Fiscal Policies Aimed at Spurring Capital Formation: A Framework for Analysis

By Robert S. Chirinko and Charles Morris

In recent years, policymakers have proposed various fiscal policies to spur long-run economic growth through increased capital formation. The Bush Administration, for example, proposed lowering the capital gains tax rate. The Clinton Administration, among other measures in its economic package, proposed reinstituting the investment tax credit. These proposals stem from heightened concerns that the U.S. economy has been growing by less than its long-run potential, and from the judgment that this subpar growth is due in part to deficient capital formation.

This article presents a framework for examining fiscal policies aimed at spurring capital formation and highlights the conditions for their success. The first section shows why capital formation is an important determinant of economic growth. The second section shows how the optimal amount of capital formation, and therefore economic growth, is determined. The third section shows how economic distortions can cause capital formation to fall short of the socially optimal amount. The final section discusses several fiscal policies that have been proposed to raise capital formation.

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CAPITAL FORMATION AND LONG-RUN GROWTH

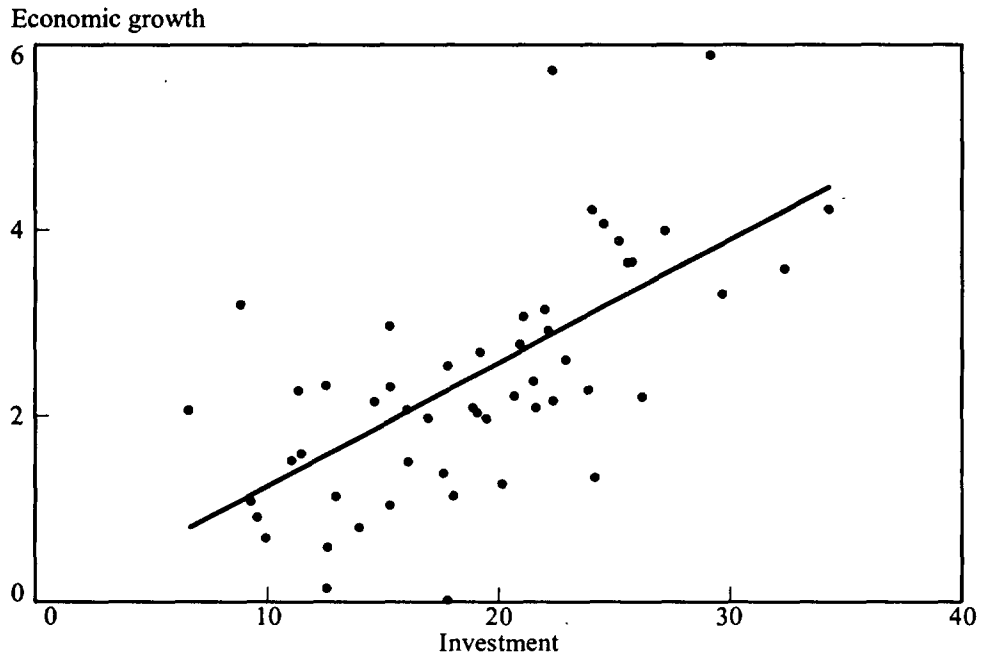
Capital formation refers to the increase in the capital stock that results from investment spending.[1] Capital formation also includes improvements in the quality of capital. For example, the development of faster personal computers also represents capital formation.

Capital formation increases per capita output by making workers more productive. For example, the substitution of typewriters for penmanship enhanced the productivity of office workers. The substitution of word processors for typewriters, in turn, has further raised office worker productivity. Because capital formation increases output per worker, the greater the amount of capital formation, the greater will be the growth rate of per capita output.

The standard theory of economic growth pioneered by Robert Solow suggests policies that raise capital formation cannot permanently raise

Chart 1

Economic Growth and Investment Are Positively Related Across Countries



Note: Economic growth is measured by the growth rate of per capita real GDP. Investment is measured by domestic real gross investment's share of real GDP. The chart shows average annual economic growth rates and investment for 52 countries.

Source: Authors' calculations using data from Summers and Heston.

the growth rate of per capita output. The key assumption in the standard model is diminishing marginal returns to capital formation. Diminishing marginal returns means each successive unit of capital adds less and less to a worker's total output. For example, giving an office worker a word processor will greatly improve performance, but giving the same worker a second word processor will have little additional effect on performance. Due to diminishing returns, as firms acquire more and more capital, the return to capital declines until it just equals the cost of capital. As a result, capital formation will eventuallystop, and there will be no growth of per capita output in the long run. In other words, policies aimed at raising capital formation can raise growth in the short run but not in the long run.[2]

In contrast to the standard theory, empirical evidence suggests there is a positive long-run relationship between capital formation and per capita growth (Chart 1). Chart 1 is a scatterplot of capital formation and economic growth. Capital formation is measured by domestic real gross investment's share of real GDP. Economic growth is measured by the percentage change in per

capita real GDP. The scatterplot includes 52 countries for which data are available from 1950 to 1988. In order to measure *long-run* growth and investment, the data point for a particular country represents the average of annual observations over the whole sample.[3] Because countries with low income levels tend to grow faster than countries with high income levels, the data were purged of the effect of the initial level of income.[4]

Chart 1 shows that countries that invest more tend to have higher long-run rates of economic growth.[5] The average relationship is summarized on the chart by a regression of growth on investment. The regression line has a positive slope, which is statistically significant and economically important.[6] According to the regression, an increase of ten percentage points in the investment share of GDP is associated with an increase of 1.3 percentage points per year in the long-run growth rate of per capita real GDP.[7]

In response to the inconsistency of the empirical evidence with the standard growth model, new theories of growth have emerged in recent years.[8] In the new theories, policies aimed at raising capital formation can raise growth in the long run. The critical feature of the new theories is that the return to capital for the economy as a whole does not diminish because capital is assumed to have a *direct* effect on an individual firm's output and an *indirect* effect on the output of other firms. As in the standard model, the direct effect of capital on a business firm's output exhibits diminishing returns. In contrast to the standard model, however, increases in a firm's capital also indirectly affect the output of other firms in the economy by increasing such factors as the stock of knowledge and the education of the work force. For example, investment by a handful of firms in personal computer technology produced knowledge that allowed many other firms to manufacture personal computers. As long as the indirect effect is sufficiently strong, the return to capital for the economy as a whole does not diminish. Without the constraint of diminishing returns, policies aimed at spurring capital formation can raise growth in the long run.

