NBER WORKING PAPER SERIES

LIFECYCLE VS. ANNUAL PERSPECTIVES ON THE INCIDENCE OF A VALUE ADDED TAX

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Working Paper No. 4619

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
January, 1994

This paper was prepared for the NBER's Tax Policy and the Economy Conference held in Washington, D.C. on November 16, 1993. Jim Poterba has provided useful comments on an earlier draft. Andrew Clarkson has provided excellent research assistance on this project. This paper is part of NBER's research program in Public Economics. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

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ABSTRACT

This paper analyzes the steady state distribution of tax burdens of a Value Added Tax (VAT) in the United States using a lifetime perspective. In contrast to an annual snapshot perspective, I find that a VAT on total expenditures would be proportional over the lifetime. Various modifications to the VAT (zero rating necessities or giving lump sum household rebates) would increase the progressivity of the tax substantially. However, the additional progressivity comes at the cost of substantial tax revenue.

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I. Introduction

Over the past 25 years most developed countries have adopted some form of a Value Added Tax (VAT). Moreover, these taxes have become important sources of revenue in many of those countries[1]. The arguments on its behalf are well known. A VAT can raise significant amounts of revenue. The Congressional Budget Office (1993) estimates that a broad based VAT imposed at a 5% rate in the United States beginning in 1995 could raise close to $70 billion in its first year. Even after exempting food, housing, and medical care, the VAT would still raise roughly $36 billion in its first year. In addition, a VAT does not distort current and future consumption decisions. Put differently, the returns to saving are untaxed - a feature that has made consumption taxes like a VAT attractive to policy makers concerned with the level of savings in the United States[2].

Despite these facts and despite a number of efforts to introduce a VAT in this country, the United States does not employ a VAT. There are two important reasons for this. First, many are suspicious that a VAT would be a "money machine". That is, it would be a "hidden"

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[1] In 1986 West Germany raised 14% of its total tax revenue from a VAT while the United Kingdom raised 18% and Denmark 27% (Tait (1988)).

[2] It has also been argued (incorrectly) that a VAT would help improve the trade balance. With appropriate border adjustments, a VAT is neutral with respect to trade (see Grossman (1980)). A VAT could encourage net exports if it was used to reduce the reliance on direct taxes of which some of the burden might be passed forward to consumers and result in higher export prices.

tax raising large sums of money and would ease pressure on Congress and the President to reduce federal spending. Second, others view the VAT as a highly regressive tax.[3]

This paper takes up the second question - whether a value added tax would in fact be regressive. Viewed in the context of a single year, a VAT does in fact look quite regressive. However, when viewed in the context of a taxpayer's lifetime, a VAT looks decidedly less regressive and in fact can look quite progressive under different design schemes. In the next section I review the literature on the incidence of consumption taxes and discuss the importance of the lifetime perspective. Section III presents the essential results of the paper. Using the 1990 Consumer Expenditure Survey (CEX), I estimate the incidence of a VAT using annual income and current consumption as my two income measures. Here I find that a broad based VAT looks essentially proportional when a taxpayer's resources over her lifetime are considered. I then consider how bequests affect this result. Over the lifetime the present discounted value of labor earnings must equal the present discounted value of consumption plus net bequests given (net of bequests received). It is by no means clear how a broad based consumption tax would affect the value of bequests even if they are not directly taxed. I consider one extreme scenario: that bequests given are not subject to nor affected by a value added tax. Accounting for bequests in this fashion does not affect the central finding of proportionality in any significant way.

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[3] In addition, there are fears that a VAT would be inflationary, that it would hinder state and local governments' ability to raise money through sales taxes, and that it would be difficult to administer. It is by no means clear why a one time price increase would fuel inflation. As for the other two concerns, these are design considerations that would need to be addressed if a VAT were implemented. Note though that a VAT with a state revenue sharing component could reduce sales tax tensions of the type currently taking place between New York and New Jersey (New York Times (Dec. 9, 1992)).

Section IV considers various ways to increase the progressivity of a VAT. I find that a VAT could be easily modified in ways that would substantially increase the progressivity of the tax. Section V concludes.

