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October 1985

CEPR Publication No. 61

THE EFFICIENCY COST OF ACHIEVING PROGRESSIVITY BY USING EXEMPTIONS

by

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This work was supported by United States Treasury Department Contact No. OS-84-1657 and by Stanford University's Center for Economic Policy Research. The views expressed in it, however, are those of the authors only. The authors would like to thank John Karl Scholz for his extremely able assistance.

1. Introduction

In the decade following the Second World War, some of the nations of Western Europe began to adopt value-added taxes (VATs). Since then, the VAT has continued to grow in importance. More nations have adopted the tax, and the rates of tax have increased substantially in many nations. Given the increased popularity of the VAT, it is not surprising that some have advocated adopting a VAT in the United States. Even though the U.S. Department of the Treasury decided not to call for adoption of a VAT in its recent report, some members of Congress are interested in the VAT as a means to raise revenue.*

This paper examines the efficiency properties of introducing a value-added tax in the United States. In particular, we compute the efficiency-equity tradeoff offered by a VAT, using an applied general equilibrium model of the U.S. economy and tax system. We examine simulations in which the value-added tax revenues are used to scale back the personal income tax. We look at both a uniform rate VAT and one which has a pattern of differentiated rates similar to those existing in Europe. The major research question we address is how much progressivity can be achieved with differentiated rates, and at what cost in terms of economic efficiency. We also report on the differences between a consumption-type and an income-type value-added tax.

In the next section, we describe the structure of the model. We devote special attention to a linear expenditure system of demands. This is a new feature of the model, developed especially for our work on value-added taxes. In section 3, we report our simulation results. In the final section, we

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* See Jeffrey Birnbaum, "Senate Finance Panel Members Begin Talking About Consumption Tax to Raise New Revenue," Wall Street Journal, June 26, 1985.

attempt to draw conclusions from the analysis about the efficiency characteristics of alternative VAT forms and particularly about the use of differentiated rates to achieve progressivity.

2. Description of the Model

Arnold Harberger has exerted an immense influence on the field of economics known as computational general equilibrium analysis. Harberger did not use the same computational procedures that we use in this model, but a great number of the assumptions he uses in his 1962 and 1966 papers are incorporated here. We use the price of labor services as the numeraire in the model. We adopt Harberger's units convention, namely, that a physical unit of a good or factor is the amount that sells for one dollar in the initial equilibrium. Within any one period, we adopt Harberger's assumption on the time frame: the period is sufficiently long to allow capital to be allocated freely among sectors, but sufficiently short so that the aggregate quantity of capital is fixed. In addition, our model retains the flavor of Harberger's analysis in that it uses assumptions of perfect competition throughout.

Our model is described in detail in Ballard, Fullerton, Shoven, and Whalley (1985). We provide a brief description here. The model is a medium scale computational general equilibrium model, calibrated to 1973 data for the United States. It combines a treatment of the entire U.S. (federal, state, and local) tax system with competitive consumer and producer behavior. For each tax policy considered, such as the introduction of a VAT, equilibrium prices and quantities are determined. The counter-factual equilibrium (or path of equilibria) is compared with the no-policy-change equilibrium situation. The model can adjust other taxes endogenously so as to maintain total government revenue. The key elasticities in the model are the labor supply elasticity (which, for our standard cases, is set at 0.15) and the elasticity of saving with respect to the real interest rate (set at 0.4). The total endowment of labor grows at an exogenous rate of 2.75 percent per year. In the base case (i.e., with no policy change), the model grows from the 1973 benchmark data in a steady-state manner.

We identify nineteen producer good industries, sixteen consumer expenditure items, and twelve consumer types which are classified by income range. These are shown in Table 1. Capital and labor services are the primary factor inputs used by industry, and these are owned by consumer groups in different proportions. These two factors are mobile between industries, and their use is dictated by the zero-profit conditions of perfectly competitive markets.

The model requires the assembly of a comprehensive and consistent micro-economic data set. Such a data set is essential for general equilibrium analysis of taxation policy. This data set provides information on factor use and factor taxes by industry, intermediate use of products, outputs of both producer and consumer goods, purchases of consumer goods by household type, incomes by source and by household type, income taxes paid, and several other items such as business investment and foreign trade. The complete 1973 data set used to calibrate the model is derived from five major sources. These include the July, 1976 Survey of Current Business, unpublished worksheets of the U.S. Commerce Department's National Income Division, the Commerce Department's Bureau of Economic Analysis Input/Output tables, the U.S. Labor Department's 1973 Consumer Expenditure Survey, and the U.S. Treasury Department's Merged Tax File.