WHAT IS THE SOCIALLY OPTIMAL AMOUNT OF CAPITAL FORMATION?

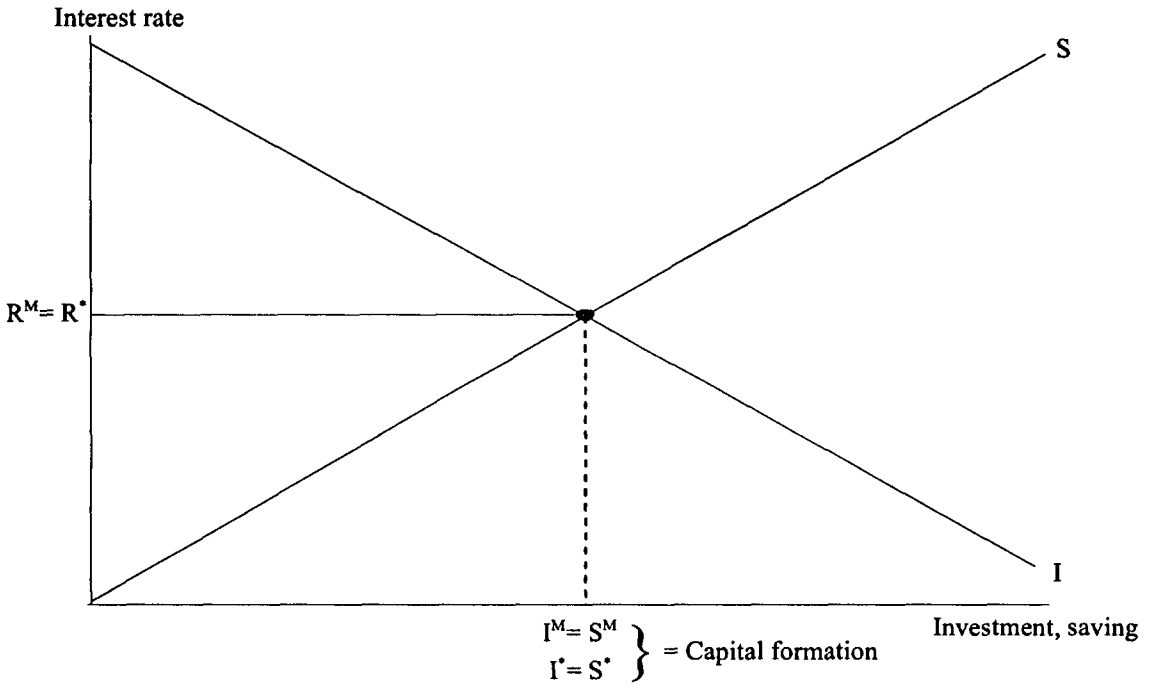
While the new growth theories imply a constructive role for economic policy in raising growth, they do not imply that policy should focus on attaining the highest possible rates of growth and capital formation. Because capital formation requires foregoing current consumption, raising economic growth is not always in society's best interest. This section shows what determines the socially optimal amount of capital formation in the absence of economic distortions. The next section discusses how economic distortions cause capital formation to fall short of the social optimum.

Capital formation depends on the demand for and supply of funds (Figure 1). To concentrate on the essential elements determining capital formation, Figure 1 excludes the role played by government in capital markets and focuses on the private demand for and supply of funds. The demand for funds is represented by the demand for investment goods (I) by firms. The investment schedule relates a firm's investment spending to interest rates (R). Along the schedule, other factors that affect investment are held constant, such as production techniques, the market environment in which goods are sold, and the level of business confidence.[9]

The investment schedule shows that investment spending increases as the interest rate falls. The downward slope of the investment schedule follows from the assumption that, when faced with an array of projects, firms will first invest in the most profitable ventures. Because the initial projects are more profitable, firms are willing and able to pay a higher interest rate to borrow funds. As investment continues, the returns from the remaining projects decline. As a result, firms will

Figure 1

Capital Formation: The Social Optimum



invest in them only at a lower interest rate. Thus, whether a project is attractive cannot be determined without reference to the prevailing interest rate.

The supply of funds is represented by the desired saving of households.[10] The saving schedule (*S*) relates household saving to the level of interest rates. Along the saving schedule, other household characteristics that affect saving are held constant. These characteristics include the level and variability of income, age, marital status, the expected inflation rate, and the access of foreigners to U.S. capital markets.[11]

The saving schedule shows that desired saving increases with interest rates. The response of saving to an increase in the interest rate is more complicated than in the case of investment because households are affected by two forces that pull in opposite directions. On the one hand, an increase in the interest rate today will raise the return on previous savings, raising the amount of funds available tomorrow. To the extent households have a target for the amount of funds needed tomorrow—for example, retirement—this "income effect" will lower saving today. On the other hand, the reward for saving increases with the interest rate and, by itself, this "substitution effect" will make households want to save more. The relative importance of the income and substitution effects on private saving is a topic of much dispute. If these effects were equally potent, saving would be completely unresponsive to the interest rate, and the saving schedule would

be vertical. As shown in Figure 1, this article assumes the saving schedule has a positive slope, reflecting the assumption that the substitution effect dominates the income effect.

