469	590
Percentage increase due to:								
1977 amendments	5.3	6.3	5.6	6.1	7.2	9.5	9.8	3.1
Doubling taxable maximum	6.8	7.2	6.9	7.5	5.8	7.3	8.7	5.2
Removing taxable maximum	12.4	11.5	10.6	10.5	6.6	8.1	12.1	6.7
Finance, insurance, and real estate								
Number of workers	575	792	557	486	644	358	823	376
Percentage increase due to:								
1977 amendments	7.0	6.7	7.2	6.1	6.9	6.9	7.8	6.9
Doubling taxable maximum	8.9	8.5	7.4	7.7	7.8	6.2	7.2	6.4
Removing taxable maximum	16.8	15.6	12.0	15.7	13.8	9.2	12.8	10.6
Nondurable manufacturing								
Number of workers	1,408	2,040	1,608	1,326	1,366	792	2,846	531
Percentage increase due to:								
1977 amendments	5.4	4.8	4.5	5.9	6.0	5.3	7.7	6.4
Doubling taxable maximum	5.9	4.4	3.9	4.5	4.1	3.7	5.0	3.5
Removing taxable maximum	10.9	7.5	6.6	7.8	7.0	6.0	8.0	5.6
Nonprofit educational services								
Number of workers	121	169	138	120	98	56	164	56
Percentage increase due to:								
1977 amendments	2.8	3.5	6.4	7.5	7.6	6.7	9.1	10.8
Doubling taxable maximum	.9	1.7	2.9	3.7	6.1	5.7	9.4	15.3
Removing taxable maximum	.9	1.7	3.1	4.6	8.2	6.2	9.8	18.1
Government educational services								
Number of workers	237	577	675	709	657	370	1,410	142
Percentage increase due to:								
1977 amendments	1.8	3.0	4.0	5.1	6.1	5.5	9.1	3.3
Doubling taxable maximum	.3	1.2	2.2	3.6	3.2	2.9	5.9	1.0
Removing taxable maximum	.3	1.2	2.2	3.7	3.2	3.0	6.1	1.0

relationship exists between firm size and the percentage increase in employer payroll-tax liability but the size distribution of firms in all industries is identical.

An example can clarify this point. The increase in payroll-tax liability resulting from the 1977 amendments is 7.5 percent for the durable manufacturing

Table 1.—Number of workers in covered employment and estimated percentage increase in employer payroll-tax liability, by industry group and size of firm—**Continued**

[Numbers in thousands]

Industry	Size of firm (number of employees)										
	Total	1-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49
Government											
Number of workers	5,963	48	78	61	43	47	43	42	32	39	32
Percentage increase due to:											
1977 amendments	4.9	.8	2.4	1.1	1.5	.7	.3	2.2	.8	1.2	1.1
Doubling taxable maximum	2.4	0	2.8	0	0	1.3	0	.6	.8	.7	1.0
Removing taxable maximum	2.5	0	2.8	0	0	1.4	0	.6	.8	.7	1.0
Nonprofessional private services											
Number of workers	9,401	1,476	971	591	426	305	244	195	183	148	139
Percentage increase due to:											
1977 amendments	4.7	2.3	3.7	4.9	5.0	4.8	5.6	4.8	4.4	4.4	5.0
Doubling taxable maximum	4.4	2.1	3.4	5.1	4.6	5.0	6.6	3.6	3.9	4.0	4.3
Removing taxable maximum	6.6	3.4	5.5	8.6	6.6	7.1	11.5	8.0	8.0	8.5	4.3
Retail trade											
Number of workers	26,843	3,174	2,688	1,852	1,425	1,100	815	694	600	548	448
Percentage increase due to:											
1977 amendments	3.7	1.6	2.8	3.5	3.5	4.0	4.1	4.3	4.0	4.4	4.9
Doubling taxable maximum	3.3	1.5	2.4	3.0	4.0	4.4	4.5	4.2	3.1	3.9	4.8
Removing taxable maximum	5.7	2.6	3.4	5.7	7.2	7.7	10.1	7.6	4.2	6.7	10.7
Agriculture, forestry, and fishing											
Number of workers	838	167	131	73	47	34	25	16	12	12	12
Percentage increase due to:											
1977 amendments	3.5	2.8	4.7	5.6	3.1	6.3	3.5	2.4	5.7	1.1	0
Doubling taxable maximum	4.0	4.7	5.4	8.1	4.8	6.3	2.8	3.4	4.6	0	0
Removing taxable maximum	6.5	7.9	10.5	15.6	9.9	6.3	2.8	3.4	4.6	0	0
Nonprofit institutions											
Number of workers	2,157	164	191	154	116	93	68	57	51	48	45
Percentage increase due to:											
1977 amendments	3.1	1.9	1.5	1.7	.7	1.5	3.5	1.7	1.3	3.9	1.9
Doubling taxable maximum	2.6	1.4	1.6	.3	.7	1.4	3.6	.9	1.4	4.7	.4
Removing taxable maximum	2.8	1.4	1.7	.3	.7	1.4	4.2	.9	1.8	5.1	.4
Military, active											
Number of workers	3,097	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Percentage increase due to:											
1977 amendments	3.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Doubling taxable maximum	1.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Removing taxable maximum	1.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Government health services											
Number of workers	553	4	2	0	1	0	1	0	1	2	3
Percentage increase due to:											
1977 amendments	2.2	0	4.5	0	8.6	0	0	0	0	0	0
Doubling taxable maximum	1.6	0	0	0	7.9	0	0	0	0	0	0
Removing taxable maximum	1.7	0	0	0	7.9	0	0	0	0	0	0
Nonprofit health services											
Number of workers	2,767	19	8	6	7	6	9	8	7	10	10
Percentage increase due to:											
1977 amendments	2.1	4.0	4.4	0	5.0	3.0	.3	1.9	0	3.3	4.2
Doubling taxable maximum	2.0	2.2	1.4	0	6.9	2.2	0	.7	0	.2	5.2
Removing taxable maximum	3.3	2.2	1.4	0	7.5	2.2	0	.7	0	.2	5.2
Military, reserves											
Number of workers	915	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Percentage increase due to:											
1977 amendments	1.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Doubling taxable maximum	.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Removing taxable maximum	.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Unknown											
Number of workers	4,855	293	211	131	76	64	63	68	32	33	26
Percentage increase due to:											
1977 amendments	5.5	3.7	9.3	2.8	4.4	7.5	2.7	3.1	3.5	6.1	6.9
Doubling taxable maximum	4.4	6.0	7.8	2.6	7.1	6.5	3.2	3.1	3.2	6.6	10.9
Removing taxable maximum	6.4	11.2	15.4	2.9	10.7	11.1	8.0	4.1	3.2	6.6	31.8

