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TAXATION AND ECONOMIC GROWTH

Eric M. Engen
Jonathan Skinner

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ABSTRACT

Tax reforms are sometimes touted to have strong macroeconomic growth effects. We consider the impact of a major tax reform on the long-term growth rates of the U.S. economy using three approaches. The first approach is to examine the historical record of the U.S. economy to evaluate whether tax cuts have been associated with economic growth. The second is to consider the evidence on taxation and growth for a large sample of countries. And finally, we use evidence from micro-level studies of labor supply, investment demand, and productivity growth. Our results suggest modest effects, on the order of 0.2 to 0.3 percentage point differences in growth rates in response to a major tax reform that changes all marginal tax rates by 5 percentage points and average tax rates by 2.5 percentage points. Nevertheless, even such small effects can have a large cumulative impact on living standards.

Eric M. Engen
Federal Reserve Board
20th and Constitution Avenues
Mail Stop 83
Washington, DC 20551
and NBER
eengen@frb.gov

Jonathan Skinner
Department of Economics
Dartmouth College
Hanover, NH 03755
and NBER
jonathan.skinner@dartmouth.edu

Introduction

By now, a presidential campaign is incomplete without at least one proposal for tax reform. Recent proposals have suggested that by reducing marginal income tax rates, or by replacing the current federal income tax with a consumption-type tax, the U.S. could experience increased work effort, saving, and investment, resulting in faster economic growth. For example, Steve Forbes vaulted briefly into the political limelight based almost solely on his advocacy of a flat tax which would have cut nearly every person's tax bill, but which was supposed to balance the budget by stimulating economic growth. The Kemp Commission suggested that its general principles for tax reform would almost double U.S. economic growth rates over the next five to ten years.[1] Most recently, presidential candidate Robert Dole proposed a 15 percent across-the-board income tax cut coupled with a halving of the tax on capital gains, with a predicted increase in GDP growth rates from about 2.5 to 3.5 percentage points.

Others have questioned whether tax reform would have such beneficial effects on economic growth.[2] If tax cuts fail to produce the projected boost in economic growth, tax revenues could decline, putting upward pressure on the deficit, worsening levels of national saving, and leading to laggard economic growth in the future. At this stage, however, there is little agreement about whether a major tax reform would provide an economic boon to the United

States, or impede economic growth.

In this paper, we reexamine the relationship between economic growth and taxation in light of the accumulated economic evidence, both from the United States and other countries. While many economists would agree with the proposition that "high taxes are bad for economic growth," we show that this proposition is not necessarily obvious, either in theory or in the data. However, we find the evidence consistent with lower taxes having modest positive effects on economic growth. While such growth effects are highly unlikely to allow tax cuts to pay for themselves, they can contribute to substantial differences in the level of economic activity and living standards, particularly over the long term.

Should We Expect Taxes To Affect Growth? A Theoretical Perspective

Before jumping into the morass of empirical evidence, it is useful to first ask the question: How does tax policy affect economic growth? By discouraging new investment and entrepreneurial incentives? By distorting investment decisions because the tax code makes some forms of investment more profitable than others? Or by discouraging work effort and workers' acquisition of skills? These questions are often addressed in an accounting framework first developed by Solow (1956). In this approach, the output (y) of an economy, typically measured by GDP, is determined by its economic resources--the size and skill of its workforce (m) and the size and technological productivity of its capital stock

(k). Thus, a country like the United States might be expected to have a greater per capita output than Mozambique because its (per capita) capital stock is so much larger and more technologically advanced, and its workers have more skills, or human capital. The growth rate of economic output will therefore depend on the growth rate of these resources--physical capital and human capital--as well as changes in the underlying productivity of these general inputs in the economy. More formally, we can decompose the growth rate of the economy's output into its different components:

$$\dot{y}_i = \alpha_i \dot{k}_i + \beta_i \dot{m}_i + \mu_i \qquad \textbf{(1)}$$

where the real GDP growth rate in country i is denoted $\dot{y}_i$ and the net investment rate (expressed as a fraction of GDP), equivalently the change over time in the capital stock, is given by $\dot{k}_i$. The percentage growth rate in the effective labor force over time is written $\dot{m}_i$, while the variable μ measures the economy's overall productivity growth.

There are two other relevant variables in Equation (1), which are the coefficients measuring the marginal productivity of capital, α_i, and the output elasticity of labor, β_i.[3] For example, if there were a one percentage point increase in the growth rate of the (skill-adjusted) labor force, and β was equal to .75, the

implied increase in the economic growth rate would be 0.75 percentage point. Alternatively, if the investment rate were to rise by 1 percentage point, and α were 0.10, the growth rate of output would rise by 0.10 percentage point.

This theoretical framework allows us to catalogue the five ways that taxes might affect output growth, corresponding to each of the variables on the right-hand side of Equation (1). First, higher taxes can discourage the investment rate, or the net growth in the capital stock ($\dot{k}_i$ in Equation (1) above), through high statutory tax rates on corporate and individual income, high effective capital gains tax rates, and low depreciation allowances. Second, taxes may attenuate labor supply growth $\dot{m}_i$ by discouraging labor force participation and hours of work, or by distorting occupational choice or the acquisition of education, skills, and training. Third, tax policy has the potential to discourage productivity growth μ by attenuating research and development (R&D) and the development of venture capital for "hi-tech" industries; activities whose spillover effects can potentially enhance the productivity of existing labor and capital.

Fourth, tax policy can also influence the marginal productivity of capital by distorting investment from heavily-taxed sectors into more lightly-taxed sectors with lower overall productivity (Harberger, 1962, 1966). And fifth, heavy taxation on labor supply can distort the efficient use of human capital by

discouraging workers from employment in sectors with high social productivity but a heavy tax burden. In other words, highly-taxed countries may experience lower values of α and β, which will tend to retard economic growth, holding constant investment rates in both human and physical capital (Engen and Skinner, 1992). We show this graphically in Figure 1, which focuses on a fixed level of the capital stock K, shown by the width of the horizontal axis. (A similar analysis holds for labor market distortions.) Suppose that the income tax on the corporate sector, as well as subsidies to non-corporate owner-occupied housing, distort the allocation of the capital stock between the corporate (c) and non-corporate (nc) sectors. (In other countries, the distortion may arise between sectors which escape taxation such as the underground economy or small-scale agriculture, versus the manufacturing sector which is easily taxed or heavily regulated.) The line denoted MP(c) is the value of the marginal product of capital in the corporate sector, while MP(nc) denotes the value of the marginal product in the non-corporate sector. Without any tax distortion, the profit-maximizing and most efficient point is C; the marginal productivity of capital is equalized in both sectors and the economy-wide return on capital is R* as shown by the dotted line. (The allocation of the total capital stock, K, is Q* units of capital in the non-corporate sector, and K-Q* units in the corporate sector.) With a tax of AB on corporate capital only, there is a distortion in the allocation of capital; capital

flows from the corporate to the non-corporate sector, so the new allocation is Q units of capital in the non-corporate sector and K-Q units of capital in the corporate sector. The net loss in output is given by ABC, the traditional Harberger welfare loss triangle. Under some plausible restrictions, the average rate of return for the entire capital stock, R, will correspond to the rate of return on new investment, given in Equation (1) by α.[4] Hence, a distortionary tax on capital (or on labor) will be reflected in lower overall rates of return on new investment (from R* to R), leading to laggard growth rates.

We have outlined five possible mechanisms by which taxes can affect economic growth. Therefore, it might appear that taxes should pay a central role in determining long-term growth. However, the conventional Solow growth model implies that taxes should have *no impact* on *long-term* growth rates. In part, this result occurs by assumption, since productivity growth η is assumed to be fixed and unaffected by tax policy. But this paradoxical result holds also because of a distinction between changes in the level of GDP and changes in growth rates of GDP. For example, suppose that the long-term growth rate of the economy, given by population and general technology growth, is 3 percentage points. In the year 2000, a "tax and spend" president is elected in the United States, and tax rates are increased by 10 percentage points across the board. (Ignore the effects of the extra government spending on the economy.) The extra

tax distortion reduces labor supply and investment, causing a sudden decline in *short-term* growth rates. But once the U.S. economy had adjusted to the harsh new tax regime, it would revert back to its original growth path, albeit at a lower absolute level than it would have been in the absence of the tax hikes. (In the Solow model, the rate of growth of the capital stock and labor supply growth reverts back to a rate consistent with general population and technology growth.) In our example above, the growth rate of the economy would be below 5 percentage points (and possibly even negative) during the transition phase. But once back to the new and inferior steady state, the long-term growth rate will continue to be 5 percentage points. In other words, the simple Solow model implies that tax policy, however distortionary, has no impact on long-term economic *growth rates*, even if it does reduce the *level* of economic output in the long-term.

