NBER WORKING PAPER SERIES

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

Don Fullerton

Working Paper No. 467

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge MA 02138

April 1980

I am indebted to my colleagues A. Thomas King, John B. Shoven, and John Whalley with whom I developed the general equilibrium taxation model used in this paper. I am also grateful to the Treasury Department's Office of Tax Analysis For Financial Assistance. This revised version of the paper incorporates changes suggested by David Bradford, Shantayanan Devarajan, Donald E. Grieson, Harvey Rosen, Nicholas Stern, and John Whalley. However, I retain full responsibility for errors and for the views expressed. This research reported here is part of the NBER's research program in Taxation. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

NBER Working Paper 467
April, 1980

On the Possibility of an Inverse Relationship
Between Tax Rates and Government Revenues

ABSTRACT

When Arthur Laffer or other "supply side advocates" plot total tax revenue as a function of a particular tax rate, he draws an upward sloping segment called the normal range, followed by a downward sloping segment called the prohibitive range. Since a given revenue can be obtained with either of two tax rates, government would minimize total burden by choosing the lower rate of the normal 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. Looking at labor tax rates and total revenue, for example, the tax rate which maximizes revenue 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 and/or labor supply elasticity would have to be much higher than most estimates would suggest.

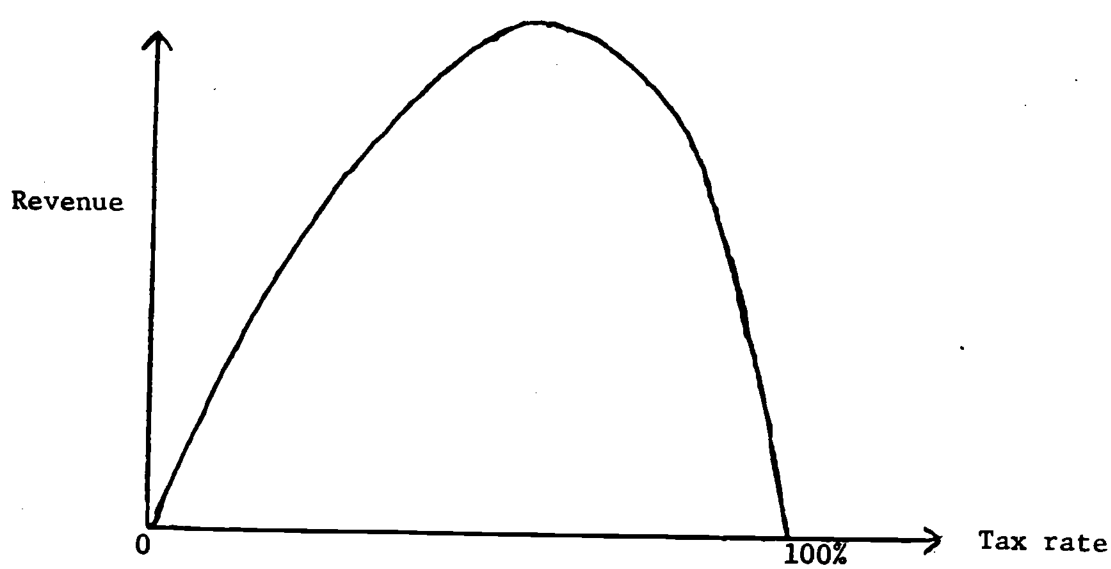
Don Fullerton
Woodrow Wilson School of Public
and International Affairs
Princeton University
Princeton, NJ 08544

(609) 452-4811

1. Introduction

Ever since Arthur B. Laffer first drew his famous curve on a napkin in a Washington restaurant five years ago, there has been considerable public debate about the possibility of an inverse relationship between tax rates and government revenue. Pictured in Figure 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 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, but with adjustment lags and a high 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.[1/]

Figure 1



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."[2/] 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.[3/] This paper attempts to correct this deficiency by using a general equilibrium taxation 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?[4/]

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 non-U. S. economy is always associated with particularly high tax rates, high factor supply elasticities, or both. The third section 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. The fourth section describes the general equilibrium model used to simulate the effects of various tax rates. These estimations are performed in section five, and the two curves are plotted for an example with a labor tax and labor supply elasticity. Section six provides some evidence on the value of the critical labor supply elasticity, and the last 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. Adam Smith, in The Wealth of Nations (1776) 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 Figure 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.

After the introduction of the Laffer curve (or perhaps the reintroduction of the Smith-Dupuit curve) in 1974, the quality of debate deteriorates significantly. Jude 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. At various points in his analysis Wanniski suggests (a) that the mere existence of a prohibitive range implies taxes should be reduced, (b) that the peak of the curve is at a 25 percent tax rate, and (c) that the peak of the curve "is the point at which the electorate desires to be taxed".[5/] The welfare maximizing government would operate somewhere on the normal range with the size of its budget determined by standard cost-benefit analysis.

