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A REVIEW OF CROSS-COUNTRY EVIDENCE ON GOVERNMENT FISCAL POLICY AND ECONOMIC GROWTH

By Shawn Ni

"It is hard to think of an influence on the private real rate of return and on the growth rate that is more direct than that of income taxes. If these do not affect the rate of growth, what does?"
— William Easterly and Sergio Rebelo (1993)

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I. INTRODUCTION

It is widely believed that fiscal policy plays an important role in determining economic growth, but the specific policies that would best foster growth are hotly debated. This study provides a review of the recent economic literature that examines the effect of government fiscal policy actions on economic growth. Because the effect of changes in tax and spending programs may take a long period of time to become evident, the findings of the studies reviewed here are based on data taken from across a large sample of countries. Despite the justifiable belief that fiscal policy does influence economic growth, interpreting the empirical evidence from aggregate cross-country data turns out to be less than straightforward. Even so, stepping back and considering the accumulated evidence reveals a robust conclusion from the data: Distortionary taxes on personal income or corporations have a strong negative effect on investment and, therefore, slow the rate of economic growth.

The fundamental theoretical and empirical issues encountered in these cross-country studies have important implications for state-level fiscal policy analysis. In many ways, states are like countries when it comes to analyzing their separate fiscal policies, so an analysis using country-based data will be similar to one using state-based data. For instance, evaluation of fiscal policy at the state level requires assessing the combined effects of spending and tax programs and dealing with many of the same methodological issues discussed later in this review. In addition, the empirical results from the cross-country studies — the

evidence that income taxes retard private investment and thus hamper economic growth — are particularly relevant for state-level fiscal policymaking.

This review begins with a discussion of the theoretical relationship between fiscal policy actions and economic growth. The theoretical effect of fiscal policy is straightforward: Any increase in an income tax reduces the after-tax returns to labor and capital, resulting in less income. If, however, the tax revenues are spent on appropriate government infrastructure, it is possible that, with high enough returns, the productivity gains will more than offset the adverse effects of the higher tax rates.

With this theoretical background established, in the following two sections we summarize and critically evaluate the voluminous empirical literature studying the effects of fiscal policy. One finding that crops up is that the simple cross-country correlation between real gross domestic product (GDP) growth and the ratio of government tax revenue to GDP provides no clear evidence that countries with lower income tax burdens, on average, grow faster than countries with higher income tax rates. This finding could support the notion that changes in tax rates have an ambiguous effect on aggregate income, but such an interpretation must be considered with caution.

Because the cross-country data are not obtained from controlled experiments, it is quite possible that such an outcome results from problems with several important issues. These include: (1) identifying the marginal effect of taxes on real GDP growth; (2) the fact that tax rates and real GDP growth are simultaneously determined; and, (3) measurement error.

Our review thus suggests that carefully designed reforms in corporate taxes and individual income taxes can foster investment and, thus, long-term growth of the economy.

For instance, measurement errors can occur because spending and tax policies are likely to be endogenous; i.e., they are dependent on other variables in the economy, such as the stage of a country's economic development. An observed change in government spending may be the result of a change in policy, a change in the economy, or some combination of those two factors. If taxes and government spending are indeed endogenous, and the researcher cannot identify a policy change from the aggregate data, estimates of the marginal impact of fiscal policy on income growth are therefore biased.

Because of the difficulties inherent in evaluating the effects of fiscal policy on aggregate output, the present study focuses on the effect of taxes on disaggregated data. In particular, we present ample evidence that distortionary taxes and government consumption reduce private investment. Because the growth rate of real GDP is positively correlated with the portion of GDP devoted to investment, increasing distortionary taxes and government consumption indirectly retards economic growth. Our review thus suggests that carefully designed reforms in corporate taxes and individual income taxes can foster investment and, thus, long-term growth of the economy.

II. THEORETICAL ANALYSIS

A Conceptual Background

A comprehensive analysis of fiscal policy must account for the nature and effects of both taxes and spending.

One important lesson to be drawn from analyzing the theoretical model developed below is that fiscal policy captures both the revenue side and the spending side of government actions. These two cannot be separated, because there is a government budget constraint. In addition, the output effect of fiscal policy depends on the types of taxes used and on the types of spending chosen.

Economic theory indicates that real GDP can either rise or fall in response to a change in fiscal policy. An increase in the income tax rate, for example, holding everything else constant, reduces the after-tax return to labor and capital. With the decline in after-tax returns, the supply of each will fall, resulting in less output. However, because fiscal policy is inherently endogenous, not everything else will be constant. If a tax rate increase translates into greater transfer payments (such as through Social Security, government pensions, etc.), there are no productivity gains. This is because, by definition, transfer payments are not made for current production, but for other reasons. Consequently, increasing tax rates to finance higher transfer payments will result in lower real GDP.

In contrast, the government could increase spending on a good or service, such as necessary infrastructure. In such an instance, the government's investment could raise the productivity of the private sector. Accordingly, if the productivity gains are large enough, the government's tax-financed infrastructure spending can raise real GDP. The bottom line is that the effect of fiscal policy depends on whether distortionary taxes on income are used to finance increases in transfer payments or to improve the economy's infrastructure in productive ways.

Economic theory also differentiates between short-run and long-run effects. In other words, if productivity growth is determined independent of fiscal policy, tax rate changes have only short-run effects, altering the level of real GDP. In contrast, some economic models we review demonstrate that fiscal policy has long-run effects because productivity growth is affected by the tax rate. For instance, Ireland (1994) showed that certain income tax cuts can stimulate enough economic growth to be self-financed in terms of long-run government revenue.

The Basic Framework

We now lay out three fundamental relationships relevant to analyzing the effect of government fiscal policy actions on economic growth. First, we specify an aggregate production function which depicts how factor inputs determine real GDP. This relationship is written as:

$$Y=F(A,K,N,K_G)$$

where Y is real GDP, K is the private capital stock, N is the labor input, A is an indicator of technology that captures total factor productivity (or TFP), and K_G is public capital. The central theoretical and empirical question is how fiscal policy affects the allocation of the factor inputs.

Second, the resource constraint for a closed economy highlights the trade-off for the economy. This can be captured by a familiar relation:

$$Y=C+I+G$$

where C is private consumption, I is investment, G is government purchases

The bottom line is that the effect of fiscal policy depends on whether distortionary taxes on income are used to finance increases in transfer payments or to improve the economy's infrastructure in productive ways.

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(which equals government consumption plus investment G^* in public capital K_G). This constraint can be interpreted as the composition of real GDP, or the outlay of output.

Third, the government budget constraint requires balancing spending and revenue in the long run. Government spending combines government purchases *(G)*, interest payments, and transfer payments. On the other side of the ledger, government revenue comes mainly from taxes.

Because the present study focuses on government fiscal policy and long-run economic growth, we will not extensively review studies dealing with the effect of government deficit financing of temporary budget shortfalls. Our review of the relevant literature focuses on the effects of an increase in taxes that is used to finance an increase in government purchases. The government budget constraint dictates that if one component of government spending changes, there must be a corresponding change in revenue, the deficit, or another type of total spending.