II. Consumption Tax Burdens

As is well known, the statutory incidence of a tax can differ markedly from its economic incidence. Despite the number of ways in which a VAT can be administered, the tax is generally considered to be a tax on consumption.[4] The final incidence of a tax will depend on whether it is passed forward (economic incidence on consumers), backwards (economic incidence on factors of production - capital and labor), or some combination of forward and backward shifting. Early studies (e.g. Musgrave, Case, and Leonard (1974) and Pechman (1985)) take the results from a wide number of empirical studies to make judgements about the appropriate shifting of individual taxes and typically conclude that consumption taxes are passed forward to and borne by consumers in proportion to their expenditures. In these studies, families are ranked according to their annual income and average tax shares by decile or quintile are computed. These studies find that average tax rates for existing consumption taxes in the United States (federal excise taxes, state and local sales and excise taxes) fall with income: consumption taxes are regressive.

As an alternative to the approach used by Pechman and others, Ballard, Scholz, and Shoven (1987) used a computable general equilibrium (CGE) model which allows for relative prices to change in response to changes in tax systems to study a VAT. They estimate that a

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[4] See Congressional Budget Office (1992) for a good discussion of the ways in which a VAT could be administered.

VAT introduced as a partial substitute for the personal income tax would produce welfare losses for lower income groups and welfare gains for higher income groups. Such a shift in taxation would be regressive.[5]

Recently, there has been considerable interest in measuring the lifetime incidence of consumption taxes. There are two reasons for this interest. First, annual income can fluctuate substantially. Given people's ability to save and spend out of accumulated savings, annual income may not be a good measure of an individual's ability to consume in a given year. Friedman (1957) formalized this notion in his Permanent Income Hypothesis (PIH) arguing that people make consumption decisions based on an unobservable measure of permanent income. If the purpose of a distributional analysis is to group and rank people by a measure of their economic welfare, permanent income is probably a better measure than annual income for ranking people. Fluctuations in annual income will tend to make a consumption tax look more regressive than it would be if we could measure and rank people by permanent income. Someone with a positive shock to income (e.g. winning the lottery) will appear "rich" and have a low consumption to income ratio (and hence a low consumption tax to income ratio) while someone with a negative shock (e.g. experiencing a temporary spell of unemployment) will appear "poor" and have a high consumption to income ratio.

Second, life cycle considerations suggest that we should view individuals by their lifetime income (viz Modigliani and Brumberg (1954)). People tend to earn low amounts of income

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[5] Pechman assumes that the system of sales and excise taxes in the U.S. would be replaced by a lump sum tax. The regressivity of the tax shift in Ballard, Scholz, and Shoven is partially due to the use of a VAT and partially due to the decreased reliance on the income tax with its progressive rate schedule.

(relative to their average income over their lifetime) in early parts of their lives as well as in old age. In a cross sectional analysis, lower income groups will include not only poor people (in a lifetime sense) but also young and old people who are not poor in a lifetime sense but are making consumption decisions based on their future ability to earn or on their past earning history. The difficulties with measuring income at the low end of the distribution are well understood by economists[6].

Recognizing the difficulties with using annual income as a measure of ability to pay, economists have conducted distributional analyses using life-cycle models in which a measure of lifetime income is used to rank households. The challenge in this approach is to measure the unobservable variable lifetime income: the present discounted value of earned income plus gifts received. Lifetime income (W) can be measured in one of two ways. As equation (1) shows, we can measure W on the sources or uses side:

$$W = \sum_{t=t_0}^{t=T} \frac{E_t + G_t}{1+\rho^{t-t_0}} = \sum_{t=t_0}^{t=T} \frac{C_t + B_t}{1+\rho^{t-t_0}} \qquad (1)$$

On the sources side, lifetime income is the present discounted value of earned income (E) and bequests received (G) while on the uses side, it equals the present discounted value of consumption (C) and bequests made (B).

Poterba (1989, 1991) has proposed using a measure of consumption as a proxy for lifetime income in studies of federal excise taxes. Under the assumption that consumption tends

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[6] Pechman resolved this measurement problem by discarding the lowest 5 percent of the families in the income distribution from his sample.

to be smoother than income, total annual consumption is likely to be a better measure of well-being than is annual income. This approach measures lifetime income from the uses side. Metcalf (1993) has used a similar approach to analyze state and local tax systems. In general, these studies find that consumption taxes are less regressive with a lifecycle perspective than when an annual perspective is employed.

