The Decline in U.S. Saving and Its Implications for Economic Growth

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By conventional measures the U S saving rate declined dramatically over the last ten years Household saving averaged just 3 8 percent of GNP in the 1980s, down from a 5 0 percent average over the previous thirty years Corporate saving has also fallen, and the government has become an increasing net borrower Overall, the net national saving rate—domestic funds available for new investment—dropped to just 3 0 percent in the 1980s, less than half of its historical average of 7.5 percent

Despite these dismal statistics, some would argue that the drop in saving rates is not a cause for concern. No apparent disaster has attended the low saving rate; instead, in the 1980s the United States enjoyed the longest peacetime expansion of the postwar period Spurred by booming stock and real estate markets, the value of wealth rose dramatically during the decade Broader measures of saving incorporating government capital investment and consumer durables show much more saving than conventional measures Furthermore, even if saving has fallen, in a market economy the rate of saving is no more than an expression of people's "time preference"—if consumers have chosen to spend more today and to leave less for tomorrow, why should we question their choice?

This article examines the saving data and finds that concerns about the low saving rate are indeed well founded. The first half of the article documents the trends in a variety of measures of saving. We find that any measure of saving that focuses on the actual acquisition of productive assets shows a clear decline in the 1980s Broader measures of saving do show higher *levels* of saving but also show the same downward trend as the conventional measures Although capital gains from the stock market caused some wealth-based measures of saving to surge in the 1980s, empirical tests reveal that these measures do not capture the growth of productive capacity stock price appreciation is a poor substitute for real asset accumulation

The second half of the article explores the consequences of the saving decline Low saving has not caused a sudden collapse in the economy, but it has caused a steady erosion of the nation's growth potential and it has been accompanied by a sharp increase in net indebtedness to foreigners. A simulation model of the economy suggests that low saving relative to past trends has already cost the economy about 15 percent of its capital stock, lowering the nation's potential output by 5 percent. This drag on growth comes at an inopportune time In the next several decades declining growth in the working age population will increasingly constrain economic growth At the same time, rising environmental costs, increasing payments to foreign owners of U.S assets, and a growing retirement population will make an increasing claim on output Continued low saving and investment reduces the nation's ability to respond to this squeeze on living standards.

On the international front, low saving has contributed significantly to the worsening of the nation's trade and investment position This development in turn has fueled support for restrictions on international trade and investment. It may also have reduced investor confidence and increased vulnerability to shocks from abroad. The U S appetite for foreign capital is especially troubling in light of the growing capital needs of

the emerging market-oriented economies of Eastern Europe and the developing world.

It is not too late to undo the damage of the 1980s. As our simulation model shows, a recovery in the net saving rate to its pre-1980s level would gradually rebuild the capital stock and would tend to reverse the deterioration in the external debt position This saving recovery could be accomplished by balancing the federal budget and raising the private saving rate by about 2 percentage points, or by pushing the government balance into surplus and buying down some of the debt accumulated in the 1980s. Deficit reduction efforts in the last several years, including the recent budget accord, are important steps in this direction, but further action would be needed to complete the process. In the short run, a higher saving rate would mean lower current spending, within a decade, however, consumption would recover to well above its current path Under reasonable assumptions about people's time preference—how they value consumption today relative to consumption tomorrow—the delayed gratification would be well worth it

The 1980s decline in U.S. saving

Saving is one of the most important but most widely misunderstood topics in economic analysis Looking at the subject broadly, we can identify three overlapping concepts of saving. All are useful in certain contexts, but they are not equally useful measures of the long-run health of the economy The three are 1) saving as the increase in net worth, 2) saving as unspent income, and 3) saving as the supply of capital

These would be equivalent if all unconsumed income were used to purchase capital and if all assets remained fixed in price But because these conditions are not satisfied in the real world, it is important to distinguish carefully between the concepts.

The relation between the three concepts

The most comprehensive way to gauge saving is to trace changes in wealth or net worth. Some commentators argue that the rapid increase in wealth in the 1980s reflected an equally rapid increase in the nation's productive potential. To demonstrate why the wealth-based measure of saving may be a deceptive indicator of changes in productive power, we trace the relationship of changes in wealth to saving and to growth in capacity. Wealth is affected not only by saving out of current income—the outright purchase of assets—but also by changes in the value of existing assets Consider the basic definition of wealth, W, as the product of a real stock of assets, A, and a price per unit of assets, P. (Clearly, wealth is equal to assets less liabilities For simplicity, we are using only the word "assets.")

$$(1)\ W = PA$$

Taking first differences, we can derive an expression for the change in wealth (suppressing subscripts on lagged values of variables for the sake of simplicity)

$$(2)\ \Delta W = P\Delta A + A\Delta P$$

The first term of equation 2, $P\Delta A$, is the product of asset prices and real asset accumulation It is conceptually equal to the conventional definition of saving as unspent income, as exemplified in the U S National Income and Product Accounts (NIPA) The second term, $A\Delta P$, is the product of the stock of assets and the change in asset prices, and represents that portion of wealth accumulation due to revaluations, or capital gains

Wealth accumulation clearly bears some causal relationship to the asset accumulation concept of saving Not only does asset accumulation increase wealth, but growth in wealth may also affect decisions to acquire new assets If people feel more wealthy because of capital gains on their assets, they may decide to spend more and put aside less resources for asset accumulation

Neither wealth accumulation nor asset accumulation necessarily measures the growth of productive capital. The assets viewed as components of wealth by the residents of a nation may include items that are not necessarily part of the productive capital stock, such as government debt [1] Suppose the asset list consists of two items, productive capital, K, and other assets, O Further suppose that each asset has a price associated with it, P_K for productive capital and P_O for other assets We can then rewrite the basic expression defining wealth as

$$(3)\ W = P_K K + P_O O.$$

Taking first differences, we have

$$(4)\ \Delta W = P_K\Delta K + P_O\Delta O + K\Delta P_K + O\Delta P_O$$

The first two terms of this expression, $P_K\Delta K + P_O\Delta O$, sum to total asset accumulation (the conventional definition of saving) Note, however, that assets may be

[1]Considerable controversy exists in the economic literature over the issue of viewing government debt as part of aggregate wealth Although an individual's holdings of government debt are clearly part of his or her wealth, it has been argued that some individuals in the population take account of the future taxes that will be levied to redeem the debt and feel poorer as a result See Robert Barro, "Are Government Bonds Net Wealth?" *Journal of Political Economy*, vol 82 (November-December 1974), pp 1095-1118 For a nontechnical discussion of Barro's work and the literature it spawned, see "The Public Purse," *Economist*, November 24, 1990, pp 77-78

accumulated in both "productive" and "nonproductive" forms. The last two terms represent the capital gains on both types of assets.

Neither increases in wealth nor asset accumulation is a precise measure of productive investment. The growth of the productive capital stock is equal to purchases of new capital, $P_K\Delta K$, plus the portion of the capital gains on existing capital that can be associated with increased productivity Thus, total wealth accumulation overstates productive investment because it includes all capital gains and purchases of unproductive assets. Asset accumulation alone also includes purchases of unproductive assets but fails to account for any increased productivity of existing assets

In the actual data, asset accumulation—the conventional definition of saving—and wealth accumulation are fairly readily observed The supply of productive capital, a primary focus of this article, is more difficult to measure Any division of assets into productive and nonproductive categories must be somewhat arbitrary. Likewise, a further division of capital gains on productive assets into those reflecting additions to productivity and a residual category will also be arbitrary.

The next portion of the article examines the data. As we shall see, untangling the various measurements of saving reveals a consistent pattern· a downtrend in the supply of capital and in the growth of productive capacity.

