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In the past few years, there has been an uprising of the "supply - side" economics, which stresses the need for a tax cut or restructuring of the tax system to promote capital formation and private savings. There were calls for, among others, liberalization of tax policy toward capital depreciation, integration of corporate and personal income taxes, and replacement of the personal income tax by a progressive consumption tax. Amid this development comes the attack by politicians and the general public on the Social Security System, which over the past forty years has provided a major source of income security for millions of retired and disabled persons and placed an important burden on the working population. Some are concerned about its distortional impact on capital formation and the supply of labor while others are worried about its long-term financial soundness. Recommendations have been made for a restructuring of the benefit system on a no-additional-cost basis[2], a rollback of the payroll tax, and the financing of a portion of social security by a value-added tax or other means (e.g., gasoline tax or general revenues). The value-added tax was in particular proclaimed by its proponents to be a new approach to the fundamental problems in our economic system left over by the Keynesian era, but the opposition is equally strong.[3] The case for or against the partial

substitution of a value-added tax for the payroll tax must be made on, aside from political realities and administrative considerations, both equity and efficiency grounds. In this paper, the distributional aspect of the partial tax substitution is considered. In so doing, various definitions of income are used, taking into account the effect of the payroll tax on the opportunity cost of non-market activity.

The data for this study are drawn mainly from the Consumer Expenditure Survey conducted by the Bureau of Labor Statistics during 1972-73. The respondents are divided into five income classes and two age groups. The focus of this analysis is placed on the consumption-type value-added tax. The Harberger model is employed in which the sources and uses of income are taken into account in determining the effect of the tax substitution. The economy is divided into three sectors - one producing capital goods and two others producing consumption goods. The consumption-goods sectors are dichotomized according to the exemption status of the VAT. The following section describes the model. In section 2, some results are presented.

1. THE MODEL

Consider an individual aged j in income class i. Assume that his utility function is given by

$$U^{ij} = U^{ij}(c_1, c_2, c_f, a), \tag{1}$$

where c_n denotes the level of current consumption of good n(n=1, 2) ; c_f denotes the level of future consumption, which takes the form of purchases of capital goods (i.e., $c_f = k-k_{-1}$, the difference between the terminal and the initial capital stock); and a is the quantity of labor devoted to nonmarket activity. Write his budget constraint as

$$p_1c_1 + p_2c_2 + p_fc_f + wa = wh + rp_fk_{-1} + T = z, \tag{2}$$

where p_n is the price of the n-th good (n=1,2,f), w is the wage rate per unit of labor, r is the rate of return on capital, h is the quantity of labor he would have supplied if he were to work full time, k_{-1} is the initial capital stock, and T denotes transfer income. z can be called "full income", which he would have earned if he were to work full time. This is to be distinguished from his actual income, labelled y, the difference being the wage earnings he has foregone in order to allocate a fraction of time to nonmarket activity.

$$y = z - wa. \tag{3}$$

The solutions to this maximization problem give rise to

$$c_n^{ij} = c_n^{ij}(p_1, p_2, p_f, w, z), \quad n = 1, 2, f; \tag{4}$$

$$\ell^{ij} = \ell^{ij}(p_1, p_2, p_f, w, z), \ \ell = h-a. \tag{5}$$

Substituting these expressions into (1), we obtain the indirect utility function:

$$U^{ij} = U^{ij}(p_1, p_2, p_f, w, z). \tag{6}$$

From (4) - (6), we see that it is full income, not actual income, which is important in determining the level of utility enjoyment, as well as desired consumption and labor supply.

To evaluate the effect of the substitution of a value-added tax for the payroll tax, let us assume that the former is a consumption-type value-added tax, and exemptions are afforded to the production of the second consumption good. In this case, the value-added tax can be considered for analytical purposes a sales tax on the first good. Let x_w be the rate of the payroll tax paid by employees, and x_v be the rate of the value-added tax. Upon replacing p_1 with $(1+x_v)p_1$ and w with $(1-x_w)$ w in (6), then differentiating the resultant indirect utility function and making appropriate substitutions, we obtain:

$$\hat{U}^{ij} = \lambda^{ij}\,[\hat{z} - \delta_1((\hat{1+x_v})+\hat{p}_1) - \delta_2\hat{p}_2 - \delta_f\hat{p}_f - \delta_a((\hat{1-x_w})+\hat{w})], \tag{7}$$

where $\lambda = (U_a^{ij}/U^{ij})(z/w) = U_z^{ij}z/U^{ij}$ is the income elasticity of the utility function, $\delta_n = p_n c_n/z$ is the fraction of full income allocated to the purchasing of good n (n=1, 2, f, a), and a hat (^) over a variable denotes the relative rate of change of that variable brought about by the tax substitution. While λ is not directly observable, we can approximate (7) without apology by the terms inside the brackets,[4] i.e., by

$$\hat{I} = \hat{z} - \delta_1((\hat{1+x_v})+\hat{p}_1) - \delta_2\hat{p}_2 - \delta_f\hat{p}_f - \delta_a((\hat{1-x_w})+\hat{w}). \tag{8}$$

Clearly, the first term represents the sources side, while the remaining terms represent the uses side, of the effect of the tax substitution on income.