To put this into operation, let fiscal policy be defined as the choice of government purchases G (including government investment G^*), government transfer payments, and combinations of taxes, subject to budget constraints in a dynamic setting. There are many possible combinations of the aforementioned policy choices, so the net effect of a combination of simultaneous choices is, in general, ambiguous. For example, suppose productive public investment is financed by a distortionary tax. This investment raises productivity through increases in public capital (K_G) in the production function,

but the increased tax rate may reduce the factor inputs K and N. The net effect on output is ambiguous. Many empirical papers are written using cross-country regressions on output growth for variations in fiscal policy, but the evidence is mixed and it is difficult to reach a definitive conclusion. A much more robust result is that distortionary taxes earmarked for distributional purposes adversely affect investment. If an increase in taxes reduces investment, and this in turn slows the increase in capital stock, such tax schemes adversely affect economic growth.

Fiscal policy consists of the government's choice of tax structure, types of spending, and debt volume. In the following subsections, we analyze the effects that changes in tax rates have on economic activity when increased revenues are used to finance either government consumption or government capital.

Fiscal Policy Effects in a Model With Endogenous Labor Supply and Saving

The following discussion illustrates how taxes and government consumption both influence output. In a general equilibrium setting, the allocation of resources — capital, labor, and technology — and of goods are determined by market-clearing processes. (The detailed model is presented in the Appendix.) For our purposes, this model is used to illustrate, in a theoretical context, how fiscal policy affects output in three different scenarios. Each scenario presents a different approach to the government's financing of its deficit.

In our model, technology (existing knowledge) combines labor, private capital, and government capital to produce goods. This can be expressed as the following production function:

$$Y=K^{\alpha} (AN)^{1-\alpha} K_G^{\theta}$$

Holding labor *(N)* and public capital *(K_G)* constant, the production function tells us that a 1-percent increase in private capital *K* raises output *Y* by α percent, where α is less than one (α being the capital share or output elasticity of private capital). Technological progress — or, more generally, the growth of knowledge — is represented by the growth rate of *A* in the production function. This factor is assumed to be exogenous, meaning that it is not affected by the economic variables of output, capital, or labor. If we further assume that knowledge grows at the same rate as the growth of public capital, the economy's growth rate is the outcome of people's decisions. That being the case, public capital investment influences real GDP growth in the long run.

Using this model, how might different means of financing government activity affect long-term economic growth? First, suppose there is an increase in *G* (and *K_G*), financed by lump-sum taxes. Even though the quantity of labor employed increases, the overall effect is to increase the capital-labor ratio *k*. In effect, this increase in private capital and public capital enhances labor productivity, which in turn induces greater employment. Total output ($Y=k^{\alpha}NK_G^{\theta}$) increases because all three resource factors increase. Consider an increase in lump-sum taxes applied toward increased purchases of *G* (and *K_G*); the model predicts that economic growth will increase.

On the other hand, if there is an increase in income tax rate τ with *G* fixed, the outcome is to reduce the capital-labor ratio *k* and decrease the labor supply. Consequently, the output per capita decreases. Next, suppose there is an increase in *G* financed by an increase in the income tax rate. With $\tau Y=G$, choosing the tax rate determines government purchases and *vice versa*. Under these conditions, the capital-labor ratio — and, consequently, real GDP — increases along with increases in the income tax rate (τ) *if* θ is greater than one half. The same result occurs if θ is less than one half but tax rate τ is sufficiently small. Under any other condition, however, output decreases with an increase in the income tax rate.

As this last case illustrates, output can either increase or decrease in response to an increase in government capital, when financed by an increase in the income tax rate. The output effects are unambiguous, however, when considering tax-financed purchases of government consumption; raising income taxes for redistributive purposes always results in lower employment, less capital accumulation, and lower output. In contrast, in cases where the government finances additional productive capital purchases by collecting greater lump-sum taxes, output will increase if the return to government capital is high enough.[1]

The effects of fiscal policy under various scenarios of tax and spending combinations are summarized in Table 1. Note that in this model economy, any effect on output happens on the long-run level. This means that during the transition to the new, long-run level, there

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Table 1 — Fiscal Policy Effects on Short-Run Output Growth

TAX	GOVERNMENT CONSUMPTION	PUBLIC INVESTMENT
Lump-sum tax	Positive effect on growth	Positive effect on growth
Income tax	Negative effect on growth	Indeterminate effect on growth

is an impact on economic growth. For the purposes of this paper, I refer to this as the effect on short-run growth.

An Endogenous Growth Model

The theoretical analysis is based on the assumption of exogenous economic growth. If growth is endogenous, however, the detrimental effect of income taxes is amplified. Ireland (1994) demonstrated such an effect using an endogenous growth model in the spirit of the framework laid out in the previous section. By setting $\alpha=1$ (which assumes that a return to capital will be constant, rather than subject to diminishing returns), output's long-run growth rate becomes dependent on capital accumulation and fiscal policy. In this model, the government's tax revenue may not always be increasing or decreasing in the income tax rate. This gives rise to the possibility of a bell-shaped relationship between tax revenue and tax rates — the so-called Laffer curve.

Ireland showed that there is indeed a Laffer curve relation in the endogenous growth model (even with $\theta=0$). Specifically, his simulations showed that under a reasonable set of parameters, lowering the tax rate from 35 percent to 15 percent (through a deficit-financed tax cut), and without violating the government budget constraint in the long run, the growth rate of real GDP increases by as much as 3.25 percent.

The foregoing theoretical discussion suggests that changes in government spending and tax rates have a qualified effect on actual output, depending on what the government does with proceeds from a tax rate increase.[2] Specifically, the output effect of government purchases depends on whether those purchases raise the total factor productivity (TFP) and how they are financed. As for changes in taxes, all else being the same, a higher tax rate theoretically reduces the returns to factors of production, thus reducing output. When a higher tax rate is combined with an increase in government spending, the negative impact on output can only be reversed if the government buys items that increase productivity. This is the caveat that some government spending, if devoted to productive forms of infrastructure or basic research and development, could have a positive effect on an economy's output.

The upshot of the analysis is that the two main factors determining the longer-run effect of government activity are whether distortionary taxes are used for finance of government purchases or for redistributive purposes, and whether economic growth is endogenous. In traditional growth models the long-run growth rate is assumed to be exogenous (i.e., independent of government policy). By contrast, in endogenous growth models the long-run growth rate depends on investment. Consequently, in endogenous growth models distortionary

taxes that discourage investment also reduce long-run growth. Next, we review the empirical evidence to see how well theory and reality match.

III. CROSS-COUNTRY EVIDENCE OF AGGREGATE DATA

The empirical studies reviewed in this section fall into two categories. The first category looks at the evidence from reduced-form, cross-country growth regressions. Specifically, they test for a statistical relationship between real GDP growth of countries and variations in fiscal policies, measured by variables such as the ratio of government tax revenue to GDP. These reduced-form regressions often are not grounded in behavioral models like the ones discussed earlier. Rather, these regression results test for qualitative relationships, focusing on finding empirical regularities in the data, such as whether countries with low tax rates, on average, grow faster than countries with high tax rates.

