A Symposium Sponsored By
The Federal Reserve Bank of Kansas City

POLICIES FOR LONG-RUN ECONOMIC GROWTH

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Jackson Hole, Wyoming
August 27-29, 1992

Contents

Foreword

The potential rate of economic growth in industrialized countries is now only half what it was in the 1960s. Growth of world saving and productivity has also declined, suggesting continued low economic growth in the future.

If these trends persist, standards of living in the industrialized countries will improve only marginally. This prospect has generated proposals for reversing the growth slump of the past two decades.

To evaluate what policies should be adopted to foster long-run economic growth, the Federal Reserve Bank of Kansas City sponsored a symposium on "Policies for Long-Run Economic Growth," at Jackson Hole, Wyoming, on August 27-29, 1992.

We appreciate the contributions of all those who helped make the symposium a notable success. Special thanks go to Bryon Higgins and Craig Hakkio, both in the Bank's Research Division, who helped develop the program.

We hope these proceedings will lead to better public understanding of the policy issues related to economic growth.

THOMAS M. HOENIG

President
Federal Reserve Bank of Kansas City

The Contributors

Alan J. Auerbach, *Deputy Chief of Staff, Joint Committee on Taxation*

Mr. Auerbach is on leave from the University of Pennsylvania where he is professor of economics and law. He is also a research associate of the National Bureau of Economic Research and the author of numerous writings on taxation, fiscal policy, mergers and acquisitions, and international competitiveness. A member of the executive committee of the American Economic Association and a fellow of the Econometric Society, he testifies frequently before Congress and has consulted for the U.S. Treasury, the Swedish Ministry of Finance, the Organization for Economic Cooperation and Development, the World Bank, and the International Monetary Fund.

Robert J. Barro, *Professor of Economics, Harvard University*

Along with his professorship at Harvard, Mr. Barro is a research associate of the National Bureau of Economic Research and a contributing editor of *The Wall Street Journal*. He has written several books on business cycles and macroeconomic policy and is widely published in professional journals. His current project is a new book on economic growth. Mr. Barro is a fellow of the American Academy of Arts and Sciences and the Econometric Society and a past officer of the American Economic Association.

C. Fred Bergsten, *Director, Institute for International Economics*

Mr. Bergsten has been director of the Institute for International Economics since its creation in 1981. He was assistant secretary of the U.S. Treasury for international affairs from 1977 to 1981, and undersecretary for monetary affairs in 1980-81. Earlier, he was a senior fellow at the Brookings Institution and a senior staff member at the National Security Council where he was an assistant for international economic affairs. A widely published author, he testifies frequently before Congress. In addition to several other posts, Mr. Bergsten serves on the Competitiveness Policy Council.

Domingo Cavallo, ***Minister of Economy and Public Works and Services, Republic of Argentina***

Mr. Cavallo assumed his current ministry position in 1991 following two years as Minister of Foreign Affairs and Culture. Earlier, he was chairman of Banco Central of Argentina, vice chairman of the Bank of Cordoba and undersecretary of development for Cordoba. He was national representative for the Province of Cordoba between 1987 and 1991. Mr. Cavallo taught at the National and Catholic Universities of Cordoba and won scholarships from the Organization of American States and the Ford Foundation for post-graduate study at Harvard University where he also earned his Ph.D. in economics.

Michael R. Darby, ***Professor, University of California at Los Angeles***

Mr. Darby joined the economics faculty at UCLA in 1973, and in 1987, became a professor in the school's John E. Anderson Graduate School of Management. He is also a research associate with the National Bureau of Economic Research, an economist working with statistics of income for the Internal Revenue Service, and chairman of The Dumbarton Group of Los Angeles and Washington, D.C. Between 1989-92, he was undersecretary for economic affairs for the U.S. Department of Commerce. He is the author of numerous publications and recipient of a number of awards, including, in 1989, the Alexander Hamilton Award, the U.S. Treasury's highest honor.

J. Bradford De Long, ***Professor, Harvard University***

Mr. De Long is Danziger Associate Professor of Economics at Harvard University where he teaches economic history. He spent the 1991-92 academic year as an Olin Fellow at the National Bureau of Economic Research where he is also a Faculty Research Fellow. From 1988 to 1991, he was head tutor in the Department of Economics at Harvard. He has written on the evolution and functioning of the U.S. and other nations' stock markets, the course and determinants of long-run economic growth, the changing nature of the American business cycle, and the history of economic thought. His latest research has resulted in the publication, as author or co-author, of one book and three journal articles.

Willem F. Duisenberg, *President, Central Bank of the Netherlands*
Mr. Duisenberg was named to his present position in 1982 after a year as executive director. Earlier in his career, he was a staff member at the International Monetary Fund (IMF), professor of macroeconomics at the University of Amsterdam, finance minister of the Netherlands, a member of Parliament, and a member and vice chairman of the executive board of Rabobank Nederland. He has also served as a director of the Bank for International Settlements, as governor of the IMF, as a Crown-appointed member of the Social and Economic Council, and as a member of the Advisory Board of the Public Expenditure Research Institute in The Hague. Mr. Duisenberg has been decorated by the governments of the Netherlands, Luxembourg, Sweden, Senegal, and Belgium.

Martin Feldstein, *President, National Bureau of Economic Research*
Mr. Feldstein is George F. Baker Professor of Economics at Harvard University as well as president of the National Bureau of Economic Research. Since joining the Harvard faculty in 1967, his research and teaching have focused on problems of the U.S. economy and the economics of the public sector. From 1982 through 1984, he was chairman of President Reagan's Council of Economic Advisers. He is a fellow of the Econometric Society and the National Association of Business Economists and a member of the Trilateral Commission, the Council on Foreign Relations, and the American Academy of Arts and Sciences.

Stanley Fischer, *Professor, Massachusetts Institute of Technology*
Mr. Fischer, the Elizabeth and James Killian Professor and Director of the World Economy Laboratory at MIT, joined the MIT faculty in 1973. From 1988 to 1990, he was vice president for development economics and chief economist at the World Bank. He has also consulted for the U.S. State Department, the International Monetary Fund and the Bank of Israel. Mr. Fischer is a fellow of the Econometric Society and the American Academy of Arts and Sciences, a Guggenheim Fellow, and a research associate of the National Bureau of

Economic Research. A native of Zambia, he holds several other appointments with international institutions.

Jacob A. Frenkel, *Governor, Bank of Israel*
Mr. Frenkel has served in his present position since mid-1991. He had been economic counselor and director of research at the International Monetary Fund since January 1987. Earlier, he was the David Rockefeller Professor of International Economics at the University of Chicago. He is a research associate of the National Bureau of Economic Research, a fellow of the Econometric Society, and a member of the Group of Thirty, the advisory committee of the Institute for International Economics, the executive committee of the Centre for Economic Policy Research in London, and the G-7 Council.

Alan Greenspan, *Chairman, Board of Governors of the Federal Reserve System*
Mr. Greenspan was appointed in 1991 to a second four-year term as chairman of the Federal Reserve Board. He began his first term in August 1987. Previously, he was chairman and president of the New York economic consulting firm of Townsend-Greenspan & Co., Inc., chairman of President Ford's Council of Economic Advisers, chairman of the National Commission on Social Security Reform, and a member of President Reagan's Economic Policy Advisory Board. He was also senior adviser to the Brookings Institution's Panel on Economic Activity, consultant to the Congressional Budget Office, and president of the National Association of Business Economists.

Otmar Issing, *Member of the Directorate, Deutsche Bundesbank*
A long-time economics educator, Mr. Issing became a member of the board of the Deutsche Bundesbank and a member of the Central Bank Council on October 1, 1990. Previously, he served as a member of the society of leading economists who comment on market economy issues and as a member of the German Council of Economic Experts. He had been professor of economics at the University of Erlangen-Nurnberg and the University of Wurtzburg and had served as dean of the faculty at both institutions. Co-founder and co-editor of *Wist Journal,* Mr. Issing belongs to a number of professional organizations including the American Economic Association.

Lawrence F. Katz, *Professor of Economics, Harvard University*
Mr. Katz joined the Harvard faculty in 1986. He is also editor of the *Quarterly Journal of Economics* and a research associate of the National Bureau of Economic Research. The author of numerous journal articles, articles in books, working papers, and reports, he has also received a number of honors and grants, most recently from the National Science Foundation and the Ford Foundation. His research interests include family income inequality, labor mobility and unemployment, wage structures and determination, problems of disadvantaged youth, and regional economic growth.

Lawrence A. Kudlow, *Chief Economist and Senior Managing Partner, Bear Steams & Co., Inc.*
Before appointment to his present position, Mr. Kudlow was a private economic consultant in Washington, D. C. where he served on both the Federal Home Loan Bank Board's Federal Savings and Loan Advisory Council and the Federal Home Loan Mortgage Corporation's Advisory Committee. During the first Reagan term, he was associate director for economics and planning in the Office of Management and Budget and chaired or served on a number of sub-cabinet committees. He was chief economist for Bear Steams and for Paine Webber in the 1970s. Earlier, he was a staff economist at the Federal Reserve Bank of New York. Mr. Kudlow is a frequent commentator on CNN and network programs dealing with business and economic issues.

N. Gregory Mankiw, *Professor of Economics, Harvard University*
Mr. Mankiw has been a member of the Harvard faculty since 1985. He was a staff economist at the Council of Economic Advisers from September 1982 to July 1983 and an instructor at the Massachusetts Institute of Technology in 1984-85. A widely-published author, he has received several research grants and in 1991, won the Galbraith Prize for Teaching. He is currently associate editor of two professional journals and has been a research associate of the National Bureau of Economic Research since 1987.

Allan H. Meltzer, *Professor of Political Economy and Public Policy, Carnegie-Mellon University*
Mr. Meltzer has been at Carnegie-Mellon University since 1964.

His work in the field of money and capital markets has brought frequent consulting assignments with Congressional committees, the U.S. Treasury Department, the Board of Governors of the Federal Reserve System, foreign governments, and central banks. He is currently serving as a member of President Bush's Economic Policy Advisory Board as well as honorary adviser .to the Institute for Monetary and Economic Studies at the Bank of Japan. Mr. Meltzer is a founder and co-chairman of the Shadow Open Market Committee and a fellow of the National Association of Business Economists.

James C. Miller III, ***Chairman, Citizens for a Sound Economy***

Besides his chairmanship, Mr. Miller is also the John M. Olin Distinguished Fellow at Citizens for a Sound Economy Foundation and at the Center for Study of Public Choice at George Mason University where he also lectures in economics. He is co-chairman of the Tax Foundation, a member of the Administrative Conference of the United States, a senior fellow of the Hoover Institution, and a member of the editorial boards of two professional journals. He further serves as a board member for several consulting firms and private business interests. He is a former Reagan cabinet member as director of the Office of Managememt amd Budget and former chairman of the Federal Trade Commission. Mr. Miller is the author of more than 100 articles and author, co-author, or editor of seven books.

Charles I. Plosser, ***Professor, University of Rochester***

Mr. Plosser is the John M. Olin Distinguished Professor of Economics and Public Policy at the William E. Simon Graduate School of Business Administration at the University of Rochester. He is also a research associate of the National Bureau of Economic Research and a member of the Shadow Open Market Committee. Author of numerous academic articles and participant in scores of seminars and conferences, he has edited economics journals and consulted for such corporations as Chase Manhattan Bank, Eastman Kodak, and The Wyatt Company. His current research focuses on relating economic fluctuations to the behavior of financial markets.

Kumiharu Shigehara, ***Head of the Department of Economics and Statistics, Organization for Economic Cooperation and Development***

Mr. Shigehara was appointed head of the economics department and chief economist at the OECD in Paris in May 1992. He undertook a number of previous assignments for the OECD during 1970-74, 1980-82, and 1987-89, serving last as director of the Policy Studies Branch. Between OECD assignments, Mr. Shigehara returned to his work at the Bank of Japan where he assumed such posts as associate adviser on international finance and domestic policy planning, representative to the Committee of Bank Supervisors at the Bank for International Settlements, and director-general of the Institute for Monetary and Economic Studies.

Horst Siebert, ***President, Kiel Institute of World Economics***

Mr. Siebert has headed the Kiel Institute and chaired the section of theoretical economics at the University of Kiel since 1989. He is also a member of the G-7 Council's steering committee, the Council of Economic Advisers, the Science Council of the Ministry of Economics, the European Academy of Science and Art, the academic board of the Central European University in Prague, and the editorial board of ***Environmental and Resource Economics.*** Earlier in his long academic career, he was professor of economics at the Universities of Mannheim and Konstanz, and a visiting scholar at universities in France, Scotland, Australia, and the United States.

Lawrence H. Summers, ***Vice President and Chief Economist, The World Bank***

Mr. Summers, on leave from his position as Nathaniel Ropes Professor of Political Economy at Harvard University, joined the World Bank in 1991. A domestic policy economist at the President's Council of Economic Advisers in 1982-83, he has been a consultant to the U.S. Treasury and the Department of Labor, to foreign governments, and to several major American corporations. The first social scientist to receive the National Science Foundation's Alan T. Waterman Award, he is also a member of the Brookings Panel on Economic Activity, a research associate of the National Bureau of Economic Research, an American Academy of Arts and Sciences fellow, and a former editor of The Quarterly Journal of Economics.

Norbert Walter, ***Chief Economist, Deutsche Bank Group***

Mr. Walter has been chief economist for the Deutsche Bank Group since January 1990. In January 1992, he also was named managing director of Deutsche Bank Research. Since 1987, he has been senior economist for the Deutsche Bank of Frankfurt. He spent 1986-87 as the John McCloy Distinguished Research Fellow at the American Institute for Contemporary German Studies in Washington, D.C. Earlier in his career, he had a long association with the Kiel Institute of World Economics where he served both as an administrator and as a professor.

Symposium Summary

George A. Kahn

The potential rate of economic growth in the industrialized countries is now only half what it was in the 1960s. Growth of world saving and productivity has also declined, suggesting continued low economic growth in the future. If these trends persist, standards of living in the industrialized countries will improve only marginally. This prospect has generated proposals for reversing the growth slump of the past two decades.

To explore policies to increase growth, the Federal Reserve Bank of Kansas City invited distinguished central bankers, academics, and financial market participants to a symposium entitled "Policies for Long-Run Economic Growth." The symposium was held August 27-29, 1992, in Jackson Hole, Wyoming. In opening comments, Federal Reserve Chairman Alan Greenspan underscored the importance of the topic by emphasizing the role of long-term forces in shaping short-term economic developments: "It has become ever more apparent . . . that what policy needs most at this stage are models that effectively tie down the developing long-term forces impinging on our economies. For unless we have some insight into how current short-term aberrations will evolve into the long term, our overall policy posture will surely prove inadequate."

Throughout the symposium, most participants agreed that economic policymakers should pay more attention to long-run growth. But participants disagreed on specific policies to promote growth. While some of the participants, mostly from the United States, advocated government programs to increase growth, other participants emphasized increased reliance on free and open markets.

This article summarizes the papers presented at the symposium and the discussions they stimulated. The first section reviews evidence on the growth slowdown and discusses traditional and new theories of economic growth. The second section examines economic policies to promote growth. The third section provides a synthesis of the issues from the perspective of overview panelists and others with a broad outlook.

The economic growth slowdown: evidence and theory

To set the stage for a discussion of policies to promote growth, the symposium began by examining the causes of the growth slowdown and the contributions of new economic theories in explaining economic growth. Participants disagreed about the relative importance of various possible causes of the growth slowdown but agreed that economic theory had advanced considerably in recent years in explaining patterns of long-term economic growth.

Evidence

In a panel discussion, Michael Darby, Horst Siebert, and Kumiharu Shigehara addressed the causes of slower economic growth. Darby questioned the extent to which long-term growth had actually declined in the United States because he felt measures of growth were biased. While the other participants acknowledged the measurement problem, they viewed the growth slowdown as real. Siebert, focusing primarily on Germany, emphasized a wide variety of structural, supply-side, and other forces. Shigehara, focusing on countries belonging to the Organization for Economic Cooperation and Development (OECD), suggested that structural problems, not supply factors, explained the bulk of the slowdown.

Darby argued that much—if not all--of the economic growth slowdown in the United States was an illusion stemming from faulty measurement. Estimating the real value of a country's output has become more difficult as the share of services and high-tech goods in gross domestic product (GDP) has grown. For example, price changes are difficult to disentangle from quality changes in the high-tech sector. Official statistics likely overstate price increases of many high-tech goods, while underestimating improvements in quality. While increased quality of a good should be reflected in real GDP, a price change should not. Likewise, in the service sector, output is often measured by hours of input without accounting for possible increases in productivity. These two biases lead to estimates of GDP growth that are too low. Moreover, because the service sector has grown relative to the goods sector over the last dozen years, the downward bias to real GDP growth has increased. Darby claimed that this downward bias accounts for most, if not all, of the decline in real economic growth in the United States.

Nevertheless, Darby still saw a problem. With the maturing of the baby boom generation and the assimilation of immigrants into the labor force, the quality of the labor force should have increased and contributed more to economic growth than it apparently did. Even if the entire growth "slowdown" was the result of measurement error, current growth rates would still be too low, given recent developments in the labor force.

Most other participants disagreed with the view that the decline in growth in the United States or elsewhere could be attributed mostly to measurement problems. For example, Siebert argued that a variety of real economic forces caused Germany's growth rate to slow over the past 40 years, then pick up slightly in the late 1980s. These forces included variations in the growth of factors of production and their productivity, changes in the relative prices of natural resources, instability in trade and macroeconomic policy, and changes in the economy's fundamental structure.

Central to Siebert's argument was the relationship between growth in the labor force and growth in the capital stock. As growth in the labor force slowed after the 1950s in Germany, the productivity of the capital stock declined and labor productivity increased. Despite the increase in labor productivity, output growth declined. More recently, as both factors of production have increased simultaneously, output growth has begun to pick up. From this experience, Siebert concluded that diminishing returns to capital limit output growth when the labor force is stable. Only with both labor and capital growing together is overall GDP growth maximized.

Within this general framework, Siebert identified other factors that have contributed to the growth slowdown. First, the oil price shocks of 1973-74 and 1979-80 reduced the productivity of capital and contributed to the slowdown in economic growth. Environmental regulation had similar effects. Second, whereas in the 1950s Germans viewed competition as the guiding force for economic institutions and policy, building safety nets for individuals became more important in later years. As a result, while Japan and the United States were creating jobs in the 1970s and early 1980s, Germany was losing jobs. Third, increased government spending and higher taxes contributed to slower growth in Germany. Finally, Siebert asserted that the rate of creation of new knowledge had slowed. Siebert concluded that to continue contributing to the German growth turnaround, policy should focus on improving institutional arrangements, rather than "influenc[ing] economic activities ad hoc."

Shigehara rejected explanations of the growth slowdown that relied solely on "traditional" factors, emphasizing instead the role of "structural" factors. Shigehara surveyed a wide range of factors that have traditionally been identified as contributing to slower growth. Among these factors are higher oil prices, less investment in research and development, a less-skilled labor force, and greater instability in financial markets. Shigehara also identified the economic characteristics that newer economic research has associated with rapid growth: high saving, a well-educated labor force, the free flow of technology across countries, export orientation, low government spending, and political stability.

Shigehara argued that while these traditional factors may have contributed to the postwar growth experience of many industrialized countries, they are insufficient to explain all of that experience. Many of the traditional factors turned from negative to positive in the 1980s, yet economic growth in most countries remained sluggish or deteriorated. This observation led Shigehara to focus on structural problems. These problems include high and variable inflation, rigid labor and product markets, and instability of macroeconomic policy. According to Shigehara, these structural problems hindered long-run decisionmaking and reduced the competitiveness of markets. Only by addressing these structural problems, Shigehara argued, will the economic growth slowdown be reversed.

Theory

Until recently, economists questioned whether policymakers could influence an economy's long-run growth rate. For example, economic theory held that higher rates of saving and investment could temporarily boost output growth, thereby permanently increasing long-run standards of living. But theory suggested that higher rates of saving and investment could not permanently increase output growth or the growth rate of living standards. In contrast, newer economic theories suggest a greater role for policy in determining long-run growth.

Charles Plosser provided a survey of both the old and the new growth theories. He concluded that the new theories had much to offer in explaining differences in growth rates across countries and across time. Gregory Mankiw, commenting on Plosser's paper, agreed that the new theories had contributed to our understanding of the growth process. Nevertheless, he argued that the old theories could be resurrected as an explanation of growth if they were reinterpreted in a more general context.

Plosser explained why the old growth theories provide limited scope for policy, while new theories provide ample scope for policy. In the old theories, diminishing marginal returns to capital limit the role of increased saving and investment. An increase in investment, for example, temporarily boosts growth of the per-capita capital stock and growth of per-capita output. But, as the per-capita capital stock grows, the return to capital falls. Eventually, growth of the per-capita capital stock and of per-capita income slows to a rate proportional to the exogenous rate of technological progress. Increasing savings and investment therefore raises the per-capita capital stock and eventually raises output per capita. It does not, however, lead to a permanent increase in the per-capita growth rate of either the capital stock or output.

Plosser described ways some economists have changed their thinking about growth and, in the process, have undone the constraint of diminishing marginal returns to capital. One way is to incorporate into theories of economic growth capital goods that can be produced without using nonreproducible inputs. Examples of such goods are human capital and the "state of knowledge." As long as the production of these capital goods has no limit, sustainable growth is possible. Another way is to incorporate capital goods—human or physical—with external effects and spillovers. If capital has these effects, a case can be made for government subsidization of its production. For example, if one worker's education and training increase the productivity of other workers, subsidizing training and education may increase economic growth and welfare. In summing up the implications of the new growth theory, Plosser said, "Societies that save and invest more will generally grow faster in the long run."