For the opposition, Kiefer (1978) asserts 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." 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." 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 considers reductions of nondistorting taxes and ignores the incentive effects central to the supply-side argument.[6/]

Canto, Joines, and Laffer (1978) build a simple equilibrium model with one output, two factors, and a labor/leisure choice on the part of consumers. 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. Each individual reacts to this wedge with an income effect and a substitution effect. In their model, however, government revenues are returned through transfers or used to buy goods which are perfect substitutes for private goods. This modelling cancels out the income effect and leaves the economy with an unambiguously positive substitution effect and upward sloping labor supply. There are three points raised by this modelling. The first point, recognized by these authors, is that 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. The second point is that if a government does nothing other than place a distorting wedge into the labor/leisure choice with a lump-sum rebate of revenues, then welfare should indeed unambiguously decrease. These authors have not allowed for any positive contribution of a government budget. Their model does not account for the inherent efficiency gain associated with correcting market failure by providing a public good. Thirdly, they fail to allow for any complementarity between private and public outputs. Clearly there are public goods such a police protection and transportation systems which act to encourage private production, more than offsetting the adverse effects of the necessary tax wedge. Since the effects of a combined tax wedge and labor complementing public good may be offsetting, the "balanced budget" labor supply curve does not have to be upward sloping as these authors insist. The aggregate uncompensated labor supply elasticity may be positive or negative, and econometric estimates of this value will be surveyed in a later section.[7/]

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." 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 (1979) 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."

Finally, Charles Stuart (1979) uses a fairly simple two sector model to find that the current 80% marginal tax wedge in Sweden exceeds their revenue maximizing rate by 10%. Sweden's high tax rates encourage barter and nonmarket activity, placing the economy on the prohibitive range.

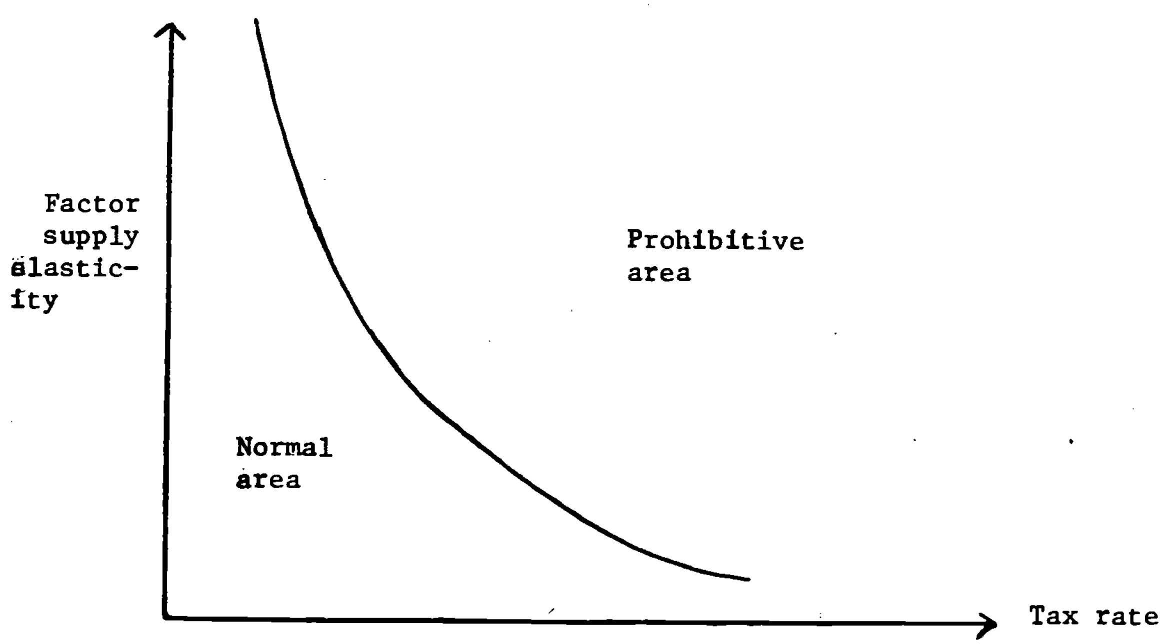
3. Another Simple Curve

A common feature of arguments from both sides of the debate is an implicit or explicit reference to factor supply elasticities. Offsetting income and substitution effects merely imply that the relevant uncompensated supply elasticity might be low or negative. The emphasis on large incentives 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 elasticies are high enough, the economy could be on the prohibitive range.

The very location of Laffer's curve in the rate-revenue space of Figure 1 depends on the supply elasticity of the factor being taxed.[8/] If that elasticity were fairly low, the total revenue maximizing point would be at a higher 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 Figure 2. Everything to the southwest of that curve signifies the "normal area", where raising rates gain revenue, and northeast of the curve is the "prohibitive area", where no rational government would knowingly operate. Each point on the curve shows the tax rate which maximizes total revenue for a given elasticity.[9/]

At an infinite supply elasticity, the government cannot acquire additional revenue by taxing that factor, and the maximum total revenue would be obtained elsewhere (a zero tax rate for that factor is best). For a large finite elasticity, the tax rate would have to be very low to remain in the normal range, reflecting a general result from the optimal tax literature. As this elasticity decreases, higher tax rates will maximize revenues. Finally, at a zero (compensated) elasticity, the tax is nondistorting, and the only bound on revenue is given by total product of the factor.

Figure 2



From this description, we can place all the advocates on a comprehensible spectrum: those who say we are in the prohibitive area believe that the relevant elasticity and/or tax rate are higher, those who say we are in the normal area believe they are lower, and those who deny the existence of the inverse relationship must believe that the uncompensated supply elasticity is zero or negative.

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 used. This model is still evolving after several years of work, and it has already been used for other purposes including the evaluation of various tax reform proposals. However, it was built as a general purpose model, and its features are surprisingly well suited for this application. No adjustments were required to obtain the following estimates. Since more thorough descriptions of the model are available elsewhere, I give only an essential outline of it here.[10/]

The economy is divided into nineteen profit maximizing producers, fifteen consumption commodities, and twelve consumers 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 a 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 these purposes.