The intersection of the investment and saving schedules determines the market equilibrium amount of capital formation (denoted by the "M" superscript in Figure 1). At the intersection, there is a unique interest rate, R^M, that equates the amount of investment willingly undertaken by firms and the amount of saving willingly undertaken by households (I^M=S^M=capital formation). In equilibrium, capital formation will remain unchanged unless the investment or saving schedules are disturbed by a change in one or more of the underlying factors—for example, changes in business confidence or expected inflation.

This market equilibrium corresponds to the socially optimal amount of capital formation when the saving and investment schedules accurately represent all of the benefits and costs of capital formation. An important assumption in economics is that households and firms will make decisions in their own self interest. In the context of saving and investment, households will choose to save and firms will choose to invest in a way that maximizes their own benefits. When the saving and investment schedules are not distorted, these individual decisions will also determine the most favorable amount of capital formation from society's perspective in the sense that no other outcome would lead to a higher level of satisfaction. In other words, in the absence of economic distortions, the market equilibrium amount of capital formation equals the socially optimal amount of capital formation (denoted by the "*" superscript).[12]

HOW ECONOMIC DISTORTIONS REDUCE CAPITAL FORMATION

The amount of capital formation determined by the market is socially optimal only in a world free of economic distortions. In the actual economy, economic distortions cause the market-determined amount of capital formation to fall short of the socially optimal amount. This section considers three sources of distortions: capital income taxation, government budget deficits, and externalities.[13]

Capital income taxation

The need for revenues and considerations of fairness have led governments to tax the income from capital assets. Capital income taxation distorts the saving and investment schedules, causing the amount of capital formation determined by the market to fall short of the amount that is socially optimal.[14]

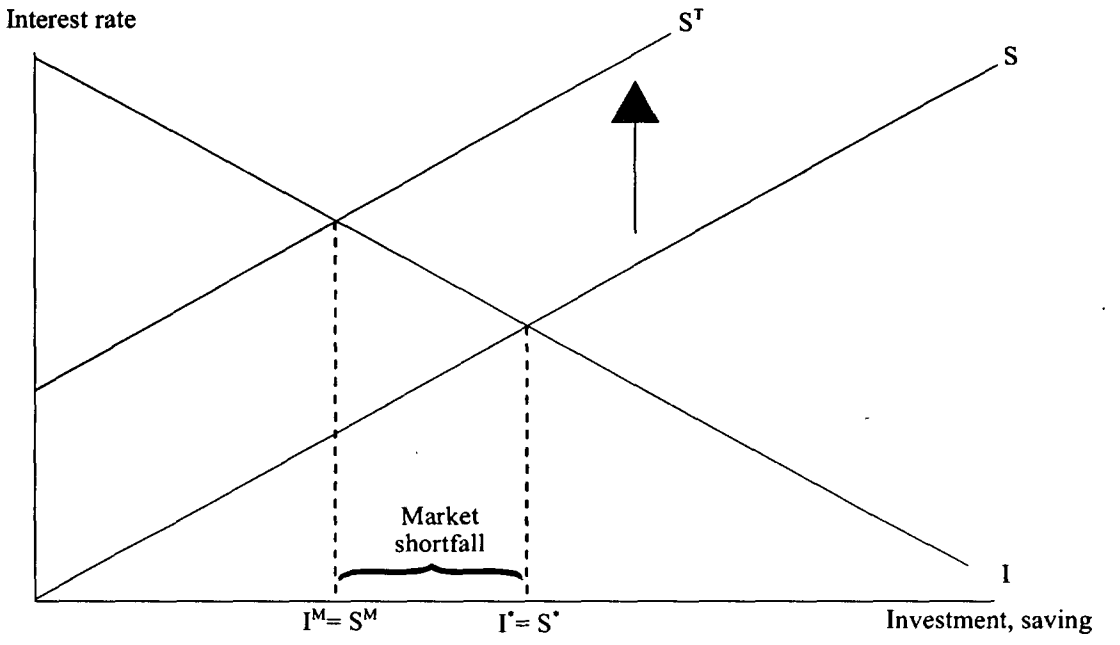
Capital taxes on households reduce the benefits of saving because they lower the post-tax return earned by households (Figure 2).[15] Households' capital income is taxed in a number of ways. Periodic dividend and interest payments are taxed at a rate depending on the households' adjusted gross income. Capital gains are taxed when assets are sold, even if the gain merely reflects the effects of inflation. Such taxes reduce households' returns. As a result, households require a higher pre-tax return to supply a given amount of saving, which is shown in Figure 2 as an upward shift in the saving schedule to S^T.

Capital taxes on households create a market shortfall in capital formation.[16] With the shift from S to S^T, the return required by households is greater than the return to investing at the initial amount of capital formation. To satisfy the higher interest rate required by savers, firms must cut back their investment projects to those with higher returns. In this new equilibrium, capital formation is less than the socially optimal amount.[17]

Capital taxes levied directly on firms also lead to a market shortfall, but by reducing the net return to investment rather than to saving. For example, taxes are assessed on business profits after allowance has been made for production and financing costs. These and other capital in-

Figure 2

Capital Income Taxes on Households



come taxes reduce the net returns earned by firms on all investments. This reduction in returns is represented in Figure 3 (which removes the effects of any household taxes) as a downward shift in the investment schedule from I to I^T. With the shift to I^T, the return to investing is less than the return required by households at the initial amount of capital formation. Consequently, firms must cut back their investment projects to those with higher returns, which creates a market shortfall relative to the social optimum.[18]