Mankiw agreed that the new theories had contributed to our understanding of economic growth but preferred to work within the framework of the traditional theory. By generalizing the traditional theory's concept of capital to include human capital, Mankiw estimated that capital's share of GDP would increase from one-th'ird to four-fifths. Mankiw claimed this higher capital share could explain international differences in income per person within the framework of the traditional theory.

The more general version of the traditional theory led Mankiw to identify four "secrets" to fast growth. First, start from behind—countries with low initial standards of living tend to grow faster than countries with high living standards. Second, save and invest. Third, educate the young. And fourth, keep population growth low. Mankiw argued that these four secrets often go unexploited because they involve sacrifice today for higher living standards tomorrow. Few politicians, Mankiw asserted, were willing to make that tradeoff.

Policies to promote growth

Evidence and theory suggest that economic policy affects long-term growth—sometimes for good, but also sometimes for bad. The possibility that policies can enhance or undermine an economy's potential for growth underscores the need for careful evaluation of policies to promote growth. Participants at the symposium focused on three types of policies—macroeconomic policies, human capital policies, and investment policies. Most participants agreed on the need for macroeconomic policies to create a stable economic environment and human capital policies to enhance labor productivity. But participants disagreed sharply about the desirability of investment policies.

Macroeconomic policies

Participants agreed broadly on the role of macroeconomic policy in promoting growth. J. Bradford De Long and Lawrence Summers argued that good macroeconomic policies are necessary—although not sufficient by themselves—for strong productivity performance. Although De Long and Summers thought macroeconomic policies could not explain the bulk of the growth slowdown, they still considered them relevant. In particular, they saw two important links between macroeconomic policy and long-run growth.

The first link is the contribution an independent central bank can make to growth. Countries with independent central banks committed to price stability are more likely to have low and stable inflation and therefore better functioning market systems. With more efficient markets, a country can potentially grow faster. De Long and Summers presented evidence to support this view. In particular, they showed that countries with the most independent central banks—Germany, Switzerland, and the United States—had the lowest average rates of inflation and fastest average rates of growth. In contrast, countries with the least independent central banks—Italy and Spain—had higher inflation and slower growth.

The second link is the damage caused by recessions. Recessions reduce investment in physical capital. In addition, human capital deteriorates when unemployment rises for a prolonged period. De Long and Summers found no evidence that a monetary policy geared more to fighting recessions than inflation raises long-term growth. Still they questioned the benefits of an overzealous pursuit of price stability. They argued that a policy of low inflation—as opposed to no inflation—avoided the financial and real costs of pursuing further disinflation. Moreover, they argued that the benefits of reducing inflation from a low rate to zero were substantially less than the benefits of reducing it from a high rate to a low rate.

Allan Meltzer, commenting on the paper by De Long and Summers, questioned the view that central bank independence leads to stronger growth. He gave two examples where the relationship broke down. First, Germany did not have an independent central bank before 1971, yet the German economy grew rapidly. And second, the strong commitment to price stability of the United States and Britain under the gold standard did not result in rapid growth.

Lawrence Kudlow agreed with De Long and Summers that an independent central bank contributed to low inflation and, therefore, to faster growth. But, in his discussion of their paper, he emphasized the role of financial capital. Since the late 1980s, Kudlow argued, the macroeconomic environment in the United States has not been conducive to financial capital formation. Growth has suffered because of increases in capital gains tax rates, longer depreciation schedules, tighter regulations on banks, higher income and payroll taxes, and sharp increases in government spending and in the federal budget deficit. In addition, other features of the tax code have been unfavorable to capital formation—for example, the double taxation of dividends and'incentives favoring debt-over equity finance. Kudlow's prescription for faster economic growth was to reverse these fiscal and regulatory disincentives to the formation of financial capital.

C. Fred Bergsten also agreed that macroeconomic policy was important but stressed fiscal policy rather than monetary policy. He argued that an important step to take was reducing the federal government budget deficit and, eventually, running budget surpluses. The 1980s saw a decline in both public and private savings. Bergsten argued that reducing budget deficits would help reverse this decline.

Human capital policies

Conference participants agreed that growth of human capital—that is, investment in education and training-contributes importantly to economic growth. Robert Barro offered international macroeconomic evidence supporting the idea that human capital is an important determinant to growth. Lawrence Katz provided corroborating evidence from microeconomic studies. And James Miller, III, presented several specific policy recommendations.

Barro found that growth was faster in countries with more human capital. He pointed to a number of channels through which human capital contributed to growth. First, human capital increases growth by spurring investment in physical capital. Second, accumulating human capital increases wages and therefore raises the opportunity cost of bearing children. As a result, families have fewer children but invest more human capital in each child. Finally, holding birth rates and investment in physical capital constant, human capital still contributes directly to economic growth. Barro argued that with more education people use new technologies more effectively, thereby raising productivity and output growth.

Katz, looking at the microeconomic evidence, agreed with Barro. Katz summarized the findings of several studies that looked directly at the relationship between an individual's education and productivity. These studies attempted to isolate the effect of education on productivity, holding constant such variables as natural ability and family background. If education had no independent effect on productivity—apart from reflecting an individual's innate ability or family background—then investment in education would not, in itself, increase human capital or productivity. However, Katz's review of the microeconomic evidence demonstrated an independent role for education. In a study of identical twins reared in the same family, for example, schooling was shown to raise productivity, earnings, and thereby economic growth.

In addition, microeconomic research has also identified other ways human capital contributes to growth. First, research supports Barro's suggestion that education of the work force increases investment in physical capital. In a study cited by Katz, industries with highly educated workers were found to invest more heavily in new technology. Second, research reviewed by Katz supported the view that there are spillover effects to education. These spillover effects imply that educating one worker increases the productivity of other workers.

Thus, the social returns to education exceed the individual returns. Finally, Katz provided evidence that education not only contributes to growth, but also contributes to a more equal distribution of the benefits of growth.

Miller, agreeing that education contributes to growth, suggested ways to improve education in the United States. Specifically, he suggested ways to improve "lower education" — kindergarten through twelfth grade — where he felt the United States compared unfavorably with other countries. Noting that spending per pupil had increased steadily in the United States while performance had deteriorated, Miller questioned the effectiveness of policies that simply spent more money on education. Instead, he suggested structural reforms. One suggestion was to increase competition in the provision of lower education by allowing parents greater choice in selecting schools for their children. Another suggestion was to rely more on private or quasi-private schools as providers of lower education. In this way, lower education in the United States might more closely resemble the U.S. system of higher education, which is the envy of the world.

Investment policies

While participants generally agreed on macroeconomic and human capital policies to promote growth, they disagreed sharply on investment policies. Three views about investment policies emerged. The first view held that programs should be adopted to stimulate specific forms of investment. The second view held that investment incentives would work better under some circumstances than under others. The third view held that policymakers should try to minimize their influence over markets, eliminating distortionary tax incentives across the board.

The case for investment incentives. De Long and Summers, looking at a cross section of countries in the postwar period, found that countries with higher investment in machinery and equipment had faster rates of growth. Investment in equipment and machinery, they argued, carried substantial external benefits and could significantly boost productivity growth. For example, they found that total output rises 0.26 percentage points for each extra percentage point of total

GDP allocated to investment in machinery and equipment. De Long and Summers argued that this strong relationship implied policymakers could boost growth by stimulating machinery and equipment investment. In particular, De Long and Summers advocated a permanent investment tax credit targeting equipment investment. In addition, they favored open trade policies without restrictions on capital goods imports and tighter fiscal policies to boost national savings.

Bergsten agreed that to boost growth in the United States, investment needed to be targeted in "strategic directions" that would earn a supernormal return. Bergsten estimated that to increase growth significantly, the overall investment rate would have to rise eight percentage points and be targeted in areas that yield substantial external effects. A one-percentage-point annual increase in the investment rate sustained for eight years would increase productivity growth from the 1 percent rate of the last decade to 2 percent in eight years. Bergsten also argued that investment needed to be stimulated without exacerbating the external deficit, which he thought should be eliminated. Bergsten therefore argued that the national savings rate needed to rise in lock step with the national investment rate.

The qualified case for investment incentives. Alan Auerbach argued that the link between investment in physical capital and economic growth is uncertain. Standard economic models do not clearly spell out how increased investment leads to faster long-term growth. Moreover, if investment's contribution to growth comes largely from spillover effects, more needs to be learned about the nature of these spillovers and about which investments have the greatest spillover effects.

Assuming that investment has these effects and therefore makes a contribution to growth, Auerbach argued that tax incentives to investment would be an appropriate policy. Evidence suggests that tax policies do affect the amount and type of investment that takes place. Although little is known about which types of investment yield the highest social returns—other than De Long and Summers' evidence for equipment and machinery—more is known about designing incentives for investment. Auerbach argued that these incentives should be designed to apply to new investment that would not otherwise have taken place. They should be permanent. And they should be directed primarily at encouraging investment not at savings. Tax incentives for savings are not always channeled into the most socially productive domestic investments. Some of the increased savings may be invested in foreign countries, in housing, or in other forms of investment that contribute less to growth.

Martin Feldstein agreed there was a case for investment incentives but disagreed with Auerbach's view that incentives for investment were more important than incentives for savings. Feldstein argued both types of incentives were important and that investment incentives work best when accompanied by savings incentives. He suggested three reasons why savings incentives were needed. First, the savings rate in the United States is so low that even if all net savings were invested in physical capital, investment spending would still be inadequate. Second, the national savings rate constrains domestic investment in the long run. As aresult, countries with high savings rates tend to have high investment rates. Third, savings incentives do not cost the government tax revenue. While the government loses personal income tax revenue through savings incentives such as Individual Retirement Accounts, it gains corporate tax revenue through the resulting increase in the capital stock. These increases largely or entirely offset the personal income tax losses.

The case against investment incentives. Other participants at the conference argued forcefully against tax incentives for investment or savings. Norbert Walter thought it would be too difficult to decide which types of investment were best for growth. The market, he said, is best suited to determine which investments promote growth. Government, he added, can most effectively promote growth by improving market conditions rather than pursuing "quick fixes." Moreover, selective investment incentives complicate tax systems, which are already too complicated and unfair.

Walter offered two examples of how competitive and open markets are more important for growth than targeted investment incentives. A positive example is Europe 1992, which has resulted in deregulation, keener competition, and the redefinition and redistribution of markets. Businesses responded to these market incentives by investing long term in Europe. Looking forward to the completion of the single European market, they increased fixed capital formation 50 percent in the second half of the 1980s. A negative example is German unification. Large government-support measures for Eastern Germany have not yet produced the desired results. East Germany demonstrates the low efficiency of strong tax incentives. From these examples, Walter concluded that Auerbach's analysis of the postwar United States is interesting but not very useful for the "urgent" cases in Europe.

Kudlow and Meltzer also argued for a free market approach. Kudlow argued that investment in equipment had, in fact, been quite strong during the 1980s. He pointed out that, relative to the 1959-90 period as a whole, the 1980s saw a surge in spending on equipment. Reacting to suggestions that tax policy target specific investments, Kudlow worried who would be choosing the targets and how those targets would be chosen. Rather than rely on policymakers to make these decisions, Kudlow preferred to let rates of return and relative prices determine the allocation of investment spending.

Similarly, Meltzer thought subsidies for equipment investment were unlikely to significantly boost long-term productivity. He argued that many "one-time" changes after World War II, such as sweeping reductions in trade barriers and the replacement of old capital, led to the strong productivity growth from 1950 to 1969. Thus, the rapid growth experienced during these early postwar years should be seen as an aberration. It is therefore unlikely that subsidizing capital accumulation can significantly raise the recent trend in productivity growth. Meltzer concluded that growth of productivity and living standards depend on the United States and other industrialized countries opening markets that have recently been restricted by quotas.

Overview of the issues

A prominent academic and several high-level policymakers offered broad observations and policy prescriptions. Stanley Fischer examined why policymakers had not taken more positive steps to stimulate growth. Otmar Issing and W. F. Duisenberg provided policy prescriptions from a European central banking perspective. Domingo Cavallo and Jacob Frenkel focused largely on how to promote growth in economies that have suffered macroeconomic instability.

Why policy advice goes unheeded

Fischer argued that most of the policy prescriptions of the new growth theory are the same prescriptions that have been offered by the World Bank and the International Monetary Fund for years: Keep budget deficits small; keep inflation low and stable; do not overvalue the exchange rate; keep the economy open to international trade; deregulate; privatize; keep the tax system simple; and invest in physical capital, infrastructure, and human capital.

Why has this advice not been followed more closely? Fischer suggested that one reason is the advice is too general. For example, it offers no specifics on how to go about increasing investment or reducing budget deficits. Nor does the advice provide guidance on how to balance the short-run costs of policies to promote growth against the long-run benefits. Reducing inflation and budget deficits lowers growth in the short run but contributes to growth in the long run. Few policymakers, Fischer argued, would ignore short-run costs in addressing long-run problems.

According to Fischer, the best time to deal with inflationary and fiscal obstacles to growth is when the economy is strong. Then, monetary and fiscal policy tools will more likely be available for short-run stabilization when the economy is weak. Unfortunately, this advice has not been followed. In the United States, fiscal policy is unavailable to boost the economy in the short run because the budget deficit was not reduced when the economy was strong. In Germany, monetary policy has had to cope with fiscal stimulus stemming from unification. Monetary policy has been tight because Germany did not pay for unification with fiscal policy. Given Europe's exchange rate mechanism, tight German monetary policy has led to an economic slowdown throughout Europe.

Perspectives of two European central bankers

Issing viewed monetary policy geared strictly toward achieving and maintaining price stability as contributing importantly to long-run economic growth. He rejected the view that monetary policymakers could stimulate economic growth in the short run while maintaining a credible commitment to price stability. Moreover, he asserted that an independent monetary policy geared toward price stability disciplines fiscal policy and labor markets. Excessive budget policies and struggles between labor and management for income shares, Issing argued, "will come up to the limits set by monetary policy." By imposing these limits, a monetary policy committed to price stability contributes further to economic growth.

Duisenberg largely echoed Issing's views on the role of monetary policy. Duisenberg argued that economic policy should be oriented primarily toward creating an environment conducive to growth, not toward giving special incentives to specific activities. Monetary policy's role in creating the proper economic environment is to ensure price stability. Price stability is the only monetary policy objective that can be sustained in the long run. And it is the only policy that minimizes the risk of sudden policy changes. Price stability therefore contributes the most to reducing macroeconomic policy uncertainty.

Economic stabilization as a prerequisite to growth

Cavallo and Frenkel emphasized the importance of stabilizing an economy before enacting policies to promote growth. Cavallo drew lessons from Argentina's efforts to reorganize its economy. He argued that reorganizing the economy was "the basic prerequisite" to achieving faster long-term growth. In reorganizing economic activity, Argentina has emphasized "greater transparency and better planning in the public sector and greater competition and improved performance in . . . the private sector." Five key measures have been taken or are under way in Argentina. They include liberalizing trade, reforming the public sector and recreating a market economy, introducing currency convertibility, reforming fiscal and tax policies, and restructuring internal and external debt.

The program to restructure the Argentine economy is succeeding. For example, inflation has come down and interest rates have fallen. Tax receipts have risen sharply, and substantial privatization has occurred. The reorganization plan has helped stabilize the economy and allowed Argentina's productive resources to be used more efficiently. Only with this step largely accomplished, Cavallo argued, could Argentina now begin trying to increase investment to stimulate growth.

Frenkel reiterated Cavallo's views, arguing that promoting growth is like a two-stage rocket. The first stage requires stabilization of the economy. Only after the first stage has run its course can policymakers concern themselves with the second stage—growth. Frenkel argued the first stage—stabilization—is particularly problematic for many countries. He pointed to four "Achilles' heels." First, policymakers are impatient and sometimes try to move to the second stage before completing stabilization programs. Second, stabilization programs often lead to extremely high interest rates. Third, to the extent policymakers use the nominal exchange rate as a tool of stabilization, real exchange rates appreciate sharply. And fourth, when governments cut spending to reduce deficits, they often cut spending on infrastructure, exactly the kind of spending required for growth.

In summing up, Frenkel argued that stabilization and growth required looking at the composition of economic aggregates, not just at the aggregates themselves. For example, not only is the size of the budget deficit important, but so is the composition of its components, government spending and tax revenues. Stabilization and growth require government spending oriented toward investment rather than consumption. Similarly, taxes should promote production, not consumption.

Conclusions

The slowdown in long-term economic growth in the industrial countries has sparked a debate about how policymakers can promote faster growth. Participants at the symposium generally agreed that increasing savings and investment, building human capital, and pursuing stable economic policies would contribute to faster growth. Participants disagreed, however, about specific policies. While some participants, mostly from the United States, favored various tax incentives for investment and possibly savings, other participants favored greater reliance on free and open markets. But these differences did not overshadow the consensus of the participants that economic growth is a critical policy issue that can no longer be ignored.

Endnote

George A. Kahn is a senior economist at the Federal Reserve Bank of Kansas City. Eric Thomas, an assistant economist, and Carol Manthey and Carrie Ross, research associates at the bank, helped prepare this summary.

Opening Remarks

Alan Greenspan

Implicit in all our views of the long term is that there are physical limits to growth, reflecting our finite globe and the fact that human beings take up space, produce wealth from physical resources, and pollute the environment accordingly.

It may be true that in some remote distant future, the population explosion will create the reality of a crowded planet fantasized in an old Star Trek episode of the 1960s where people were stacked one on top of another. But for any imaginable future no practical limit is likely to emerge. To be sure, human beings have physical dimension and the necessary food and shelter presupposes increasing physical requirements in a finite world space. But urban concentrations — foreconomic as well as social reasons — are far more dense than world average population concentration and there appears little in the way of limits at least so far as our most far-reaching models can contemplate.

Nor is there any reason to be concerned that the doubtless limited reserves of certain commodities doom levels of activity to some definable levels. As presumed physical limits and shortages emerged in decades past, the price system diverted ever increasing proportion of real value added to conceptual inputs relative to physical inputs. Ideas replaced physical things. Transistors replaced vacuum tubes. The functions are the same but ideas have replaced bulk. Lightweight fiber optics and amalgam of scant material and extraordinary insight are displacing copper wires in the rapidly expanding value-added of telecommunications. New technologies have advanced the state of architecture and building.

The inevitable increase in the ratio of real value-added per pound is strikingly evident in trade statistics where increasing real exports per pound in the United States statistics confirm other data which indicate the growth of U.S. gross domestic product (GDP) inputs in tons is far slower than growth in real GDP. Similar gains in real imports per pound attest to the same phenomena in those countries from which we import. The data are really quite striking.

Since the accumulation of knowledge is irreversible, with the possible exception of the Dark Ages, we can assume as pressure on physical resources continues to mount the price mechanism will continue to create incentives for ever more concentrated impalpable inputs into our gross domestic products.

Indeed, the distinction between the physical and the impalpable is likely to become ever more vague. Future human needs and wants will surely appear increasingly in small packages. Hence, while it is conceivable in some far distant future that population may run into physical restraints, there is no meaningful notion which delimits the growth in real impalpable gross domestic product per capita.

Worldwide, we are currently struggling with short-term forecasting models which have been less than adequate for policy purposes. We are endeavoring to infer the current operational economic structure from the very little recent history which appears relevant. In so doing, we find ourselves reaching increasingly back in the distant past when asset value changes and debt burdens appeared at best somewhat similar to much of what we observe today. Accordingly, we have had to become especially innovative in manipulating the add factors in the current econometric models built largely on post World War II experiences, which for the moment appears insufficient. It is not easy to make these models track economic processes as they are currently evolving. It has become ever more apparent from these exercises that what policy needs most at this stage are models that effectively tie down the developing long-term forces impinging on our economies. For unless we have some insight into how current short-term aberrations will evolve into the long term, our overall policy posture will surely prove inadequate.

This symposium will also cast light on the forces driving growth worldwide, concerns which have been particularly vexing to Americans who are especially fearful that their children will not reach the living standards the current generation enjoys. I trust the papers will shed light on these increasingly important issues.

Causes of Declining Growth

***Michael R.** Darby*

From 1979 to 1989, growth in U.S. real gross domestic product (GDP) slowed to only 2.5 percent per year. From 1989 through the first half of 1992, growth has slowed further to only 0.5 percent, with growth reduced about 2 percent below normal due to transitory cyclical factors. Thus, either way you look at it, what is alternately termed trend, secular, steady-state, or capacity growth has slowed to about 2.5 percent. This growth is very slow compared to the trend growth of nearly 4 percent experienced in 1948-65 or even the 3.1 percent of 1965-79. In the perspective of this century, recent U.S. growth is slow but not unprecedented: for example, trend real GNP growth was only about 2.25 percent during 1929-48 as the capital stock fell due to the Depression and World War II.

This observation provides part of the explanation for slower recent growth compared to 1948-65: the earlier postwar period was dominated by a catch-up in the capital stock to levels consistent with the equilibrium labor-output ratio, and growth averaged only about 3.1 percent over the years 1929-65, the same as this century taken as a whole. I believe that many other countries also experienced rapid growth in the decades immediately following World War II as they restored their capital stock and adopted not only American technology but many American institutions. As they converged to a new equilibrium, these countries, too, would naturally experience a slower trend growth rate. However, my role is to concentrate on the United States and leave it to those who follow to see whether the catch-up framework or the remainder of my remarks can be applied to other countries.

Granted that the United States cannot expect normal growth much above 3 percent, 2.5 percent falls short of 3 percent. Indeed, it can be argued that the period since 1979 should have been better than average both because of more rapid labor-force quality improvements and because increases in average hours worked roughly offset slower growth in employment. Thus it is not surprising that an important question for central bankers and other economic policymakers is "Why has growth declined and what can we do to increase it?' Once again the organizers of the Jackson Hole Symposium have confronted us with a question whose difficulty is exceeded only by its importance.