The second category of studies reviewed present empirical estimates of the kind of production functions discussed earlier. This literature focuses on assessing the productivity of public capital. It is important to note that, as with all such empirical work, regressions from both types of studies are influenced by model specification, measurement errors in tax rates, and potential endogeneity of explanatory variables. In our summary of the findings, we will highlight, when appropriate, these potential problems.

Cross-Country Regressions of GDP Growth and Government Consumption

We begin our review by focusing on the analyses using a reduced-form regression approach in which government consumption is measured along with tax rates. In this subsection, fiscal policy is measured by government consumption spending.

An early and representative analysis of this sort is found in Kormendi and Meguire (1985). Using a sample of 46 countries with data from 1950 to 1977, they regressed the average annual growth rate of real GDP on the ratio of government consumption to GDP, along with other control variables, such as initial per-capita GDP level and population growth over the sample period. Their cross-sectional approach indicated that the ratio of government consumption to GDP has a statistically insignificant effect on GDP growth. Grier and Tullock (1989) extended the Kormendi and Meguire study by estimating a more sophisticated regression — one that uses observations across countries and across time. Their pooled regression used a similar set of control variables, but Grier and Tullock used five-year averages of GDP growth rates. They implicitly assumed that the parameters in the model held for both temporal as well as cross-country variations of GDP growth rate. Based on this estimation technique, Grier and Tullock found that the ratio of government consumption to GDP had a negative and statistically significant effect on GDP growth. The evidence from these two studies indicates that higher government consumption spending relative to GDP,

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on average, has no positive effect on real GDP growth. At worst, such an increase in this ratio may lead to slower growth compared with countries having lower ratios of government consumption to GDP.[3]

Production Function–Based Regressions on Productivity of Public Capital

A production function approach serves as an alternative method for estimating the role of government spending. It is possible to write the percentage change in real GDP as determined by the percentage change in private capital, the percentage change in employment, and the percentage change in government capital.[4]

The parameter θ represents the output elasticity of public capital. It is interpreted as follows: A 1-percent increase in public capital raises GDP by θ percent, holding private capital and labor constant. Rati Ram (1986) used government consumption to replace public capital in the equation on page 5, and the ratio of private investment to GDP replacing the growth rate of private capital. He obtained an estimate for θ of about 1.0 from cross-country data, using the modified version of the equation. His time-series regression of individual countries found θ to be positive for most countries.

Aschauer (1989) conducted a time-series regression of the production function for U.S. data. His estimate for θ is about 0.5 for nonmilitary public capital, larger than the labor share in the production function β. Aschauer's estimates imply that public capital is an

important determinant of the productivity of private sectors. Based on this evidence, Aschauer attributed the decline in the U.S. TFP between 1970 and 1985 to a decline in public infrastructure investment.

The significant and positive coefficient θ found in these production function–based regressions must be interpreted cautiously, however. Both Ram and Aschauer interpreted this finding as evidence of the extremely important role of public capital in production. However, it is misleading to claim that high public capital generates faster growth. This is because the parameter θ measures the contribution of public capital *given the ratio of private investment to GDP* (or growth rate of private capital stock). The problem arises because public capital is not independent of private investment. In a world with distortionary taxes, raising public investment by one unit would likely lead to a reduction in private investment by more than one unit. The real net effect of an increase in public capital becomes less obvious, then.

The theoretical models discussed earlier show that raising public capital can either increase or decrease GDP. The outcome depends on whether the government uses the proceeds to purchase productive forms of public capital, and whether the return to that public capital is great enough to offset the deleterious effects of the lower after-tax returns to factors of production. Accordingly, cross-country regressions that fail to account for the differences in fiscal policy (in addition to public capital) can result in misleading conclusions. In more technical terms, the regressions are misspecified because they include only

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one type of government spending. Such misspecification means that the estimated statistical relationship is sensitive to the omitted government spending measure.

To help correct for this problem, panel data sets are used to add greater variation. Holtz-Eakin (1994) estimated a modified version of the production function approach, this time using state-level output (Y_{st}). He added a separate time trend, and used a state-specific dummy variable in order to account for effects that are special to that particular state in the regression.[5] What Holtz-Eakin found is that the effect of public capital on output is insignificant. Once the unobserved state-specific factors are controlled, government capital does not appear to improve productivity in the private sector. Furthermore, Holtz-Eakin rejected the notion that the unobserved state-specific effect is randomly distributed across states. This evidence suggests that the unobserved difference in cross-state factor productivity is positively correlated with each state's public capital stock. If a state is relatively more productive for unspecified reasons, it also would have a relatively high level of public capital stock. If one controls for the unobserved fixed effect of the state, the results show that when states increase their public capital, they do not, on average, realize greater output.

Unobserved heterogeneity can also affect the estimates of reduced-form models. The panel data estimation by Fölster and Henrekson (2001) used data from Organization for Economic Cooperation and Development (OECD) countries. Based on this sample of countries, they found that average tax rates and the ratio of government expenditure to GDP were negatively correlated with GDP growth. Countries that have higher average income tax rates, therefore, tend to realize slower output growth than countries with lower average income tax rates. In addition, countries with higher ratios of government spending to output tend to grow slower than countries with lower ratios.

For the sake of completeness, several studies provide indirect evidence regarding the productivity of public investment in different countries. Keefer and Knack (2007) found that public investment (relative to GDP or total investment) is dramatically higher in countries with low-quality governance, such as limited political checks and balances, or no competitive elections. This may be because government officials use public investment to serve their own interests, as public choice theory would suggest is often the case, or because weak yet enlightened governments use public investment to substitute for private investment. Both explanations imply that public capital is less productive in countries with weak governance.

In this vein, the analysis in Mauro (1998) found that governments in countries with high levels of corruption tend to spend less on education but more on public capital. His explanation was that it is easier for government officials to extract rents from public capital than from education spending. Mauro and other studies relating the composition of government spending to "quality of governance" suggest that although public capital may be productive if allocated by an effective government, in practice its productivity is severely hampered by self-serving government officials.

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A More Detailed Breakdown of Fiscal Policy

Arguably, the returns to public capital depend on the type of public capital purchased by governments. Fiscal policy is multidimensional; in other words, different types of spending have potentially different impacts. As such, researchers are likely to produce misleading statistical results if their analysis is limited to government consumption or public capital, and if they try to glean quantitative measures of the relationships between them. Barro (1991) estimated a cross-country regression of GDP growth on a large number of macro-variables, including both public investment and government consumption relative to GDP. He found that the share of government consumption is negatively correlated with GDP growth, but that the share of public investment has an insignificant correlation with growth. Munnell (1992) and Glomm and Ravikumar (1997) comprehensively surveyed empirical estimates of public infrastructure's output elasticity. When public capital is narrowly defined as highway and roads, estimates of the output elasticity θ based on state-level data and cross-country data range from 0.05 to 0.2.[6]

Some authors have reached firm conclusions after limiting the scope of their models and data, but there is evidence that the statistical relationships they have found are not robust. For example, after analyzing many competing models, Levine and Renelt (1992) reported that the estimated effects on output of all aggregate measures of fiscal policy variables (including government consumption, government spending, and government deficits) are quite fragile in cross-country growth regressions. In other words, the results should be considered as "conditional" on the set of explanatory variables, sample used, etc. This means that there is likely to be no consistent, reliable relationship between fiscal policy measures and a country's growth rate.