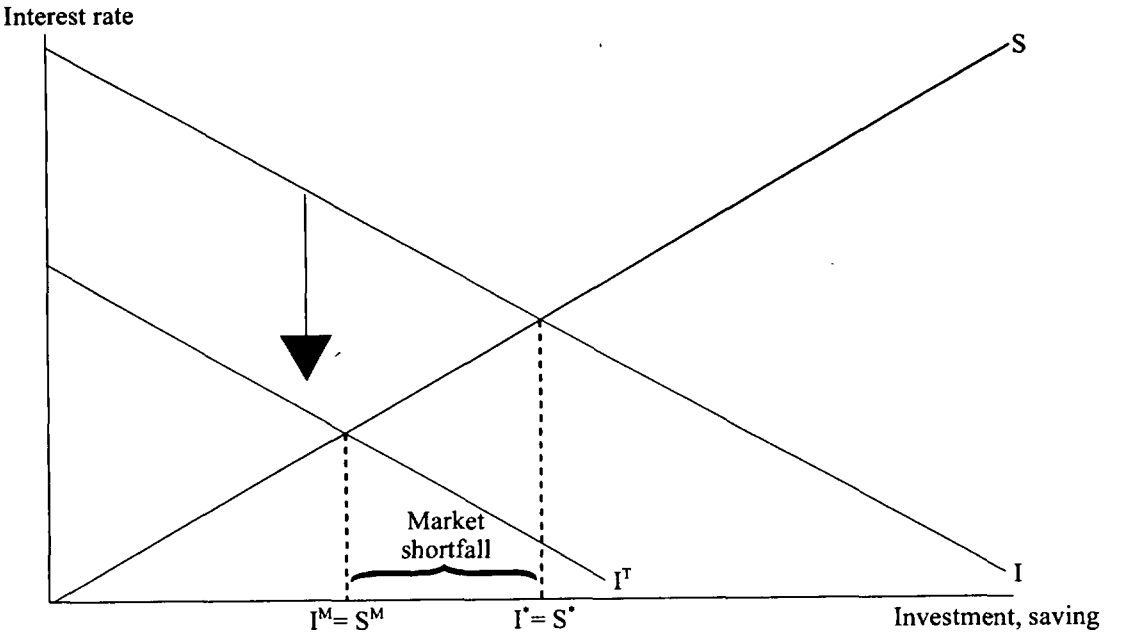
The degree to which capital income taxation creates a market shortfall in capital formation depends critically on the slopes of the saving and investment schedules. For example, suppose the saving schedule is nearly flat because saving is very responsive to interest rates. In this case, taxing households' capital income would have a large effect on capital formation. On the other hand, if the investment demand schedule is very steep, then, even if the saving schedule is as pictured in the figures, shifts in the saving schedule would have only a modest effect on the equilibrium amount of capital formation. Unfortunately, no consensus has yet to emerge on the empirical slopes of the investment and saving schedules.

Government budget deficits

The size of the federal government budget deficit has been a major topic on the policy agenda for a number of years. Government deficits

Figure 3

Capital Income Taxes on Businesses

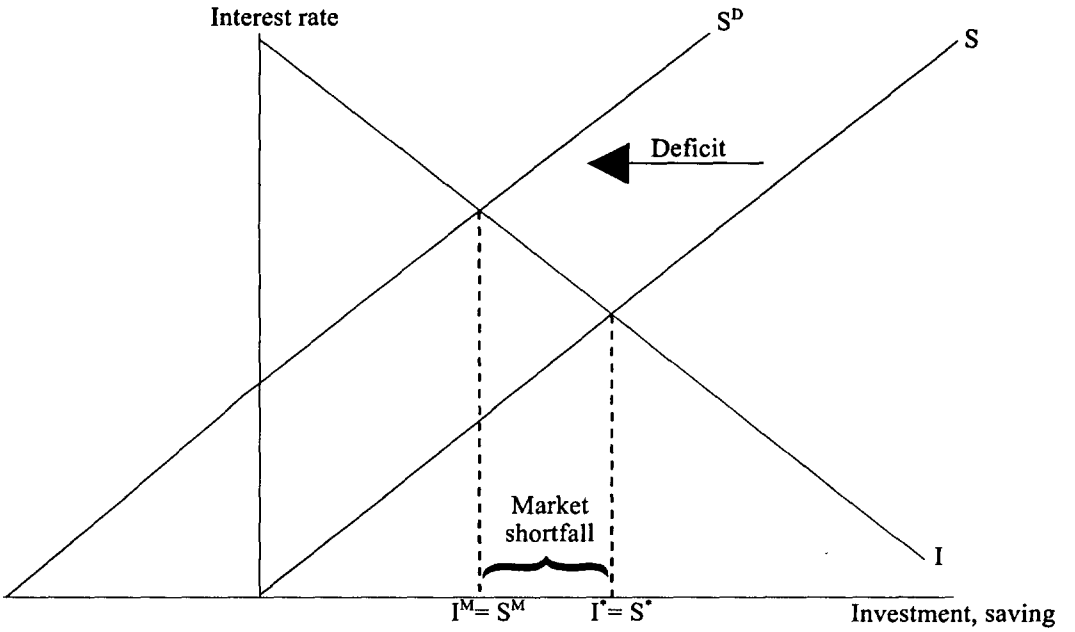


create a shortfall in private capital formation by reducing the pool of saving available for private sector borrowers, thus "crowding out" private capital formation (Figure 4). To the extent that deficits are not used for investment purposes, total capital formation is reduced.[19] An important feature of government borrowing is that it is insensitive to interest rates. That is, the government will borrow whatever it needs to finance its deficit no matter what the interest rate because its budget deficits are always financed. As a result, deficits reduce the funds available for private capital formation, and the saving schedule shifts leftward from S to S^D. This shift equals the size of the deficit. With the shift from S to S^D, the return to investing is less than the return required by households at the initial amount of capital formation. Faced with a higher required return, firms are now more selective in choosing projects and cut back their investment. At the new equilibrium, private investment is crowded out, reducing capital formation below the socially optimal level.