Having managed until this January the agency responsible for creating our GDP and related measures, I am a frank agnostic as to whether this shortfall in measured trend growth relative to our expectations reflects problems of measurement or a real economic phenomenon. In these remarks, I shall first consider measurement problems as an explanation of the apparent slow growth. Although I believe it possible that we ultimately shall find that these problems explain much or all of the shortfall in measured normal growth, we must confront the possibility that the decline is real. Accordingly, I shall then set mismeasurement aside and consider some explanations for a real decline in secular growth. Regardless of whether or not secular growth has really declined, cost-effective policies to promote growth are important goals for the United States or any economy.

Problems of measurement

It has always been difficult to measure real GDP because it is very difficult to divide nominal revenue reported in firms' accounts into its price and output components. This is a relatively simple task for basic commodities but becomes progressively more difficult for the more high-tech goods and for services for which even the units of output are far from obvious: a pound of computers or a billion floating-point operations? A hospital day or days of healthy life saved? An hour of a grocery clerk's time or pounds of potatoes sold at retail? With the notable exception of computers where a hedonic price index has been introduced, there seem to be large net downward biases in estimates of output growth for high-tech goods and services. Indeed, for many services, output is measured by hours of input with productivity growth simply assumed zero. Some areas such as banking or air travel are even worse. Malabre and Clark (1992) recently produced a remarkable ***Wall Street Journal*** article on just this issue.

Many economists have spent a great deal of time thinking about the implications of mismeasurement of quality change on measured real GDP growth and reached a rough consensus that the net bias is downward and, more controversially, on the order of anywhere from 0.5 to 2 percent.

Working-stiff macroeconomists as well as real-world policymakers have generally thrown up our hands and tried not to think about these messy issues since we can live with a downward bias as long as it seems to be pretty much constant. Unfortunately for us economists—although it would be fortunate for the economy if true—there is some reason to believe that the downward bias has increased significantly over the last 12 years or so and this may mean that the shortfall in secular growth is more apparent than real. The main reason that the downward bias may have increased significantly is sharply accelerated growth in the broadly-defined service sector compared to the goods sector.

As Table 1 illustrates for the normal-employment years 1965, 1979, and 1989, what has occurred is not an increase in payroll employment growth in the services sector of the economy, but a shift from slower growth to an actual decline in the goods sector—a net swing of one and three-quarters points. I worked through the arithmetic to find that this sectoral shift could reasonably account for an increase in the downward bias in real GDP growth of about 0.6 percentage point.[1] Therefore, measured trend growth since 1979 may have been reduced from about 3.1 to 2.5 percent due to the interaction of the accelerated shift toward the services sector and the much greater downward bias there. This more rapid shift toward services from goods may reflect the shift toward nontradable goods as a result of the dollar appreciation which had persistent effects throughout much of this period. A shift back toward tradable goods could thus cause more rapid measured output growth over the coming decade.

Table 1
Growth Rates of Nonfarm Private Employment
Establishment Data

Period	All Sectors	Goods Sector	Services Sector	Services - Goods Sectors
1965 - 79	2.691	1.343	3.571	2.228
1979 - 89	2.035	-.440	3.189	3.629

Notes:
1 All rates calculated as continuously compounded annual rates.
2 "All sectors" includes goods, services, and structures sectors.

I should note that I have taken care to compute average growth rates of output, inputs, and productivity between normal-employment years not affected by price-control measurement problems. Given the strong procyclical movement in productivity, the apparent overstatement of real output and productivity levels during price-control periods, and the very small normal productivity growth rate, failure to do so can greatly distort comparisons. For example, during a recession, measured productivity may fall by 3 or 4 percent. When periods like decades are compared, ending one period during a recession would reduce measured average productivity growth during that period by nearly half a percentage point and add it to the next period's growth, thus producing a spurious swing on the order of 0.8 percentage point.

In addition to this pure bias problem, there is a also a price-index problem. This problem arises because the fastest growing sectors—especially cbmputers—tend to have the fastest falling relative prices. The shift from 1982 to 1987 as the base for calculating real output very slightly increased output growth in 1965-79 but reduced real GNP growth significantly during 1979-89. The net effect of the base-year change on measures of relative output and productivity growth between the two periods amounts to 0.3 percentage points. The combination of the estimated increase in downward bias plus the price-index effect on recent growth thus comes to just about a full percentage point of doubt about the measured 0.6 point output growth decline.

I do want to pursue the possibility of changing mismeasurement further because we really will not have a good idea of how significant it is until further progress on the economic statistics is made under the Boskin initiative—if ever, given current Congressional threats to gut the statistical agencies' budgets. So let us turn to real explanations of the decline in real GDP growth.

Real explanations

The years 1948-64 were a period of slow labor growth and rapid labor-productivity growth while 1965-79 was a period of rapid labor growth and slow labor-productivity growth. In a 1984 ***American ,Economic Review*** article, I showed that these differences in labor-productivity growth could be explained primarily by changes in the quality or human-capital content of the labor force and secondarily by rapid growth in the capital-labor ratio over the 1948-65 period. The labor-quality index was based on education, age-sex distribution, and acculturation of immigrants. During the baby-bust/low-immigration 1948-65 period, labor quality grew 0.4 percentage points faster than the 1900-79 average while during the baby-boom/high-immigration 1965-79 period, labor quality grew 0.4 percentage points less than that average. Robert Barro will demonstrate tomorrow the importance of human capital in understanding variation'in economic growth across countries.

Since my labor-quality index worked well earlier, I conducted a preliminary analysis for this conference, and found that the labor-quality index for 1979-89—the years for which I had sufficient data—grew about 0.1 percentage point faster than in 1900-79 or 0.5 percentage point faster than in 1965-79. Holding other factors constant then, we should have seen the 0.7 percentage-point decline in private employment noted in Table 1 largely offset by a 0.5 percentage-point increase in labor-productivity growth. However, gross private product (GPP) growth fell by the full 0.7 percentage point with productivity growth unchanged; so we need to identify other factors which were not constant to explain an approximate shortfall of one-half percent in both output and labor-productivity growth.

Things get even messier if we consider alternative measures of labor input. For example, while the establishment data indicate that growth in GPP per employee is virtually constant comparing 1965-79 to 1979-89, growth in GPP per hour declined by 0.3 percentage point in the latter period because average hours worked declined by only 0.3 instead of the 0.6 percentage point reduction measured in the earlier period. That is, GPP per hour declines by 0.3 percentage point when human-capital factors would predict a half point rise. In my 1984 study I had linked interpolated census data to extend the household-survey data back over the century. In Table 2, I illustrate that the household data indicate a 0.8 percentage point drop in GPP per hour growth in 1979-89 versus 1965-79. It seems that one lesson is that the input series may be measured every bit as imprecisely as the output series.

Table 2
Growth Rates of Private Employment and Labor Productivity
Comparison of Establishment and Household Survey Data

	Private Employment		GPP Per Employee		GPP
Period	Establishment data	Household data	Establishment data	Household data	
1965-79	2.691	2.188	.522	1.025	3.212
1979-89	2.035	1.834	.511	.713	2.547

	Average Hours		GPP Per Hour	
Period	Establishment data	Household data	Establishment data	Household data
1965-79	-.595	-.281	1.117	1.306
1979-89	-.313	.177	.824	.536

Notes:
1 All rates calculated as continuously compounded annual rates.

Since it is very important to maintain a long-run perspective with respect to output and productivity trends, I want to concentrate, with all due caveats, on the linked census-household data in Table 3. The post-1979 productivity growth which seemed low in the previous table here appears extraordinarily low relative to 1900-79 as a whole—some 1.2 percentage points below normal after accounting for labor quality. Things are even worse if one believes the average hours worked numbers—1.6 percentage points below the 1900-79 norm. I conclude that looking carefully at the measures of labor input cannot explain why growth has declined, but rather only deepens the mystery.

Table 3
Growth Rates of Private-Sector Labor Productivity Measures
Linked Census-Household Data

		Growth Rates of					
Period	GPP	Private Emplmt.	GPP/PE	Quality Index	GPP/QAPE	Average Hours	GPP/QATHWP
1900-79	3.23	1.40	1.82	.31	1.54	-.23	1.74
1900-29	3.42	1.77	1.65	.12	1.51	-.22	1.76
1929-65	2.98	.87	2.10	.60	1.51	-.27	1.78
1965-79	3.21	2.19	1.02	-.07	1.10	-.28	1.38
1979-89	2.55	1.83	.72	.39	.32	.18	.15

Definitions:

GPP/PE	Gross Private Product/Private Employment
GPP/QAPE	Gross Private Product/Quality-adjusted PE
GPP/QATHWP	Gross Private Product/Quality-adjusted Hours Worked
Quality Index	Darby (1984) Index which adjusts labor force for age, sex, education, and immigrant acculturation

Notes:

1 All rates calculated as continuously compounded annual rates.

2 The first three lines are from or as implied in Darby (1984). The last two lines update and extend Darby (1984) using later data.

Neoclassical growth theory tells us that output per quality-adjusted hour of labor should grow as the sum of the product of the capital coefficient and capital-labor ratio growth and a trend or residual factor normally termed something like technical progress or total-factor productivity growth. "Technical progress" in this sense reflects not only technology change but any other changes in the efficiency with which the geometrically-weighted average of inputs is converted into output. I particularly have in mind here such factors as changes in regulation. Standard measures of capital investment do not seem to indicate any dramatic movement in the capital-labor ratio and it is too easy to conclude that growth has slowed because of declining technical progress since that merely labels our ignorance. Both the DeLong and Summers and Auerbach papers explore the important issue of whether different forms of investment have different growth implications because of spillover effects. I would also like to raise the issue of the effects of rapid increases in regulation on the aggregate production function and, hence, productivity and growth. We economists frequently talk about making rational tradeoffs between growth and the environment or other social values, but I know of no systematic attempt to quantify those tradeoffs as an explanation of changes in technical progress.

Conclusions

Many commentators, not all of whom are running for elective office, give a very alarming picture of disappearing growth: 4 percent in the 20 years after World War II, then just over 3 percent in the next 15 years, then 2.5 percent in the next 10 years, and only half a percent lately. I have explained why I think that nihilistic view is simply wrong. Indeed, there is a substantive argument that increased downward bias alone has lowered measured trend growth since 1979 from 3.1 or 3.2—3.5 using 1982 dollars—to about 2.5 percent. On this view, recent growth—transitory cyclical effects aside—is at least comparable to the measured growth experienced in the first 80 years of this century, and maybe a bit stronger.

While the glass may be half full, it also seems to me that there is a very real sense in which it remains at least half empty. The baby boom is maturing and immigrants are acculturating. We should be experiencing strong growth in output per empleyee from both the human-capital and average-hours viewpoints. Thus, even normal trend growth or a bit above would seem too low. Economists are a clever bunch and all may be explained over the next few years if not the next few days. I certainly am eager to begin that process and shall not delay it by saying any more.

Endnotes

[1]There is no unique way to quantify the effects of the drop in goods-sector labor on measured real GDP that actually occurred with what would have been recorded if the 1965-79 growth in goods-sector labor had continued with a corresponding reduction in service-sector labor growth:

Year	Goods Output	Services Output	Total Output	Average Growth Rate from 1979
1979	1532	1389	2921	n/a
1989	1959	1906	3865	2 80%
1989-hypoth	2341	1762	4103	3.40%

Thus the esttmate of a 0.6 percentage point Increase in the downward bias in real GDP growth assumes that the 3 percentage point difference in productivity growth between the two sectors reflects differences in measurement biases and not reality.

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Causes of Declining Growth in Industrialized Countries

Kumiharu Shigehara

A clear break in the post-World War II pattern of rapid productivity growth was a virtually universal phenomenon across Organization for Economic Cooperation and Development (OECD) countries, in most of them beginning in the early 1970s. This development had implications for both the evolution of aggregate supply, as well as the growth of real income and the types of macroeconomic and structural policies needed to sustain and enhance economic welfare. The 1980s saw some signs of revival in output and productivity growth in the OECD area, but they are not yet broad enough, nor have they been sustained long enough to justify optimism about improved trends.

This conference comes at an opportune moment for assessing the causes and consequences of the slowing of output and productivity growth. In recent years economists have begun to rethink the fundamental sources of long-term growth. Although it is premature to say that a new consensus has been reached, the associated empirical work is by now sufficiently advanced that it is useful to take stock and extract the policy lessons, if any, from this effort.

Let me summarize my views up front. We know many more stylized facts than we used to about the characteristics of countries that grow fast over the long term. In brief, rapid growth is associated with high saving, well-educated work forces, and the ability to tap the technology of the leading countries. Export orientation, low government spending, and stable political systems are also often linked with good growth performance. Based on the work that I have seen, however, the changes in these factors are insufficient to account entirely for the clear break in the postwar pattern of OECD growth.

In this paper, I will raise the possibility that part of the growth and productivity slowdown may reflect such factors as high and variable inflation and increased structural rigidities, although their impacts are extremely difficult to quantify. I shall argue that stable rules with respect to macroeconomic policymaking that allow economic agents to take a long-term view, encouragement of competitive behavior, and flexibility in labor and product markets are extremely helpful in establishing a basic environment conducive to the improvement of growth and productivity performance.

In developing my argument, I will first discuss the postwar trends in respect to OECD growth. Second, I will discuss both the "earlier" candidates for explaining the growth slowdown and more recent explanations. Third, I will stress some factors that have been relatively overlooked until now and suggest how they may alter our interpretation of the empirical evidence. Finally, I will distill some policy implications from this work, and give my views on some of the items currently on the international policy agenda that may have a bearing on the evolution of long-term growth.

Styled facts of OECD growth

In virtually all OECD countries, the slowing of business-sector output and labor productivity occurred between 1968 and 1975, with a noticeable concentration around the time of the first oil shock. Overall, the average annual growth rate of OECD business-sector output declined from 5.3 percent between 1960 and 1973 to 2.7 percent between 1973 and 1990—a slowing that can be accounted for almost entirely by the drop in the growth of output per worker (Table 1). In some countries, notably the United States, somewhat faster employment growth initially offset some of the slowdown in business-sector productivity growth. But, for the OECD as a whole, employment growth has been about the same in both the pre- and post-1973 periods.

Table 1
Business-Sector Output, Productivity and Employment Data

	Output			Total Factor Productivity			Labor Productivity			Employment		
	1960-73	1973-79	1979-90	1960-73	1973-79	1979-90	1960-73	1973-79	1979-90	1960-73	1973-79	1979-90
U.S.	4.0	2.5	2.5	1.6	-.4	.2	2.2	.0	.6	1.7	2.6	1.9
Japan	10.0	3.5	4.3	5.9	1.4	2.0	8.6	2.9	3.0	1.3	.6	1.2
Europe	4.9	2.4	2.3	3.2	1.4	1.3	5.0	2.7	2.1	-.1	-.2	.3
OECD	5.3	2.7	2.7	2.8	.5	.8	4.1	1.4	1.5	1.1	1.3	1.3
	1979-85		1985-90	1979-85		1985-90	1979-85		1985-90	1979-85		1985-90
U.S.	2.2		2.7	.1		.3	.7		.4	1.5		2.3
Japan	3.9		4.8	1.8		2.4	2.8		3.3	1.0		1.5
Europe	1.5		3.5	1.0		1.7	1.9		2.2	-.4		1.2
OECD	2.3		3.3	.7		1.0	1.5		1.4	.8		1.8
	1960-73		1973-90	1960-73		1973-90	1960-73		1973-90	1960-73		1973-90
U.S.	4.0		2.5	1.6		.0	2.2		.4	1.7		2.1
Japan	10.0		4.0	5.9		1.8	8.6		3.0	1.3		1.0
Europe	4.9		2.3	3.2		1.3	5.0		2.3	-.1		.1
OECD	5.3		2.7	2.8		0.7	4.1		1.5	1.1		1.3

Source: OECD, Analytical Data Base.

As the greater part of the post-1973 slowing of output growth came from labor productivity in virtually all OECD countries, I will concentrate on this element of the growth slowdown for most of my talk.[1] For simplicity I will ignore multifactor productivity, whose trends have moved broadly in line with labor productivity in most countries and whose measurement is more controversial.

One should first ask whether it is correct to focus on the post-1973 productivity slowdown. As Angus Maddison and others have emphasized, post-1973 performance is actually pretty good, if one takes a long historical perspective.[2] The 1950s and 1960s appear to be exceptional, in terms of the rapidity of productivity growth, as compared to the average record in the first half of this century (Table **2).** In the United States, the rapid growth of the early postwar period has been attributed to an abundance of new technology that was not fully exploited due to the Great Depression and World War II. Other countries took advantage of the new opening of trade and mobility of technology following the war to catch up to the U.S. productivity level. Empirically, this sort of catch-up is important in explaining productivity growth differences between countries and changes over time within the fast-growers. Hence, some slowing was inevitable, but, in my opinion, not to the degree actually observed.

While in some countries, notably the United States and the United Kingdom, there was some apparent revival of productivity growth in manufacturing in the 1980s, productivity growth has remained low at the economywide level (Table 3). Some analysts have argued that measurement problems have led to an understatement of overall productivity growth, but the consensus is that the economywide productivity slowdown is real and cannot be accounted for by data errors.[3]

Causes of the slowdown

The earlier candidate explanations

The productivity slowdown more or less coincided with four important events:

Table 2
Growth in GDP per capita

Average growth rates in percent

	United States	Japan	Europe	OECD average
1900-13 [1]	2.0	1.0	1.3	1.6
1913-50 [1]	1.6	.9	.8	1.3
1950-73 [1]	2.2	8.0	4.1	3.5
1973-87 [1]	1.5	2.8	1.8	1.9
Memo:				
1960-73 [2]	2.7	8.3	3.8	3.7
1973-90 [2]	1.5	3.1	1.8	1.9

GDP Per Capita

	Thousands of 1990 $US based on PPPs			US = 100		
	1960	1973	1990	1960	1973	1990
United States [2]	11.7	16.6	21.4	100	100	100
Japan [2]	3.7	10.5	17.6	32	63	82
Europe [2]	6.4	10.4	14.1	54	63	66
OECD [2]	7.7	12.3	17.0	66	74	79

1 Data from Maddison (1989)
2 Data from OECD (1992).

Source: Maddison (1989), OECD (1992).

Table 3
Basic Data on Manufacturing Industry
Average growth rates in percent

	Output			Labor Productivity			Hours Worked		
	1960-73	1973-79	1979-90	1960-73	1973-79	1979-90	1960-73	1973-79	1979-90
U.S.	4.8	1.6	1.8	3.3	1.2	2.5	1.4	.4	-.6
Japan	12.7	3.2	5.4	10.2	5.0	4.1	2.3	-1.8	1.2
Europe	5.7	2.2	1.5	5.8	4.1	3.2	-.1	-1.9	-1.6
OECD	6.8	2.2	2.4	5.7	3.1	3.0	1.0	-1.0	-0.6
	1979-85		1985-90	1979-85		1985-90	1979-85		1985-90
U.S.	.7		3.2	1.9		3.1	-1.2		.1
Japan	5.8		4.9	3.9		4.3	1.8		.6
Europe	.4		2.8	3.5		2.8	-2.4		-.7
OECD	1.7		3.3	3.0		3.1	-1.1		-.1
	1960-73		1973-90	1960-73		1973-90	1960-73		1973-90
U.S.	4.8		1.7	3.3		2.0	1.4		-.2
Japan	12.7		4.6	10.2		4.4	2.3		.1
Europe	5.7		1.7	5.8		3.5	-.1		-1.7
OECD	6.8		2.3	5.7		3.0	1.0		-.7

Note: Labor productivity is measured as output per hour
Source: U.S. Bureau of Labor Statistics.

—the first oil price hike;
—some research and development (R&D) slowdown (mainly in the United States);
—many inexperienced workers entering labor markets as a result of the baby boom and rising female participation; and
—the breakdown of the Bretton Woods system and the financial instability that both preceded and followed it.

All of these factors have been put forward as major candidate explanations for the slowdown. There is a vast literature that attempts to quantify the impacts of the first three, and let me briefly summarize the results of such attempts. I will come back to the interaction of productivity performance and financial stability a little later.

In general, the bottom line of this work is that these supply-related factors were not significant enough to account for the bulk of the slowdown. For either energy prices or R&D to account for the bulk of the slowdown would require an impact that is greatly disproportionate to their weight in economic activity.[4] Some analysts have argued that energy could indeed have such a disproportionate impact via a large energy-using bias in technological progress, but if that were the case, I think we would have seen far more discussion of whether high energy taxes outside of North America were key factors deterring growth.[5] Similarly, most calculations of the impact of demographic changes yield small effects, especially when averaged over 15-20 years.[6]

Furthermore, history has provided us with some further testing of these possibilities. In the 1980s, all of these factors have been reversed without there being much effect on measured productivity. Oil prices have come down; spending on R&D as a percent of GDP increased in many countries (Table 4); the work force is more experienced in most countries (Table 5); and strike activity is well below previous levels (Table 6). Productivity growth increased in the late 1980s in most countries, but this gain is correlated with a decline in unemployment and some pickup in inflation—which is more characteristic of a demand, than supply-induced, advance. In sum, it is hard to see these three factors as prime candidates for explaining the observed changes in medium-term productivity trends in the OECD area.

Table 4
Spending on R&D as a Percentage of GDP

	1963	1975	1981	1989
United States	2.7[1]	2.3	2.4	2.8
Japan	1.5	2.0	2.3	3.0
Germany	1.4[2]	2.2	2.4	2.9
France	1.6	1.8	2.0	2.3
United Kingdom	2.3[2]	2.0	2.4	2.3

1 From Kendrick (1981).
2 1964.

Sources: OECD, Division of Science, Technology and Industry Indicators, Kendrick (1981).

Table 5
Demographic Changes

	1960-70	1970-80	1980-90
Share of labor force aged 25 or less			
United States	.20	.25	.21
Japan	.23	.16	.13
Europe	.20	.20	.19
Share of women in labor force			
United States	.34	.39	.43
Japan	.40	.38	.40
Europe	.34	.35	.39

Source: OECD. Labor Force Statistics.