Easterly and Rebelo (1993) attempted to explain why the statistical relationships between economic growth and fiscal policy are fragile. Their approach is to investigate how public investment and marginal tax rates are correlated with output growth. Their cross-sectional regression based on data from 28 OECD countries shows that comparable increases in per-capita public investment in different sectors are not equally important in affecting output growth. For instance, investment in transport and communication is positively correlated with growth. However, the link between most fiscal policy variables and growth is not robust. They also find evidence that fiscal policy is not exogenous; rather, it is jointly determined with economic growth.[7]

Evidence from Cross-Country Regressions: Testing for Endogeneity

The idea that government expenditures and tax rates are simultaneously determined is so ingrained that this idea has coined a law of economics: Wagner's Law, which says that government consumption and transfer payments take up an increasing share of GDP as a country develops, and income taxes also increase.[8]

Several authors have offered theories and empirical evidence to test for the

Table 2 — A Summary of Cross-Country GDP Growth and Government Fiscal Policy

STUDY	DATA AND TYPE OF REGRESSION	CONTROL VARIABLES	THE EFFECT OF POLICY VARIABLE ON GDP GROWTH
Kormendi and Meguire (1985)	46 countries from 1950 to 1977; cross-sectional regression	Initial level GDP; population growth; standard deviation of real GDP growth; inflation; standard deviation of inflation rate; growth of export / GDP	Growth of government consumption / GDP: insignificant
Ram (1986)	115 countries from 1960 to 1980; cross-sectional and time-series regressions	Private investment / GDP; growth of labor force	Public capital growth: significantly positive
Crier and Tullock (1989)	Five-year average data, for 24 OECD countries from 1951 to 1980, and 89 other countries from 1966 to 1980; pooled regression	Initial level GDP; mean population growth; standard deviation of real GDP growth; mean inflation rate; standard deviation of inflation rate	Growth of government consumption / GDP: negative
Aschauer (1989)	U.S. aggregate data from 1949 to 1985, output/private capital; time-series regression	Labor / private capital; public capital / private capital	Public capital significantly raises productivity of private sector
Barro (1991)	About 100 countries from 1960 to 1988; cross-sectional regression	Initial per-capita GDP; investment / GDP; proxies for human capital; population growth; time; regional and social dummy variables	Government consumption / GDP: negative; public investment / GDP: insignificant
Easterly and Rebelo (1993)	About 100 countries from 1970 to 1988; cross-sectional regression	Log initial per-capita GDP; human capital proxies; political instability proxies; marginal tax rates	The correlation between most fiscal policy variables and output growth is not robust
Engen and Skinner (1992)	107 countries; cross-sectional regression	Similar to Barro (1991)	Change in government expenditure / GDP: negative
Holtz-Eakin (1994)	U.S. state-level from 1969 to 1986; panel data regression	Private capital; labor; time dummy variable; state fixed effect or random effects	Public capital does not contribute to productivity of private sector
Folster and Henrekson (2001)	OECD countries from 1970 to 1995, five-year average; panel data regression	Initial per capita GDP; investment / GDP; proxies for growth in human capital; population growth; country fixed-effect	Tax revenue / GDP: negative; government expenditure / GDP: negative

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endogeneity of fiscal policy. One argument points to the pressure for redistribution and the rise of transfer payments in industrialized economies. Peltzman (1980) reports empirical evidence consistent with the idea that modernization produces a more educated middle class, and that more power for the middle class generates more pressure for redistributive taxes.

Alesina and Rodrik (1994) developed a model economy in which income inequality leads to high redistributive taxation, which in turn slows economic growth.

Becker and Mulligan (2003) suggested an alternative explanation for correlations among income, taxes, and government spending. They argued that tax collection in industrialized countries is more efficient,

Countries with high marginal tax rates have lower private investment than countries with low marginal tax rates. Furthermore, countries with high government consumption spending have lower private investment than countries with low government consumption.

so the social cost of government spending is lower than in developing countries. This creates a positive cross-country correlation between income and the size of government. Slemrod (1995) reviewed the theory and empirical evidence regarding the cross-country correlation between income level and the size of government. His survey led him to conclude that it is difficult to measure the degree to which government involvement is the result of a policy choice or which forms of government action reflect efforts by market participants to avoid taxation. For example, the ratio of tax revenue to GDP is a better proxy for tax rates in developed economies, because the compliance rate in rich countries is higher than in poor countries.

As noted in the introduction, fiscal policy concerns government spending, revenue, and deficit financing. An important question about fiscal policy is whether tax cuts financed by government debt affect private savings and capital accumulation. Regarding the long-run effect of government policy, Diamond (1965) presented a model economy in which an increase in government debt reduces the steady-state ratio of capital to labor, and raises interest rates. Barro (1974) extended Diamond's model, adding a bequest motive that links generations. Barro presented the Ricardian equivalence theory, stating that with this intergenerational link, changes in government debt have no effect on capital accumulation.[9]

Table 2 summarizes the various cross-country regressions on GDP growth and the size of government found in the wide range of empirical studies considered in the present paper.

IV. FISCAL POLICY AND INVESTMENT: CROSS-COUNTRY EVIDENCE

This section sharpens the focus to consider the relationship between fiscal policy measures and capital accumulation. In contrast to the somewhat tenuous empirical relationship between fiscal policy variables and GDP growth uncovered in this review of economic literature, empirical results based on cross-country data yield a robust inverse relationship between fiscal policy and private investment. More specifically, countries with high marginal tax rates have lower private investment than countries with low marginal tax rates. Furthermore, countries with high government consumption spending have lower private investment than countries with low government consumption. What this suggests is that, given the production function used earlier, government taxation and spending can reduce private investment, which leads indirectly to decreased output.

The Link Between Private Investment and Output

Before reviewing the literature on taxes and investment in the private sector, it is useful to set the stage by discussing the empirical relation between investment in capital goods and economic growth. DeLong and Summers (1991) concluded that investment in equipment leads to growth. They argued that because of the spillover effect — a term that describes how market activity also affects people outside of any given investment or

transaction — the social rate of return on equipment investment is 30 percent per year or higher. Their analysis suggested that creating tax incentives in order to induce more investment in capital goods can bring high positive externalities to the economy. The causal relationship between equipment investment and real GDP growth is not universally agreed upon, but the correlation between the two is well established.[10]

A more recent test of the relationship between equipment investment and output is provided by a 2002 study of the Congressional Budget Office (CBO), which reported that annual TFP growth from 1996 to 2001 of the non-farm business sector was about 0.3 percent higher than the growth from 1982 to 1995. The CBO attributed this acceleration in TFP growth entirely to the rapidly increasing quality and capacity of computer hardware. Although the contribution of the IT industry to improving economy-wide TFP is widely accepted (albeit more difficult to estimate), equipment production by itself creates new knowledge and raises TFP growth.

