A Review of Cross-Country Evidence on Government Fiscal Policy and Economic Growth

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1. Introduction

It is widely believed that fiscal policy plays an important role in determining economic growth. As economists William Easterly and Sergio Rebelo (1993) noted, “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?” This study reviews recent economic studies regarding the effect of government fiscal policy on economic growth across countries. Even with a deep-rooted conviction of the role of fiscal policy, interpreting the empirical evidence from aggregate cross-country data turns out to be less than straightforward. However, a robust pattern does emerge from the reviewed studies. Distortionary taxes (whether personal income taxes or corporate taxes) have a strong negative effect on investment.

The fundamental theoretical and empirical issues encountered in these cross-country studies have important implications for state-level fiscal policy analysis. For instance, evaluation of state fiscal policy requires assessing the combined effects of spending and taxes and dealing with methodological issues discussed later in the review. In addition, the empirical results in the cross-country studies — the evidence that income taxes retard private investment — are particularly relevant for state-level fiscal policymaking.

This review begins with a discussion of the theoretical relationship between fiscal policy variables and output growth. The theoretical effect of fiscal policy is complex because government spending and taxes are linked via the government budget constraint. The magnitude of the positive effects of government spending on output growth depends on whether the spending is used for income distribution or government purchases, and on whether the government purchases enhance the productivity of the private sector. In general, a stimulating effect of government spending may not overcome the negative effect of the taxes that are necessary to finance the spending.

With this theoretical background, we then summarize and critically evaluate the voluminous empirical literature studying the effects of fiscal policy, using cross-country data. The cross-country correlation between GDP growth and government tax revenue/GDP ratio is tenuous, and regressions of GDP growth on fiscal policy variables produce mixed results. Although the mixed empirical results confirm the aforementioned theoretical ambiguity, it is likely that they stem from the difficulty of relating aggregate tax or government spending data to fiscal policy decisions. The lack of robustness in empirical results may be the consequence of misspecification of empirical models, measurement errors, and the endogeneity of fiscal policy variables. For instance, aggregate tax and spending measurements do not capture all important aspects of fiscal policy. A more challenging problem is that spending and tax policies are likely to be endogenous; i.e., they are dependent on the stage of a country's economic development. This means that an observed change in government spending may be the result of a change in policy, a change in the economy, or a combination of these. Estimates of the impact of fiscal policy are biased if taxes and government spending are endogenous and the researcher cannot identify a policy change from the aggregate data.

Because of the difficulties of evaluating the effect of fiscal policy on aggregate output, we direct our attention to the effect of taxes on more disaggregated data — in particular, on investment. We present ample evidence that distortionary taxes and government consumption reduce private investment. Because GDP growth rate is positively correlated with the investment share of GDP, distortionary taxes and government consumption indirectly retard economic growth. Our review of studies on corporate investment suggests that carefully designed reforms in corporate taxes and individual income taxes can foster investment and, thus, long-term growth of the economy.

2. Theoretical Analysis

2.1 The Basic Framework

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 is that fiscal policy influences the economy through both taxes and government spending. Because government spending must be constrained by tax revenue in the long run, one cannot analyze the effect of government spending in isolation from the effect of taxes. In addition, the output effect depends on the nature of taxes and spending. The effect of government spending depends on whether it consists of transfer payments or investment. We assume in theory government investment raises the productivity of the private sector, although one can certainly think of scenarios where government investment creates distortions and lowers overall productivity of the private sector. The effect of taxes depends on whether distortionary taxes on income or lump-sum taxes are used to finance government purchases. High income taxes are likely to retard growth even when they are used to finance public investment, because they distort the role of prices as transmitters of socially efficient values and create disincentives for working or investing. Finally, government purchases may affect output differently in the long run and in the short run, and output-stimulating government spending may be detrimental to the well-being of citizens. In theory, whether fiscal policy can affect long-run growth hinges on whether that long-run economic growth is endogenous (i.e., driven by economic variables controllable by human beings) or exogenous (i.e., not controllable by human beings). In endogenous growth models, fiscal policy can affect technological progress and long-run growth. If growth is driven by technological progress in the long run, and the latter hinges on investment in capital, then income taxes create a large negative effect on growth. Economist Peter Ireland's study of endogenous growth (1994) demonstrated that certain income tax cuts can stimulate enough growth to be self-financed in the long run.