Fullerton and Rogers (1993) have conducted an extensive study of lifetime incidence of the U.S. tax system; in effect, they've "redone" Pechman in a lifetime setting. The authors construct a measure of lifetime income by estimating age-income profiles for different demographic groups. This is used to impute a stream of wage rates from which their lifetime income can be constructed: they measure lifetime income on the sources side.[7] Fullerton and Rogers find that the system of federal, state, and local sales and excise taxes in the United States is roughly as regressive in a lifecycle perspective as in an annual perspective. This finding cannot be easily carried over to a VAT. The tax rates facing consumers in their study range widely from 0 (housing) to 79% (tobacco). Much of the regressivity is due to the fact that necessities tend to be taxed at higher rates than are luxury goods[8]. Presumably, a VAT would be structured differently.

Policy makers may be apprehensive about an approach that must make heroic assumptions about future income and consumption streams to assess the distributional impact of a

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[7] They estimate wage profiles rather than earned income profiles in order to include leisure as a consumption good.

[8] Fullerton and Rogers' results are also somewhat sensitive to their use of a Stone-Geary utility function. Varying the minimum required purchase has a large effect on the measured regressivity of consumption taxes.

consumption tax. The Joint Committee on Taxation (JCT) (1993) recently has considered this issue and proposed using a five year window to approximate lifetime income. This approach probably deals best with the problem of transitory fluctuations to income but does not capture life cycle considerations very well. The JCT found that nearly 90% of the observations in their study were in a five year average income decile that was within one decile of their annual income decile. They conclude that single year income measures are reasonably good measures for permanent income (p. 86). This finding contrasts sharply with Fullerton and Rogers' analysis, however, in which they find that less than half (46%) of the individuals in their sample are in a lifetime income decile within one decile of their annual income decile. Fullerton and Rogers' finding indicates that a five year income measure may not be a good proxy for lifetime income and that analyses based on lifetime income measures may give substantially different results than analyses based on annual income measures.

III. The Distribution of a VAT

In this section, I consider the distribution of a 5% value added tax introduced as an additional tax with no change in government expenditures using data from the 1990 Consumer Expenditure Survey.[9] I will assume that the burden of a VAT is borne by consumers and compute the tax burden as the statutory rate multiplied by the dollar amount of consumption.[10]

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[9] This is an absolute incidence experiment. I do not consider what is done with the revenue raised by the tax.

[10] In latter parts of the paper, I consider deductions as well as lump sum subsidies. Most VATs are administered by the invoice method in which the tax is paid at each stage of manufacture on total value with a credit allowed for taxes paid at previous stages. From the viewpoint of determining the tax burden, this is equivalent to implementing a VAT as a retail sales tax at the national level.

The forward shifting assumption is consistent with previous work by Pechman (1985), Musgrave, Case, and Leonard (1974) and others. In addition, I will measure taxes at the household level.

Data for the analysis come from the 1990 CEX family expenditure files. The CEX interviews families once every three months for 5 quarters. Information from the second through fifth interviews is publicly available and can be used to construct estimates of annual consumption[11]. New households enter the sample every quarter and depart after their fifth interview. Families interviewed in a given quarter are asked about consumption over the last three months. Because families may be interviewed at any date within the quarter, data from the previous three month period can be included in the current quarter. Thus, families interviewed in the first quarter of 1990 may report some expenditures from the last quarter of 1989. Similarly, families interviewed in the first quarter of 1991 may report expenditures from 1990. I use families who report complete income information, are interviewed for all four quarters (that are publicly released), and who enter the sample in either the first or second quarter of 1990. This gives me 1561 observations for my sample.

To compare annual and lifetime measures, I will use annual before tax income for the annual measure and current consumption as a measure of lifetime income. The before tax income measure comes from the 1990 CEX. I construct current consumption as total expenditures (as reported in the CEX) less new vehicle purchases, housing costs for homeowners, and contributions for pensions and life insurance. These deductions are in large part a form of saving. To measure the consumption component of housing and automobiles, I

[11] There is also a diary component to the study. I do not use this part of the CEX.

include an imputed rental value for owner occupied housing (reported in the CEX) and impute an automobile consumption value using an approach of Cutler and Katz (1991).[12]

Table 1 provides summary statistics on current consumption and income for my sample while table 2 presents the cutoff values for each decile. Mean income at $34,794 is substantially higher than mean current consumption at $27,780 (ignore the last column for now). The skew in income is apparent: mean income is 25% greater than the median while mean consumption is only 15% greater than median consumption. Income is also more variable. The coefficient of variation for the income measure is .75 while only .58 for current consumption. Note also that annual income less current consumption is negative for the lowest three deciles and increases monotonically with consumption (or income). Presumably, consumption exceeds income for many in the lowest deciles because annual income for many of these households has been reduced by an income shock that is not expected to persist over time.