In order to generate a consistent data set, a number of adjustments are made. All data on industry and government uses of factors are accepted as given, while the data on consumer factor incomes and expenditures are correspondingly adjusted. Tax receipts, transfers, and government endowments

TABLE 1

Classification of Industries, Consumer Expenditures, and Consumer Groups In the Model

Industries	Consumer Expenditures
1. Agriculture, Forestry, and Fisheries	1. Food
2. Mining	2. Alcoholic Beverages
3. Crude Petroleum and Gas	3. Tobacco
4. Contract Construction	4. Utilities
5. Food and Tobacco	5. Housing
6. Textiles, Apparel, Leather Products	6. Furnishings
7. Paper and Printing	7. Appliances
8. Petroleum Refining	8. Clothing and Jewelry
9. Chemicals and Rubber	9. Transportation
10. Lumber, Furniture, Stone	10. Motor Vehicles, Tires, and Auto Repair
11. Metals, Machinery, Miscellaneous Manufacturing	11. Services
12. Transportation Equipment	12. Financial Services
13. Motor Vehicles	13. Reading, Recreation, misc.
14. Transportation, Communications, and Utilities	14. Nondurable-Nonfood Household Items
15. Trade	15. Gasoline and Other Fuels
16. Finance and Insurance	
17. Real Estate	
18. Services	
19. Government Enterprise	

Consumer Groups

(Households classified by $thousands of 1973 gross income)

1. 0-3	5. 6-7	9. 12-15
2. 3-4	6. 7-8	10. 15-20
3. 4-5	7. 8-10	11. 20-25
4. 5-6	8. 10-12	12. 25+

are accepted as given, and government expenditures are adjusted in order to yield a balanced budget. Similar adjustments ensure that supply equals demand for all goods and factors, and that trade is balanced.

The fully consistent data set defines a single-period benchmark equilibrium in transactions terms. These observations on values are then separated into prices and quantities by making the Harberger assumption that a physical unit of a good or factor is the amount that sells for one dollar. All benchmark equilibrium prices are thus $1 and the observed values are the benchmark quantities.

The equilibrium conditions of the model are then used to determine the behavioral equation parameters consistent with the benchmark data set. This procedure calibrates the model to the benchmark data, in the sense that the benchmark data can be reproduced as an equilibrium solution to the model before any policy changes are considered. In order to implement this procedure, we specify the elasticities of substitution between capital and labor in each industry on the basis of econometric estimates in the literature. Factor employments by industry are used to derive production function weights, and expenditure data are used to derive utility function weights. This calibration procedure ensures that, given the benchmark data, the various agents' behaviors are mutually consistent before we evaluate policy changes.

Each industry produces a single producer good from a combination of capital services, labor services, and the outputs of other industries. Factor-input decisions are assumed to be made on the basis of cost minimization, and these decisions are affected by the tax system since taxes alter the relative producer prices of inputs for each industry.

The use of primary factors by each industry is described by a separate constant elasticity of substitution (CES) production function. The intermediate use of products by industries is described by a conventional fixed coefficient input-output matrix. This matrix is derived from published 1972 input-output data for the United States which is updated to 1973. No substitution between primary factors and intermediate inputs is permitted.

A number of taxation instruments are treated as production taxes and directly affect costs of industries. The corporate income tax, corporate franchise tax, and the property tax are in combination treated as *ad valorem* taxes on the use of capital services. The Social Security tax, unemployment insurance taxes, and public workmen's compensation taxes are treated as *ad valorem* taxes on the use of labor services. In making these choices on the modeling of factor taxes, we follow in the Harberger tradition.

In addition to taxes on the use of primary factors, the model includes taxes on the intermediate use of producer goods by industry and taxes on outputs of producer goods. Intermediate input taxes include the registration fees paid on motor vehicles for business use. Producer output taxes include the federal manufacturers' excise taxes paid on purchases for intermediate or final use.

The income of each consumer group in any period is determined by the ownership of labor and capital services and receipt of transfer income, such as Social Security payments, from the government. Demands for consumer goods, savings, and leisure are assumed to be generated by utility maximization subject to the household budget constraint.

In the standard version of the model (with Cobb-Douglas demands), the nested utility function is given by

$$(1) \qquad U\left(H\left(\prod_{i=1}^{15} X_i^{\lambda_i}, L\right), C_f\right)$$

where H is a CES function determining the allocation of current expenditures between consumption goods X_i and leisure L, while the purchase decisions on the

X_i are determined by a Cobb-Douglas subutility function as shown. U is another CES function, determining the allocation of income between those current expenditures and expected future consumption C_f. The demand for C_f results in a derived demand for savings.

