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SWEDEN'S LAFFER CURVE: TAXATION AND THE UNOBSERVED ECONOMY

by

Edgar L. Feige and Robert T. McGee

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Sweden's Laffer Curve: Taxation and the Unobserved Economy*

Edgar L. Feige*

Robert T. McGee*

* University of Wisconsin-Madison and Florida State University, respectively.

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Abstract

Recent research on the unobserved economy suggests that the phenomenon has important implications for both macroeconomic policy and public finance. This paper focuses attention on the public finance implications by developing a simple macromodel from which it is possible to derive a Laffer curve. The model reveals that the shape and position of the Laffer curve depend upon the strength of supply side effects, the progressivity of the tax system and the size of the unobserved economy. Using alternative parameterizations of each of these effects, it is possible to obtain rough empirical estimates of the Laffer curve for Sweden.

I. Introduction

Supply side economics, the Laffer curve and the Unobserved Economy are subjects which have captured the interest of economists in their effort to understand and design cures for the growing macroeconomic and public finance malaise which appears to be affecting many of the world's most developed economies. High rates of unemployment and inflation, combined with slower rates of real growth and ever widening government deficits, have focused economists' attention on the interrelated issues of macroeconomic stabilization and public finance policy. The questions raised by the supply side, Laffer curve and Unobserved Economy literature focus on the effects of tax rates on economic performance and the ability of governments to sustain the ambitious social welfare programs established in the past decade.

While there is much controversy about what the Laffer curve looks like and where various economies are on their curves, it is generally accepted that the dependence of tax revenues on tax rates is too oversimplified in standard macroeconomic theory to deal with these issues. To remedy this deficiency we present a highly aggregated supply side model that attempts to elucidate some of the main issues involved.

The amount of tax revenue realized under any particular legislated income tax rate structure depends at the aggregate level on three basic and distinct influences. First there is a supply side effect on tax revenues. The tax base is influenced by the existence of taxes which alter the set of profit and utility maximizing capital and labor choices. In general there will be some tendency to withdraw capital and labor from the market as tax rates increase, leaving less incentive to participate in taxed market production.

Leisure and non-taxed home production activities are made relatively more attractive by higher tax rates. Likewise the use of capital in home production and the abandonment of capital projects may increase as capital income from market production is increasingly taxed. The extent of supply side tax base shrinkage will depend on the degree of substitution factor owners engage in between the untaxed home and taxed market sectors. This substitution depends on the elasticity of the labor and capital supplies.

There is, in addition, a second potential source of tax base shrinkage due to higher taxes. Even if factor supplies are relatively inelastic, this second source can create a limit to tax revenues below 100% taxation. Rather than withdrawing labor and capital services from the market, individuals may react to higher tax rates by simply continuing their activities but refusing to report them and pay taxes on them. Hence the tax base may shrink as taxes rise because the scope of tax evasion increases as the benefits from evading taxes rise with tax rates. Naturally the extent of tax evasion will depend on public morality, attitudes toward government and likely penalties, as well as the tax rate itself. These non-tax rate influences on tax evasion mean the Laffer curve depends on a complex set of political and sociological factors.

In this paper we attempt to distinguish both empirically and theoretically the influence of the supply side and the unobserved economy on the tax revenue function. We also distinguish a third effect on the Laffer curve due to the progressivity of the tax system. In a system of proportional income taxation a legislated across-the-board tax cut of 10% will reduce the aggregate tax rate by a corresponding 10%. In a progressive income tax system a 10% across-the-board cut in individual tax rates will only reduce the aggregate tax rate by 10% if there is no effect of the tax cut on the tax base. If the tax base rises with the tax cut, then there will be an endogenous rise in the aggregate tax rate which will partially offset the effect of the legislated tax rate structure cut on the aggregate tax rate. Since the tax revenue function is generally discussed in terms of aggregate

tax rates, it is important to allow for this endogenous influence on aggregate tax rates.

The aggregate relationship between tax rates and tax revenues will depend on these three influences. We present a framework for systematically examining these inter-relationships. The basic model structure distinguishes three types of economic activity and looks at the effect of legislated tax rates on the allocation among these types of activity in a progressive tax system. The focus is on the Laffer curve that results in such a model.

Figure 1 illustrates the basic distinction we make among types of economic activity. First, there is an observed sector of economic activity which has as its empirical counterpart the net national income. In our model net national income is assumed to constitute the tax base. Since most activity measured in national income utilizes money as a medium of exchange, we will refer to this sector as the monetary observed sector, the official sector or just the observed sector.

In addition Figure 1 shows two unobserved sectors which escape detection in the national income accounts. The monetary unobserved sector includes income generated in markets using money as a medium of exchange. This income is taxable but is not observed in the official statistics because it is hidden to evade taxation. Underreporting of incomes and off-the-books labor are examples of activities contributing to the monetary unobserved economy.

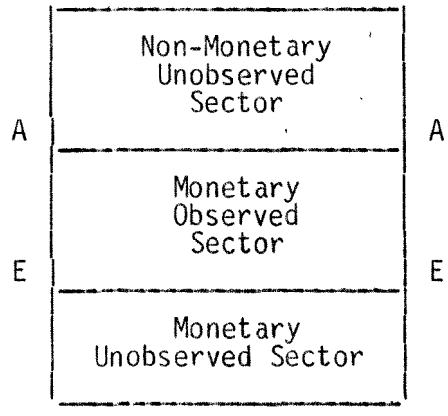
As the tax rate on observed sector income rises we would expect the line EE to rise in Figure 1 reflecting the growing proportion of unobserved monetary income as tax evasion shrinks the tax base.

Higher tax rates will also cause the AA line to shift in Figure 1 as the non-monetary unobserved sector increases, reducing the size of the observed sector and hence, the tax base. The non-monetary unobserved sector represents those activities, such as home production and barter, which are able to legally avoid taxation. Many of these activities are conceptually equivalent

to market activities; yet, because they involve no market transactions, they escape detection in the national income accounts.[1]

Figure 1

Taxonomic Breakdown of Economic Activity



In the next section we present a macro model which allows us to distinguish the relative roles of the supply side and unobserved monetary economy effects on tax revenues. Section 3 gives some simple graphic illustrations of how the model works. Section 4 uses the model to empirically estimate the Swedish Laffer curve. We find Sweden to be past its Laffer curve peak and use the model to simulate a tax cut which expands output without reducing revenue. Since these results are critically dependent on our underlying assumptions about the model parameters, we also present results for a wide range of variation in the assumptions.

II. Model Specification

The model consists of three basic parts shown in equations (1) - (10). Total market output, Y, consisting of monetary observed and monetary unobserved income, is determined by equations (1) - (5). These equations

[1]Feige (1980) has a more in depth discussion these distinctions. The supply-side effect in our model is based on the withdrawal of factor supplies from the monetary economy as net of tax marginal compensation in the market decreases. We might expect this elasticity to be greater in the long-run than the short-run. As tax increases drive people into home and barter activities, certain scale efficiences may develop to make barter and home production activities more attractive. Also technical change will begin to reflect the increased orientation toward home production. Do-it-yourself techniques and consumer durables will develop to facilitate the structural shift to home production.

represent the production function, labor market, and capital market. The demands for labor and capital are based on their marginal products. The supplies of labor and capital are based on their respective net-of-tax marginal returns, $(1 - t')W$ and $(1 - t')r$. The elasticity of labor and capital supply are δ and β, respectively. In our framework δ and β reflect the degree to which factor owners shift their provision of factor supplies from the monetary to the non-monetary sector to legally avoid taxes as the marginal retention rates on factor incomes decline. These supply elasticities also include the more traditional substitution possibility that lower factor returns may increase leisure and idle capital. In Figure 1 this substitution is illustrated by a downward shift in the AA line.