Each consumer has initial endowments of labor and capital services which can be sold for use in production. Because of perfect factor 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 those two groups 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 between those two groups 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.

The various Federal, state, and local taxes are typically modelled as <u>ad valorem</u> 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. Social security, workmen's compensation and unemployment insurance appear as taxes on use of labor. These rates differ by industry partly because different proportions of workers hit the social security maximum, but they average 10% 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% for the lowest income group, to an average marginal tax rate of 40% 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 recalculate 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.[11/]

The model does not include involuntary unemployment, inflation *per se*, or other aspects of disequilibria. It measures real effects without a money equation, expressing all prices in relative terms. Voluntary unemployment is captured through the labor/leisure choice, however, and the interaction of inflation with effective tax rates is modelled by adjusting those rates appropriately.[12/] The model thus concentrates on microeconomic behavior and can meet the supply-side advocates on their own ground.

A potential difference, however, is our 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 between labor's marginal product and leisure's implicit price. Though the government does not intend to subsidize leisure, some programs do 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 successful, the payments will have more income effect and less substitution effect. To the extent that the reader wishes to use a larger wedge in the following simulations, a higher tax rate can be used in describing the current U. S. economy.[13/]

5. Estimation

Supply-side advocates refer to several different types of taxes when they claim an inverse relationship between a particular tax rate and government revenue. The curve in Figure 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.[14/] 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% of net payments to factors. The personal income tax takes another 1% to 40% of marginal labor income, depending on the consumer's marginal tax bracket. The total wedge thus ranges from 11% to 50% of labor income.[15/] One problem with interpreting a general formulation like the Laffer curve is that either average or marginal tax rates might be applicable. The average rates are needed to determine total revenues, but marginal rates are more important for incentive effects. A solution is to vary the industrial labor tax rate of 10% since this rate is both average and marginal. Variations in this rate alone are reported below, but the reader should remember that the additional wedges created by the personal income tax and other taxes always remain. The tax wedges reported are thus understatements of the model's true wedge.[16/]

The consistent 1973 data set, with adjustments described above, also shows a

Table 1

Total Revenue Associated with each Labor Tax Rate, in Billions of 1973 Dollars

Rate on Net Income	Rate on Gross Income	Labor Supply Elasticity with Respect to Net-of-Tax Wage								
		.15	.50	1.00	1.50	1.75	2.00	2.50	3.00	4.00
-.10	-.111									341.79
.00	.000								355.82	365.57
.05	.048						354.00	357.46	360.56	365.93
.10	.091	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00
.15	.130					364.00	361.98	358.23		349.18
.20	.167				369.80	365.17	360.85			
.25	.200				370.82	363.62	356.91			
.30	.231	439.48		391.82	369.60		350.57			295.40
.40	.286			396.49	361.52					
.45	.310			396.60						
.50	.333	503.71		395.43						
.60	.375			389.75						
.70	.412	555.56	474.13	380.36						
.90	.474	597.41	481.65							
.95	.487		481.98							
1.00	.500	615.16	481.78	336.60						
1.30	.565	657.84	476.01							
1.50	.600	678.84								
1.70	.630	694.90								
2.00	.667	711.16								
2.30	.697	719.58								
2.40	.706	720.89								
2.50	.714	721.53								
2.55	.718	721.60								
2.60	.722	721.52								
2.70	.730	720.92								
3.00	.750	715.79								
3.50	.778	697.79								
4.00	.800	670.19								
5.00	.833	593.30								

Simulations were made selectively to save computational expense. Not all possible rates are reported.