industry group and 3.7 percent for the retail trade group. Assume that a positive relationship exists between firm size and the percentage increase in employer payroll-tax liability such that the increases are 3 percent for small firms, 5 percent for medium firms, and 8 percent for large firms. Assume further that durable

Table 1.—Number of workers in covered employment and estimated percentage increase in employer payroll-tax liability, by industry group and size of firm—**Continued**

[Numbers in thousands]

Industry	Size of firm (number of employees)							
	50-99	100-249	250-499	500-999	1,000-2,499	2,500-4,999	5,000 or more	Unclassified and unknown
Government								
Number of workers	332	508	402	496	563	314	2,700	183
Percentage increase due to:								
1977 amendments	1.0	1.8	2.6	3.2	2.8	3.7	6.7	4.7
Doubling taxable maximum	.2	.7	1.0	1.5	1.3	1.9	3.4	2.0
Removing taxable maximum	.3	.7	1.0	1.5	1.3	2.3	3.5	2.0
Nonprofessional private services								
Number of workers	832	817	410	334	345	147	252	1,588
Percentage increase due to:								
1977 amendments	6.1	6.0	5.5	7.1	6.6	8.3	7.3	1.2
Doubling taxable maximum	5.5	5.1	6.3	6.5	5.9	6.5	5.0	1.8
Removing taxable maximum	8.1	7.1	10.9	8.8	7.7	6.7	5.9	2.9
Retail trade								
Number of workers	2,376	1,609	913	783	1,007	690	4,514	1,606
Percentage increase due to:								
1977 amendments	5.1	4.7	3.4	3.5	3.3	3.3	4.2	1.9
Doubling taxable maximum	5.3	4.7	3.4	2.4	2.5	2.8	3.4	1.1
Removing taxable maximum	9.2	8.1	5.9	3.7	3.7	5.6	5.3	1.4
Agriculture, forestry, and fishing								
Number workers	56	50	19	10	20	2	16	139
Percentage increase due to:								
1977 amendments	2.5	2.8	5.9	4.5	2.9	8.6	3.1	1.4
Doubling taxable maximum	2.7	1.9	3.9	.7	1.0	16.6	.8	1.0
Removing taxable maximum	3.8	1.9	5.8	.7	1.0	16.6	.8	1.0
Nonprofit institutions								
Number of workers	264	348	267	138	55	24	33	41
Percentage increase due to:								
1977 amendments	2.7	3.5	3.7	4.0	8.2	8.6	8.3	1.0
Doubling taxable maximum	2.1	2.5	3.3	4.3	7.8	6.6	6.3	3.6
Removing taxable maximum	2.2	2.5	3.4	4.3	8.2	7.2	6.3	6.8
Military, active								
Number of workers	.....	.....	.....	.....	.....	.....	.....	3,097
Percentage increase due to:								
1977 amendments	.....	.....	.....	.....	.....	.....	.....	3.0
Doubling taxable maximum	.....	.....	.....	.....	.....	.....	.....	1.2
Removing taxable maximum	.....	.....	.....	.....	.....	.....	.....	1.2
Government health services								
Number of workers	34	84	85	87	77	35	128	6
Percentage increase due to:								
1977 amendments	.1	1.4	.7	1.5	1.7	1.1	4.4	1.5
Doubling taxable maximum	0	.8	1.0	.2	.8	.1	3.8	0
Removing taxable maximum	0	.8	1.2	.2	.8	.1	4.1	0
Nonprofit health services								
Number of workers	112	276	374	676	916	184	116	24
Percentage increase due to:								
1977 amendments	1.6	1.5	1.5	1.7	2.1	3.6	5.2	1.1
Doubling taxable maximum	.9	.7	1.3	1.4	2.2	4.1	4.8	.8
Removing taxable maximum	.9	.8	2.6	2.7	3.6	6.2	6.4	.8
Military, reserves								
Number of workers	.....	.....	.....	.....	.....	.....	.....	915
Percentage increase due to:								
1977 amendments	.....	.....	.....	.....	.....	.....	.....	1.3
Doubling taxable maximum	.....	.....	.....	.....	.....	.....	.....	.4
Removing taxable maximum	.....	.....	.....	.....	.....	.....	.....	.4
Unknown								
Number of workers	210	345	272	319	411	269	978	1,054
Percentage increase due to:								
1977 amendments	8.4	5.5	5.3	5.4	5.5	5.3	6.5	2.5
Doubling taxable maximum	8.5	4.7	5.0	3.2	4.6	3.8	4.3	1.9
Removing taxable maximum	11.2	5.8	8 8	3.4	7.6	4.8	5.4	2.3

Table 2.—Estimated percentage increase in employer payroll-tax liability, by industry group

[Numbers in parentheses represent the rank of the magnitude of effect of each change in the maximum taxable amounts]