Equations (1) - (5) can be solved for total monetary sector output as a function of the model's structural parameters and the marginal tax rate, t'. The result is

$$Y = c(1 - t')^m$$

where c is a function of the model parameters and m depends solely on the Cobb-Douglas coefficient, α, and the factor supply elasticities. These portmanteau parameters and subsequent equations presented in the paper are derived in a technical appendix available from the authors upon request. In essence, m weights the factor supply elasticities according to the relative contribution of each factor in the technology of production. m is the aggregate supply elasticity. If m is zero, market factor supplies are inelastic and there is no substitution between the home and monetary sector. If m is not zero, the tax base will decrease with higher tax rates as factors withdraw from the market.

Model Specification

I. National Income Determination

Production Function -	$Y = a_0 K^{\alpha} L^{1-\alpha} = F(K,L)$	(1)
Labor Demand -	$W = F_L$	(2)
Capital Demand -	$r = F_K$	(3)
Labor Supply -	$L = a_1 ((1 - t')\, w)^{\delta}$	(4)
Capital Supply -	$K = a_2 ((1 - t')\, r)^{\beta}$	(5)

II. Division of Income Between Observed and Monetary Unobserved Sectors

Utility Function - $U = a\, Y_0^{\lambda}\, Y_u^{1-\lambda}$ (6)

Income Constraint - $I = P_0 Y_0 + P_u Y_u = 1Y_0 + (1 - t')Y_u$ (7)

First Order Condition - $\gamma = \lambda\,(1 - t')/(1 - \lambda\, t')$ (8)

Observed Income - $Y_0 = \gamma Y$ (9)

III. Tax Revenue Function

Constant Progressivity Factor - $T = \theta\, Y_0^{\,{}^N TY_0}$ (10a)
($^N TY_0$ constant)

or

Historical Relationship - $T = tY_0$ where $t = .829t' - .069$ (10b)
(between t' and t)

or

Declining Progressivity Factor - $T = Y_0 - dY_0^p$ (10c)
(p constant)

The distribution of monetary sector output determined by the supply side and government tax policy is

$$Y = (1 - t)Y_0 + Y_u + G$$

where $G = tY_0 = T$ and t is the average tax rate, Y_0 is observed income, and T are tax revenues. The government's share of observed sector output is assumed to be used for purposes unconnected to individual's provision of factor supplies to the market.[2] A general equilibrium in the model implies aggregate demand exhausts aggregate supply because factor incomes are just sufficient to purchase aggregate output (i.e. Say's Law holds in the model).

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[2]For alternative assumptions about the expenditure relation to taxation and revenues see Hansson and Stuart (1982), Lindbeck (1980), and Shoup (1981).

Equations (6) - (9) determine the allocation of market output between the observed and unobserved monetary sectors. Increased tax evasion corresponds to an increase in the latter sector as illustrated by an upward shift in the EE line of Figure 1. Equation (6) is the representative individual's revealed preference for observed output, Y_0, versus unobserved monetary sector output, Y_u. If λ is unity, preference for observed sector output is absolute and there will not be any tax evasion. In general λ will lie between zero and one, with a higher value for λ indicating a higher preference for observed sector output. λ is a portmanteau parameter depending on such factors as public morality, attitudes toward government, and the perceived risk involved in evading taxes by operating in the unobserved monetary sector. It is a summary measure of effective tax morality.

Equation (7) is the income constraint facing the representative individual deciding between observed and unobserved monetary sector output. Taking official sector output as the numeraire good, we assume unobserved monetary sector output is competitively priced at the margin where it enjoys a factor cost discount advantage of t'.[3]

Maximizing (6) subject to the constraint (7), we obtain the first order condition (8), which shows the share γ of observed sector to total monetary sector output rises with λ and falls as t' rises, increasing the relative price advantage of unobserved monetary sector output.

Equations (1) - (5) determine total monetary sector output and equations (6) - (7) determine what part of that output enters the tax base, Y_0.

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[3]In a more detailed presentation it is possible to disaggregate the equations (1) - (5) into 10 equations where one set of five determines the observed monetary sector and the other determines the unobserved monetary sector production. One way to combine the two sectors into an aggregate is to assume the aggregate production relation is the same for monetary unobserved and observed sector output. If this is the case and factor supplies move competitively between sectors then the two sector model reduces to our case.

An alternative way to view the model is to assume that the monetary unobserved economy is simply the result of putting a certain percentage $(1-\gamma)$ of aggregate output off-the-books and a certain percentage (γ) in the-official-books. In this case we have a one sector model where producer-consumers optimize their income split between reported and evaded income. In this case λ partially reflects attitudes toward risk and t' can be seen as including the expected penalty from tax evasion.

Equation (10a) assumes a constant progressivity factor tax revenue function. If $N_{T\gamma_0}$ is one, taxes are proportional and the aggregate tax rate is independent of the tax base. More generally, $N_{T\gamma_0}$ will be greater than one in a progressive system and less than one in a regressive system. It is simple to verify from (10a) that $N_{T\gamma_0}$ is the ratio of the marginal to average aggregate tax rate.

An across-the-board tax increase of X% on all tax rates in the rate structure will raise θ by X%. θ is the exogenous component of the aggregate tax rate. In addition there will be an endogenous component because Y_0 may react to the exogenous tax change depending on equations (1) - (8). If Y_0 is affected by the tax legislation, the effect of an X% increase in θ on the aggregate average and marginal tax rates will depend on such factors as the progressivity of the tax system, the elasticity of supply, and the sensitivity of the unobserved monetary economy to tax rates.

Equation (10a) permits an analytical solution to the model. With this solution we can substitute in values for the structural parameters to obtain estimates for Laffer curve characteristics.

Equations (10b) and (10c) are alternative tax revenue functions reflecting different assumptions about the relationship between the average and marginal tax rates. Equation (10b) assumes a linear historical relationship between t' and t. Equation (10c) assumes a constant disposable income elasticity with respect to total income. While they have the advantage over (10a) of allowing the average tax rate to rise relative to the marginal tax rate, they have the disadvantage of not allowing an analytic solution to the model. Nevertheless we can do numerical simulations with them to compare with our analytical results from the constant $N_{T\gamma}$ case.

III. A Graphical Analysis of the Implied Laffer Curve

The Laffer curve elasticity, $N_{T\theta}$, of tax revenue with respect to across-the-board tax cuts can be derived from the model. The result is

$$N_{T\theta} = \frac{(1-\chi)}{1 + (N_{T\gamma} - 1)\chi}, \text{ where } \chi = \frac{(m + 1)t'}{1 - t'} - \frac{\lambda t'}{1 - \lambda t'} \qquad (11)$$

If χ is sufficiently large, tax revenues will expand with tax cuts. This is more likely: 1) the greater the marginal tax rate, t', 2) the more elastic factor supplies are (i.e., the larger δ and β are, the larger m is); and 3) the weaker the preference for observed sector output (i.e., the smaller λ is).