Demands for the nineteen producer goods are derived from the demands for the sixteen consumer expenditure items using a transition matrix, "Z". An element z_{ij} of this matrix is the amount of producer good i needed to produce one unit of consumer expenditure item j. The distinction we make between producer and consumer goods enables us to simultaneously use national accounts data on a producer good classification and the 1972-73 Consumer Expenditure Survey defined for consumer goods.

The sixteenth consumer expenditure item is savings, and the Z matrix permits us to treat it like other goods. We assume that the demand for savings depends upon the current rate of return on capital, given by the current price of capital services relative to the purchase price of new capital goods. We thus assume myopic expectations in the sense that the current rental and purchase price of capital is expected to prevail in all future periods. Actual patterns of investment good purchases are the basis for constructing the column of the transition matrix that converts the consumer's demand for savings into demands for producer goods. This treatment assumes an equality between savings and investment. Savings of one period result in an equiproportional increase in the capital service endowment of households, where the conversion between net investment and capital service units uses a real net-of-tax rate of return of 4 percent.

Progressive personal income taxes are incorporated by a sequence of linear tax functions, one for each consumer. With a negative intercept and a marginal tax rate applied to all income, we can replicate observed 1973 tax payments and still apply the appropriate marginal rate to changes in income. State and local income taxes are modelled as percentage surcharge taxes applied to the federal levy.

Government purchases are derived from a Cobb-Douglas demand function defined over producer goods. Government real expenditures are assumed to equal tax receipts less transfers. Thus, we assume that the government budget is balanced. The foreign trade sector receives a simple treatment in order to close the model. By assuming that the net value of exports less imports for each producer good remains constant, we can calculate the net quantity transactions at any given vector of producer prices and transform domestic demands to market demands.

Next, we shall review the differences between the standard version of the model (with Cobb-Douglas demands for the 15 consumer goods) and the new version (with Stone-Geary or linear expenditure system demands). In the Cobb-Douglas version of the model, the demand functions are given by

$$(2) \qquad X_i = \frac{\alpha_i I_x}{P_i} \qquad \text{for all } i = 1, \ldots, 15$$

where X_i is the demand for good i, α_i is the income available for allocation among the 15 consumer goods, and P_i is the price of good i. If we substitute the demand functions (2) into the utility function, we get the indirect utility function:

$$(3) \qquad V_X = \prod_{i=1}^{15} \left(\frac{\alpha_i I_X}{P_i}\right)^{\alpha_i}$$

Next, we can easily isolate and solve for I_X. The income solution of the indirect utility function is I_X, the expenditure function:

(4) $$I_X = V_X \prod_{i=1}^{15} \left(\frac{P_i}{\alpha_i}\right)^{\alpha_i}, \quad \sum_{i=1}^{15} \alpha_i = 1.0$$

Since the Cobb-Douglas utility function is homothetic, we have the special property that income spent on X (I_X) equals the maximized value of X (V_X) multiplied times the ideal price index, P_X:

(5) $$P_X = \prod_{i=1}^{15} \left(\frac{P_i}{\alpha_i}\right)^{\alpha_i}$$

This ideal price index goes directly into the next stage of the maximization process.

Rather than using the Cobb-Douglas formulation of the standard model, we adopt a Stone-Geary (LES) inner nest. This presents the following problem, since the Stone-Geary utility function is not homothetic, the helpful properties discussed above do not apply. However, the Stone-Geary function <u>is</u> homothetic with respect to a "displaced origin." This is the property that we exploit in using the Stone-Geary function as the inner nest.

Let us define γ_i as the ith component of the displaced origin or as the minimum required level of consumption for commodity i, and let us further define Γ as the sum of the values of the requirements:

(6) $$\Gamma = \sum_{i=1}^{15} P_i \gamma_i$$

The Stone-Geary demand functions are given by

(7) $$X_i = \gamma_i + \frac{\beta_i (I_X - \Gamma)}{P_i}$$

where β_i is the marginal propensity to consumer commodity i out of discretionary income.