Industry group	Estimated percentage increase in tax liability due to—		
	1977 amendments	Doubling taxable maximum	Removing taxable maximum
Total	6.3	4.9	7.8
Transportation, communications, and utilities	9.1(1)	4.5(8)	6.0(10)
Wholesale trade	8.7(2)	9.1(2)	15.1(2)
Mining	7.8(3)	5.1(4)	6.7(6)
Construction	7.6(4)	4.8(6)	6.9(5)
Durable manufacturing	7.5(5)	4.5(8)	6.6(7)
Professional private services	6.8(6)	10.2(1)	21.2(1)
Finance, insurance, and real estate	6.8(6)	7.7(3)	13.5(3)
Nondurable manufacturing	6.0(8)	4.8(6)	8.0(4)
Nonprofit educational services	6.0(8)	4.9(5)	5.7(11)
Government educational services	5.9(10)	3.5(12)	3.6(13)
Government	4.9(11)	2.4(15)	2.5(16)
Nonprofessional private services	4.7(12)	4.4(10)	6.6(7)
Retail trade	3.7(13)	3.3(13)	5.7(11)
Agriculture, forestry, and fishing	3.5(14)	4.0(11)	6.5(9)
Nonprofit institutions	3.1(15)	2.6(14)	2.8(15)
Military, active	3.0(16)	1.2(18)	1.2(18)
Government health services	2.2(17)	1.6(17)	1.7(17)
Nonprofit health services	2.1(18)	2.0(16)	3.3(14)
Military, reserves	1.3(19)	.4(19)	.4(19)

manufacturing is composed primarily of large firms and that retail trade is composed primarily of small firms. Under these assumptions, the difference in the percentage increase in payroll-tax liability between durable manufacturing and retail trade primarily reflects differences in the distribution of firm sizes between the two industries, that is, a firm-size effect rather than an industry effect. Thus, the industry estimates presented in table 2 reflect not only an industry effect but possibly a firm-size effect as well.

Impact of Changes in Taxable Maximum by Firm Size

The first row in table 1, which aggregates across industries, presents the increase in employer payroll-tax liability by firm size. For convenience, these estimates (except for the "unclassified and unknown" class) are shown separately in table 3. The increases by firm size resulting from the 1977 amendments range from 3.9 percent to 8.4 percent; the increase for all firms is 6.3 percent. The rise in employer payroll-tax liability for all firms as a result of doubling the taxable maximum is 4.9 percent, with individual firm-size estimates ranging from 4.1 percent to 7.0 percent. Removal of the taxable maximum increases the payroll-tax liabilities of all firms by 7.8 percent, with the firm-size estimates ranging from 5.7 percent to 12.8 percent.

Caution must also be used in interpreting the firm-size estimates presented in table 3. Differences in the firm-size estimates should not be interpreted as resulting solely from differences in firm size. Such an interpretation is possible only if (1) there is no industry effect on the percentage increase in employer payroll-tax liability or (2) there is an industry effect but the industry distribution of firms in all size classes is identical.

Again, an example is in order to clarify this point. As a result of the 1977 amendments, the increase in payroll-tax liability for the smallest firm-size class (1-4 employees) is 3.9 percent, and the increase for the largest firm-size class (5,000 or more employees) is 8.4 percent. Assume that there is an industry effect such that firms in retail trade have an increase in employer payroll-tax liability of 4.0 percent and that firms in durable manufacturing have an increase of 8.0 percent. Assume further that the vast majority of small firms are in retail trade and that the vast majority of large firms are in durable manufacturing. Under these assumptions, the difference in the percentage increase in payroll-tax liability between the smallest and largest firm-size classes primarily reflects an industry effect, that is, the location of firms in one industry rather than another, rather than a firm-size effect. Thus, the firm-size estimates presented in table 3 should not be interpreted as reflecting only the effect of firm size on employer payroll-tax liability. The firm-size estimates, like the industry estimates presented in table 2, reflect both an industry effect and a firm-size effect.

Analysis of Industry and Firm-Size Effects

The industry estimates presented in table 2 and the firm-size estimates presented in table 3 reflect both an

Table 3.—Estimated percentage increase in employer payroll-tax liability, by size of firm

Size of firm (number of employees)	Estimated percentage increase in tax liability due to—		
	1977 amendments	Doubling taxable maximum	Removing taxable maximum
All firms	6.3	4.9	7.8
1-4	3.9	5.3	10.5
5-9	6.3	7.0	12.8
10-14	5.8	6.5	12.5
15-19	5.7	6.0	11.1
20-24	5.9	6.0	10.5
25-29	6.1	6.2	10.4
30-34	6.0	5.3	9.2
35-39	5.5	5.3	9.7
40-44	5.7	5.2	8.7
45-49	5.9	5.7	10.4
50-99	6.0	5.5	9.5
100-249	5.7	4.8	7.7
250-499	5.5	4.4	6.8
500-999	5.7	4.3	6.4
1,000-2,499	6.0	4.2	6.4
2,500-4,999	6.3	4.1	5.7
5,000 or more	8.4	5.0	6.8

industry effect and a firm-size effect on the percentage increases in employer payroll-tax liability. It would be desirable to disentangle or isolate each of these effects or, more precisely, to (1) estimate the effect of industry on the percentage increase in employer payroll-tax liability while holding constant or standardizing for the firm-size effect, and to (2) estimate the effect of firm size on the percentage increase in employer payroll-tax liability while holding constant or standardizing for the industry effect. Multiple regression analysis makes it possible to isolate the industry and firm-size effects. Two basic regression equations are estimated for each change in the taxable maximum:

$$T = a + bFS + c\,IND + e \qquad (1)$$

$$T = a + bFS + c\,IND + d\,FS^2 + e \qquad (2)$$

Where T is the percentage increase in employer payroll-tax liability for a given firm-size class resulting from a given change in the taxable maximum;
a is a constant;
FS is the size of the firm or, more precisely, the midpoint of the firm-size class;
b is the coefficient of FS;
IND is a vector of industry dummy variables;
c is a vector of coefficients of IND; and
e is the error term.

Equation (1) assumes a linear relationship between the percentage increase in employer payroll-tax liability and firm size. Equation (2), which includes firm size squared, allows for a nonlinear relationship between the two variables. The basic data used in the regression analysis are contained in table 1, which presents estimates of the percentage increase in employer payroll-tax liability for 20 industry groups disaggregated into 18 firm-size classes. Firm-size estimates are not appropriate for the industry groups military-active and military-reserves. They, together with unknown industry and unknown size categories, are excluded from the empirical analysis. Thus, the regression analysis is performed using 17 firm-size estimates for each of 17 industry groups (a total of 289 observations or sample points). For simplicity, clarity, and brevity, the estimated regression equations are presented in the technical note along with a brief discussion of the multiple regression technique. What are presented and discussed here, based on the regression analysis, are the nature and magnitude of the firm-size and industry effects on the percentage increase in employer payroll-tax liability.

