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ON THE POSSIBILITY OF AN INVERSE RELATIONSHIP BETWEEN TAX RATES AND GOVERNMENT REVENUES

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When Arthur Laffer and other 'supply side advocates' plot total tax revenue as a function of a particular tax rate, they draw an upward-sloping segment called the normal range, followed by a downward-sloping segment called the prohibitive range. A brief literature review indicates that tax rates on the prohibitive range in theoretical and empirical models have been the result of particularly high tax rates, high elasticity parameters, or both. The labor tax rate which maximizes total revenue, for example, will depend on the assumed labor supply elasticity. This paper introduces a new curve which summarizes the tax rate and elasticity combinations that result in maximum revenues, separating the 'normal area' from the 'prohibitive area'. A general-purpose empirical U.S. general equilibrium model is used to plot the Laffer curve for several elasticities, and to plot the newly introduced curve using the labor tax example. Results indicate that the U.S. could conceivably be operating in the prohibitive area, but that the tax wedge or labor supply elasticity would have to be much higher than most estimates would suggest.

1. Introduction

Ever since Arthur B. Laffer first drew his famous curve on a napkin in a Washington restaurant seven years ago, there has been considerable public debate about the possibility of an inverse relationship between tax rates and government revenue. Pictured in fig. 1, the curve plots total revenue against the tax rate and claims to show that there are two rates at which a given revenue can be collected. The tax rate of fig. 1 generally refers to any particular tax instrument, while revenues generally refer to total tax receipts. An increase in the payroll tax rate, for example, could affect not only its own revenue, but work effort and thus personal income tax revenues.

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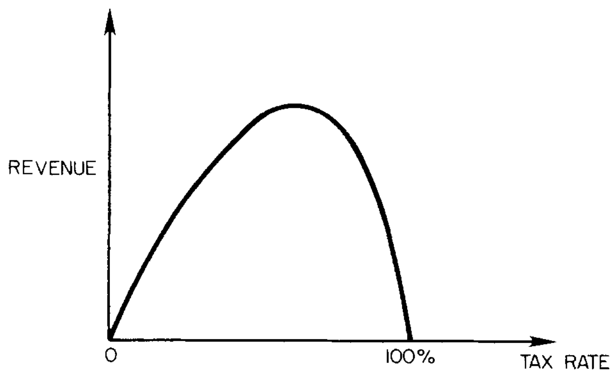

Fig. 1

The upward-sloping portion of the curve is called the 'normal' range and the downward-sloping segment is the 'prohibitive' range. No rational government would knowingly operate on the latter range in the long run, because the same revenue could be obtained with a lower tax rate. However, with adjustment lags in the private sector and a high social discount rate, such tax rates might be used in the short run. The prohibitive range is said to exist because the high tax rates stifle economic activity, force agents to barter, and encourage leisure pursuits. It is also made plausible by remembering that excess burden varies with the square of the tax rate.

The debate has been conducted mostly in the spheres of politics and journalism, and it includes a wide variety of unsupported claims and opinions. These range all the way from the assertion that the prohibitive range does not exist to the claim that 'we are well within this range at present'.[1] Simple theoretical models can show that the prohibitive range does indeed exist, but the U.S. position on the curve is clearly an empirical matter. Despite the obvious importance of this issue for fiscal policy, there has been no serious estimation of the curve using an economic model.[2] This paper attempts to correct this deficiency by using a general equilibrium taxation

[1]Michael Kinsley (1978) correctly claims that there is no logical necessity for revenues to be zero at 100 percent tax rates, due to nonmonetary incentives for work effort, but he incorrectly infers that 'there's no logical reason to assume without proof that the Laffer curve ever reverses direction at all' (p. 38). Laffer (1980) points out that even if a motivated person still works with a 100 percent tax rate, there must be some higher rate that will make him stop. The curve will still have the shape of fig. 1. The quote in the text is from Laffer (1977, p. 79).

[2]Several papers have described models in which there exists the possibility of a prohibitive range. See Canto, Joines and Laffer (1978) and Beck (1979) for examples. Other empirical papers have found governments operating in this range, as seen in the next section. Also, Kiefer (1978) provides estimates of revenue effects from the DRI, Wharton, and Chase Econometric models. None of these papers plots out the Laffer curve, however, nor do they estimate its relationship to various elasticity parameters.

model to address two questions. First, what is the position of the U.S. on the curve today? Second, what is the relationship between the location of the curve itself and critical parameters like the appropriate factor supply elasticity?[3]

The next section offers a brief review of some salient points from the debate. A common aspect of previous studies is that a prohibitive range for some local or national economy is always associated with particularly high tax rates, high factor supply elasticities, or both. Section 3 sets out the conditions under which a lower tax rate could result in higher revenues. These conditions are summarized in a new curve, plotting the appropriate factor supply elasticity against the tax rate. Section 4 describes the general equilibrium model used to simulate the effects of various tax rates. These estimations are performed in section 5, and the two curves are plotted for an example with a labor tax and labor supply elasticity. Section 6 provides some evidence on the value of the critical labor supply elasticity, and the final section concludes that to operate in the prohibitive range, the tax wedge must be very high, or the factor supply elasticity must be very high, or there must be some combination of the two.