The size of the shortfall in capital formation due to government deficits depends on the slopes of the saving and investment schedules, as well as on two other key and controversial assumptions. First, because current deficits must eventually be paid off with higher taxes, households might increase their saving somewhat to help pay the higher taxes. In that case, the saving schedule would lie between S^D and S in Figure 4. In the extreme, if households increased their saving by enough to fully pay off

Figure 4

Government Deficits



future taxes, government deficits would have no effect on capital formation.[20]

The second factor that might mitigate the effects of government deficits is international capital flows. To the extent that funds flow across national borders, the higher interest rates induced by government deficits would attract foreign funds, replacing the funds lost to the government. In the extreme case of perfectly integrated world capital markets, international capital flows would surge whenever domestic interest rates differed from world interest rates, and the differential between the two rates would disappear quickly. As a result, government deficits would not affect interest rates or capital formation.[21]

Externalities

A key assumption in the analysis of the socially optimal amount of capital formation is that firms and households realize all of the costs and benefits associated with their investment and saving decisions. A "positive externality" occurs when households or firms do not realize all of the benefits created by their actions. Externalities are another type of distortion that creates a market shortfall in capital formation.[22]

Positive externalities may exist in capital formation. Indeed, such positive externalities are one of the key assumptions in many of the new growth theories. Some empirical evidence indicates

that investment in machinery and equipment plays a particularly pivotal role in stimulating growth through learning externalities or as a stimulant to innovation. For example, calculations by DeLong and Summers indicate that the social return to investment in machinery and equipment is much higher than the private return, perhaps as high as 30 percent.

Other types of investment may also generate positive externalities. Some have argued that small firms generate benefits in the form of new ideas and new jobs in excess of the returns accruing to entrepreneurs and venture capitalists. Viewed from the perspective of the aggregate economy, capital formation by small firms yields social benefits that exceed private benefits. In these and other cases, investment generates a positive externality not appreciated fully by private market participants.

Positive externalities produce a market shortfall in capital formation (Figure 5). If investment produces a positive externality, then the socially optimal investment schedule (I^E) lies to the right of the investment schedule faced by market participants (I). The I^E schedule shows the amount of investment firms would undertake if they considered both the private and external benefits from investing. At a given interest rate, firms would be willing to invest more if they actually faced this hypothetical investment schedule. Thus, the socially optimal amount of capital formation—the intersection of I^E and S—exceeds the private market outcome, and there is a market shortfall in capital formation.

POLICIES TO SPUR CAPITAL FORMATION

The distortions that produce shortfalls in capital formation, and therefore in economic growth, suggest a natural framework for assessing policies to spur capital formation. Specifically, policies should be evaluated by the extent to which they reduce the distortions that disrupt capital formation.[23] It is often difficult to evaluate policies, however, because policies that reduce one distortion often produce other distortions as side effects.[24] This section discusses four of the more popular policies that have been proposed to raise capital formation and identifies some of the side effects that might accompany them.

Reducing the federal budget deficit

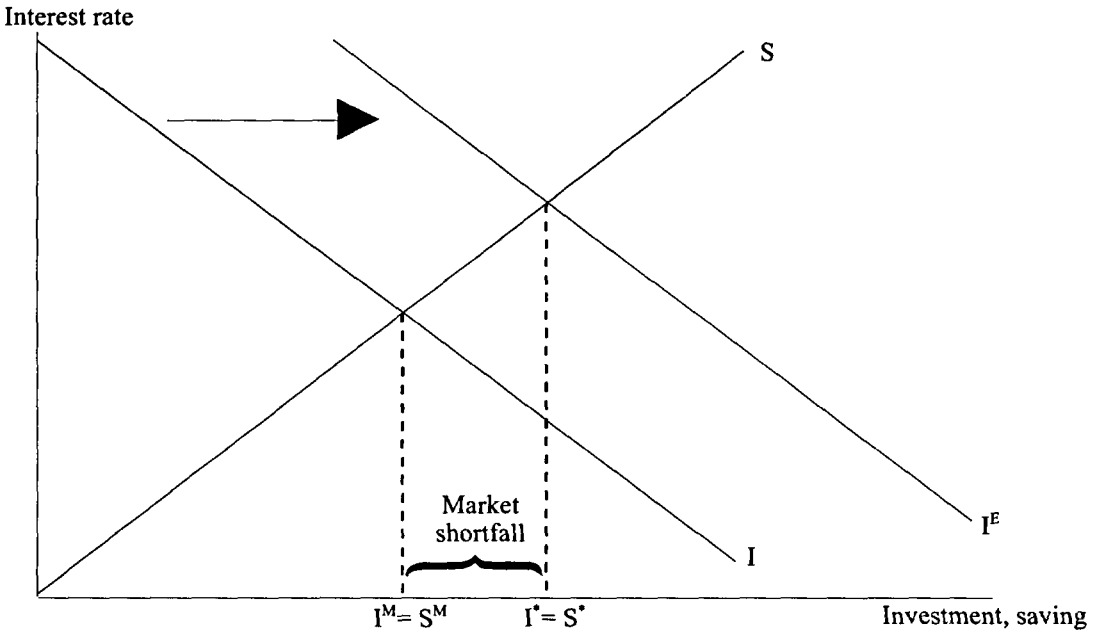
Deficit reduction has been the policy action receiving the most recent attention for stimulating capital formation. The federal deficit has swelled since the late 1970s, rising from just 11 percent of private saving in the latter half of the 1970s to 31 percent in 1992. The focus on deficit reduction is in response to the widely held view that high (and growing) federal budget deficits increase competition for the scarce pool of private saving, raise interest rates, and crowd out private investment (Figure 4). Viewed in isolation, reducing the budget deficit will raise capital formation if the absorption of resources by the government is a major distortion.