A single Laffer curve is determined by specifying values for the aggregate elasticity parameter (m), the preference parameter for observed output (λ), and the progressivity parameter $N_T\gamma$. A change in any of these parameters is sufficient to shift the Laffer curve in a predictable way.

Tax revenues are maximized when the χ in equation (11) is equal to 1. Under this condition the elasticity of tax revenues with respect to legislated tax changes will be zero. For lower values of χ, the revenue elasticity is positive and for higher values it is negative. It is clear from the formula for χ that a higher supply elasticity (m) produces a higher value of χ and hence a lower revenue elasticity. Likewise a lower preference for observed sector output, results in a higher value of χ and in a lower revenue elasticity.

χ can be regarded as the measure of tax base shrinkage due to an across-the-board rise in income tax rates. This shrinkage consists of two parts: namely, 1) the shift of economic activity from the monetary sectors (observed and unobserved) to the non-monetary sector ("do it yourself" and leisure); and 2) the shrinkage of the observed monetary sector relative to the unobserved monetary sector as higher taxes increase the relative price advantage of dealing in the unobserved monetary sector. The first effect depends on the aggregate supply elasticity parameter, m. The second depends on the preference for observed versus unobserved monetary sector output, λ.

In addition, a counteracting tendency will be induced if the tax system is progressive. This is reflected in the denominator of (11). If the tax increase shrinks the tax base, there will be a partial lowering of the aggregate tax rate if the tax system is progressive. This induced tax rate

change depends both on the extent of tax base shrinkage measured by γ and on the degree of progressivity measured by $(N_T\gamma - 1)$.

This counteracting endogenous tax cut in response to a legislated tax increase has the effect of lowering the tax revenue elasticity in a progressive system below what it would be in a proportional system.

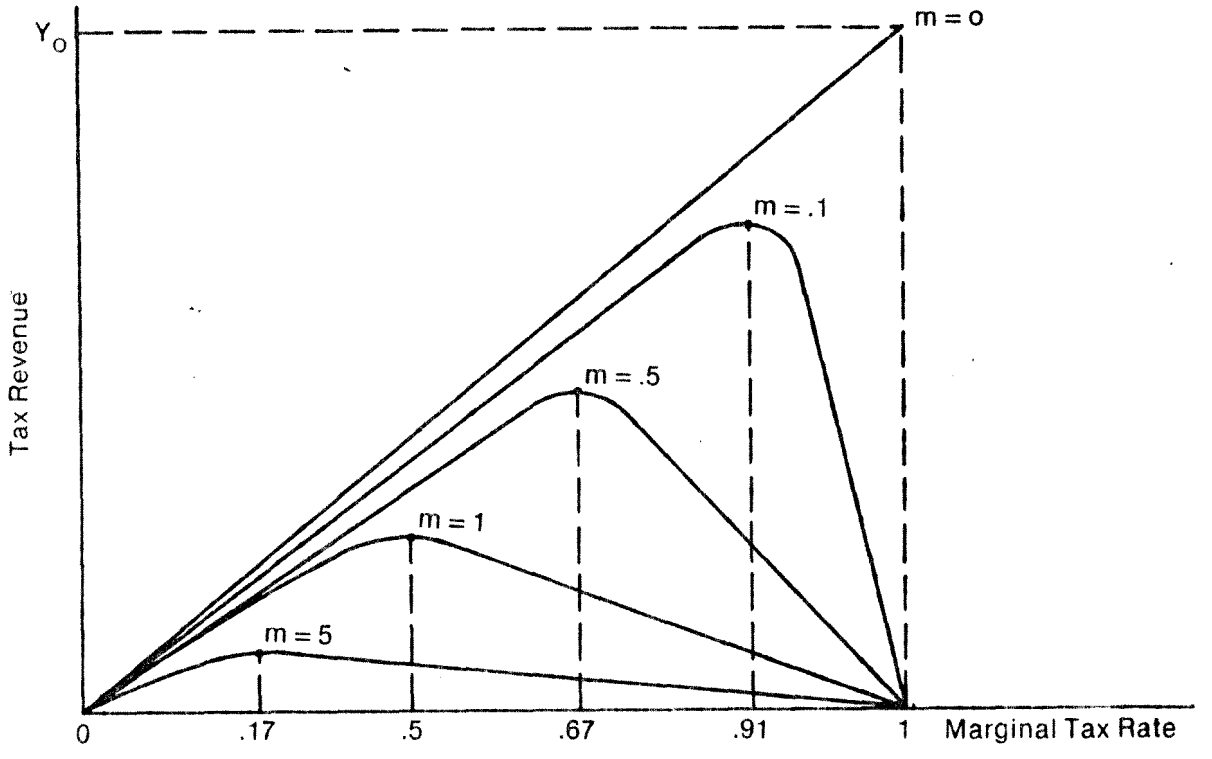
Some simple examples will illustrate the influence of these various factors on an economy's Laffer curve. Let us start with the influence of supply elasticity and assume for the moment that there is no unobserved monetary sector and that the tax system is proportional. Under these conditions the revenue maximinizing tax rate formula reduces to

$$t' = \frac{1}{1 + m} \tag{12}$$

As the aggregate output supply elasticity rises, the revenue maximizing tax rate falls. This is illustrated in Figure 2, where alternative Laffer curves are presented for various elasticity values. In the extreme case where the elasticity is zero (i.e., no substitution of capital or labor occurs between the non-monetary and monetary sector as a result of changing tax rates), the Laffer curve is a line through the origin with slope equal to the fixed amount of the tax base. In this case, the maximum revenue occurs at 100% taxation.

Figure 2

Alternative Laffer Curves for Various Elasticity Values
(No Unobserved Economy)



As the value of the supply side elasticity rises, the revenue realized at any particular tax rate falls as well as the maximum revenue tax rate. This is illustrated in Figure 2 by the vertical decline in each successive Laffer curve and by the leftward shift of the revenue peak as the supply elasticity rises. It is simply a result of the positive relation between supply elasticity and tax base shrinkage. This is, however, only a partial picture since we are ignoring the unobserved monetary economy option and progressivity in taxes.