We now lay out three fundamental relationships relevant to government fiscal policy analysis of economic growth. First, an aggregate production function depicts how factor

inputs determine GDP: $Y = F(A, K, N, K_G)$; Y is GDP, K is private capital stock, N is labor input, A is an indicator of technology that captures total factor productivity (or TFP), 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: $Y = C + I + G$, where *C* is private consumption, *I* is investment, *G* is government purchases (which equals government consumption plus investment *G** in public capital K_G). This constraint can be interpreted as the composition of GDP, or the outlay of output.

Third, the government budget requires balancing spending and revenue in the long run. Government spending includes government purchases (*G*), interest payments, and transfer payments; revenue comes mainly from taxes. Because our focus is 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.

We review the economic literature, studying the effects of an increase in taxes 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 either revenue or the deficit, or with the total spending level in one or more other categories of spending. Fiscal policy concerns 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. Because of the high dimensionality of fiscal policy choices in practice, 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. The investment raises the productivity through K_G in the production function, but the increase in tax rate may reduce the factor inputs *K* and *L*. The net effect on output is not obvious. Many empirical papers are written about cross-country regressions on output growth (so that we have variations in fiscal policy). The evidence is that it is difficult to reach a definitive conclusion. A much more robust result is that distortionary taxes for distributional purposes adversely affect investment, and hence adversely affect capital accumulation and growth. The theoretical questions we will address here concern the channels through which fiscal policy affects economic growth.

2.2. Fiscal Policy Effects in a General Equilibrium Model With Endogenous Labor Supply and Saving

The following illustrates, in a general equilibrium model, how taxes and government consumption influence output. In a general equilibrium model, resource allocations are determined by an equilibrium of the markets for capital, labor, and goods. The details of the model are presented in the appendix. The model is based on the most commonly used production function in the growth literature, $Y = K^{\alpha}(AN)^{1-\alpha}K_G^{\theta}$. Holding labor and public capital constant, a one-percent increase in private capital *K* raises output *Y* by α percent (α being the capital share or output elasticity of capital). The technological progress (the growth rate of *A*) is assumed to be exogenous, and is not affected by output, capital, or labor. If the growth of knowledge is proportional to the growth of public capital, endogenous growth follows. In that case, public capital investment influences GDP growth in the long run.

This specific model makes it possible to examine how fiscal policy affects output in different scenarios. An increase in *G* (and K_G), financed by lump-sum taxes, increases the capital-labor ratio *k.* The labor supply *N* can be shown to increase as well, because more private capital and public capital enhance labor productivity. The total output $Y = k^{\alpha}NK_G^{\theta}$ increases because all three factors increase. In comparison, an increase in income tax rate τ with *G* fixed (for income redistribution) reduces the capital-labor ratio *k* and lowers labor supply. Consequently, the output per capita decreases. Lastly, when an increase in G is financed by an increase in income tax rate, with $\tau Y = G$ (so that choosing the tax rate determines government purchases and vice versa) in the model presented in the appendix, labor supply *N* is independent of the tax rate (and government purchases). The capital-labor ratio *k* increases in τ if θ is greater than one half. The per-capita output increases in τ if θ is greater than one half, or if θ is less than one half, but tax rate τ is sufficiently small. Otherwise, output decreases.

The discussion shows that the output effect of government purchases can be quite

complex if they are financed by a flat-rate income tax. Raising income taxes for redistributive purposes always results in lower employment, less capital accumulation, and lower output. In contrast, government capital purchases financed by lump-sum taxes may have the opposite effect. 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.