Table 3 provides a tabulation of current consumption against income. Roughly 9% of the households in the lowest income decile have current consumption above median consumption in the sample. In addition, 36% of the households are in a consumption decile at least two deciles away from their income decile. This dispersion of consumption within income deciles should make one cautious about using income as a measure of well being.

Another way to see the difficulties associated with using annual income in an incidence analysis is depicted in figure 1. I computed the median ratio of total expenditures to before tax income by age of head of household and graphed this variable against age. As the lifecycle

[12] See the appendix for details on the construction of automobile consumption. For renters, I include their rent payment.

model predicts, all but one of the observations where the median ratio exceeds one are for ages below 25 and above 60. In addition, I regressed this ratio against age, age squared, and age cubed.[13] Figure 1 also shows the graph of the predicted ratio against age. The graph has peaks at age 18 and 78, once again suggesting that the young and the old are making expenditure decisions taking variables other than current income into account.

One problem with the consumption measure described above is that it does not include bequests. Lifetime income on the uses side consists of consumption plus bequests given. As Menchik and David (1982) have noted, a VAT would likely exempt bequests from taxation. How one should think about bequests when constructing a VAT is not entirely clear. Bequest behavior can be categorized in the following ways: accidental, altruistic, "warm glow", and strategic bequests. Bernheim (1987) finds little support for either accidental or altruistic bequests[14]. One can reasonably think of "warm glow" and strategic bequests as a form of consumption that should be taxed. To the extent that the bequest is worth less to the recipient (since it will be taxed upon consumption), the bequest is also worth less to the donor. Put differently, one could argue that these forms of bequests are in fact taxed by a VAT.

Rather than argue that a VAT does in fact tax bequests, I proceed by providing an alternative measure of current consumption which includes an annualized value of bequests. In

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[13] I also ran the regression with age raised to the fourth. The t statistic on this variable was 1.1. The graph of predicted expenditures to income against age looks very similar to the graph using a cubic polynomial.

[14] It is not clear how one would think about these forms of bequests with a VAT. If bequests are accidental, should one consider these either as lifetime income or as a form of untaxed consumption? If bequests are due to altruism, one must reconsider the lifetime approach to measuring tax incidence. Altruism suggests that the lifetime of a dynasty is the appropriate measure rather than the lifetime of a member of the dynasty.

the analysis below, I do not assume that bequests are part of the tax base. I do this to consider whether including bequests as part of the income measure affects the distributional effects of the tax. To understand the importance of bequests, consider equation (2) below which rewrites the uses side of the lifetime income definition:

$$W_0 = B + C \tag{2}$$

where B is the present discounted value of bequests given and C the present discounted value of consumption. Current consumption can serve as a proxy for C; my tax base is misspecified by ignoring B. To add bequests to the tax base, I rely on work by Menchik and David (1982). The first column of table 4 reproduces table 4 of their article. Using an extensive data set on income tax returns and probate records, they construct an estimate of the ratio of bequests to lifetime income. Let ϕ represent this ratio.

$$\varphi = \frac{B}{B+C}. \tag{3}$$

We can also think of ϕ as the ratio of annualized bequests to the sum of annualized bequests and current consumption. Equation (3) can be rewritten in terms of annualized bequests and current consumption as

$$\frac{B}{C} = \frac{\varphi}{1-\varphi} \tag{4}$$

If $C^* = C + B$, we can write C^* as

$$C^* = C(1+\frac{B}{C}) = (1+\frac{\varphi}{1-\varphi})C = (\frac{1}{1-\varphi})C \tag{5}$$

The second column of table 4 reports the ratio $1/(1-\phi)$. This ratio serves as an adjuster to measure true lifetime income on an annual basis. Bequests as a ratio of income are U shaped with a trough at about the 80th percentile. Current consumption is increased by 30% in the lowest decile with the adjustment falling to 8.5% in the 8th decile. It then rises sharply with bequests increasing current consumption by 20% in the top decile[15].