Having established this foundation, the following sections focus on macro and micro evidence across countries for how government fiscal policy influences investment.

The Adverse Impact on Investment of Distortionary Taxes

A voluminous empirical literature has established that countries with high distortionary taxes tend to have low investment and low output growth.

Easterly (1993) noted that in developing countries, differential taxes and tariffs commonly result in substantial distortions in the prices of capital goods. He showed that the variance in the relative prices of investment goods is negatively correlated with output growth in cross-country data. Using cross-country growth regression analysis, Jones (1994) found that machinery prices (relative to consumption goods) have a strong negative correlation with GDP growth, whereas the price of non-machinery capital has no significant correlation with growth.

Jones' empirical finding is based on the fact that the price of machinery (relative to consumption goods) is heavily influenced by effective tax rates. To illustrate the importance of distortionary taxes, Jones argued that, using conservative estimates of relevant parameters, eliminating taxes on machinery investment in India would have raised the country's growth rate by half a percent. This increased growth rate would represent about one third of the nation's actual growth from 1960 to 1980. Jones also contended that an investment tax credit in the United States would have raised U.S. GDP growth from 1960 to 1985. In a related study, Lee and Gordon (2005) estimated cross-sectional and panel-data GDP growth regressions on tax rates in 70 countries. They found that corporate taxes reduce output growth in both cross-sectional and fixed-effect panel data regressions. Specifically, their coefficient estimates suggested that, considering the sample countries as a whole, a 10-percent cut in the corporate tax rate increases real GDP growth by 1 percent to 2 percent.

A voluminous empirical literature has established that countries with high distortionary taxes tend to have low investment and low output growth.

Alesina, Ardagna, Perotti, and Schiantarelli (2002) looked at the effects on economic growth of increased expansion in the public sector. They found that such an expansion impedes economic growth through multiple channels. Leaving aside the obvious effects of distortionary taxes, they found that employment in the public sector crowds out employment in the private sector. This lowers the profits of private firms and reduces their investment demand. Alesina, et al., showed that in OECD countries, public spending is negatively correlated with investment in the private sector. From their pooled regressions, using the data of 18 countries, they concluded that government spending lowers business profit — which, in turn, reduces investment and, therefore, negatively impacts economic growth.

Instead of focusing on aggregate investment, Cummins, Hassett, and Hubbard (1996) investigated the effect of tax reforms on firms' investments. Using firm-level panel data in 14 OECD countries, cross-firm variations in the panel data allowed the authors to obtain a more precise estimate of the effect of tax reforms than possible using the more common aggregate time series data. Using a the neoclassical Q theory of investment, they found that corporate income taxes reduce net returns on capital and the firm's optimal investment. In 12 out of the 14 countries their sample comprised, tax cuts resulted in significantly greater corporate investment.

Both theoretical and empirical analysis indicates that distortionary taxes significantly and negatively affect private investment at the aggregate and firm level. The studies cited above capture distortions of the tax system using average or statutory corporate tax rates. Other studies show that taxes can influence investment decisions in much more subtle and profound ways than can be inferred by merely considering the putative impact of taxes, especially in developing economies. Not all corporate taxes influence investment equally, and the impact of particular taxes depends on the economic environment of the country. For example, Hsieh and Parker (2007) argued that taxing retained earnings is more harmful than taxing the dividends or capital gains of a financially constrained firm. In a developing country, where many firms have little or no access to external financing and must therefore rely on internal funds for investment, cutting taxes on retained earnings spurs aggregate investment. They present evidence that Chile's reform of cutting corporate taxes on retained earnings in the mid-1980s produced an investment boom. They report that investment spending increased by 10 percent and was entirely funded by the increase in retained earnings. Further, this investment boom played a central role in generating GDP growth that averaged 6 percent per year between 1985 and 2005.

To further illustrate the complexity of the impact of taxes on investment, Michael Devereux and Rachel Griffin (1998) examine the locational effects of tax structures made by U.S. multinationals. A multinational may choose to supply the European market, for instance, either by exporting to that market or by locating its plant there. Taxes on its profits are one consideration in the decision of where to locate. The

evidence indicates that when a firm has plants located in different countries, it is the average corporate tax rate over all locations, rather than the statutory tax rate in each location, that plays a critical role in determining plant location. Devereux and Griffin's empirical analysis of firm-level data supports the theory.

There also is evidence that corporate tax has a profound impact on a firm's finances. Hines and Rice (1994) showed that U.S. multinationals' factor employment responds to local tax rates. For their sample period (basically, the late 1980s), the corporate tax rate was about 34 percent; the effective tax rate for a multinational firm depends on the difference between the U.S. tax rate and foreign tax rate. They estimated that more than 20 percent of U.S. foreign direct investments, and about one third of the foreign profits of U.S. firms, belong to the tax haven affiliates of U.S. corporations. The empirical estimates by Hines and Rice are consistent with the conclusion that multinational firms shift reported profits across countries to maximize after-tax profits.

In a world of increasing globalization, flow of capital may become increasingly responsive to taxes on corporate profits. The results of these studies suggest that tax policy influences investment in ways that economic theory would suggest are consistent with taxpayer incentives. These results also provide a note of caution for policymakers (and their advisors) who might believe that the distortions created by tax systems are easily summarized by a few simple statistics and linear regressions.

Based on the evidence, the policy challenge is twofold: First, policymakers could use the results of these studies as a rationale to seek tax policies that would mitigate the deleterious effects of taxes on economic growth. Second, because the effects of taxation differ across types of taxes, the government must further attempt to identify taxes that generate very little revenue. The tax holy grail would include those taxes that have small adverse effects but that generate a great deal of revenue.

How Corporate Taxes and Income Taxes Affect Investment and Entrepreneurship

The U.S. economy is no exception to the cross-country correlation between investment and output growth. From 2001 to 2005, the growth of labor productivity and TFP slowed substantially. According to the U.S. National Income and Product Accounts, reported by the Bureau of Economic Analysis (BEA), the investment share of GDP — especially investment in equipment and software — declined sharply during this period. The small increase in equipment investment that has occurred since 2005 barely makes up for the replacement of obsolete machinery, and does little to raise capital stock.

One obvious policy variable that plays an important role in determining investment is corporate taxes. An international comparison of corporate taxes by the CBO (2005) showed that although the United States has one of the highest statutory corporate rates, the government collects relatively low revenue from OECD countries. One reason may be high tax avoidance, made possible by the high elasticity of investment with respect

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A progressive individual income system discourages entrepreneurs from creating small businesses, which also discourages the investment demand and job creation that such new businesses may bring.

to taxes. Another reason is that the United States offers generous depreciation allowance schedules. The U.S. corporate tax system renders the user cost of new equipment relatively low in comparison to the user cost of the equipment a few years after the investment. The system appears structured to favor new investment in equipment over long-term use of capital. In other words, the U.S. system is more likely to encourage innovation than to increase the number of manufacturing jobs. But the recent experience of low equipment investment in the United States suggests that such an approach is misguided. A profit-maximizing firm is more concerned with the effective tax over the entire life cycle of the capital. High cost of capital after the initial years of investment may offset the generous depreciation allowance and deter new investment. A more effective policy of boosting investment and creating jobs would be to lower the high statutory corporate tax rate.