So then how can taxation affect output growth rates? We focus on two possible mechanisms. The first is that when the structure of taxes change, *short-term* output growth rates would be expected to change as well along a possibly lengthy transition path to the new steady-state. If one believes that the Dole or the Forbes tax reforms would expand output by 5 percentage points, and it takes 10 years to make the transition to the new steady-state, growth rates will be higher, on average, by about 0.5 percentage point during this period before

settling back down to their long-run values.[5] Ten years is a long-term horizon for presidential candidates, but is still the short-term in the Solow model. And these short-term effects are clearly important, since they result in a permanent increase in GDP.

The second possibility arises within the context of the new class of "endogenous growth" models (e.g., Romer, 1986, and Lucas, 1990). In these models, the stable growth rate of the Solow model, stapled down by technology and workforce productivity growth, is replaced by steady-state growth rates which can differ, persistently, because of tax and expenditure policies pursued by the government (e.g., King and Rebelo, 1990). The endogenous growth framework emphasizes factors such as "spillover" effects and "learning by doing," by which firm-specific decisions to invest in capital or in R&D, or individual investments in human capital, can yield positive external effects (on μ for example) that benefit the rest of the economy. In these models, taxes *can* then have long-term, persistent effects on output growth. However, the question still remains: what is the magnitude of these tax effects on economic growth?

A number of recent theoretical studies have used endogenous growth models to simulate the effects of a fundamental tax reform on economic growth.[6] All of these studies conclude that reducing the distorting effects of the current tax structure would permanently increase economic growth. Unfortunately, the

magnitude of the increase in economic growth is highly sensitive to certain assumptions embodied in the economic models used in these studies, with little empirical guidance or consensus about key parameter values. Consequently, these studies reached substantially different conclusions concerning the magnitude of the boost in growth rates. At one extreme, Lucas (1990) calculated that a revenue-neutral change that eliminated all capital income taxes while raising labor income taxes would increase growth rates negligibly. At the other extreme, Jones, Manuelli, and Rossi (1993) calculated that eliminating all distorting taxes would raise average annual growth rates by a whopping 4 to 8 percentage points.[7] (An "across-the-board" reduction in distortionary tax rates in these models, rather than complete elimination of distortionary taxes, would be expected to have a smaller positive effect on economic growth.) Most recently, the simulation model in Mendoza, et al (1996) suggests relatively modest differences in economic growth of roughly 0.25 percentage point annually as the consequence of changes of 10 percentage points in tax rates.

These simulation models of endogenous growth fail to provide a comfortable range of plausible effects of taxes on growth, and thus tend to raise more questions than they answer. Moreover, they are likely to miss many relevant characteristics of the U.S. tax system. No macroeconomic model allows for the possibility of a firm undertaking financial restructuring to reduce taxable

income, or of timing issues in deferred taxes, or the possibility of tax evasion.[8] Often the simulation analysis is performed in terms of a single flat-rate tax in the context of a (single) representative agent model. Ultimately one needs to consider the empirical record to make informed judgements about whether tax policy exerts a strong influence on economic growth.

Below, we take three separate approaches to judge the empirical record. First, we take a quick look at the U.S. historical record to see if there is an easily discernable link between changes in U.S. tax policy and changes in economic growth across time. Second, we consider whether differences in growth rates across countries can be attributed, at least partially, to variation in tax policy. Third and finally, we survey the micro-level studies of how taxes affect specific subsectors of the economy and build up from these micro-level studies to make inferences about aggregate tax effects.

An Informal Look at Taxes and U.S. Economic Growth

Anecdotal stories about the U.S. tax code can sometimes have a larger impact on the policy debate than a stack of statistical studies. The Kemp Commission (NCR, 1996), for example, highlighted the complaint of one frustrated businessman:

> "As an entrepreneur, I experience first hand the horrors of our tax system. It has grown into a monstrous predator that kills incentives, swallows time, and chokes the hopes and dreams of

> many. We have abandoned several job-creating business concepts due to the tax complexities that would arise."

While this testimony is suggestive that the tax system adversely affects incentives, it is not entirely clear whether the entrepreneur is concerned about the tax rate *per se* or the complexity of the tax system more generally. And we are not sure what fraction of entrepreneurs are of like mind, or how much investment is affected adversely by the tax code. For example, surveys from a few decades ago indicate that typical businesspeople did not view taxes as an impediment to business decisions; in one study conducted in Britain in the early 1960s, not a single executive out of the sample of 181 replied that they abandoned the introduction of new plant or equipment during the past 7 years because of tax changes (Corner and Williams, 1965).[9] More recent survey studies suggest a larger impact of taxation on the discount rates used to evaluate private investment projects (Poterba and Summers, 1995); even among these tax-savvy Fortune 1000 executives, 36 percent reported that a corporate tax cut from 34 to 25 percent would not make them more likely to engage in investment projects.[10]

An alternative approach is to look at the historical evidence from time-series changes in taxation and output growth. The Kemp Commission's report (NCR, 1996) relied on time-series comparisons to argue that the patterns are self-evident:

> America has experienced three periods of very strong economic growth in this century: the 1920s, the 1960s, and the 1980s. Each of these growth spurts coincided with a period of reductions in marginal tax rates. In the eight years following the Harding-Coolidge tax cuts, the American economy grew by more than five percent per year. Following the Kennedy tax cuts in the early 1960s, the economy grew by nearly five percent per year... In the seven years following the 1981 Reagan tax cuts, the economy grew by nearly four percent per year while real federal revenues rose by 26 percent.

This approach does not try to perform the "growth accounting" exercise detailed in the theoretical section, but asks simply whether there are discernible differences in GDP growth following tax cuts. We consider the latter two tax reforms in Figure 2, which shows real GDP growth rates (both total and per capita) in the U.S. between 1959 and 1994 in the bottom panel, with the relevant tax series graphed in the upper two panels.[11] To smooth out year-to-year volatility in GDP growth rates, we present three-year moving averages of GDP growth rates in the bottom panel of Figure 2, both for aggregate growth rates, and for per capita growth rates. The two economic expansions noted above during the 1960s and the 1980s are apparent, as are the other expansions following recessions (shown by the shaded regions). The general slowdown in economic growth over the last three decades can be seen also.

Moving to the top panel of Figure 2, we next consider the ratio of tax revenue to GDP--a commonly-used measure of the average tax burden. The top

line shows U.S. federal government revenue (measured on a NIPA basis) as a percentage of GDP. The lower line is state and local government tax revenue (measured on a NIPA basis) as a percentage of GDP. Since 1959, the average federal tax rate has risen by about 2 percentage points, but has generally hovered around 20 percent of GDP; the average individual income tax rate has remained relatively constant, while growth in social insurance taxes has been generally offset by the decline in corporate and excise taxes. State and local government average tax burdens have risen by about 3 percentage points over the last three decades.

The Kennedy-Johnson tax cuts in 1964 resulted in a small decline in the average tax rate. Real GDP growth averaged a robust 4.8 percent over the subsequent 1964 to 1969 period. However, the extent to which this growth was caused by the tax cuts is unclear, as GDP growth had averaged over 5 percent in the two years *prior* to 1964.

The Reagan tax cuts also lowered the average tax rate, and real GDP growth averaged a healthy 3.9 percent from 1983 to 1989, significantly above the preceding period from 1980-82 that was dominated by recession.[12] But it is a difficult task to sort out whether the strong growth during the 1980s was the consequence of supply-side effects of lowering marginal tax rates, traditional Keynesian aggregate demand effects fueled by tax cuts and expanding defense

expenditures, or a recovery that would have occurred without the tax change.[13] Indeed, Feldstein and Elmendorf (1989) suggest an entirely different cause for the 1980s expansion; expansionary monetary policy combined with a strong dollar and active business investment.