Before we further expand (8), a word must be said about the transfers component of income. In a recent paper, Browning [1978] has argued that government transfers have become an important source of income, especially for the lower-income classes, and that once the existence of transfer income is incorporated into the general equilibrium analysis of tax incidence a very different pattern of burdens emerges for some taxes. In particular, he shows that when low-income families have a large proportion of their income in the form of transfers, excise and sales taxes, which have been shown in existing studies to be a major regressive element of the tax system, are now quite progressive. His argument relies on, among others, the assumptions that all individuals allocate the same fraction of their income on each good, and that transfers are constant in real terms. The former assumption contradicts the findings of cross-sectional studies of the consumption function. While some transfers are now fully indexed, others are not. Even those which are fully indexed are indexed according to the Consumer Price Index instead of the GNP deflators used in the Browning study.[5] Nonetheless, on theoretical grounds, there is a merit in taking into explicit account the transfer component of income. What has to be determined is the degree of indexation that transfers are actually accorded. Let us assume that

$$T = T_{-1} \cdot [((1+x_v)p_1)^{\sigma\beta} \; p_2^{\sigma(1-\beta)}] \tag{9}$$

This implies that

$$\hat{T} = \sigma [\beta((\hat{1+x_v})+\hat{p}_1) + (1-\beta)\hat{p}_2], \tag{10}$$

where $\beta = \eta_1^a / (\eta_1^a + \eta_2^a)$, η_n^a is the fraction of aggregate actual income spent on good n, and a hat over a variable denotes the relative rate of change of that variable. The bracketed expression in (10) is therefore equal to the

rate of change in the consumer price index. If $\sigma = 1$, transfers are fully indexed; if $\sigma < 1$, they are only partially indexed.

Upon expanding (8) and taking into account (10), we obtain:

$$\hat{I}^{ij} = (\gamma_a^{ij}-\delta_a^{ij})[(\hat{1-x_w})+\hat{w}] + \gamma_k^{ij}(\hat{rp_f}) + (\gamma_T^{ij}\sigma\beta-\delta_1^{ij})[(\hat{1+x_v})+\hat{p}_1]$$

$$+ [\gamma_T^{ij}\sigma(1-\beta)-\delta_2^{ij}]\hat{p}_2 - \delta_f^{ij}\hat{p}_f. \qquad (11)$$

Here, γ_a^{ij}, γ_k^{ij} and γ_T^{ij} are fractions of full income derived from labor, capital and transfers, respectively. γ_m^{ij} and δ_n^{ij} are fractions of full income. It is, however, more convenient to translate these fractions from fractions of full income to fractions of actual income as follows:

$$\gamma_m^{ij} = (1-\delta_a^{ij})\theta_m^{ij}, \quad \gamma_a^{ij} = (1-\delta_a^{ij})\,\ell^{ij}/\alpha^{ij}, \quad m = k, T;$$

$$\delta_n^{ij} = (1-\delta_a^{ij})\eta_n^{ij}, \quad n = 1,2,f.$$

Here, θ_m is the fraction of actual income derived from source m, η_n is the fraction of actual income spent on good n, and $\alpha = \ell/h$. As can be seen from (11), the distributional effect of tax substitution depends on the relationship between actual and full income, the fractions of income derived from each source and spent on each good, the degree of indexation of transfers, as well as the relationship between individual and aggregate allocation of expenditures. In particular, given that transfers are indexed, an increase in the price of good 1 brought about by the imposition of the VAT reduces real income only to the extent that $\delta_1^{ij} < \gamma_T^{ij}\sigma\beta$.

We have yet to determine the extent of the changes in the output prices and factor rewards brought about by the tax substitution. For this purpose, the Harberger-type model will be assumed. As before, the economy is divided into three production sectors. The first two sectors produce consumption goods while the last produces capital goods. Furthermore, the first sector is subject to the VAT (value-added tax). The following equations specify the supply side of the model.

$$O_i = F^i(K_i, L_i), \quad i = 1, 2, f; \tag{12}$$

$$p_i F^i_K(K_i, L_i) = rp_f; \tag{13}$$

$$p_i F^i_L(K_i, L_i) = (1+x_e)w; \tag{14}$$

$$K_1 + K_2 + K_f = K; \tag{15}$$

$$L_1 + L_2 + L_f = L(.) \quad . \tag{16}$$

In (12), the production functions are assumed to exhibit neoclassical properties: that is, they are homogeneous of degree 1, with positive but diminishing marginal products. Equations (13) and (14) determine the demand for capital and labor, respectively, with the wage cost including employers' contribution to social security at the rate of x_e.
(15) and (16) are the equilibrium conditions for the factor markets, which require that the demand for (i.e., the left-hand side) and the supply (i.e., the right-hand side) of each factor of production must be equal. In the short run, the supply of capital is inelastic but the supply of labor is dependent upon the wage rate, among others. The aggregate supply of labor can be derived by adding up individual supply functions derived in (5),

$$L(.) = \sum_i \sum_j \ell^{ij} ((1+x_v)p_1, p_2, p_f, (1-x_w) w, z). \tag{17}$$

To complete the model, we need the equilibrium conditions for the output markets. These conditions are specified in the following equations:

$$D_n(.) = Q_n(.), \quad n=1,2,f; \tag{18}$$

$$D_n(.) = \sum_i \sum_j c_n^{ij} ((1+x_v)p_1, p_2, p_f, (1-x_w) w, z). \tag{19}$$

(19) says that the aggregate demand for each good n (n=1,2,f) is equal to the sum of individual demands for that good as determined in (4). (18) says that the markets for final outputs are in equilibrium when the demand for and the supply of each good are equal.

If transfers are absent or are fully indexed, the above system determines only the relative prices. If, however, transfers are present and are only partially indexed, the absolute prices are determined.. For expository convenience, let us consider the case in which all three sectors have the same relative factor intensities: that is, the three production functions differ from each other by only a scalar factor. In this case, because of the assumption of perfect factor mobility implicitly made in (13) and (14), the relative prices of all three goods received by producers must then be constant. Equilibrium conditions (18) and (19) now determine only the output composition but not prices, absolute or relative. Equations (13) and (14) can be further solved for the equilibrium relationship between the real rate of return on capital and the cost of per unit of labor services to employers. The latter include both the wage compensations and employers' contributions to social security. Thus

$$r = \phi ((1+x_e) w/p), \quad \phi' < 0. \tag{20}$$

If the production function is of the Cobb-Douglas form, the above factor-price frontier can be written as

$$r = A((1+x_e)\ w/p)^{-(1-\pi)/\pi}, \tag{20a}$$

where A is a constant and π is the share of capital in total output. The elasticity of r with respect to the real wage rate is therefore equal to the share of labor relative to the share of capital. Equations (9) , (17) and (20) now jointly determine the wage rate, the rate of return on capital and the price level. Because the relative prices received by producers are constant, the VAT must be shifted forward completely. The payroll tax, on the other hand, can be shifted either way depending upon the elasticities of the demand and the supply of labor. The distributional implications are different unless all individuals receive the same fraction of income from each source.