2. A brief literature review

The idea of an inverse relationship between tax rates and revenue is not entirely new. In *The Wealth of Nations* (1776), Adam Smith could hardly be more explicit:

> High taxes, sometimes by diminishing the consumption of the taxed commodities, and sometimes by encouraging smuggling, frequently afford a smaller revenue to government than what might be drawn from more moderate taxes (Book V, Chapter II).

The trade literature, as exemplified by Caves and Jones (1973), has always understood the existence of a revenue maximizing tariff. This pre-Laffer edition contains a hump-shaped tariff revenue curve which looks just like fig. 1. With respect to internal taxes, Jules Dupuit in 1844 states:

> By thus gradually increasing the tax it will reach a level at which the yield is at a maximum ... Beyond, the yield of tax diminishes ... Lastly a tax [which is prohibitive] will yield nothing [Dupuit (1844)].

After the introduction of the Laffer curve (or perhaps the reintroduction of the Smith–Dupuit curve) in 1974, the quality of debate deteriorates

[3]In general, the location of the curve depends on both supply and demand elasticities, consumption and production parameters, and other circumstances in the economy. In wartime, for example, individuals might be willing to work harder at high tax rates to generate larger tax revenues. Later sections estimate the curve using a model of the 1973 U.S. economy.

significantly. Wanniski (1978) chronicles every fiscal catastrophe from the fall of the Roman Empire to the Great Depression and attributes each of them to some tax hike occurring within a few years in either direction. He states that the peak of the curve 'is the point at which the electorate desires to be taxed' (p. 98). On the same page, Wanniski suggests that 'if the tax rate is zero ... production is maximized' and that 'revenues plus production are maximized at [the peak of the curve]'.[4] The welfare maximizing government would instead operate somewhere on the normal range with the size of its budget determined by marginal cost–benefit analysis.

For the opposition, Kiefer (1978) comments that there is no tax rate for the overall economy which can be measured on the horizontal axis, and that 'the Laffer Curve represents a gross simplification of a major portion of macro-economics into a single curved line' (p. 15). These arguments are not compelling, either, in view of the large number of economic models which oversimplify in order to comprehend and convey economic phenomena. Kiefer also begrudges the supply side concentration, reminding us that income and substitution effects tend to be offsetting. 'By concentrating primarily on incentive and supply side effects, the Laffer Curve largely ignores the actual mechanism by which fiscal policy exerts its biggest and most immediate impact — demand side effects' (p. 16). One gets the feeling that these antagonists are talking past one another, using different models that are not comparable. Take for example the claim that the existence of a prohibitive range implies a marginal propensity to consume of greater than one. This Keynesian wisdom assumes no distorting taxes, no accelerator mechanism, and no incentive effects, all of which are central to the supply side argument.[5]

Canto, Joines and Laffer (1978) build a simple equilibrium model with one output, two factors, and a labor/leisure choice on the part of a single consumer group. Their utility function includes discounted consumption and leisure of each future period, a formulation which is very similar to the larger empirical general equilibrium model used later in this paper. Another similarity is that capital is inelastically supplied in any one period, but can grow over time. Labor taxes in these models place a wedge between the wage paid by producers and net wage received by workers. Individuals react to this wedge with an income effect and a substitution effect. In their model, however, government revenues are returned through transfers or are used to

[4]Walter Heller (1978) has his own complaints about Wanniski's evidence: 'At a time when only a few million Americans paid income taxes and federal spending was less than 5% of GNP, we are asked to believe that federal income tax cuts alone powered the growth of GNP from £70 billion in 1921 to $103 billion in 1929' (p. 47).

[5]Also, supply side advocates typically assume an equivalence between bond and tax financed spending, so that spending itself creates a wedge. Debates over the rationality of consumers and the net wealth of government bonds are best conducted elsewhere. For the purposes of this paper, I grant this equivalence.

buy goods that are perfect substitutes for private goods. This modelling cancels out the income effect and leaves the economy with an unambiguously positive substitution effect and an upward-sloping labor supply curve.

There are three points raised by this modelling. First, as recognized by these authors, if transfers are given to individuals other than those who pay taxes, and if individuals have different preferences, then income effects do not necessarily cancel. Second, if a government does nothing other than place a distorting wedge into the labor/leisure choice of homogeneous consumers and then return revenues in lump-sum fashion, of course output and welfare would both fall. These authors have not allowed for any positive contribution of a government budget. Their model does not account for the income effect of an efficiency gain that can be associated with correcting market failure by providing a public good. Third, they fail to allow for any complementarity between private and public outputs. Clearly there are public goods such as police protection and transportation systems which act to encourage private production, more than offsetting the adverse effects of the necessary tax wedge. Thus, the 'balanced budget' labor supply curve does not have to be upward sloping as these authors insist. Positive and negative estimates for the aggregate uncompensated labor supply elasticity will be surveyed in a later section.[6]

In empirical work, Grieson et al. (1977) find the possibility of an inverse relationship between tax rates and revenue for local government in New York: 'The inclusion of state taxes lost when economic activity leaves both the city and state would ... raise the possibility of a net revenue loss as a result of an increase in business income taxes' (p. 179). They find that the nonmanufacturing sector has fewer alternatives to the New York City location and should be taxed more heavily relative to the manufacturing sector whose response to tax is more elastic. Grieson (1980) finds the two sectors reversed for Philadelphia, where nonmanufacturing is under greater competitive pressure. Still, 'Philadelphia may have been at or very close to the revenue maximizing point ... before the recent income tax increase, which raises the possibility of it having been in excess of the socially optimal one' (p. 135).