Over the longer term, since 1959 both the average federal tax rate and the average state-local tax rate have risen--by about 2 percentage points and 3 percentage points, respectively. At the same time, average growth rates in real GDP have declined, from 4.4 percent during the 1960s to only 2.4 percent in 1986-95. These coincident trends over the last three and a half decades are consistent with the hypothesis that higher taxes have stunted economic growth. Before arriving at conclusions about taxation and growth from this single observation (which does not account for other factors that were also changing over this time period), we note that the average tax rate series is unlikely to reflect the *marginal* tax distortion, which economic theory suggests is more important in affecting economic growth through households' and firms' choices of saving, investment, and work.

The middle panel of Figure 2 shows the marginal individual income tax rates relevant for households at the 75th, 50th, and 25th percentiles of the income distribution in each year (Hakkio, Rush, and Schmidt, 1996).[14] From 1960 to the early 1980s, marginal tax rates at the 75th percentile grew while marginal tax

rates at the 25th percentile declined slightly. There was some reduction in output growth coincident with the increase in the upper-middle class marginal tax rates. However, GDP growth rates continued to fall over the past decade even as the marginal tax rates for both upper and lower-income households declined.[15] In other words, the time-series correlation between marginal tax rates and growth rates yields a decidedly mixed picture; some decades were correlated positively, and others negatively.

Finally, we correct the first sentence of the quotation from the Kemp Commission above. The most rapid growth rates in this century were, in fact, during the period 1940-45, when output grew at 12.5 percentage points annually. During this same period, the federal tax system expanded dramatically, with median marginal tax rates rising from 3.6 percent in 1940 to 25 percent in 1945. Yet it would be ludicrous to claim on that basis that higher tax rates have a positive effect on output growth, given the obvious confounding events during this period. Nevertheless, highlighting the period 1940-45 is useful for two purposes. The first is that it illustrates the risks of trying to discern incentive effects of taxation using short-term time-series data. This is a point reinforced by the experience of Sweden's tax reform, when the economy fell into a recession just after a major tax reform substantially trimmed marginal tax rates (Agell, Englund, and Sodersten, 1996). And second, it suggests that one should look

most carefully at GDP growth rates before and after the early 1940s when the federal income tax experienced its major expansion. Stokey and Rebelo (1995) looked for this break in long-term output growth rates and were unable to find any significant difference. On the other hand, given the major disruptions in economic activity occurring during the 20th century, it may be asking too much of the data to detect what might be very small differences in growth rates, on the order of a ½ percentage point, caused by the distortionary effects of taxation.

More formal econometric methods may hold greater promise for uncovering the pure effects of taxation on economic growth, because that type of analysis attempts to control for other factors that affect output independently of tax policy. The problem is that time-series analysis is best suited for detecting short-term effects of changes in tax policy on output growth, which, as noted above, may reflect Keynesian demand-side expansionary effects or other unmeasured factors associated with tax cuts. In addition, figuring out *which* characteristics of a particular tax reform--changes in top marginal tax rates, depreciation allowances, tax progressivity, tax rates on capital gains--caused changes in growth rates is particularly problematic in aggregate time-series analysis. For these reasons, we turn our attention next to cross-country studies.

Tax Policy and Growth: The Cross-Country Evidence

An alternative empirical approach is to draw on the experience of

different countries to investigate how tax policy affects economic growth. Countries have very different philosophies about taxation, and very different methods of collecting their revenue. During the past several decades, some countries have increased taxation quite dramatically, while in other countries tax rates have remained roughly the same. Some countries incorporated value-added taxation in the 1960s (e.g., France, Britain) while others shifted away from corporate taxation (the United States). The advantage of using such cross-country comparisons is that we can use many countries with different tax structures and rates of GDP growth rates to test for correlation (and one hopes, causation) between tax policy and growth.

In general, studies of taxation using cross-country data suggest that higher taxes have a negative impact on output growth, although these results are not always robust to the tax measure used. Using reduced-form cross-section regressions, Koester and Kormendi (1988) estimated that the marginal tax rate--conditional on fixed average tax rates--has an independent, negative effect on output growth rates. Skinner (1988) used data from African countries to conclude that income, corporate, and import taxation led to a greater reductions in output growth than average export and sales taxation. Dowrick (1992) also found a strong negative effect of personal income taxation, but no impact of corporate taxes, on output growth in a sample of OECD countries between 1960

and 1985. Easterly and Rebelo (1993) found some measures of the tax distortion (such as an imputed measure of marginal tax rates) to be correlated negatively with output growth, although other measures of the tax distortion were insignicant in the growth equations.

Most empirical studies of taxation and growth are "reduced form" estimates in that they specify a linear model of output growth rates, with tax rates, labor resource growth, and investment rates on the right-hand side of the equation. However, taxes do not necessarily enter the growth accounting framework in Equation (1) in a linear fashion. We explored this possibility in Engen and Skinner (1992), where the primary growth effect of tax distortions on production is hypothesized to depress the economy-wide return on capital, α, and on labor, β (as in Equation 1 and Figure 1). Using cross-country data for 1970-85, Engen and Skinner (1992) found that an increase of 2.5 percentage points in the average tax burden (total taxes divided by GDP) is predicted to reduce long-term output growth rates by 0.18 percentage points, holding constant the supply of investment and labor.

A recent McKinsey (1996) study points to the potential importance of the intersectoral allocation of capital. The study observed that Japan and Germany both had much higher rates of investment. But because U.S. investment appeared to be allocated to more profitable (i.e., higher productivity)

sectors, the net increment to the effective capital stock, and hence to national income, was considerably greater in the U.S., despite the lower investment rate. Similarly, King and Fullerton (1984, page 301) in their study of tax systems in the U.K., Sweden, West Germany, and the U.S., found a strong negative correlation between economic growth and the intersectoral variability in investment tax rates.[16]

Of course, nearly any tax will tend to distort economic behavior along some margin, so the objective of a well-designed tax system is to avoid highly distortionary taxes and raise revenue from the less distortionary ones. There is some evidence that how a country collects taxes matters for economic growth. Figure 3, reproduced from Mendoza, Milesi-Ferretti, and Asea (1996), shows the correlation among the OECD countries between income taxes (on labor and capital) and economic growth (panels A and B) and consumption taxes and economic growth (panel C), over the period from 1965-1991. These scatter plots, largely confirmed in regression analysis, suggest that income taxation is more harmful to growth than broad-based consumption taxes.

It is useful to consider the growth effects of a major tax reform using these cross-country regression estimates. Suppose that marginal tax rates are cut by a uniform 5 percentage points and average tax rates are cut by 2.5 percent of GDP, leading to a (static) revenue loss of $185 billion annually. This

hypothetical tax reform was chosen because it is probably on the outer fringe of politically feasible tax reform, losing more than twice as much revenue as the tax proposal supported by presidential candidate Robert Dole. Were such a plan enacted, the tax-to-GDP ratio would revert to levels last seen in 1958. As noted above, the estimated coefficients from Engen and Skinner (1992) that ignores possible changes in the supply of capital and labor implies an increase in long-term growth rates of 0.18 percentage points. Including estimates of the responsiveness of investment to the marginal tax rate from Mendoza, Milesi-Ferretti, and Asea (1996) suggests that this hypothetical tax reduction would increase investment by 1.35 percent, boosting the predicted growth rate effect of the tax cut to 0.32 percentage points annually.[17]

5. Sandtraps in Cross-Country Econometric Analysis

To this point, we have been taking the results of the cross-country econometric studies at face value. Any empirical study must be treated with some caution, but in many of the studies cited above; particularly the cross-country studies, one must be particularly careful in the interpretation of the coefficients (see Levine and Renault, 1992, and Slemrod, 1995). We consider just four of these potential problems below.

First, studies of taxation and growth may find negative growth effects resulting from taxation, but it is more difficult to measure the potential benefits of

the spending financed by the revenue collected. The combined impact of distortionary taxes and beneficial government expenditures may yield a net improvement in the workings of the private sector economy (e.g., Barro, 1991a,b). An example of the deleterious effects caused by the absence of government spending comes from the World Development Report (World Bank, 1988);

> According to the Nigerian Industrial Development Bank (NIDB), frequent power outages and fluctuations in voltage affect almost every industrial enterprise in the country. To avoid production losses as well as damage to machinery and equipment, firms invest in generators.... One large textile manufacturing enterprise estimates the depreciated capital value of its electricity supply investment as $400 per worker.... Typically, as much as 20 percent of the initial capital investment for new plants financed by the NIDB is spent on electric generators and boreholes (World Bank, 1988; p. 144)

That is, when the government of Nigeria did not provide the necessary electricity supply, private firms were forced to generate electricity on their own, and presumably at much higher cost. Clearly, a tax in Nigeria earmarked for (new) government expenditures on improving the electrical system would be likely to enhance economic growth even if the taxes distorted economic activity. The problem is that taxes are not necessarily earmarked to those expenditures most conducive to economic growth, either because of political "inefficiencies"

or because of redistributional policies that may yield benefits for society, but will not be reflected in robust GDP growth rates (Atkinson, 1996).[18] Thus, one must be careful in interpreting the coefficients on tax and output growth studies to remember that these estimates reflect just one part--the costs--of a combined tax and expenditure system.