Suppose we assume that supply is inelastic (i.e., m = 0) but allow for a non-zero preference for unobserved sector output in the monetary economy and continue to assume proportional taxation. In this case the formula for the revenue maximizing tax rate reduces to

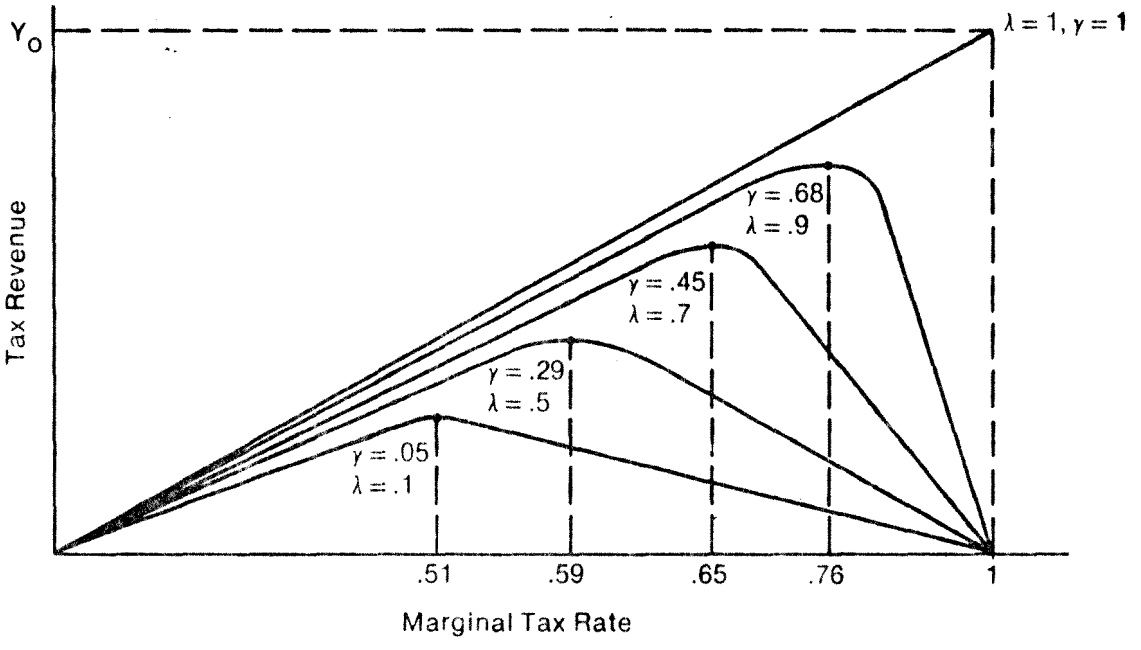
$$t' = \frac{1-\sqrt{1-\lambda}}{\lambda} \tag{13}$$

where λ is the preference for observed sector output.

Figure 3 shows the effect of alternative preference values on the Laffer curve in this special case. In general, as preferences fall for official sector output, the Laffer curve falls as well as the maximum revenue tax rate.

Figure 3

Alternative Laffer Curves for Various Preferences for Observed vs. Unobserved Market Output (Inelastic Factor Supplies)



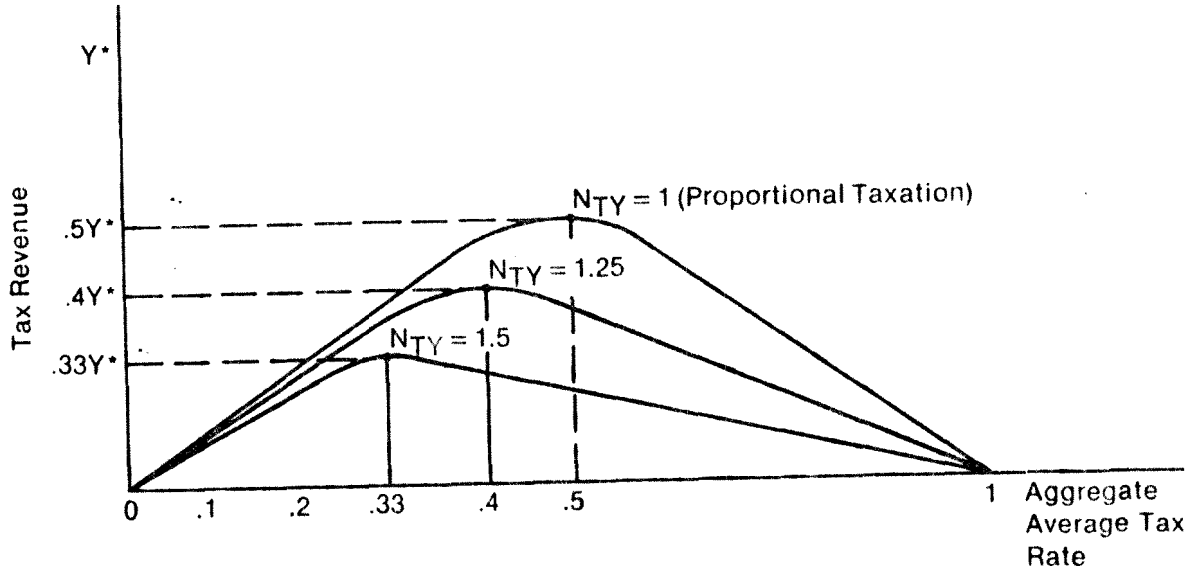
If, for example, preference is absolute for monetary observed sector output, we have the linear Laffer curve displayed in Figure 3. There is no unobserved monetary activity (i.e., $\gamma = 1.0$). However, as effective public morality declines and tax evasion increases (e.g. $\gamma = .7$), the monetary unobserved economy alternative takes an increasing share of the potential tax base and the Laffer curve declines and peaks earlier. Thus, even though market output is inelastic, there may be the usual type of Laffer curve because a higher proportion of output goes untaxed when the unobserved monetary sector increases.

The progressivity factor, $N_{T\gamma}$, will influence the maximum revenue level. This can be illustrated by holding supply elasticity and preferences constant

and by looking at alternative Laffer curves for alternative values of N_{TY}. In Figure 4 we assume m = 1 and λ = 1.

Figure 4

Alternative Laffer Curves for Various Degrees of Progressivity in the Tax System



In this special case, the revenue maximizing marginal tax rate is .5 (from equation (12)). In a progressive system this marginal rate will be reached at a lower average tax rate than in a proportional system. Suppose, for example, that Y* is the tax base when the marginal tax rate is .5. If the tax system is proportional, the average tax rate is also .5 at the revenue maximum and tax revenues are .5Y*. This situation is characterized by the uppermost Laffer curve in Figure 4.

If, on the other hand, the revenue elasticity with respect to the tax base is 1.25, the average tax rate is .4 when the marginal rate is .5. In general, for any given marginal tax rate, the average tax rate declines with the degree of progressivity, N_{TY}.

These diagrams reflect the effect which progressivity has on the revenue elasticity formula in (11). When taxes are proportional (i.e., N_{TY} = 1), the denominator of (11) reduces to 1. As progressivity rises from 1, the denominator of (11) becomes larger (if there are supply side and/or unobserved

economy effects on the tax base), and the revenue elasticity is reduced at any given tax rate.

These examples illustrate the basic workings of tax revenues in the model. In the next section we simulate the Laffer curve for the Swedish economy under alternative assumptions about the crucial model parameters. Confidence in the results depends on confidence in the parameters which are not easily measured. Nevertheless we are able to test the sensitivity of the results to alternative parametric specifications.

IV. Estimating the Swedish Laffer Curve

To simulate Sweden's Laffer curve with the model, we need empirical estimates of the model's parameters. For our base year we chose 1979. The average effective tax rate for Sweden in 1979 was computed to be .62. This is the ratio of total tax revenues to total national income in factor values. Total tax revenues include direct and indirect taxes collected by central and local governments, and social security contributions. While it is common to use GDP as the denominator for the average tax rate, our model is specified in terms of factor incomes and net rather than gross national product. Therefore, national income in factor values is the appropriate statistic to put in the denominator if we want the tax rate to reflect the tax bite on factor incomes.