For Sweden, Stuart (1981) uses a fairly simple two-sector model to find that the current 80 percent marginal tax wedge exceeds the revenue maximizing rate. For the U.S., Canto, Joines and Webb (1979) evaluate the 1964 Kennedy tax cuts which included the reduction of the top personal rate from 91 to 70 percent. They find that the Kennedy tax cuts may have increased or decreased revenues, equally likely possibilities.

Perverse revenue effects are more likely from selected tax cuts than from

[6]These three shortcomings of the Canto, Joines and Laffer (1978) theoretical model are not explicitly corrected in the empirical model used below, but they are implicitly corrected through the possibility of positive or negative labor supply elasticities.

general tax cuts, if they can be directed at individuals or activities that are unusually sensitive to tax rates. Hausman (1982) simulates tax cuts separately for husbands and for wives, finding less revenue loss from the latter group because of their higher labor supply elasticity. Feldstein, Slemrod and Yitzhaki (1980) find that capital gain realizations are very sensitive to the effective tax rate: 'An important implication of this high coefficient is that a reduction in the tax rate on capital gains would actually increase the total revenue collected' (p. 786).[7] On the other hand, Minarik (1981) finds that capital gain realizations respond to ordinary fluctuations in individual effective tax rates. As a result of this self-averaging over time, statutory rate reductions cannot be expected to generate enough additional realizations to increase revenues.

3. Another simple curve

Two prominent themes from this debate are high marginal tax rates and implicit or explicit reference to high factor supply elasticities.[8] Offsetting income and substitution effects merely imply that the relevant uncompensated supply elasticity might be low or negative. The emphasis on large incentive effects in the supply side argument implies a large elasticity. The open nature of a local economy implies mobile factors and a more elastic response to a local tax. Indeed, the entire debate reduces to the empirical matter of determining the relevant parameter values. If supply elasticities are high enough, the economy could be on the prohibitive range.

The very location of Laffer's curve in the rate-revenue space of fig. 1 depends on the supply elasticity of the factor being taxed. If that elasticity were fairly low, the total revenue maximizing point would be at a high tax rate for that factor, and conversely. One can imagine a third dimension on that diagram giving different elasticity values. The hill would then be converted into a ridge, running from a low tax rate and high elasticity combination to a high rate and low elasticity pair. The crest of that ridge is plotted in fig. 2. Everything to the southwest of that curve signifies the 'normal area', where raising rates increases revenue, and northeast of the curve is the 'prohibitive area', where no rational government would

[7]Three points serve to mitigate the strength of this result. First, a capital gains tax cut might unlock a flood of realizations in the short run, without necessarily increasing revenues in the long run. Second, increased selling of corporate stock does not necessarily imply increased saving and capital formation (i.e. buying of corporate stock). Third, the capital gains tax cut is likely to increase corporate retained earnings, decrease the dividends paid out, and thus reduce personal tax revenue from dividends.

[8]Other themes from this literature include minimum wage laws, regulation of business, nonmarket activity, and the complexity of tax rules. The Laffer curve itself focuses on tax rates, however, so this paper will consider different tax rates and assume unchanged complexity. The relevant elasticity for this exercise would provide not just the response of labor supply, but the response of taxable labor supply.

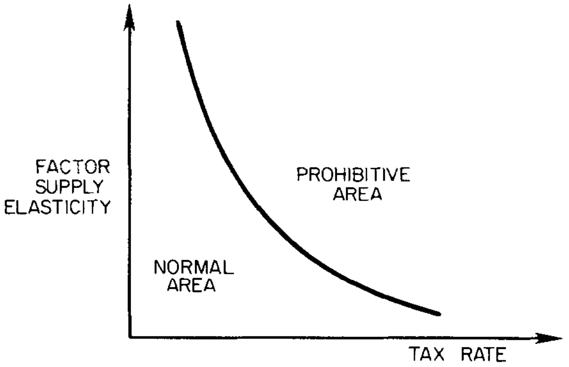

Fig. 2

knowingly operate. Each point on the curve shows the tax rate which maximizes total revenue for a given elasticity.

Suppose, for a simple example, that homogeneous labor L is taxed at the proportional rate t. Labor demand and supply are based, respectively, on the gross-of-tax wage w and the net-of-tax wage $w(1-t)$, in constant elasticity forms:

$$L_d = Aw^{\eta}, \qquad \eta < 0, \tag{1}$$

$$L_s = B[w(1-t)]^{\varepsilon}, \qquad \varepsilon > 0. \tag{2}$$

Tax revenue R is equal to twL, so differentiation and algebra provide:

$$\frac{\partial R}{\partial t} = wL\left[1 + \frac{\partial L}{\partial t}\cdot\frac{t}{L} + \frac{\partial w}{\partial t}\cdot\frac{t}{w}\right]. \tag{3}$$