Second, one should be very wary of the data, particularly from developing countries with large agricultural or informal sectors where the measurement of income is difficult indeed.[19] Even in developed countries, it is well known that GDP measures suffer from biases and mismeasurement of productivity in service sectors, for example.[20] Measuring "the" effective tax rate is even more difficult, given the wide variety of tax distortions, methods for measuring them, and variation across countries in administrative practices.

Third, there are real difficulties with reverse causation; one doesn't know whether regression coefficients reflect the impact of investment on GDP growth rates, for example, or the reverse influence of GDP growth rates on investment, or both effects combined (see Blomstrom, Lipsey, and Zejan, 1996). Sometimes these biases creep in because of the way the regression variables are constructed. Suppose one wanted to estimate an explicitly short-term relationship between the change in the tax burden, typically measured as the ratio of tax revenue to GDP, and the percentage growth rate in GDP. Any positive

measurement error (or short-term shock) in GDP will shift GDP growth rates up, but also tend to shift the tax-to-GDP ratio down, thereby introducing a spurious negative bias in the estimated coefficient.[21] One can try to avoid such bias by introducing as explanatory variables the percentage growth rate in the *level* of taxation, or of government expenditures, rather than the change in the *ratio*, as above. In this case, the bias would go in the opposite direction, because countries that grow rapidly also tend to experience rapid growth in tax collection and in spending.[22] One approach for both of these problems is to use instrumental variables for changes in government spending and taxation (Engen and Skinner, 1992), although the problem still remains to find appropriate exogenous instruments.

Another "reverse causality" problem comes in deciding what factors to include on the right-hand side of a growth regression. Should one control for other factors such as inflation, political unrest, and the share of agriculture in total output? On the one hand, these are factors that could be spuriously correlated with tax policy, and one would clearly want to control for them. But on the other hand, a shrinking share of agriculture in output, or political unrest, or inflation could themselves be symptomatic of the underlying growth rate of the economy. During severe recessions, countries often resort to high inflation rates as a means of financing expenditures after their tax collection efforts have collapsed. This

reverse causation makes it harder to argue that inflation "causes" poor economic growth, as well as making it difficult to interpret the coefficients on all other variables. In sum, reverse causality is really the Achilles Heel of the typical cross-country regression. Nearly every variable on the right-hand side of the regression is suspect.

Fourth, as noted by Slemrod (1995), countries may differ both in their tastes for government-sector spending (the demand side) and differ in their ability to raise tax revenue (the supply side). Suppose that more developed countries experience a lower cost of raising tax revenue, perhaps because industrial production is much easier to tax than agricultural production. Then countries that grow quickly may also experience a more pronounced drop in their cost of raising tax revenue, which could in turn lead to more rapid growth in tax revenue. The researcher might well find a spurious positive correlation between tax rates and output growth. By the same token, countries that grow fast may exercise a greater taste for government spending (sometimes known as Wagner's law), leading to a shift to the right in the demand for government spending. As Slemrod points out, such a model would imply that, in a cross-section of countries, there could be little correlation between output growth, government spending, and taxation.[23] Slemrod's point is therefore a cautionary one, that the regression coefficients one actually estimates may have little to do with the

Solow-style production function written in Equation 1 (see also Islam, 1995). But this point also suggests that even if taxes affect growth rates adversely, cross-country regression models would be biased against detecting such effects.

6. Sectoral Studies of Taxation and Growth

A third approach is to consider separately the effect of taxes on the disaggregated "micro" components in Equation (1), such as labor supply, human capital, investment, and technological growth. We then combine these effects to arrive at an aggegrate "bottom up" measure of how our hypothetical tax reform -- cutting marginal tax rates by 5 percentage points, and average rates by 2.5 percent -- might affect output growth.[24] The advantage of this approach is a more accurate measure of how economic agents respond to tax incentives, often with data generated by a natural experiments such as tax reform or other (exogenou) legislative change. There are two disadvantages to this strategy, however. First, we are unable to account for the spillover effects of both human and physical capital accumulation, as in the hypothesized correlation between the level of investment and technological innovation (see Boskin, 1988). And second, even with this disaggregated approach there is virtually no empirical evidence on some key parameter values.

(i) Change in the labor force

Consider first the effects of taxation on labor supply. The top panel of

Figure 4 contains a graph that shows marginal labor income tax rates for the U.S. from 1965 to 1988 from Mendoza, Razin, and Tesar (1994) plotted against the average weekly hours for workers in private nonagricultural industries and also the civilian labor force participation rate. As labor income tax rates have increased, average weekly hours have declined. On the other hand, labor force participation has increased. (Although not shown, participation has generally increased for women while falling for men.) Thus, the effect of increased marginal labor taxes appears to be ambiguous based on this simple time-series examination.

A voluminous empirical literature has examined how taxes affect the labor supply of individuals within various demographic groups (e.g., Killingsworth, 1983; Hausman, 1985; MaCurdy, Green, and Paarsch, 1990; Triest, 1990, 1996; Bosworth and Burtless, 1992; Mariger, 1994; Eissa, 1996a,b) Generally, the results suggest quite modest labor supply effects of tax policy in the United States.[25] Most estimates suggest that both work hours and labor force participation for men are only mildly responsive to historically-experienced tax changes, and Heckman (1993) concludes that most of the evidence points to a relatively larger participation effect than hours effect. Estimated uncompensated tax elasticities are usually small, often in the range of zero to 0.1.[26] Recently, Eissa (1995) recently found that married women in high-

income households are more responsive to tax changes--with tax elasticities in the range of 0.6 to 1--with approximately equal importance on hours and participation changes. However, working married women make up a relatively small part of the labor force and often have relatively tenuous ties to the labor force (Eissa, 1996a). Unmarried women generally have similarly small labor supply responses to taxes as men (Eissa, 1996a).

For the purposes of our equation (1) above, we would like to know how tax policy affects the rate of change in quality-adjusted labor supply $\dot{m}$. Consider first short-term effects. If the labor supply elasticity is assumed to be 0.15, and marginal tax rates decline by 5 percentage points, then one might expect an increase of 0.75 percent in total hours worked. Assuming labor income comprises 75 percent of total output, and the labor market transition is spread over a 10-year transition period, the net change in GDP growth rates over the short-term (10-year) period would be 0.06 percent annually. In the long-term, however, only tax-induced changes in the accumulation of education or human capital more generally would affect the growth rate $\dot{m}$.

A number of empirical studies (e.g. Romer (1990), Mankiw, Romer, and Weil (1992), and Judson (1996)) suggest that measures of human capital have statistically and economically important effects on economic growth, although some (e.g., Barro and Lee, 1992) estimate that the affect is quite small.

However, the effect of taxes on human capital formation is quite uncertain. Theoretically, the effect is ambiguous and, not surprisingly, simulation analysis can lead to a variety of conclusions. Trostel (1993) simulates substantial long-term elasticities of human capital with respect to taxation; he suggests a long-term increase in human capital of 0.97 percent per one percentage point decrease in the marginal tax rate (p. 339). Hence our hypothetical 5 percentage point reduction in the marginal tax rate would be predicted to increase the stock of human capital by 4.8 percent. In equilibrium, maintaining that higher level of human capital requires an extra 4.8 percent additional net investment in human capital. Suppose that $\dot{m}_i$ were about 3 percent annually. The new level of equilibrium growth in human capital would rise to 3x1.048, or 3.14 percent annually.[27] Assuming the factor share coefficient is 0.75, the net effect on growth would be 0.10 percentage points.