Effect of Firm Size

The empirical results show that, by holding constant or standardizing for the industry effect, a statistically significant positive linear relationship is revealed between firm size and the percentage increase in employer payroll-tax liability as a result of the 1977 amendments.[10] A positive linear relationship means the larger the size of the firm the greater the percentage increase in employer payroll-tax liability. The empirical results also suggest, however, that the relationship between firm size and the percentage increase in employer payroll-tax liability as a result of the 1977 amendments is better represented by a nonlinear relationship. The relationship is basically that of an inverted U, that is, the percentage increase in employer payroll-tax liability increases with firm size up to a particular firm size but beyond this size the percentage increase in tax liability decreases with firm size.[11]

With respect to doubling the taxable maximum, a statistically significant positive linear relationship is apparent between firm size and the percentage increase in employer payroll-tax liability when the industry effect is held constant or standardized. No empirical support for a nonlinear relationship is found between the two variables as a result of doubling the taxable maximum. With respect to removing the taxable maximum, no statistically significant relationship, either linear or nonlinear, is found between firm size and the percentage increase in employer payroll-tax liability when the industry effect is held constant or standardized.

The empirical analysis permits the estimation or prediction of the percentage increase in employer payroll-tax liability for firms of various sizes in each industry group. For brevity, such estimates are presented for only two industry groups—nonprofit institutions and durable manufacturing (table 4). Although the level of the estimates differs for each industry group, it should be noted that changes in the estimates as firm size increases are identical for each industry. The first column in table 4 shows that, as a result of the 1977 amendments, the percentage increase in employer payroll-tax liability increases with firm size up to 8,000 employees. Beyond this point, a slight decline in tax liability occurs as firm size increases. Differences in the estimated percentage increases in employer payroll-tax liability among firms of similar size are very small. For example, firms with 50, 100, 250, or even 500 employees in the nonprofit institutions industry group have estimated increases in tax liability of about 3 percent, whereas firms with 5,000, 8,000, or even 10,000 employees have increases of about 6 percent. In the durable manufacturing industry group, the smallest firms have increases in tax liability of about 5.75

[10] Throughout this article, a relationship is judged to be statistically significant if it is significant at the 95-percent level of confidence or better, that is, if such a relationship would occur by chance in 5 or fewer cases out of 100.

[11] It should be noted that the inverted U shape is not found in the basic data. When plotted, the data display an "incomplete" inverted U shape or, more precisely, an inverted backward J shape.

Table 4.—Predicted percentage increase in employer payroll-tax liability, by size of firm in nonprofit institutions and durable manufacturing industry groups

Size of firm (number of employees)	Predicted percentage increase in tax liability due to—		
	1977 amendments	Doubling taxable maximum	Removing taxable maximum[1]
	Nonprofit institutions		
50	3.00	2.77	3.09
100	3.04	2.78	3.09
250	3.16	2.79	3.09
500	3.35	2.82	3.09
1,000	3.71	2.87	3.09
2,500	4.65	3.02	3.09
5,000	5.71	3.27	3.09
8,000	6.16	3.57	3.09
10,000	5.96	3.77	3.09
	Durable manufacturing		
50	5.58	4.56	7.56
100	5.62	4.57	7.56
250	5.74	4.58	7.56
500	5.93	4.60	7.56
1,000	6.29	4.65	7.56
2,500	7.23	4.80	7.56
5,000	8.29	5.05	7.56
8,000	8.74	5.35	7.56
10,000	8.54	5.55	7.56

[1] Predicted percentage increase is the same for all firm sizes because there is no statistically significant firm-size effect.

percent, and the largest firms have increases of about 8.75 percent. Thus, in both industry groups, the largest firms have percentage increases about three percentage points greater than those of the smallest firms.[12] This difference is quite substantial given the fact that the percentage increase in employer payroll-tax liability aggregated across all firms in all industries as a result of the 1977 amendments is 6.3 percent.

With respect to doubling the taxable maximum from the base established by the 1977 amendments (column 2 of table 4), the percentage increases in employer payroll-tax liability rise with firm size when the industry effect is held constant. The firm-size effect is quite small, however. In all industry groups the largest firms (5,000 or more employees) have percentage increases in payroll-tax liabilities about one percentage point larger than the smallest firms (500 or fewer employees), a difference that is much smaller than the corresponding difference resulting from the 1977 amendments.

Column 3 of table 4 shows the estimated percentage increases in employer payroll-tax liability for firms of various sizes as a result of removing the taxable maximum from the base established by the 1977 amendments. When the industry effect is held constant, no statistically significant relationship is revealed between firm size and the percentage increase in employer payroll-tax liability. Therefore, all firms within an industry have the same estimated increase in tax liability as a result of removing the taxable maximum.

The estimated percentage increases in employer payroll-tax liability presented in table 4 suggest the existence of a substantial firm-size effect resulting from the 1977 amendments, but only a relatively small or nonexistent firm-size effect resulting from doubling or removing the taxable maximum from the base established by the 1977 amendments. These results suggest that, although the distribution of earnings by firm size is quite different below the taxable maximum established by the 1977 amendments, it is quite similar above the maximum. This fact is not surprising. At $29,700, the taxable maximum established for 1981 by the 1977 amendments, about 93 percent of wages in covered employment would be taxable for the employer. Individuals with earnings exceeding this level are probably in high-level management. It is plausible that the proportion of a firm's total wages and salaries going to its high-level management does not vary substantially with firm size. Although the salaries of high-level managers might be expected to increase with firm size, it might also be expected that the ratio of high-level managers to total employees would decrease somewhat with firm size. The net effect may be to keep the proportion of total wages and salaries going to high-level management fairly similar among firms of different sizes.