If the relative factor intensities differ from sector to sector, the imposition of the VAT also alters the price received by producers of good 1 relative to those received by producers in the two other sectors. As a result, the VAT may be shifted only partially forward, and a portion of the tax burden falls on either capital or labor.

2. EMPIRICAL RESULTS

The data for this analysis are drawn mainly from the consumer expenditure survey (CEX) conducted by the Bureau of Labor Statistics during 1972 - 73.[6] Among the 19975 records in the CEX, 18903 records contain complete information about income and are used in the present analysis. The households are divided into five after-tax income classes and two age groups: those whose heads are younger than 62 and those whose heads are 62 or older. The age group of 62+ count for only 25% of the population but, as can be expected, proportionately more of them belong to the lower ends of income distribution Table 1 shows that more than 50% of the lowest quintile belong to this age group while more than 90% of the highest quintile are younger than 62. The mean after-tax household income of this age group, $6,703 in 1972 dollars, is only 60% of that of the age group of less than 62 ($11,206). For the purposes below, we shall call the <u>parity</u> the ratio of the mean income of this age group to the mean income of the age group of less than 62. It is also useful to summarize the distribution of income in terms of a simple index. Three commonly-used indexes are the Gini coefficient, the variance of the logs of income and the coefficient of variation. The Gini coefficient is a summary measure of the Lorenz curve. It is defined as the ratio of the area between the Lorenz curve and the diagonal to the total area under the diagonal in the square whose two axes are cumulative share of income and cumulative share of population. Following Theil [1967], this measure can be defined numerically as

$$G = \frac{(1/n^2)\sum\sum_{ij}|Y_i - Y_j|}{2\bar{Y}} \quad , \tag{21}$$

where Y_k is the income of the k-th economic unit (k=i,j), $\bar{Y}$ is the mean income of

TABLE 1. AGE PROFILE OF INCOME DISTRIBUTION

RANK	L62	62+	TOTAL
20%	46.22	53.77	100.00
40%	65.24	34.75	100.00
60%	83.90	16.09	100.00
80%	89.51	10.48	100.00
100%	91.05	8.94	100.00
TOTAL	75.19	24.80	100.00

the population, and n is the size of the population. This coefficient is a decreasing function of the equality and is equal to zero when the distribution is perfectly equal. The variance of logs of income and the coefficient of variation are, respectively, given by

$$LV = (1/n)\Sigma(\log Y_j - \log\bar{Y})^2, \tag{22}$$

$$S = (1/n)(\Sigma(Y_j - \bar{Y})^2)^{1/2} / \bar{Y} . \tag{23}$$

Among these three measures, the coefficient of variation attaches equal weight to transfers at different income levels, the Gini coefficient attaches more weight to transfers affecting middle-income classes, and the log variance weights transfers at the lower ends more heavily.[7] The Gini coefficient computed before the tax substitution from the CEX is equal to .354; the log variance is equal to .603, and the coefficient of variation is equal to .646[8] (see Table 8).

Tables 2 and 3 present the sources and uses of income.[9] In each age group, the percentage of transfers in total actual income is higher the lower is the income bracket. In the age group of less than 62, transfers constitute 50% of the income of the lowest quintile but only 7% of the income of the highest quintile. In the age group of 62 and over, they constitute 86% of the income of the lowest bracket, compared to 23% for the highest bracket. Between the two age groups, the older group receive far more transfers; their mean transfer income is $3,300, or 50% of mean total income, compared to $1,217 or 11% of mean total income for the age group of less than 62.

The uses of income are divided into three categories: consumption expenditures that constitute the potential base of the VAT, consumption expenditures that are potentially exempt from the VAT, and personal savings.

TABLE 2: SOURCES OF INCOME.

RANK	LABOR INC	CAPT INC	TRANS INC	TOTAL INC
		LT62:		
20%	1012.(44.)	132.(6.)	1143.(50.)	2287.(100.)
40%	3867.(70.)	404.(7.)	1251.(23.)	5522.(100.)
60%	7015.(81.)	599.(7.)	1064.(12.)	8678.(100.)
80%	10427.(85.)	772.(6.)	1108.(9.)	12307.(100.)
100%	16682.(79.)	2892.(14.)	1479.(7.)	21053.(100.)
TOTAL	8880.(79.)	1109.(10.)	1217.(11.)	11206.(100.)
		62+:		
20%	126.(5.)	234.(9.)	2166.(86.)	2526.(100.)
40%	942.(16.)	952.(16.)	3882.(67.)	5776.(100.)
60%	3181.(35.)	1790.(20.)	4168.(46.)	9139.(100.)
80%	6186.(48.)	2329.(18.)	4325.(34.)	12840.(100.)
100%	10219.(43.)	8242.(35.)	5379.(23.)	23840.(100.)
TOTAL	1998.(30.)	1385.(21.)	3320.(50.)	6703.(100.)
		AGGREGATE:		
20%	540.(22.)	182.(8.)	1693.(70.)	2415.(100.)
40%	2861.(51.)	583.(10.)	2166.(39.)	5610.(100.)
60%	6399.(73.)	790.(9.)	1562.(18.)	8751.(100.)
80%	9979.(81.)	938.(8.)	1445.(12.)	12362.(100.)
100%	16091.(76.)	3383.(16.)	1828.(9.)	21302.(100.)
TOTAL	7174.(71.)	1177.(12.)	1739.(17.)	10090.(100.)