Table 6
Days Lost Due to Labor Disputes
(Millions of Days)

	U.S.*	Japan	Germany	France*	U.K.
1971	33.0	6.0	4.5	3.5	13.6
1972	18.0	5.1	.1	2.5	23.9
1973	19.0	4.6	.6	2.6	7.2
1977	21.3	1.5	.0	2.4	10.1
1978	23.8	1.4	4.3	2.1	9.4
1979	20.4	.9	.5	3.2	29.5
1988	4.4	.2	.0	1.0	3.7
1989	16.5	.2	.1	.8	4.1
1990	5.9		.4		1.9

Note: Cross-country data are not strictly comparable because of differences in coverage.

* Adjusted to reflect change in national coverage.

Source: International Labor Organization.

More recent candidate explanations

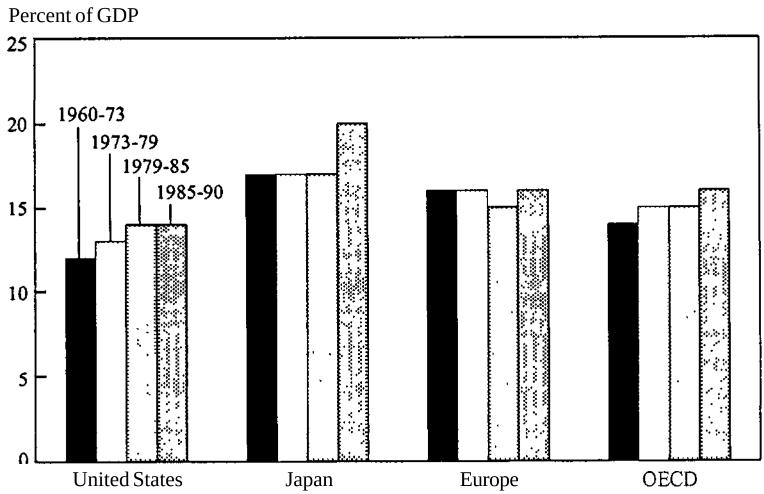
In recent years, the "new" growth theories and the associated empirical work have greatly advanced our knowledge of the factors associated with long-run growth.[7] To be sure, many of the factors emphasised by the "new" theories were stressed in the "old" growth economics as well. However, the emphasis on the potential productivity bonus to human and physical capital and on teasing out the factors associated with cross-country growth differences are important distinguishing features.

The empirical work associated with the new growth theories has in some cases produced very impressive estimated effects. According to one study (Levine and Renelt), raising the GDP share of private investment by 6 percentage points is associated with about a one-percentage-point increase in the per capita GDP growth rate.[8] Harris and Steindel at the New York Fed argue for somewhat smaller productivity effects for the United States than estimated by Levine and Renelt, but even so, their results show that the cumulative effects on potential output over a decade or so of higher U.S. saving and investment would be quite substantial.[9] It is argued that this bonus to physical investment generally results from externalities coming from learning-by-doing, spillovers, demonstration effects or so-called "thick market effects" that improve productivity by enlarging markets. However, it is worth noting that, with the possible exception of spillovers, the other mechanisms generating externalities have been difficult to pin down empirically.[10]

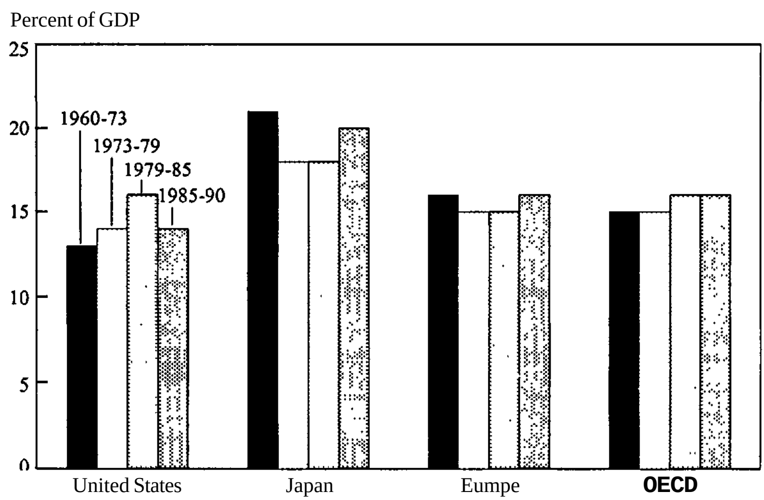
Whatever the source of this bonus to investment may be, it cannot account for the bulk of the post-1973 productivity slowdown in OECD countries. Private capital formation in the OECD area as a whole has been somewhat weaker, but not sufficiently so as to explain the slowdown (Chart 1).[11] As for the results of empirical studies focusing on the retrenchment of public infrastructure as a factor accounting for the private-sector productivity slowdown, some recent work at the OECD suggests that, on the one hand, the estimated magnitude seems too high, and on the other, the implied contribution of the remaining conventional factors is diminished excessively.[12] However, even if the estimated contribution of public capital formation to U.S. private-sector productivity appears unrealistically high, the widespread shift in public spending priorities to transfers and entitlements in the 1970s and the failure to rein this back in most OECD countries in the 1980s has probably adversely affected productivity performance. Indeed, work at the OECD shows that public investment as a proportion of GDP declined to very low levels in the 1980s in most OECD countries except Japan (Table 7).[13]

Human capital, mainly measured by the growth or level of education has also been found to be significant in many cross-sectional studies which have covered developing and developed countries jointly. But this factor does not sufficiently explain the OECD productivity slowdown. Most studies find that OECD education levels continued to improve after 1973 (Table 8).[14]

Chart 1
Investment and Capital Accumulation
Nominal Investment'

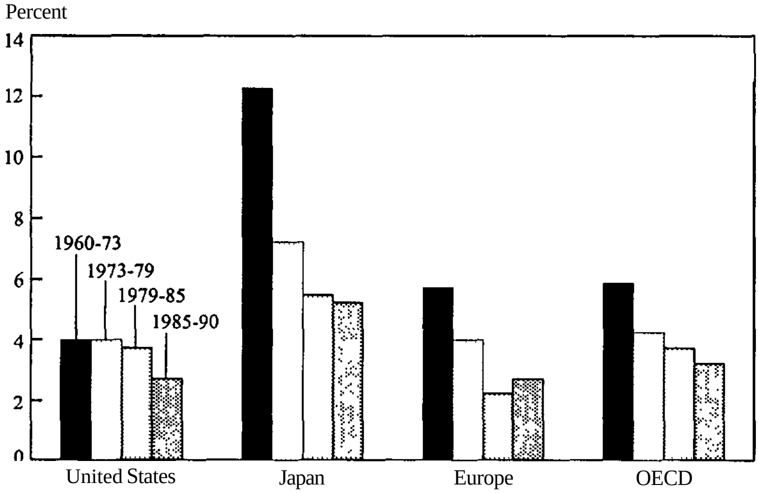


Real Investment[1]



[1]Non-residential business sector gross investment as percent of business sector output.

Chart 1 (continued)
Gross Capital Stock[2]
(annualized growth rates)



[2]The change in the gross capital stock equals gross real investment less estimated scrapping.

Table 7
Net Public Infrastructure Investment
(As percent of GDP)

	1963-73	1973-79	1979-88
United States	3.6	2.2	1.5
Japan	5.5	6.8	6.2
Europe	2.5	2.1	1.7
OECD	3.6	3.0	2.4

Source: Ford and Poret (1992).

Table 8
Educational Attainment in the OECD:
Average Years of Schooling

Estimated by Maddison

	1950	1973	1984
United States	9.5	11.3	12.5
Japan	8.1	10.2	11.2
Germany	8.5	9.3	9.5
France	8.2	9.6	10.8
United Kingdom	9.4	10.2	10.9

Estimated by Barro

	1960	1975	1985
OECD	6.2	7.3	8.3

Note: For Maddison average years of schooling in population aged 25-64. For Barro unweighted average of individual OECD countries' average years of schooling for population 25 and older.

Source: Barro (1992), Maddison (1987).

It is hard to feel confident that the route to faster productivity growth in the OECD is simply increasing the number of people in university and graduate programs. In studies where levels, rather than growth rates, of human capital are found to be important, there is again not much explanation for the downturn since a slow productivity growth country like the United States still has the most highly educated population by most measures and no OECD country shows an absolute decline in education levels. It is true that concerns have been expressed in the United States about educational quality, but most other advanced OECD countries have similarly high levels of educational attainment and slowing growth rates. Hence, if we are looking to education as the culprit for the slowdown, we have to find an explanation that holds for all countries.

Political stability is also stressed as an important determinant of growth in some of the empirical studies. While factors related to political instability cannot be ignored, they are probably far more relevant for developing countries than for OECD economies.

More fundamental causes

Despite the questions I have raised about these studies, let me stress that they have advanced our knowledge of growth processes greatly. My concern is that they may be taken too literally, that it is tempting to assume that the coefficients obtained in statistical regressions can be translated into quantitative predictions of the effects of real-world policy actions. One worry was raised above—the associations of these factors with long-term productivity performance does not encompass individual OECD country experience over the last 20 years, a long time by the standards of most of our analyses.

Apart from this, however, I wonder whether policymaking would not be helped by a focus on more fundamental causes. Let me propose a set of such basic causes for the slowdown. While this set is not opposed to the previous set, and in fact is largely complementary, it can be more helpful in identifying the desired course of policy actions to enhance productivity performance and economic welfare.

My first proposition is that the interaction of OECD inflation and productivity performance over the last 30 years merits more attention (Table 9). In part, high and variable inflation affects productivity performance adversely by distorting the investment decisions that are made. While one can find different estimates of these and other costs of inflation in different studies, ranging from small to quite substantial, it is difficult to forget the twisted allocations of time and resources that came from the interactions of inflation with accounting and tax systems, and the anguish felt by the least sophisticated investors as they saw the value of their savings diminished.[15] It may not have been accidental that the OECD productivity slowdown in the 1970s followed the deterioration of price performance in many OECD countries which led to the breakdown of the Bretton Woods system. Indeed, there is some preliminary empirical work at the OECD which lends support to this proposition.[16] Although inflation is by now its lowest in 20 years in most OECD countries, residual uncertainty and credibility problems may be limiting an underlying improvement in productivity performance.

Table 9
OECD Inflation Rates[1]
(Annualized Growth Rates)

	1960-73	1973-79	1979-85	1985-90
United States	3.6	8.0	6.3	3.7
Japan	6.0	8.1	2.5	1.2
Europe	5.2	11.2	8.5	4.6
OECD	4.4	8.8	6.2	3.5

[1] **Growth of implicit GDP deflator.**

My proposed explanations for the slowdown extend beyond inflation shocks to embrace the increasing structural rigidities and growing ossification of economies, increases in rent-seeking activities, exemplified by the growth of nontariff barriers and impediments to trade, and the problems that some financial markets have experienced in channeling investment funds toward long-term productive uses.

It is striking that there is some evidence that the 1960s, which we view in retrospect as a relatively tranquil period, showed more shifts in resources across sectors than the post-1973 period, when large supply and demand shocks might have been expected to induce such transfers.[17] The willingness of labor and investors to shift resources from one sector to another depends largely on their confidence that the rewards of such shifts exceed the rewards of attempting to preserve old structures. The rise in NAIRUs (the unemployment rates that are consistent with stable inflation) in most OECD countries suggests a marked deterioration in the efficiency of labor markets, at considerable economic and social cost.

Labor market rigidities perpetuated and magnified the initial productivity growth slowdown in OECD countries. For several years after the first oil shock, real wage growth in most countries did not slow down in line with productivity. This resulted in a sustained increase in the labor share of national income, and a compression of profits in most OECD countries. The wedge that emerged between real wage and productivity growth contributed to a rise in the NAIRU, tending to reduce levels, if not growth rates of potential output—whether or not there is a link between the slowing of productivity growth and subsequent higher unemployment is unclear.[18]

Another avenue by which structural problems may have affected OECD productivity trends is by altering the efficiency (or "the quality"), as opposed to the quantity, of investment. Let me give a few examples. Unfettered flows of direct investment across national boundaries as well as domestic investment are obviously desirable—in principle, foreign direct investment (FDI) serves to integrate economies, transfer technologies, and allow benefits from specialization. As such, it may contribute disproportionately to productivity growth. However, the benefits of FDI may be largely lost if other motives are at work—such as the shift of export industries' production base from home to foreign countries in an effort to avoid tariff and nontariff barriers. Some such motivation appears to underlie the pattern of Japanese foreign investment in recent years (Tables 10, 11). Indeed, such FDI essentially represents insurance against the risk of higher trade barriers, insurance that is both unnecessary in a well-functioning trading system and undesirable. In short, trade protectionism may distort the pattern, and damage the efficiency, of both domestic and foreign investment.

Table 10
Japanese Outward Foreign Direct Investment (% of Total)

	1981	1985	1990
European Community	7.7	**14.8**	23.4
United States	26.2	44.2	45.9
Asia	13.7[1]	11.6	12.4

[1] 1982
Source: OECD. DAFFE

Table 11
Export Restraint Arrangements 1987-88[1]

	September 1987	May 1988	Reported increase between September 1987 and May 1988
Total export restraint arrangements [1]	135	261	126[2]
By protected markets			
European Community	69[3]	138[4]	69
United States	48	62	14
Japan	6	13	7
Other industrial countries	12	47	35
Eastern Europe	--	1	1

1 Includes voluntary export restraints, orderly marketing arrangements, export forecasts, basic price systems, industry-to-industry arrangements, and discriminatory import systems. Excludes restrictions under the Multifiber Arrangement.

2 Of the reported increase. almost half were in existence prior to 1988 but were reported by GATT only in 1988.

3 Includes 20 arrangements involving individual EC member states.

4 Includes 51 arrangements involving individual EC member states.

Source: Kelly, *et* al. (1988).

Other than the oil price shock, the great macroeconomic event of the early 1970s was the breakdown of the international monetary system based on fixed exchange rates. Whatever the merits of flexible exchange rates in principle, the subsequent period was marked by large nominal and real exchange rate fluctuations. Under these conditions, FDI could represent a way of buying real exchange rate insurance for investors and, as such, would be completely rational. However, if the movements of exchange rates did not reflect fundamentals, but rather derived from mistaken policies or other sources, the resulting pattern of investment might not be as productive as that which would emerge in a more stable environment.

The fragility of the financial system and its institutions in recent years, stemming from bad loans and irregular transactions, and the debt problems of the corporate and household sectors in a number of OECD countries, also seem to suggest that capital markets may not have fulfilled their function of allocating savings to their most productive uses. Indeed, a number of observers have expressed concern that the overall trend toward liberalization in financial markets has not produced healthy results. For example, in a recent paper, Burton Malkiel has provided evidence that U.S. stock prices reflect short-term growth prospects far more now than in the 1960s, giving managers of firms an incentive to focus investment decisions on the short run.[19] However, I shall argue later that the increased financial market volatility, sustained deviations of capital market prices from fundamentals, and misallocation of savings that occurred in the 1980s should not be taken as unavoidable, natural consequences of financial market deregulation. But the bottom line may be that, effectively, we have a smaller capital stock than is shown in national accounts data.

I am taking the liberty of a speechmaker to raise many questions that I cannot answer in a completely satisfactory way. The observable implications of both the new growth theories and my proposed explanations are largely the same. Analytically, the question is whether the slowing of productivity growth is associated with a set of more fundamental factors that are not captured in the data typically used by economists in evaluating the sources of productivity growth. In order to test this hypothesis rigorously, we would need a set of empirical proxies for structural factors. Such factors are notoriously difficult to quantify and there has been some natural tendency to look under better-lit lampposts.[20] At the OECD we are engaged in a substantial effort to develop indicators of structural flexibility and rigidities. Analytical underpinning of such indicators and their quantification, even imperfectly, would be of great help in guiding policy toward sectors of the economy whose functioning may be adversely affected by distortions of various sorts. However, such exercises are highly data- and resource-intensive, and their success would depend greatly on cooperation by member countries in developing and providing statistical measures.

For policymakers the question is to which set of problems they should direct their attentions. Should the regression coefficients of the new growth literature be read literally as suggesting that increases in saving and in investment in physical and human capital could increase productivity growth substantially? To the extent that my proposed explanatory factors are an important component of productivity growth, then increased investment in physical and human capital will not yield the expected outcomes, unless accompanied by sound macroeconomic management and structural reforms. Conversely, a set of macroeconomic and structural policies that improves incentives and flexibility in the private sector may of its own raise saving, investment, and productivity, ultimately proving more effective than aggressive policy interventions to push up the investment rate.

Policy implications

Much good policy advice—resist inflation, do not interfere with markets, encourage competition and trade, do not expropriate the returns to labor and capital—is at least 200 years old, probably older. So it is difficult to be too imaginative in offering policy advice, especially when good policy in the long run often means being consistent and resisting short-term fixes.

Some policies are easy to advocate because they are consistent with what would be considered good policy for other reasons. Stability, consistency, and credibility in macroeconomic policy management are important. It is difficult for the private sector to make long-term plans when policy goals are not adhered to. There are many good reasons to pursue prudent monetary and fiscal policies, even if productivity gains are possibly long-term and their size uncertain. One can point to fiscal deficits that got out of hand in the 1970s in most OECD countries—and the subsequent excessive reliance on monetary policies in containing inflationary pressures in the 1980s—as a major mechanism that compounded the supply slowdown with contractionary monetary policies (Table 12). You do not have to be in favor of crash investment programs to recognize that there is good reason to avoid crowding out and disincentives to saving and investment.

As I noted earlier, the outcomes of many asset allocation decisions made in the 1980s have given rise to concern about the functioning of deregulated financial markets. However, the increased volatility in financial markets in the 1980s may have been, at least in part, a result

Table 12
Trends in Government Spending and Deficits
As percent of GDP

	Period Average				Selected Years				
	1960-73	1973-79	1979-85	1985-90	1960	1973	1979	1985	1990
					Budget Deficits				
U.S.	-.3	-.9	-2.2	-2.5	.7	.5	.4	-3.1	-2.5
Japan	.9	-2.8	-3.3	1.0	1.7	.5	-4.7	-.8	2.9
Europe	--	-3.5	-4.8	-3.6	--	-1.1	-4.0	-4.9	-3.5
					Government Outlays				
U.S.	29.5	32.6	35.6	36.6	27.0	30.6	31.7	36.7	36.0
Japan	19.5	28.4	33.1	32.3	17.5	22.4	31.6	32.3	32.3
Europe	34.8	43.4	48.3	48.3	31.3	38.5	45.6	49.4	48.4

Source: OECD, National Accounts.

of the mismanagement of macroeconomic policies which disturbed the proper formation of expectations in the financial markets. In part also, perhaps, private financial institutions and market participants themselves had to learn how to act in a deregulated environment. In some cases, regulatory reform and elimination of rigidities in other sectors did not proceed apace with financial market reforms, possibly inducing some economic agents and financial intermediaries to make investments that they would not otherwise have done. In fact, financial liberalization itself has not gone far enough in many OECD countries in the 1980s. More complete financial liberalization would allow market participants to vote more freely with their money, if not their feet. At the same time, there is probably room for better supervision and a better understanding of the forces leading to financial market volatility.

Establishing a well-administered and well-respected set of rules for the international trading system under the Uruguay Round and beyond would be very useful in encouraging both the private and public sectors to devote their attentions to more profitable activities in competitive markets in a global context. The failure to complete the Uruguay Round, in spite of several well-published deadlines, sends a signal that rent-seeking and protectionist interests may have the upper hand over the interests of the general public. Members of regional trading blocs have to be especially watchful that their policies with respect to trade in goods and services do not distort trade and capital flows with countries outside the blocs. I think a consensus is beginning to emerge that, even for countries within the trading blocs, benefits will be maximized if trade barriers with outside areas are lowered rather than raised. Despite this consensus, I am worried that when countries enter cyclical downturns, it will be easy and even popular to hold off lowering trade barriers with the outside and raise new ones.

In many countries directing labor market policies toward encouraging job seeking and human capital formation would have multiple benefits: reducing unemployment directly, preventing the erosion of human capital that comes from long periods of unemployment, and encouraging new entrants to the labor force to acquire the human capital that will make them both employable and flexible. Some recent OECD work (Englander and Egebo) which focused on European

Monetary System (EMS) countries, but which has broader applications, illustrated how labor market rigidities could greatly increase adjustment costs following negative supply or cost shocks.[21]

In sum, major policy efforts will be needed over this decade to improve productivity performance relative to the previous two decades. However, I do not think there is a magic bullet. Our best strategy would be to aim at establishing an economic environment in which longer-term productivity-enhancing activities are encouraged. This will require, in part, sound, stable, and credible macroeconomic policy rules that allow economic agents to take a long-term view. At the same time, it will also require a broad range of structural reforms to increase flexibility economywide. Given the inherent uncertainty of our knowledge of the factors underlying productivity growth, such a broad-based program stands a better chance of success than approaches that emphasize more aggressive interventions across a narrower set of policies.

Endnotes

[1]Output will refer to business-sector output, and productivity to business-sector output per worker unless otherwise stated

[2]Maddison (1989). Baumol and others (1989).

[3]Gordon and Baily (1991), Denison (1985), Englander (1991). To quote the conclusions of a recent conference at the OECD that dealt with the measurement error question (OECD, 1991), . . . the perceptton of a productivity growth slowdown reflects real phenomena beyond evident measurement error and would unlikely bechanged significantly by just improving measurement tools and approaches, though such improvements are indeed necessary.

[4]Denison (1985), Grubb (1986), Solow (1987), Englander and Mittelstädt (1988).

[5]Dale Jorgenson has been an articulate proponent of the energy-using bias view. See, for example, Jorgensen (1990).

[6]Denison (1985), Maddison (1987).