Effect of Industry

As stated earlier, the empirical analysis not only allows estimation of the effect of firm size on the percentage increases in employer payroll-tax liability with the industry effect held constant, but it also permits estimation of the industry effect with the firm-size effect held constant. Table 5 presents the estimated (or predicted) percentage increases in employer payroll-tax liability for firms in each of the industry groups with firm size held constant.

The estimates of the percentage increase in employer payroll-tax liability by industry presented in table 5 suggest a substantial industry effect. As a result of the 1977 amendments, the estimated increases in tax liability by industry group range from about 2 percent in government health services to about 8 percent in wholesale trade. When the taxable maximum is doubled, the estimated increases range from about 1 percent in government and government health services to about 10 percent for professional private services. The estimated increases in tax liability by industry group resulting from removal of the taxable maximum range from

[12] As indicated earlier, this difference in percentage increase in payroll-tax liability between the largest and smallest firms applies to all the industry groups in the empirical analysis.

Table 5.—Predicted percentage increase in employer payroll-tax liability, by industry group with firm size held constant

Industry group	Predicted percentage increase in tax liability[1] due to—		
	1977 amendments	Doubling taxable maximum	Removing taxable maximum
Transportation, communications, and utilities	7.42	2.87	6.09
Wholesale trade	8.40	9.00	15.56
Mining	7.52	5.52	7.77
Construction	8.27	5.00	7.28
Durable manufacturing	6.30	4.66	7.56
Professional private services	7.44	9.83	19.59
Finance, insurance, and real estate	6.88	7.94	13.40
Nondurable manufacturing	5.70	5.25	9.15
Nonprofit educational services	3.71	2.87	3.09
Government educational services	3.71	2.87	3.09
Government	2.26	.98	3.09
Nonprofessional private services	5.67	4.87	7.48
Retail trade	3.71	2.87	6.35
Agriculture, forestry, and fishing	3.71	2.87	3.09
Nonprofit institutions	3.71	2.87	3.09
Government health services	1.68	.83	3.09
Nonprofit health services	3.71	2.87	3.09

[1] The predicted percentage increases in tax liability assume a firm size equal to the mean value of the firm-size variable. For industries where the regression coefficient on the industry dummy variable is insignificant, the coefficient is assumed to be zero.

about 3 percent for several industry groups to about 20 percent for professional private services. Although substantial differences are apparent in the percentage increases in payroll-tax liability by industry resulting from all three changes in the taxable maximum, the largest differences result from removal of the taxable maximum, and the smallest differences result from the 1977 amendments.

A comparison of the industry and firm-size effects shows that the most important determinant of a firm's percentage increase in payroll-tax liability as a result of a change in the taxable maximum is the industry in which it is located. The effect of firm size, if any, is secondary. The only substantial effect of firm size on the percentage increase in employer payroll-tax liability occurs as a result of the 1977 amendments.

Summary and Conclusions

The empirical analysis presented in this article suggests the following conclusions:

(1) There are substantial firm-size and industry effects on the percentage increases in employer payroll-tax liability as a result of the 1977 Amendments to the Social Security Act. More specifically, the largest firms (5,000 or more employees) will, on the average, experience increases in employer payroll-tax liability that are three percentage points higher than those of the smallest firms (500 or fewer employees). With respect to the industry effect, firms in some industry groups will experience, on the average, increases in employer payroll-tax liability as low as 2 percent. Firms in other industry groups will experience increases as large as 8 percent.

(2) If the taxable maximum were doubled from the base established by the 1977 amendments, a substantial industry effect on the percentage increases in employer payroll-tax liability would result but the firm-size effect would be small. Firms in some industry groups would experience increases in payroll-tax liability as low as 1-2 percent; firms in other industry groups would experience increases as high as 9-10 percent. With respect to firm size, the largest firms would experience increases in employer payroll-tax liability averaging only about one percentage point greater than those of the smallest firms.

(3) If the taxable maximum were removed from the base established by the 1977 amendments, a substantial industry effect on the percentage increases in employer payroll-tax liability would result but no firm-size effect would occur. The increases in employer tax liability according to industry would range from a low of 1-2 percent to a high of 15-20 percent.

(4) The most important determinant of a firm's increase in employer payroll-tax liability as a result of changing the taxable maximum is the industry in which it is located. Firm size plays a secondary role in determining a firm's percentage increase in payroll-tax liability, but its role is a substantial one with respect to those increases resulting from the 1977 amendments.

(5) In general, the industry groups with both the smallest and largest percentage increases in payroll-tax liability are service industries.

(6) For most industry groups, position in the distribution of percentage increases in payroll-tax liability is approximately the same regardless of the particular change in the taxable maximum. For some industry groups, however, there is a significant change in position.

(7) Because rather broad industry groupings are used in the empirical analysis, the estimated industry and firm-size effects of changes in the taxable maximum on the percentage increases in employer payroll-tax liability should be considered as only indicative of the actual industry and firm-size effects. Specifically, the use of broad industry groupings means that the estimated industry effects are, in some sense, really averages of the industry effects within the more narrowly defined component industries. The use of these groupings also means that the estimated firm-size effects may reflect an industry effect as well because differences in firm sizes in these groupings may be related to industry differences among the more narrowly defined component industries.

Technical Note

Estimated Regression Equations

The analysis of the industry and firm-size effects of an increase in the taxable maximum on the percentage increases in employer payroll-tax liability presented in the fourth section is based on multiple regression analysis of data presented in table 1. Two basic regression equations are estimated for each change in the taxable maximum:

$$T = a + b\,FS + c\,IND + e \quad (1)$$
$$T = a + b\,FS + c\,IND + d\,FS^2 + e \quad (2)$$

where T is the percentage increase in employer payroll-tax liability for a given firm-size class resulting from a given change in the taxable maximum;
a is a constant;
FS is the size of the firm or, more precisely, the midpoint of the firm-size class;[13]
b is the coefficient of FS;
IND is a vector of industry dummy variables;
c is a vector of coefficients of IND; and
e is the error term.

The matrix of industry dummy variables is constructed as follows: The agriculture industry dummy, for example, is constructed by assigning a one to the agriculture industry variable for each of the 17 observations of the tax liability variable in the agriculture industry group, and assigning zero to the agriculture industry variable for the other 272 observations. The same procedure is followed in constructing the other 16 industry dummy variables.