(b) Change in the net investment rate

The bottom panel of Figure 4 shows marginal capital income tax rates for the U.S. from 1965 to 1988 from Mendoza, Razin, and Tesar (1994) plotted against private nonresidential fixed investment as a percentage of GDP. As has been noted before (e.g., Chirinko, 1993; Hassett and Hubbard, 1996), a simple examination of the time-series evidence suggests little relationship (and possibly a positive correlation) between investment and capital income tax rates.

However, as before, this type of analysis is surely too simplistic.

Alternatively, Figure 5 shows a graph from data on the OECD countries comparing capital income taxes with investment rates, taken from Mendoza, Milesi-Ferretti, and Asea (1996). There is a moderate negative correlation between tax rates and investment rates; more detailed regression analysis suggests that a 10 percentage point change in the tax rate on profits could affect investment rates by at most one to two percentage points. It should be noted, however, that one shortcoming of these capital tax measures is that they use weighted statutory rather than effective rates, and thus they cannot account for the dramatic increase in effective marginal tax rates on capital during periods of inflation (see for example King and Fullerton, 1984, and Fullerton and Karayannis, 1993).

A number of recent studies (e.g., Auerbach and Hassett, 1991; Cummins, Hassett, and Hubbard, 1994, 1996; Chirinko, Fazzari, and Meyer, 1996) have found significant effects of tax policy on investment, suggesting a plausible range for the investment elasticity for changes in the user cost of capital in the range of 0.25 to 1. This finding is potentially important because, although Levine and Renelt (1992) find that almost all results are fragile in cross-country growth regressions, they do find a positive, robust correlation between growth and investment.

How might a change in the nature of investment decisions affect output growth? Suppose we adopt an investment elasticity of 0.5; then a 5 percentage point drop in marginal tax rates should boost investment rates by 2.5 percent, or by about 0.4 percent of GDP. Assuming the net marginal product of capital is 10 percent, output growth rates might be expected to grow by another 0.04 percentage points. We assume this boost in the growth rate would be permanent, although in the Solow-style model, the growth effects would diminish over time.

One factor that could stifle tax-induced investment expansions is a lack of new saving to finance the increased investment. In an economy without foreign capital flows, the increased demand for investment would be financed by the additional supply of saving attracted by higher net interest rates. But simulation models (Engen, 1996) and empirical studies (Skinner and Feenberg, 1990) find support, at most, for only a modest response of personal saving to the interest rate (See also Elmendorf (1995) and references cited therein). The relevant source of financing for the extra investment may also include be retained earnings of firms and foreign investors.[28] In any case, the investment elasticities gained from micro-level studies of firm investment behavior *already* reflect the additional cost or difficulty incurred by firms in providing additional financing for their investments, suggesting the pure investment demand elasticities may be even larger.

(c) The impact of taxation on the productivity residual μ

Taxes can affect the output growth in another way, by discouraging innovations and economic organizations that result in increased levels of output, holding constant the supply of capital and labor. In other words, distortionary tax policy may permanently reduce the level of technological growth μ. Of course, by its nature, trying to determine whether the residual effect μ is caused by tax policy, or by some other factor (of which there are always many candidates) is always problematic. Here we consider two examples; the effects of tax policy on research and development, and its impact on entrepreneurship.

Hall (1993) studied the impact of the tax credit for R&D on R&D spending using two sources of variation; changes in the tax code over the 1980s and differences in the taxable status of individual firms that affected their ability to take advantage of the credits. She found quite large effects; for every $1 billion lost in tax revenue, a $2 billion increase in R&D spending. Since R&D is about 2.5 percent of GDP (Nonneman and Vanhoudt, 1996), Hall's estimates imply that a five-percentage point tax advantage to R&D would increase R&D spending by 0.25 percent of GDP. Using a rate of return to R&D spending of 30 percent (e.g., Grilliches, 1988), the net effect would be a 0.075 increase in GDP growth rates.

A second possibility is that the hypothetical tax cut, for example on

capital gains, would stimulate entrepreneurship and innovation, which in turn would augment productivity growth. Poterba (1989) investigated the tax incentives faced by venture capitalists, and concluded that venture capital was only a small fraction of total capital income, so that tax cuts were a blunt sword to encourage "high-tech" industries. Furthermore, tax-exempt institutions provided a large fraction of start-up funds, and these institutions are not subject to income taxation. However, Anand (1996), looking specifically at the telecommunications industry, finds that capital gains do appear to affect venture capital financing.

Another view of taxation and entrepreneurship emerges from a recent study quantifying labor hiring decisions by self-employed workers. Carroll, et al (1996) found that a 6 percentage point decline in the marginal tax rate of a (Schedule C) entrepreneur in the top tax bracket increased by 11 percent the likelihood of hiring at least one employee. However, the magnitude of these effects, and their impact on aggregate employment, are not well enough understood to hazard a numerical estimate of their growth effects.

(d) Summing up

To complete our "bottom-up" analysis, we simply add the growth effects based on changes in human capital, investment, and technological growth. The long-run growth effect of this tax reform is estimated to be 0.22 percentage point,

while the short-term growth effect, which includes the transitional effects of increased labor supply, increases to 0.28 percentage points.

Aside from the considerable uncertainty inherent in nearly every empirical parameter used in these calculations, there are some further caveats. First, the calculation ignores the reduction in the sectoral distortion of capital and labor, which in the section on cross-country regressions was found to be important. Second, these estimates reflect a uniform reduction of 5 percentage points in marginal tax rates for all income-generating activities. It may be the case that tax cuts in capital gains, or tax credits for R&D, coupled with increases in consumption taxes, or a shift to a flat tax, could yield stronger growth effects with less pronounced revenue effects. Nevertheless, these results suggest growth effects from a major tax reform on the order of one-quarter of one percent per year.

5. Lessons for Policy

While the last word on taxation and economic growth certainly has not been heard, there are some lessons that we think can be taken from the evidence thus far.

First, we think that tax policy does affect economic growth. There is enough evidence linking taxation and output growth to make the reasonable inference that beneficial changes in tax policy can have modest effects on output

growth. The implied effects from the "bottom up" micro-level studies, and the "top down" cross country regressions, are quite close in magnitude: a major tax reform reducing all marginal rates by 5 percentage points, and average tax rates by 2.5 percentage points, is predicted to increase long term growth rates by between 0.2 and 0.3 percentage points. Whether these effects on output growth are permanent (lasting forever) or transitory (lasting perhaps 10-15 years) is difficult to determine, both because our data sources do not extend for a lengthy period, but also because tax regimes themselves generally have such short half-lives.

Second, even these modest growth effects can have an important long-term impact on living standards. For example, suppose that an inefficient structure of taxation has, since 1960, retarded growth by 0.2 percent per annum. Accumulated over the past 36 years, the lower growth rate translates to a 7.5 percent lower level of GDP in 1996, or a net reduction in output of more than $500 billion *annually*. So the potential effects of tax policy, although difficult to detect in the time-series data, can have potentially very large effects in the long-term.

Third, it appears highly unlikely that past tax reforms have been self-financing in the aggregate. There is evidence that tax changes focused on high income taxpayers may be self-financing, perhaps because of changes in financial

arrangements as well as shifts in economic activity (e.g., Feldstein, 1995; Feldstein and Feenberg, 1996). Of course, the historical record does not relate specifically to a flat tax or a consumption-based tax, which could have quite different effects, but we think it unlikely that any tax system could engender the long-term increases in growth rates necessary to completely pay for the tax cuts.

We want to be careful here about the context of our conclusions about taxation and growth in the policy debate over dynamic scoring. Typically, dynamic scoring of tax revenue in response to changes in the tax code involve two adjustments; one is the microeconomic change in the tax base, holding constant macroeconomic variables, and the other is the change in macroeconomic climate caused by the tax reform (Auerbach, 1996b). Here, we say nothing here about the first, microeconomic effects, which could well be quite large (as in the short-term response of capital gains realization to changes in the capital gains tax cut). We simply claim that the second, macroeconomic effect is likely to be modest.

Fourth, a major shortcoming with nearly all cross-country and time-series studies is the difficulty of measuring the marginal tax burden appropriately. The average tax rate does not reflect the marginal tax burdens hypothesized to affect economic decisions. Even statutory marginal tax rates may not adequately reflect the quite complex intertemporal incentive effects of a complex tax system.

In many countries, tax policy is administered at the local level, where the tax collector may not even have a current copy of the relevant statutes.