Setting (3) equal to zero, we have three equations that can be solved for w, L, and the revenue-maximizing tax rate t. Since $L_s = L_d$ in this partial equilibrium system, we can use (1) and (2) to express w as a function of t. Substituting that w back into (1), we can also express L as a function of t. Differentiating these expressions, substituting into (3), and solving for t, we have:[9]

$$t = \frac{\eta - \varepsilon}{\eta(1+\varepsilon)}. \tag{4}$$

If $\eta > -1$ (demand is inelastic), then higher tax rates can always achieve

[9]Eq. (4) is derived somewhat differently in Blinder (1981).

more revenue. If $\eta < -1$, however, then the relationship between t and ε will look like fig. 2:

$$\frac{\partial t}{\partial \varepsilon} = \frac{-1}{(1+\varepsilon)^2}\left(\frac{1+\eta}{\eta}\right) < 0 \tag{5}$$

and

$$\frac{\partial^2 t}{\partial \varepsilon^2} = \frac{2}{(1+\varepsilon)^3}\left(\frac{1+\eta}{\eta}\right) > 0, \tag{6}$$

so the curve slopes down and is convex to the origin. The easiest case to see is where $\eta = -\infty$, so that $t = 1/(1+\varepsilon)$. Then the revenue maximizing rate approaches one as ε goes to zero, and it approaches zero as ε becomes infinite.[10]

We can now reconcile conflicting claims of the previous section. Those who find an inverse relationship between tax rates and revenues must believe that the relevant elasticity is high, that the relevant tax rate is high, or both. Those who find a normal range must believe that one or both of these parameters is low. Finally, those who deny the existence of an inverse relationship at any tax rate might really just believe that the uncompensated supply elasticity is zero or negative (or that demand is inelastic).[11]

4. The general equilibrium model

To simulate the effects of different tax rates for a variety of factor supply elasticities, a previously developed general equilibrium taxation model is employed. This model has been used to evaluate various tax reform proposals, but it was built as a general purpose model. Its features are surprisingly well suited for this application, as no adjustments were required to obtain the following estimates. Since more thorough descriptions of the model are available elsewhere, only an essential outline of it is provided here.[12]

[10]Several points are manifest. First, this analysis oversimplifies by using a given elasticity for all tax rates to find the revenue maximizing point. As the tax rate varies, so would equilibrium prices, incomes, and preference parameters like the factor supply elasticity. Second, a given time frame is implied since elasticities might increase as more time is allowed for adjustment. Third, neither elasticities nor tax rates have to be positive. The southwest quadrant contains a symmetrical curve showing the maximum revenue loss from a subsidy. Finally, note that similar analyses can be performed with respect to η, the labor demand elasticity.

[11]A zero uncompensated elasticity can mask a high compensated elasticity, however. Hausman (1981) points out that while the former is relevant to determine actual factor supply (and thus the tax base and revenues), the latter is relevant for the efficiency cost of distortions.

[12]See Fullerton, Shoven and Whalley (1978) and Fullerton, King, Shoven and Whalley (1981). This model provides more detailed features than would be necessary to demonstrate the relationships of figs. 1 and 2. Some form of general equilibrium model is required, however, to capture indirect effects. Although certain aspects of this model have been updated since the calculations for this paper were performed, the changes do not significantly affect these results.

The economy is divided into 19 profit-maximizing producers, 15 consumption commodities, and 12 consumer groups differentiated by income class. Each industry has a Cobb–Douglas or Constant Elasticity of Substitution (CES) production function, where the elasticity of substitution between capital and labor is chosen as a 'best-guess' value from evidence in the literature. Each output can be used as an intermediate input through a fixed coefficient input–output matrix. Outputs can be purchased by government, used for investment, or converted into consumer goods. There is also a simple foreign trade sector, though this model of the U.S. economy should be considered closed for purposes of this paper.

Each consumer has initial endowments of labor and capital services which can be sold for use in production. Because of perfect mobility and competition, the net-of-tax return to each factor is equal among industries. A consumer can also choose to buy some of his own labor endowment for leisure. The capital stock is fixed in any one period, but the dynamic version of the model allows the savings response to augment the stock in later periods. Demand functions are based on CES utility functions with double nesting. The choice between present and future consumption is represented by the outside nest, and the elasticity of substitution between them is based on an estimate of the uncompensated savings elasticity with respect to the net-of-tax rate of return. For this value we use 0.4 as found by Boskin (1978). The breakdown of present consumption into commodities and leisure is represented by the inside nest, and the elasticity of substitution in this choice is based on an estimate of the uncompensated labor supply elasticity with respect to the net-of-tax wage. For this value we typically use 0.15, but relationships for different labor elasticity values will be derived below.[13]

The various federal, state, and local taxes are typically modelled as ad valorem tax rates on purchases of appropriate products or factors. Corporate income taxes and property taxes are modelled as different effective rates of tax on use of capital by industry.[14] Social security, workmen's compensation and unemployment insurance appear as taxes on use of labor. These rates differ slightly by industry because different proportions of workers hit the social security maximum, but they average 10 percent of payments to labor. Personal income taxes operate as different linear schedules for each consumer group, with marginal tax rates increasing from an average of 1 percent for

[13]Leisure in the baseline is taken as three-fourths of observed labor, reflecting the assumption that 40 hours are worked out of a possible 70 hours each week. Because of the CES form, the income elasticity of demand for leisure is one. From the Slutsky equation, it can then be shown that the compensated labor supply elasticity is equal to the uncompensated elasticity plus 3/7. A tax increase alone will cause a reaction based on the uncompensated elasticity, but if revenues are returned to consumers then their net behavior will approximate the larger compensated response.