The last column of table 1 provides summary statistics on the bequest adjusted consumption variable. Mean (median) consumption is now roughly $4,000 ($2,500) higher than when bequests are ignored[16]. Table 5 presents distributional results for a 5% VAT tax on total expenditures for the three measures of income: annual income, current consumption, and bequest

[15] It may be surprising that the bequest to lifetime income ratio is not monotonic in income. However, there is no reason to believe that it should be. A monotonically increasing relationship implies that the elasticity of bequests with respect to lifetime income is greater than one. While various theories of bequests can help explain why the elasticity should be positive, no theory requires that bequests be a luxury good.

[16] Kotlikoff (1988) estimates reported transfers of $45.5 billion in 1974 or 3.1% of GDP. Grossing this number up to 1990 using the 1990 GDP yields a per capita value of transfers of $689. Assuming 2.7 people per household (1990 value) yields an estimate of $1,860 in annual transfers per household.

adjusted current consumption. Households are sorted by the appropriate income measure and allocated to deciles[17]. The average VAT tax rate is computed for each household and the median is identified within each decile. Using annual income to rank households leads to a VAT looking distinctly regressive. Median tax rates fall from 7.1% in the lowest decile to 3.2% in the highest decile. However, the story dramatically changes when current consumption is used to rank households and construct tax rates. Now, the lowest decile faces a median tax rate of 5.0% while the highest decile faces a median rate of 5.1%. Furthermore, there is no distinct pattern to rates moving from the lowest to highest decile. This pattern is very similar to results shown in Caspersen and Metcalf (1993) using the 1988 CEX.[18] Adjusting consumption for bequests (but not subjecting bequests to a VAT) does not alter the results very much. Median tax rates fall by about 1.2% at the bottom and 0.8% at the top of the distribution while falling about 0.4% in the 7th and 8th deciles. It does not appear that excluding bequests in the construction of a proxy for permanent income affects the results significantly.

The results in table 5 suggest that a broad based VAT would be roughly proportional if viewed over the lifecycle. So far I have not considered variations on the basic VAT to alter its progressivity. In the next section, I take up this subject, first considering reasonable categories of expenditures that would not be subject to a VAT and then variations on a VAT.

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[17] For households in a few deciles, adjusting consumption for bequests may move them into a different decile. I use an iterative procedure to correct for this problem.

[18] See table 5 in that paper.

IV. Altering A VAT's Distribution

Few countries subject all expenditures to a value added tax. Of the 21 countries surveyed by Ernst and Young in 1991, 15 apply a lower or a zero rate to basic foodstuffs while 20 partially or fully exempt health services.[19] Housing is more complicated. In general, most VAT countries do not tax residential shelter.[20] If the United States were to adopt a value added tax, these three categories of consumption - food, shelter and medical care - would be likely candidates for special treatment. Table 6 presents distributional results for a VAT which zero rated these three categories of consumption. Two pictures emerge from this table. First, removing these three classes of consumption from a VAT would substantially diminish the revenue potential of a VAT.[21] Second, the tax becomes substantially more progressive. Using annual income as a base, average tax rates are nearly constant across the income distribution, rising from 1.65% at the low end to 1.77% in the middle before falling back to 1.65% at the top of the distribution. Using current consumption as a proxy for permanent income, the tax looks decidedly progressive. The top decile median average tax rate is 2.3 times as large as the corresponding tax rate for the first decile. Adjusting consumption for bequests reduces median average tax rates for all deciles with the largest change occurring at the bottom and top of the distribution. The top rate is now 2.4 times as large as the bottom rate.

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[19] Only New Zealand subjects health services to a VAT. See Appendix A of Ernst and Young (1991) for details.

[20] See Tait (1988) for a general description of the treatment of housing. In the United Kingdom, the treatment of real property changed after the defeat of the UK in a court case brought against the European Commission in the European Court of Justice. As a result of that decision, zero-rating of buildings is largely confined to residential and charitable properties.

[21] The Congressional Budget Office (1993) estimates that zero rating these three categories would halve the tax revenue from a VAT.