The extent to which a lower deficit will raise capital formation, however, depends on how the reduction is financed. For example, suppose the deficit is reduced by raising capital income taxes on households and firms. Raising capital income taxes will lower the post-tax return to saving by households (Figure 2) or investment by firms (Figure 3). Thus, tax financing magnifies one distortion and, all else being the same, lowers capital formation.

The way deficit reduction is financed can also affect the distribution of capital formation across different markets. For example, a tax change that discourages investment in residential real estate will have a favorable effect on the market for business plant and equipment, as investors withdraw some of their funds from the relatively less attractive housing market.

Figure 5

Externalties



The existence of multiple effects is common in evaluating public policies. An analysis of multiple effects is similar to that contained in the above figures, except that many markets would be considered simultaneously and the saving and investment schedules in each market would depend on circumstances in other markets. Reducing the deficit to stimulate capital formation is based on the judgment that the response to lower interest rates is sufficiently strong to counteract the effects of higher capital income taxes.

Reinstituting the investment tax credit

The investment tax credit has been a frequently used instrument of tax policy. An investment tax credit subsidizes investment by allowing businesses to deduct a percentage of their investment from their taxes.[25] Starting in the 1960s, the investment tax credit has been set at various rates, removed, resurrected retroactively, and then eliminated completely in the Tax Reform Act of 1986. Reinstituting the investment tax credit was part of the Clinton Administration's initial economic proposal to Congress, but it was not part of the 1993 budget bill enacted into law.

A key motivation for an equipment investment tax credit is the evidence suggesting there are positive externalities associated with equipment investment that benefit the entire economy (Figure 5). In the presence of such externalities, business equipment investment will fall short of

its socially optimal amount. Thus, subsidizing this type of capital formation is the appropriate policy.[26]

As with deficit reduction, financing the investment tax credit creates additional distortions that temper capital formation. On the one hand, if there is no compensating tax increase, the budget deficit will rise. On the other hand, if the subsidy is financed by increasing some other tax, then there will be an additional distortion that lowers capital formation. Subsidizing equipment investment with a tax credit is based on the judgment that the gains from exploiting the favorable externality exceed the costs from adding distortions elsewhere in the economy.

Lowering the capital gains tax rate

The 1993 budget bill did not include an investment tax credit, but it did lower the capital gains tax rate for specific types of saving. In general, lowering taxes on capital gains increases the return to savers. More specifically, the capital gains tax cut in the 1993 budget bill was targeted at savers that supply capital to small businesses. This policy is motivated by the perception that small businesses generate a positive externality. In the presence of positive externalities, capital formation by small businesses will fall short of its socially optimal amount (Figure 5). Thus, a subsidy targeted at small business capital formation is the appropriate policy.

Choosing between a saving or investment subsidy to stimulate small business capital formation depends on several considerations. Because a given market shortfall in capital formation can be remedied by subsidizing either saving or investment, it is unclear which subsidy is appropriate. Thus, the choice of tax instrument will depend on other considerations, such as administrative simplicity, income redistribution, political feasibility, or interactions with other aspects of the tax code. The latter is perhaps most important in choosing to lower capital gains tax rates because many small firms will have little if any profits with which to use an investment tax credit. Since the investment tax credit is not refundable, firms without any profits would obtain no immediate benefit from an investment credit. Targeting savers who can respond to the incentives provided by a tax cut may be a much more effective way of stimulating small business capital formation.

The desirability of subsidizing small businesses by a targeted cut in the capital gains tax rate is based on two judgments. First, lowering the capital gains tax rate is the most effective tax instrument for directing funds to small businesses. Second, as with the other policies considered above, the gains from exploiting the favorable externality exceed the costs from adding distortions that arise from financing the cut in capital gains taxes.

Replacing capital income taxation by consumption taxation

Replacing the income tax with a consumption tax is a policy favored by many economists. The taxation of capital income retards capital formation because, as illustrated in Figures 2 and 3, the returns to saving and investment are distorted. If the taxation of capital income is the problem, then the solution is simply to choose a tax system that does not tax capital income.

Avoiding the taxation of capital income can be accomplished by taxing only the income spent on consumption. A consumption tax can be implemented in various ways. For example, expanding the tax benefits of IRAs to all forms of saving and eliminating the requirement that the funds can be used only for retirement is one way of replacing the income tax with a consumption tax. Alternatively, the income tax could be replaced by imposing a national sales tax or national value-added tax. In all cases, the net effect is to exempt income from taxation until it is used

for consumption. Concerns with equity and transition problems in moving from an income to a consumption tax have resulted in only modest political interest for this policy initiative.[27]

CONCLUSIONS

Heightened concerns that the U.S. economy has been growing by less than its long-run potential have spurred fiscal policy proposals to raise long-run economic growth through increased capital formation. This article presents a framework for examining fiscal policies aimed at raising capital formation. Three sources of market shortfalls in capital formation are capital income taxes, government budget deficits, and externalities associated with investment in capital goods. Given these distortions, the ultimate success of growth-oriented policies—such as deficit reduction, investment tax credits, capital gains tax rate cuts, and consumption taxation—depends on whether they reduce the economic distortions responsible for the market shortfalls in capital formation.

While the criterion for successful growth-oriented policies is easy to articulate, it is more difficult to evaluate because of interactions among markets and uncertainties about the responsiveness of investment and saving to interest rates and other factors. Quantitative analysis is needed to get a firmer understanding of these market interactions and empirical magnitudes important in determining capital formation. Nonetheless, the important lesson to be drawn from this article is that public policy discussions should focus on those distortions that disrupt the capital formation process and are amenable to policy actions.