[14]The effective tax rate in each industry is equal to capital taxes paid divided by capital income. For a comparison of this 'average' tax rate with an alternative 'marginal' treatment in this model, see Fullerton and Gordon (1982).

the lowest income group to an average marginal tax rate of 40 percent for the highest income group.

The model is parameterized for 1973 using data from the National Income and Product Accounts, the Bureau of Labor Statistics' Consumer Expenditure Survey, and the Treasury Department's Merged Tax File. These data are adjusted for known inaccuracies of government collection procedures and for general equilibrium consistency requirements. This 'benchmark' data set is used to solve backwards for relevant preference parameters and tax rates, so that the model solution can replicate the benchmark equilibrium. The user can specify different tax rates to calculate a simulated equilibrium with different resource allocations for comparison with the benchmark. The model is solved using a variant of Scarf's algorithm for an equilibrium price vector where excess demands and profits are zero.

The model does not include involuntary unemployment, endogenous inflation, or other aspects of disequilibria. It is essentially a microeconomic model, expressing all prices in relative terms. Voluntary unemployment is captured through the labor/leisure choice, however, and the interaction of inflation with effective marginal tax rates is modelled by adjusting those rates appropriately. The modelling of capital gains, for example, accounts for the nominal gains that are subject to tax.

Of potential controversy, however, is the modelling of government transfers as essentially lump-sum payments to consumer groups in proportion to their observed 1973 receipts from social security, unemployment compensation, food stamps, and other welfare programs. Supply side advocates may like to model these payments as additional work disincentives, increasing the wedge betweeen labor's marginal product and leisure's implicit price. Though lawmakers probably do not intend to subsidize leisure, some programs have that effect. The incentive depends on the program's ability to isolate important characteristics such as age, disability, and number of dependents which make the recipient unable to work. If this intention is successful, the payments will not have a substitution effect. The income effect of transfer programs could also reduce labor supply, but this effect is captured in the model.[15]

[15]The difference between paying people who do not work, and paying people not to work, is the difference between a marginal payment with incentive effects, and a lump-sum payment. Legally, an employee must be laid off to be eligible for unemployment compensation. A worker can ask to be laid off, but employers may be reluctant to circumvent the intent of the law. These transfers are not automatically and fully available to nonworkers. Similarly, AFDC payments are designed to select recipients by particular characteristics, maximizing the lump-sum effect and minimizing disincentive effects. Social security payments are higher for the blind or disabled. Finally, note that these transfers, to the extent that they are disincentives, do not always apply to marginal hours. Most individuals who take an extra hour of leisure do not become eligible for transfers at all. Laffer (1980) is correct, however, that if transfer payments include a means test, work disincentives can be large for some individuals. Another more thorough study could undertake to measure incentive effects of transfers.

5. Estimation

Supply side advocates refer to several different types of taxes when they claim an inverse relationship betwen a particular tax rate and government revenue. The curve in fig. 2 could be plotted by varying a product tax rate against the price elasticity of demand for that product, or by plotting capital tax rates against the elasticity of savings with respect to the net-of-tax return to capital. The latter example was attempted with the empirical model, but no prohibitive area was discovered.[16] For this reason, the example used here is the labor tax against the labor supply elasticity.

In our basic model, the tax on labor used by industry averages 10 percent of net factor payments. The personal income tax takes another 24.9 percent of marginal labor income, weighting the twelve marginal tax rates by labor income of each group. The total wedge thus takes 31.8 percent of marginal labor income gross of all tax.[17] This overall marginal rate is the relevant single parameter for summarizing incentive effects in the model, and this is the parameter varied in simulations for the horizontal axes of figs. 1 and 2. The overall average rate is 19.2 percent, dividing total labor taxes by gross labor income.

Marginal tax rates determine incentives, but average tax rates by definition determine revenues. A more progressive tax structure will therefore attain an earlier revenue maximum. For this reason, progressivity should not be altered in simulating alternative tax rates. Unfortunately, however, there is no unambiguous measure of progressivity. Simulations in this paper will hold constant the first of three possible progressivity measures defined in Musgrave and Musgrave (1980). The effect of this selection is that the same number of percentage points are added to or subtracted from all average *and* marginal labor tax rates of all consumers when a rate change is simulated. Such changes are summarized by referring to changes in the 31.8 percent

[16]Over forty simulations were performed in seeking a prohibitive area for capital taxes. Using the dynamic version of the model, tax rates were raised to 83 percent of gross capital income, savings elasticities were increased to 4.0, and equilibria were calculated out 50 years in the future. Normally, discount rate problems arise in determining whether the present value of revenues has increased or decreased. In this case, however, there was not a single period of the raised-tax sequence of equilibria which had lower revenues than the corresponding period of the benchmark sequence. Inverse relationships may exist for high effective rates of tax on certain types of real capital income for certain individuals. No overall inverse relationship was discovered in this model, however, because the tax distortion applies to the savings decision, while savings are only an increment to the capital tax base. More than 50 years would be required for the tax base reduction to offset a tax rate increase and result in lower revenues.