[7]Lucas (1985) and Rower (1990) are seminal articles. For a readable review, see Stern (1991).

[8]Levine and Renelt (1992).

[9]Harris and Steindel (1991).

[10]Jaffee (1986), Bernstein (1987) estimate spillover effects.

[11]Gross investment as a share of GDP (the Investment variable used in many empirical studies) has been relatively stable in OECD countries. Net capital formation (gross investment minus scrapping) has slowed more markedly, but its empirical effects are not out of line with what standard neoclassical economics would have suggested.

[12]Aschauer (1989, 1990), Aaron (1990). Ford and Poret (1991).

[13]Oxley and Martin (1991). The share of public investment in total government expenditures also fell sharply.

[14]Jorgenson and Fraumeni (1991). Maddison (1989) and Barro (1992) find an overall improvement in labor quality in the 1980s. (In Jorgenson and Fraumeni the noneducation sector correspondsclosest to the aggregate business sector). In general, the contribution of laborquality is small relative to the size of the productivity slowdown.

[15]For example, McTaggart (1992) and Howitt (1990) find a substantial productivity benefit to lowering inflation.

[16]For example, a preliminary empirical study by OECD staff finds that a 10-percentage-point increase in inflation is associated with about a one-percentage-point slowing of productivity growth for a sample of 18 OECD countries over three periods (1960-73, 1973-79, and 1980-90). Other explanatory variables incorporated in the estimation are capital accumulation, labor force growth, educational attainment, convergence to the productivity-leading countries (the United States), and dummy variables for the 1973-79 and 1980-90 periods. The significance of inflation variables, even in the presence of the post-1973 variables, suggests that the estimated inflation effect is not capturing supply shocks that were common to the OECD countries, but rather differences in the response of economic policies or economic structure among OECD countries. These estimated effects are larger than those found in studies, such as Fischer (1992) and Corbo and Rojas (1992). that include developing countries.

[17]United Nations Economic Commission for Europe (1981).

[18]One of the research mandates given to the OECD at the recent Ministerial meeting is to examine the causes of, and explore solutions to, the problem of persistently high unemployment.

[19]Malkiel (1992).

[20]Exceptions are Olson (1992), Lindbeck (1983) and Baumol and others (1989)

[21]Englander and Egebo (1992).

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Why Has Potential Growth Declined? The Case of Germany

Horst **Siebert**

Since the 1950s, economic growth rates in industrialized countries have declined. Whereas the per capita growth rate of gross domestic product in industrial countries was 3.7 in the 1950s and 4.2 in the 1960s, the growth rate came down to 3.0 in the 1970s and to 2.1 in the 1980s (Table 1). This picture of declining growth rates is even stronger when the growth rate is not expressed on a per capita basis.

However, we do not observe a uniform picture for the industrial countries (Chart 1). There is no major decline for the United States in terms of the per capita growth rate. France, Germany, Italy, and Japan reduced the gap in per capita income to the United States, but they experienced a strong decline of their growth rate whereas the low rate of the United Kingdom remained rather stable. A similar picture as in Chart 1 for the Eastern European countries shows a steep decline in the 1970s and the 1980s.

I would like to analyze more closely the case of Germany, where the growth rate of gross domestic product (GDP) per capita has come down considerably over the last 40 years, somewhat picking up in the late 1980s (Chart 2).

A perfect explanation would require a multifactor approach (Maddison 1987) that analyzes the change in productivity, the augmentation of factors as well as a set of supplementary conditions including structural change, the availability of natural resources, foreign trade, and economic policy.

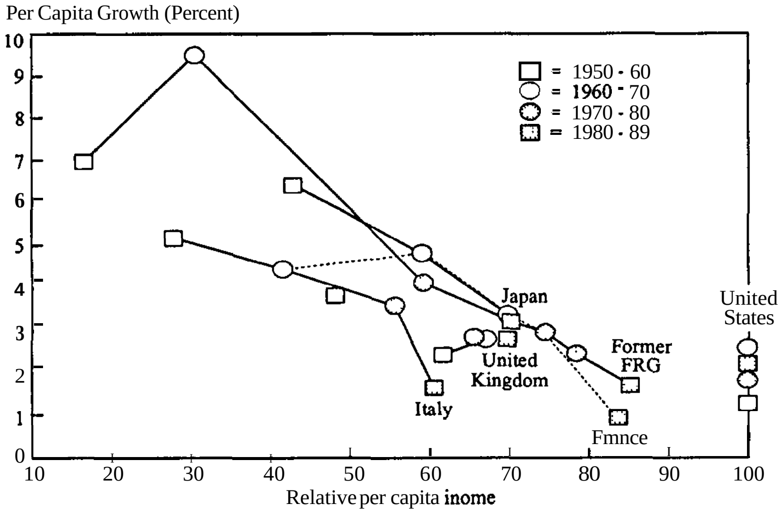
Table 1
Economic Growth (a) in Industrial Countries, 1950-1991
(in **percent)**

Country	50s	60s	70s	80s (b)
Austria	5.4	4.1	3.5	2.1
Belgium	2.4	4.4	3.2	2.2 (c)
Canada	1.3	3.4	2.9	1.2
Finland	4.0	4.3	3.1	2.5 (c)
France	3.7	4.7	3.2	1.5
FR Germany	6.8	3.6	2.8	2.1
Italy	5.3	4.5	3.6	1.8 (c)
Japan	7.1	9.4	4.0	3.7
Netherlands	3.3	4.0	2.7	1.1 (c)
Norway	2.8	3.6	4.6	1.8
Sweden	2.6	3.7	1.8	1.5
United Kingdom	2.1	2.4	2.4	2.3 (c)
United States	1.4	2.5	1.9	1.5
Mean	3.7	4.2	3.1	1.9
Coefficient of Variation	52.5	40.7	25.0	37.2

[a] Average growth rate of GDP per capita in international dollars of 1980. (b) 1980-91. (c) 1980-90.

Source: Robert Summers and Alan Heston (1988); International Monetary Fund (various issues); own calculations.

Chart 1
Growth Rates of Industrial Countries

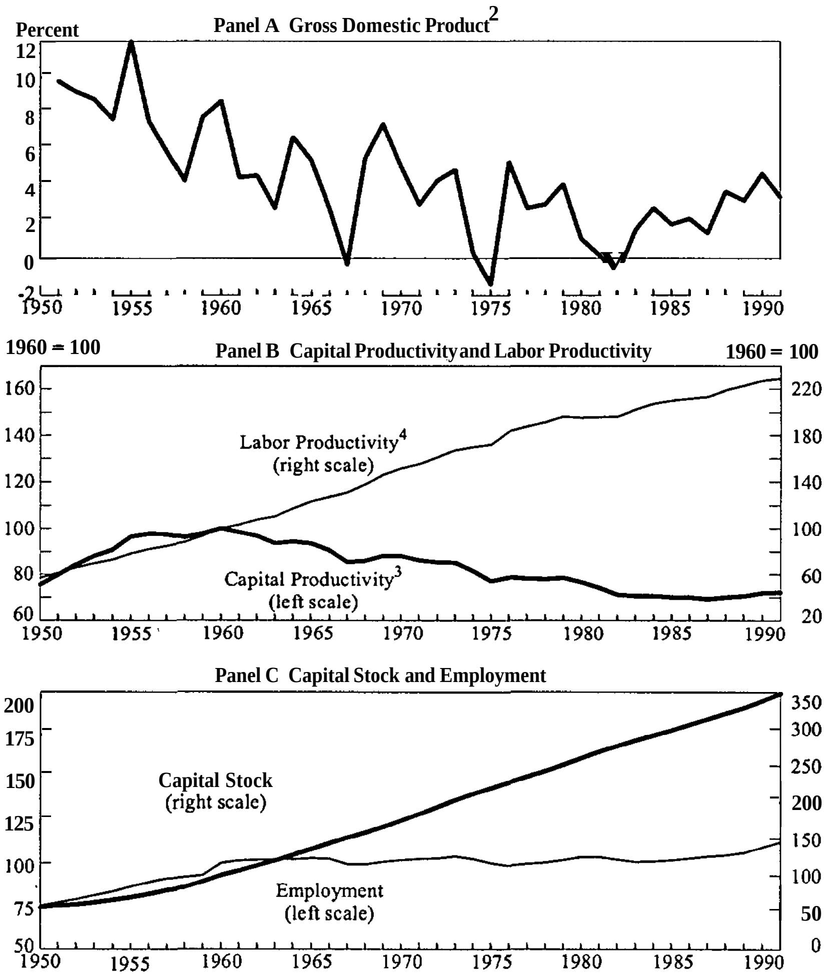


A first approach is to look at the development of factor productivities. In the German case, both labor and capital productivity increased in the 1950s, but after 1960, both productivities follow a diverging trend.

Labor productivity rises with a lower rate of increase in the early and late 1980s. Capital productivity exhibits a negative trend in the 1960s and 1970s, reaching 72.3 percent of the 1960 level in 1991. In the 1980s, capital productivity remains constant with some slight improvement in the late 1980s. Total factor productivity exhibits a falling trend (4.8 percent in the 1950s, 2.4 percent for 1960-73, 0.6 percent for 1973-82, and 1.2 percent for 1982-91).[1]

The 1950s can be characterized as a period in which the production capacity has continuously increased. Both capital and labor (measured as persons engaged, that is, persons employed, including self-employed persons) are augmented considerably with the capital stock nearly doubling. In this period of capital widening, capital and labor are not really moving down their respective marginal productivity

Chart 2
GDP and Productivity in West Germany[1]



[1] 1950 - 1959 excluding West Berlin and Saarland
[2] In 1985 prices; percentage change over previous year.
[3] Gross Domestic Product (in 1985 prices) divided by Capital Stock (in 1985 prices)
[4] Gross Domestic Product (in 1985 prices) divided by Employment

curves. These curves shift outward due to the augmentation of the other factor and due to technical progress.

In the 1960s, 1970s, and early 1980s, the work force remains stable in spite of an active immigration policy in the 1960s. The capital stock nearly triples in real terms. In this period of capital deepening, the capital intensity rises, and capital productivity falls while labor productivity increases. Capital is working its way down the falling marginal productivity curve.

In the late 1980s (since 1987), capital productivity starts rising again. The labor force increases by roughly 3 million between 1982 and 1991. The capital stock also grows. On a more moderate scale than in the 1950s, capital widening takes place.

This analysis leads to a rather simple conclusion: it is favorable for economic growth when both capital and labor increase and when capital and labor productivity rise simultaneously. Unfortunately, in most cases, the real world is more complex in that one factor remains constant and has to be substituted by another factor. This does not preclude that growth may take place in the more complex case when only one factor such as capital is augmented. Increasing only one factor, however, means moving down the marginal productivity curve unless there is technological progress.

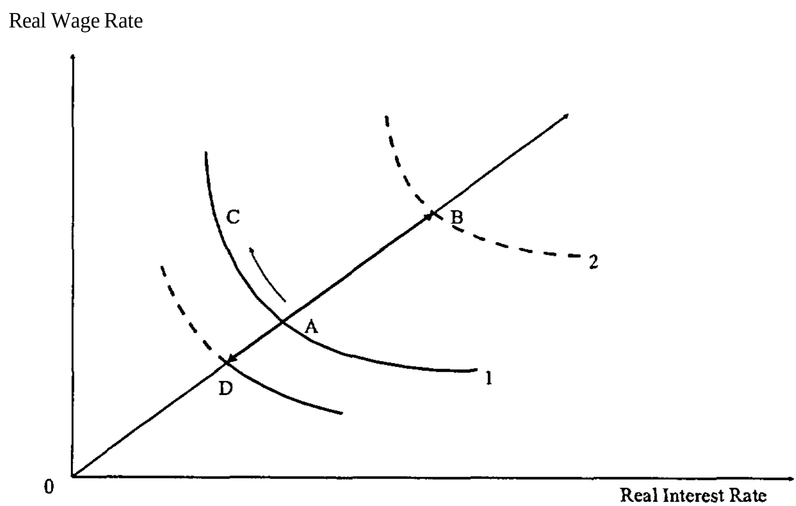
An alternative approach to explain the 1950s is that augmentation of labor went together with a catching up to the pre-war situation. During the 1930s and during the war, theinternational division of labor was severely restricted. This distortion of the German economy implied that there was an unusual growth potential. In addition, part of the capital stock was destroyed during the war. Thus, catching up explains part of the West German growth story in the 1950s and the 1960s (Heitger [1982], Fischer [1988]). A similar argument applies to France, Italy, and Japan.

Productivity changes and variations in factor supply are difficult to distinguish. As a rule, capital accumulation goes hand in hand with an increase in technology if a more recent vintage of capital is added to the capital stock (embodiment effect). In addition, there is learning by doing with accumulated investment. In the German case, capital formation was associated with a modernization of the capital stock.

Human capital, built up by education as well as by training on the job, may be arather important variable in explaining growth. Whereas the German university system is deficient in producing an academic elite as the U.S. system does, it generates a broad group of educated persons. Moreover, the German vocational system represents an asset.

In Figure 1, the factor price frontier denoting the maximum possible real factor prices illustrates some of the points made. If both factors grow and technology remains constant, real factor rewards and productivities do not change. The economy remains in point A. Growth simply takes place by increasing inputs quantitatively. With technical progress, for instance when labor quality improves, the economy moves to a higher factor price frontier (Movement AB). The central issue of empirical growth analysis is to distinguish factor augmentation and productivity growth.

Figure 1



A third case is factor deepening, for instance, a higher capital intensity implying a fall in the real interest rate and an increase in the real wage (Movement AC). Again this case may be linked to an increase in technical knowledge through modernization of the capital stock.

The two oil crises of 1973-74 and 1979-80 represent cases of factor shortening or factor reduction. Marginal productivity schedules of capital and labor as well as the factor-price-frontier shift to the left (Movement from A to D in Figure 1).

The existing capital stock is made partially obsolete because it no longer corresponds to the new price vector. For both oil shocks, capital productivity declines, and the increase in labor productivity is reduced.

For the United States, Jorgensen (1988) concludes that the climb in real energy prices "provides part of the solution of the problem of disappointing U.S. economic growth since 1973." Griliches (1988 p. 9) looking at the research and development explanation of a productivity slowdown sees "the most likely direct causes of these pervasive declines in the growth rates of productivity" in the oil price hikes.

Factor shortening also occurs in the case of environmental protection. The environment as a third or fourth factor of production is made more scarce by environmental legislation. Roughly 1 percent of GNP was spent on environmental protection in Germany and in the industrial nations since the early 1970s. Of course, environmental expenditures constitute factor income, but the new environmental constraint increased the opportunity costs of traditional production and may well have reduced the growth rate of traditional GNP. The increased scarcity of nature as a sink has played a similar role as the reduced availability of energy, albeit in a more continuous pattern. Of course, this raises the question of how we measure growth.

The analysis presented so far has an interesting implication for the transition process of East Germany. The metamorphosis from a central planning system to a market economy means that a new price vector governs and that the existing capital stock oriented toward the old prices becomes largely obsolete. There is an ample supply of qualified labor, and capital accumulation is needed to equip the labor supply with machines. With nearly 3 million of the East German labor force of 7 million either unemployed or in the second labor market or commuting, labor augmentation can take place by drawing labor to the first labor market. Thus, labor augmentation and capital widening can occur simultaneously. The potential gains from participating in the division of labor with the industrialized countries point to the same direction. This should represent a positive scenario for East Germany. In terms of Figure 1, the given factor price frontier of East Germany reflects the obsolete capital stock, and a movement from A to B is possible.

With an export share of 33 percent of GNP (Japan, 15 percent; United States, 8 percent), Germany can be expected to have benefited from the integration into the world economy after 1945 and into Western Europe. Openness matters in economic growth. Intensifying the international division of labor acts similarly as technical progress; it is a factor of economic growth operating perpetually over time. It is hard to pin this determinant down statistically,[2] but as a policy matter, it is worthwhile to take into account that apositive environment of free trade contributes to growth in the world economy as well as in individual countries.

Another implication of the German story is that attitudes of people, institutions, and economic policy matter. This can be clearly seen by the difference in economic performance between West and East Germany. But it is also illustrated by the experience of West Germany. In the 1950s, West German economic policy was focused on rebuilding the country and integrating more than 12 million refugees who came before 1950. People were prepared to put in work effort to improve their personal lot, and economic policy set the incentives in the appropriate way.

In the 1950s, the social market economy protecting the individual by a social net was slowly developed. In the 1970s, the social net was extended considerably. Equity issues became more prominent. Internationally, the social market economy with its social net has been interpreted as a consensus economy (or the "modele rhenan") in which the efficiency loss due to social safety is the price to be paid for social stability. Looking more closely, however, the opportunity costs of the social net are high, and they affect people negatively who supposedly are to be protected. Legislation of the 1970s included improved benefits in the case of unemployment and retirement for the individual, but protection also crept to specific sectors and firms. Labor market regulations aiming to protect the individual worker through layoff restraints and social closing plans established new exit conditions without understanding that implicitly the rules for market entry were changed. Whereas in the 1950s, competition as a guiding principle of the economy was more easily accepted, protection of the individual became more important in the 1970s. In the period 1973-83, Germany lost 800,000 jobs, whereas in the same period, 18 million jobs were created in the United States and 5 million in Japan. Germany was a prototype of Eurosclerosis.

This argument is in line with an explanation of the slowdown as the result of institutional hysteresis. Introducing rules to protect the insiders of the labor market and the existing firms means that the set of constraints relevant for decisionmaking of individuals and firms becomes more binding. Restraints become more powerful by partioning (Siebert 1982). Rent-seeking of interest groups introduces additional constraints. The economy loses its efficiency as well as its flexibility to react to real shocks (Olsen 1982, 1988; Lindbeck 1983). The behavior and attitudes of individuals change to a less entrepreneurial pattern. Germany of the 1970s is of this type.

In the 1980s, Germany slowly followed a different line of policy. Some institutional rules of the labor market were slightly changed; some restrictions on market entry were reduced. Institutional competition arising from the Cassis-de-Dijon-verdict of the European Court and from the completion of the internal market served as a can opener for some West German regulation. Institutional competition was allowed to overcome vested interests to some extent. One lesson is that from time to time, you have to rattle the institutional boat in order to keep the economy flexible. Part of the story of the 1980s was that fiscal policy brought down the budget deficit from 4 percent of GNP in 1982 to zero in 1988—in sharp contrast to the advice given by some American economists. It is not surprising that the growth rate of GDP per capita, capital productivity, and employment show a more positive picture in the late 1980s.

Besides labor market regulations and institutional conditions of market entry and exit, taxation and the relative size of government also may seem to have played a role in determining economic growth. An increased share of government spending seems to be associated with lower growth rates once a certain level of the government share of GNP is surpassed. Taxes disturb allocation, and as a rule, they represent a negative incentive for work effort, saving, and investment (Boskin 1988). There is an optimal size of government being determined by the benefit of providing public goods such as infrastructure and by the burden of taxation. In Germany, the share of tax and social security revenue in GNP has increased from 29.5 (1950) to 42.2 (1989);[3] the share of government spending in GNP has risen from 31.1 (1950) to 48.9 (1991). On the whole, the tax burden in European countries has increased, reaching, for instance, 56.1 in Sweden (1989) and 46.0 in the Netherlands, in contrast to 30.1 in the United States and 30.6 in Japan (Heitger 1992).

The policy issue here is to specify the optimal mix between the provision of public goods and the tax burden, the optimal structure of the tax system, that is, which type of taxes is less distortive (for example, the consumption tax), and the optimal structure of government, that is, which governmental level should provide which public goods and to what extent so-called public goods can be privatized by appropriate institutional arrangements.

The policy answer is that countries are not only involved in competition in the commodity market but also in the factor markets if factors are mobile. Institutional or locational competition is a beauty contest of the immobile factors for the mobile factors. The institutional arrangement of the world economy has to be inducive to strengthen institutional competition.

Finally, another suspect that we should look at in a Schumpeterian tradition (Griliches 1988) or in the interpretation of new growth theory (Romer 1986) as a candidate for a slower growth would be a slowdown in the rate of creation of new knowledge and its application. The data on total factor productivity (Table 1) indicate a decline, but they are questionable. Unfortunately, I have no evidence on the level of research and development (R&D) activity, on R&D investment, or on the flow of new knowledge. One may raise the question to what extent the contestability of markets has changed over time—for instance, in the announcement period of the single market—and to what extent an impact on new knowledge and its implementation can be traced. With some caution[4] the policy strategy is to increase the contestability of markets and to promote conditions that represent an incentive to intensify the search for new technical knowledge and its implementation.

Looking for policy conclusions, a long-run orientation of economic policy aiming at strengthening the supply side is the right approach for economic growth. Such an approach puts emphasis on the contestability of markets, on an open economy being integrated in the international division of labor, on open markets including labor markets with free access of outsiders, and on incentives to find new technical knowledge. Economic policy should not generate distortions between sectors of the economy, and it should not produce distortions over time, that is, intertemporal inconsistencies. Economic policy should be steady, stressing institutional arrangements; it should be "Ordnungspolitik" defining the appropriate frame of reference for private activities, and it should refrain from "Prozesspolitik" by attempting to influence economic activities ad hoc and reacting to changes in the policy situation and to popular demand. Last not least, the government should see its role in providing public goods, taking into account the opportunity costs that taxes create in the private sector. Growth policy needs a long breath.