In the absence of any exemption, all consumption expenditures are subject to the consumption-type VAT. However, as a practical matter, exemptions are likely to be afforded to certain consumption goods, such as food, medical care and housing. Classification of expenditures used in Table 3 follows quite closely that of McLure [1973]. Items included in the tax base under the assumption of liberal exemptions are alcohol and tobacco, housing repairs, household operations, household furnishings and equipment, clothing, vehicle purchases, vehicle rent and maintenance, gasoline and oil, recreation, and insurance. The tax base so computed is equal to 49% (=$4238/($4238+$4377), see last line, table 3) of total consumption expenditures. The tax base under the assumption of limited exemptions includes, in addition to items mentioned above, food and medical-care expenses, and is equal to 74% (=$6381/($6381+$2234), see last line, panel A, table 3) of total consumption expenditures.[10] Under either classification, the age group of 62 and over spends a smaller fraction of income on goods subject to the VAT. Likewise, in each age group, the poor buy less of the VA-taxed goods than the rich.

In the following computations, we assume that a 5% VAT is imposed with which to replace a portion of payroll taxes, and the reduction in payroll tax liabilities is uniform among all income classes.[11] Furthermore, the fraction of after-tax income allocated by each cohort to each expenditure category is unaffected by the tax substitution. This amounts to assuming that the utility function is of the Cobb-Douglas form. An important factor affecting its distributional impact is of course the shifting pattern of the taxes. Four cases are considered, respectively, in Tables 4-7. Table 4 assumes that employees' portion of payroll taxes is borne by the employees while employers' portion is borne by the employers; thus each percentage point of reduction in combined payroll taxes reduces the wage cost paid by employers by .5 percentage-

TABLE 3 : USES OF INCOME

(A) Limited Exemptions

RANK	VAT CONS	NONVAT CONS	SAVINGS	TOTAL INC
		LT62:		
20%	2767.(121.)	1313.(57.)	-1793.(-78.)	2287.(100.)
40%	4389.(79.)	1661.(30.)	-528.(-10.)	5522.(100.)
60%	6114.(70.)	2062.(24.)	502.(6.)	8678.(100.)
80%	8034.(65.)	2519.(20.)	1754.(14.)	12307.(100.)
100%	11392.(54.)	3796.(18.)	5865.(28.)	21053.(100.)
TOTAL	7141.(64.)	2427.(22.)	1638.(15.)	11206.(100.)
		62+:		
20%	2153.(85.)	969.(38.)	-596.(-24.)	2526.(100.)
40%	3913.(68.)	1481.(26.)	382.(7.)	5776.(100.)
60%	5530.(61.)	1878.(21.)	1731.(19.)	9139.(100.)
80%	7085.(55.)	2319.(18.)	3436.(27.)	12840.(100.)
100%	10242.(43.)	5081.(21.)	8517.(36.)	23840.(100.)
TOTAL	4086.(61.)	1640.(24.)	977.(15.)	6703.(100.)
		AGGREGATE:		
20%	2438.(101.)	1126.(47.)	-1149.(-48.)	2415.(100.)
40%	4223.(75.)	1599.(29.)	-212.(-4.)	5610.(100.)
60%	6020.(69.)	2032.(23.)	699.(8.)	8751.(100.)
80%	7936.(64.)	2496.(20.)	1930.(16.)	12362.(100.)
100%	11290.(53.)	3910.(18.)	6102.(29.)	21302.(100.)
TOTAL	6381.(63.)	2234.(22.)	1475.(15.)	10090.(100.)

(B) Liberal Exemptions

RANK	VAT CONS	NONVAT CONS	SAVINGS	TOTAL INC
		LT62:		
20%	1800.(79.)	2280.(100.)	-1793.(-78.)	2287.(100.)
40%	2797.(51.)	3253.(59.)	-528.(-10.)	5522.(100.)
60%	4059.(47.)	4117.(47.)	502.(6.)	8678.(100.)
80%	5427.(44.)	5126.(42.)	1754.(14.)	12307.(100.)
100%	7989.(38.)	7199.(34.)	5865.(28.)	21053.(100.)
TOTAL	4842.(43.)	4726.(42.)	1638.(15.)	11206.(100.)
		62+:		
20%	1047.(41.)	2075.(82.)	-596.(-24.)	2526.(100.)
40%	2224.(39.)	3170.(55.)	382.(7.)	5776.(100.)
60%	3310.(36.)	4098.(45.)	1731.(19.)	9139.(100.)
80%	4616.(36.)	4788.(37.)	3436.(27.)	12840.(100.)
100%	7133.(30.)	8190.(34.)	8517.(36.)	23840.(100.)
TOTAL	2412.(36.)	3314.(49.)	977.(15.)	6703.(100.)
		AGGREGATE:		
20%	1395.(58.)	2169.(90.)	-1149.(-48.)	2415.(100.)
40%	2598.(46.)	3224.(57.)	-212.(-4.)	5610.(100.)
60%	3939.(45.)	4113.(47.)	699.(8.)	8751.(100.)
80%	5344.(43.)	5088.(41.)	1930.(16.)	12362.(100.)
100%	7914.(37.)	7286.(34.)	6102.(29.)	21302.(100.)
TOTAL	4238.(42.)	4377.(43.)	1475.(15.)	10090.(100.)

points and it raises the after-tax income received by employees by .5 percentage points. Note that the reduced payment of the payroll tax is worth more to the individual than an increase in the wage rate by the same amount because the latter is subject to income taxation. Assuming that the marginal income tax rate (x_y) is 30 percent, the increase in disposable income resulting from a one-percentage point increase in the wage rate is only .7 percentage points while that resulting from a one percentage-point reduction in the payroll tax is one full percentage point. This is shown in equation (11) by the fact that the coefficient of $\hat{x}_w$ is augmented by $x_w/(1-x_y-x_w)$.[12] As can be seen from equation (20), the elasticity of the real rate of return on capital with respect to the real wage rate is equal to the share of labor to the share of capital, which is 3, given that the share of labor is .75 and the share of capital is .25 . Therefore, if the employers' portion of the payroll tax cut were completely passed on to consumers in the form of lower prices, the cut in the price level would have been equal to .75x.5 = .375 percentage points for each percentage point of reduction in payroll taxes, where .75 is the share of labor and .5 is the reduction in the wage rate resulting from the cut in payroll taxes. If, on the other hand, the employers' portion of the tax cut were completely absorbed by capital without causing any change in prices, the increase in capital income would have been .5x3.=1.5 percentage points for each percentage point of the tax cut, where .5 is the reduction in the wage rate due to the decrease in payroll taxes and 3 is the elasticity of the factor-price frontier.