[17]The model defines labor income as net of the 10 percent factor tax on industries, but gross of the personal income tax on individuals. For a marginal dollar of this labor income, $1.10 is the gross-of-tax payment, $0.10 is the payroll tax, and $0.249 is the marginal personal tax paid, averaged over the 12 groups. The total marginal tax rate is thus $(0.1+0.249)/1.10$, which equals 31.8 percent, except for rounding. By the same formula for different groups, personal marginal rates between 1 and 40 percent imply total marginal rates between $(0.1+0.01)/1.10$, which equals 10 percent, and $(0.1+0.4)/1.10$, which equals 45.5 percent.

overall marginal rate on gross labor income.[18]

The consistent 1973 data set also shows a total tax revenue of $360 billion and a national income of $1,252 billion. Our expanded notion of welfare, including leisure valued at the net-of-tax wage, is $1,690 billion. These values are replicated for any possible labor supply elasticity as long as tax rates are unchanged. Simulations with labor tax rates other than 31.8 percent will have revenues which depend on the elasticity, and it becomes necessary to specify the disposition of extra revenues. One possibility is simply to allow a budget surplus or deficit. If a surplus implies lower future taxes, however, individuals may react to an effective tax rate that is different from the specified rate for the simulation. Higher revenues must eventually be spent or returned (see footnote 5). A second possibility is to increase public expenditure on the 19 industry outputs of the model. Though government spending has no macroeconomic effects on inflation or unemployment in this model, it does have a microeconomic effect on the pattern of demands for commodities. It indirectly affects the demand for capital and labor through the different factor ratios of production. Instead, additonal revenues are returned to consumers in lump-sum fashion, in proportion to their original after-tax incomes.[19]

The results from over sixty simulations are summarized in table 1.[20] The first column shows the total revenue resulting from different labor tax rates using the basic model's value of 0.15 for the labor supply elasticity with respect to the net-of-tax wage. The 'observed' total revenue of $360 billion corresponds to the basic tax rate of 31.8 percent, and total revenues are positively related to tax rates up to a tax which is 78.8 percent of gross labor income. Beyond that rate, revenues start to fall.[21]

[18]Thus, labor tax rate changes can be thought of as changes in the proportional payroll tax rate or as changes in all average and marginal personal tax rates, on labor income only.

[19]This lump-sum rebate has no direct effect on prices since no tax rates are altered. It could have an indirect effect on prices of the simulated equilibrium, however, since consumers include the income in their expanded budgets for purchase of commodities and leisure according to their own preference patterns. This disposition of revenues corresponds exactly to that of Canto, Joines and Laffer (1978), reviewed in section 2. By symmetry, a decrease in revenue is accompanied by a lump-sum charge on consumers in the same proportions. Total government tax revenues are defined to be inclusive of income returned to consumers, and exclusive of any lump-sum charges necessary to keep government spending on commodities constant.

[20]These simulations are static in the sense that total endowments of labor and capital are fixed. Labor can be sold to industry or retained for leisure in the simulation, while both factors can be reallocated among industries.

[21]Like Canto, Joines and Laffer (1978), this model ignores production-encouraging aspects of any public goods made possible through increased revenue. As a result, national income (GNP) falls by $292 billion when the elasticity is 0.15 and the tax rate is raised to 78.8 percent. Though the return to the fixed capital stock rises, labor supply falls off by almost half. The gross-of-tax wage rises, but the net-of-tax wage falls by 40 percent in the new equilibrium. If the increased leisure is valued at the net-of-tax wage, then the $292 billion income fall is offset by a $177 billion leisure gain, with a $115 billion net loss in real terms. These calculations use a Laspeyres index, valuing old and new quantities at base prices.

Table 1

Total revenue associated with each labor tax rate (in billions of 1973 dollars).

	Labor supply elasticity with respect to net-of-tax wage								
Rate on gross labor income[a]	0.15	0.50	1.00	1.50	1.75	2.00	2.50	3.00	4.00
0.166									341.79
0.249								355.82	365.57
0.285						354.00	357.46	360.56	365.93
0.318	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00
0.347					364.00	361.98	358.23		349.18
0.374				369.80	365.17	360.85			
0.399				370.82	363.62	356.91			
0.422	439.48		391.82	369.60		350.57			295.40
0.464			396.49	361.52					
0.482			396.60						
0.499	503.71		395.43						
0.531			389.75						
0.558	555.56	474.13	380.36						
0.605	597.41	481.65							
0.615		481.98							
0.625	615.16	481.78	336.60						
0.674	657.84	476.01							
0.700	678.84								
0.722	694.90								
0.750	711.16								
0.772	719.58								
0.779	720.89								
0.785	721.53								
0.788	721.60								
0.791	721.52								
0.797	720.92								
0.812	715.79								
0.833	697.79								
0.850	670.19								
0.875	593.30								

[a]Simulations were made selectively to save computational expense. Not all possible rates are reported. These rates on gross income include social security taxes and personal income taxes at the overall marginal rate, all as a fraction of gross labor income.

Any column of data from table 1 can be used to plot an example of fig. 1, as is done in fig. 3 for the 0.15 elasticity. In any of these Laffer curve diagrams, the modelled U.S. economy is represented by 0.318 on the labor tax rate axis. If the various tax rates, transfers, and elasticities are reasonable, as modelled, then the U.S. economy is well down the normal range of the curve. For those who prefer a high elasticity, fig. 4 plots another Laffer curve.