The effects of fiscal policy under various scenarios of tax and spending combinations are summarized in Table 1.

Table 1. The Effects of Fiscal Policy on Short-Run Output Growth (or on Long-Run Output Level) in the General Equilibrium Model Depends on the Nature of Taxes and Spending

Tax/Spending	**Government consumption**	**Public investment**
Lump-sum tax	Positive	Positive
Income tax	Negative	May be positive or negative

2.3. An endogenous growth model

The above theoretical analysis is based on the assumption of exogenous growth. As noted earlier, if growth is endogenous, then the detrimental effect of income taxes is amplified. Ireland (1994) examined an endogenous growth model in the framework laid out in section 2.2. By setting $\alpha = 1$ (which makes return to capital constant, rather than decreasing as capital stock increases), the long-run growth rate becomes dependent on capital accumulation and fiscal policy. The tax revenue G may not always be increasing or decreasing in tax rate τ, giving rise to the possibility of a bell-shaped relationship between tax revenue and tax rates — known as the Laffer curve. Ireland showed that there is indeed a Laffer curve in the endogenous growth model (even with θ=0). Specifically, his simulation showed that under a reasonable set of parameters, by lowering the tax rate to 15 percent (through a deficit-financed tax cut) from anywhere between 15 percent to 35 percent, GDP growth rate is increased by as much as 3.25 percent, without violating the government budget constraint in

the long run. In endogenous growth models, government consumption reduces long-run growth because the latter is positively related to capital accumulation.

What is the output effect of government spending and tax rates? The above discussion suggests that the answer depends. Specifically, the effect of government purchases depends on whether those purchases raise the total factor productivity (TFP) and how they are financed. As for the effect of taxes, holding everything else constant, a higher tax rate reduces the returns to factors of production, thus reducing the amount of output. When combined with an increase in government spending, the negative impact on output can only be overturned if the government buys things that increase productivity, such as infrastructure or basic research and development. Two main factors are whether distortionary taxes are used for finance of government purchases or for redistributive purposes, and whether the economic growth is endogenous. Next, we review the empirical evidence.

3. Cross-Country Evidence of Aggregate Data

The regression studies reviewed in this section fall into two categories. First, reduced-form cross-country growth regressions examine the statistical relationship between GDP growth of countries in the sample and variations in fiscal policies (measured by variables such as government tax revenue/GDP ratio). The reduced-form regressions are not grounded in behavioral models like the ones discussed earlier. Second, regressions based on production functions focus on the productivity of public capital given the inputs from private sectors. Both types of studies are influenced by model specification, measurement errors in tax rates, and potential endogeneity of explanatory variables. We will summarize the findings in literature and discuss these potential problems.

3.1 Cross-country Regressions of GDP Growth and Government Consumption

The cross-country regression by economists Roger Kormendi and Philip Meguire (1985) was one of the first reduced-form empirical studies about the determinant of economic growth. Kormendi and Meguire regressed the average GDP growth rate from 1950 to 1977 in

46 countries on the government consumption/GDP ratio, along with other control variables, such as initial per-capita GDP level, and population growth over the sample period. They found that the government consumption/GDP ratio has an insignificant effect on GDP growth. Extending the Kormendi and Meguire study, economists Kevin Grier and Gordon Tullock (1989) ran a pooled regression with a similar set of control variables, but 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. They found that government consumption/GDP ratio had a negative effect on GDP growth. In other words, countries with higher government consumption spending relative to GDP, on average, grow slower than countries with lower ratios.

In both studies, the only fiscal policy variable is the government consumption/GDP ratio. Its estimated effect on GDP growth differs substantially with different use of data samples. Such sensitivity is not unusual for cross-country regressions, for 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 the government consumption/GDP ratio and GDP growth 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 in section 3.3.