Panel A, table 4 represents the distributional effect of a 5% VAT under the assumption of limited exemptions. The mean before-tax gross labor income in the CEX is $8958, of which 79% is covered by social security (based on the 1972 figure from the Social Security Bulletin, Annual Statistical Supplement, 1976).

TABLE4: REDISTRIBUTIONAL EFFECTS OF TAX SUBSTITUTION.
TRANSFERS ARE 1.000 INDEXED, AND PAYROLL TAX IS .500 BACKWARD SHIFTED.
1.000 OF THE FORWARD SHIFT RESULTS IN PRICE INCREASE.

RANK	(1) LT62	(2) 62+	(3) TOTAL	(4) LFCYCLE	(5) LT62	(6) 62+	(7) TOTAL	(8) LFCYCLE
	ACTUAL INC				FULL INC			
				(A) LIMITED EXEMPTIONS				
				IMPOSITION OF A VAT OF .050				
20]	-6.03	-4.23	-5.02	-5.48	-5.05	-1.11	-4.57	-3.84
40]	-3.97	-3.36	-3.75	-3.79	-3.70	-1.43	-3.56	-3.03
60]	-3.52	-3.01	-3.43	-3.37	-3.44	-1.71	-3.38	-2.93
80]	-3.26	-2.75	-3.21	-3.11	-3.23	-1.88	-3.18	-2.84
100]	-2.70	-2.14	-2.65	-2.53	-2.69	-1.69	-2.65	-2.38
TOTAL	-3.18	-3.03	-3.16	-3.15	-3.05	-1.29	-3.07	-2.71
				ROLLBACK OF THE PAYROLL TAX BY .036				
20]	2.61	1.63	2.05	2.31	2.19	.44	1.87	1.65
40]	3.28	1.89	2.78	2.87	3.06	.82	2.64	2.40
60]	3.62	2.42	3.42	3.26	3.54	1.38	3.36	2.90
80]	3.77	2.83	3.67	3.50	3.74	1.95	3.64	3.22
100]	3.70	2.75	3.60	3.40	3.68	2.18	3.59	3.21
TOTAL	3.64	2.31	3.42	3.39	3.49	.99	3.33	3.01
				COMBINED EFFECTS				
20]	-3.42	-2.60	-2.97	-3.17	-2.86	-.67	-2.70	-2.19
40]	-.69	-1.47	-.97	-.92	-.64	-.62	-.92	-.63
60]	.10	-.59	-.01	-.10	.10	-.33	-.01	-.03
80]	.51	.09	.47	.39	.51	.06	.46	.38
100]	1.00	.61	.96	.88	.99	.49	.95	.83
TOTAL	.46	-.72	.27	.23	.44	-.29	.26	.20
				(B) LIBERAL EXEMPTIONS				
				IMPOSITION OF A VAT OF .076				
20]	-5.97	-3.12	-4.37	-5.10	-5.00	-.62	-3.98	-3.72
40]	-3.85	-2.90	-3.51	-3.57	-3.59	-1.24	-3.33	-2.90
60]	-3.55	-2.74	-3.42	-3.31	-3.47	-1.56	-3.36	-2.91
80]	-3.35	-2.72	-3.29	-3.17	-3.33	-1.87	-3.26	-2.90
100]	-2.89	-2.27	-2.82	-2.69	-2.87	-1.79	-2.81	-2.54
TOTAL	-3.28	-2.72	-3.19	-3.17	-3.15	-1.16	-3.11	-2.76
				ROLLBACK OF THE PAYROLL TAX BY .036				
20]	2.64	1.64	2.08	2.33	2.22	.44	1.89	1.67
40]	3.31	1.91	2.81	2.90	3.09	.83	2.67	2.42
60]	3.66	2.44	3.46	3.30	3.58	1.40	3.40	2.93
80]	3.81	2.86	3.71	3.53	3.78	1.97	3.68	3.25
100]	3.74	2.78	3.64	3.44	3.72	2.21	3.62	3.25
TOTAL	3.68	2.34	3.46	3.42	3.53	1.00	3.37	3.04
				COMBINED EFFECTS				
20]	-3.33	-1.48	-2.29	-2.76	-2.79	-.37	-2.09	-2.05
40]	-.53	-.99	-.70	-.67	-.50	-.41	-.67	-.47
60]	.11	-.30	.04	-.01	.11	-.16	.04	.03
80]	.46	.14	.43	.37	.46	.10	.42	.35
100]	.85	.52	.82	.75	.85	.41	.82	.71
TOTAL	.40	-.38	.27	.25	.38	-.15	.26	.28

The VAT base per economic unit under limited exemptions is $6381. Therefore, ignoring the indirect effects of the tax changes, the 5% VAT enables a rollback of combined payroll taxes by 4.6 percentage points (=.05x$6381/(.79x$8958)) or 3.6 percentage points in effective rate (as a percentage of total labor income instead of covered income). Other assumptions employed here are (1) the VAT is completely shifted forward, (2) the employers' portion of the burden of the payroll tax is completely passed on to consumers in the form of lower prices, and (3) transfers are fully indexed. Assumption (3) follows Browning [1978]. By assumptions (1) and (2), the effect of a 5 percent VAT with limited exemptions accompanied by a rollback of the payroll tax by 3.6 percentage points is to raise the prices of the VA taxed goods by 3.8 percentage points, to reduce other consumer prices and the prices of capital goods 1.2 percentage points, and to reduce the equilibrium wage rate by 2.2 percentage points. By assumption, nominal capital income is unaffected.