ENDNOTES

1 In general, capital formation will be less than investment because of depreciation, the amount of existing capital that "disappears" due to normal wear and tear or to obsolescence as technology improves. Depreciation is not considered in this article because it would complicate the analysis without changing any of the conclusions.

2 See Mankiw and Plosser for more complete discussions of the Solow growth model and its policy implications.

3 The data are from Summers and Heston. The real investment share of real GDP was averaged over the years 1950 to 1988. The growth rate of per capita real GDP was averaged over the years 1951 to 1988 because 1950 was the first year the level of per capita real GDP was available. Guyana was excluded from Chart 1 even though data were available from 1950 to 1988 because it was clearly an outlier the average real investment share of real GDP was 31 percent and the average growth rate of per capita real GDP was -0.7 percent. Including Guyana does not change the qualitative results (see endnote 6).

4 The data were purged of the effect of the initial level of income by regressing the average growth rate of per capita real GDP (y) and the real investment share of real GDP (I) on the initial level of per capita real GDP. The average of y across countries was then added to the residuals from the growth equation, and the average of I was added to the residuals from the investment share equation.

5 This discussion assumes that causality runs from investment to growth. Of course, part or all of the positive relationship between growth and investment may be because there are more investment opportunities in countries with strong economic growth. An example from industry that demonstrates this point is the relative investment and growth of Wal-Mart and Sears. Specifically, a high rate of investment probably is not the source of Wal-Mart's growth relative to Sears; rather, strong growth and the resulting investment opportunities probably are the source of Wal-Mart's high rate of investment.

6 The coefficient on investment is 0.13 and is statistically significant at less than the 0.1 percent level. When Guyana is included in the regression, the coefficient on investment falls to 0.10 but is still statistically significant at less than the 0.1 percent level.

7 Some researchers believe that the evidence in Chart 1 does

not contradict the standard growth model because the average growth rates do not adequately represent long-run growth (Mankiw, Romer, and Weil). Instead, they believe it can take an economy more than 40 years to reach its long-run equilibrium level of output. According to this view, the growth rates in Chart 1 represent temporary differences in growth that occur as the countries move toward their long-run equilibrium level of per capita output. Thus, under this interpretation, the evidence does not contradict the standard model's prediction that growth and the investment share are unrelated.

8 The new growth theories are called *endogenous* growth theories because growth is generated "inside" the model rather than "outside" the model as in the Solow model with *exogenous* growth. See Plosser for a survey of the varieties of endogenous growth models.

9 Chirinko provides a detailed analysis of the investment schedule.

10 Firms also contribute to aggregate private saving but, for the sake of expositional simplicity, their role is ignored. In this article, all saving is done by households, and all investment is done by firms.

11 Kotlikoff provides a detailed analysis of the saving schedule.

12 The socially optimal amount of capital formation is defined in terms of economic efficiency. This definition ignores other factors, such as equity, the distribution of resources, and other noneconomic factors, which may cause society to desire a different amount of capital formation. This article only focuses on economic efficiency, though other considerations are important, if not paramount, in deciding actual outcomes. See Rosen for a more complete discussion of the complicated subject of welfare economics.

13 See Auerbach or Rosen for more detailed discussions of the topics discussed in this section. Our analysis of market shortfalls focuses on only *private* capital formation, thus ignoring the role of and shortfalls in government infrastructure investment (for example, highways and roads, water and sewer systems, mass transit networks, and airports). Recent policy discussions (see Munnell) suggest that the government has been insufficiently vigorous in funding public infrastructure and, as a consequence, the social returns from additional infrastructure investment are large. Thus, shortfalls amenable to policy actions may also exist with respect to *public* capital formation.

14 Given the complexity of the tax code, it is difficult to be definitive about the impacts of capital income taxation on capital formation. For example, while increasing the corporate income tax rate will usually lead to a decrease in investment incentives, highly leveraged firms during inflationary times may actually be tempted to increase investment because of the tax deductibility of nominal interest payments. See Pechman or Rosen for an extended discussion of various tax provisions.

15 These returns must be compared to those available from other assets (for example, housing). Decreases in the returns on alternative assets (perhaps due to changes in tax rates) will shift the supply curve downward.

16 The analysis in this section focuses on just the immediate effect of taxation. A more detailed analysis would take into account that the extra tax revenues obtained from savers could be used to reduce taxes elsewhere in the economy. These additional factors are discussed below when evaluating policies to spur growth.

17 "Market shortfalls" should be distinguished from the related concept of "capital shortages." In many discussions, "capital shortages" refer to an excess demand for investment relative to the supply of saving. However, as shown in Figure 1, such a "shortage" would be eliminated in a market economy by movements of the interest rate until all market participants were satisfied. However, insofar as "capital shortages" refer to a divergence between the market equilibrium and the social optimum, then it is similar to the "market shortfalls" concept used in this article.

18 The "market shortfalls" displayed in Figures 2 and 3 are identical. This equality follows from the result in the public finance literature that the incidence of the tax in terms of equilibrium values for the interest rate (net of the tax) and capital formation is the same whether levied on households or firms.

19 While the deficit may affect the economy in a variety of ways, the focus here is on the role of deficits in creating a shortfall in private capital formation. Among other important issues about the deficit not discussed here are how it should be measured, its effects on current macroeconomic activity, and its consequences for future generations. See Eisner and Friedman for further discussion of these issues. The text also ignores that government spending may be directed toward socially worthwhile ends (for example, aiding flood victims in the Midwest) or investment in public infrastructure (for example, roads and bridges). Consequently, Figure 4 contains only a partial analysis of the effects of deficits.