Appendix 1
GDP, Capital and Labor Force, West Germany, 1950-1991

	Capital[a] Stock	Capital Stock (Middle of Year)	1960=100	GDP[a]	Capital Productivity	1960=100	Labor Force (Employment)	1960=100	Labor Productivity	1960=100	Growth Rate of GDP	Increase in Total Factor Productivity (Percent)
1950	1674.00	1704	56.2	367.84	.2197	75.4	19570	75.1	.0188	57.2		
1951	1733.44	1765	58.2	404.02	.2331	79.9	20091	77.1	.0201	61.2	9.8	6.62
1952	1796.86	1833	60.5	441.23	.2456	84.2	20522	78.7	.0215	65.4	9.2	6.44
1953	1868.24	1913	63.1	480.15	,2570	88.1	21074	80.9	.0228	69.3	8.8	5.83
1954	1957.48	2008	66.3	516.91	.2641	90.6	21671	83.1	.0239	72.6	7.7	4.24
1955	2058.99	2122	70.0	579.03	.2812	96.5	22500	86.3	.0257	78.3	12.0	7.11
1956	2184.58	2254	74.4	623.10	.2852	97.8	23154	88.8	.0269	81.9	7.6	3.61
1957	2322.67	2392	78.9	659.96	,2841	97.5	23683	90.9	.0279	84.8	5.9	2.56
1958	2460.79	2533	83.6	688.58	.2798	96.0	23895	91.7	.0288	87.7	4.3	1.79
1959	2605.44	2772	91.4	742.20	.2849	97.7	24171	92.7	.0307	93.4	7.8	5.09
1960	2937.59	3031	100.0	856.48	.2916	100.0	26063	100.0	.0329	100.0	8.7	5.68
1961	3124.24	3224	106.4	895.19	.2865	98.3	26426	101.4	.0339	103.1	4.5	1.58
1962	3324.03	3428	113.1	936.28	.2817	96.6	26518	101.7	.0353	107.4	4.6	2.33
1963	3531.31	3635	119.9	962.24	.2725	93.5	26581	102.0	.0362	110.2	2.8	.76
1964	3739.65	3856	127.2	1026.34	.2744	94.1	26604	102.1	.0386	117.4	6.7	4.83
1965	3973.09	4095	135.1	1081.45	.2722	93.4	26755	102.7	.0404	123.0	5.4	3.02
1966	4216.46	4338	143.1	1111.96	,2637	90.5	26673	102.3	.0417	126.9	2.8	1.26
1967	4459.51	4569	150.7	1108.75	,2486	85.3	25804	99.0	.0430	130.8	-.3	.41
1968	4678.53	4790	158.1	1169.99	.2501	85.8	25826	99.1	.0453	137.9	5.5	3.85
1969	4902.41	5026	165.8	1257.09	.2564	87.9	26228	100.6	.0479	145.9	7.4	4.76
1970	5149.55	5285	174.4	1321.40	.2566	88.0	26560	101.9	.0498	151.4	5.1	2.90

	Capital Stock[a]	Capital Stock (Middle of Year)	1960=100	GDP[a]	Capital Productivity	1960=100	Labor Force (Employment)	1960=100	Labor Productivity	1960=100	Growth Rate of GDP	Increase in Total Factor Productivity (Percent)
1971	5420.63	5564	183.6	1361.16	.2511	86.1	26668	102.3	.0510	155.3	3.0	.98
1972	5707.39	5853	193.1	1419.12	.2486	85.3	26774	102.7	.0530	161.3	4.3	2.43
1973	5999.15	6143	202.7	1488.19	.2481	85.1	27066	103.8	.0550	167.3	4.9	2.49
1974	6286.05	6409	211.5	1492.08	.2374	81.4	26738	102.6	.0558	169.8	.3	.00
1975	6532.70	6645	219.2	1471.22	.2252	77.2	26020	99.8	.0565	172.1	-1.4	-.01
1976	6757.75	6873	226.8	1549.80	.2293	78.7	25682	98.5	.0603	183.6	5.3	5.26
1977	6988.91	7108	234.5	1593.91	.2281	78.2	25919	99.4	.0615	187.1	2.8	1.22
1978	7226.50	7350	242.5	1641.64	.2272	77.9	26130	100.3	.0628	191.2	3.0	1.32
1979	7473.00	7606	250.9	1709.17	.2287	78.4	26568	101.9	.0643	195.8	4.1	1.95
1980	7738.45	7873	259.8	1727.51	.2232	76.6	26980	103.5	.0640	194.8	1.1	-.01
1981	8007.74	8130	268.2	1730.52	.2161	74.1	26951	103.4	.0642	195.4	.2	-.01
1982	8252.56	8363	275.9	1714.14	.2077	71.2	26630	102.2	.0644	195.9	-.9	-.01
1983	8473.19	8587	283.3	1740.90	.2055	70.5	26251	100.7	.0663	201.8	1.6	1.75
1984	8699.84	8810	290.7	1789.35	.2057	70.5	26293	100.9	.0681	207.1	2.8	1.93
1985	8919.18	9027	297.8	1823.18	.2044	70.1	26489	101.6	.0688	209.4	1.9	.53
1986	9135.08	9248	305.1	1863.77	.2040	70.0	26856	103.0	.0694	211.2	2.2	.52
1987	9360.42	9475	312.6	1890.28	.2019	69.3	27050	103.8	.0699	212.7	1.4	.21
1988	9589.04	9710	320.4	1959.41	.2043	70.1	27261	104.6	.0719	218.7	3.7	2.39
1989	9830.89	9963	328.7	2022.78	.2058	70.6	27631	106.0	.0732	222.8	3.2	1.42
1990	10095.07	10244	338.0	2118.75	.2099	72.0	28433	109.1	.0745	226.8	4.7	1.80
1991	10392.35	10555	348.2	2191.05	.2108	72.3	29173	111.9	.0751	228.5	3.4	.79

[a] In 1985 Prices

Source: Statistisches Bundesamt

Endnotes

[1]Estimates based on Table 1 in the appendix are my own calculations. Total factor productivity growth is calculated as the residual not explained by labor and capital growth. Weights used are 0.7 for labor and 0.3 for capital.

[2]For developing countries compare the analysis of Edwards (1992). Dornbusch (1992) is rather skeptical about these results. Benefits from trade vary with the size of a country. A large country is likely to experience smaller distortions in autarky and consequently, benefits less from trade in relative terms.

[3]The share of social security contribution in GNP has risen from 8.5 percent in 1950 to 17.1 percent in 1991.

[4]Technological leadership does not automatically guarantee economic leadership. Audretsch (1992) suggests that the same industrial organization that generates a large flow of new technical ideas, that is, a very competitive environment, may not be conducive to the manufacturing of new products.

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The Search for Growth

Charles I. Plosser

The idea that capital investment is essential to the long-run rate of growth of a nation is a common, if somewhat vague, axiom of most policy discussions of economic growth and development. Yet for the better part of a generation the preeminent theory of economic growth developed by the Nobel Prize winning economist Robert Solow and the data summarized by the important contributions of Edward Denison, John Kendrick, Solow, and others provided us with virtually no basis for making such claims. Perhaps even more striking was the fact that the theory seemed unable to explain the extreme and persistent differences in living standards or growth rates across countries. Finally, the theory and evidence offered little scope for policymakers to influence the long-run rate of growth of an economy. For these reasons, many economists interested in positive economic theories came to view growth theory as a rather sterile, and uninteresting branch of economics through most of the 1960s and 1970s. Understanding business cycles and monetary economics became much more popular pursuits among academic economists.[1]

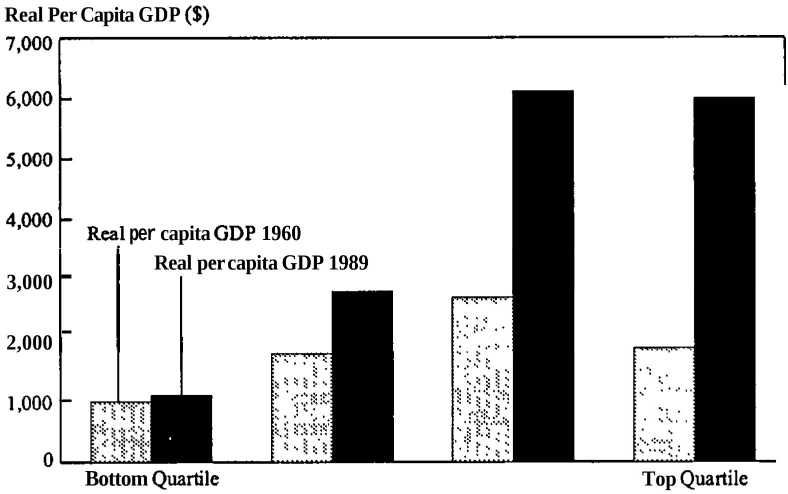
The importance of understanding the sources of long-term economic growth and the public policies that influence it should be self-evident, but let's try to attach some numbers to the concept that may help put the discussion in some perspective. By almost any measure, the range of living standards across countries is enormous. By some measures, real income per capita in such countries as Bangladesh, Ethiopia, Haiti, and Bolivia was less than 5 percent of U.S. per capita income in 1989.

Perhaps more important than the existence of these very poor countries is the fact that not all countries that start out poor remain poor—while others seem unable to raise their standard of living above mere subsistence levels. Countries such as Botswana and Korea had per capita incomes of less than 10 percent of that in the United States in 1960 and by any metric would be classified as very poor. Yet by 1989, Botswana had increased its per capita income by almost eightfold, growing at a compounded annual rate of about 7 percent. Korea grew at an annual rate of about 6 percent, resulting in an almost sixfold increase in per capita income over the three decades. The United States, on the other hand, grew at an annual rate of about 2 percent resulting in an increase of only about 75 percent over the same time interval. Other countries that were not as poor as Botswana and Korea but that experienced significant growth over this 30-year interval include Cyprus at an annual rate of 4.7 percent, Greece at 4.3 percent, Hong Kong at 6 percent, Japan at 5.6 percent, Malta at 6 percent, Portugal at 4.1 percent, and Singapore at 6.4 percent. At a growth rate of 4 percent per year rate, real per capita income doubles every 17 years; at a 5 percent rate, it doubles every 14 years.

While these countries obviously made great strides in improving their living standards over the last generation, other countries were not so fortunate. Indeed, most countries that were poor in 1960 remain among the poorest in 1989.[2] All the more reason why it is important to ask why Botswana grew at a 7 percent rate while Bangladesh and Ethiopia grew at only about 0.5 percent per year. Why did Korea grow at 6 percent while Bolivia grew at only 0.5 percent? And why did Singapore grow in excess of 6 percent annually while New Zealand and the Philippines grew at less than 1.5 percent per year? Was there something about the national economic policies followed by these countries that led to either rapid growth or stagnation?

The differences in welfare levels produced by these differential growth rates is staggering. For example, Chart 1 shows the magnitude of the consequences of a country's being among the fast growers versus the slow growers. The countries in the top quartile of growth over the 1960-89 period grew at an average annual rate of about 4.1 percent and their per capita incomes increased from just under $2,000 per year to more than $6,000 per year. Those countries in the bottom

Chart 1
Average Real Per Capita GDP in 1960 and 1989



quartile of growth over the period grew at a rate that was indistinguishable from 0.0 percent. For the United States, an extra two percentage points added to the average growth rate would add about 22 percent or $3,500 to real per capita gross domestic product (GDP) over the next decade and more than 80 percent or $1 2,800 per capita over 30 years! By contrast, the gain from eliminating fluctuations in per capita incomes through stabilization policies is relatively small.[3] The ability of any economy to raise living standards from one generation to the next depends on its ability to sustain economic growth.

During the last half dozen years, many academic economists have turned their attentions to the challenges of understanding economic growth. Building on the work of Solow (1956), Cass (1965), and Koopmans (1965), these economists are seeking to remedy the shortcomings of the earlier attempts to model the growth process and in doing so are exploring new and potentially important sources of economic growth and the avenues for policies to influence the long-term welfare of a nation.

The traditional view of economic growth

Modern work on economic growth can trace its intellectual roots to the work of Robert Solow. The basic neoclassical model of economic growth developed by Solow is, first and foremost, a model of capital accumulation. Its influence on the profession and its thinking about aggregative economics is based on a combination of its simplicity and its contribution to the quantification of various factors influencing economic growth. The model's foundation rests on the concept of an aggregate production function that combines labor and physical capital to produce a composite good that is associated with the output of the economy. The level of output is also influenced by the level of "technology" or "productivity" of the factors of production. The model is silent, however, on the factors influencing the evolution of technology.

The characteristics of the production function are central for the model's predictions about growth. The essential features are: (1) constant returns to scale (for example, doubling of all inputs leads to a doubling of output); and (2) diminishing marginal returns to both capital and labor (for example, increasing capital by a factor of two and holding labor input fixed raises output by less than a factor of two). Diminishing returns to physical capital limits the ability of the Solow framework to deliver a very satisfactory explanation of cross-country differences in income per capita or rates of growth. As we will see below, it is the key feature that distinguishes the traditional view of economic growth from the new or endogenous theories of growth.

The technology of the sort just described is frequently expressed in the form of a Cobb-Douglas production function which is written

$$Y = AK^{1-\alpha}L^{\alpha}, \text{ and } 0 < \alpha < 1$$

where total output, Y, is produced from physical capital, K, and labor, L. The level of technology is captured by A, which grows at some predetermined rate. This formulation exhibits both constant returns to scale and diminishing marginal returns to each input. The degree of diminishing returns to capital is measured by (1-a). The smaller this value (that is, the larger is a) the smaller are the rewards to increasing the capital stock. The capital stock accumulates over time through net investment such that $K_{t+1} - K_t = I_t - \delta K_t$, where 6 is the depreciation rate of physical capital. It is often easier to express this framework in per capita terms so that production is written as $YL = y = A[K/L]^{1-\alpha} = Ak^{1-\alpha}$ and the accumulation of capital becomes $k_{t+1} - k_t = it - \delta k_t$.[4]

An economy that produces output according to this neoclassical technology exhibits some striking and important characteristics. For the moment assume that the rate of population growth is constant and that there is no growth in productivity or technology. The first important feature is that given a savings/investment rate, and therefore, a rate of accumulation of physical capital, the per capita output of the country will reach a steady state or constant value. Similarly, the per capita amount of capital also reaches a constant level. The reason is that as the per capita capital stock grows, the return to capital falls and, because of the constant investment rate, the amount of new investment per capita increases but at a diminishing rate. Eventually the amount of new investment per capita will just equal the depreciation on the larger capital stock and then growth of the per capita capital stock will stop. Thus the level of income and the level of capital will grow at the same rate as the population; per capita values will not exhibit growth.[5] If we allow for technological progress or productivity growth, then per capita income and capital stocks would grow at a rate that is proportional to the rate of technological change.

The second important implication of the Solow framework is that the savings/investment rate is a fundamental determinant of the long-run standard of living. Countries with higher savings/investment rates will have higher per capita incomes in the steady state. The intuition behind this result is simply that a higher investment or savings rate results in more accumulated capital per worker which, in turn, increases the per capita output of the economy, but at a decreasing rate. Thus the Solow model suggests that sustained or long-run differences in the level of per capita income across nations is associated with differences in savings rates. Thriftiness, however, while impacting the long-term wealth of a society, does not cause it to grow faster. In steady state, the growth rate of per capita income is independent of the savings rate. In other words, in the long run, societies that save more will not grow faster than those that save less.[6]

Although exogenous technological progress is the only source of long-term or steady state growth in per capita incomes and consumption, the Solow framework does predict per capita growth during the transitions from one steady-state level to another. Suppose that through some impulse, a society became more savings oriented, perhaps as the result of a change in tax policy that encouraged savings. In the long run, the new higher rate of investment will enable workers to use more capital and thus operate at a higher capital/labor ratio and produce more output per worker. In order to get to the higher standard of living, the economy must, for some period of time, grow faster than the growth rate of technology. However, once the new higher steady state is achieved, per capita income growth will return to a rate proportional to the rate of technological change. The rate at which the gap is closed between the initial income level and the new steady state critically depends on the degree of diminishing returns.

The last important implication of the traditional view of growth is that countries that have access to similar production technologies and have similar savings/investment rates should converge to similar steady-state levels of per capita income. This convergence property means that the poor country, which starts with a lower capital/labor ratio, will grow faster during the transition as it catches up to the rich country, but both countries will ultimately arrive at the same standard of living. The case for convergence assumes that both countries are closed economies so that there is no trade between them. If the economies were open so that international borrowing and lending were feasible, then the economies are likely to converge more quickly. Since the poor country has less capital per worker, the returns to capital investment will be higher than in the rich country. The poor country will be attractive to foreign investors and the capital stock is likely to grow even more quickly, thereby speeding up the process of convergence. Of course, countries with different savings rates will have different steady states so just because one is poor and one is rich does not imply that convergence will occur or that one will grow faster than the other.

At this purely qualitative level, the Solow model makes an important distinction between factors that influence the level of per capita income and those that influence the growth rate. The commonly held view that changes in tax structures that make savings and investment more attractive activities that can result in sustained increases in an economy's rate of growth, is simply not an implication of the traditional Solow analysis of economic growth. Sustained growth in living standards comes about from productivity or technological growth. Unfortunately, the theory has nothing to say about how this productivity growth is determined or how policy might influence it.

Quantifying the basic neoclassical model of growth

One of the attractive features of the classical framework is that it permits the decomposition of economic growth into that portion due to the growth of inputs (physical capital and labor) and due to the growth of technology or productivity. This practice of growth accounting involves computing the shares of national income devoted to the compensation of both physical capital and labor. Assuming the inputs to production are paid their marginal products, then the labor's share corresponds to the exponent a in the Cobb-Douglas production function. Table 1, derived from Maddison (1987), presents estimates of factor shares for a variety of industrialized countries. These estimates put capital's share (1-a) at about 0.3 and labor's share at about 0.7. The similarity of factor shares across countries and across time is one of the stylized facts of economic growth that any theory must confront.

Table 1
Estimates of Factor Shares in GDP[1]
(average for 1973-82)

	Total capital share	Total labor share
France	.31	.70
Germany	.30	.70
Japan	.29	.71
Netherlands	.30	.70
United Kingdom	.26	.74
United States	.27	.73
Average	.29	.71

[1] Source: Maddison (1987)

If capital's share is about 0.3 then the production technology exhibits sharply diminishing returns to capital formation. Other researchers have put capital's share above 0.4 for some countries and some time periods, but in much of the literature it is frequently assumed that capital's share in GDP is about one-third and labor's share is about two-thirds (that is, $a = 2/3$). Sharply diminishing returns to capital formation places limits on the Solow model's ability to account for cross-country differences in per capita incomes and growth rates. For example, it says that a doubling of the capital stock per capita increases steady state income per capita by only about 26 percent $[(2^{1/3} - 1)100]$. Thus for capital accumulation to account for the fact that the United States has 20 times the income per capita of Kenya, the capital stock per capita in the United States would have to be about 8,000 times the capital stock in Kenya! According to Summers and Heston (1991) U.S. capital per worker is only about 26 times that of Kenya. Even for countries more similar to the United States than Kenya, diminishing returns limits the explanatory power of the Solow model. Summers and Heston report that the capital stock per worker in the United States is approximately 22 percent higher than in Sweden while per capita income is more than 40 percent higher. The difference in physical capital can account for only about a 7 percent differential in per capita incomes if the share of fiscal capital in output is just one-third. Thus the Solow model with such sharply diminishing returns accounts for very little cross-country variation in per capita incomes.[7]

Neither can the model offer much help explaining differences in growth rates by appealing to the transitional dynamics. Imagine that a country could increase its rate of net investment by 50 percent. The model predicts that the growth rate would immediately increase, but would gradually decline over time until the new higher steady-state capital stock per capita was reached. The new steady-state income per capita would rise by about 22 percent.[8] If the country completed the transition to this higher steady state in exactly 30 years, then the increase in the average annual growth rate would only be about 0.7 percent per year.[9] Thus large increases in investment rates have little ability in the theory to explain growth rate differentials.

The above observations can be summarized by looking at the growth rates of productivity. If capital accumulation does not account for much of the observed per capita growth, then the Solow model must rely on exogenous growth in technology or productivity. Since productivity growth is measured as the residual after accounting for factor accumulation, it is often referred to as the "Solow residual." As can be seen from Table 2, productivity growth accounts for a substantial portion of economic growth in many countries and across many time periods. For example, the growth acceleration during the period 1950-73 from the previous 40 years and the slowdown since 1973 is, to a large degree, accounted for by variations in productivity growth, not variations in factors.

Table 2
Real GDP Growth and productivity[1]

	1913-50		1950-73		1973-84	
	GDP growth	Productivity	GDP Growth	Productivity	GDP Growth	Productivity
France	1.20	1.42	5.10	4.02	2.20	1.84
Germany	1.30	.86	5.90	4.32	1.70	1.55
Japan	2.20	1.10	9.40	5.79	3.80	1.21
Netherlands	2.40	1.25	4.70	3.35	1.60	.81
U.K.	1.30	1.15	3.00	2.14	1.10	1.22
U.S.	2.80	1.99	3.70	1.85	2.30	.52
Average	1.87	1.30	5.30	3.58	2.12	1.19

[1] Source: Maddison (1987).

Implications for tax policy

The implications of the Solow model of economic growth should be fairly clear from the preceding discussion. Nevertheless, it is useful to explicitly consider a quantitative example that can serve as a benchmark for later discussions. King and Rebelo (1991) have simulated the quantitative impact of changes in the income tax in the Solow model. They calibrate the model by selecting the conventional value of $a = 2/3$ for labor's share, a depreciation rate of 10 percent $(6 = .1)$ and a growth rate of technology of 2 percent. Because of the technological progress, this economy grows at 2 percent per year in the steady state.

The tax experiment explored by King and Rebelo is an increase in the average income tax rate from 20 percent to 30 percent. The steady-state growth rate is determined by the rate of technological progress so the long-run growth rate is unaffected by this policy. However, the tax increase does result in a lower steady-state capital stock and thus a lower steady-state level of output. King and Rebelo calculate that the capital stock declines by 18.2 percent in the long run. This translates into about a 6.5 percent decline in the level of income from what it otherwise would have been. During the transition to this lower capital stock the economy grows at less than its steady-state rate of 2 percent. If the new steady state is reached in 30 years, then the average annual growth rate is reduced by a mere 0.2 percent by this 50 percent increase in average tax rates. Thus high tax rates would not appear to cause much damage to this economy.[10] By like token, lower taxes would not reap many benefits.