The Stone-Geary utility function is

(8) $$U_X = \prod_{i=1}^{15} (X_i - \gamma_i)^{\beta_i} , \sum_{i=1}^{15} \beta_i = 1.0$$

We substitute the demand functions into the utility function (8) to get the indirect utility function:

(9) $$V_X = \prod_{i=1}^{15} \{\beta_i (\frac{I_X - \Gamma}{P_i})\}^{\beta_i}$$

or

(9′) $$V_X = (I_X - \Gamma) \prod_{i=1}^{15} (\frac{\beta_i}{P_i})^{\beta_i}$$

Now we can solve for I:

(10) $$V_X = AI_X - A\Gamma$$

where

(11) $$A = \prod_{i=1}^{15} (\frac{\beta_i}{P_i})^{\beta_i}$$

Solving (10) for I_X, gives us

(12) $$I_X = \frac{V_X}{A} + \Gamma$$

Equation (12) is crucial to our problem. Clearly the maximized value of utility, V_X, cannot be multiplied by any ideal price index to get I_X. In fact, the ideal price index for the Stone-Geary function is quite messy. However, _if_ we ignore Γ, we have a homothetic relationship between discretionary income, I_{XD}, and the indirect utility from consumption in excess of the requirements

$$(13) \qquad I_{XD} = I_X - \Gamma = V_X \prod_{i=1}^{15} \left(\frac{P_i}{\beta_i}\right)^{\beta_i}$$

This equation (13) has _exactly_ the same form as equation (4) for the ordinary Cobb-Douglas function (except that presumably the α's and β's differ).

This suggests that we can use the ideal price index for the Cobb-Douglas form (equation (5)), appropriately modified to include the Stone-Geary weights. The ideal price index (for _discretionary_ consumption) is

$$(14) \qquad P_{XD} = \prod_{i=1}^{15} \left(\frac{P_i}{\beta_i}\right)^{\beta_i}$$

We use P_{XD} as the price for the composite of discretionary consumption in the next higher stage of the maximization process. This maximization procedure will give us, ultimately, a full set of prices, quantities and utilities, just as in the standard version of the model. To do welfare evaluation, we will have a stream of discretionary H from the base case and revised case, and a set of Γ from the base case and revised case. Our welfare measure would consist of two parts. The first would compare discretionary H in the base with discretionary H in the revised case. The second would compare the Γs.

3. Simulation Results

The first type of VAT that we model is an ideal consumption VAT, where the tax base is the value of current period production less investment. All expenditures/goods (other than leisure) are taxed at a uniform rate. We also model an ideal income-type VAT. Under an income-type VAT, firms are only allowed to deduct the value of depreciation in the current production period. Thus, the tax base equals the sum of consumption plus net investment. In each case, we consider destination-based taxes. This has no effect on the results (see Goulder, Shoven, and Whalley (1983) for a discussion of the equivalence between origin-based and destination-based taxes).

Against these two idealized VATs we model a more politically realistic "mean European VAT." The primary distinguishing characteristics of the European VATs are the consumption base, the destination basis, and differentiated rate structure. Thus, we model a destination-based, consumption-type VAT with rates ranging from 0 to 15 percent. The rate structure is given in Table 2. With this structure, we can determine the magnitude of the distortions in consumption decisions, caused by a differentiated rate structure. We can also determine which groups win and which lose from such a structure.

We perform a set of simulations in which we reduce the personal income tax by the size necessary to offset a 5, 10, and 15 percent consumption- and income-type VAT. We do the same exercise with the differentiated VAT (which raises the same amount of revenue as a 6.54 percent flat consumption-type VAT). We report on the long-run, steady-state effects. These simulations are very sensitive to the manner in which the income tax is scaled. We perform simulations reducing the income tax using additive replacement and multiplicative replacement. Additive replacement refers to additive changes to marginal income tax rates. That is, the same number of percentage points are added to

TABLE 2

Nominal Rates of Value-Added Tax, GEMTAP Simulations 1973 Calibrations

Commodity Group	Nominal Rate (percentages)
Food	5
Alcoholic Beverages	15
Tobacco	15
Utilities	5
Housing	0
Furnishings	15
Appliances	15
Clothing and Jewelry	15
Transportation	5
Motor Vehicles, Tires, and Auto Repair	15
Services	0
Financial Services	0
Reading, Recreation and Miscellaneous	10
Nondurable, Nonfood Household Items	10
Gasoline and Other Fuels	15

all household marginal income tax rates. Lower income households have a larger percentage tax change than wealthy households under additive replacement. Under multiplicative replacement, revenues are recovered by multiplying the marginal tax rates of all households by the same scalar.