The 4.0 labor supply elasticity and current tax rates place the U.S. well onto the prohibitive range.[22]

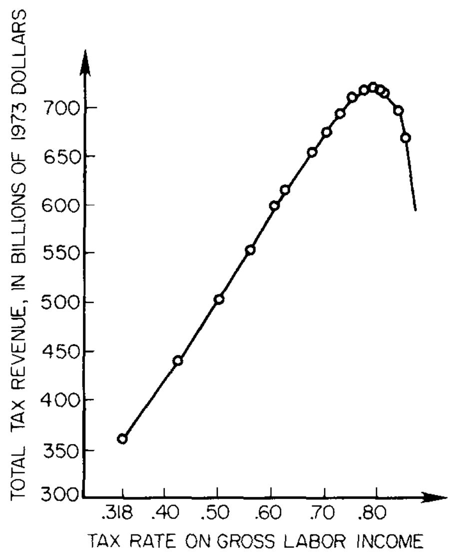

Fig. 3. Laffer curve with a 0.15 labor elasticity.

Underlined in each column of table 1 is the maximum revenue point for that elasticity. These tax rate and elasticity combinations correspond to points on a curve like fig. 2. When plotted for this example, the curve is shown in fig. 5. On this curve, with tax rates as modelled, the labor supply elasticity would have to be at least 2.5 to put the U.S. over the peak and onto the prohibitive range. Alternatively, if the supply elasticity were at least 1.0 and the true overall tax rate were at least 48.2 percent, then again U.S. taxes could be operating irrationally. The continuum of fig. 5 allows the reader to select a plausible tax rate and elasticity combination to determine whether the U.S. is now in the prohibitive area.

6. What is the labor supply elasticity?

The empirical model was fairly careful in establishing all of the basic tax

[22]In the 4.0 elasticity case, even the small jump from a 31.8 percent labor tax rate to a 34.7 percent rate causes a 9 percent fall in labor supply, a $70 billion reduction in national income, a $44 billion increase in the value of leisure, and a net welfare loss of $26 billion in real terms. A small tax cut with this high elasticity results in symmetrical increases in labor supply, output, and welfare. All tax cuts increase welfare in this model because revenue is replaced with lump-sum charges as in Canto, Joines and Laffer (1978). Such opportunities may not in fact be available.

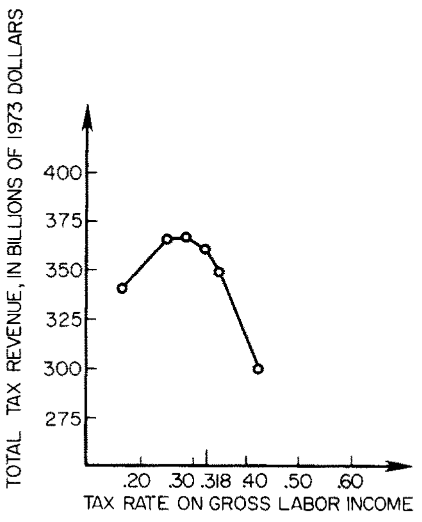

Fig. 4. Laffer curve with a 4.0 labor elasticity.

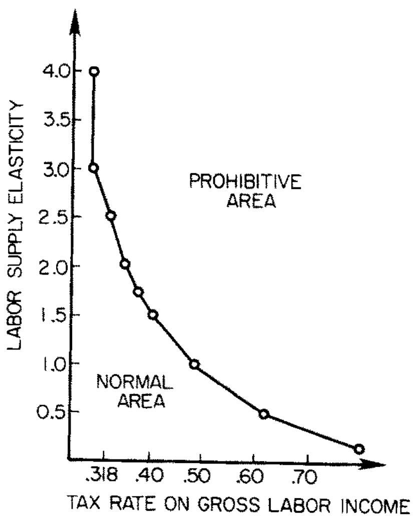

Fig. 5. Elasticity and tax rate combinations.

Table 2

Estimates of the uncompensated labor supply elasticity.

Authors	Data subset	Tyoe of data	Range of estimates
A. For males			
Finegan (1962)	Male family heads	Inter-occupational	−0.35 to −0.25
Rosen (1969)	Male family heads	Inter-industrial	−0.30 to −0.07
Kalachek–Raines (1970)	Male family heads	U.S. cross-section	+0.05 to +0.30
Owen (1971)	Male family heads	U.S. time-series	−0.24 to −0.11
Greenburg–Kosters (1973)	Poor male family heads	U.S. cross-section	−0.16 to −0.05
Boskin (1973)	Different male subgroups	U.S. cross-section	−0.07 to +0.18
Hill (1973)	Poor male family heads	U.S. cross-section	−0.32 to −0.07
Ashenfelter–Heckman (1973)	Male family heads	U.S. cross-section	−0.15
Fleisher–Parsons–Porter (1973)	Male ages 45–59	U.S. cross-section	−0.25 to −0.10
Ashenfelter–Heckman (1974)	Married males	U.S. cross-section	Zero
Burtless–Hausman (1978)	Low-income males	Gary NIT cross-section	Zero
Hausman (1981)	Married males	U.S. cross-section	Zero
B. For females			
Finegan (1962)	Females	Inter-occupational	−0.095
Leuthold (1968)	Females	U.S. cross-section	−0.067
Kalachel–Raines (1970)	Females	U.S. cross-section	+0.20 to +0.90
Boskin (1973)	Different female subgroups	U.S. cross-section	−0.04 to +1.60
Ashenfelter–Heckman (1974)	Married females	U.S. cross-section	0.87
Hausman (1981)	Married females	U.S. cross-section	0.9
Hausman (1981)	Female household heads	U.S. cross-section	0.5
C. Aggregate			
Winston (1966)	Aggregate	International cross-section	−0.11 to −0.05
Lucas–Rapping (1970)	Short run aggregate	Time-series	1.35 to 1.58
Lucas–Rapping (1970)	Long run aggregate	Time-series	Zero to 1.12