Saving as unspent income

The NIPA compiles data on saving defined as unspent income. Income that is not spent is necessarily used to acquire assets or repay debts Sectoral saving is merely sectoral income less the sum of transfers to other sectors and spending on currently consumed goods and services. Table 1 documents movements in saving, defined this way, over the last generation for the total economy and for the household, corporate, and government sectors. It breaks down the postwar period into four phases. the high-growth 1950s (1953-61), the boom years (1962-73), the productivity slowdown (1974-79), and the most recent period (1980-89, further divided into 1980-84 and 1985-89)

Household saving

Household or personal saving as a share of GNP is shown in the first column in Table 1. Personal saving is usually measured as a percentage of disposable personal income—the commonly reported personal saving rate—but to facilitate comparison with other measures, it is here shown relative to GNP It is clear that personal saving was unusually low in the expansion of the 1980s

Personal saving is arbitrarily defined in the NIPA For example, increases in corporate profits add to personal income and saving only if they are distributed as dividends But if corporate stock values reflect increases in undistributed profits, household shareholders benefit from retained earnings Another anomaly arises in the area of employee benefit plans Employer payments into the reserve funds of private retirement and insurance plans are counted in personal income and saving, while similar payments by government employers are not included Given these anomalies in the construction of personal saving, it makes sense to focus on broader measures of saving.[2]

Corporate and private saving

Corporate saving consists of corporate profits after payment of taxes and dividends Column 2 of Table 1 shows that corporate saving, like household saving, was

[2]Personal saving is still a useful indicator for other purposes While the level of the personal saving rate at any one time may be a poor clue to overall saving (or even to saving by and in behalf of households), changes in the personal saving rate may give some indication as to the underlying strength of consumer demand In general, although special factors such as government pay raises can distort monthly or quarterly data, declines in the personal saving rate are associated with strong growth in consumer demand, while increases are associated with weakness in consumer demand

Table 1

U.S. National Saving

(Percent of GNP)

	(1) Household Saving	(2) Corporate Saving	(3) Private Saving	(4) Government Saving	(5) Net National Saving
1953-61	4 6	2 8	7 4	−0 6	6 9
1962-73	5 1	3 3	8 3	−0 4	7 9
1974-79	5 4	2 5	7 9	−1 2	6 8
1980-89	3 8	1 7	5 5	−2 5	3 0
1980-84	4 7	1 6	6 2	−2 5	3 8
1985-89	2 9	1 9	4 7	−2 5	2 2

unusually low in the expansion of the 1980s In part, the weakness in corporate saving reflects the increasing share of corporate revenues going toward interest expense However, rising corporate interest payments help increase household income and saving. Nonetheless, the sum of household and corporate saving, net private saving, has also been unusually low in recent years (column 3)

Government saving

By NIPA definition all government outlays are either spent on currently produced goods and services or transferred to other sectors, so government saving is simply tax receipts less spending—that is, the government surplus As column 4 shows, the consolidated government budget position (federal plus state and local) went from approximate balance or small deficit for the bulk of the postwar period into deep deficit in the early 1980s. Somewhat surprisingly, the late 1980s saw no improvement in government saving: partial success in curbing the federal deficit was offset by a deterioration in the state and local surplus [3]

Like the definitions of corporate and household saving, the definition of government saving is arbitrary The U.S NIPA differs from the national income accounts of some other countries in treating capital spending by the government as a current outlay rather than saving However, including government capital spending in saving and investment will not change the downtrend: government spending on nonmilitary structures fell to 1¾ percent of GNP in the 1980s from about 2⅓ percent in the 1970s.

The NIPA data on government saving contains other distortions Like corporate saving, government saving has been held down by increased interest payments to households In addition, as mentioned above, government contributions to employee benefit plans are not viewed as compensation of government workers Since both distortions are offset in the household sector, a less deceptive idea of trends in saving can be found by looking at total national saving—the sum of government and private saving (column 5). These figures confirm that national saving has reached exceptionally low levels in recent years

Saving as the increase in wealth

The Federal Reserve Board compiles detailed sectoral data on wealth accumulation and holdings that can be used to calculate both parts of equation 2—the asset accumulation, or saving, portion and the revaluation portion However, a number of adjustments are necessary to make these "Flow of Funds" data useful for our purposes

A preliminary issue is the relationship of these data to the NIPA Information on sectoral asset accumulation in the Flow of Funds differs from its NIPA counterpart for definitional reasons (some saving flows are allocated to different sectors in the two systems), although in principle national saving is defined identically.[4] There are also statistical differences between the systems Table 2 uses Flow of Funds data to calculate saving flows as defined in the NIPA. This procedure suppresses the definitional differences between sectoral saving in the two systems and makes it possible to identify the pure statistical differences A comparison of Tables 1 and 2 shows that the decline in household and private saving in the 1980s is less pronounced in the Flow of Funds data than in the NIPA With the government sector included, however, the national saving

[3]The annual data from 1986 to 1989 do show some reductions in the overall government deficit

[4]The Flow of Funds counts purchases of consumer durable goods in asset accumulation and saving We do not follow this procedure and have removed consumer durables from the data on household asset accumulation and wealth The Flow of Funds treatment of consumer durables does not add to the statistical discrepancies between the Flow of Funds and the NIPA because the Flow of Funds uses the NIPA data on durable goods spending

Table 2

U.S. National Saving as Measured with Flow of Funds Data

(Percent of GNP)

	(1) Household Saving	(2) Corporate Saving	(3) Private Saving	(4) Government Saving	(5) Net National Saving
1953-61	5 6	1 9	7 5	−,9	6 7
1962-73	5 6	2 2	7 8	− 5	7 3
1974-79	5 6	2 7	8 3	−1 5	6 8
1980-89	4 7	1 5	6 1	−2 9	3 2
1980-84	5 5	1 6	7 0	−2 9	4 1
1985-89	3 9	1 4	5 2	−2 9	2 3

decline from the mid-1970s to the late 1980s is comparable in the two systems (although the Flow of Funds shows a decline of about 1 percentage point less if the comparison is made from the 1960s)

We will use the Flow of Funds sectoral asset accumulation data without any definitional or statistical adjustments [5] We will, however, make some adjustments in the Flow of Funds wealth data to derive a comprehensive national wealth accumulation series Some of these adjustments are conceptually simple and easy to make, others, however, are more complicated We present alternative ways of handling the more difficult adjustments

First, the data are adjusted for biases caused by inflation In an inflationary period, the nominal value of wealth must grow at least at the rate of inflation to maintain its purchasing power Accordingly, for all our measures of wealth accumulation we will deduct an estimate of the inflationary component to get a more relevant measure of wealth accumulation trends.[6]

Second, the data are carefully consolidated to avoid double counting. There is no ideal way to measure aggregate wealth accumulation, because one sector may own a claim to the wealth accumulated by another sector (Household ownership of corporate stock is the most obvious example) The most natural way to consolidate the nation's balance sheet is to assume that household wealth accumulation accurately represents economy-wide wealth accumulation, since households are the ultimate beneficiaries of the income generated by productive assets For example, corporate accumulation of productive assets should at least indirectly increase the wealth of household shareowners

To analyze the role of saving in economic growth, the data should ideally be adjusted so that only assets adding to the economy's productive potential are included in wealth For example, household wealth includes holdings of government debt If this government debt is used to finance capital assets (such as roads and bridges), then it should be included in economy-wide wealth, but if it is used to finance current spending (such as government salaries), then it does not add to economy-wide wealth. In practice, changes in government debt, even at the state and local level, do not appear closely related to changes in government capital and therefore may be better left out of our wealth calculations

Another problem that may require adjustment of the data is the inclusion of corporate stock at market value in the standard household wealth measure In the short run, increases in plant and equipment owned by corporations may not be reflected in stock market values. There may also be swings in stock market values that do not reflect changes in the productive potential of firms In particular, changes in tax laws and shifts in investor sentiment can have as strong an impact on stock prices as changes in true productive capacity

To eliminate some of these distortions, Table 3 presents a number of alternative measures of aggregate wealth accumulation All these measures net out the increase in wealth necessary to maintain its purchasing power. Column 1 shows the inflation-corrected increase in the Flow of Funds measure of household wealth (excluding holdings of consumer durable goods) This measure includes corporate equity holdings in the form of both direct household ownership and indirect ownership through mutual funds and fiduciaries Column 2 removes the acquisition of government debt, federal as well as state and local Column 3 replaces the inflation-corrected increase in the market value of corporate equity holdings with the increase in corporate net worth, a measure which will more closely reflect corporate accumulation of productive capital (The corporate net worth series values physical assets at their reproduction cost, so it is affected by changes in asset prices in relation to the general price level as well as by actual investment)

Column 1 shows a marked resurgence in the conventional measure of wealth accumulation in recent years In fact, wealth accumulation in the second half of the 1980s was stronger than in any period since the 1950s. Column 2 shows that removing private sector accumulation of government debt makes a modest difference to this result, but the resurgence in the late 1980s is still

[5] Except for our removal of consumer durables from Flow of Funds asset accumulation and household wealth See footnote 4

[6] The inflation measure used in the calculations was the increase in the implicit price deflator for personal consumption expenditures Similar calculations were done in Carol Corrado and Charles Steindel, "Perspectives on Personal Saving," *Federal Reserve Bulletin*, vol 66 (August 1980), pp 613-26

Table 3

Household Wealth Accumulation in Excess of General Price Inflation

(Percent of GNP)

	(1) Total	(2) Excluding Government Debt	(3) Total, with Corporate Equity Valued on Net Worth Basis
1953-61	13 2	12 9	8 9
1962-73	7 9	8 0	9 6
1974-79	8 6	8 3	15 8
1980-89	8 4	6 9	4 6
1980-84	5 2	4 2	3 7
1985-89	11 6	9 7	5 5

evident Changing the treatment of corporate wealth accumulation, however, makes a crucial difference. Column 3 shows that when corporate net worth is used in place of stock market values, the 1980s as a whole emerges as a period of pronounced weakness in wealth accumulation, especially in comparison with the strength of the 1970s.[7]

The distinction between columns 1 and 3 comes essentially from radically different estimates of capital gains. Table 4 shows capital gains (in excess of general price inflation) on the market value of corporate equity and on corporate net worth In the second half of the 1980s, capital gains on corporate equity averaged about 7 percent of GNP—compared with capital *losses* of about 2 percent of GNP in the late 1970s. Capital gains on corporate net worth were essentially zero in the 1980s, after amounting to about 2½ percent of GNP in the late 1970s. The capital gains and losses on corporate equity feed into the wealth accumulation series shown in column 1 of Table 3, while those on corporate net worth feed into the series shown in column 3 The sharp divergence in the movement of the two capital gains series in the 1970s and 1980s lies behind the divergent movement of the two wealth accumulation series.