The parameters of the regression equations are estimated using ordinary least squares. The parameter a is the constant and the parameters b, c (a vector), and d are partial regression coefficients. The tax liability variable, T, is the dependent variable or the variable to be explained. FS, FS^2, and IND are the independent or explanatory variables. The partial regression coefficient on either firm-size variable can be interpreted as the change in the dependent variable (percentage increase in payroll-tax liability) as a result of a one-unit change in that particular independent variable with all the other independent variables in the estimated equation held constant. The regression coefficients on the industry dummy variables have a different interpretation than those of the regression coefficients on the firm-size variables. Although there are 17 industry dummy variables, only 16 are included in the estimation of the regression equations. The industry dummy that is arbitrarily chosen to be excluded is nonprofit institutions. The regression coefficient on any industry dummy can be interpreted as the difference in the percentage increase in payroll-tax liability between that industry and the excluded industry.[14]

The regression coefficients on the firm-size variables capture the firm-size effect while holding the industry effect constant, and the regression coefficients on the industry dummy variables capture the industry effect while holding the firm-size effect constant. The statistical significance of the regression coefficients is tested through the use of a two-tail t test and the application of a 95-percent confidence level.

In addition to estimating the parameters of the regression equation, the coefficient of multiple determination (adjusted for degrees of freedom), $\bar{R}^2$, and the F statistic are calculated. The $\bar{R}^2$ can be interpreted as the proportion of variation in the dependent variable that can be explained by all the independent variables included in the estimated equation. Whereas the t statistic is used to test for the statistical significance of individual regression coefficients, the F statistic is used to test for the statistical significance of the entire set of regression coefficients.

Equation (1) assumes a linear relationship between the increase in employer payroll-tax liability and firm size. A statistically significant regression coefficient on the firm-size variable indicates the existence of a linear relationship between firm size and the percentage increase in payroll-tax liability. The sign of the regression coefficient reveals whether the relationship is positive or negative.

Equation (2), which includes firm size squared, allows for a nonlinear relationship between firm size and the percentage increase in employer payroll-tax liability. If the regression coefficients on both the firm-size and firm-size-squared variables are statistically significant, the relationship between firm size and payroll-tax liability is nonlinear. More specifically, a negative and statistically significant regression coefficient on the firm-size variable accompanied by a positive and statistically significant regression coefficient on the firm-size-squared variable indicates that the relationship between firm size and the percentage increase in employer payroll-tax liability is U shaped. A positive and statistically significant regression coefficient on the firm-size variable accompanied by a negative and statistically significant regression coefficient on the firm-size-squared variable indicates that the relationship between firm size and the percentage increase in employer payroll-tax liability has an inverted U shape.

[13] For the largest size class (5,000 or more employees), a midpoint of 10,000 is assumed. Unpublished administrative data from the Social Security Administration indicate that the median size of firms with 5,000 or more employees is about 10,000 employees.

[14] The constant term in the estimated regression equations is interpreted as the estimated percentage increase in tax liability for the excluded industry group. Thus, the value of the constant term will depend upon the industry group excluded.

In some cases the regression coefficient of the firm-size variable estimated from equation (1) will be statistically significant and the regression coefficient of both firm-size variables estimated from equation (2) will also be statistically significant. Such a result suggests that the relationship between firm size and the percentage increase in employer payroll-tax liability is best represented by a nonlinear relationship. In cases where the regression coefficient on the firm-size variable estimated from equation (1) is statistically significant but the regression coefficients on both firm-size variables estimated from equation (2) are statistically insignificant, the relationship between firm size and the percentage increase in employer payroll-tax liability is linear rather than nonlinear.[15]

Table I presents the estimated regression equations. First, the estimated effects of the 1977 Amendments to the Social Security Act are examined (equations (1a) and (2a)). In equation (1a) the regression coefficient of the firm-size variable is highly significant and positive.[16] The value of the coefficient is 0.0004, which means that an increase in firm size by one unit (one employee) will raise the percentage increase in payroll-tax liability by .0004 percentage points. Put another way, a firm with 10,000 employees will have a percentage increase in payroll-tax liability that is approximately four percentage points higher than that of a firm with 10 employees. About two-thirds of the regression coefficients of the industry dummy variables are statistically significant. This proportion indicates a significant industry effect, and the size of the regression coefficients indicates that the magnitude of the effect is substantial. For example, the regression coefficient on the construction industry dummy variable is 4.5588 and is highly significant, indicating that the percentage increase in payroll-tax liability for firms in this industry group is approximately 4.5 percentage points higher than that of nonprofit institutions, the excluded industry group.

In equation (2a) the regression coefficients of both the firm-size and firm-size-squared variables are statistically significant. This finding indicates that the relationship between firm size and the percentage increase in employer payroll-tax liability is better represented by a nonlinear relationship. The fact that the regression coefficient on the firm-size variable is positive and the regression coefficient on the firm-size-squared variable is negative indicates that the relationship between firm size and the percentage increase in payroll-tax liability has an inverted U shape. Again, about two-thirds of the regression coefficients of the industry dummy variables are significant.[17]

By means of the estimated parameters from equation (2a) the percentage increases in employer payroll-tax liability can be estimated for various firm sizes within each industry group.[18] These estimates are made using the following formula:

$$T = 2.9582 + 0.0008\,FS - 0.00000005\,FS^2 + c_i\,IND$$

where c_i is the regression coefficient on the ith industry dummy.

For example, the estimated increase for a firm with 100 employees in the durable manufacturing industry group is

$$T = 2.9582 + 0.0008(100) - 0.00000005(10{,}000) + 2.5824$$
$$T = 5.62$$

The estimated percentage increases in employer payroll-tax liability by firm size for nine arbitrarily selected firm sizes in the durable manufacturing industry group are presented in column 1 of table 4. If these estimates are desired for the nonprofit institutions industry group—the industry group excluded in estimating the regression equations—the same procedure is used except that the value of c_i is set at zero. Thus, the estimated increase for a firm with 100 employees in the nonprofit institutions industry group is

$$T = 2.9582 + 0.0008(100) - 0.00000005(10{,}000) + 0$$
$$T = 3.04$$

(The estimated percentage increases in employer payroll-tax liability by firm size in the nonprofit institutions industry group are also presented in column 1 of table 4.)