Recently, Lester Thurow (1993) argued that a VAT could be made substantially more progressive by allowing an exemption of $4,000 in spending per person. A family of 4 would be able to exempt the first $16,000 in spending from a VAT. With a 5% VAT, this would reduce their tax liability by $800. To capture the flavor of this proposal, I consider a VAT with a $1,000 refundable credit per household combined with a VAT. I adjust the tax rate to raise the same amount of revenue as a 5% VAT without the credit. Table 7 reports distributional results where current consumption is used as a proxy for lifetime income. If total expenditures are taxable, the VAT rate becomes 8.5% while if food, shelter, and health care are excluded, the rate becomes 10.3%. VAT burdens as a share of lifetime income are now markedly progressive. If total expenditures are taxed, the median average tax rate in the lowest decile is now negative: these households tend to pay less than $1,000 in VAT. The average tax rate rises sharply by decile with the rate in the top decile now exceeding 7%. Excluding food, shelter, and medical care leads to a subsidy for the median taxpayer in the bottom 3 deciles. The top rate now is 5.8%.

Another way to think about the distributional effects of a VAT with a $1,000 household credit is to consider what rate structure on a consumed income tax would raise the same revenue and maintain the same Suits Index as does the VAT with credit. I considered a three rate consumed income tax where total expenditures are subject to a graduated rate structure with breakpoints at the 25th and 75th percentiles. We can preserve revenue and the Suits Index with a rate structure of 2.0, 6.5%, and 11.9% when current consumption is used to measure people's economic well-being. To duplicate the effects of a VAT with credit and exclusions for food, shelter, and medical care, rates of 0%, 4.2%, and 12.4% will suffice if total expenditures are

the base of the tax[22]. Table 8 reports median average tax rates (with current consumption in the base) for these consumed income taxes. For the tax that is equivalent to a VAT on total expenditures the bottom tax rate was set to zero and the middle and top rate were set to raise the same amount of revenue and preserve the Suits Index value, conditional on the marginal rates increasing with income. It is not possible to construct a set of tax rates that satisfy the above conditions with the lowest rate being zero. The lowest value I can set the bottom rate is 2.0% and meet the required conditions. Once various expenditures are excluded from the VAT it becomes possible to set the rate on the lowest bracket equal to zero.

There are two basic messages in these results. First, the conventional wisdom that a value added tax is regressive is not correct when a lifetime perspective is used. Second, there are relatively easy ways to modify a VAT to increase its progressivity (in either the annual or lifetime perspective).

V. Conclusion

A value added tax is viewed as being a regressive tax and has been opposed by many for its impact on the poor. This paper has argued that when "rich" and "poor" are properly measured, a VAT may not burden the poor substantially more than it would the rich. When a lifetime perspective is taken, a VAT on total expenditures is roughly proportional. In addition, various modifications of a VAT could substantially increase the progressivity of the tax. In this paper I have considered household credits as well as the exclusion of various spending categories

[22] The Suits Index for a VAT on total expenditures with a $1,000 household credit is 0.243. If food, shelter, and health expenditures are zero rated, the Suits Index rises to 0.433.

from the tax base. The effect of these modifications on the distribution of a VAT can be quite substantial, with the VAT now looking quite progressive.

In closing, let me note that the results discussed above are steady-state results assuming households are subject to a VAT for their entire lives. The transitory incidence of a VAT would be substantial and is likely to be of considerable interest to policy makers. Imposing a VAT today would lead to a substantial shift in taxes to current owners of capital, many of whom are elderly. An alternative way to impose a consumption tax like a VAT is via a wage tax[23]. While the steady state effects of a wage tax and a comprehensive VAT would be equivalent, a wage tax would exempt current owners of capital from the consumption tax in the transition.

From a policy making perspective, it may be more attractive to impose a wage tax than a VAT and thereby avoid imposing a transitional burden on the current elderly (and other capital owners). However, the wage tax approach comes with an efficiency cost. A VAT can be viewed as a wage tax with a one time lump sum tax on existing capital. The lump sum nature of the tax reduces the deadweight loss associated with the imposition of the consumption tax. Moreover, the welfare gains resulting from the lump sum component of the VAT can be substantial[24].

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[23] Referring back to equation (1), a wage tax is levied on the sources side of the lifetime budget constraint while a VAT is levied on the uses side.