Saving as the supply of capital

The decline in national saving in the 1980s did not necessarily result in a one-for-one drop in productive investment First, the official data may misclassify some categories of spending. On the one hand, although both consumer durables and government capital expenditures are classified as current spending, they may be more akin to investment. On the other hand, some components of investment may add less to productive capacity than others. Plant and equipment investment in some ways is very different from inventory and residential investment. Second, foreigners are responsible for a portion of capital formation in the United States If foreign capital inflows exceed outflows, then national investment will exceed national saving Third, as noted earlier, increases in the value of existing assets may implicitly add to the supply of capital if these revaluations reflect increases in their productive potential.

The contribution of foreign saving

Net national saving is one possible measure of the supply of capital This aggregate represents the resources Americans make potentially available for funding productive capital formation. However, capital formation in the United States need not be financed just from domestic sources. The first column of Table 5 repeats the data on trends in national saving shown in Table 1 The second column adds net foreign investment in the United States (excluding foreign purchases of government debt) to net saving We see that despite the surge in foreign investment in the 1980s this measure of the supply of capital has fallen well below its pace in earlier decades.

The large net capital inflows of the 1980s were the financing counterpart of the U S. current account deficit. In principle, current account deficits could stem from high levels of domestic investment that draw in foreign funds In practice, however, the current account deficits of the 1980s mainly reflected high U S consumption. Thus, the foreign inflow simply offset part of the weakness in U S. saving rather than contributing to a high investment rate Furthermore, in any circumstances, foreign investment inflows are not perfect substitutes for domestic saving. A foreign-owned factory might employ just as many workers and produce as many goods as an American-owned plant. However, the profits from the factory's operations will be earned by the foreign own-

[7]Indeed, if government debt accumulation is removed from the column 3 data, the 1980s look even more anemic, with a decade-average ratio of wealth accumulation to GNP of about 3 percent

Table 4

Household Capital Gains in Excess of General Price Inflation

(Percent of GNP)

	Corporate Equity†	Corporate Net Worth
1953-61	7 2	1 0
1962-73	0 5	0 0
1974-79	−2 1	2 6
1980-89	4 8	−0 4
1980-84	2 4	−0 7
1985-89	7 2	−0 2

†Including gains on holdings of insurance companies and pension funds

Table 5

Net Capital Supplies from Saving

(Percent of GNP)

	(1) From National Saving	(2) From National and Foreign Saving
1953-61	6 9	6 4
1962-73	7 9	7 1
1974-79	6 8	6 0
1980-89	3 0	4 0
1980-84	3 8	3 9
1985-89	2 2	4 1

ers, not by Americans Thus, foreign investments will not produce as much income for Americans—or U S GNP—as otherwise equal American investments [8]

It follows that neither of the two aggregate measures in Table 5 precisely captures the saving available to generate GNP growth [9] The column 1 measure (net national saving) does not include foreign productive investment in the United States and so understates the accumulation of productive capital The column 2 measure overstates the accumulation of capital all else equal, capital owned by foreigners will generate less GNP than capital owned by Americans Nonetheless, the decline in both measures in the 1980s suggests strongly that the supply of capital to the United States out of U.S. and foreign saving has fallen

Redefining productive investment

On the expenditure side of the NIPA, national saving equals the sum of net foreign investment, residential and inventory investment, and nonresidential fixed investment Clearly, not all of these investment categories contribute equally to the growth of productive capacity—only the last is conventionally viewed unambiguously as capital accumulation For example, it is plausible to argue that residential investment does not add to the productive capacity of the United States in the same way that other categories do [10] Although this view may represent only a value judgment—homes surely do add to economic well-being—many important issues, such as the future external position of the United States, would hinge more directly on the growth of resources in the business sector of the economy than on the growth of the housing stock

An opposite problem arises with government investment and spending on consumer durables. Government spending on infrastructure clearly adds to the productive capacity of the U.S. economy, but it is not counted as saving in the NIPA (although in the household wealth data, infrastructure spending financed through debt sales to the private sector would be indirectly counted). The national income accounts in most other countries address this problem by distinguishing between government consumption and investment. Consumer durable spending, like housing, creates a stream of future services to consumers, yet it is counted as consumption rather than investment. The failure to include these investment-like expenditures could distort the saving picture.

Although it is reasonable in principle to include infrastructure spending in the supply of capital, in practice actually counting such spending is difficult Not only is it difficult to classify government capital outlays as productive or nonproductive, but it is also difficult to calculate service lives and depreciation schedules for such unique assets (What is the true service life of an airport?) Consumer durables pose similar problems. Nevertheless, including these categories in saving does not change the overall picture While it is true that government investment and consumer durable expenditures are fairly sizable, they also show the same downward trend as private saving in the 1980s, especially outside the military The decline in government spending on structures was noted earlier; consumer durable spending fell from over 12 percent of GNP in the middle 1970s to less than 9 percent in the 1980s.[11]

Are capital gains a form of saving?

A more critical issue in analyzing the connection between saving trends and capital formation concerns the treatment of capital gains. From an individual perspective, capital gains can properly be included in saving the fundamental purpose of saving is the accumulation of wealth so that consumption may be higher in the future, either for an individual or for his or her heirs Anything that adds to wealth can, from an individual's viewpoint, be considered saving. From a policy viewpoint, the aggregate wealth accumulation data shown in column 1 of Table 3 are important because they give a sense of how rapidly or slowly U.S consumers are reaching targeted levels of wealth The acceleration of capital gains in the 1980s probably played an important role in the strong growth of consumer spending in the period and the weakness in

[8]These issues are discussed more fully in M A Akhtar, "Adjustment of U S External Balances," in Federal Reserve Bank of New York, *74th Annual Report, 1988*

[9]Another issue is the treatment of depreciation All saving measures used in this paper are net of depreciation Net saving is available for use in increasing the net capital stock If productive capital is defined in terms of the gross capital stock, then analysis might better focus on gross saving trends (gross saving is net saving plus depreciation) No definitive case can be made for the superiority of the net capital stock to the gross stock as a measure of productive U S capital See A Steven Englander and Charles Steindel, "Evaluating Recent Trends in Capital Formation," Federal Reserve Bank of New York *Quarterly Review*, vol 14, no 3 (Autumn 1989), pp 7-19 However, the trends in gross saving are similar to those in net saving

[10]Of course, on an ex ante basis the saving flows invested in residences could have been invested in other forms of capital

[11]For a discussion of the importance of infrastructure spending, see Michael J Boskin, Marc S Robinson, and Alan M Huber, "Government Saving, Capital Formation and Wealth in the United States, 1947-85," in Robert E Lipsey and Helen Stone Tice, eds , *Measurement of Saving, Investment, and Wealth*, pp 287-356 (Chicago University of Chicago Press, 1988) It has been argued that the decline in infrastructure growth has played a critical role in the weakness of U S productivity growth since 1973 See David A Aschauer, "Is Public Investment Productive?" *Journal of Monetary Economics*, vol 23 (March 1989), pp 177-200

national saving. However, if rapid growth in household wealth is due mainly to revaluations of existing assets, or to government debt issuance, the increased wealth may not represent increased productive capacity Hence, the supply of saving available for capital formation may be inadequate, and increases in consumption stemming from capital gains may not be sustainable

Table 1 reflected this traditional view by omitting capital gains and losses However, some portion of aggregate capital gains will reflect increases in the true productive power of assets, and we may legitimately include these gains when we compute saving as the supply of capital available for increases in productive capacity

Table 6 attempts to construct comprehensive measures of the supply of capital In Table 6 a portion of aggregate capital gains (as always in this article, over and above overall price inflation) is added to the Table 5 saving flows [12] Gains and losses on residential real estate are excluded because realistically they are not part of and cannot be made available for productive investment,[13] but gains and losses on other assets are included. Essentially, columns 1 and 2 of Table 6 correspond to columns 1 and 3 of Table 3 but exclude changes in the value of government debt and capital gains on residential real estate Columns 3 and 4 of Table 6 add to columns 1 and 2 changes in the value of foreign asset holdings. Columns 1 and 3 use stock-market-based valuation of corporations, columns 2 and 4 value corporations on a reproduction cost basis.