Figure 3

Laffer Curve with a .15 labor elasticity

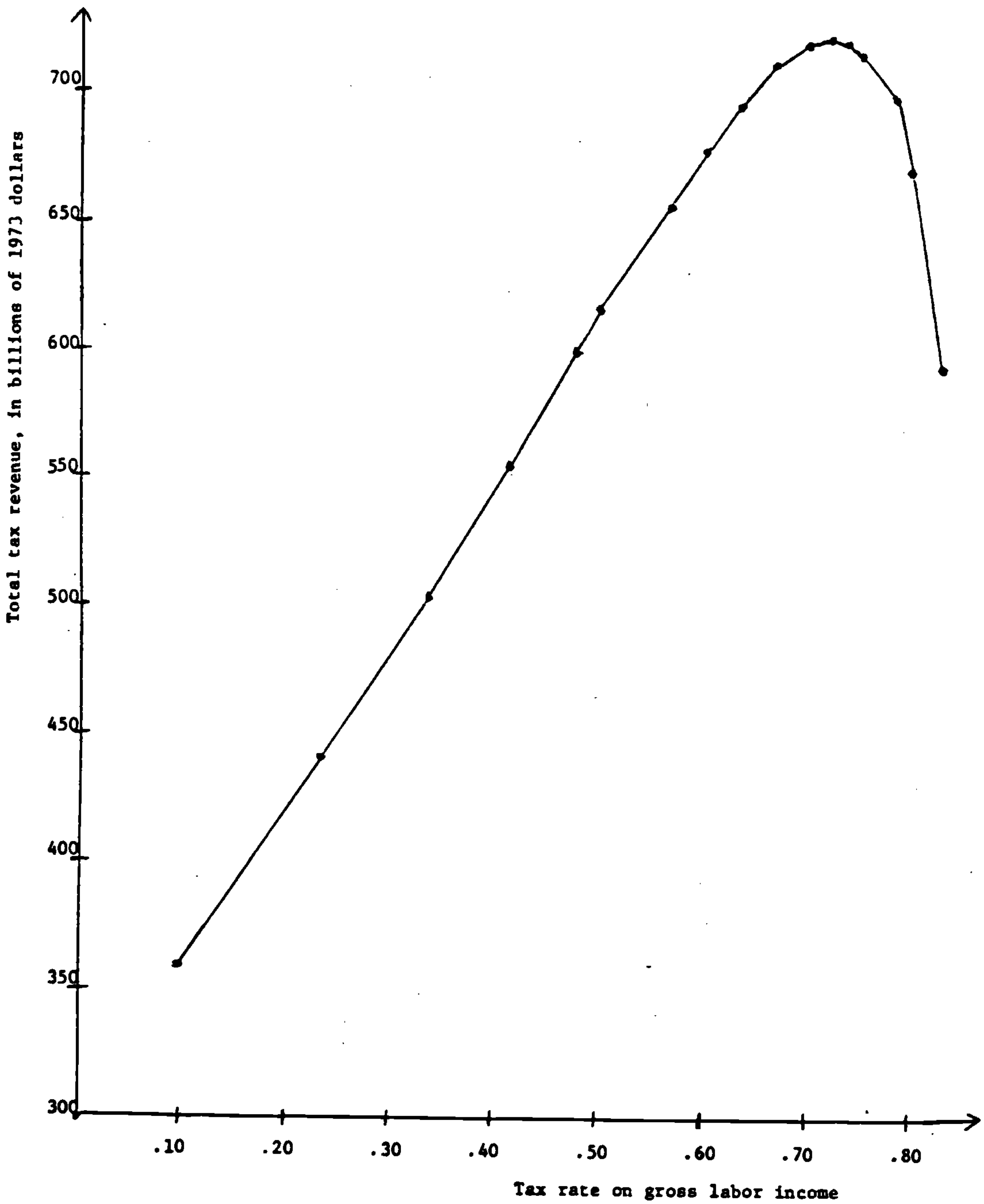


Figure 4

Laffer Curve with a 4.0 Labor Elasticity

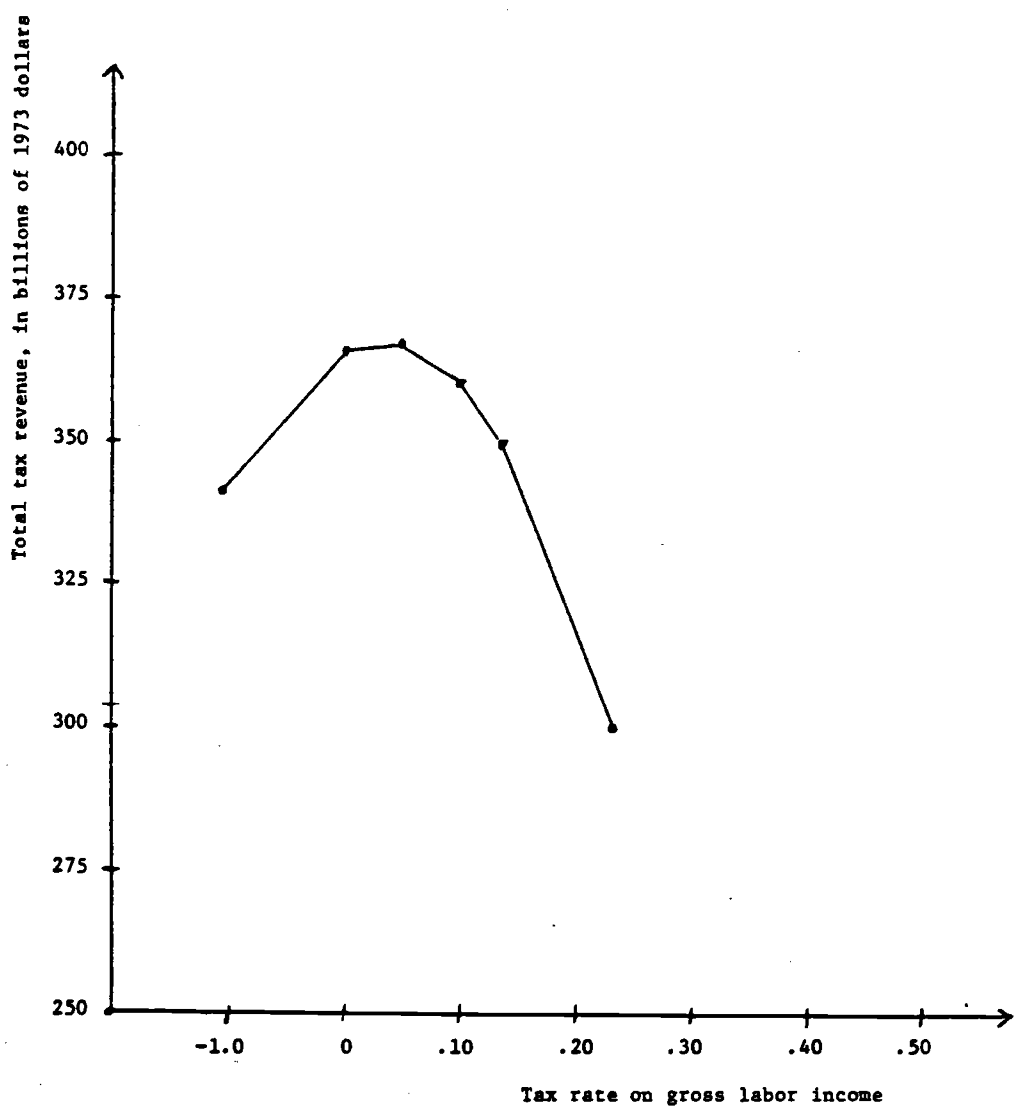
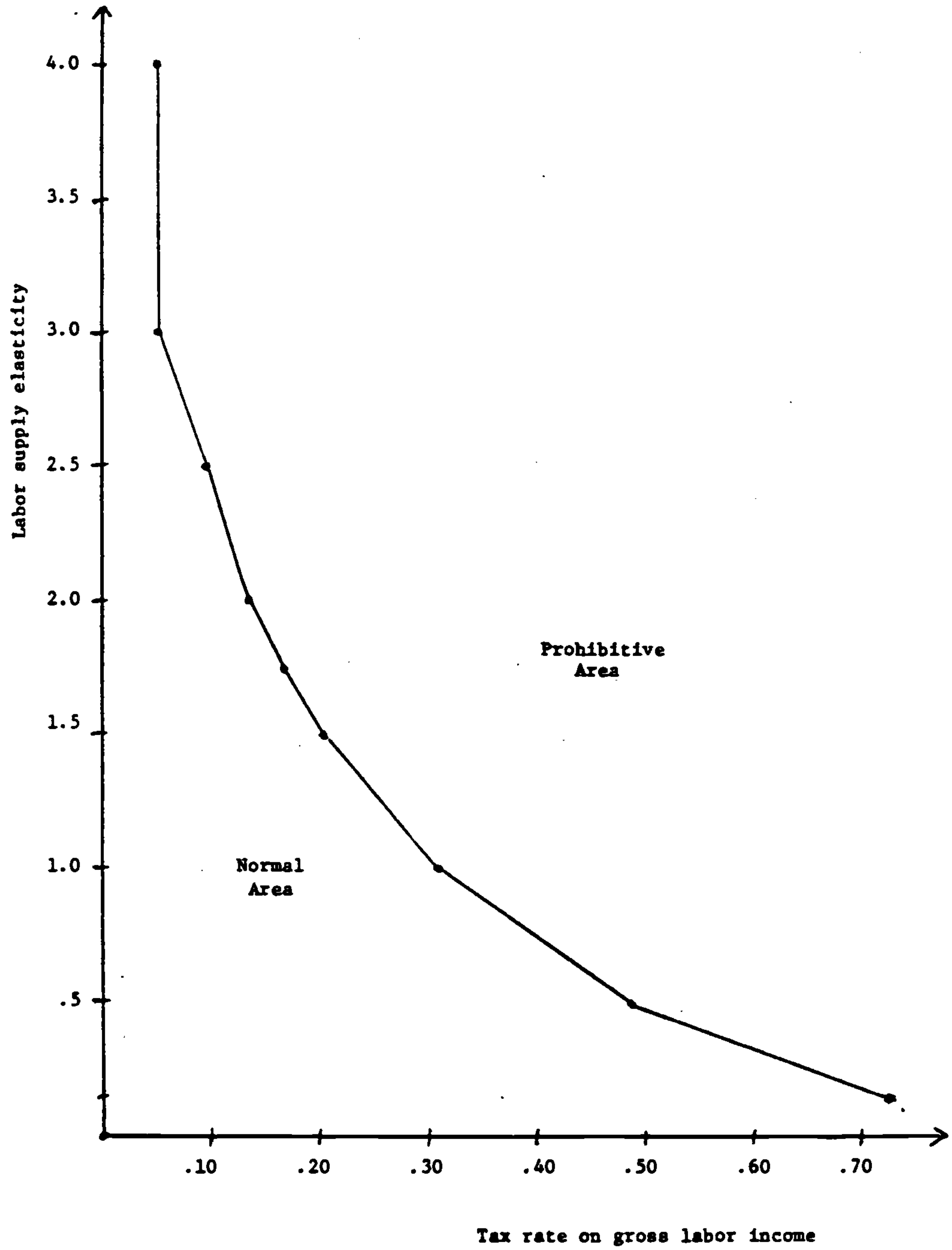


Figure 5

Elasticity and Tax Rate Combinations



total tax revenue of $360 billion compared to a national income of $1,252 billion.[17/] These values are replicated for any possible labor supply elasticity as long as tax rates are unchanged. Simulations with labor tax rates other than 10% will have revenues which depend on the elasticity. Additional revenues are rebated to consumers in lump-sum fashion, in proportion to their original after-tax income. These rebates are necessary because general equilibrium conditions require a balanced government budget, and increases in government purchases would influence the equilibrium solution.[18/]

The results from over sixty simulations are summarized in Table 1.[19/] The first column shows the total revenue resulting from different labor tax rates using the basic model's value of .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 10%, and total revenues are positively related to tax rates up to a tax which is 255% of net labor income, or 71.8% of gross income.[20/] Beyond that rate, revenues start to fall.[21/]

Any column of data from Table 1 can be used to plot an example of Figure 1, as done in Figure 3 for the .15 elasticity. In any of these Laffer curve diagrams, the modelled U. S. economy is represented by .10 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, Figure 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/]

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 Figure 2. When plotted for this example, the curve is shown in Figure 5. On this curve, with tax rates as modelled, the labor supply elasticity would have to be at least 2.5 to put us over the peak and onto the prohibitive range. Alternatively, if the supply elasticity is at least 1.0 and the tax rate is at least 30% (in addition to the personal rates from 1% to 40%), then again we could be operating irrationally. The continuum of Figure 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 rates, including the .10 labor tax 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 -.29 to a +.42 labor supply elasticity, while Boskin's (1973) division by sex, race, and age found estimates from -.07 (for prime-age white males) to a +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 (1976).