Individual income taxes also play an important role in determining investment. Income taxes are obviously an important determinant of savings and labor supply. The literature on that subject is too vast to cover here, but we instead discuss some less obvious channels through which income tax reform can influence investment and job creation.

Corporate income in the current U.S. system is subject to double taxation, because both corporate and individual income are taxed separately. The vast majority of small business owners pay taxes in the form of individual income taxes rather than corporate taxes. In considering corporate *versus* personal

income taxes, one should recognize that *tax burdens are shifted through changes in market prices.* The notion that statutory tax rates on corporations and workers in different industries are not good measures of the tax burden can be traced to Harberger (1962). In a more recent study, Carroll, Holtz-Eakin, Rider, and Rosen (2000) found that raising marginal individual tax rates reduced firms' overall revenue growth, business investments, and hiring. On the supply side of the same industry, corporate income tax and personal income tax rates can affect the decision to form a business in the first place. Gentry and Hubbard (2000) showed that the probability of becoming self-employed increased as tax rates become less progressive. Their result suggests that a progressive individual income system discourages entrepreneurs from creating small businesses, which also discourages the investment demand and job creation that such new businesses may bring. More recently, Goolsbee (2004) found empirical evidence that the relative burden of corporate taxes and personal income taxes have a significant impact on the share of real economic activity done by corporations.

A primary concern about tax reform is its impact on government budgets. Will tax cuts result in a substantial shortfall of revenue, or will they result in an expansion of the tax base large enough to overcome the reduced tax rate? As noted earlier, using a model in which long-run growth depends on capital accumulation, Ireland (1994) showed that cutting an income tax rate from 35 percent to 15 percent can be self-financing in the long run. In a recent

study of this issue, Mankiw and Weinzierl (2006) used a growth model similar to that in the appendix of this paper, and found that tax cuts can be self-financing. Starting at a benchmark of a 25-percent tax rate on capital and labor income, their model yielded the result that more than one half of a given cut in capital income tax and about 17 percent of a given cut in labor income tax will be self-financing in the long run. In a world of endogenous growth, this implies that three quarters of a capital income tax cut and about 20 percent of a labor income tax cut will be self-financing. The authors also found that it takes very little time for the tax base to respond to a labor income tax cut, but it takes decades for the tax base to respond fully to a capital income tax cut.

In the short run, government fiscal policymakers should be concerned with the budgetary implications of tax reforms and the corresponding requisite adjustment of government spending. Over a longer horizon, policymakers must weigh the costs that result from distortions of social welfare and reduced economic growth against the potential benefits of government consumption and public capital. Trabandt and Uhlig (2007) estimated that, for the U.S. economy, about 20 percent of a labor tax cut and one half of a capital tax cut would be self-financing. For 15 countries of the European Union, they found that more than half of a labor income tax cut and more than 80 percent of corporate tax cuts would be self-financing.[11] It is quite possible, therefore, that some reforms of the corporate tax system would be entirely self-financing.

Overall, the evidence presented in this section suggests that countries with high marginal tax rates realize lower standards of living (in terms of GDP per capita) than countries with relatively lower marginal tax rates. The empirical evidence focuses on the relationship between capital accumulation and tax rates because capital accumulation is linked to economic growth. It logically follows that a higher tax rate reduces output through lower capital accumulation.

V. CONCLUDING REMARKS

This study offers a brief review of the cross-country evidence regarding the relationship between fiscal policy and economic growth. Fiscal policy encompasses a variety of interrelated choices for government officials that do not permit simple answers, whether in theory or through empirical analysis. Theoretical analysis shows that because taxes, government consumption, and investment in public capital are determined jointly by the government budget constraint, the economic effect of an increase in government spending depends on how taxes are collected, how the tax revenue is spent, and how any resultant public capital enters into aggregate production. Furthermore, there is strong evidence that a country's taxes and government spending are endogenously determined by its stage of development. It is, therefore, unrealistic to expect robust and clear-cut results from cross-country, reduced-form regressions attempting to explain average real GDP growth over time. On the other hand, studies using

The empirical evidence focuses on the relationship between capital accumulation and tax rates because capital accumulation is linked to economic growth. It logically follows that a higher tax rate reduces output through lower capital accumulation.

disaggregated data indicate that tax policy profoundly affects the economic incentives that underlie investment decisions. There is strong evidence that countries with higher income tax rates tend to have less investment, a key component of economic growth across countries.

The lessons provided by theoretical models of economic growth and cross-country empirical evidence have important implications for state-level fiscal policy. A substantial portion of state government spending is devoted to public infrastructure, such as highways and bridges, and to public education. Evaluating the effect of these investments on a state's economic growth requires overcoming the econometric difficulties of cross-country data (such as the endogeneity of government investment) discussed in this study. The lesson from cross-country data — that distortionary corporate and personal income taxes hinder private investment and, consequently, economic growth — is particularly relevant to the crafting of state-level fiscal policy. A key reason for this is because capital is likely to be more mobile across state boundaries than between countries. The lesson of international studies — that not all tax cuts are equally effective in promoting private investment — suggests that when analyzing the fiscal policy of a state government, one must take into account the institutional constraints of that state.

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APPENDIX

A Dynamic General Equilibrium Model

A model from economists Baxter and King (1993) suggests that savings and labor supply are determined by a representative agent, who maximizes utility:

$$\text{MAX} \sum_{t=0}^{\infty} \beta^t \{\ln C_t + \theta_L \ln(1-N_t)\}$$

(where K_0 and $\{TR_t\}_{t=0}^{\infty}$ are taken as given)

$$\text{s.t. } C_t + K_{t-1} - (1-\delta)K_t = (1-\tau)Y_t + TR_t \quad (A1)$$

Labor supply is endogenous here, because the agent values leisure $(1-N)$. The government budget is balanced in each period (allowing for deficit financing does not change the market allocations). Hence, $\tau Y_t = G_t + TR_t$. The income tax finances government purchases and transfer payments. These transfer payments can be negative, in which case government purchases are financed by income taxes and lump-sum taxes. Government purchases add to public capital accumulation as follows:

$$K_{G,t+1} - (1-\delta)K_{G,t} = G_t.$$

For simplicity, the production function is assumed to be Cobb-Douglas (1928) — $Y = K_{\alpha}N^{1-\alpha}K_G^{\theta}$ — with constant technology.

Note that for the Cobb-Douglas production function, the labor and capital productivity depends on capital-labor ratio $k = K/N$. At the steady state, the equilibrium allocation (K, N, Y) is given by:

$$C + \delta K = K^{\alpha}N^{1-\alpha}K_G^{\theta} - G, \quad (A2)$$

$$\theta_L/(1-N) = (1/C)(1-\tau)(1-\alpha)(Y/N), \quad (A3)$$

$$(1-\tau)\alpha(Y/K) + 1 - \delta = 1/\beta, \quad (A4)$$

$$\delta K_G = G. \quad (A5)$$

We consider only the long-run effect in the level (which corresponds to a short-run effect in the growth rate). Condition (A2) is a resource constraint, (A3) and (A4) are marginal conditions for labor and saving, and (A5) states that steady-state government purchases exactly offset depreciation of public capital stock. From (A2), we have $C = N(k^{\alpha}K_G^{\theta} - \delta k) - G$. Plugging this in (A3) solves N.