The key point in Table 6, as in Table 3, is that it makes a crucial difference whether corporate wealth is valued by the stock market or by reproduction cost. If we value corporations by the stock market, the increase in productive wealth as a share of GNP in the 1980s was sharply higher than in the 1970s and even somewhat higher than in the 1960s If we value corporate assets at reproduction cost, the accumulation of wealth was quite low.

It seems natural to disregard the stock-market-based data since, by construction, the reproduction cost measures are more closely related to the increase in the officially measured stock of physical capital Nevertheless, the stock market measures should be influenced by expected future streams of earnings, and increases in these measures may pick up expected future increases in the productivity of the existing capital stock (say from future improvements in technology) In this sense, at least some share of capital gains in the stock market may represent a form of "investment" and "saving "

A simple way to test whether all stock market capital gains actually reflect future increases in productive capacity and output is to use lagged changes in a capital input measure derived from stock market data in an aggregate production function. Details of this exercise can be found in the Box. In general, the results indicate that stock-market-based series have had little ability to predict future output This finding means that we can reject the hypothesis that all past stock market capital gains and losses reflected changes in the future productive power of capital Thus, in the past, not all changes in stock market wealth were a form of "investment " Our finding further suggests that a measure of the amount of saving actually available for capital formation might well exclude stock-market-based capital gains and losses, although it is certainly true that stock market fluctuations will in part reflect changes in the long-run potential of the economy The problem is that we can neither readily differentiate this source of market fluctuations from others, nor assume that all market changes reflect changes in long-run potential

Once we have recognized the limitations of the stock-

[12]The actual asset accumulation flows used in Table 6 were taken from the Flow of Funds They differ from the NIPA saving series for reasons discussed earlier

[13]Actual purchases of residential real estate are included in the aggregate supply of capital calculations because ex ante they were available to be invested in other forms

Table 6

Estimates of the Supply of Capital

(Percent of GNP)

	Domestic Sources Only		Domestic and Foreign Sources	
	(1) Equity Market Valuation	(2) Reproduction Cost Valuation	(3) Equity Market Valuation	(4) Reproduction Cost Valuation
1953-61	13 0	8 7	12 6	8 2
1962-73	7 0	8 7	6 8	8 6
1974-79	5 7	12 9	5 2	12 8
1980-89	7 8	4 0	8 9	5 0
1980-84	6 1	4 7	6 5	5 0
1985-89	9 5	3 4	11 3	4 9

Box: The Stock Market as a Measure of Saving

Measures of wealth based on the stock market rose more rapidly in the 1980s than those based on the reproduction cost of capital. If the increase in the stock market represents a form of productive saving for the future, then past experience should show that a measure of the capital stock based on the stock market is a good indicator of future output growth.

We assume that output can be explained by a Cobb-Douglas production function, which in logarithmic terms can be written as

$$\ln Y = a + \alpha \ln L + (1-\alpha) \ln K + \lambda t,$$

where Y equals output; L, labor input; K, capital input, λ, the rate of total factor productivity growth; and t, time.† The expression can be restated as

$$\Delta \ln(Y/L) = (1-\alpha)\Delta \ln(K/L) + \lambda$$

We estimated this equation for the nonfinancial corporate sector, comparing a number of measures of the capital input. One measure is the standard net nonresidential capital stock; the others are derived from stock market pricing of the capital stock. We assumed that all the difference between nonfinancial corporate net worth and the market value of nonfinancial corporate equity can be assigned to different valuations of the capital stock. A constant-dollar valuation of the capital stock based on the stock market was derived by dividing this nominal value by the implicit capital stock deflator. If changes in the stock market are truly indicative of future increases in productivity and output (thus making these changes a form of saving), a lag on this measure should help explain output. Accordingly, simple three-year and five-year moving averages of the real stock market capital variable were used as proxies for K.

The estimated equations included a number of standard corrections for cyclical productivity changes and shifts in trend productivity growth. The table reports the coefficients of the capital input variables and the equations' residual standard errors. We see that the three-year and five-year stock market variables show little sign of being adequate proxies for the capital input. The estimated coefficients on these variables, which ideally should equal capital's share of income (about one-third), are barely positive. The coefficient on the net capital stock, though considerably higher than anticipated, is more plausible (it is possible that this term picks up the effect of omitted variables such as inventories and natural resources). Finally, the standard errors of the regressions with the stock market variables are quite high relative to the standard errors in the regression using the conventional capital stock variable.

†For further details, see Englander and Steindel, "Evaluating Recent Trends."

Performance of Capital Input Measures in Production Relationships

Capital Input Measure	Coefficient	Equation Residual Standard Error
Net capital stock	770	01
Stock-market-based measure (three-year average)	005	07
Stock-market-based measure (five-year average)	043	07

Note: The estimated equations are of the form

$$\ln(\text{lprod}) = a_0 + a_1 \ln(\text{caphrs}) + a_2\, \text{cycl} + \sum_{i=3}^{7} a_i T_i,$$

where

lprod = nonfarm business sector labor productivity
caphrs = the ratio of capital to hours worked
cycl = a measure of capacity utilization (the ratio of actual to potential real GNP, as calculated by the Federal Reserve Board staff)
T_i = a set of time trends (allowing for breaks in 1952-61, 1962-68, 1969-73, 1974-79, and 1980-88)

market-based data, the evidence on U.S. saving trends becomes clearer: saving, in the sense of supplying capital for the expansion of the U.S. economy, has reached extremely low levels This conclusion is true for all three concepts of saving; it is true whether we include or exclude foreign capital; and it is true regardless of how broadly we define investment [14]

The case for higher U.S. saving

Clearly U.S. saving in the 1980s was low by just about any measure, but should this be a cause for concern? On the surface, the economy performed reasonably well despite the low saving rate. Indeed, the declining saving rate spurred consumption, contributing to the cyclical recovery following the 1982 recession. For the decade as a whole, annual growth in GNP per capita averaged only about 0.5 percentage point below the postwar average.[15] U.S. external debt grew, but the foreign investors brought in new capital, and net indebtedness to foreigners remained small as a share of GNP. If low saving has hurt the U.S. economy, the effects are well disguised.

The remainder of this article uses a simulation model of the U.S. economy to uncover, and quantify, the subtle costs of low saving. The model links the three basic components of growth—saving and investment, labor force growth, and technological advance—to economic growth and the U S. external debt position. Three variations of the model are employed to accommodate the diverse views held by growth experts about the interaction between investment and technological change the traditional model that considers technology to be independent of investment and two alternative forms of the model that regard new capital investment as a spur to technological change. Details of the model are presented in the Appendix

With this model we ask. What has been the cost of low saving in terms of economic output, living standards, and external indebtedness? What would be required to rectify the situation? Would the sacrifice of current consumption be worth it? And finally, what are the limits of what higher saving rates can accomplish?

The legacy of the 1980s

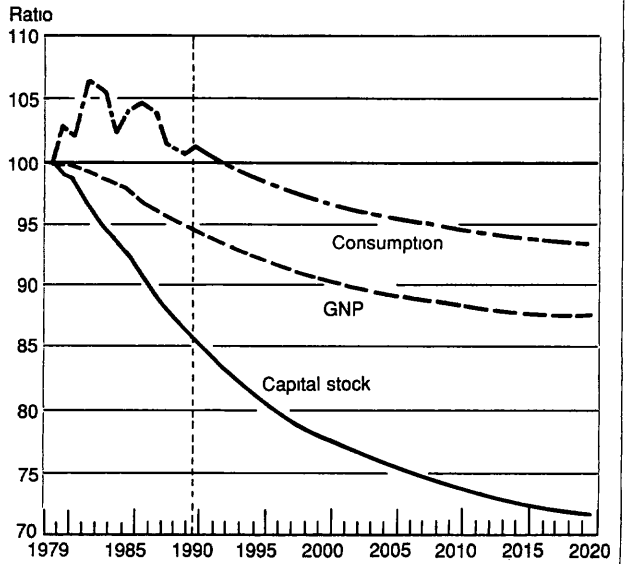
Low saving in the 1980s left the U.S economy with a relatively low capital stock, low output, and a large foreign debt A simple way to quantify the damage is to compare two saving scenarios (using the NIPA saving data) The first, a "status quo" scenario, assumes that the net saving rate followed its actual path in the 1980s, falling to about 2.0 percent in 1990, and will remain at that level into the future The second, the "1950-79 trend" scenario, assumes that the net saving rate never fell from its 1950-79 average of about 7½ percent.