3.2 Production-Function-Based Regressions on Productivity of Public Capital

An alternative way of estimating the role of government spending is a production function approach. Let the production function be:

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

The GDP growth rate can be written as:

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

Adding an error term to the right side of (2) sets up a cross-country regression. The parameter θ represents the output elasticity of public capital, meaning that a 1-percent increase in public

capital raises GDP by θ percent, holding private capital and labor constant. Economist Rati Ram (1986) used government consumption to replace public capital in (2), and private investment/GDP ratio to replace the growth rate of private capital. He obtained an estimate for θ of about 1.0 from cross-country data, using a modified version of (2). His time-series regression of individual countries found θ positive for most countries.

Economist David Aschauer (1989) conducted a time-series regression of the production function on 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. These estimates imply that public capital is an important determinant of the productivity of private sectors. Aschauer attributed 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 is interpreted 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 private investment/GDP ratio (or growth rate of private capital stock). But public capital is not independent of private investment. In the world of distortionary taxes, raising one unit of public investment would likely lead to a reduction in private investment by more than one unit. It becomes less obvious, then, what the net effect of an increase in public capital really is.

The theoretical models discussed earlier show that raising public capital may either increase or decrease GDP, depending on whether the government uses the proceeds to purchase public capital, and whether the return to the public capital is great enough to offset the deleterious effects of the lower after-tax returns to factors of production. Cross-country regressions that fail to account for the differences in fiscal policy (in addition to public capital) result in misleading conclusions.

One way to account for unobserved heterogeneity is to use panel data sets containing observations of different states (or countries) during different time periods. Economist Douglas Holtz-Eakin (1994) conducted such an exercise for state-level output Y_{st} in a modified version of production function (1) with a time effect γ_t, a state specific effect f_s,

and an error term.

$\ln Y_{st} = \alpha \ln K_{st} + \beta \ln N_{st} + \theta \ln G_{st} + \gamma_t + f_s + \mu_{st}$, his estimate for the contribution of public capital, θ, is insignificant. This means that once the unobserved state-specific factors are controlled, government capital does not improve productivity in the private sector. Furthermore, Holtz-Eakin rejected the notion that the unobserved state-specific effect f_s is randomly distributed across states. This suggests that the unobserved difference in cross-state factor productivity is positively correlated with the state's public capital stock. If a state is productive for unspecified reasons, it would have a relatively high level of public capital stock. If we control for the unobserved fixed effect of the state, then variation in public capital does not correlate with the state's output.

Unobserved heterogeneity affects the estimates of reduced form models of growth rate as well. The panel data estimation by economists Stefan Fölster and Magnus Henrekson (2001), using data from Organization for Economic Cooperation and Development (OECD) countries, shows a negative correlation between average tax rates and government expenditure/GDP with GDP growth.

Several studies provide indirect evidence on the productivity of public investment in different countries. Economists Philip Keefer and Stephen Knack (2007) found that public investment (relative to GDP or total investment) is dramatically higher in countries with low-quality governance (e.g., those with limited political checks and balances, or no competitive elections). This may be because government officials use public investment as an opportunity to serve their own interests and/or because weak governments use public investment to substitute for private investment. Both explanations imply that public capital is less productive in countries with weak governance. Mauro (1998) finds that in countries with high levels of corruption, governments tend to spend less on education but more on public capital. His explanation is that it is easier for government officials to extract rents from public capital than from education spending. These papers relating the composition of government spending to "quality of governance" imply that while public capital may be productive if allocated by an effective government, in practice its productivity is severely hampered by self-serving government officials.

3.3. Empirical Analysis With More Attention to Details

Clearly, different types of public capital have different effects on GDP. Economists Alicia H. Munnell (1992), and Gerhard Glomm and B. Ravikumar (1997), have provided comprehensive surveys of empirical estimates of output elasticity of public infrastructure. When public capital is more 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. While 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 it is difficult to measure 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.