In most of the tables in this section, we show the change in economic efficiency as measured by the sum over our twelve consumer classes of the present value of a stream of Hicksian equivalent variations. The figures show the welfare gain as a percentage of the present discounted value of consumption plus leisure in the base sequence of equilibria. The discounted value of future welfare is approximately $49 trillion. This is definitionally equal to the total value of the total wealth (physical capital and human capital) of the economy.

We have calculated the welfare gain for a flat 5, 10, and 15 percent VAT. Table 3 reports the results for a revenue-neutral, destination-based, consumption-type VAT, where revenue neutrality is achieved by scaling back the personal income tax in either an additive or multiplicative manner. For a given revenue requirement, a multiplicative adjustment changes the marginal tax rates of high rate households more than an additive adjustment. Thus, when tax increases are necessary for equal yield, additive replacement is more efficient. However, in these VAT simulations, where tax reductions are necessary for equal yield, multiplicative replacement is more efficient.

Several observations can be made regarding the numbers in Table 3. First, they appear to be rather large, indicating that a switch to raising part of federal revenues from a flat consumption-type VAT could increase welfare considerably. The gain for a 10 percent VAT with a multiplicative reduction of marginal tax rates is almost one percent of the discounted value of future welfare or roughly $488 billion. It should be emphasized that this is a pure welfare gain, with the government spending the same amount of resources. It is somewhat larger than

TABLE 3

Efficiency Gain for the Substitution of a Destination-Based Consumption-Type Flat VAT for Some of the Personal Income Tax Revenue (equal yield)

LES Inner Nest

	Type of Income Tax Scaling	
VAT Rate	Additive	Multiplicative
5%	0.294% ($145.9)	0.533% ($264.7)
10%	0.553% ($274.6)	0.983% ($488.7)
15%	0.783% ($388.9)	1.370% ($680.7)

NOTE: Figures are percentages of the total present value of welfare. Numbers in parentheses are in billions of 1973 dollars.

the gain we found for integrating the corporate and personal income tax systems and indexing capital gains for inflation. It also is about three-fourths of the gain that could be achieved by a total elimination of the personal income tax and a switch to a progressive consumption tax. Both of these benchmark results were reported on in Fullerton et al. (1983). Table 3 shows that the incremental gains from further increased in the rate of value-added tax are diminishing. The numbers also indicate that an additive adjustment for revenue neutrality is much less efficient than a multiplicative adjustment. The reason for this is that those whose labor supply decisions and intertemporal consumption choices are most distorted by the income tax are the high income high tax rate households. The multiplicative adjustment reduces their tax rate more, and thus results in a larger efficiency gain.

In Table 4, we show the distribution of the welfare effects among the various income classes, for two of the policy changes that were highlighted in Table 3. It is clear that the aggregate welfare gains of Table 3 are not shared equally by all groups. In fact, there is a fairly strong tradeoff between equality and efficiency. Both with additive and multiplicative replacement, the gains from the consumption-type VAT are concentrated among the highest income classes. The lowest income classes are worse off under the new policy, and sometimes substantially worse off. The losses to the low-income groups are greatest under multiplicative replacement. This is because multiplicative replacement leads to much smaller decreases in their marginal income tax rates than does additive replacement.

Table 5 contains the overall welfare effects for a flat rate income-type VAT. The gains are much smaller, and, in fact, with an additive reduction in the personal income tax, introducing a VAT decreases welfare. This result is consistent with out finding in Fullerton et. al. (1983) that the present

Table 4

Welfare Effects of Destination-Based Consumption-Type VATs By Consumer Group

LES Inner Nest

Household Income (In 1973 $)	10% Flat VAT Additive Replacement	10% Flat VAT Multiplicative Replacement
0-3	-1.858%	-5.718%
3-4	-1.085%	-4.240%
4-5	-0.586%	-3.173%
5-6	-0.405%	-2.672%
6-7	-0.242%	-2.304%
7-8	0.005%	-1.652%
8-10	0.299%	-0.855%
10-12	0.491%	-0.109%
12-15	0.692%	0.406%
15-20	0.975%	1.570%
20-25	1.053%	2.277%
25+	0.892%	4.987%

Table 5

Efficiency Gain for the Substitution of a Destination-Based Income-Type Flat VAT for Some of the Personal Income Tax Revenue (equal yield)

LES Inner Nest

	Type of Income Tax Scaling	
VAT Rate	Additive	Multiplicative
5%	-0.041% ($-20.3)	0.203% ($101.1)
10%	-0.105% ($-52.3)	0.336% ($166.9)
15%	-0.188% ($-93.5)	0.415% ($206.0)

NOTE: Figures are percentages of the total present value of welfare. Numbers in parentheses are in billions of 1973 dollars.