Chart 1, using traditional model estimates, shows that low saving made possible a surge in consumption in the 1980s but at considerable long-run cost By 1989 low saving had cost the U.S. economy about 15 percent of its capital stock and about 5 percent of its potential GNP Furthermore, by the end of the century, the accumulated loss could grow to 28 and 10 percent, respectively In fact, even the gain to consumption should be short-lived. by the early 1990s weak economic growth should push consumption below the 1950-79 trend scenario

The U.S. net external debt position suffered as well. In the 1970s, with U.S. saving and investment roughly in balance, the United States was a modest net capital exporter As the saving rate declined in the 1980s, however, an increasing portion of investment was financed by net foreign capital inflows. Of course, the

Chart 1

Impact of Low Saving



Note The chart shows the status quo scenario relative to the 1950-79 trend scenario

[14]The United States was not the only nation to see a decline in saving in the 1980s See Andrew Dean, Martine Durand, John Fallon, and Peter Hoeller, "Saving Trends and Behavior in OECD Countries," *OECD Economic Studies*, no 14 (Spring 1990), pp 7-58

[15]Real GNP growth averaged 2 6 percent from 1980 to 1989, down from 3 6 percent over the previous thirty years In per capita terms, the decline was more modest, reaching 1 6 percent in the 1980s from 2 2 percent in the previous period

Table 7

U.S. External Position in Book and Market Value

(Percent of GNP)

	Book Value			Market Value		
	Assets	Liabilities	Net Assets	Assets	Liabilities	Net Assets
1979	20 4	16 6	3 8	26 0	17 9	8 1
1989	27 0	39 7	−12 7	42 2	44 7	−2 5
1999†	36 3	55 6	−19 3	48 5	63 5	−15 0
2009†	46 1	68 9	−22 8	58 3	81 2	−22 9

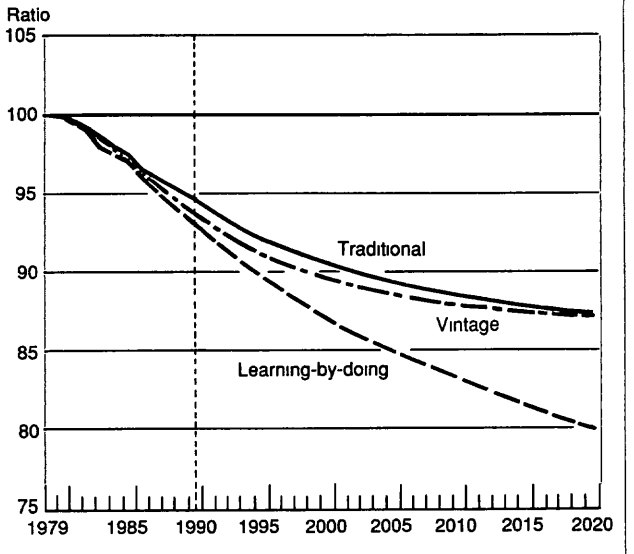
†Projections assume a status quo scenario with net capital inflows of 1.6 percent of GNP per year, GNP growth of 6 3 percent per year, and growth in total capital flows of 8 percent per year

causes of the surge in external debt are complex, but it is reasonable to argue that low saving played a key role.[16] Foreign investments in the United States grew fivefold in the 1980s, while U S investments abroad grew less than threefold As a result, the United States went from a net creditor position of 4 percent of GNP in 1979 to a net debtor position of 13 percent a decade later (Table 7) If net capital inflows continue at the current pace of 1½ percent of GNP, U S net indebtedness will reach 19 percent of GNP by the turn of the century and eventually grow to a peak of over 25 percent.[17]

The cost of low saving may be even greater than the traditional model suggests. Many recent studies of economic growth have emphasized the link between capital formation and technological change If capital "embodies" new technology, a decline in saving may be a double blow to the economy: not only is there less capital, but existing capital also becomes increasingly outdated Chart 2 shows the GNP path under three assumptions about technological change the traditional model, in which technology is independent of investment, the "vintage" model, which assumes higher investment lowers the average age and adds to the productivity of capital, and the "learning-by-doing" model, which assumes that new investment not only adopts the latest technology, but actually encourages further innovations

Chart 2

Impact of Low Saving on Real GNP under Alternative Models



Note The chart shows the status quo scenario relative to the 1950-79 trend scenario.

The alternative models suggest much stronger impacts on GNP from lower saving than does the traditional model In both alternative models the level of GNP is an additional 1 to 2 percentage points lower by 1989. In the vintage model these technology effects eventually peter out [18] In the learning-by-doing model,

[16]The economic mechanism was as follows low private saving and high government borrowing put upward pressure on U S interest rates, this made U S investments relatively more attractive, encouraging net capital inflows, these inflows in turn took some of the pressure off of interest rates The overall result was that U S net investment fell about one-third less than net saving during the 1980s, with the difference accounted for by increased capital inflows

[17]A number of measurement problems plague the official data Adjusting the data, however, does not alter the general picture of a deteriorating trend For example, in the official data, direct investment is measured at book values, a procedure which understates the value of the generally older U S investments abroad When the data are adjusted to market values (as shown in Table 7), the level of net debt is much lower but the trend is nearly as bleak from 8 percent in the black in 1979 to 3 percent in the red in 1989, and 15 percent in the red by the turn of the century For details behind these calculations, see Appendix

[18]As the economy approaches its long-run growth path, growth in the capital stock slows so that new capital is no longer a dispropor-

however, lower investment means a slower pace of "learning" and technological innovation, permanently reducing annual GNP *growth* by 0 3 percent.

The benefits of a saving recovery

It is not too late to undo the damage of the 1980s Charts 3 and 4 present traditional model estimates of the impact of a saving recovery Chart 3 shows the impact on economic growth of a "recovery" scenario, in which the net saving rate rebounds to its historical average of about 7½ percent over the next five years. Chart 4 puts this recovery in perspective, comparing it with the 1950-79 trend scenario (in which the saving rate never declines) and with the status quo scenario (in which the saving rate remains at its 1990 level of about 2 percent) All three scenarios assume that the labor force grows in line with the official projections of the Social Security Administration The simulations also assume a 1 percent contribution to growth from technological advance

In the status quo case the economy continues along its current low growth path until about 2010 (Chart 3) Saving is just sufficient to replace worn out capital and provide for net capital growth of about 2 percent Real output, consumption, and investment also settle into an equilibrium growth path of 2 percent Early in the next century, as the "baby boom" generation begins to retire, the labor force stops growing, pulling down GNP growth to about 1½ percent. With the saving rate unchanged, the United States continues to rely on foreign capital inflows equivalent to 1½ percent of GNP.

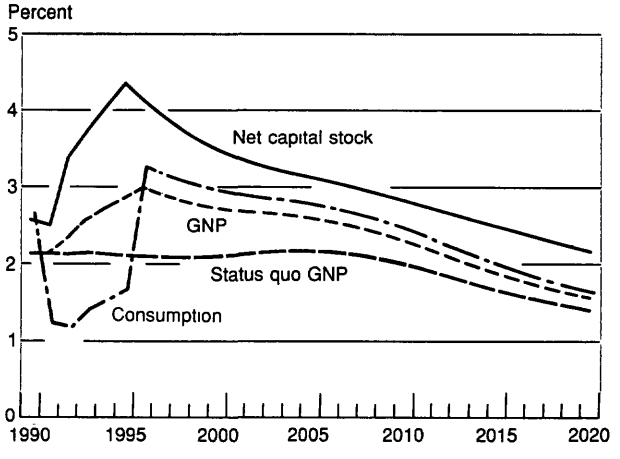
An increase in the saving rate upsets this equilibrium Higher saving flows into investment, and net capital stock growth surges, pulling up GNP growth as well The GNP growth acceleration is relatively modest but can extend over a long period of time. In the first five years of the saving recovery, GNP growth averages 0 5 percentage point higher than in the status quo; the differential then notches up to 0 8 percent in the second five years and declines thereafter The growth expansion is self-limiting, however. In the years following the saving rebound, the capital stock rises relative to GNP but saving remains fixed as a share of GNP, so growth in the capital stock tends to slow over time As a result, consumption, investment, and GNP all gradually settle into a new path at higher levels, but with the growth rate back at its original pace of about 2 percent (Chart 4) [19]