The progressivity factor, N_{TY}, for the Swedish tax system was obtained by weighting the marginal tax rates on labor and capital income by their respective income shares and by dividing the resultant aggregate marginal tax rate by the income share weighted average of the average tax rates on labor and capital income. The result, based on 1979 tax rates reported by Hansson and Stuart (1982) for labor and capital, was a revenue elasticity of 1.34 with respect to the tax base. This implies a marginal tax rate of about .83 for Sweden in 1979.

The aggregate elasticity of supply with respect to the marginal retention rate on aggregate income was taken to be about .2. While empirical estimates are not available for Swedish labor and capital supply elasticities, Hansson

and Stuart's (1982) extensive survey of the empirical literature on labor supply elasticity suggests a value of .18 which is not unreasonable. The aggregate supply elasticity of .2 was obtained by weighting this labor supply elasticity by a labor factor income share of .81 and by averaging the result with an assumed capital supply elasticity of .28 weighted by capital's 19% share in the factor income.

Boskin (1978) has estimated the interest elasticity of private saving at around .3-.4. Summers (1981) presents results which indicate an elasticity greater than unity. Both these studies criticize earlier literature which estimated much lower elasticities. These results for the U.S. suggest a good deal of uncertainty exists about this elasticity. We regard our value as a compromise between extremes. Results are presented for higher and lower values as well as our plausible value.

Finally, we need an empirical estimate of the size of the unobserved monetary sector to parameterize the utility function. In a survey of emprical studies on tax evasion in Sweden, Hansson (1982) concludes by saying that "As a reasonable cautious conclusion, the above results show that it is unlikely that the taxable unobserved economy exceeds, say, 10% of GDP."[4]

Other work by Feige suggests a larger value of, say, 20% or more for the size of Sweden's monetary unobserved sector relative to total output. Since all of the methods used to measure the unobserved monetary sector are inherently uncertain, we treat 10% as a plausible value for this sector, but we also present results for a lower limit estimate of 5% and an upper limit estimate of 20%.

We also present results for lower and upper bound estimates of the progressivity factor (i.e. $N_T\gamma=1$ and $N_T\gamma=1.5$) and the supply elasticity (i.e. m=0 inelastic and m=1 unit elasticity supply).[5]

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[4]Hansson (1982), p. 18

[5]The actual numbers and data sources used are included in a data appendix available from the authors upon request.

Table 1 shows alternative values for the revenue maximizing average tax rate under the different assumptions about the model's parameters. These range from a low of 32% to a high of 91%. The table illustrates that the revenue maximizing tax rate declines as output elasticity, progressivity, and the unobserved economy increase. These tax rates are obtained by finding the tax rate that makes the revenue elasticity in (11) zero.

TABLE 1

Alternative Estimates of Revenue Maximizing Average Tax Rates for Sweden (1979)

Supply Side Effects

	Inelastic			Plausibly elastic			Highly elastic		
	Unobserved Economy			Unobserved Economy			Unobserved Economy		
	5%	10%	20%	5%	10%	20%	5%	10%	20%
Proportional	.91	.88	.83	.80	.78	.75	.50	.49	.48
Plausibly Progressive	.68	.66	.62	.60	.58	.56	.37	.37	.36
More Progressive	.61	.59	.55	.53	.52	.50	.33	.33	.32

Under our most plausible set of conditions, maximum revenues are obtained when the tax rate is .58. Since the average tax rate in Sweden in 1979 was .62, this result implies that Sweden was to the right of its Laffer curve peak in 1979. Stuart's (1981) study of the Laffer curve in Sweden also found that the Swedish tax rate on labor income had exceeded the revenue maximizing level based on a 1969 parameterization of his model. Other studies by Feige and McGee indicate that the U.S., U.K. and the Netherlands have not passed their revenue maximum tax rate.[6]

Table 2 shows the estimated maximum tax revenues under alternative assumptions about supply elasticities, progressivity and the unobserved economy. If, for example, we maintain our other most plausible conditions

[6]Feige and McGee (1982a), (1982b), (1982c).

while varying the aggregate supply elasticity, we see in part A of Table 2 that maximum revenues range from 233 billion Kronor in the inelastic case to 444 billion Kronor in the unit elastic output case. The apparent contradiction of higher maximum revenue associated with higher supply elasticities is easily explained. The model is parameterized around actual Swedish tax rates and tax revenues. As Table 1 illustrates, whether Sweden is to the right or left of its revenue peak depends critically on the aggregate supply elasticity. For example under plausible assumptions for progressivity and unobserved economy values, peak revenues occur at average tax rates of .66 when supply is inelastic and .37 when supply is highly elastic (see Table 1). Table 2A must be interpreted in this light.

Since maximum revenues occur at an average tax rate of .66 when supply is inelastic, an actual tax rate of .62 implies Sweden is to the left of the revnue peak of 233 billion Kronor reported in Table 2A. The average tax rate would have to be raised to .66 to attain this revenue level under these circumstances.

On the other hand, maximum revenues occur at an average tax rate of .58 when supply is plausibly elastic. Therefore the actual tax rate would have to be decreased from .62 to .58 to attain the revenue level, 233 billion Kronor, reported in the middle of Table 2A.

Finally, if supply were highly elastic, revenue maximization would occur at an average tax rate of .37. Since the actual rate is .62, this scenario would imply Sweden was far to the right of its revenue maximum. Consequently the revenue level could be drastically increased in this case from the actual level of 229 billion Kronor to the maximum level of 433 billion Kronor reported in Table 2A.

The extraordinarily high revenue for the most elastic case, makes that high an elasticity seem very unlikely, since peak revenues occur at a marginal tax rate of 49% which Sweden had passed by 1960. Because revenues have increased rather than decreased as rates have risen since then, the highly elastic case can be ruled out on emprical grounds. We should caution,

however, that economic growth and inflation make the level of tax revenues at any particular tax rate higher by shifting the Laffer curve upwards. Since we have not modelled in any of these expansionary effects on tax revenues, these results are best viewed as counterfactuals for what could have occurred in 1979. Revenue projections for the future should build in growth and inflation effects on tax revenues. Nevertheless, the implausibility of the high elasticity case result seems to suggest aggregate supply elasticity is indeed less than unity.

Table 2B shows how varying the progressivity factor affects the level of maximum revenues. The results suggest that a proportional tax system could obtain 312 billion Kronor compared to 233 billion for the current system and 208 billion for the upper limit progressivity assumption. Since the latter number is less than the actual revenue level in 1979, we can rule out the highest progressivity case. Obviously, equity considerations are not measured in the model, but this comparison does give a feel for the efficiency loss resulting from progressive taxation. As Hansson and Stuart (1982) point out, a more complete examination of this issue must include expenditure effects of the fiscal system as well as revenue effects. Since our model is neutral on the expenditure effects, we can not present a full measure of the efficiency loss from progressive taxation.

Table 2C shows how the assumption about the relationship between the marginal and average tax rate affects the maximum revenue level. Our most plausible case assumes a specification where there is a constant ratio of t' to t. The alternative elasticity specification, (10b), uses the observed historical relationship between the marginal and average tax rate to determine the relevant elasticity. This has the advantage of allowing the ratio of the marginal to average tax rate to decline somewhat as rates increase. Despite the theoretical differences between these two specifications, there is little empirical difference in the Laffer curves that result form each.[7]

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[7]See Stuart (1981). Our computed tax rates for 1979 fit well with Stuart's (1981) linear relation between t and t' for five year intervals from 1954 to 1974. We altered his intercept slightly to make the 1979 point fit the historical relation exactly. The result was a relation $t = .829\ t' - .069$.