Condition (A4) illustrates that the net of tax return to capital is determined by the discount factor of the economic agent (β) and the rate of depreciation (δ). These parameters are not influenced by fiscal policy. From (A4), we obtain $(1-\tau)\alpha k^{\alpha-1}K_G^{\theta} = 1/\beta + \delta - 1$. This condition shows that, in the long run, given the income tax rate τ, more public capital raises the capital-labor ratio k. Also, given the level of public capital income, higher tax rate τ reduces the capital-labor ratio.

APPENDIX B

The Econometrics of Endogeneity

It is likely that fiscal policy is endogenous in modern economies. Accordingly, econometric techniques must take simultaneity bias into account in both cross-country and time-series regressions.

To illustrate the consequences of simultaneity bias, let y_i be output growth

> *If public investment is abnormally high during economic booms and abnormally low during recessions, there is a positive cross-time correlation between the regressor and the error term.*

and let x_i be the fiscal policy variable in country i. Suppose we run the cross-section regression $y_i = a + bx_i + \varepsilon_i$, and find parameters in the model to minimize the sum of the squares of the residuals ε_i. The obtained parameters (a and b) are called "least squares" estimates. The expected difference between the estimate of b and its true value is determined by the cross-country correlation between x_i and the error term ε_i. If the error and the regressor are positively correlated, the bias of the least squares estimate b is upward. There are reasons to believe that in cross-country regressions using a growth rate of a very long sample period — say, 30 years — fiscal policy variables (taxes or government spending) may be affected by output growth, which results in a positive cross-country correlation between the regressor and the error term. In this case, fiscal policy variables are endogenous. The endogeneity of the fiscal policy variables may be caused by the institutional setup of the fiscal policy, or by the fact that both GDP growth and public investment (or taxes) are influenced by a third unmeasured factor, like human capital.

Time-series regression may suffer from a similar bias: If public investment is abnormally high during economic booms and abnormally low during recessions, there is a positive cross-time correlation between the regressor and the error term. The endogeneity problem can be resolved if researchers use an appropriate structure model that distinguishes variations in taxes (or government spending) that originate in a policy shift from those caused by changes in the state of the economy. For instance, economists

Shaghil Ahmed and John Rogers (2000) developed a structural vector autoregression model to analyze the long-run effects of fiscal and monetary policy.

REFERENCES

Ahmed, Shaghil, and John H. Rogers, "Inflation and the Great Ratios: Long-term Evidence from the U.S.," *Journal of Monetary Economics*, vol. 45, 2000, pp. 3–35.

Alesina, Alberto, Silvia Ardagna, Roberto Perotti, and Fabio Schiantarelli, "Fiscal Policy, Profit, and Investment," *American Economic Review*, vol. 92, 2002, pp. 571–589.

Alesina, Alberto, and Dani Rodrik, "Distributive Politics and Economic Growth," *Quarterly Journal of Economics*, vol. 109, 1994, pp. 465–490.

Aschauer, David, "Is Public Expenditure Productive?," *Journal of Monetary Economics*, vol. 23, 1989, pp. 177–200.

Barro, Robert, J., "Are Government Bonds Net Wealth?," *Journal of Political Economy*, vol. 82, 1974, pp. 1,095-1,117.

Barro, Robert J., "Economic Growth in a Cross-Section of Countries," *Quarterly Journal of Economics*, vol. 106, 1991, pp. 407–443.

Baxter, Marianne, and Robert G. King, "Fiscal Policy in General Equilibrium," *American Economic Review*, vol. 83, 1993, pp. 315–334.

Becker, Gary S., and Casey B. Mulligan, "Deadweight Costs and the Size of Government," *Journal of Law and Economics*, vol. 46, 2003, pp. 293–340.

Blomstrom, Magnus, Robert Lipsey, and Mario Zejan, "Is Fixed Investment the Key to Growth?," *Quarterly Journal of Economics*, vol. 111, 1996, pp. 269–276.

Bohn, Henning, "The Behavior of U.S. Public Debt and Deficits," *Quarterly Journal of Economics*, vol. 113, 1998, pp. 949–963.

Carroll, Robert, Douglas Holtz-Eakin, Mark Rider, and Harvey S. Rosen, "Income Taxes and Entrepreneurs' Use of Labor," *Journal of Labor Economics*, vol. 18, 2000, pp. 324–351.

Cobb, Charles W., and Paul H. Douglas, "A Theory of Production," *American Economic Review*, vol. 18 (Supplement), 1928, pp. 139–165.

Congressional Budget Office Report, "The Role of Computer Technology in the Growth of Productivity," May 2002.

Congressional Budget Office Report, "Corporate Income Tax Rates: International Comparisons," November 2005.

Cummins, Jason G., Kevin A. Hassett, and R. Glenn Hubbard, "Tax Reforms and Investment: A Cross-Country Comparison," *Journal of Public Economics*, vol. 62, 1996, pp. 237–273.

DeLong, J. Bradford, and Lawrence H. Summers, "Equipment Investment and Economic Growth," *Quarterly Journal of Economics*, vol. 106, 1991, pp. 445–502.

Devereux, Michael P., and Rachel Griffith, "Taxes and the Location of Production: Evidence from a Panel of U.S. Multinationals," *Journal of Public Economics*, vol. 68, 1998, pp. 335–367.

Diamond, Peter A., "National Debt in a Neoclassical Growth Model," *American Economic Review* vol. 55, 1965, pp. 1,126–1,150.

Easterly, William, "How Much Do Distortions Affect Growth?," *Journal of Monetary Economics*, vol. 32, 1993, pp. 187–212.

Easterly, William, and Sergio Rebelo, "Fiscal Policy and Economic Growth: An Empirical Investigation," *Journal of Monetary Economics*, vol. 32, 1993, pp. 187–212.

Engen, Eric M., and Jonathan S. Skinner, "Fiscal Policy and Economic Growth," The National Bureau of Economic Research, working paper 4223, 1992.

Feldstein, Martin, "Government Deficits and Aggregate Demand," *Journal of Monetary Economics*, vol. 9, 1982, pp. 1–20.

Fölster, Stefan, and Magnus Henrekson, "Growth Effects of Government Expenditure and Taxation in Rich Countries," *European Economic Review*, vol. 25, 2001, pp. 1,501–1,520.

Gentry, William M., and R. Glenn Hubbard, "Tax Policy and Entrepreneurial Entry," *American Economic Review*, vol. 90, May 2000, pp. 283–287.

Glomm, Gerhard, and B. Ravikumar, "Productive Government Expenditures and Long-Run Growth," *Journal of Economic Dynamics and Control*, vol. 21, 1997, pp. 183–204.