Eventually the temporary fall in saving is "forgiven,"

Footnote 18 continued
tionate part of the total At this point the average age of the capital stock stops declining and technological advance returns to its long-run trend See Appendix for details

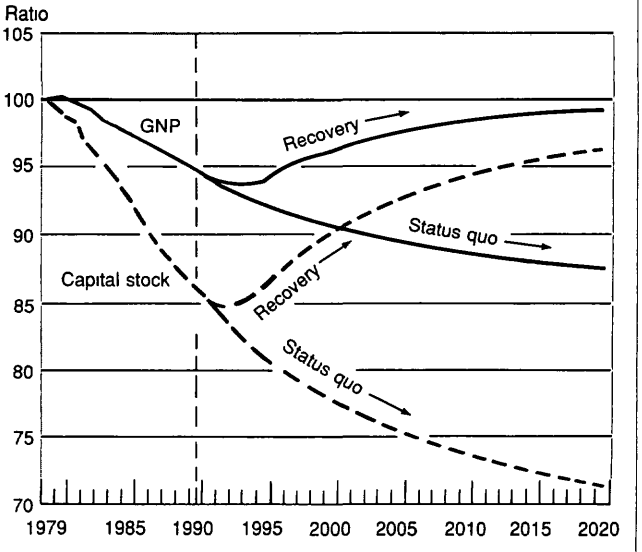
[19] In the traditional model, permanently raising the GNP growth rate requires an ever-increasing saving rate For example, raising growth by 1 percent would require increasing the saving rate by about 0 4 percentage point each year *for as long as growth is to be kept higher*

Chart 3
Impact of a Saving Recovery on Real Growth



Note Chart shows growth in net capital stock, GNP, and consumption for the saving recovery scenario

Chart 4
Comparison of the Recovery and Status Quo Scenarios



Note Each series is plotted relative to the 1950-79 trend scenario

in the sense that GNP returns to its 1950-79 trend path. As Chart 4 shows, however, this recovery can take a considerable period of time. By 2010, twenty years after the saving rate rebounds, real GNP and the capital stock are still 1 8 percent and 6.0 percent, respectively, below their 1950-79 trend scenario levels

The benefits of higher saving are greater if the new investment also encourages technological change Chart 5 shows the recovery and status quo paths for GNP under both the traditional model and the alternative learning-by-doing model.[20] The low saving of the status quo scenario is especially damaging in models with embodied technology Unlike the traditional model, in which the loss of output eventually stabilizes, the learning-by-doing model shows GNP steadily dropping relative to trend Clearly a saving recovery is preferable to this steady loss of output. Nevertheless, even with the saving recovery, the learning-by-doing model never fully forgives the saving shortfall of the 1980s: GNP settles below the trend scenario because of the permanent lost learning of the 1980s.

A rise in the saving rate could also cause a dramatic improvement in the U S. external asset position (Chart 6) During the 1980s increased foreign capital inflows replaced roughly one-third of the drop in net national saving, preventing an even more dramatic drop in net national investment As a reasonable first approximation our model assumes that this process reverses when net national saving rebounds. With saving restored to its pre-1980s average, the United States could again become a (modest) net capital exporter, causing a steady decline in the net debt position as a share of GNP[21] Note, however, that this improvement in the nation's net debt position does not eliminate our dependence on foreign capital Instead, continuing efforts by investors to diversify their portfolios internationally should mean continued rapid growth in both external liabilities and assets, even as the gap between the two narrows[22]

The long-run consumption reward

If the sole goal of economic policy is to maximize output, a higher saving rate is always better, and the only policy question is how to get it higher Presumably the principal goal of higher saving is not just higher GNP, but higher living standards as well The ultimate test of saving policy, therefore, is whether it improves the time profile of consumption

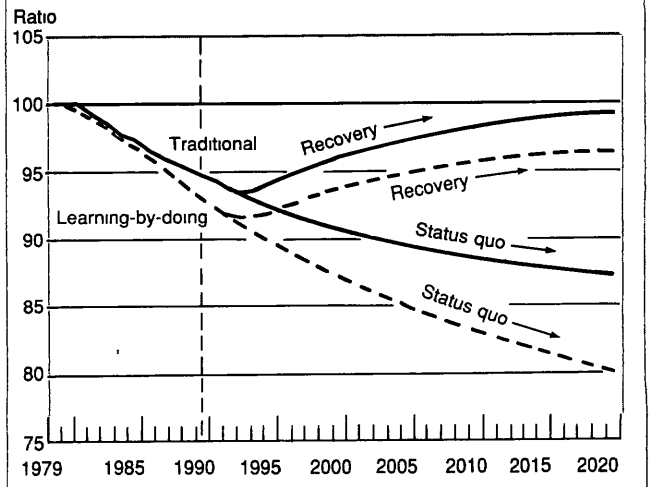
[20]To keep the chart uncluttered, the "vintage" model is excluded As Chart 2 suggests, the vintage model behaves like the learning-by-doing model in the short run and the traditional model in the long run

[21]As the Appendix shows, if net capital inflows do not decline in response to the saving recovery, the benefits to GNP from higher saving are even greater

[22]In the 1980s, total capital flows, the sum of inflows and outflows, grew at an annual rate of 12 7 percent, almost twice as fast as nominal GNP growth of 7 6 percent Our simulations assume that this diversification continues at a more modest pace in the future, with 8 percent growth in total capital flows and 6½ percent growth in GNP See Appendix for further details

Chart 5

Impact of a Saving Rate Recovery on Real GNP under Alternative Models



Note: Each series is plotted relative to the 1950-79 trend scenario

Chart 6

International Capital Position in the Recovery Scenario

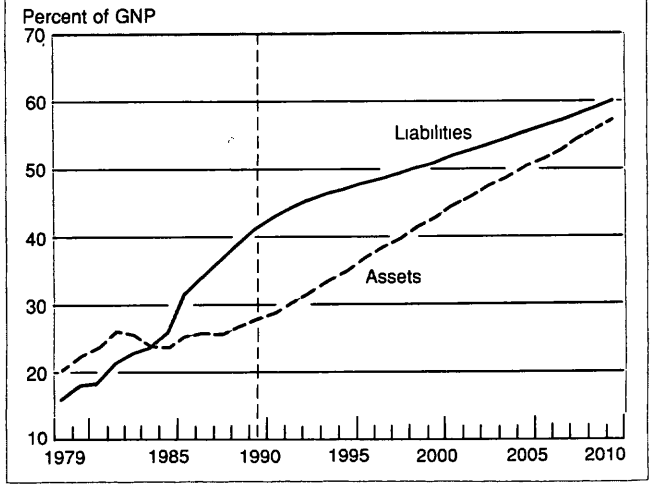


Chart 7 compares aggregate consumption for the status quo and recovery scenarios with aggregate consumption for the 1950-79 trend A permanently lower saving rate can have considerable immediate benefit to consumption. Had the saving rate remained on trend in the 1980s, consumption would have averaged 3 3 percent less than it actually was. Yet the payback for this consumption binge is already being felt By 1992, if the status quo continues, the cumulative income loss from low saving will already have pushed consumption below the trend level. Most of the costs of the consumption binge would be felt in the next century when consumption drops to 10 percentage points below trend and then stays there forever (This is what some commentators mean when they say that low saving has "mortgaged" our future.)