There is a certain injustice to these authors in 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 how they account for labor participation rates and as to whether they account for the balanced budget effects of government spending as discussed above. The numbers in Table 2 are only provided to give the reader a framework for choosing a plausible aggregate labor supply elas-

Table 2

Estimates of the Uncompensated Labor Supply Elasticity

Authors	Data Subset	Type of Data	Range of Estimates
A. For males			
Finegan (1962)	Male family heads	Inter-occupational	-.35 to -.25
Rosen (1969)	Male family heads	Inter-industrial	-.30 to -.07
Kalachek-Raines (1970) (1970)	Male family heads	U. S. cross-section	+.05 to +.30
Owen (1971)	Male family heads	U. S. time-series	-.24 to -.11
Greenburg-Kosters (1973)	Poor male family heads	U. S. cross-section	-.16 to -.05
Boskin (1973)	Different male subgroups	U. S. cross-section	-.07 to +.18
Hill (1973)	Poor male family heads	U. S. cross-section	-.32 to -.07
Ashenfelter-Heckman (1973)	Male family heads	U. S. cross-section	-.15
Fleisher-Parsons-Porter (1973)	Male ages 45-59	U. S. cross-section	-.25 to -.10
Ashenfelter-Heckman (1974)	Married males	U. S. cross-section	Zero
B. For females			
Finegan (1962)	Females	Inter-occupational	-.095
Leuthold (1968)	Females	U. S. cross-section	-.067
Kalachek-Raines (1970)	Females	U. S. cross-section	+.20 to +.90
Boskin (1973)	Different female subgroups	U. S. cross-section	-.04 to + 1.60
Ashenfelter-Heckman (1974)	Married females	U. S. cross-section	.87
C. Aggregate			
Winston (1966)	Aggregate	International cross-section	-.11 to -.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

ticity. 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 -.40 to zero. Borjas and Heckman (1978) review the econometrics of these studies and reduce the bounds to -.19 and -.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 .20 and .90 in cross-section studies. To obtain the model's .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. In any case, the ratio of male to female income should be at least 3.0 (though decreasing). Taking a relatively high male elasticity of -.10 and a relatively high female elasticity of +.90, the three-to-one weighted average is a .15 aggregate elasticity.

7. Conclusion

This paper investigates a number of analytical and empirical arguments about the relationship between tax rates and government revenues. A general equilibrium tax model was 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 a national tax on labor income, but that tax rates and/or labor supply elasticities would have to be very high for that possibility to occur. Available evidence about the value of the relevant elasticity parameter does not support the view that our government is currently behaving irrationally with respect to that tax.

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 and/or a high elasticity could place a tax in the prohibitive area. The tax on purely nominal capital gains, for example, or the under allowance of depreciation can result in high tax rates on real capital income. These accounting procedures and nominal personal income tax brackets should be adjusted for inflation by indexing. 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. The "notch" effect of welfare recipients who become ineligible at a given income level results in implicit marginal tax rates of 100% 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 to 100 for particular states or industries. This mobility implies that one jurisdiction cannot charge higher tax rates than its neighbors, and it applies increasingly to international factor flows. These latter considerations do not confirm the existence of a tax on the prohibitive range, but they make one much more plausible.

Finally, though the results of this paper tend to reject the notion of an inverse relationship between major U. S. taxes and government revenues, they do not necessarily invalidate the claim that these taxes 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. Though 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.

Footnotes

1. The tax rate of Figure 1 generally refers to any particular tax instrument, while revenues generally refer to total tax receipts. Thus we must account for the effect of one tax on all other tax bases. An increase in the payroll tax rate, for example, could affect not only its own revenue, but work effort and income tax revenues.

2. Michael Kinsley (1978) correctly claims that there is no logical necessity for revenues to be zero at 100% 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." Laffer (1978) points out that there must be some higher rate where economic activity goes to zero. "If every time a person goes to the office he receives a bill from the government instead of receiving a check from his employer, sooner or later even the wealthiest and most highly motivated will stop going to the office. There won't be any earnings, and total government revenue will equal zero. For the sake of argument, imagine the government collects zero revenue at 100 percent tax rates." The quote in the text is from Laffer's "Statement Prepared for the Joint Economic Committee Hearings on the Macroeconomic Impact of the Administration's National Energy Plan," May 20, 1977, reprinted in Laffer and Seymour (1979).

3. Several papers have described models in which there exists the possibility of a prohibitive range. See Canto, Laffer and Odogwu (1977) and Canto, Joines and Laffer (1978). Other empirical papers have found examples of local governments operating in this range. See Grieson et al (1977) and Ronald E. Grieson (1979). Estimates from DRI, Wharton, and Chase Econometric models are also provided in Kiefer (1978). None of these papers plot out the Laffer curve however, or estimate its relationship to various elasticity parameters. As shown below, an open economy like a local government is more likely to be burdened with a ceiling on revenues.

4. In general, the location of the curve depends on consumption parameters, production parameters, and other circumstances in the economy. In wartime, for example, individuals might be willing to work harder at higher tax rates to generate larger tax revenues. Later sections estimate the curve with a model of the 1973 U. S. economy.