The multidimensional nature of fiscal policy suggests that limiting analysis to government consumption or public capital likely produces misleading conclusions. Economist Robert Barro (1991) ran 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.

While some authors have reached firm conclusions when limiting the scope of models and data, many others doubt that one can obtain robust empirical results from aggregate data. After analyzing many competing models, economists Ross Levine and David Renelt (1992) found that the estimated effective outputs of all aggregate measures of fiscal policy variables (including government consumption, government spending, and government deficits) are fragile in the cross-country growth regressions.

The discussion of theoretical models indicates that distortionary taxes (such as income taxes) are likely to retard growth regardless of whether the revenue is used for government consumption or government investment. Some empirical studies lend support to this notion. Economists Eric Engen and Jonathan Skinner (1992) developed a sophisticated econometric

model to estimate the effect of tax rates and government investment, using data from more than 100 countries. They concluded that a budget-balancing increase in government spending and taxes reduces the growth rate.

The study by Easterly and Rebelo (1993) may shed light on why estimates of the effects of fiscal policy variables are so fragile. Economists Enrique Mendoza, Assaf Razin, and Linda Tesar (1994) showed that estimating marginal tax rates in different countries is quite involved. Using marginal tax rates computed by themselves, Easterly and Rebelo investigated how public investment and marginal tax rates correlate with output growth. Their cross-sectional regression showed that comparable increases in per-capita public investment in different sectors are not equally important to output growth. Investment in transport and communication is positively correlated with growth, but the link between most fiscal policy variables and growth is not robust. They also find evidence that fiscal policy is not exogenous. Their analysis of the panel data of 28 OECD countries shows that between 1870 and 1988, the government revenue/GDP ratio and the income tax share of government revenue are positively correlated with per-capita income and population size, while the custom tax share of government revenue is negatively correlated with population size. It is widely accepted that government expenditures and tax rates are not exogenous in the long run. Government consumption and transfer payments take up an increasing share of GDP as a country develops (this is known as Wagner's Law), as do income taxes. Highlights of the cross-country regressions on GDP growth and the size of government are summarized in Table 2.

Several authors present theories and empirical evidence about the endogeneity of government fiscal policy. One argument points to the pressure for redistribution and the rise of transfer payments in industrialized economies. Economist Sam Peltzman (1980) found empirical evidence that modernization produces a more educated middle class, and that more power for the middle class generates more pressure for redistributive taxes. Economists Alberto Alesina and Dani Rodrik (1994) developed a theory that income inequality leads to high redistributive taxation, which in turn slows economic growth.

Economists Gary Becker and Casey 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, and that therefore 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. Economist Joel Slemrod (1995) reviewed the theory and empirical evidence regarding the cross-country correlation between income level and the size of government. He concluded that it is difficult to measure the degree to which government involvement is the result of a policy choice, and what reflects efforts to avoid taxation. For example, tax revenue/GDP ratio is a better proxy for tax rates in developed economies, because the compliance rate in rich countries is higher than in poor countries.

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 1950–1977, 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, R. (1986)	115 countries from 1960–1980, 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 1951–1980, and 89 other countries from 1966–1980, 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 1949–1985, output/private capital, time-series regression	Labor / private capital, public capital / private capital	Public capital significantly raises productivity of private sector
Barro R. (1991)	About 100 countries from 1960–1988, cross-sectional regression	Initial per-capita GDP, investment / GDP, proxies for human capital, population growth, time, regional, and social dummies	Government consumption / GDP: negative; public investment / GDP: insignificant
Easterly	About 100 countries	Log initial per-capita GDP, human	The correlation between

and Rebelo (1993)	from 1970–1988, cross-sectional regression	capital proxies, political instability proxies, marginal tax rates	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 1969–1986, panel data regression	Private capital, labor, time dummy, state fixed effect or random effects	Public capital does not contribute to productivity of private sector
Folster and Henrekson (2001)	OECD countries from 1970–1995, 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