The search for new mechanisms for growth

The basic weakness of the traditional view of economic growth stems from two related factors. First, physical capital exhibits sharply diminishing returns in the production process, making it difficult for the model to be reconciled with cross-country variations in either living standards or growth rates. The second, related factor, is that the model does not provide any explanation for steady-state growth. Long-term growth is independent of savings and investment and is determined by the exogenously specified rate of technological progress. Since technology or productivity is not determined by the model, the theory provides no framework for understanding the economic forces and policies that influence the most important source of growth. While it may turn out to be true that there are severe limits on the ability of public policy to influence the long-run growth rate, it is important that we arrive at that conclusion some way other than by relying on models that simply beg the question.

The new growth theories attempt to address these deficiencies by constructing models where steady-state growth arises endogenously. The literature in this area is expanding at an exponential rate and it is impossible, nor is it my intent, to survey the scores of papers and theoretical perturbations they explore. What I will try to do is to summarize what I consider to be two major strands to this increasingly technical literature in fairly simple terms. I apologize, in advance, to all those authors whose work I am summarizing but whom I fail to individually reference.

All of the models of endogenous growth must break the constraint of diminishing returns to accumulation imposed in the basic Solow or neoclassical model. The way this is done varies, but for my purposes it is convenient to divide the approaches into two broad strategies. The general set of implications of the new theories of endogenous growth is that societies that save and invest more will generally grow faster in the long run and therefore policies that affect the savings rate will have more important and sustained consequences for economic welfare.

The first group of models focuses on a broad measure of reproducible capital that includes not only physical capital, as stressed in the Solow framework, but other types of capital as well, especially human capital. The key to obtaining positive growth in the long run in these models is that there must be some subset of these capital goods whose production does not require the use of nonreproducible inputs. These models are the closest in spirit to the traditional framework of Solow, but the production technology is such that the role of investment and capital accumulation becomes a much more important channel for influencing growth. In these models, tax policy is more important for the long-run growth rate to the extent that it influences the long-run rate of accumulation of either physical or human capital.

The second strategy for generating endogenous growth captures a wide variety of approaches under one heading. These approaches must also break the link between capital, somehow measured, and diminishing returns, but they do so because there is some kind of spillover, externality or public good feature to the model. That is, private returns may be diminishing, while social returns are not because of the spillovers or externalities. What distinguishes these models from the previous ones is that external effects frequently result in competitive equilibrium being sub-optimal. If so, then there may be some scope for government policy to bring about a welfare improving outcome. In some ways it may be useful to think of these as attempts to model technology as a reproducible factor of production.

Models with reproducible factors of production

One way to break the link between diminishing returns and capital accumulation is to think of all inputs to the production process as some form of reproducible capital, either physical or human. The idea is that what matters for production is not raw labor measured in terms of persons or hours worked, but the quality or efficiency of the labor as indexed by the knowledge or acquired skills of the worker. This broad measure of capital may also include other types of capital such as the state of knowledge.[11]

The simplest form of this sort of process is one developed by Rebelo (1991) where output is expressed as a linear function of a .broadly defined concept of capital. It is frequently referred to as the "AK" technology since the production function is written $Y = AK$.[12] This production function retains the property of constant returns to scale, but it no longer exhibits diminishing returns to capital accumulation. It is a special case of the production function in (1) with a = 0.

This simple technology generates the most basic of all endogenous growth models. Since the production of output no longer faces diminishing returns as in the Solow framework, it can exhibit perpetual growth in per capita values. The reason is that since there are no diminishing returns to capital accumulation, a constant rate of investment can result in an ever growing capital stock per capita and thus steady-state growth.[13] Thus to raise the long-run growth rate of an economy, it is sufficient that the savings rate rise.

In the Solow framework with diminishing returns to capital accumulation, the long-run growth rate is independent of the rate of savings or investment. Instead, steady-state growth is determined by an exogenously given rate of technological progress. In this class of endogenous growth models, the long-run growth rate is fundamentally determined by the saving and investment decisions of the citizens of the economy. This suggests that anything that influences the incentives of people to save and invest is potentially an important factor for influencing long-run growth prospects. Tax policies are obviously one important factor influencing investment decisions. Since capital and financial markets are central to the efficient allocation of investment, regulation and development of the financial sector may be important for sustained economic growth.[14] The importance of investment in these endogenous growth models for the long-run prospects of a nation stands in stark contrast to the Solow framework where raising the investment rate causes transitional growth, but has no impact on steady-state or long-term growth.

This simple endogenous growth model exhibits the essential features of almost all the models of this class. Nevertheless, it is instructive to add more structure to the framework. Rebelo (1991) explores the implications of various extensions of this simple linear model that treat the production of consumption, physical capital, and human capital as separate goods with distinct production functions. He demonstrates that in order to generate endogenous steady-state growth, it is only necessary that a "core" of capital goods be produced without the use of nonreproducible factors and according to a constant returns-to-scale technology. For example, the production of the consumption or physical capital good may involve nonreproducible factors or exhaustible resources, but as long as the production of human capital is constant returns to scale in human capital, then sustained growth is possible.

Quantifying the impact of taxes

King and Rebelo (1990) have calibrated both a one- and two- sector endogenous growth model of the sort described by Rebelo. The one sector model is essentially the linear technology model described above. The parameters are the same as in the Solow type model except that $a = 0$ so capital's share is one so that K must be interpreted as a broad measure of capital including human capital.

The tax experiment is again an increase in the income tax rate from 20 percent to 30 percent. Since the increase in taxes has an immediate effect on the investment rate by lowering the after-tax return to all forms of capital accumulation, the economy's long-run growth rate drops. Under the parameter values chosen, the economic growth rate drops by 1.63 percent, from 2 percent per year to 0.37 percent per year.

The consequences are large. After 30 years, an economy growing at 2 percent per year increases per capita income by 81 percent while an economy growing at 0.37 percent increases per capita income by just 12 percent.[15] Even after just 10 years, the economy growing at 2 percent increases by 21 percent while one growing at 0.37 percent increases by just 3.8 percent.

King and Rebelo also explore the consequences of taxation in a two-sector model where one sector produces a familiar consumption/physical capital good and the other sector produces a core capital good labeled human capital. The basic results are similar. However, the two-sector model permits the ability to distinguish between taxes levied on physical goods and capital and human capital. Since income taxation amounts to taxing consumption and investment at the same rate, an increase in the tax rate reduces the long-run growth rate of the economy. It brings this about by reducing the capital/labor ratio in the economy. On the other hand, a consumption tax acts like a nondistortionary lump-sum tax and will have no impact on the long-run growth rate. As long as physical capital is used in the production of human capital, then even if human capital is not taxed directly, a tax on income in general impacts growth but the magnitude depends on the importance of physical capital in the production of human capital.

The lessons learned from these exercises is that investment in a broad concept of capital that includes human capital, can have quantitatively large effects on a nation's growth rate and thus the welfare of its citizens. From a public policy perspective, this means that policies intended to influence investment may be quantitatively more important than suggested by the traditional Solow view of capital accumulation. Specifically, investment in human capital plays a more prominent role and thus should not be ignored simply because it is harder to measure than physical capital.

Growth with externalities and spillovers

The models I group under this category are similar to the ones just described in that to generate sustained growth they must exhibit constant returns to scale in reproducible factors for some set of capital goods. They differ because they exhibit external effects. Nevertheless, it is important to keep in mind that it is not the external effects that generate sustained growth, but it is constant returns to scale in all inputs that can be accumulated.

The work of Robert Lucas (1988), for example, emphasizes that human capital accumulation has external effects on the productivity of the economy. He postulates that an individual worker is more productive, regardless of his skill level, if other workers have more human capital. The important implication of the external effect is that under a purely competitive equilibrium its presence leads to an under-investment in human capital because private agents do not take into account the external benefits of human capital accumulation. Since the equilibrium growth rate in this model depends on the rate of investment in both physical and human capital for all the reasons discussed previously, the externality implies that growth would be higher with more investment in human capital. This framework suggests the possibility that a government subsidy to human capital formation or schooling could potentially result in a substantial improvement in economic growth and welfare.

Another example of the role played by external effects has been proposed by Paul Romer (1986) in one of the seminal contributions to the new work on growth. Building on the work of Kenneth Arrow (1962) and others, Romer's framework is conceptually similar to Lucas' model just described except that the source of the externality is the stock of knowledge. Knowledge is produced by individuals, but since newly produced knowledge can, at best, be only partially kept secret, the production of goods and services depends not only on private knowledge, but on the aggregate stock of knowledge as well. Firms or individuals only partially reap the rewards to the production of knowledge and so a market equilibrium results in an under-investment in knowledge accumulation. Knowledge in this framework is closely related to the level of technology so that Romer is explicitly attempting to make technological progress something that is determined by the model rather than imposed externally. Some of Romer's more recent work (for example, Romer [1990]) continues to stress the importance of invention and the development of new technologies as the engines of economic growth. In these newer models, firms cannot appropriate all the rewards to knowledge production so that the social rate of return exceeds the private rate of return to certain forms of capital accumulation. Since knowledge and invention are developed by private profit maximizing firms, the economy may under-invest in these forms of capital. Consequently, public policies regarding tax incentives for research and development, patents and property rights, and regulatory issues may be critical to raising the growth rate and economic welfare in these economies.

Barro (1990) has explored a framework that includes tax-financed government services. In Barro's framework, government provides two types of services. First, government provides consumption-related services directly to households. These could be anything from food-stamps to art work. Second, the government sector supplies productive goods that can be considered public capital and serve as an input to private production. Services from infrastructure such as roads and bridges as well as courts and police services which may enhance property rights are candidates for public provided capital. Both types of services are assumed to be financed by a flat rate income tax. The production function must, as stressed before, exhibit constant returns to scale in factors that can be accumulated, in this case private and public capital. Otherwise, the long-run growth rate is once again determined by the rate of technological progress.[16]

The two types of government services impact long-run growth in different ways. First, government consumption services have no productive impact in this model economy, yet they are financed by an income tax that lowers the return to the accumulation of capital. Consequently, increases in government supplied consumption services reduces the long-run growth rate of the economy. Second, government supplied capital induces two offsetting effects. An increase in public capital raises the returns to private capital accumulation and thus raises the long-run growth rate. The increase in the income tax rate necessary to provide the capital acts to reduce the long-run growth rate. To balance these two effects and thus maximize growth, the government must supply public capital at the same level as would be provided by the private sector. Supplying more or less capital lowers the long-run growth rate. Thus a shift from productive to nonproductive spending by government would lower the long-run growth rate. Barro also argues that looking across countries, one should expect to see that the higher the ratio of productive spending to output, the lower long-run growth rates will be.[17]

Industrial policies and endogenous growth

To some, these models with externalities are attractive because they appear to provide a rationale for government intervention and may have been seen as justifying a type of "industrial policy." Unfortunately, the leap from theory to practice in this case is a particularly large one. In the first place, welfare improving subsidies of specific activities are usually assumed to be offset by a nondistorting lump-sum tax elsewhere in the economy. In reality, tax and subsidy schemes are never so clear-cut. Subsidies are often financed by distortionary taxes and thus the benefits may be partially or totally offset. Second, the models generally say that it may be beneficial to reduce the tax on, say, research and development or on investment in those technologies that have the greatest external benefits. Such prescriptions are not easily translated into a method of "picking winners." The policymaker still does not know which investments will have the biggest external benefits nor is he likely to know in advance which industries will make the greatest contributions to the state of knowledge or human capital. Perhaps the best way to interpret these models is to recognize that reducing the taxation on investment in human capital and the production of knowledge will generally result in increases in sustained growth rates and to the extent such investments generate external benefits to the economy, the rewards are enhanced.

Economic growth in a cross-section of countries

Table 3 summarizes some of the facts surrounding the growth experiences for a broad cross-section of countries for the period 1960-89. The variables are ones that are frequently found in empirical studies of economic growth. The 97 countries had an average growth rate over the period of just over 2 percent. Of the 97 countries I have arbitrarily classified, the 23 that grew on average less than 0.5 percent per year as slow growth countries and they grew at an average annual rate of about -0.3 percent. The 14 countries that grew faster than 3.5 percent are classified as fast growth countries.[18]

Table 3
Growth Characteristics of a Cross-Section of Countries 1960-1989

	Overall average n=97	Slow growth <.5% n=23	Fast growth >3.5% n=14	Correlation with GDP growth rate
Real per capita GDP growth 1960-89	2.03%	-.26%	4.88%	1.00
Investment share of GDP	.21	.17	.26	.61
Government consumption share of GDP	.15	.15	.14	.10
Inflation rate	23.00%	42.11%	7.90%	-.17
Standard deviation of inflation rate	52.38	137.19	5.68	-.16
Exports as a share of GDP	.28	.24	.35	.30
Imports as a share of GDP	.33	.30	.40	.31
Secondary school enrollment rates 1960	.21	.06	.34	.41
Primary school enrollment rates 1960	.74	.44	.98	.54
Population growth	2.06%	2.55%	1.26%	-.36
Revolutions and coups per year	.20	.35	.12	-.37
Real per capita GDP in 1960	$1840	$889	$1968	.20

There are several interesting aspects to these data. First, countries that grow faster typically devote a larger share of GDP to investment. They have sharply lower inflation rates and thus resort to inflation as a source of tax revenue to a lesser degree than the countries that grow slowly. Fast-growing countries also are engaged in trade with other countries to a greater degree than slow-growing countries. Moreover, it is not just export trade that is associated with fast-growing countries, but imports also constitute a larger share of GDP. Both secondary and primary school enrollments rates are higher in faster growing economies. These enrollment rates have been used by Barro (1991) and others as proxies for investment in human capital. Population growth in the slow-growth countries is 1.3 percent higher than in the faster growing economies. The average number of revolutions or coups is a variable intended to capture the political (in)stability of a country and is clearly larger for the sample of slow growth economies.

Barro (1991) and others have presented evidence that government consumption to GDP is negatively related to growth in some samples. The measure used in Table 3 indicates that slow growing economies have more government consumption to GDP that fast growing countries, but the correlation is weak. The measure used in Table 3 does not correspond to the nonproductive government spending emphasized in Barro's model. For a smaller sample of countries, Barro constructs a measure of government consumption that omits spending on education and national defense. He argues that these expenditures are more like public investment than consumption. He finds that measured appropriately, government consumption has significantly negative association with average growth rates. He also finds that public investment is largely unrelated to economic growth.

I have also reported the simple correlation of each variable with the real per capita growth rate. These correlations point to investment, trade, and school enrollments as the most correlated activities with growth. The school enrollment rates are of particular interest since they are as strongly correlated with real income growth as investment.

Finally, many authors have noted that in broad samples of countries initial income levels are not correlated with subsequent economic growth. If the Solow model is interpreted literally, the transitional dynamics of the model would suggest that poor countries should grow faster than rich ones so the correlation should be negative. In this sample the correlation is positive rather than negative. Charts 2-5 visually depict several of these associations summarized in the table. In Chart 2 the 97 countries are divided into quartiles based on their income per capita in 1960. The average growth rate of the countries in each quartile for the subsequent 29 year is then plotted. In this sample, this simple chart shows that richer countries on average grew faster during the period than poor countries.

Charts 3-5 divide the countries according to their growth rate rather than income. Chart 3 shows the positive association between investment shares and growth. This is one of the most robust correlations in the table. Chart 4 highlights the association between school enrollment rates in 1960 and growth. The more rapid growing countries appear to have been investing more in human capital. This result is particularly

Chart 2
Real Per Capita Growth and Real Income

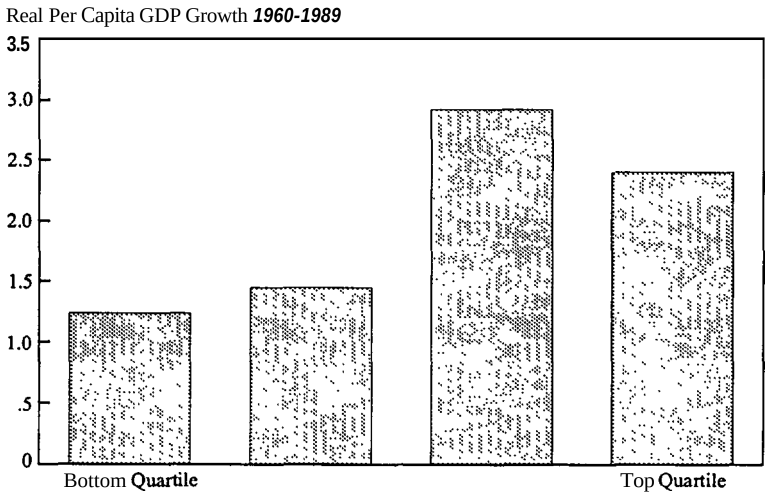


Chart 3
Investment Shares and Real Per Capita Growth

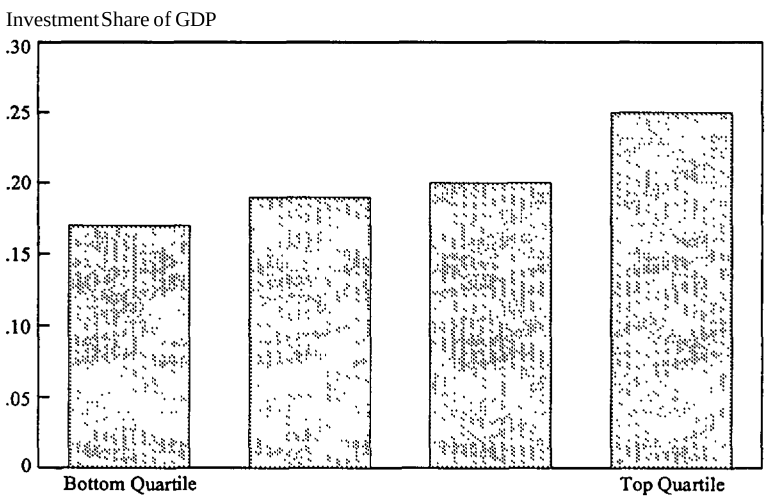


Chart 4
School Enrollment Rates and Real Per Capita Growth

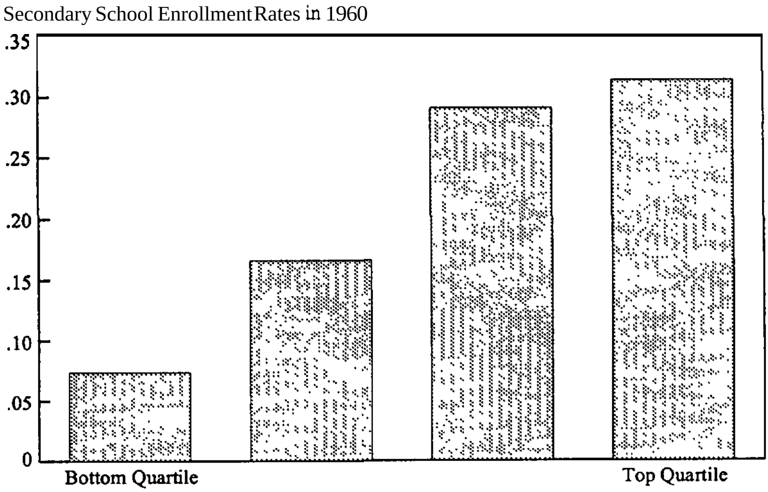
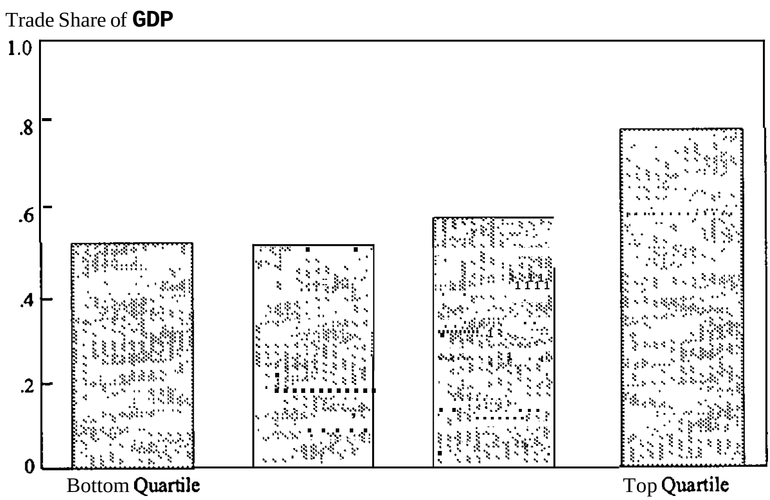


Chart 5
Trade Share of GDP and Real Per Capita Growth



important given the significant role played by human capital accumulation in the new models of long-term growth. Finally, Chart 5 breaks down the relation between the volume of trade and growth. The fastest growing countries engaged in more trade in relation to the size of the economy than slower growing nations.

While these comparisons are interesting and instructive, the sample contains a very wide variety of countries whose experiences, endowments, and forms of government are quite different. It is helpful to break out a subsample of countries that are potentially more similar to see if the relations observed previously are robust. Table 4 replicates the previous table for 24 countries of the Organization for Economic Cooperation and Development (OECD). Compared to the larger sample this is a fairly homogenous group of countries which were generally among the richest nations in 1960, if not always the fastest growing.

It is instructive to note the features that are associated with slower economic growth and compare them to the broader sample. First, the association between growth and investment remains strong. In this sample a negative correlation between growth and government spending is more pronounced. There is also a negative association between the initial level of income and growth. Finally, Table 4 includes a variable that measures the average tax rate on income and profits in each country. In the endogenous growth models such a tax would act to discourage investment in both physical and human capital and thus lower the growth rate. The correlation is indeed negative as seen in the table. Chart 6 displays this negative association between tax rates and growth.