rates, including the 31.8 percent labor rax rate, but it is much less explicit about the aggregate labor supply elasticity. The econometric literature gives many estimates for population subgroups, since different individuals will typically have different rates of response to a new net-of-tax wage. Finegan's (1962) occupational study found managers, craftsmen, and clerical workers varying from a −0.29 to a +0.42 labor supply elasticity, while Boskin's (1973) division by sex, race, and age found estimates from −0.07 (for prime-age white males) to +1.60 (for elderly black women). Since taxes do not distinguish among these characteristics, the relevant elasticity parameter is an aggregate one. Table 2 summarizes a number of econometric studies and is based mostly on discussion in Killingsworth (1982).

A certain injustice is perpetrated against these authors by reporting their results in such summary fashion. Each study has its own measure of the wage, its own data-year or time-period, its own mean values, and its own functional forms. The studies differ as to whether they account for labor participation rates and as to whether they account for the balanced budget effects of government spending, discussed above.[23] The numbers in table 2 are provided only to give the reader a framework for choosing a plausible aggregate labor supply elasticity. Since few aggregate studies are available, male and female estimates can be roughly combined.

Elasticity estimates for males are mostly small and negative, ranging from −0.40 to zero. Borjas and Heckman (1978) review the econometrics of these studies and reduce the bounds to −0.19 and −0.07. The estimates for females are more often positive, and can be large in absolute value. Killingsworth finds that females' elasticity estimates are mostly between 0.20 and 0.90 in cross-section studies. To obtain the model's 0.15 aggregate labor supply elasticity, perform a rough numerical calculation. The *Statistical Abstract* shows that the median money income of male employed civilians has consistently been twice that of females. It also shows about a 1.7 ratio of males to females in the labor force, a ratio which is decreasing with time. By multiplication, the ratio of total male to female labor income would be about 3.4 (though decreasing). Taking a relatively high male elasticity of −0.10 and a relatively high female elasticity of +0.90, the three-to-one weighted average is a 0.15 aggregate elasticity.

7. Conclusion

This paper investigates a number of analytical and empirical arguments

[23]The most recent and perhaps the most thorough estimates are provided in Hausman (1981). His methodology includes consideration of progressivity, transfer programs, labor force participation, fixed costs of working, and a market wage which depends on the hours worked. These features can result in budget sets that are nonconvex and labor supply that is discontinuous. However, the study still excludes choices with respect to the type of job, the intensity of work on the job, nonpecuniary rewards, on the job training, and intertemporal considerations.

about the relationship between tax rates and government revenues. A general equilibrium tax model is used to plot this relationship as well as another relationship between tax rates and factor supply elasticities. This new curve shows that the U.S. economy could conceivably be operating in the 'prohibitive range' for taxes on labor, but that reasonable estimates of an aggregate labor supply elasticity and of an overall marginal labor tax rate are both low enough to suggest that broad-based cuts in labor tax rates would not increase revenues.

The tax rate and elasticity relationship can be applied to other federal, state, or local taxes to find circumstances where a particularly high tax rate on real income or a particularly high elasticity could place a tax in the prohibitive area. A tax on purely nominal capital gains, for example, or an underallowance for depreciation can result in high effective tax rates on some types of real capital income. Future research could investigate the responsiveness of these particular investments to high effective rates. The 'marriage penalty' which places a secondary worker in the higher marginal tax bracket of his or her spouse may represent another high rate of tax on an elastically supplied factor.[24] Welfare programs that make recipients ineligible at a given income level imply effective marginal tax rates of 100 percent or higher. Also, the high elasticity argument is particularly applicable for state and local governments since factors are generally more mobile within national boundaries. McGuire and Rapping (1968, 1970) find labor supply elasticities of 20–100 for particular states or industries. This mobility implies that one jurisdiction cannot charge higher tax rates than its neighbors and may apply increasingly to international factor flows.

Finally, although the results of this paper tend to reject the notion of an inverse relationship between major U.S. tax rates and government revenues, they do not necessarily invalidate the claim that these tax rates and revenues should be lowered. Even on the normal range, taxes may be higher than desired by voters. Preferences can change over time, fewer public goods may now be demanded, and the electorate can legitimately request a tax decrease. Although incentive effects can still be important without perverse revenue effects, the point is that the 'economics of the tax revolt' are less the economics of incentive effects and more the economics of public choice.

[24]Feenberg and Rosen (1982) simulate the effects of four proposals to reduce or eliminate the marriage penalty. Each has its own welfare effects and redistributions, but none implies higher revenue.

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