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, economist Peter Diamond (1965) theorized that government debt reduces the steady-state capital-labor ratio and raises interest rates. On the other hand, Barro (1974) presented the Ricardian equivalence theory, stating that a motive to bequest by current taxpayers implies the neutrality of government debt. The empirical validity of these theories is a subject of heated debate; examining macroeconomic data, economists Martin Feldstein (1982) and Kormendi (1983) reached opposite conclusions. Economist John Seater (1993) reviewed the competing theories and empirical tests of the effect of government debt. Another economist, Henning Bohn (1998), found that in the United States, deficits lead to spending cuts, which indicates that the government budget constraint plays an important role in determining the time series of government spending.

3.4. Econometric implications of endogenous fiscal policy variables

The likely endogeneity of government fiscal policy variables causes a simultaneity bias in cross-country and time-series regressions. The consequences of simultaneity bias are illustrated below. Let y_i be output growth 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 the 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, then 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, then 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.

4. Fiscal Policy and Investment: Cross-Country Evidence

Because of the complications in empirical analysis of fiscal policy for the economy as a whole, a sharper focus on the relationship between investment and government policy may be instructive. In contrast to the tenuous relationship between fiscal policy variables and GDP growth, cross-country data yield a robust pattern showing that distortionary taxes and government consumption reduce private investment.

Before reviewing the literature on taxes and investment in the private sector, we first discuss the empirical evidence of the effect that investment in capital goods has on economic growth. Economists Bradford De Long and Lawrence Summers (1991) concluded that

investment in equipment leads to growth. They argued that because of the spillover effect, the social rate of return on equipment investment is 30 percent per year or higher. Because of the high positive externalities that such investment brings to the economy, it is desirable to create tax incentives in order to induce more investment in capital goods. While the causal relationship between equipment investment and GDP growth is not universally agreed upon (economists Magnus Blomstrom, Robert Lipsey, and Mario Zejan [1996] argued that the correlation of capital investment with economic growth reflects the reverse causality), the correlation between the two is well established.

A more recent example of the role of equipment investment is provided by a 2002 study of the Congressional Budget Office (CBO), which found that annual TFP growth from 1996 to 2001 of the non-farm business sector was about 0.3 percent higher than that from 1982 to 1995. CBO attributed this acceleration in TFP growth entirely to production 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.

In the following, we will focus on macro and micro evidence across countries on how government fiscal policy influences investment.

4.1. 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 relative prices of investment goods is negatively correlated with output growth in cross-country data. Economist Charles Jones (1994) found in a cross-country growth regression 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. The price of machinery is heavily influenced by effective tax rates.

Jones argued that, based on conservative estimates of relevant parameters, eliminating taxes on machinery investment in India would have raised the country's growth rate by half a percent, or about one third of its actual growth from 1960 to 1980. He also contended that an investment tax credit in the United States would have raised U.S. GDP growth from 1960 to 1985, as well. Running cross-sectional and panel-data GDP growth regressions on tax rates in 70 countries, economists Young Lee and Roger Gordon (2005) found that corporate taxes reduce output growth in both cross-sectional and fixed-effect panel data regressions. Specifically, their coefficient estimates suggested that, for the sample countries as a whole, a 10-percent cut in the corporate tax rate will increase GDP growth by 1 percent to 2 percent.

Economists Alberto Alesina, Silvia Ardagna, Roberto Perotti, and Fabio Schiantarelli (2002) showed that expansion in the public sector retards growth through multiple channels. Besides the obvious effect of distortionary taxes, they found that employment in the public sector crowds out employment in the private sector, and lowers profit and investment demand. They 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 and that lower profit reduces investment.