Fifth, the composition of the tax system is probably as important for economic growth as is the absolute level of taxation. Countries are able to mobilize tax resources through broad-based tax structures with efficient administration and enforcement will be likely to enjoy faster growth rates than countries with lower overall tax collections assessed inefficiently. In short, the design of the tax system is likely to exert a modest, but cumulatively important, influence on long-term growth rates.

Endnotes

1. The Kemp Commission was formally known as the National Commission on Economic Growth and Tax Reform (1996).

2. For examples, see Gravelle (1995) and Gale (1996).

3. The two coefficients are not measured in the same units because $\dot{k}_t$ is expressed as a ratio of GDP and $\dot{m}_t$ as a percentage change.

4. See Auerbach, Hassett, and Oliner (1994) for a discussion of how α corresponds to the (net or gross) return on capital.

5. David (1977) suggests that much of the 19th century in the US was characterized by a transition from a low to a high capital-intensity economy. On the other hand, King and Rebelo (1993) finds that traditional Solow growth models generate implausible transition paths in shifting from one equilibrium to another.

6. There is an extensive simulation literature showing transitional gains in economic efficiency using the framework of dynamic computable general equilibrium models; see Ballard, Fullerton, Shoven, and Whalley (1985), Auerbach and Kotlikoff (1987), Fullerton and Rogers (1993), Auerbach (1996a), and Engen and Gale (1996). Like the endogenous growth literature, the results from such studies often depend on the structure of the simulation model. In a life cycle model with perfect certainty and perfect foresight, Auerbach and Kotlikoff (1987) and Auerbach (1996a) find quite dramatic shifts in some aggregate variables (such as saving rate) during the transition to a new steady state. In a model with uncertainty about future earnings, Engen and Gale (1996) find more moderate shifts in output and saving during the transition to a new tax regime

7. Stokey and Rebelo (1995) provide a excellent survey of this literature and explain why the theoretical simulation models differ so dramatically in their implications for growth.

8. For a discussion of these issues, see Alm (1996), Slemrod (1990, 1994, 1995) and Auerbach and Slemrod (1996).

9. Moreover, only 8 percent said they had even postponed investment. Also see Holland (1969) for survey evidence on the labor supply of highly-paid executives.

10. Specifically, the survey question asked whether the tax cut would reduce or increase the "hurdle rate" or the *minimum* rate of return required before approving internal corporate investments.

11. Including earlier periods is complicated by the fact that revised GDP figures are currently only available on a consistent basis from 1959. Also, Lindsey (1990) notes that the Coolidge-Mellon cuts in the 1920s affected only the top quarter of households as most U.S. citizens paid no income tax during that time.

12. During 1971 to 1979, the economy expanded at an annual average rate of 3.5 percent including the recession years of 1974-75. Growth averaged 3.2 percent over the 1982-89 period.

13. Sorting out the difference between supply-side and demand-side expansions is important, since demand-side expansions tend to deflate later into recessions, while supply-side shifts correspond to permanent improvements in the productive capacity of the economy.

14. We are grateful to the authors for making this data on tax rates at different income percentiles available to us. Note that these tax rates only reflect the federal individual income tax and do not incorporate federal corporate income, EITC, payroll, or state income taxes.

15. An alternative measure of the tax distortion is the top statutory federal income tax rate. The top rate reached its zenith during the 1950s and early 1960s, when it was 91 percent. Since then it has bounced steadily downward to 28 percent, briefly, in 1988, with a jump back up to 39.6 percent by 1993. (See Pechman (1985) for an historical summary of most of this time period.) The economic expansion of the 1980s coincided with a marked decline in top marginal tax rates, leading some to conjecture a causal relationship between the cuts in top marginal rates and the economic expansion. However, taking the long view (circa 1960-88), a general decline in the top marginal rate occurred as average GDP growth rates tended to fall.

16. In the King and Fullerton study, based on 1980 data, West Germany exhibited the least degree of intersectoral distortion, trailed closely by the U.S. In the McKinsey study, the factors identified as important --the motivation of managers to show profits, for example--are extremely difficult to quantify across countries on a consistent basis. Furthermore, as Kevin Hassett pointed out to us, the productivity of the capital stock may not necessarily be an indicator of better organization. In the absence of perfect world capital markets, a country may exhibit a higher productivity of capital because capital is scarce (that is, the capital-labor ratio is low). In this case an increase in the capital stock might lower capital productivity but make the economy better off.

17. The investment effect is calculated using the first equation from Table 4 in Mendoza, Milesi-Ferretti, and Asea (1996), , assuming that marginal labor and capital taxes are both cut by 5 percentage points, while the output effect assumes a marginal product of capital equal to .10 (See Auerbach, Hassett, and Oliner, 1994.) Unfortunately, we have no estimates from cross-country equations on labor supply effects.

18. Empirical evidence from a cross-section of states suggests either that government spending yields no positive growth effects (Holtz-Eakin, 1994), or that only educational spending yields positive effects (Evans and Karras, 1994). Aschauer (1989) argues that the productivity effects are quite large.

19. The commonly-used Summers and Heston (1991) data include a grade, ranging from A to D, that summarizes the authors' estimate of the reliability of the data. Engen and Skinner (1992) weighted their estimates with a numerical scale of this reliability; results were similar although standard errors were smaller.

20. For a non-technical discussion, see "The Real Truth About the Economy: Are Government Statistics Just So Much Pulp Fiction?" (Business Week, November 7, 1994).

21. For example, Grier and Tullock (1989) find a negative correlation between output growth and the growth of government expenditures, although they do not interpret the correlation as reflecting reverse causation.

22. Ram's (1986) estimated positive correlation between the growth in government spending and output growth appears to be an example of this problem.

23. The analogy is to market prices for competitive goods; regressing price on quantity (or conversely) tells the researcher nothing about the nature of the supply curve or of the demand curve without further identifying variables.

24. This is the approach followed by Agell, Englund, and Soderstein (1996) in considering the Swedish tax reform of the early 1990s. The "bottom up" and "top down" terminology is due to Slemrod (1995).

25. Lindsey (1987), Navratil (1994), Auten and Carroll (1995), Feldstein (1995), and Slemrod (1996) find evidence of behavioral responses to tax reforms by documenting increases in reported taxable incomes following reductions in tax rates during the 1980s. However, it is difficult in these analyses of taxpayers' income to separate the effects of "real" responses--such as changes in labor supply--from the effects of compensation, timing, and reporting responses.

26. We focus here on uncompensated elasticities, because we are considering a tax cut. However, if government expenditures are highly substitutable with market consumption goods, or under Ricardian equivalence, one might prefer to use compensated elasticities, which are generally higher.

27. Strictly speaking, in the growth accounting framework in Equation (1) the percentage growth rate $\dot{m}_i$ will be unaffected by the higher level of human capital because human capital growth is defined in percentage terms. We instead consider an alternative renormalization in which the denominator is the pre-tax-cut level of human capital.

28. Of course, government tax policy could also be used to encourage saving through targeted saving programs such as IRAs or 401(k)s. While there is some debate about their effectiveness in increasing saving (see the Fall 1996 issue of the *Journal of Economic Perspectives*), the macroeconomic effects of the these programs are probably not large given their modest size relative to GDP.