As argued in the preceding section, the appropriate measure of the distributional impact of tax substitution is the change in full income. Unfortunately, this is not directly observable. Two possible cases are considered. The first four columns pertain to the case where full income is equal to actual income, while the next four columns pertain to the case where actual income is equal to a fraction, FA, of full income. Certainly, if less-than-full employment is involuntary, the imputed value of nonmarket activity may be considered equal to zero, and the assumption that actual income equals full income is appropriate. If it is voluntary, the imputed value of nonmarket activity is equal to the market wage rate. The assumption made in the determination of FA is that 50% of less-than-full employment is voluntary and the remaining 50% is involuntary.

Columns (1) and (2) in the first section show the direct effect of the

imposition of a 5% VAT on actual income. In spite of full indexation of transfers, on the average no one benefits from the resulting increase in the prices of the VA taxed goods. The reason is that given β=.74(=$6381/($6381+$2234); see last row, table 3(A)), γ_T must be at least 25% higher than δ_1 in order for an individual to benefit from an increase in the prices of the VA-taxed goods, which is not the case for any one of the ten groups. However, lower-income classes are hurt more than the higher-income brackets as they spend a relatively larger portion of their income on those goods which are subject to the VAT. Those younger than 62 are also hurt more than the age group of 62 and over both because they spend relatively more on VA-taxed goods and because, given that transfers constitute a smaller portion of their income, they are not helped as much by the indexation of transfers. Columns (1) and (2) in the second section show the effect of the rollback of combined taxes by 3.6 percentage points. Since they derive a larger portion of income from labor, those younger than 62 benefit more than the age group of 62+ from the rollback of payroll taxes. As can be seen from the last section, with the exception of the two lowest brackets, their gains from the rollback of the payroll tax exceed their losses from the imposition of the VAT. In the age group of 62 and over, on the other hand, only the two highest brackets benefit from the tax substitution. On balance, the age group of 62 - enjoy a gain in real income by .5% while the age group of 62+ suffer a loss in real income by .3%; this is reflected in a reduction in the parity from .598 to .595. In terms of the three indexes summarizing the distribution of income, as can be seen from table 8, the effect of tax substitution is to increase both the Gini coefficient and the coefficient of variation by one percent and to increase the log variance by 3.5 percent. The reason it has a greater impact on the log variance is that it has a larger negative effect on the lower-income brackets and the log

variance is more sensitive to transfers at the lower end of income distribution.

Panel (B), table 4 differs from panel (A) only in that liberal exemptions are now assumed. As can be seen from table 3(B) (last line), the VAT base per economic unit under liberal exemptions is $4238. Thus, to roll back the (combined) payroll taxes by 3.6 percentage points now requires the imposition of the VAT at the rate of 7.6%. The increase in the prices of the VA taxed goods is now 4.9%, while the changes in all other prices and the wage rate are the same as before. As can be seen from the first two columns in the last section, the gains to the age group of 62- and the losses to the age group of 62+ are both smaller than under limited exemptions. Liberalization of exemptions also reduces the losses to the lower brackets and the gains to the higher brackets. Table 8 shows that the proportionate increases in all three indexes of income inequality are less than under limited exemptions.

There is empirical evidence that combined employer and employee taxes may be completely backward shifted.[13] Table 5 shows the distributional effect of the tax substitution for this case. Tables 6 and 7 present, respectively, the cases where transfers are only partially indexed (50%) and where a fraction (50%) of the employers portion of the burden of payroll taxes is passed on to consumers. Two facts stand out. First, the degree of indexation of transfers does not affect significantly the distributional effect of the tax substitution (at least when the changes are marginal). This is true regardless of the extent to which payroll taxes are backward shifted or passed on to consumers; nonetheless, the difference it makes tends to concentrate on the lower ends of income distribution. Second, the direction and the extent to which the burden of payroll taxes is shifted both have greater effects on the distributional impact of the tax substitution. The greater is the burden shifted backward the more likely the tax substitution will increase income

TABLE 5: REDISTRIBUTIONAL EFFECTS OF TAX SUBSTITUTION. (Combined Effects)
TRANSFERS ARE 1.000 INDEXED, AND PAYROLL TAX IS 1.000 BACKWARD SHIFTED.

RANK	(1) LT62	(2) 62+	(3) TOTAL	(4) LFCYCLE	(5) LT62	(6) 62+	(7) TOTAL	(8) LFCYCLE
	ACTUAL INC				FULL INC			
				(A) LIMITED EXEMPTIONS				
20%	-4.15	-4.03	-4.09	-4.12	-3.48	-1.05	-3.72	-2.74
40%	-.97	-2.70	-1.59	-1.48	-.90	-1.15	-1.51	-.98
60%	.02	-1.50	-.24	-.43	.02	-.85	-.23	-.24
80%	.49	-.58	.38	.18	.49	-.40	.37	.23
100%	.88	-.15	.77	.56	.87	-.12	.77	.56
TOTAL	.34	-1.71	.01	-.05	.33	-.73	.01	.15
				(B) LIBERAL EXEMPTIONS				
20%	-4.07	-2.92	-3.43	-3.72	-3.41	-.76	-3.12	-2.60
40%	-.82	-2.23	-1.32	-1.23	-.76	-.95	-1.26	-.82
60%	.02	-1.21	-.19	-.35	.02	-.69	-.19	-.19
80%	.44	-.53	.34	.16	.44	-.37	.33	.20
100%	.73	-.26	.63	.43	.73	-.20	.63	.44
TOTAL	.28	-1.38	.01	-.04	.27	-.59	.01	.10

inequality, the reason being that the backward shift benefits most those who derive the largest portion of their income from labor, namely those in the middle class who are younger than 62. Except when payroll taxes are completely shifted backward, inequality indexes are also higher the smaller is the fraction passed on to consumers. In any case, the Gini coefficient is least sensitive and the log variance is most sensitive to the tax substitution.