Goolsbee, Austan, "The Impact of the Corporate Income Tax: Evidence from State Organizational Form Data," *Journal of Public Economics*, vol. 88, 2004, pp. 2,283–2,299.

Grier, Kevin, and Gordon Tullock, "An Empirical Analysis of Cross-National Economic Growth, 1951-80," *Journal of Monetary Economics*, vol. 24, 1989, pp. 259–274.

Harberger, Arnold, "The Incidence of the Corporate Income Tax," *Journal of Political Economy*, vol. 70, 1962, pp. 215–240.

Hines, James R., and Eric M. Rice, "Fiscal Paradise: Foreign Tax Havens and American

Business," *Quarterly Journal of Economics*, vol. 109, 1994, pp. 149–182.

Hsieh, Chang-Tai, and Jonathan A. Parker, "Taxes and Growth in a Financially Underdeveloped Country: Evidence from the Chilean Investment Boom," *Economia*, vol. 8, 2007, pp. 1–40.

Holtz-Eakin, Douglas, "Public Sector Capital and the Productivity Puzzle," *Review of Economics and Statistics*, vol. 76, 1994, pp. 12–21.

Ireland, Peter N., "Supply-Side Economics and Endogenous Growth," *Journal of Monetary Economics*, vol. 33, 1994, pp. 559–571.

Jones, Charles, "Economic Growth and the Relative Price of Capital," *Journal of Monetary Economics*, vol. 34, 1994, pp. 359–382.

Keefer, Philip, and Stephen Knack, "Boondoggles, Rent-Seeking, and Political Checks and Balances: Public Investment under Unaccountable Governments," *Review of Economics and Statistics*, vol. 89, 2007, pp. 566–572.

Kormendi, Roger, "Government Debt, Government Spending, and Private Sector Behavior," *American Economic Review*, vol. 73, 1983, pp. 994–1,010.

Kormendi, Roger, and Philip Meguire, "Macroeconomic Determinants of Growth: Cross-Country Evidence," *Journal of Monetary Economics*, vol. 16, 1985, pp. 141–163.

Lee, Young, and Roger Gordon, "Tax Structure and Economic Growth," *Journal of Public Economics*, vol. 89, 2005, pp. 1,027–1,043.

Levine, Ross, and David Renelt, "A Sensitivity Analysis of Cross-Country Growth Regressions," *American Economic Review*, vol. 82, 1992, pp. 942–963.

Mankiw, Gregory N., and Matthew Weinzierl, "Dynamic Scoring: A Back-of-the-Envelope Guide," *Journal of Public Economics*, vol. 90, 2006, pp. 1,415–1,433.

Mauro, Paolo, "Corruption and the Composition of Government Expenditure," *Journal of Public Economics*, vol. 69, 1998, pp. 263–279.

Mendoza, Enrique G., Assaf Razin, and Linda L. Tesar, "Effective Tax Rates in Macroeconomics: Cross-Country Estimates of Tax Rates on Factor Incomes and Consumption," *Journal of Monetary Economics*, vol. 34, 1994, pp. 297–323.

Munnell, Alicia H., "Infrastructure Investment and Economic Growth," *Journal of Economic Perspectives*, vol. 6, 1992, pp. 189–198.

Peltzman, Sam, "The Growth of Government,"

Journal of Law and Economics, 23, 1980, pp. 209–287.

Ram, Rati, "Government Size and Economic Growth: A New Framework and Some Evidence from Cross-Section and Time-Series Data," *American Economic Review*, vol. 76, 1986, pp. 191–203.

Seater, John J., "Ricardian Equivalence," *Journal of Economic Literature*, March 1993, pp. 142–190.

Slemrod, Joel, "What Do Cross-Country Studies Teach About Government Involvement, Prosperity, and Economic Growth?," Brookings Institution Papers on Economic Activity, no. 2, 1995, pp. 373–431.

Trabandt, Mathias, and Harald Uhlig, "How Far Are We from the Slippery Slope? The Laffer Curve Revisited," Department of Economics, working paper, University of Chicago, 2007.

NOTES

[1] It is important to note that the even when the lump-sum tax is applied to capital purchases, it may still be undesirable. This is because unproductive government purchases financed by lump-sum taxes represent a tax burden, and create a negative income effect (i.e., a reduction in the purchasing power of households), which results in lower consumption of both goods and leisure.

[2] Note that we are assuming that the government is on the upward-sloping portion of the Laffer curve.

[3] In both studies, the only fiscal policy variable is the ratio of government consumption to GDP. Its estimated effect on GDP growth differs substantially with different use of data samples. Such sensitivity is not unusual for cross-country regressions, because the effect of fiscal policy depends on a variety of factors (as illustrated in the theoretical models), but the multi-dimensional differences in fiscal policy are masked by summary statistics. The empirical models impose the restriction that the relationship between GDP growth and the ratio of government consumption to GDP is the same across countries. The heterogeneity in fiscal policy, absent in the model, means that the regressions are potentially misspecified. We will elaborate on the factors that may cause bias in these regressions later in section III.

[4] Let the production function be:

$$Y = K^{\phi} N^{\beta} K_G^{\theta} \qquad (1)$$

The GDP growth rate can be written as:

$$\Delta Y/Y = \phi \Delta K/K + \beta \Delta N/N + \theta \Delta K_G/K_G \quad (2)$$

Adding an error term to the right side of (2) sets up a cross-country regression.

[5] Formally, Holtz-Eakin estimated the following regression:

$$\ln Y_{st} = \alpha \ln K_{st} + \beta \ln N_{st} + \theta \ln G_{st} + \gamma_t + f_s + \mu_{st}$$

where γ is the coefficient on the time trend and f is the state-specific fixed effect.

[6] Although one may think that these are plausible estimates of how public infrastructure improves private productivity and output, evaluating the effect of public education spending on GDP is more challenging, because there is no direct measure of the human capital produced by public education and the contribution of human capital to GDP. For further discussions of the measurement issues, see Glomm and Ravikumar (1997) and the references they cite.

[7] Specifically, Easterly and Rebelo use panel data spanning the period 1870 to 1988. They show that the ratio of government revenue to GDP and the income tax share of government revenue are positively correlated with per-capita income and with population size. They further find evidence that the custom tax share of government revenue is negatively correlated with population size.

[8] Appendix B provides a more thorough discussion of endogeneity in econometric specifications.

[9] The empirical validity of the so-called Ricardian Equivalence Result has been addressed by numerous researchers. See, for example, Martin Feldstein (1982), Roger Kormendi (1983), John Seater (1993) and Henning Bohn (1998) for just a glimpse of the findings presented to uncover whether Ricardian Equivalence is evidenced in the data. Ricardo originally argued that governments must offset any spending increase with an increase in the present value of taxes. Such offsetting actions are implied in an infinite-horizon government budget constraint and have been dubbed the Ricardian Equivalence Hypothesis.

[10] Magnus Blomstrom, Robert Lipsey, and Mario Zejan (1996) argued that the correlation of capital investment with economic growth reflects reverse causality.

[11] Note that these estimates are all based on simulations of stylized models of flat taxes, and they are abstracted from many features of the tax systems currently in place.

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