The third alternative specification for the revenue elasticity with respect to the tax base, (10c), is also presented in Table 2C. This is the case of a constant elasticity with respect to disposable income. This specification can be used to analyze the effects of tax changes which change disposable income by the same percentage across-the-board.[8] It has the advantage of allowing the marginal and average tax rates to converge at high rates. It also implies exogenous tax changes which leave the redistributive effect of the system unaffected.

Since the average rate rises faster than the marginal rate in this specification, it generally results in a higher revenue maximizing average rate than the other alternatives. It also creates more revenues at the maximum. In this case Sweden has not passed its revenue maximizing tax rate. This exception points out the importance of the tax structure for the nature of the Laffer curve. Different Laffer curves will result when we consider different ways of obtaining the same average tax rate.

Table 2D shows how the assumption about the size of the unobserved economy affects the maximum revenue level. In general, a higher revenue level is possible the smaller the unobserved economy. Given the actual marginal tax rate in 1979, a smaller unobserved economy size in the first order condition for utility maximization, equation (8), implies a higher preference for observed sector output. This means less leakage of the tax base into the unobserved monetary economy as the tax rate rises.

Maximum revenues decline from 243 billion Kronor with a 5% unobserved monetary sector assumption to 214 billion Kronor with a 20% unobserved economy assumption. Since 214 is less than actual revenues in 1979 this result implies a lower supply elasticity is necessary to reconcile a 20% unobserved monetary economy with actual Swedish tax revenues.

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[8]This specification is discussed in Hansson and Stuart (1982), Jakobsson and Normann (1972), and Kanbur (1982).

Table 2 - Estimated Maximum Tax Revenues under Alternative Assumptions about Supply Elasticities, Progressivity, and the Unobserved Economy.*

(Billions of Kronor)

Supply Elasticity Assumption (A)

Inelastic	Plausibly Elastic	Highly Elastic
233	233	444

Progressivity Assumption (B)

Proportional	Plausibly Progressive	Highly Progressive
312	233	208

Relationship Between Average and Marginal Tax Rate (C)

Historical Equation (10b)	Constant Ratio Equation (10a)	Constant Elasticity of Disposable Income Equation ((10c)
231	233	242

Unobserved Economy Assumption with Cobb-Douglas Utility Assumption (D)**

5%	10%	20%
243	233	214

* In each simulation, all parameters other than the one being varied are set at their "most plausible" value.

** The maximum revenue level and tax rate were also computed for CES utility functions with elasticity of substitution .5 and 1.5, respectively. Under our most plausible assumptions maximum revenues were approximately 2 billion Kronor lower in the former case and 2 billion higher in the latter case. The revenue maximizing tax rate rose slightly in the former case and fell slightly in the latter case.

Effects of a Tax Cut Which Leaves Revenues Unchanged

If Sweden is indeed past its Laffer curve peak, it is possible to raise the same revenues at a lower tax rate. An interesting experiment with the model is to simulate the effects of a tax cut to the other rate which raises the same level of revenues as the 1979 tax rate. Since such a tax cut results in higher output and a lower unobserved monetary sector, it is hard to imagine an easier way to improve Sweden's economic performance.

The lower position of Figure 5 shows the simulated Laffer curve for Sweden based on what we believe to be the most plausible set of assumptions. The upper position of the figure relates changes in the tax rate to changes in total and observed sector output. The figure illustrates the effect of reducing Swedish taxes to the other rate which yields the 1979 revenue level. Cutting the average tax rate from 62% to 54% leaves revenue unchanged at 233 billion Kronor (from point A to point B in the bottom half of the Figure).

The horizontal line in the upper half of the Figure shows the potential monetary or market sector output which results when there are no taxes. This line occurs at 587 billion Kronor. The curve directly below the potential output line shows the level of actual output as the tax rate varies. The vertical distance between the potential and actual output line reflects the amount of supply side substitution from the monetary market economy to the non-monetary unobserved sector. As we mentioned before, this substitution out of market activity is basically into the leisure and home production sector where non-taxable alternative activities become more attractive at higher tax rates. Compared to their level at a zero tax rate, these activities increase by an amount equal to approximately 35% of total market activity at the 1979 tax rate.

The gap between the total and observed output line at any particular tax rate in Figure 5 shows the amount of unobserved monetary output which by assumption is 10% at the 1979 tax rate. Thus the total unobserved sector, monetary and non-monetary, is at least 45% of total output under our most plausible conditions. This is a conservative estimate because it does not

include any home activities that occur at a zero tax rate (i.e. it assumes a zero unobserved sector at a zero tax rate).

Reducing the tax rate to 54% causes a supply side increase in actual output of 44.6 billion Kronor, shown as the vertical distance CD in Figure 5 and an unobserved monetary sector decrease of 12.8 billion Kronor. The sum of these two amounts is the distance EF, which shows the total increase of 57.4 billion Kronor in observed sector output due to the tax reduction. This amounts to a 16% increase in national income, which is substantial considering the five years up to 1980 showed no real income increase in Sweden. Despite the exaggerated claims of supply side economists, it appears their arguments have some merits in the Swedish case. If the same revenues can be obtained at lower tax rates, there would seem to be little reason for not cutting taxes.

Figure 6 presents the analogous graphs for the case in which the average-marginal tax rate relationship conforms to its historical time path. In this case the corresponding effects of reducing the aggregate tax rate to 56%, where revenues are the same, is a 9.9 billion Kronor reduction in the unobserved monetary sector and a 32.9 billion Kronor increase in actual output from the supply side effect. The net result is an observed increase of about 12% in net national income. Thus whether we assume across-the-board or historical tax cuts, the results are quite similar.

V. Conclusion

The model we have presented is very simple and highly aggregated. Nevertheless it illustrates some novel interrelationships between supply side, tax evasion, and progressivity effects on tax revenues. It differs from other models, such as Stuart's (1981), in three basic respects.

First, we distinguish between tax evasion and tax avoidance by differentiating the monetary and non-monetary unobserved sectors. Supply side substitution refers to the movement of resources from the monetary to the non-monetary sector where taxes can be legally avoided. In addition substitution can occur from the monetary observed to the monetary unobserved sector as tax evasion increases.

Second, we have allowed the capital stock to respond to tax changes. Third, we have allowed for endogeneity of the aggregate tax rate, which depends on the tax base in addition to the exogenous rate structure.

Our model has enabled us to obtain estimates of the Laffer curve's shape as well as Sweden's position on it. Contrary to our results for other countries, we find Sweden to have passed its Laffer curve peak. This is true despite our finding that effective tax morality is higher in Sweden than in the other countries we have examined. The relatively higher tax rates in Sweden explain this apparent paradox.

One question that arises is why rational policy makers would raise taxes to rates beyond the revenue maximizing rate. Buchanan and Lee (1982a, 1982b) have suggested that the answer may lie in the short term time horizons faced by political decision makers. If labor and capital supply elasticities are greater in the long run than in the short run, then tax rate increases may initially raise tax revenues, but ultimately reduce revenues, as factor supply adjustments are completed. For politicians seeking re-election in the short run such tax increases may be rational. The same logic suggests the revenue gain associated with a tax cut in an economy past its Laffer curve peak may only materialize after an initial short term revenue drop.