[24] Auerbach, Kotlikoff, and Skinner (1983) have demonstrated in a large scale simulation model that imposing a consumption tax generates efficiency gains over a wage tax on the order of 4% of lifetime resources.

Appendix

AI. Imputing Annual Vehicle Consumption

My approach to constructing an annual measure of vehicle consumption follows Cutler and Katz (1991). I begin by running a regression of spending per vehicle on household characteristics for those households which reported the purchase of at least one vehicle.[25] The regression is reported in Table A1 at the end of the paper. Spending on vehicles goes up with age, other expenditures (over the plausible range of the sample), and aftertax income. Spending is also higher for smaller families, and families with male or non-white heads of households. This regression is used to impute the value of a new car that each household would purchase if they purchased a car that year. I then assume that cars depreciate straightline over an 8 year period and use that value as the consumption value per vehicle in the household. Finally, I multiply this consumption value by the number of vehicles owned by the household.

[25] From the quarterly CEX data, I can construct an estimate of how many cars were purchased over the course of the year.

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Table 1. Summary Statistics on Income and Consumption

	Annual Income	Current Consumption	Current Consumption with Bequests
Mean	34,794	27,780	31,696
Median	27,900	24,140	26,622
Standard Deviation	26,155	16,189	19,233
X_{25}	14,994	16,585	18,791
X_{75}	47,685	35,676	38,709
Coefficient of Variation	.75	.58	.61

Summary statistics from 1990 Consumer Expenditure Survey. Annual income is the before tax income measure reported in the CEX. Current consumption is total expenditures with two sets of adjustments. First, shelter costs for homeowners, new vehicle purchases, life insurance premiums, and pension contributions are subtracted from total expenditures. Second, annual rental values for owner occupied housing and vehicles are added back in. See text for more details as well as the adjustment for current consumption with bequests. X_{25} refers to the value at the 25^{th} percentile, while X_{75} refers to the value at the 75^{th} percentile. There are 1561 observations in the data set.

Table 2. Boundary Values for Deciles

Decile	Annual Income	Current Consumption	Current Consumption with Bequests
1	8,536	10,729	13,174
2	12,400	14,639	16,827
3	17,572	18,131	20,397
4	22,725	20,926	23,294
5	27,870	24,131	26,622
6	35,402	28,216	30,878
7	43,319	32,796	35,724
8	53,012	38,207	41,455
9	68,410	49,898	57,831
10	190,360	152,324	182,484

This table reports the upper limit values for the deciles for three different income measures from the 1990 CEX. For example, 8,536 is the maximum value for the first annual income decile. The values reported for the tenth decile are the maximum values in the sample.

Table 3. Consumption vs. Income in the 1990 CEX

Income Deciles	Consumption Deciles 1	2	3	4	5	6	7	8	9	10
1	**53.2**	19.2	7.7	6.4	4.5	3.9	1.9	1.9	1.3	0.0
2	30.8	**30.8**	13.5	12.2	5.8	2.6	1.9	2.6	0.0	0.0
3	9.0	24.4	**23.1**	16.0	7.7	9.6	5.1	1.9	1.9	1.3
4	6.4	14.1	25.0	**18.0**	17.3	5.1	7.0	4.5	1.9	0.6
5	0.6	6.4	14.7	17.3	**17.3**	19.2	12.8	6.4	1.3	3.8
6	0.0	3.8	4.5	14.7	26.3	**17.3**	17.3	10.3	3.8	1.9
7	0.0	1.3	7.7	12.2	10.9	17.3	**19.9**	16.0	10.3	4.5
8	0.0	0.0	2.6	1.9	7.7	14.1	19.2	**25.6**	21.8	7.0
9	0.0	0.0	0.6	1.3	1.9	7.7	11.5	20.5	**32.0**	24.4
10	0.0	0.0	0.6	0.0	0.6	3.2	3.2	10.2	25.5	**56.7**

This table presents a tabulation of annual income against current consumption from the 1990 Consumer Expenditure Survey. Cell entries are the probability of being in a consumption decile conditional on being in a given income decile. Consumption is net of expenditures on automobiles and housing and inclusive of rental equivalents for those durables. Pension and life insurance contributions are also excluded. There are 1561 observations in the data set.