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Figure 1

The Effect of Intersectoral Distortions on the Average Rate of Return

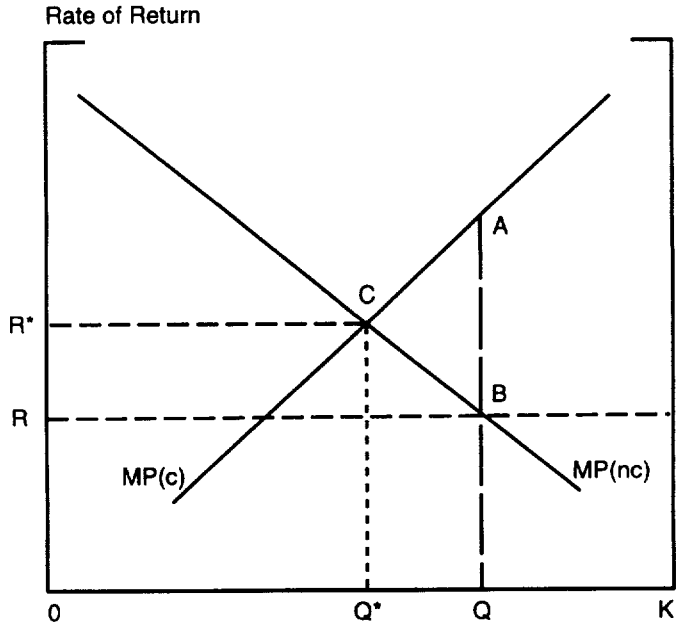
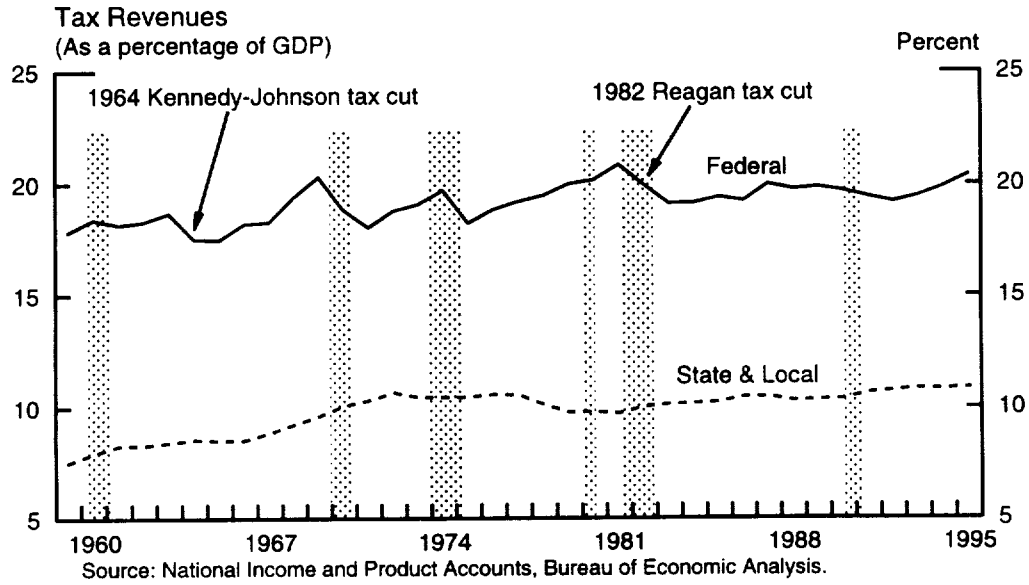


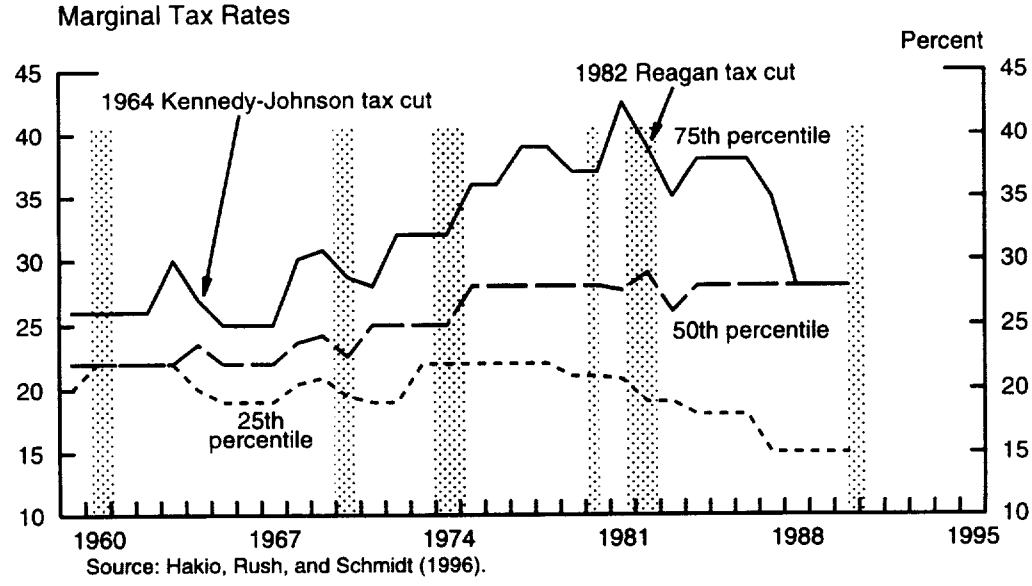
Figure 2

Average Tax Rates, Marginal Tax Rates and GDP Growth in the U.S.

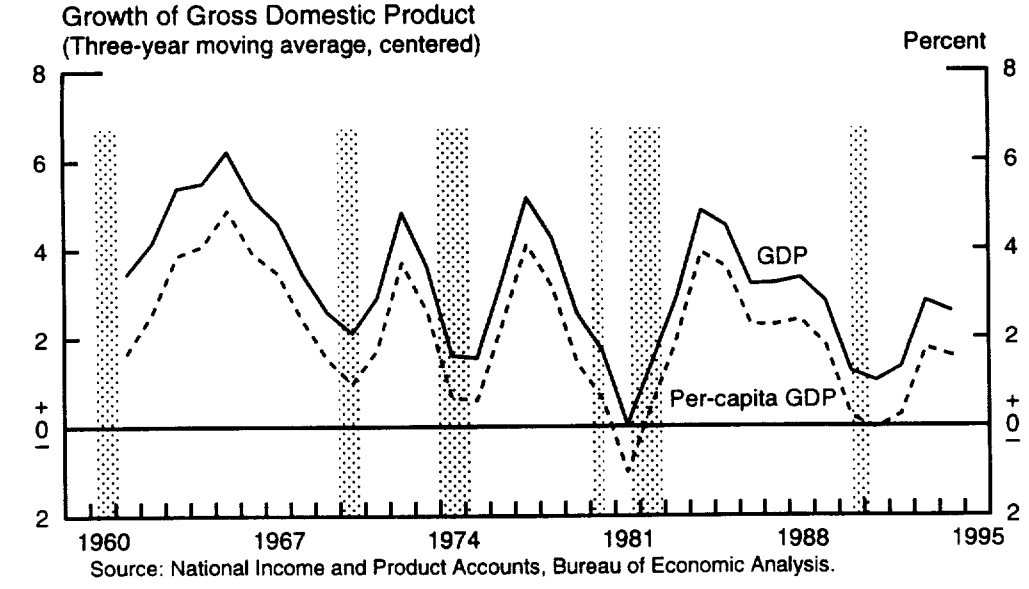
(1959-1995)



Source: National Income and Product Accounts, Bureau of Economic Analysis.



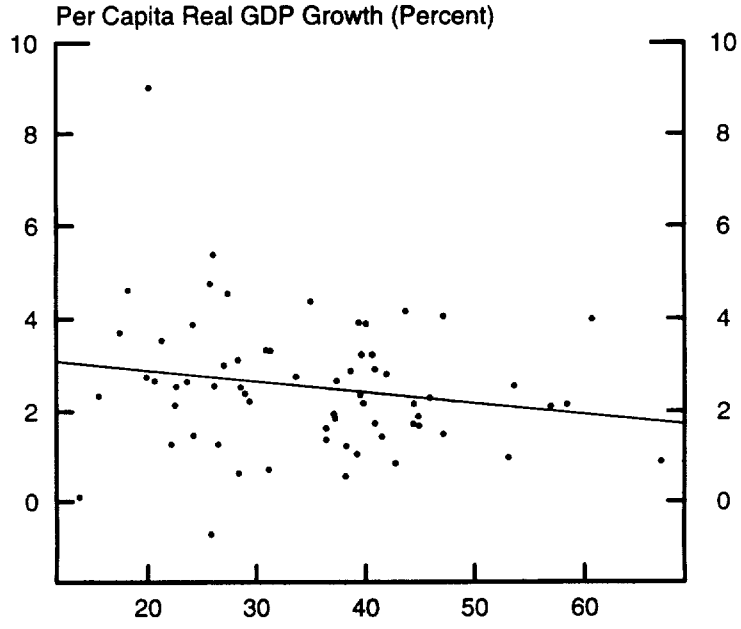
Source: Hakio, Rush, and Schmidt (1996).



Source: National Income and Product Accounts, Bureau of Economic Analysis.