In the recovery scenario the excesses of the 1980s are reversed in the 1990s. Consumption drops sharply and then gradually converges back to the trend level. In fact, in the traditional model the highest possible consumption path is achieved with gross saving rates of close to 30 percent.[23] If saving rises above 30 percent, the gain to consumption from higher output is more than offset by the need for more resources to maintain the capital stock

The consumption "reward" for higher saving can take many years to materialize. For example, consumption in the recovery scenario will not surpass consumption in the status quo scenario until the turn of the century (Chart 7) Determining whether this delayed gratification would be worthwhile requires some measure of people's time preference—the rate of discount that equates the utility of current and future consumption. The precise magnitude of this discount rate is a matter of considerable dispute, yet under any reasonable assumption the saving rate appears low For example, even if the discount rate is as high as 5 percent and if people's time horizon is only thirty years (they essentially do not care about unborn generations), society is still better off under the recovery scenario than under the status quo Indeed, the status quo saving rate would only be justified if the discount rate were as high as 10 percent [24]

Difficult, but not impossible

Restoring the capital stock to its pre-1980s path will require a sustained increase of more than 5 percentage points in the national saving rate. This task appears particularly daunting in view of the downward trend of the last decade Furthermore, with most studies showing only a limited response of private saving to incentives, the main burden of adjustment must fall on the worst saver of all—the federal government

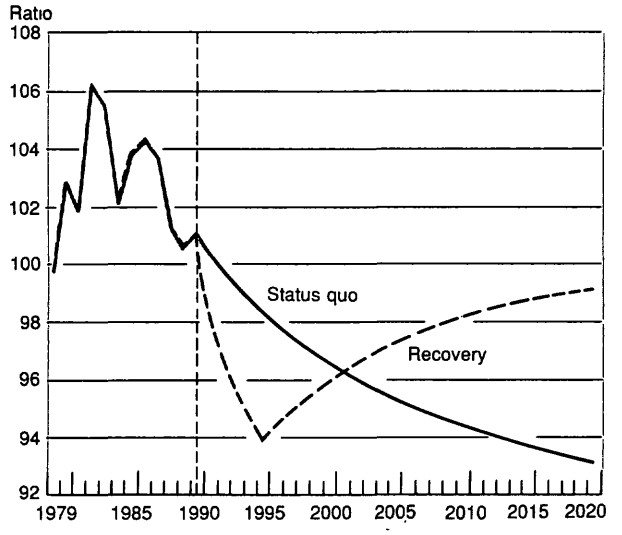
Recent efforts to reduce the budget deficit suggest that significant progress can be made. The Congressional Budget Office estimates that in the absence of the fall 1990 budget accord the 1995 budget deficit (excluding revenues from the sale of thrift assets) would have been 2.8 percent of GNP. The accord reduced this to 0 8 percent of GNP—in other words, the agreement goes roughly two-thirds of the way toward a balanced budget Continuing this process all the way to budget balance would increase the national saving rate a total of 3 percentage points from current values. By the end of this decade this partial rebound in the saving rate could add about 7½ percent to the U S. capital stock, increase real GNP by about 2 percent, and slow growth in net external debt to the point where it would no longer be increasing as a share of GNP.

Not only should the budget deficit be eliminated, but a case can also be made for a budget surplus With a

[23]The growth literature calls this the "golden rule" consumption path

Chart 7

Real Consumption under Alternative Saving Scenarios



Note Each series is plotted relative to the 1950-79 trend scenario

[24]If saving is "suboptimal," why don't people save more? In many ways government tax and spending policy tends to discourage saving and redirect income to less productive uses But even without these distortions, private saving decisions are probably not "socially optimal " By ensuring a healthy economy, with a growing economic pie, saving contributes to social stability and confidence in the future For these and other reasons, private decisions may yield less saving than what is collectively desirable

budget surplus the Federal government could begin buying down debt accumulated in the 1980s, freeing up resources for private investment. One way to generate a surplus would be to balance the non-Social Security portion of the budget The annual surplus of the Social Security System now offsets about one-fourth of the deficit in the rest of the budget By the turn of the century, the Social Security surplus could reach 2 percent of GNP Balancing the budget exclusive of Social Security trust funds and pushing the unified budget into surplus, therefore, could raise the saving rate almost 5 percentage points. This is close to the saving path suggested by the recovery scenario discussed earlier

Conclusion

The 1980s saw net national saving fall to its lowest rate of the postwar period. All measures of saving that estimate the actual acquisition of productive assets confirm this finding The costs of this poor performance have been subtle but quite real. temporarily higher consumption has been gained at the long-run expense of several years' worth of GNP growth and a complete reversal of the U S external debt position. In particular, our simulation results show the following

- Traditional model estimates indicate that the drop in saving in the 1980s has already cost the U S. economy about 15 percent of its capital stock, lowering potential output by about 5 percent. By the end of this century, if the status quo continues, the accumulated loss in capital and output will grow to 28 percent and 10 percent, respectively
- The actual cost may be even greater In an alternative, learning-by-doing model, which links capital formation to the pace of technological innovation, the estimated loss to potential output was over 7 percent in 1990 and could rise to about 15 percent by the year 2000.
- Foreign capital inflows in the 1980s prevented an even greater shortfall in the capital stock, but in the process the United States has gone deeply into debt At current rates of net capital inflow, in ten years the United States will pay more than 1 percent of its annual income to service this foreign debt, an exact reversal of its position ten years ago
- The U.S. net saving rate would have to climb 5½ *percentage points as a share of GNP to offset the decline of the 1980s, restore* the trend in capital growth, and end the deterioration of our external debt position
- Most of this gap could be closed by balancing the federal budget excluding the Social Security surplus The recent budget accord is a significant step in this direction.
- Raising the saving rate will require lower current consumption The present saving rate can be justified only if people put a very low value on future consumption compared with present consumption. If we assume a reasonable "discount rate" of 2 percent per year—roughly the real return to government bonds in the postwar period—lifetime consumer satisfaction is maximized with a net saving rate four times the current pace

A higher saving rate is not a cure-all for the nation's ills Higher saving means a higher level of output, but it does not sweep away the inflation and unemployment problems of the business cycle Although higher saving would probably reduce the nation's *net* foreign indebtedness, it will not mean an end to the gross inflow of foreign capital Furthermore, not all saving is equally productive. The growth benefits of higher saving could be greatly increased by eliminating tax distortions favoring less productive investments. Finally, in the 1980s not only did private spending shift out of investment into consumption, but public investment lost out to current spending as well. A healthier economic outlook will require redirecting all kinds of spending toward investment—not only in plant and equipment, but also in infrastructure, education, environmental safeguards, and research

Appendix: The Growth Model

All growth simulations in the text are based on a detailed neoclassical representation of the U S economy This simple growth framework is a powerful tool for exploring alternative paths for the economy Offering a clear connection between results and assumptions, the framework can be easily manipulated, and it has a long track record of use in previous research.† The model also has some disadvantages It is highly simplified, lumping capital and output into very broad aggregates It also ignores the short-run costs of changing the saving rate, focusing instead on the long run ‡ This Appendix reviews the main equations of the model and then tests the robustness of the results to changes in model parameters Several notation conventions are followed· a "%" before a variable indicates a growth rate, "(-1)" means "lagged one period," "Δ" signifies the change from a year ago, and a "C" suffix means "measured in constant 1982 dollars "

Labor

Labor input is measured by aggregate hours worked Growth in hours is assumed to equal the growth in working age population plus an add factor to account for increased participation rates·

(1) %LAB = %POP + ADD.

Most simulations use the "middle" population projections of the Social Security Administration§ and assume an add factor of 0 1 percent Variables measured in per capita terms also use the Social Security Administration's projections for total population

Capital

The model treats the nominal gross saving rate as exogenous, distributes saving among its various uses, and then calculates the implied capital accumulation The basic saving identity determines the share of GNP going to investment

(2) I/GNP = S/GNP + NFI/GNP,

where S is gross national saving, I is gross investment, and NFI is net foreign capital inflows We assume that, in line with the 1980s experience, net foreign capital inflows decline by one-third of any improvement in the saving rate ‖

(3) NFI/GNP = [015 − 333•(S/GNP − .13)]

Investment is divided between residential (IR), nonresidential (IN), and inventories (IV). We assume that, consistent with the 1979-89 trend, a gradually declining share of investment goes into the residential sector and a fixed portion goes into inventories

(4) I = IR + IN + IV
= (3 − 00178•T)•I + (67 + 00178•T)•I
+ 03•I,

where T is a time trend equal to 1 in 1991.††

These nominal investment flows are converted to real investment by subtracting the assumed rate of inflation of 4 percent A portion of real nonresidential investment (INC) is allocated to the farm (IFC) and "other" (IOC) sectors, and the remainder goes to nonfarm business (INFBC).

(5) INFBC = INC − IFC − IOC

These investment flows, along with assumed depreciation rates, determine capital accumulation The key capi-

†The basic framework was developed in Robert M Solow, "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics*, vol 70 (1956), pp 65-94 Recent extensions of the model include Paul M Romer, "Increasing Returns and Long-Run Growth," *Journal of Political Economy*, vol 94, no 5 (1986), pp 1002-37, Robert E Lucas, "On the Mechanics of Economic Development," *Journal of Monetary Economics*, vol 22, pp 3-42, and Maurice F Scott, *A New View of Economic Growth* (Oxford Clarendon Press, 1989) Two recent applications are a study of the Social Security system, Henry Aaron et al , *Can America Afford to Grow Old?* (Washington D C Brookings Institution, 1989), and a study of demographic trends, Keith Carlson, "On Maintaining a Rising U S Standard of Living into the Mid-21st Century," Federal Reserve Bank of St Louis *Review*, vol 72, no 2 (1990), pp 3-16

‡A sharp increase in the saving rate could cause the economy to weaken if slower consumption growth is not immediately offset by increased investment Policy makers could mitigate some of the short-run impact In any event, these initial effects will be unimportant in the long run

§*1988 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds* (Washington, D C Government Printing Office)

‖From 1979 to 1989, net national saving declined 5 1 percentage points as a share of GNP, over the same period, capital inflows increased 2 0 percentage points relative to GNP, replacing 38 percent of the lost saving

††To keep the model simple, we ruled out linking housing to population growth This simplifying assumption has little bearing on the results

Appendix: The Growth Model *(continued)*

tal equation is for nonfarm business (KNFBC).