Table 4. Adjustment Factors for Bequests

	ϕ	$\frac{1}{1-\phi}$
1	.231	1.300
2	.142	1.166
3	.117	1.133
4	.105	1.117
5	.097	1.107
6	.089	1.098
7	.083	1.091
8	.078	1.085
9	.137	1.159
10	.165	1.198

ϕ represents the ratio of lifetime bequests to lifetime income and is reproduced from Menchik and David (1982),table 4. The second column represents one plus the ratio of annualized bequests to current consumption.

Table 5. Distribution of a VAT on Total Expenditure

Decile	Annual Income	Current Consumption	Adjusted Current Consumption
1	7.07	5.00	3.85
2	5.66	5.00	4.21
3	5.29	4.95	4.37
4	4.33	4.92	4.40
5	4.31	4.79	4.35
6	3.96	5.08	4.61
7	3.83	4.99	4.58
8	3.61	4.99	4.59
9	3.51	5.09	4.39
10	3.15	5.09	4.25

This table reports median tax rates by decile for different income measures. VAT liabilities per household are computed as 5% of total expenditures in the 1990 CEX. Tax rates are computed as the ratio of VAT liability to the appropriate income measure. Households are sorted by the income measure and the median tax rate within each decile reported. There are 1561 observations in the data set.

Table 6. Distribution of a VAT on Food, Medical Care, and Shelter Zero Rated

Decile	Annual Income	Current Consumption	Adjusted Current Consumption
1	1.65	1.11	0.87
2	1.65	1.56	1.34
3	1.77	1.87	1.65
4	1.70	1.91	1.71
5	1.77	2.09	1.89
6	1.77	2.39	2.15
7	1.73	2.23	2.07
8	1.70	2.30	2.12
9	1.65	2.40	2.07
10	1.65	2.50	2.08

This table reports median tax rates by decile for different income measures. VAT liabilities per household are computed as 5% of total expenditures less food, shelter and health expenditures in the 1990 CEX. Tax rates are computed as the ratio of VAT liability to the appropriate income measure. Households are sorted by the income measure and the median tax rate within each decile reported. There are 1561 observations in the data set.

Table 7. Distribution of a VAT with $1000 Refundable Credit

Decile	Base of VAT: Total Expenditures	Base of VAT: Food, Shelter, and Medical Care Excluded
1	-4.24	-7.75
2	0.30	-2.41
3	2.44	-0.21
4	3.30	1.00
5	3.75	1.79
6	4.74	3.06
7	5.17	3.11
8	5.64	3.93
9	6.35	4.86
10	7.07	5.76
rate	8.5%	10.3%

This table reports median tax rates by decile. VAT liabilities per household are computed as 5% of the relevant base in the 1990 CEX less a refundable credit of $1,000. Tax rates are computed as the ratio of net VAT liability to current consumption. Households are sorted by current consumption and the median tax rate within each decile reported. There are 1561 observations in the data set.

Table 8. Distribution of a Consumed Income Tax on Total Expenditures

	VAT Equivalent Base	
Decile	Total Expenditures	Food, Shelter, and Medical Care Excluded
1	2.00	0.00
2	2.00	0.00
3	2.04	0.00
4	2.59	0.58
5	2.93	0.94
6	3.68	1.55
7	3.99	1.86
8	4.34	2.23
9	6.01	4.33
10	7.75	6.67
rates	2.0% 6.5% 11.9%	0.0% 4.2% 12.4%

This table reports median tax rates from a consumed income tax by consumption decile. The tax liability per household is computed from a progressive rate schedule on a tax base of total expenditures in the 1990 CEX. Individual average tax rates are computed as the ratio of tax liability to current consumption. Households are sorted by consumption and the median tax rate within each decile reported. There are 1561 observations in the data set. Marginal tax rates are chosen to raise the same amount of revenue as the VAT in table 7 and have an equivalent value for the Suits Index.

Table A1. New Vehicle Purchase Regression

Variable	Coefficient
Age of Household Head	50.47 (18.24)
Other Expenditures	.100 (.045)
Other Expenditures squared ($1,000,000)	-.281 (.350)
After Tax Income	.080 (.017)
Family Size	-570.51 (179.53)
Male Head of Household	322.89 (604.26)
Non-white Head Household	2338.00 (912.47)
Intercept	493.84 (1620.94)
N	415
$\bar{R}^2$	.242

Figure 1. Consumption to Income Profile