5. Other interesting claims of Wanniski include (d) "if the tax rate is zero . . . production is maximized," and (e) "revenues and production are maximized at (the peak of the curve)." 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 (it was 3% in 1929), 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." Arthur Laffer, on the other hand, calls it "the best book on economics ever written."

6. 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.

7. 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.

8. Product taxes are equally relevant. Convert general product taxes to equivalent taxes on factors, or consider specific product taxes by plotting against demand elasticities. Also, either a compensated or uncompensated elasticity might consistently be used as the relevant parameter.

9. This analysis over-simplified 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. Also, both curves are intentionally vague about the particular tax rate and elasticity involved because they have a general significance which requires specific application. Both curves will be estimated for a particular factor tax and factor supply elasticity.

10. See Fullerton, Shoven, and Whalley (1978, 1979) and Fullerton, King, Shoven and Whalley (1979a, 1979b).

11. John Whalley points out that many of these features provide more detail than would be necessary to demonstrate the relationships of Figure 1 and 2. This comment is correct, but it is analogous to saying that a fancy electric can-opener is not required to open a can. My analogous response is that if the fancy can-opener already exists, then why not use it?

12. Effective capital tax rates are calculated by measuring each industry's real use of capital with replacement cost depreciation. The modelling of capital gains accounts for the largely nominal gains that are subject to tax. The combined effect of inflation and nominal income brackets in a progressive tax system can be modelled by increasing effective rates.

13. The difference between paying people who don't 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 non-workers. 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 (1978) is correct, however, that "if transfer payments included 'means', 'needs', or 'income' tests they too should be included." Another more thorough study could undertake to measure incentive effects of transfers.

14. Over forty simultations were performed in seeking a prohibitive area for capital taxes. Using the dynamic version of the model, rates were increased to 500% of net capital income (83% of gross capital income), savings elasticities were increased to 4.0, and equilibria were calculated out to fifty years in the future. There was not a single case discovered where total revenues were less than the revenues associated with a lower tax rate for the same period. Inverse relationships between tax rates and revenues 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 fifty years would be required for the tax base reduction to offset a tax rate increase and result in lower revenues.

15. The model measures labor income after the industries' factor tax but before the individual's personal income tax. Since the factor tax is 10% of labor income, and personal tax is another 1% to 40% of marginal labor income, the wedge can be expressed as 11.1% to 83.3% of net labor income after all taxes, or 10% to 45.5% of labor income gross of all taxes.

16. For those who wanted a higher wedge to account for the disincentive effects of welfare programs, the extra wedge of the personal income tax could roughly compensate for the ignored wedge of the transfer payments.

17. Our expanded notion of welfare, including leisure valued at the net-of-tax wage, is $1,690 billion.

18. A decrease in revenue is corrected by a similar lump-sum charge on consumers in proportion to their original after-tax income, so that government purchases still remain constant. In this sense, the model is much like Laffer's since a change in the tax wedge is accompanied by a positive or negative lump-sum redistribution.

19. 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.

20. The tax rate on gross income (t_G) is related to the rate on net income (t_N) by the formula $t_G = t_N/(1 + t_N)$.

21. The computer model provides much other information about the simulated equilibrium. With the .15 elasticity and 71.8% tax rate, labor supply falls off by almost half. The gross-of-tax wage rises, but the net-of-tax wage

falls by 40% in the new equilibrium. Because of the distortion in labor/leisure choices, national income falls by more than the increased value of leisure for a net loss of $269 billion in real terms.

22. In the 4.0 elasticity case, even the small jump from a 10% to 15% tax rate causes a 9% fall in labor supply and a net welfare loss of $26 billion in real terms.

References

Ashenfelter, Orley, and Heckman, James (1973), "Estimating Labor Supply Functions," in Cain, Glen G. and Harold W. Watts (eds.) Income Maintenance and Labor Supply, Rand McNalley, Chicago (1973).

________________, (1974), "The Estimation of Income and Substitution Effects in a Model of Family Labor Supply," Econometrica, Vol. 42, No. 1, January, pp. 73-85.

Borjas, George J., and James J. Heckman (1978), "Labor Supply Estimates for Public Policy Evaluation," Proceedings of the Industrial Relations Research Association.

Boskin, Michael J. (1973), "The Economics of the Labor Supply," in Cain, Glen G. and Harold W. Watts (eds.) Income Maintenance and Labor Supply, Rand McNalley, Chicago (1973).

________________, (1978), "Taxation, Saving and the Rate of Interest," Journal of Political Economy, Vol. 86, No. 2, April, Part 2, pp. S37-S27.

Canto, Victor A., Douglas H. Joines and Arthur B. Laffer (1978), "An Income Expenditure Version of the Wedge Model," mimeo, University of Southern California.

Canto, Victor A., Arthur B. Laffer, and Onwochei Odogwu (1977), "The Output and Employment Effects of Fiscal Policy in a Classical Model," mimeo, University of Southern California.

Caves, Richard E., and Ronald W. Jones (1973), World Trade and Payments, Little-Brown and Co., Boston, Toronto.

Dupuit, Jules (1844), "On the Measurement of the Utility of Public Works," translation in K. J. Arrow and T. Scitovsky (eds.) Readings in Welfare Economics, published for the American Economic Association by Richard D. Irwin, Inc., Homewood, Illinois (1969).

Finegan, T. Aldrich (1962), "Hours of Work in the United States -- A Cross-Sectional Analysis," Journal of Political Economy, Vol. 70, No. 5, October, pp. 452-470.