(6) KNFBC = INFBC + (1 − δ)*KNFBC(-1),

where "δ" is the depreciation rate and is assumed fixed at .111 for most of the simulation period. Residential capital is similarly determined by adding new investment (IRC) to lagged capital (KRC) and subtracting depreciation, but with a .025 depreciation rate.[‡‡]

Output

Real GNP is divided into six components, value added by nonfarm business (RNFBC), services from housing (RRC), farm (RFC), government (RGC), "other" (ROC), and the rest of the world (ROWC).

(7) GNPC = RNFBC + RRC + RFC + RGC + ROC + ROWC

"Other" and government are assumed to grow at the same rate as aggregate hours plus a constant, and farm output is assumed to grow at a fixed rate. The rest-of-world component is a linear function of the accumulated external asset position, and it assumes a 7.5 percent return on new flows (see the next section). Residential output (RRC) is measured as a simple product of the return to housing services and the real stock of housing (KRC).

(8) RRC = .085*KRC

Nonfarm business output is modeled using the traditional Cobb-Douglas formulation, as well as two variations with different assumptions about technological progress. The basic model is:

(9) RNFBC = [1 + .7*%LAB + .3*%KNFBC + %TECH1]*RNFBC(-1),

where technological advance (%TECH1) is assumed to add a constant 1 percentage point to output growth. In the vintage model, %TECH2 depends on the average age of the capital stock.

(10) %TECH2 = .01 − .02*ΔAGE,

and AGE depends on the rate of gross investment.[§§]

(11) ΔAGE = .84 − .92*(INFBC/KNFBC)*AGE(-1)

The vintage model implies that a one-year drop in the average age of capital adds 2 percentage points to output. In the learning-by-doing model, technological advance is a linear function of the rate of investment.

(12) %TECH3 = .06*(I/GNP)

With an investment rate of, say, .18, this equation implies a contribution to growth from new technology of 1.1 percent per year. The parameters for both the vintage and learning-by-doing models are calibrated so that they explain roughly half of the contribution to growth from technology innovation in the postwar period. In other words, half of technology advance is assumed to be embodied in capital and the remainder is assumed to be independent of capital formation.

External asset position

The U.S. external asset position is equal to last period's net assets minus the current period's net capital inflows.

(13) NETA = NETA(-1) − NFI

Net capital flows are determined as shown in equation 3 above. In addition, the net asset data are adjusted from book value to market value to account for the undervaluing of direct investments. This undervaluing of investment is particularly large for the older U.S. investments abroad. The methodology, which relies on stock market values, is drawn from a paper by Michael Ulan and William G. Dewald.[¶¶] For all future years we assume that average stock market values grow 6 percent per annum.

Model characteristics and sensitivity

With nonfarm business accounting for about 80 percent of output, the model behaves very much like a pure Cobb-Douglas model. Higher saving boosts growth, although some of the effect is mitigated by the leakage of capital abroad and the failure of some sectors to respond to the higher saving and capital formation. Once the saving rate stabilizes at a new higher level, the capital-output ratio and the growth in output, investment, and

‡‡We assume that, except for a transition period, inflation is the same for investment and noninvestment goods (4 percent) and that depreciation is constant. We also assume that during the first ten years, in line with recent experience, nonresidential investment inflation is only 3 percent and the depreciation rate rises .001 per year. These assumptions have roughly an offsetting impact on real capital formation.

§§The coefficients are derived from a regression for the period 1949-89.

¶¶"Deflating U.S. Twin Deficits and the Net International Investment Position," U.S. Department of State, Working Paper Series no. 12, 1989.

Appendix: The Growth Model *(continued)*

consumption all settle on a roughly constant long-run path. There is a minor tendency for growth to slow over time because of the expected slowdown in labor force growth as the "baby boom" generation reaches retirement

By necessity the simulation model adopts a number of reasonable but somewhat arbitrary assumptions in order to produce usable results Here we show the GNP response to the saving rate recovery under alternative model parameters These sensitivity tests illustrate the robustness of the model results and give readers a chance to see how their own prior assumptions change the findings.

Most of the model parameters are not important to the basic findings of the model. As Table A1 shows, changing the labor force, technology growth, and depreciation assumptions does not materially affect the results The most important assumptions in the model relate to the link between capital and output. The estimates for the alternative models in the table show that if technology is partly driven by investment, the output effects of higher saving can be considerably higher. Furthermore, the output effects are quite sensitive to the coefficient on capital. Our model assumes a coefficient of .3, estimates in the literature range from .2 to .33 and higher. Even with the lowest reasonable parameter value, however, the saving rebound has considerable output effects

The international dimension

A second set of crucial parameters in the model relate to the role of foreign capital in the economy In an economy open to foreign investment, such as the United States, a drop in saving need not result in an equal loss of investment and potential GNP Instead, the GNP loss will be mitigated to the extent that foreigners fill the saving gap and that some of the output generated by their investment accrues to U.S residents rather than to the foreign owners Here we explore the sensitivity of our results to two key assumptions. the capital flow response to changes in saving and the return to foreign capital.

The capital flow assumption in the model (equation 3) is a compromise between two extremes One extreme is to assume perfect capital mobility, with investors indifferent to the country and currency in which they invest In this environment, a drop in the U S saving rate will only temporarily raise U S. interest rates, causing a foreign capital inflow that fully offsets the decline in U S saving [†††] The other extreme is to assume a closed economy response, in which changes in U S interest rates have no effect on net foreign capital flows.[‡‡‡] In this case, a drop in saving would raise U.S. interest rates and cause a one-for-one drop in U S. investment The assumption adopted in the article seems consistent with actual experience in the 1980s lower saving was partially offset by foreign capital inflows but not enough to prevent a rise in U.S interest rates relative to other countries and a drop in U S investment.

The assumed return to foreign capital is also a compromise between extremes. Foreign investment probably produces just as much output as domestic investment, but it produces less gross *national* product Part of the income generated accrues to the owners, but part also

[†††]This result strictly holds only in the "small country" case In practice, U S investment would tend to fall in proportion to the drop in the global pool of saving For a discussion of these issues, see Martin Feldstein and Charles Horioka, "Domestic Saving and International Capital Flows," *Economic Journal*, vol 90 (June 1980), pp 314-29

[‡‡‡]Here we assume that capital flows continue at historical rates and do not respond to any change in relative saving and interest rates

Table A1

Impact of the Saving Recovery on GNP under Alternative Assumptions

(Percent Deviation from the Status Quo)

	After Ten Years	After Twenty Years	After Fifty Years
Traditional model	6 0	10 7	15 6
With 1 percent labor growth	6 0	10 7	14 9
With 2 percent technical advance	6 1	10 8	15 1
With 1 percent more depreciation	6 3	11 2	15 4
With 0 6 capital coefficient	12 4	25 3	44 5
Vintage model	7 5	12 1	15 9
Learning-by-doing model	7 6	14 9	29 8

Table A2

Long-Run Impact of the Saving Recovery on GNP under Alternative International Parameters

(Percent Deviation from the Status Quo)

Domestic Share* (In Percent)	Closed Economy	Compromise	Open Economy
37	17 9	17 0	14 0
57	17 9	15 6	9 8
76	17 9	14 2	5 8

*The portion of output that accrues to U S residents when foreigners invest in the United States

Appendix: The Growth Model *(continued)*

accrues to the government in the form of higher taxes and to workers benefiting from the higher demand for labor The model assumes a 7½ percent net return to foreign investors, implying that about half of the output gain from foreign investment goes to the investor and the remainder is diverted to U S. residents

Table A2 shows the results of varying both assumptions Like the last column of Table A1, Table A2 shows the long-run (fifty-year) output gain under a saving recovery. The middle entry in the table shows the results for the traditional model with the standard assumptions. The greatest gain from saving is in the closed economy case, where changes in the saving rate have a one-for-one impact on domestic investment The saving effect is weakest in the case of a pure open economy in which a very large domestic share of the output is generated by foreigners' investments (bottom right-hand corner of the table) In this case, higher U.S saving simply displaces foreign investors, and the U S. only gains to the extent that foreigners no longer earn their (small) profit share