The above formula for calculating the estimated percentage increases in employer payroll-tax liability by firm size for each industry group implies that differences between firm sizes in the estimated percentage increases in tax liability will be identical for all industry groups. The level of the estimated percentage increases in tax liability by firm size for each industry group, however, will depend upon the value of the regression coefficient of the relevant industry dummy variable.

[15] Of all the possible outcomes with respect to the signs and significance of the regression coefficients of the firm-size and firm-size-squared variables, only those that are useful in understanding the empirical results presented in table I have been discussed.

[16] When a two-tail t test and a 95-percent confidence level are applied, the critical t value for the regression coefficients presented in table I is approximately 1.96. If the computed t statistics (which appear in parentheses under the estimated regression coefficients in the table) exceed the critical t value, the regression coefficients are judged to be statistically significant.

[17] It should be noted that the mathematical relationship indicated by the empirical results is an inverted U shape. If the actual data on the percentage increase in payroll-tax liability and firm size are plotted, however, the resulting relationship has an "incomplete" inverted U shape or, more precisely, an inverted backward J shape.

[18] For purposes of calculating the estimated percentage increase in payroll-tax liability, a statistically insignificant regression coefficient on either the firm-size variable or the industry dummy variable is assumed to be zero.

The estimated parameters from equation (2a) can also be used to calculate the percentage increases in employer payroll-tax liability for different industry groups when firm size is held constant. These estimates are made as follows:

$$T_i = 2.9582 + 0.0008\ FS - 0.00000005\ FS^2 + c_i IND_i$$

First, the values of FS and FS^2 are set at their mean values. Thus, the estimate of the percentage increase in payroll-tax liability by industry group assumes a firm whose size is equal to the mean value of the firm-size variable. The mean value of the firm-size variable is 1,007 employees. Thus,

$$T_i = 2.9582 + 0.0008(1{,}007) - 0.00000005(1{,}014{,}049) + c_i IND_i$$

For example, the estimated percentage increase for firms (equal in size to the mean value of the firm-size variable) in the construction industry is

$$T = 2.9582 + 0.0008(1{,}007) - 0.00000005(1{,}014{,}049) + 4.5588$$
$$T = 8.27$$

The estimated percentage increases in employer payroll-tax liability for the 17 industry groups, with firm size held constant, are presented in column 1 of table 5.

Consider now the estimated effects of doubling the taxable maximum (equations (1b) and (2b) of table I). In equation (1b) the regression coefficient of the firm-size variable is positive and significant. The value of the coefficient is 0.0001, which implies that a firm with 10,000 employees will have a percentage increase

Table I.—Regression equations relating the percentage increase in employer payroll-tax liability to size of firm and industry group using pooled data (n = 289)

[t statistics shown in parentheses]

Variable	1977 amendments		Doubling taxable maximum		Removing taxable maximum	
	Linear (1a)	Nonlinear (2a)	Linear (1b)	Nonlinear (2b)	Linear (1c)	Nonlinear (2c)
Constant	3.0881	2.9582	2.7663	2.7326	3.0877	3.1889
	(7.72)	(7.49)	(5.60)	(5.50)	(3.26)	(3.36)
Firm size	.0004	.0008	.0001	.0003	-.00003	-.0004
	(8.98)	(5.55)	(2.71)	(1.35)	(-.31)	(-1.12)
Firm size squared	.....	-.00000005	.....	-.00000001	.....	.00000006
		(-3.32)		(-0.68)		(1.08)
Transportation, communications, and utilities	3.7118	3.7118	1.1000	1.1000	3.0000	3.0000
	(6.59)	(6.71)	(1.58)	(1.58)	(2.25)	(2.25)
Wholesale trade	4.6824	4.6824	6.1353	6.1353	12.4765	12.4765
	(8.31)	(8.47)	(8.83)	(8.82)	(9.37)	(9.37)
Mining	3.8118	3.8118	2.6529	2.6529	4.6824	4.6824
	(6.77)	(6.89)	(3.82)	(3.81)	(3.52)	(3.52)
Construction	4.5588	4.5588	2.1353	2.1353	4.1941	4.1941
	(8.10)	(8.24)	(3.07)	(3.07)	(3.15)	(3.15)
Durable manufacturing	2.5824	2.5824	1.7882	1.7882	4.4765	4.4765
	(4.59)	(4.67)	(2.57)	(2.57)	(3.36)	(3.36)
Professional private services	3.7235	3.7235	6.9647	6.9647	16.5000	16.5000
	(6.61)	(6.73)	(10.02)	(10.01)	(12.39)	(12.40)
Finance, insurance, and real estate	3.1647	3.1647	5.0706	5.0706	10.3118	10.3118
	(5.62)	(5.72)	(7.29)	(7.29)	(7.75)	(7.75)
Nondurable manufacturing	1.9824	1.9824	2.3824	2.3824	6.0588	6.0588
	(3.52)	(3.58)	(3.43)	(3.42)	(4.55)	(4.55)
Nonprofit educational services	.2647	.2647	-.3000	-.3000	.2706	.2706
	(.47)	(.48)	(-.43)	(-.43)	(.20)	(.20)
Government educational services	-.4353	-.4353	-1.2824	-1.2824	-1.4176	-1.4176
	(-.77)	(-.79)	(-1.84)	(-1.84)	(-1.06)	(-1.07)
Government	-1.4529	-1.4529	-1.8882	-1.8882	-2.0059	-2.0059
	(-2.58)	(-2.63)	(-2.72)	(-2.71)	(-1.51)	(-1.51)
Nonprofessional private services	1.9529	1.9529	2.0059	2.0059	4.3941	4.3941
	(3.47)	(3.53)	(2.89)	(2.88)	(3.30)	(3.30)
Retail trade	.3529	.3529	.6471	.6471	3.2588	3.2588
	(.63)	(.64)	(.93)	(.93)	(2.45)	(2.45)
Agriculture, forestry, and fishing	.4059	.4059	1.0824	1.0824	2.3294	2.3294
	(.72)	(.73)	(1.56)	(1.56)	(1.75)	(1.75)
Government health services	-2.0353	-2.0353	-2.0412	-2.0412	-2.1706	-2.1706
	(-3.61)	(-3.68)	(-2.94)	(-2.93)	(-1.63)	(-1.63)
Nonprofit health services	-.9000	-.9000	-.8882	-.8882	-.5529	-.5529
	(-1.60)	(-1.63)	(-1.28)	(-1.28)	(-.42)	(-.42)
$\bar{R}^2$	.65	.67	.61	.61	.62	.62
F	32.94	32.88	27.45	25.90	28.63	27.12