In columns (5) and (6), the impact of the tax substitution on the distribution of full income is presented, and is shown to be smaller than that on the distribution of actual income. The reason is that neither the sources nor the uses of income from nonmarket activity are taxed. Nevertheless, the assumption that 50% of less-than-full employment is voluntary across the board is also responsible for this result. It is conceivable that there may be more involuntary less-than-full employment among the lower income brackets than among the higher income classes. If this were the case, the distribution of full income would have been more unequal than that of actual income. On the other hand, if individuals in the higher-income classes suffered more involuntary less-than-full employment, columns (5) and (6) would have overestimated the inequality in the distribution of full income.

From a long-run point of view, it is more interesting to examine the effect of tax substitution on the distribution of lifetime income.[14] Let us write the lifetime budget constraint as

$$\sum_{0}^{t'} [(1+x_v)p_1(t)c_1(t)+p_2(t)c_2(t)]/(1+r)^t + B/(1+r)^{t'} \qquad (24)$$

$$= \sum_{0}^{t'} [(1-x_w)w(t)+T(t)]/(1+r)^t + H,$$

TABLE 6: REDISTRIBUTIONAL EFFECTS OF TAX SUBSTITUTION. (Combined Effects)
TRANSFERS ARE .500 INDEXED, AND PAYROLL TAX IS .500 BACKWARD SHIFTED.
.5 of the burden results in price increase.

RANK	(1) LT62	(2) 62+	(3) TOTAL	(4) LFCYCLE	(5) LT62	(6) 62+	(7) TOTAL	(8) LFCYCLE
	ACTUAL INC				FULL INC			
				(A) LIMITED EXEMPTIONS				
20%	-3.42	-2.61	-2.98	-3.18	-2.87	-.67	-2.71	-2.19
40%	-.69	-1.40	-.98	-.92	-.65	-.62	-.93	-.64
60%	.10	-.60	-.01	-.10	.10	-.33	-.01	-.03
80%	.51	.08	.47	.39	.51	.06	.46	.38
100%	.99	.61	.96	.88	.99	.49	.95	.83
TOTAL	.46	-.72	.27	.23	.44	-.30	.26	.30
				(B) LIBERAL EXEMPTIONS				
20%	-3.34	-1.49	-2.30	-2.77	-2.79	-.38	-2.09	-2.05
40%	-.54	-1.00	-.71	-.67	-.50	-.42	-.67	-.48
60%	.11	-.30	.04	-.02	.10	-.16	.04	.02
80%	.46	.14	.43	.37	.46	.10	.42	.35
100%	.85	.51	.82	.75	.85	.41	.81	.71
TOTAL	.40	-.39	.27	.25	.38	-.15	.26	.28

where H is the amount of inheritance the individual receives from his benefactors, B is the terminal bequests he leaves to his heirs, and t' is the life span. If there are no bequests and transfers, and the VAT is comprehensive so that the p_2c_2 term disappears, then the VAT has the same effect as payroll taxes. The presence of bequest motives and transfers does not alter this conslusion if $B/(1+r)^{t'} = \Sigma T/(1+r) + H$. This is indeed the assumption made by Barro [1974](in the marginal sense) when he argued that social security does not necessarily discourage private savings. If this assumption is violated or if certain consumption goods are exempt from the VAT, then the VAT may have a different effect than payroll taxes. Unfortunately, the cross-sectional data provided by the Consumer Expenditure Survey do not permit us to investigate the distributional effect of the tax substitution on lifetime income except under the extreme assumption that there is no intertemporal mobility between income classes. Those in the age group of 62- who are in the lower income brackets may be poor because they suffer temporary unemployment or because they voluntarily trade their current income for future income by investing in human capital. As soon as they are able to capitalize their investment in human capital or the causes for their unemployment or withdrawal from the labor market are removed, they will be able to move up in the income distribution. Likewise, those who are currently in the higher brackets may suffer downward mobility. Therefore, to accurately evaluate the distributional impact of the tax substitution on lifetime income, we must take into account the intertemporal mobility of households between income classes, which is not permitted by our data. The conclusion reached here regarding the distribution of lifetime income can at best be considered tentative. If the real rate of interest is equal to the growth rate of the population, the effect of the tax substitution on lifetime income can be approximated by the change of the mean income of combined age groups

TABLE 7: REDISTRIBUTIONAL EFFECTS OF TAX SUBSTITUTION. (Combined Effects)
TRANSFERS ARE 1.000 INDEXED, AND PAYROLL TAX IS .500 BACKWARD SHIFTED.
.2500 of the burden results in price increase.

RANK	(1) LT62	(2) 62+	(3) TOTAL	(4) LFCYCLE	(5) LT62	(6) 62+	(7) TOTAL	(8) LFCYCLE
	ACTUAL INC				FULL INC			
				(A) LIMITED EXEMPTIONS				
20]	-3.87	-2.86	-3.32	-3.56	-3.24	-.73	-3.02	-2.47
40]	-1.06	-1.33	-1.17	-1.14	-.99	-.56	-1.11	-.86
60]	-.28	-.29	-.29	-.29	-.28	-.16	-.28	-.24
80]	.09	.31	.11	.15	.09	.22	.11	.13
100]	.98	1.73	1.06	1.21	.97	1.37	1.05	1.10
TOTAL	.23	-.36	.14	.12	.22	-.14	.13	.15
				(B) LIBERAL EXEMPTIONS				
20]	-3.78	-1.74	-2.65	-3.16	-3.17	-.44	-2.41	-2.33
40]	-.91	-.86	-.90	-.89	-.84	-.35	-.86	-.70
60]	-.29	.01	-.24	-.20	-.28	.01	-.23	-.19
80]	.03	.37	.07	.13	.03	.26	.07	.10
100]	.83	1.64	.92	1.09	.83	1.30	.91	.98
TOTAL	.17	-.02	.14	.13	.16	.00	.14	.13