income tax system is somewhat more efficient than a pure income tax. This reflects the fact that the present income tax system (both in the real world and in the model) is somewhere between a consumption tax and an income tax, due to the ability to shelter certain forms of saving from the tax system. Roughly half of saving in 1973 utilized sheltered vehicles, primarily pension accumulation, the addition to life insurance reserves, and the acquisition of new residential housing. Switching towards an income-type VAT increases the intersectoral efficiency of the economy, but sacrifices some of the relative intertemporal efficiency of the partial consumption tax nature of the present income tax. Depending on whether the personal tax adjustment takes the additive or multiplicative form, the efficiency consequences of the introduction of a revenue neutral income-type VAT are either a very small welfare loss or a modest efficiency gain. We interpret the results of Tables 3 and 5 as indicating that a consumption-type VAT is the more desirable even though it involves the practical difficulty of distinguishing between consumption and investment goods.

Corresponding to the efficiency difference between a consumption- and income-type VAT is a very different allocation of resources. Perhaps the most important difference is that first-period saving is up 8.9 percent with the 10 percent consumption-type VAT, but down 4.9 percent with the introduction of an income-type VAT.

In Table 6, we show the distribution of the welfare effects among the various income classes, for the 10 percent income-type VATs. The general pattern that we saw in Table 4 is repeated here. The adoption of a VAT is a regressive change, regardless of whether multiplicative or additive replacement is used. The degree of regressivity is much greater under multiplicative replacement.

Table 6

Welfare Effects of Destination-Based Income-Type Flat VATs by Consumer Group

LES Inner Nest

Household Income (In 1973 $)	10% Flat VAT Additive Replacement	10% Flat VAT Multiplicative Replacement
0-3	-2.589%	-6.647%
3-4	-1.856%	-5.158%
4-5	-1.337%	-4.034%
5-6	-1.143%	-3.501%
6-7	-0.954%	-3.097%
7-8	-0.695%	-2.413%
8-10	-0.375%	-1.567%
10-12	-0.164%	-0.777%
12-15	0.088%	-0.199%
15-20	0.379%	1.007%
20-25	0.445%	1.723%
25+	0.175%	4.377%

Table 7 compares the efficiency consequences of a VAT with the differentiated rates of Table 2 (which are similar to the rate structures found in Europe) with that of a flat rate VAT of 6.54 percent. Both taxes are of the consumption type and raise the same amount of first period revenue. Table 7 suggests that rate differentiation reduces the efficiency gain offered by a consumption-type VAT by a significant amount. With either additive or multiplicative adjustments to preserve revenue neutrality, the efficiency gain is reduced by about $107 billion by the differentiation of the rates. This figure, like all the dollar figures in these tables, is in 1973 dollars. The welfare sacrifice caused by rate differentiation is eight percent of 1973's GNP, and about 0.2 percent of the present value of future welfare (including leisure).

The comparison of flat versus differentiated rates in continued in Table 8, which displays the welfare change for each of our twelve consumer categories. Two things are immediately apparent. First, while a revenue neutral substitution of a VAT for the personal income tax may be efficiency improving, it involves the expected regressive impact on the distribution of welfare (or income). Notice that the additive adjustment to the personal income tax concentrates more of the tax cut on the lower income households and thus reduces the regressive nature of the VAT substitution considerably. However, even with a flat consumption-type VAT, those with incomes of under $7,000 end up worse off. Table 8 also shows that rate differentiation does not improve the welfare situation of the lower income groups very much. The only households which are better off with differentiated rates rather than flat rates are those with incomes below $6,000. Eight of our twelve income groups are worse off in an absolute sense with rate differentiation than without it. In some cases, the difference is considerable. For example, the present value of

Table 7

Destination-Based Consumption-Type VAT:
Efficiency Gains for Differentiated Rates Versus Equal-Yield Flat Rate VAT

LES Inner Nest

Type of VAT	Type of Income Tax Scaling: Additive	Multiplicative
Differentiated Rates	0.161% ($80.0)	0.464% ($230.5)
Flat Rate (6.54%)	0.377% ($187.3)	0.679% ($337.6)

NOTE: Figures are percentages of the total present value of welfare. Numbers in parentheses are in billions of 1973 dollars.