in employer payroll-tax liability only about one percentage point higher than that of a firm with about 10 employees. Thus, although the effect of firm size is statistically significant, the magnitude of the effect is relatively small. In equation (2b) the regression coefficients of both the firm-size and firm-size-squared variables are not statistically significant. The results in equation (1b) in conjunction with the results in equation (2b) indicate that the relationship between firm size and the percentage increase in employer payroll-tax liability is linear rather than nonlinear. In both equations, about two-thirds of the regression coefficients of the industry dummy variables are significant, which indicates a significant industry effect. The size of the regression coefficients indicates that the magnitude of the effect is substantial.

Using the estimated parameters of equation (1b), the percentage increases in payroll-tax liability by firm size for each industry group can again be estimated. Such estimates for nonprofit institutions and durable manufacturing are presented in column 2 of table 4. The percentage increases in payroll-tax liability by industry can also be estimated, with the effect of firm size held constant (column 2 of table 5).

Equations (1c) and (2c) of table I present the estimated effects of removing the taxable maximum. In both equations, the regression coefficients of the firm-size and firm-size-squared variables are not statistically significant. This finding indicates that no relationship between firm size and the percentage increase in employer payroll-tax liability results from removing the taxable maximum. In both equations (1c) and (2c), about two-thirds of the regression coefficients of the industry dummy variables are statistically significant. Again, the size of the regression coefficients indicates that the magnitude of the industry effect is substantial.

Using the parameters of equation (1c), the percentage increases in payroll-tax liability by firm size for each industry group can be estimated. Column 3 of table 4 presents such estimates for nonprofit institutions and firms in durable manufacturing. Because no significant relationship is found between firm size and the percentage increase in payroll-tax liability, the firm-size effect is assumed to be zero. Thus, the estimated percentage increases by firm size are identical in column 3 of table 4 for both groups. The percentage increases in payroll-tax liability by industry can also be estimated with firm size held constant (column 3 of table 5).

Data Base and Limitations

The data used in this study are from the 1-percent Employee-Employer File for 1974, one of the Social Security Administration's Continuous Work History Sample files. Annually reported agricultural work is excluded from the tables. It is believed, however, that less than 1.5 percent of covered agricultural wages exceeds the taxable limit. Self-employment income and tips are also excluded.

Employer size relates to the number of employees working for the firm during the pay period that included March 12, 1974, as reported by employers on their "Employer's Quarterly Federal Tax Return" (Internal Revenue Service Form 941) for the first quarter of 1974. If that number was omitted, it was estimated based on other information, such as the number of workers reported in the entire quarter. The size of the employing firm is listed as unknown in cases where insufficient information is available on which to base an estimate of a missing figure.

The number of workers given for a particular size and industry class cannot be directly interpreted as a measure of the weight of that class relative to that of the other classes. For instance, retail trade firms with fewer than 5 workers employed 3,174,000 workers over the year. Yet, if retail trade workers are disproportionately part-time, part-year, or low-hourly-wage employees, the impact of this group on the percentage increase in tax liability for that size class may be less than that of a smaller group of workers in some other industry.

The industry categories in this article consist of combinations of major groups of the Standard Industrial Classification (SIC), as described in the **Standard Industrial Classification Manual, 1972**. The industry categories are:

(1) Agriculture, forestry, and fishing. Information about farm workers is generally reported once a year on a special form. Only those workers who were reported, properly or improperly, on the **quarterly** Form 941 are included in this study.

(2) Mining.

(3) Construction.

(4) Durable manufacturing. Includes lumber;furniture; products made of wood, stone, clay, glass, and concrete; primary metal industries; and fabricated metal products, including machinery.

(5) Nondurable manufacturing. Includes food, tobacco, textiles and clothing, paper, printing, publishing, chemicals, petroleum, and rubber and leather products.

(6) Transportation, communications, and utilities. Includes local and long-distance transportation of passengers and freight; U.S. Postal Service; pipe lines; communications; and electric, gas, and sanitary services.

(7) Wholesale trade.

(8) Retail trade. Goods.

(9) Finance, insurance, and real estate.

(10) Professional private services. Includes business, health, legal, educational, and social services; museums; and membership organizations. Excludes governmental and private nonprofit organizations.

(11) Nonprofessional private services. Includes lodging, personal, automotive, repair, recreational, and household services, except governmental and private nonprofit organizations. Household employers are not classified here by size. The approximately 900,000 domestic workers who were reported on "Employer's Quarterly Tax Return for Household Employees" (Internal Revenue Service Form 942) are listed in the "unclassified and unknown" size category.

(12) Government health services. Primarily State and local government since most Federal Government employment is not covered under the social security program. About 72 percent of State and local government employment is covered. (See category 14.)

(13) Government educational services. Also primarily State and local. (See category 14.)

(14) Government. All government services except those noted in the above two categories. The payroll of an unknown proportion of government providers of health and educational services is reported by those governments as part of their general activities, and is, therefore, included in this category.

(15) Nonprofit health services.

(16) Nonprofit educational services.

(17) Nonprofit institutions. All nonprofit institutions except firms in categories 15 and 16 and membership organizations.

(18) Military, active. Firm size is "unclassified and unknown."

(19) Military, reserves. Firm size is "unclassified and unknown."

(20) Unknown. Includes workers for which industry is unknown.