Rather than focusing on aggregate investment, economists Jason Cummins, Kevin Hassett, and Glenn Hubbard (1996) investigated firm-level panel data in 14 OECD countries dealing with the effect of tax reforms on firms' investments. The cross-firm variations in the panel data allowed the authors to obtain a more precise estimate of the effect of tax reforms than would have been possible using a time series of aggregate data. The neoclassical Q theory of investment serves as the benchmark for their regression. In this model, corporate income taxes reduce net returns on capital and the firm's optimal investment. They found that tax cuts resulted in significantly greater corporate investment in 12 out of the 14 countries.

Both theoretical and empirical analysis indicate that distortionary taxes significantly affect private investment at aggregate and firm levels. The studies cited above measure distortions of the tax system by average or statutory corporate tax rates. Several studies show that taxes can influence investment decisions in much more subtle and profound ways than

can be inferred by considering merely the putative impact of taxes on average, 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, economists Chang-Tai Hsieh and Jonathan 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 no access to external financing and rely on internal funds for investment, cutting taxes on retained earnings spurs aggregate investment. They present evidence that Chile's mid-1980s reform of cutting corporate taxes on retained earnings produced annual increases in investment by the size of 10 percent of the GDP. This investment boom funded by the increase in retained earnings played a central role in generating GDP growth of 4.5 percent per year during the decade following the tax cut.

A study by economists Michael Devereux and Rachel Griffin (1998) on the choices of plant locations by U.S. multinationals further illustrates the complexity of the impact of taxes on investment. A multinational may choose to supply the European market either by exporting to that market or by locating its plant there. Taxes on profits are one consideration. They showed that when the firm has plants located in different countries, the average corporate tax rate over all locations, rather than the statutory tax rate in each location, plays a critical role in determining the location of the plants. Their empirical analysis of firm-level data supports the theory. The corporate tax has a profound impact on a firm's finances. Economists James Hines and Eric Rice (1994) showed that U.S. multinationals' inputs in production respond to local tax rates. They estimated that more than 20 percent of U.S. foreign direct investment and about one third of the foreign profits of U.S. firms belong to the tax haven affiliates of U.S. corporations. The corporate tax rate for their sample period (the late 1980s) 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. The empirical estimate by Hines and Rice is 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. These examples suggest that tax policy influences

investment in ways that are consistent with economic theory that takes taxpayer incentives into account. But the distortions created by tax systems are too complex to be summarized by a few simple statistics and linear regressions.

The Chilean experience studied by Hsieh and Parker indicates that the effectiveness of cutting certain taxes depends on the country's financial institutions. The two studies on U.S. multinationals suggest that the effect of corporate taxes in one country depends on the corporate tax rates of other countries. We conclude from these studies that not all taxes are equally harmful to economic growth. The challenge for policymakers is to identify the taxes that significantly discourage investment but generate little revenue.

4.2. How Corporate Taxes and Income Taxes Affect Investment and Entrepreneurship

In the last part of the review, we will focus on investment and output growth in the United States. 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 has 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 and especially investment in equipment and software declined sharply during this period. A small increase in equipment investment since 2005 barely makes up for the replacement of obsolete machinery, and does little to raise the capital stock.

One obvious policy variable that may play an important role in determining investment is corporate taxes. An international comparison of corporate taxes by the CBO (2005) shows that the United States has one of the highest statutory corporate rates, but collects relatively low revenue from OECD countries. One reason may be high tax avoidance, made possible by the high elasticity of investment with respect to taxes. Another reason is that the United States offers generous depreciation allowance schedules. The U.S. corporate tax system renders user cost of new equipment relatively low when compared to user cost of the equipment a few years after the investment. The system appears to favor new investment in equipment (which is more likely to encourage innovation) over long-term use of capital

(which is more likely to determine the number of manufacturing jobs). But the recent experience of low equipment investment in the United States suggests that such an argument 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 is 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. Instead, we will discuss some less obvious channels through which income tax reform may influence investment and job creation.