Table 8

Welfare Effects of Destination-Based Consumption-Type VATs
By Consumer Income Class

LES Inner Nest

Household Income (In 1973 $)	Differentiated VAT Additive Replacement	Flat VAT Additive Replacement	Differentiated VAT Multiplicative Replacement	Flat VAT Multiplicative Replacement
0-3	-0.853%	-1.250%	-3.450%	-3.841%
3-4	-0.553%	-0.729%	-2.683%	-2.851%
4-5	-0.253%	-0.392%	-2.001%	-2.134%
5-6	-0.197%	-0.270%	-1.729%	-1.797%
6-7	-0.265%	-0.160%	-1.661%	-1.549%
7-8	-0.211%	0.007%	-1.333%	-1.108%
8-10	-0.052%	0.206%	-0.833%	-0.571%
10-12	-0.066%	0.335%	-0.472%	-0.068%
12-15	0.072%	0.470%	-0.120%	0.280%
15-20	0.242%	0.661%	0.649%	1.067%
20-25	0.367%	0.714%	1.204%	1.547%
25+	0.680%	0.608%	3.496%	3.415%

NOTE: The figures are percentages of the total present value of welfare.

welfare is 0.40 percent higher for those with 1973 incomes between $12,000 and $15,000 with a 6.54 percent flat rate VAT than it would be with the differentiated rates shown in Table 2.

The results of Table 8 lead us to three conclusions. First, rate differentiation is not a very efficient way in which to redistribute resources among households. The wealthy consume more of every commodity, although the consumption proportions do fall as income increases. It appears that adjustments to the personal income tax or even changes in the much-maligned means-tested transfer programs are more efficient ways of affecting the distribution of income or welfare. To some extent, this is simply another example of the principle that it is more efficient to use instruments which are more closely associated with the policy target. Affecting the income distribution by adjusting income-related transfers or taxes more directly affects the income distribution than differentially taxing commodities whose consumption proportions are only weakly correlated with income.

Second, even though rate differentation does reduce the regressive effects of the VAT somewhat, the VATs are always regressive. Rate differentiation is not a sufficiently powerful tool to make an inherently regressive tax policy change into a progressive one. Third, the method of preserving revenue yield can be very important. If we compare the first and second columns of the table, and then compare the first and third columns, it is clear that the choice between additive and multiplicative replacement is actually more important than the choice between a flat rate structure and a differentiated one.

The major new model development associated with this paper is the incorporation of the linear expenditure system or Stone-Geary inner nest in the consumer utility functions. This closes off a portion of each consumer's income and reduces the overall degree of responsiveness of consumption choice, relative to the Cobb-Douglas formulation that has been used in earlier versions of this model. For purposes of comparison, we also include some results for the Cobb-Douglas formulation. In Tables 9 and 10, we report on the aggregate welfare effects for a flat consumption-type VAT and a flat income-type VAT. Thus, these tables are comparable with Tables 3 and 5. Once again, we see that a consumption-type VAT is more efficient in the aggregate than an income-type VAT. Also, the earlier result on the greater efficiency of multiplicative scaling is confirmed in Tables 9 and 10. In Table 11, we report the aggregate welfare effects of the differentiated and flat consumption-type VATs. Thus, Table 11 is comparable with Table 7. The results in the Stone-Geary and Cobb-Douglas cases are qualitatively similar, but the efficiency disadvantage of rate differentiation is noticeably greater in the Cobb-Douglas case. This is not surprising, since the Cobb-Douglas formulation is more elastic than the Stone-Geary. Finally, in Table 12, we present the distribution of welfare effects among the various income classes, for the differentiated and flat VATs. Table 12 is to be compared with Table 8. The basic stories that emerge from Table 8 and Table 12 are fairly similar. If anything, our conclusions about the equity/efficiency tradeoff and the inefficiency of rate differentiation are supported more strongly in the Cobb-Douglas case. Whereas the four poorest groups were better off under a differentiated VAT than with a flat VAT with the Stone-Geary model, now it is only the single poorest group that is better off under a differentiated VAT. It is important to note that we still have the result that the VAT is regressive, even with differentiated rates and additive scaling.

TABLE 9

Efficiency Gain for the Substitution of a Destination-Based Consumption-Type Flat VAT for Some of the Personal Income Tax Revenue (equal yield)

Cobb-Douglas Inner Nest

	Type of Income Tax Scaling	
VAT Rate	Additive	Multiplicative
5%	0.291% ($144.8)	0.532% ($264.4)
10%	0.549% ($272.7)	0.980% ($486.9)
15%	0.778% ($386.5)	1.362% ($676.6)

NOTE: Figures are percentages of the total present value of welfare. Numbers in parentheses are in billions of 1973 dollars.