Fleisher, Belton M., Parsons, Donald O., and Porter, Richard D. (1973), "Asset Adjustment and Labor Supply of Older Workers," in Cain, Glen G. and Harold W. Watts (eds.) Income Maintenance and Labor Supply, Rand McNalley, Chicago (1973).

Fullerton, Don, John B. Shoven, and John Whalley (1978), "General Equilibrium Analysis of U. S. Taxation Policy," 1978 Compendium of Tax Research. Office of Tax Analysis, U. S. Treasury Department, Washington, D. C., pp. 23-58.

______________, (1979), "General Equilibrium Impacts of Replacing the U. S. Income Tax with a Progressive Consumption Tax," mimeo, National Bureau of Economic Research, Cambridge, Massachusetts.

Fullerton, Don, A. Thomas King, John B. Shoven, and John Whalley (1979a), "Corporate and Personal Tax Integration in the U. S.: Some Preliminary Findings from a General Equilibrium Analysis" in R. Haveman and K. Hollenbeck (eds.) Microeconomic Simulation, Institute for Research on Poverty, Madison, Wisconsin.

______________, (1979b), "Static and Dynamic Resource Allocation Effects of Corporate and Personal Tax Integration in the U. S.: A General Equilibrium Approach" submitted to the American Economic Review.

Greenberg, David H., and Kosters, Marvin (1973), "Income Guarantees and the Working Poor: The Effect of Income Maintenance Programs on the Hours of Work of Male Family Heads," in Cain, Glen G. and Harold W. Watts (eds.) Income Maintenance and Labor Supply, Rand McNalley, Chicago (1973).

Grieson, Ronald E. (1979), "Theoretical Analysis and Empirical Measurements of the Effects of the Philadelphia Income Tax," Journal of Urban Economics (forthcoming).

Grieson, Ronald E., William Hamovitch, Albert M. Levenson, and Richard D. Morgenstern (1977), "The Effect of Business Taxation on the Location of Industry," Journal of Urban Economics, Vol. 4, April, pp. 170-185.

Heller, Walter (1978), "The Kemp-Roth-Laffer Free Lunch," The Wall Street Journal, July 12, p. 20. Reprinted in Laffer and Seymour (1979).

Hill, C. Russell (1973), "The Determinants of Labor Supply for the Working Urban Poor," in Cain, Glen G. and Harold W. Watts (eds.) Income Maintenance and Labor Supply, Rand McNalley, Chicago (1973).

Kalachek, Edward D., and Raines, Fredric Q. (1970), "Labor Supply of Lower Income Workers," pp. 159-186 in President's Commission on Income Maintenance Programs, Technical Studies, U. S. Government Printing Office, Washington, D. C.

Kiefer, Donald W. (1978), "An Economic Analysis of the Kemp/Roth Tax Cut Bill H.R.8333: A Description, An Examination of Its Rationale, and Estimates of Its Economic Effects," Congressional Record, August 2, pp. H7777-H7787. Reprinted in Laffer and Seymour (1979).

Killingsworth, Mark R. (1976), "Neoclassical Labor Supply Models: A Survey of Recent Literature on Determinants of the Supply of Time to the Labor Market," manuscript, Fisk University.

Kinsley, Michael (1978), "Alms for the Rich," The New Republic, Vol. 179, August 19, 1978, pp. 19-26. Reprinted in Laffer and Seymour (1979).

Laffer, Arthur B. (1978), "An Equilibrium Rational Macroeconomic Framework," mimeo, University of Southern California.

Laffer, Arthur B. and Jan P. Seymour (eds.) (1979), The Economics of the Tax Revolt: A Reader, Harcourt Brace Javanovich, New York.

Leuthold, Jane H. (1968), "An Empirical Study of Formula Income Transfers and the Work Decision of the Poor," Journal of Human Resources, Vol. 3, No. 3, Summer, pp. 312-323.

Lucas, Robert E., and Rapping, Leonard A. (1970), "Real Wages, Employment and Inflation," pp. 257-305 in Phelps, E. S., et al., Microeconomic Foundations of Employment and Inflation Theory, W. W. Norton Co., New York.

McGuire, Timothy W., and Rapping, Leonard A. (1968), "The Role of Market Variables and Key Bargains in the Manufacturing Wage Determination Process," Journal of Political Economy, Vol. 76, No. 5, September-October, pp. 1015-1036.

__________, (1970), "The Supply of Labor and Manufacturing Wage Determination in the United States: An Empirical Examination," International Economic Review, Vol. 11, No. 2, June, pp. 258-268.

Owen, John D. (1971), "The Demand for Leisure," Journal of Political Economy, Vol. 79, No. 1, January-February, pp. 56-76.

Rosen, Sherwin (1969), "On the Interindustry Wage and Hours Structure," Journal of Political Economy, Vol. 77, No. 2, March-April, pp. 249-273.

Smith, Adam (1776), The Wealth of Nations, J. M. Dent & Sons, Ltd., London, reprinted 1975.

Stuart, Charles, (1979), "Swedish Tax Rates, Labor Supply and Tax Revenues," University of Lund, Sweden, and University of Western Ontario, Canada, mimeo.

Wanniski, Jude (1978), The Way the World Works: How Economies Fail and Succeed, Basic Books, New York.

Winston, Gordon C. (1966), "An International Comparison of Income and Hours of Work," Review of Economics and Statistics, Vol. 48, No. 1, February, pp. 28-39.