Corporate income in the current U.S. system is subject to double taxation of the corporate and individual income taxes. The vast majority of small business owners pay taxes in the form of individual income taxes rather than corporate taxes. Economists Robert Carroll, Douglas Holtz-Eakin, Mark Rider, and Harvey S. Rosen (2000) presented empirical evidence that raising marginal individual tax rates reduces firms' overall revenue growth, business investments, and hiring. 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 economist Arnold Harberger (1962). On the supply side of the same industry, corporate income tax and personal income tax rates affect the decision of business formation. Economist Austan Goolsbee (2004) found empirical evidence that the relative burden of corporate taxes and personal income taxes can have a significant impact on the share of real economic activity done by corporations. Economists William Gentry and Glenn Hubbard (2000) showed that the probability of becoming self-employed increases as tax rates become less progressive. Their result suggests that a progressive individual income system discourages entrepreneurs from creating small businesses, along with the investment demand and job creation that such new businesses may bring.

One primary concern about tax reform is its impact on government budgets. Over the long run, will tax cuts result in a substantial shortfall of revenue, or 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. Using a growth model similar to those in the appendix of this paper, economists Gregory Mankiw and Matthew Weinzierl (2006) showed that starting at a benchmark of a 25-percent tax rate on capital and labor income, 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, three quarters of a capital income tax cut and about 20 percent of a labor income tax cut will be self-financing. The authors estimate that it takes very little time for the tax base to respond to a labor income tax cut, but decades to fully respond 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. In the long run, they should weigh the costs that result from distortions of social welfare and economic growth against the benefits of government consumption and public capital. Economists Mathias Trabandt and Harald 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; and that for 15 countries of the European Union, more than half of a labor income tax cut and more than 80 percent of corporate tax cuts would be self-financing. Note that these simulations are based on stylized models of flat taxes, and are abstracted from many features of the tax systems currently in place. It is quite possible that some reforms of the corporate tax system would be entirely self-financing.

5. Concluding Remarks

This study briefly reviews the cross-country evidence regarding the relationship between fiscal policy and economic growth. Fiscal policy concerns a variety of interrelated choices that do not permit simple answers in theory and cannot be characterized by a few statistics. Theoretical analysis shows that because taxes, government consumption, and investment in public capital are jointly determined by the government budget constraint, the effect of an increase in government spending depends on how taxes are collected, how the tax revenue is spent, and how 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 growth rate regressions. On the other hand, studies of disaggregated data indicate that tax policy has profound effects on economic incentives. There is strong evidence across countries that distortionary taxes reduce the investment that is a key component of economic growth.

The lessons provided by 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 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 taxes (such as corporate and personal income taxes) retard private investment and growth is particularly relevant to the crafting of state-level fiscal policy, because capital is more mobile across states than across 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.

Appendix

A Dynamic General Equilibrium Model

We consider a model from economists Marianne Baxter and Robert King (1993), in which savings and labor supply are determined by a representative agent, who maximizes utility:

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)

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

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

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

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

$$\delta K_G = G. \quad \text{(A5)}$$

We consider only the long-run effect in the level (which corresponds to a short-run effect in 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.

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. 465–90.

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. 1095-1117.

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. XLVI, 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. 949–63.

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*, 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.

De Long, 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. 1126–1150.

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," NBER 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. 1501–1520.

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. 2283–2299.

Grier, Kevin, and Gordon Tullock, "An Empirical Analysis of Cross-National Economic Growth, 1951-80," *Journal of Monetary Economics* vol. 24, 1989, pp. 259-74.

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," *Economica*, forthcoming.

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. 566–72.

Kormendi, Roger, "Government Debt, Government Spending, and Private Sector Behavior," *American Economic Review* vol. 73, 1983, pp. 994–1010.

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. 1027–1043.

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. 1415–1433.

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," NBER working paper 4864, 1994.

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?" Brooking 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," working paper, Department of Economics, University of Chicago, 2007.