in each income class. This is shown in columns (3) and (7), table 4, for actual income and full income, respectively. Columns (4) and (8) assume that the real rate of interest is equal to 3% and the income of the representative individual in each income bracket is given by column 4, table 2 (e.g., $2506 for the lowest quintile) until he is 62, and is given by column 8, $2567 for the lowest quintile) for age 62 until the end of his life. The results obtained in either columns (3) or (4) are intermediate between those shown in columns (1) and (2). In other words, the distributional impact of the tax substitution on lifetime income is between its impact on the current income of the two age groups. The higher is the interest rate, the closer it is to the impact on the current income of the age group of 62-, and vice versa. One thing, however, is clear. The tax substitution brings small gains to the two highest income brackets at much greater costs to the lower brackets. In terms of summary indexes for income inequality, the before-tax-substitution Gini coefficient of the distribution of income among the age group of 62- is .31379 for current income and .35290 for lifetime income. The effect of the partial tax substitution is to raise the former by 1.10% and the latter by 1.2%. Given that there is no income mobility, the adverse impact of the tax substitution on income distribution is likely to be greater over the lifecycle of the economic unit than within the current period.

Table 8: Summary of the Effect of Replacing 3.6% of the Payroll Tax with a Value-Added Tax

Indexation of Transfers	Backward Shift of Payroll Tax	Burden of Payroll Tax Borne by Consumers	Exemption Status	Gini Coefficient	Log Variance	Coefficient of Variation	Parity
Before Tax Substitution				.35445	.60284	.64568	.59816
100(%)	50(%)	50(%)	LM	+ 1.20(%)	+ 4.09(%)	+1.25(%)	-.05(%)
			LB	+ 0.95	+ 3.25	+0.98	-.04
100	100	0	LM	+ 1.41	+ 5.15	+1.46	-.03
			LB	+ 1.16	+ 4.28	+1.19	-.03
50	50	50	LM	+ 1.20	+ 4.10	+1.26	-.05
			LB	+ 0.96	+ 3.27	+0.99	-.04
100	50	25	LM	+ 1.43	+ 4.45	+1.54	-.02
			LB	+ .118	+ 3.59	+1.27	-.01

* LM = Limited Exemptions, LB = Liberal Exemptions.

3. CONCLUDING REMARKS

The results obtained in this paper suggest that, at least in the marginal sense, the distributional effect of the partial substitution of a consumption-type VAT for the payroll tax is more sensitive to the shifting pattern of the burden of the payroll tax than to the extent of the indexation of transfers. In any case, such partial substitution of taxes tends to affect most adversely individuals in the lowest income brackets. Our results suggest tentatively that the redistribution effect of the tax substitution tend, under certain conditions, to be less on full income and lifetime income than on actual current income. Lack of data has forced us to make two heroic assumptions. First, the fraction of wage income covered by social security is identical for all income classes. Because of the existence of taxable maximum, the actual coverage rate is lower for those whose income exceeds taxable maximum. Thus this assumption tends to overstate the gains of the reduction of payroll taxes to the upper-income classes. Second, the burden of the VAT is assumed to be shifted forward completely. This assumption can be justified if all industries have the same capital/labor ratio and there is perfect capital mobility. If these conditions are not satisfied, the above assumption will overstate the losses to the upper-income classes who spend a larger portion of income on VA-taxed goods. On balance, the biases in the estimated redistributional effects are likely to be small.

FOOTNOTES

1. The author wishes to thank R. Dye, J. Hambor, M. Packard, P. Petri and especially B. Bridges for valuable comments and suggestions on an earlier version of this paper.

2. See, for example, the report of the 1979 Advisory Council on Social Security.

3. See, for example, remarks by Rep. Al Ullman at a conference on the value-added tax sponsored by the Chamber of Commerce of the U.S., September 1979; G. M. Brannon, "The Value-Added Tax Again - and Again," Tax Notes, December 18, 1978, p. 691; J. Pechman, "Value Added Tax: The Case Against," Tax Notes, January 22, 1979, p. 83.

4. See Willig [1976] for justification.

5. For critiques of Browning [1978], see Meerman [1980] and Smeeding [1979].

6. Based on the extract prepared by P. Petri of Brandeis University and B. Wixon and S. Johnson of the Social Security Administration.

7. See Atkinson [1970].

8. Separately, Brittain [1972, p. 197] has estimated the Gini coefficient for the Social Security population to be within the range between .46 and .50 for the period of 1951-1969.

9. Capital income and labor income in Table 2 are after-tax incomes computed according to the following formula:

$$Y_i^a = Y_i^b[1 - \text{Taxes}/(Y_k^b + Y_\ell^b)], \quad i = k, \ell$$

where Y_i^a and Y_i^b are, respectively, the after-tax and before-tax income of factor i, and Taxes include all taxes paid by individuals, such as federal, state, and local income taxes, property taxes, and social security taxes.

10. The base of the VAT in 1970 computed by McLure from the NIPA is equal to 46.6% of total consumption expenditures under liberal exemptions and 75.5% of total consumption expenditures under limited exemptions.

11. Other scenarios are possible: for example, changes in payroll taxes can take the form of changes in the taxable maximum. See Bridges [1977].

12. Assume that the individual pays an income tax of x_y and a payroll tax of x_w. Then the w term in (2) becomes $(1-x_y-x_w)\,w$. Upon differentiation, we have

$$((1-x_y-x_w)w)\hat{} = \left(\frac{-x_w}{1-x_y-x_w}\right)\hat{x}_w + \hat{w}.$$

In actual computation, this replaces the first bracketed expression, $(1-x_w)\hat{}+\hat{w}$, in (11), and $1-x_y-x_w$ is approximated by the ratio of disposable to gross income.

13. Hagens and Hambor [1979] have reported that about 60% of combined employer and employee social insurance taxes, including unemployment insurance contributions, are backward shifted after three years, while 90% of OASDHI payroll taxes are shifted backward after three years.

14. See Whalley [1979] for discussions of the relationship between income and consumption taxes in the lifecycle model.

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