Figure 3a

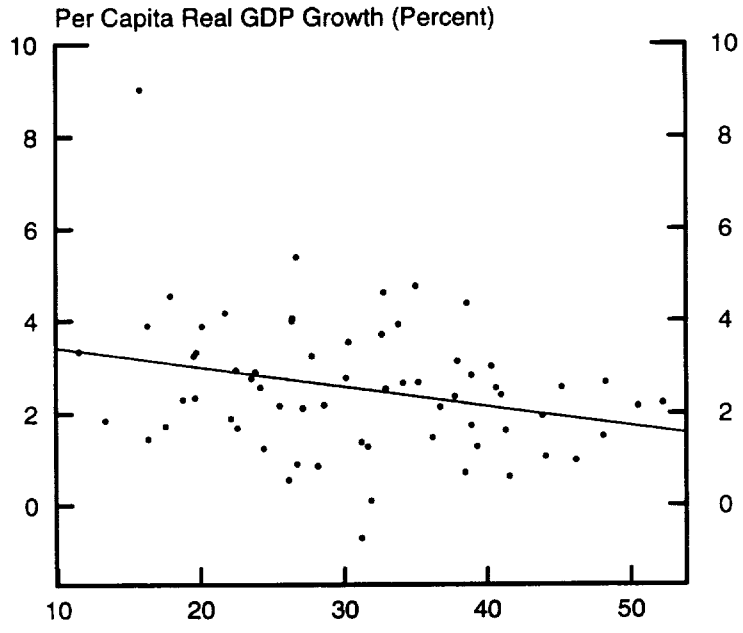
Growth and the Capital Income Tax, OECD Countries



Source: Mendoza, Milesi-Ferretti, Asea, 1995.

Figure 3b

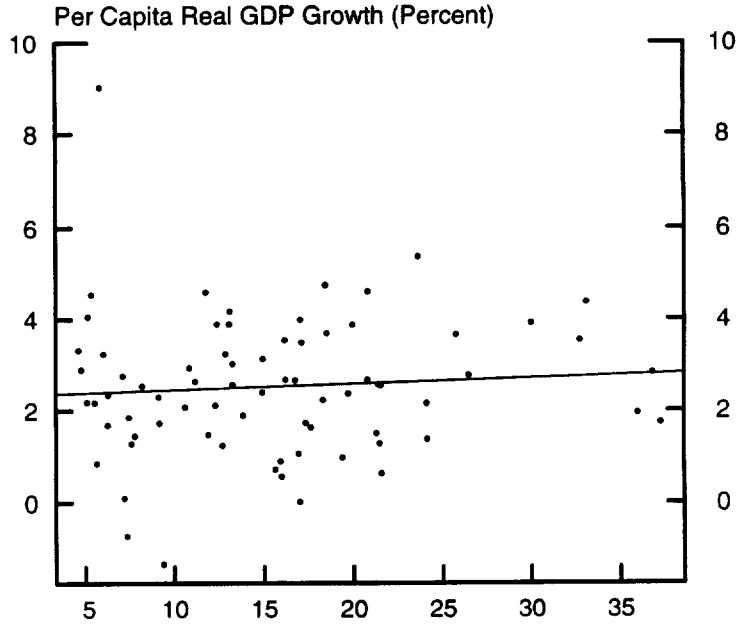
Growth and the Labor Income Tax, OECD Countries



Source: Mendoza, Milesi-Ferretti, Asea, 1995.

Figure 3c

Growth and the Consumption Tax, OECD Countries

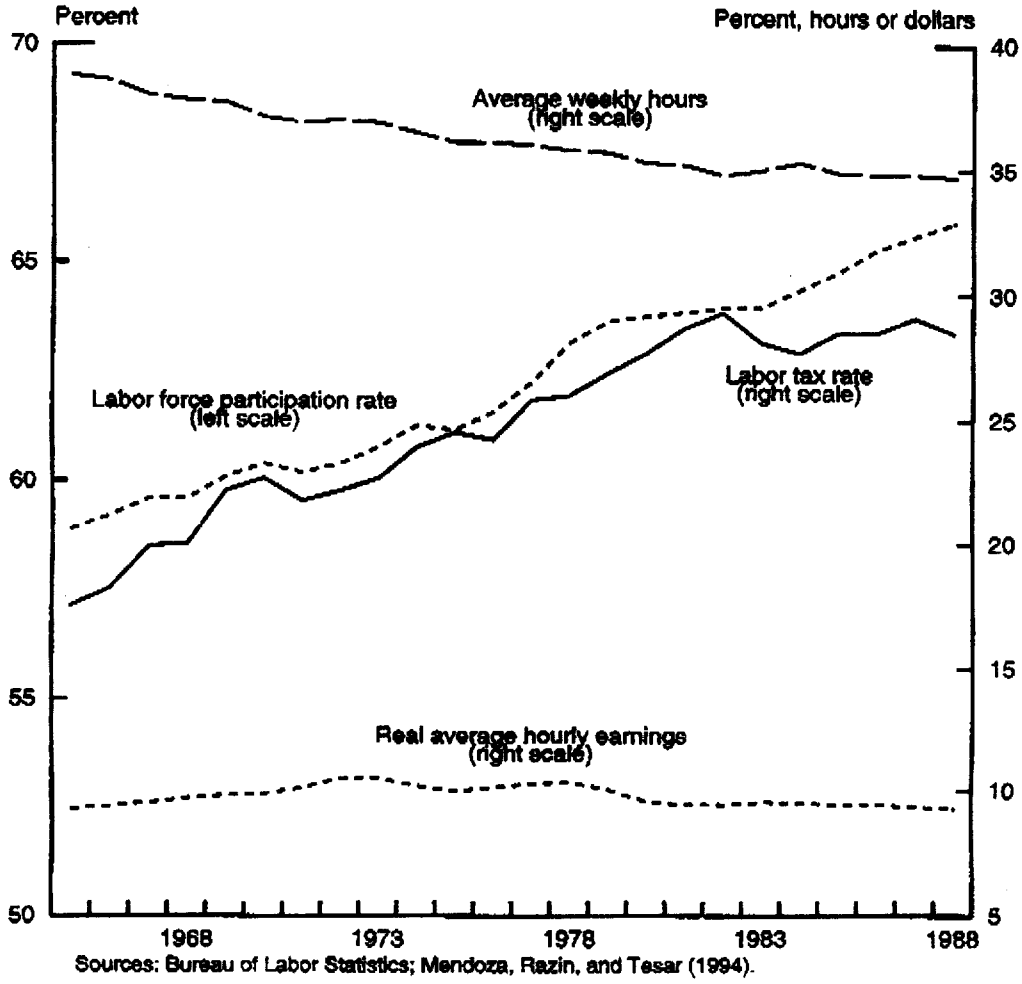


Source: Mendoza, Milesi-Ferretti, Asea, 1995.

Figure 4 (modified)

Labor, Investment and Factor Tax Rates

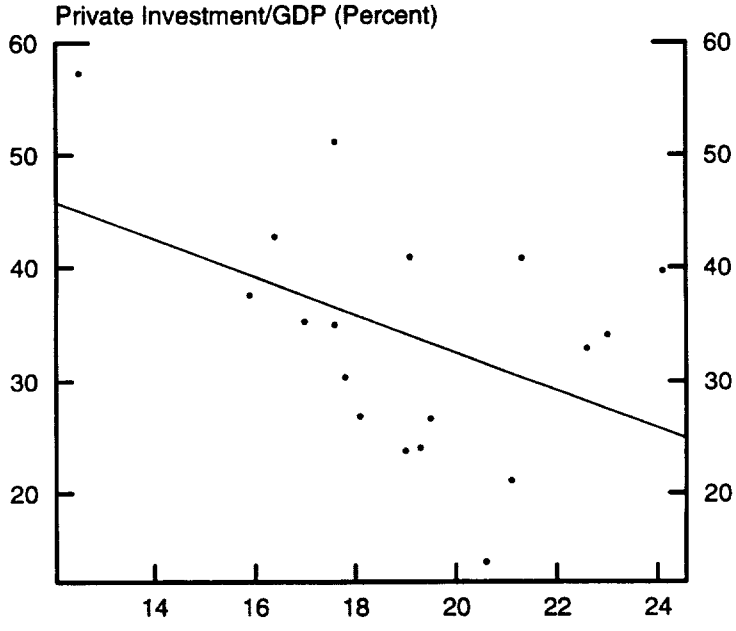
(1965-1988)



Sources: Bureau of Labor Statistics; Mendoza, Razin, and Tesar (1994).

Figure 5

Capital Income Taxation and Investment Rates, OECD Countries



Source: Mendoza, Milesi-Ferretti, Asea, 1995.