TABLE 10

Efficiency Gain for the Substitution of a Destination-Based Income-Type Flat VAT for Some of the Personal Income Tax Revenue (equal yield)

Cobb-Douglas Inner Nest

	Type of Income Tax Scaling	
VAT Rate	Additive	Multiplicative
5%	-0.034% (-$16.6)	0.211% ($105.0)
10%	-0.090% (-$44.8)	0.348% ($172.8)
15%	-0.165% ($81.9)	0.428% ($212.6)

NOTE: Figures are percentages of the total present value of welfare. Numbers in parentheses are in billions of 1973 dollars.

TABLE 11

Destination-Based Consumption-Type VAT:
Efficiency Gains for Differentiated Rates Versus an Equal-Yield Flat Rate VAT

Cobb-Douglas Inner Nest

Type of VAT	Type of Income Tax Scaling: Additive	Type of Income Tax Scaling: Multiplicative
Differentiated Rates	-0.114% (-$56.5)	0.169% ($83.0)
Flat Rate (5.97%)	0.344% ($170.8)	0.625% ($310.5)

NOTE: Figures are percentages of the total present value of welfare. Numbers in parentheses are in billions of 1973 dollars.

TABLE 12

Welfare Effects of Destination-Based Consumption-Type VATs by Consumer Group

Cobb-Douglas Inner Nest

Households classified by $thousand of 1973 gross income	Differentiated VAT Additive Replacement	Flat VAT Additive Replacement	Differentiated VAT Multiplicative Replacement	Flat VAT Multiplicative Replacement
0-3	-0.93%	-1.17%	-3.32%	-3.55%
3-4	-0.69%	-0.69%	-2.67%	-2.67%
4-5	-0.44%	-0.38%	-2.07%	-2.00%
5-6	-0.40%	-0.26%	-1.84%	-1.70%
6-7	-0.49%	-0.16%	-1.79%	-1.47%
7-8	-0.45%	0.00%	-1.50%	-1.05%
8-10	-0.31%	0.18%	-1.04%	-0.55%
10-12	-0.34%	0.30%	-0.72%	-0.08%
12-15	-0.22%	0.43%	-0.40%	0.25%
15-20	-0.06%	0.61%	0.31%	0.98%
20-25	0.06%	0.66%	0.83%	1.43%
25+	0.39%	0.57%	3.02%	3.20%

NOTE: The figures are percentages of the total present value of welfare.

4. Conclusion

The message of this research to date is clear. The efficiency advantages of a VAT compared to other tax sources requires a flat rate and strongly favors a consumption basis for the tax. Achieving progressivity through rate differentiation is expensive in terms of efficiency. An important question raised by this research is the political feasibility of a flat VAT. Most of Europe has failed to maintain a flat rate, although Denmark, Norway, and Sweden have done relatively well in that regard. Both Australia and New Zealand are currently proposing the introduction of flat consumption-type VATs and are under some considerable political pressure to exempt certain items. Further, no one has come up with a satisfactory way in which to tax financial services.

Finally, it may be appropriate to mention some other important issues which we have not discussed. To the extent that the VAT is used to replace a portion of the income tax, special problems of intergenerational equity arise. The imposition of a VAT would place an extra burden on the elderly, who must pay taxes on consumption that has already been taxed by the income and payroll tax. Similar problems exist for housing. If previously built houses are exempt from tax while new construction is subject to VAT, owners of existing houses receive windfall gains upon the imposition of the VAT. These problems of intergenerational equity are important under any change in the relative degree of taxation of consumption and saving, including the adoption of a consumption tax or a wage tax. For further discussion of these intergenerational issues, see Auerbach, Kotlikoff, and Skinner (1983).

Another important issue is the treatment of the nonprofit sector. The nonprofit sector in the United States is much larger than in Europe. The tax treatment of this sector under a VAT is not clear. How should nonprofit and for-profit hospitals be treated? If they are made exempt, how should other educational and training activities, such as secretarial and technical schools, be treated?

Determining the taxable income of financial insitutions is complex. Services at such insitutions are provided at little or no cost. In return, depositors and shareholders permit their funds to be used. To some degree the investment income is merely held by financial insitutions activing as fiduciaries for depositors and shareholders. These types of complexities account for the exemption of financial institutions in the European VATs.

Despite these problems, the Europeans have successfully implemented value-assed taxes often with fewer problems than had originally been anticipated. Our research suggests that if the value-added tax is considered for the United States, efficiency will be substantially enhanced by implementing a consumption-type VAT with as flat a rate structure as possible.

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