An alternative explanation for a tax rate greater than the revenue maximizing rate is that policy makers simply do not have adequate information on the true relationship between the rate structure and revenue level. To improve understanding, our model attempts to theoretically describe and measure this relationship. As the Buchanan and Lee work suggests, further extension should incorporate the time perspective, adjustment costs, and expectations of individuals about the government's actions which may cause differences in the adjustment paths to the long run equilibrium position on the Laffer curve. Our model has only looked at this equilibrium position.

It would also be useful to make the elasticity of factor supplies endogenous rather than exogenous. We have presented a three sector model where substitution between the monetary and non-monetary sector is based on

exogenous factor supply elasticities, which presumably result from the implicit optimization by factor owners. Given these elasticities factor owners optimize their resource provision between the two distinct monetary sectors. A more general treatment would treat the full three sector optimization problem making the supply elasticities endogenous to the model.

Finally, the varied results in Table 1 point out the need for good measures of the basic parameters to estimate even a model with the heuristic simplicity of ours.[9]

Overall the results predict that, ceteris paribus, the recent Swedish tax cuts should raise output without a loss of revenue.

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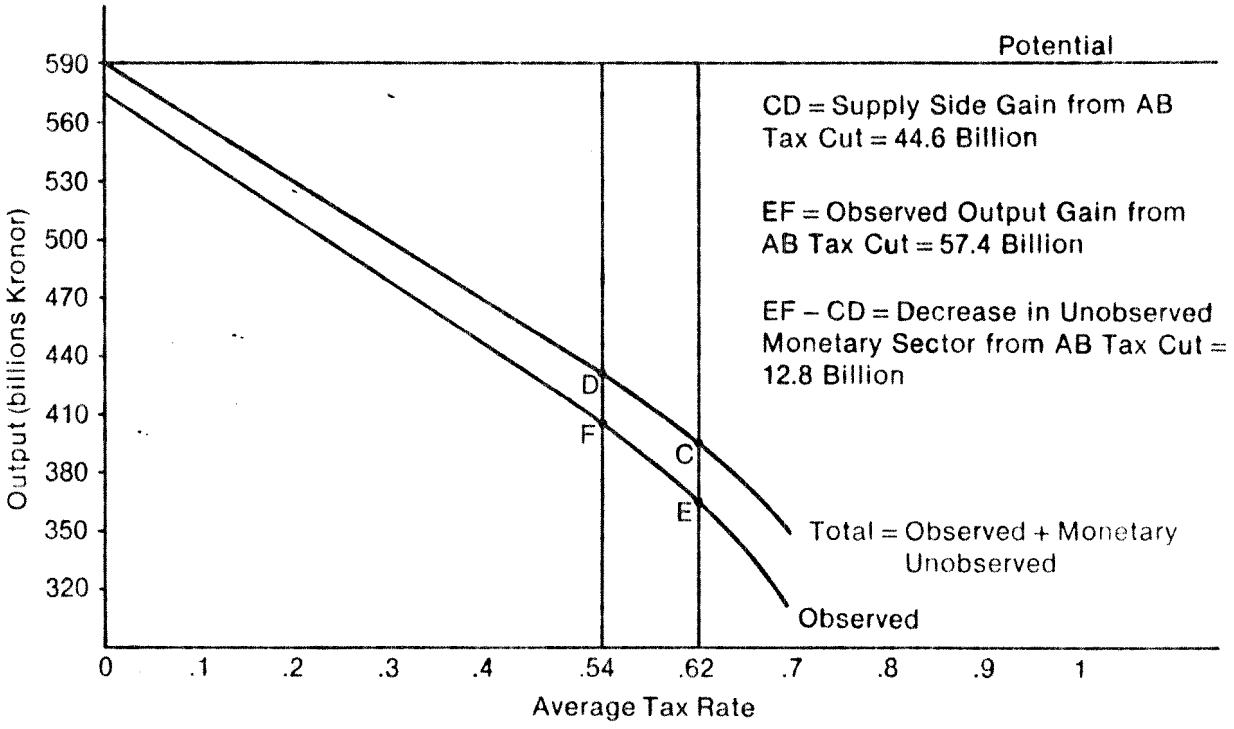
[9]Despite these qualifications our results for our most plausible assumptions are consistent with other work by Stuart (1981) and Hansson and Stuart (1982), which also finds Sweden to be past its revenue maximizing tax rate.

Figure 5
Supply Side and Unobserved Monetary Economy Effects of Cutting Tax Rates to Maintain Tax Revenues (N_{TY} = 1.34 constant)