20 That forward-looking households completely anticipate future taxes to pay for today's deficit and increase saving appropriately is labeled the "Ricardian Equivalence" proposition. This proposition is named after the classical econo-

mist David Ricardo (who did not believe that it would hold as an empirical proposition), and has been introduced into recent debates about the deficit by Robert Barro. See B. Douglas Bernheim for a critical review of the theory and evidence for Ricardian Equivalence.

[21] The empirical debate over capital mobility was initiated by Martin Feldstein and Charles Horioka, who concluded that capital was relatively immobile and hence domestic saving was important for domestic capital formation. This conclusion is as controversial as it is crucial. See Feldstein and Bacchetta for some recent evidence.

[22] Frequently proposed solutions to externalities are for the government to modify market incentives or impose regulations. Economists prefer the former solution because it attacks the externality problem directly by exploiting economic incentives. Some have argued that externalities do not require government intervention and that self-interested individuals can reach an efficient outcome once property rights are established. This solution, introduced by Ronald Coase, becomes less applicable the more substantial are negotiating costs and the less reliable and more restricted the flow of pertinent information.

[23] As noted above, the reader should bear in mind that the impacts of the three distortions on capital formation depend on several assumptions that are implicit in the figures, especially the slopes of the demand and supply schedules.

[24] A complete evaluation would require a quantitative analysis of market interactions and the empirical responsiveness of saving and investment to changes in interest rates and other factors. In addition, when the economy has multiple distortions, removing one capital market distortion may not necessarily lead to an improvement in the welfare of the economy. In light of these "second best" considerations, piecemeal changes in the tax code are generally undesirable and need to be evaluated in a more detailed model than is presented in the figures.

[25] There are two general types of investment tax credits. A unilateral credit applies to all equipment investment and has been the method adopted in previous U.S. legislation. An incremental investment tax credit applies to all equipment investment above a prespecified level of past expenditures. While both types of tax credits provide an incentive to increase investment, the government loses less revenue from the incremental credit.

[26] Since it is unlikely that each type of equipment capital will generate the same level of externalities, the argument in the text suggests that the investment credit should vary across equipment types. While such variation may be the correct policy in principle, administrative and political concerns might dictate a uniform investment credit in practice.

[27] See McClure and Zodrow, and Miller for further discussion of the difficulties in implementing a consumption tax system.

REFERENCES

Auerbach, Alan J. 1992. "Investment Policies to Promote Growth," *Policies for Long-Run Growth*, Federal Reserve Bank of Kansas City, pp. 157-84.

Barro, Robert J. 1974. "Are Government Bonds Net Wealth?" *Journal of Political Economy*, November/December, pp. 1095-1117.

Bernheim, B. Douglas. 1987 "Ricardian Equivalence: An Evaluation of Theory and Evidence," in Stanley Fischer, ed., *NBER Macroeconomics Annual 1987*, Cambridge: MIT Press, pp. 263-303.

Chirinko, Robert S. 1993. "Business Fixed Investment Spending: A Critical Survey of Modeling Strategies, Empirical Results, and Policy Implications," Federal Reserve Bank of Kansas City, Research Working Paper RWP 93-01. (An abridged version is in the *Journal of Economic Literature*, December 1993, pp. 1875-1911.)

DeLong, J. Bradford, and Lawrence H. Summers. 1992. "Macroeconomic Policy and Long-Run Growth," *Policies for Long-Run Growth*, Federal Reserve Bank of Kansas City, pp. 93-128.

Eisner, Robert. 1986. *How Real Is the Federal Deficit?* Cambridge: Ballinger Press.

Feldstein, Martin S., and Phillipe Bacchetta. 1991. "National Saving and International Investment," in B. Douglas Bernheim and John B. Shoven, eds., *National Saving and Economic Performance*. Chicago: University of Chicago Press (for the NBER), pp. 201-20.

_____, and Charles Horioka. 1980. "Domestic Saving and International Capital Flows," *Economic Journal*, June, pp. 314-29.

Friedman, Benjamin M. 1988. *A Day of Reckoning: The Consequences of American Economic Policy Under Reagan and After*. New York: Random House.

Kotlikoff, Laurence J. 1989. *What Determines Savings?* Cambridge: MIT Press.

Mankiw, N. Gregory. 1992. *Macroeconomics*. New York: Worth Publishers, Chapter 4.

_____, David Romer, and David Weil. 1992. "A

Contribution to the Empirics of Economic Growth," *The Quarterly Journal of Economics*, May, pp. 407-37.

McClure, Charles E., Jr., and George R. Zodrow. 1987. "Treasury I and the Tax Reform Act of 1986: The Economics and Politics of Tax Reform," *Journal of Economic Perspectives* 1, Summer, pp. 37-58.

Miller, Glenn H., Jr. 1984. "Alternatives to the Current Individual Income Tax," Federal Reserve Bank of Kansas City, *Economic Review*, September/October, pp. 3-16.

Munnell, Alicia H. 1990. "Overview," *Is There a Shortfall in Public Capital Investment?* Boston: Federal Reserve Bank of Boston, pp. 1-20.

Pechman, Joseph A. 1987. *Federal Tax Policy*, 5th ed., Washington: Brookings Institution.

Plosser, Charles I. 1992. "The Search for Growth," *Policies for Long-Run Economic Growth*, a symposium sponsored by the Federal Reserve Bank of Kansas City, pp. 57-86.

Rosen, Harvey S. 1987. *Public Finance*, 2nd ed., Homewood, Ill.: Richard D. Irwin, Inc.

Solow, Robert. 1956. "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics*, February, pp. 65-94.

Summers, Robert, and Alan Heston. 1991. "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988," *Quarterly Journal of Economics*, May, pp. 327-68.