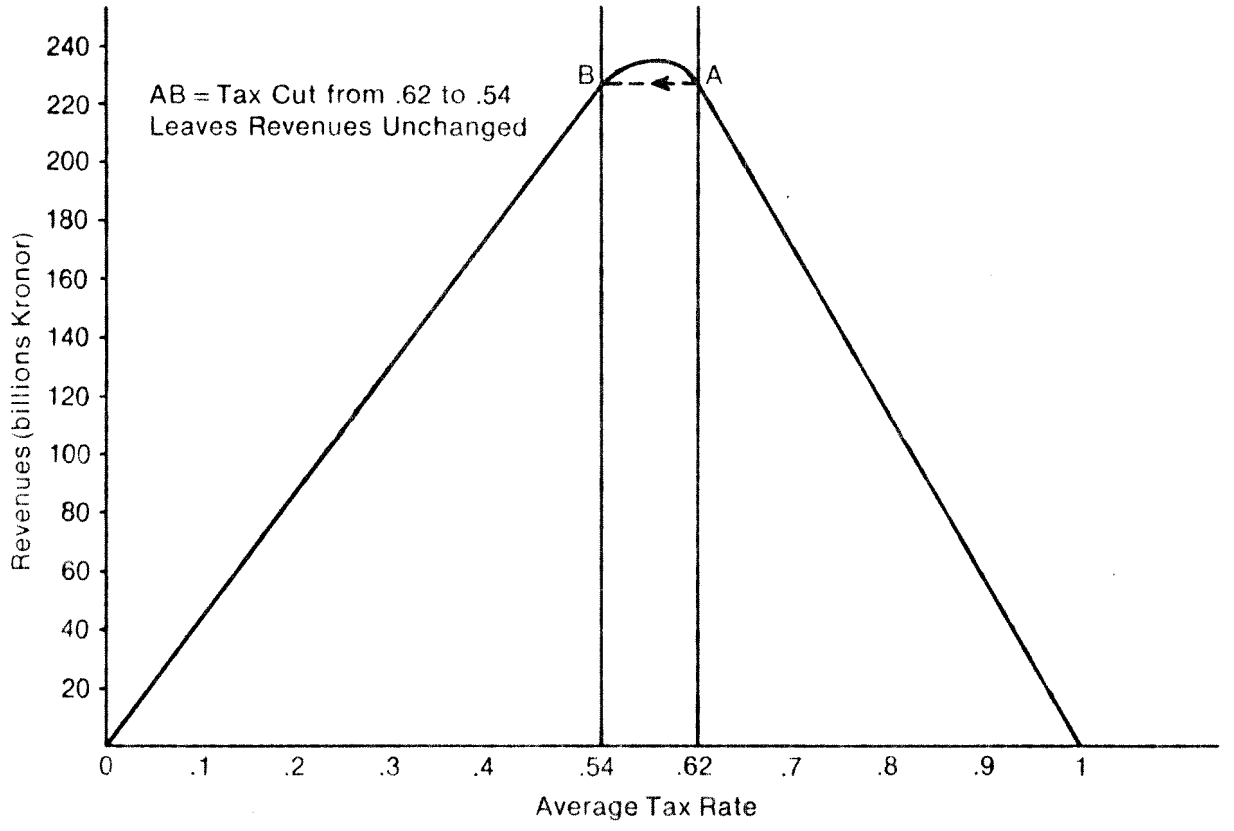
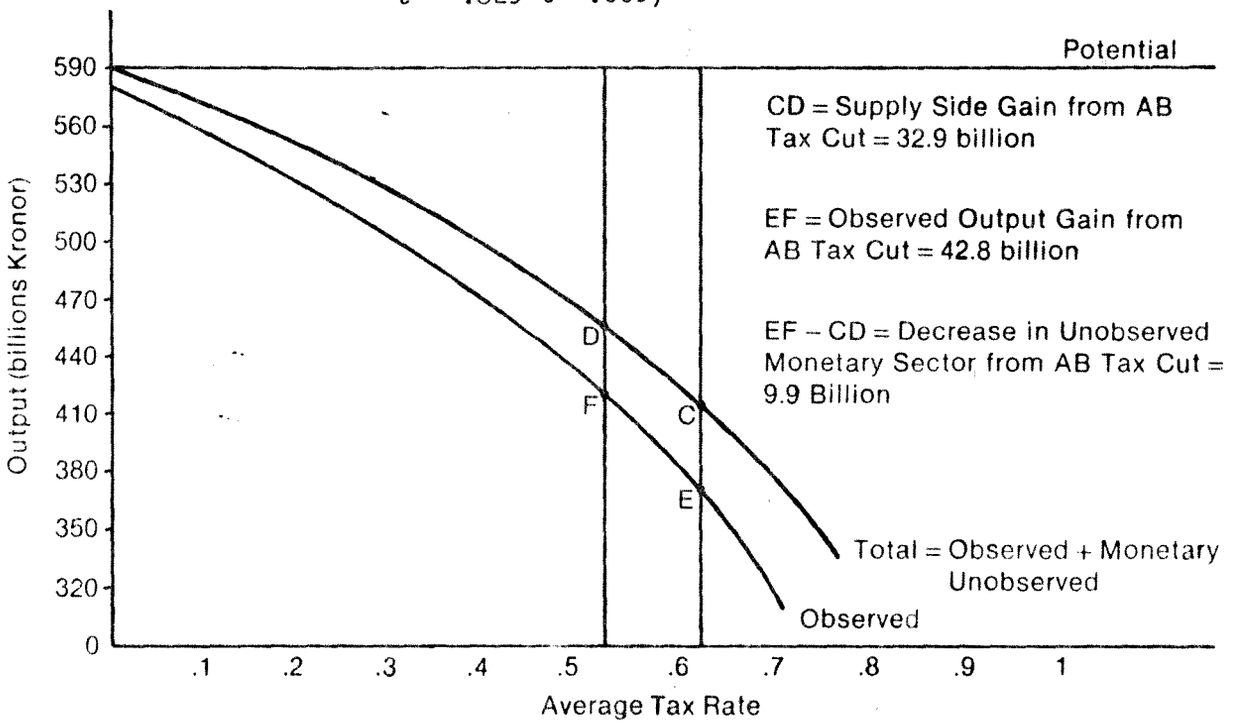
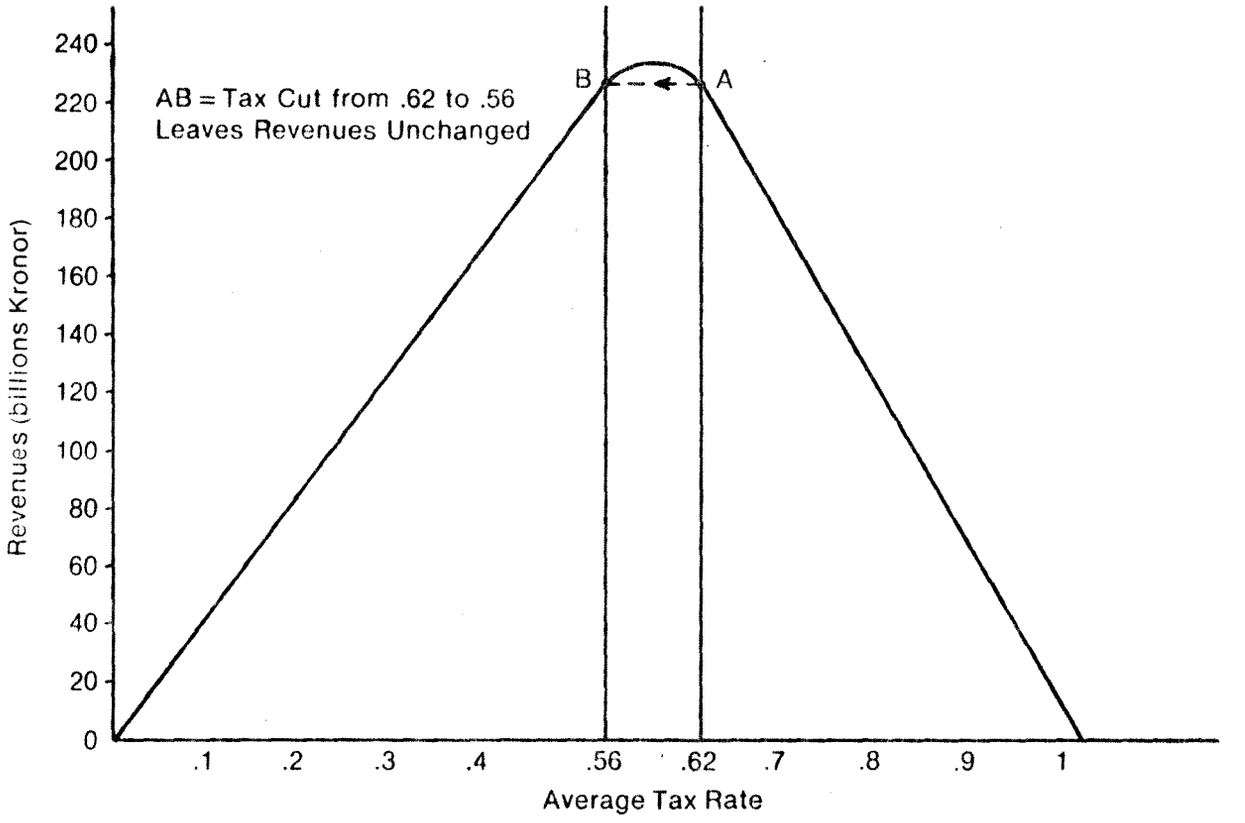


Figure 6
Supply Side and Unobserved Monetary Economy Effects of Cutting Tax Rates to Maintain Tax Revenues (N_{TY} satisfies historical relation: $t = .829\ t' - .069$)





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