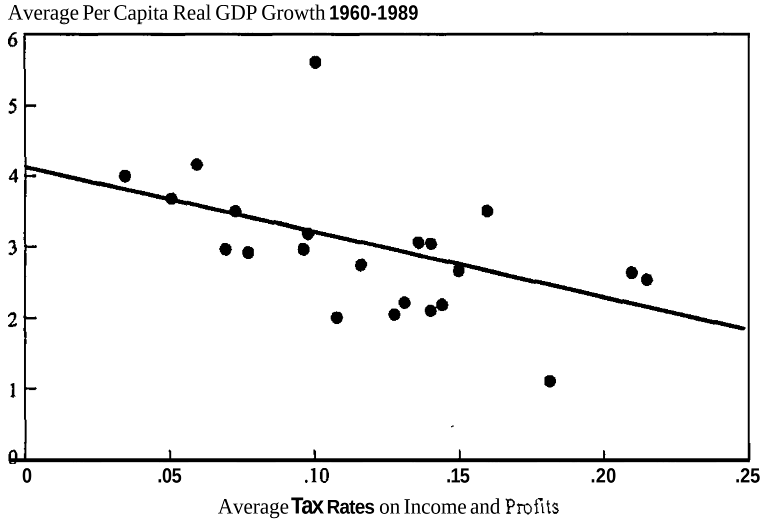
It would be wrong to take these simple correlations as evidence of causation running from the variable of interest in Tables 3 or 4 to real economic growth. Many of them, such as investment rates, are endogenous variables. That is, investment may cause more rapid economic growth, but rapid economic growth may also increase the demand for investment goods. Other variables might be spuriously correlated with growth simply because they may be correlated with a third more important variable. In fact, many of these variables are correlated with each other so determining the marginal impact on growth of any one of them may prove difficult. On the other hand, this sort of information is suggestive and important for understanding various factors related to long-run growth.

The empirical strategy followed in most of the literature is to estimate various cross-country regressions in search of a set of stable relations among the various variables suggested by the theories. One of the major difficulties is that the data necessary to adequately test the predictions of both the old and new models of growth are not available. In some cases the quality of the data is suspect and is likely to be heavily influenced by measurement error.[19]

Table 4
Growth Characteristics for OECD Countries 1960-1989

	Overall average n=24	Slow growth <3.0% n=13	Fast growth >3.0% n=11	Correlation with GDP growth rate
Real per capita GDP growth 1960-89	3.00%	2.40%	3.71%	1.00
Investment share of GDP	.23	.21	.25	.61
Government consumption share of GDP	17	.19	.16	-.45
Income & profit taxes share of GDP	.12	.14	.10	-.52
Inflation rate	9.03%	8.33%	9.84%	.13
Standard deviation of inflation rate	5.61	5.38	5.87	.13
Exports as a share of GDP	.29	.31	.27	-.17
Imports as a share of GDP	.30	.31	.29	-.11
Secondary school enrollment rates	.50	.51	.50	-.15
Primary school enrollment rates	1.10	1.10	1.09	.03
Population growth	.78%	.88%	.67%	-.14
Real per capita GDP in 1960	$4333	$4990	$3534	-.68

Chart 6
Real Economic Growth and Tax Rates in OECD Countries



Levine and Renelt (1992) have examined these cross-country regressions in great detail attempting to identify those relations that appear robust. The following findings are summarized from their conclusions:

> Investment rates (for both physical and human capital) display a robust positive correlation with average growth rates across a wide variety of samples and specifications.
>
> Trade as a share of GDP is positively correlated with investment. Moreover, import shares work as well as export shares so growth appears to be closely associated with trade not just exports as is sometimes asserted.
>
> Poor countries seem to grow faster than rich countries if the initial level of human capital is held fixed as measured by school enrollment rates. This conditional convergence property appears significant over the 1960-89 period but does not appear to hold oxer the 1974-89 period.

Trade policy variables appear closely related to investment and so their separate impact on growth cannot be determined independently of investment.

The correlation of some fiscal policy variables with growth is dependent on what other factors or policies are held fixed.

In some ways it is not surprising that policy variables are not robustly correlated to growth, especially when investment is held fixed. After all, if there is a channel for policy it is through its impact on the incentives to save and invest. Moreover, policies are complex and varied ranging from monetary and fiscal policies to regulatory and trade restrictions. Finally, policies within a country are frequently highly correlated. For example, countries that have strong and large central governments frequently adopt a wide range of potentially slow growth policies including higher taxes, more restrictive trade policies, more regulation of financial intermediaries, and so on. So if we are clever, we may find a way of summarizing an entire package of government policies employed by a country but it may prove very difficult or impossible to disentangle empirically the separate effects of one aspect of policy from another.

Solow revisited

The work on endogenous growth models and their emphasis on broader concepts of capital has prompted a number of authors to ask if the original Solow framework with diminishing returns can be made more consistent with data by broadening the concept of capital. Barro (1991), Barro and Sala-i-Martin (1992) and Mankiw, Romer, and Weil (1992), for example, find evidence that after controlling for potential differences in steady states, and in particular differences in investment in human capital, poor countries grow faster than rich countries. Conditional convergence of this sort is usually interpreted as supporting the Solow framework and its dependency on diminishing returns and as inconsistent with endogenous growth models.

The logic of the Solow model with diminishing returns is that countries will converge to a steady-state level of income per capita, but not necessarily the same steady state. Thus without accounting for the potential differences in the steady-state income levels there would be no reason to expect to see poor countries growing faster than rich ones and, indeed, Chart 2 and Table 3 make it clear that they don't. However, convergence would be anticipated in the Solow framework after conditioning on the determinants of the steady-state level of income.

Mankiw, Romer, and Weil (1992) find evidence of such conditional convergence but find that reasonable estimates are produced only after broadening the concept of capital to include human capital. As a result, the version of the Solow model constructed by these authors exhibits a capital share that is at least 0.67 rather than the value of 0.33 that is commonly associated with physical capital. Barro and Sala-i-Martin (1992), through a similar analysis, arrive at an estimate of capital's share of 0.8. Both of these results point to a much more important role for capital accumulation and human capital accumulation because their implied models are much less influenced by the sharply diminishing returns of the standard neoclassical framework. Nevertheless, these analyses remain silent on the sources of sustained economic growth since technological progress or productivity improvements remain the sole source of growth in the steady state.

It was noted earlier that in the Solow framework with capital's share set at 0.33, the convergence to a new steady state should have a half-life of six to 10 years. With capital's share increased to 0.67, the half-life increases to something on the order of 30 years; One implication of this slower transition is that the impact of policies that alter the steady-state growth rate is spread out over much longer periods so that impact on growth rates of the transitional dynamics in these models is even less. For example, if a policy increases the steady-state level of income by 25 percent, but it takes 60 years instead of 30 years to fully close the gap, then, during the transition, growth rates would on average only be 0.4 percent per year higher compared to 0.8 percent higher for the model with a shorter transition period. Thus, using the Solow model, even with a much higher capital share, does not really offer much additional explanation for growth.

It is worth noting at this point that conditional convergence of the type uncovered by these authors is not necessarily inconsistent with the new theories of endogenous growth. In some settings where there are multiple sectors, the new theories do predict transition paths from one steady-state path to another. Thus it is very likely that some form of convergence will be found in these models as well. What the empirical literature has found may simply be evidence for the existence of transitional dynamics not a discriminating test of old vs. new theories of growth.

An assessment and prospects for the future

The new theories of economic growth seek explanations for sustained economic growth and persisting disparities across countries in income levels and growth rates. The traditional view based on the work of Robert Solow appeared to leave too much of such explanations to unobserved exogenous forces like technological progress. Indeed, economic policies intended to influence the rate of physical investment could not affect steady-state growth in this traditional framework. Such policies could influence the level of steady-state output and thus the transition to new long-run equilibrium. However, diminishing returns to capital accumulation make it virtually impossible for the traditional model of growth to explain much of the very large variations in income levels or growth rates.

The new growth theories are extensions of the basic neoclassical framework developed by Solow. The feature that distinguishes these models from the neoclassical framework is that they entertain the possibility that the returns to capital accumulation are no longer bound by diminishing marginal productivity. In order to generate sustained economic growth, these models focus on the existence of a "core" set of capital goods that are constant returns to scale in reproducible factors of production. Breaking the dependence on diminishing returns is frequently achieved by considering broad forms of capital in the production process and especial focusing on the role of human capital. Another closely related strategy is to consider endogenous technological progress where private investment in the acquisition of knowledge or technology has external benefits that offer an escape from the limitations of diminishing returns.

The implication of these models is that capital accumulation in all forms is quantitatively more important than in the traditional framework. Consequently, they provide an interesting and rich laboratory for investigating the impact of policy on economic growth. The sorts of public policies that impact the incentives of millions of individuals to save and invest in both physical and human capital as well as invest in the development of new technologies turn out to be central to the long-run rate of growth.

It is too early to measure how successful these attempts will be to explain growth and understand how policies are likely to interact with anation's growth rate. As yet these models have simply not confronted the data in ways that will deliver answers to such important questions. Understanding the role and significance of human capital or the accumulation of knowledge and technology are difficult but the payoffs are large.

Endnotes

'whether economists have been any more successful at these endeavors remains an open question.

[2]Of the 24 countries, out of a sample of 97, whose per capita incomes were in the bottom quartile in 1960, 18 were in the bottom quartile in 1989, and 23 remained among the bottom 50 percent.

[3]Lucas (1987) argues that eliminating variability in consumption of the magnitude experienced in the United States over the postwar period would be equivalent in utility terms to an increase in average real consumption of somewhere between 0.1 percent and maybe as much as 0.75 percent. On the other hand, raising the long-term growth rate by two percentage points would be equivalent in utility to an increase of 31 percent in real consumption.

[4]I am assuming that the population and the labor force are the same. For purposes of this discussion, nothing of importance is sacrificed with this simplification. It should be apparent that this production technology exhibits diminishing returns to the capital/labor ratio *K/L*.

[5]In technical terms, the growth rate of the per capitacapital stock can be wntten as $(k_{t+1}-k)/k_t = g_{kt}$ so that dividing the capital accumulation equation through by k yields $g_k = i/k - \delta = sAk^{-\alpha} - \delta$, where s is the investment rate i/y. As the capital stock per capita grows, the first term, $sAk^{-\alpha}$, declines until it reaches **6**.

[6]The discussion in the text will typically proceed as if the savings rate is predetermined since this makes certain aspects of the framework more intuitive. However, it is Important to keep in mind that savings rates are chosen by agents and so are endogenously determined. In order to affect changes in the savings rate, the incentives to savings/investment must be altered.

[7]Mankiw, Romer, and Weil (1992) find that if capital's share is set at one-third, they can only explain 28 percent of the cross-country variation in long-run average income levels using a sample of 75 countries. The model explains even less of the variation among OECD countries.

[8]The investment to output ratio is proportional to the capital and output ratio in the steady state and given the Cobb-Douglas technology is $Y/L = A[K/Y]^{(1-\alpha)/\alpha}$ or $y = A[k/y]^{(1-\alpha)/\alpha}$.

[9]How fast an economy converges to a new steady state is a matter of considerable debate. Estimates apparently depend on the sample and other characteristics that are held fixed. Barro and Sala-i-Martin (1990) and Mankiw, Romer, and Weil (1992) estimate that one-half the gap is closed anywhere between 25 years and 110 years depending on the sample considered. The Solow model with a = 2 3 predicts that the gap should close much more rapidly and depends on several parameters. King, Rebelo, and Plosser (1988) compute the half-life of the transition as ranging from five to 10 years under a reasonable range of parameter assumptions.

[10]King and Rebelo measure the welfare loss to this economy of the increase in taxes as equivalent to a permanent 1.6 percent drop in real consumption.

[11]See Uzawa (1965) and Lucas (1988) for early work on incorporating the accumulation of human capital into a model of economic growth.

[12]In per capita terms, this production function is $Y/L = y = AK/L = Ak$.

[13]For this model with a constant Investment rates, the growth in the per capita capital stock can be expressed as $g_k = sA - 6$. Thus anything that raises the rate of investment, s, or the level of technology, A, will also raise the growth rate.

[14]The role of financial intermediaries and their ability to allocate investment is explored by King and Levine (1991, 1992) and by Roubini and Sala-i-Martin (1991).

[15]The welfare consequences are equally large. King and Rebelo estimate the loss due to the tax increase is equivalent to a drop of 65 percent in real consumption.

[16] The potential for a sub-optimal competitive equilibrium arises in this framework if, for example. tax rates are fixed so that an Increase in private capital results in an increase in public capital because output and therefore, public spending rises. If the increase in public capital is not recognized as part of the return to private capital accumulation then the resulting competitive equilibrium will produce too little growth since the social rate of return exceeds the private rate of return.

[17]The reasoning behind this point is somewhat subtle. If governments are optimizing, then the reason why different countries exhibit different spending ratios is that the relative productivity of public vs. private capital differs across countries. Countries with higher spending ratios and higher taxes are likely to experience lower growth rates because public capital must be financed through a distortionary tax.

[18]The standard deviation of the average growth rates for the 97 countries is 1.78 percent so the slow and fast growth countries are those that are slightly less than one standard deviation from the mean.

[19]Summers and Heston (1991) grade the quality of their extensive cross-country data set and many of the countries rate a C- or D, especially in Asia, Africa, and South America. Yet a large fraction of the cross-country variability in growth rates arises from countries on these continents.

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Commentary: The Search for Growth

N. Gregory Mankiw

For evaluating economic well-being, the single most important statistic about an economy is its income per capita. Income per capita measures how much the typical citizen receives for his contribution to economic activity. And it measures the flow of resources available for current consumption or for investment in the future.

Despite all our problems, the United States continues to be blessed with a high level of income per capita. U.S. income per capita is 1.5 times England's, 4.5 times Argentina's, and **23** times India's. The United States and Japan are so close in income per capita that the comparison becomes difficult, but by most measures, the standard of living in the United States is still higher.

Yet, another way of looking at the data is less encouraging. Many countries are growing faster than we are. Over the past 30 years, income per capita rose by 5.1 percent per year in Japan and *2.5* percent in Germany, but by only 2.1 percent in the United States. Of the 24 countries in the Organization for Economic Cooperation and Development (OECD), only three grew more slowly than the United States.

So the United States is richer than most countries, but many countries are growing faster. Obviously, if the United States continues to grow more slowly than the rest of the world, it will eventually lose its status as the economic frontrunner. And, if history is any guide, it risks losing its role as a military and political superpower as well.

What determines whether a country grows rapidly like Japan, or slowly like the United States? How should economists model the process of economic growth? How can policymakers encourage faster growth? These are the questions that theorists of economic growth try to answer. In his paper, Charles Plosser surveys some of the prominent theories. He considers traditional theories of economic growth, as derived from the early work of Robert Solow, and endogenous growth theories, which have attracted much interest during the past decade.

Although I agree with most of Plosser's assessments, I would put a different "spin" on the conclusion. Rather than saying that we need new theories of economic growth, I would suggest that we merely need to reinterpret traditional theories.

Plosser correctly points out that traditional growth theory, such as Solow's, emphasizes the accumulation of capital. The usefulness of the theory is, therefore, limited to capital's importance in the production process. In assessing traditional growth theory, the key question is, how important is capital accumulation to production and growth?

To answer this question, Solow's theory points us toward a specific number: the share of national income earned by capital. The capital share has two roles in Solow's theory. First, the larger the capital share, the more important are rates of investment in explaining international differences in steady-state income. Second, the larger the capital share, the longer is the time horizon over which an increase in investment will stimulate economic growth.

So how large is the capital share? According to the national income accounts, capital receives only one-third of gross income. If this fact is plugged back into Solow's theory, we learn that capital accumulation cannot easily explain the large international differences that we observe. One-third is simply not a large enough capital share to make capital accumulation the key to understanding economic growth.

Economists differ in how they react to this conclusion. A common reaction is to discard Solow's theory and replace it with some newer, fancier theory. By contrast, my reaction is less radical. Perhaps Solow's theory is right, but the fact is wrong. Perhaps capital actually receives much more than one-third of income.

There are two ways to argue that the capital share is larger than one-third. One argument is that there are positive externalities to capital. That is, some of the benefits to capital accumulation may accrue not to the owners of capital but to others in society. This would occur if, for example, new ideas arise as capital is built and these ideas enter the general pool of knowledge. In this case, even if capital receives only one-third of income, in some sense it deserves credit for more than one-third. How much extra credit is hard to judge.

A second argument for a larger capital share is that capital is a much broader concept than is suggested by the national income accounts. In the national income accounts, capital income includes only the income of physical capital, such as plant and equipment. More generally, we accumulate capital whenever we forgo consumption today in order to produce more income tomorrow. Surely, one of the most important forms of capital accumulation is schooling. Yet the return to this human capital is not part of capital income in the national income accounts; instead, it is part of labor income. Therefore, the accounts substantially underestimate the capital share of income.

To gauge the true capital share, we need to decide how much of labor income should be credited to human capital. To do this, we might look at the minimum wage, which is roughly the return to labor with minimal human capital. The minimum wage today is roughly one-third of the average wage. This fact suggests that the return to human capital is about two-thirds of labor income, or almost half of national income.

Another way to estimate the human-capital share of income is to look at the return to schooling. A large literature in labor economics finds that each year of schooling raises a worker's wage by about 8 percent. Moreover, the average American has about 13 years of schooling. Together these facts imply that the average worker earns almost three times as much as he would without any human capital. In other words, about two-thirds of the average worker's earnings is the return to his education. Again, this suggests that the human-capital share of national income is almost one-half.

If we add this estimate of the human-capital share to the physical-capital share of one-third, we find that the income from all forms of capital equals about 80 percent of national income. This increase in the capital share from its traditional value of one-third to this new value of four-fifths is crucial for how we evaluate theories of economic growth. This new higher capital share implies that traditional growth theory, with its emphasis on capital accumulation, can explain the huge international differences in income per capita that we observe. And it implies that high saving and investment can lead to high growth over a horizon of many decades.

Let me now turn to the key question for policymakers: How can a country achieve a high rate of economic growth? The Solow growth model, interpreted broadly to include human capital, suggests that there are four secrets to fast growth.

Secret to growth #1: Start behind.

As Plosser points out, the Solow growth model implies convergence in standards of living. That is, holding other things constant, countries that start off poor will tend to grow faster than countries that start off rich.

This prediction of the theory explains much of the slow U.S. growth during the past 30 years. Many countries have grown more quickly than the United States simply because they started so far behind. Germany grew quickly in the period after World War II because it was making up for the destruction of the war. Japan had to catch up not only from the war, but also from its low state of development before the war. In 1950, income per capita in Japan was only one-sixth of income in the United States. Now that these countries are approaching the level of income in the United States, their growth rates have fallen and are closer to ours.

Secret to growth #2: Save and invest.

Individuals build their wealth by consuming less than their income and investing the difference. Nations are no different. The more a nation saves and invests, the more capital its workers have to work with, and the greater are their productivity and wages.

This simple lesson does not bode well for the United States. During the 1980s, gross national saving in the United Sates averaged about 18 percent of GNP, compared to 31 percent for Japan. So not all of Japan's fast growth has been catch-up; part of it has come from greater thriftiness.

This comparison leads many to advocate policies to raise national saving. One way would be to stimulate private saving through tax incentives, such as a switch from income taxation to consumption taxation. Another way would be to raise public saving—that is, to reduce the government budget deficit that represents ***negative*** saving for the nation.

Secret to growth #3: Educate the young.

As with physical capital, building human capital requires a sacrifice today in order to reap a benefit in the future. When we spend money on schools and teachers, that money is unavailable for current consumption. Students who are building human capital must forgo the wages they would have earned if they were in the labor force.

Fortunately, U.S. investment in human capital is not as meager as U.S. investment in physical capital. An impressive 60 percent of our students continue their education beyond high school, as compared to 30 percent in Japan and Germany. Yet many countries do a better job of educating the students that they do have in school. The typical Japanese high school student spends 240 days per year in school, compared to 180 days for the typical American student.

Secret to growth #4: Keep population growth low.

When the population of a country grows rapidly, it is more difficult to provide new workers with the tools and skills needed for production. In other words, rapid population growth depresses the amount of physical and human capital available for each worker, which in turn, reduces each worker's productivity.

Rapid population growth is not a problem for the United States, but it is a primary cause of poverty in the Third World. Over the past several decades, the U.S. population has been growing at about 1.2 percent per year, which means that the population doubles every 58 years. By contrast, the typical country in sub-Saharan Africa has a population growth rate of 2.8 percent per year, so the population doubles every 25 years. Not surprisingly, African productivity lags far behind the rest of the world.

So there are the four secrets of economic growth. These secrets come from the most basic Solow growth theory, and they are consistent with the international evidence.

One nagging question remains: If the secrets of growth are as simple as I have suggested, why does the United States have such a low growth rate? Why don't we pursue policies to raise the growth rate? To some extent, the failure of American economic policy to promote growth may reflect a genuine confusion about how rapid growth is best achieved. But one can also take a darker view of the situation: If capital accumulation is the key to growth, then prosperity tomorrow requires sacrifice today. It is a rare politician who is willing to be the bearer of such a difficult truth.

Endnote

[1]Professor Mankiw's remarks are based on his joint work with David Romer and David Weil. See N. Gregory Mankiw, David Romer, and David Weil, "A Contribution to the Empirics of Economic Growth," *Quarterly Journal of Economics,* (May 1992), pp. 407-37.

Macroeconomic Policy and Long-Run Growth

J. Bradford De Long
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The long-run trend of productivity growth is the sole important determinant of the evolution of living standards. The current recession has seen as large a fall in American consumption per capita as any post-World War II recession—a year-over-year decline of about 2.3 percent. Yet the post-1973 productivity slowdown in the United States has been an order of magnitude more significant, reducing current consumption by nearly 30 percent. And the post-1973 productivity slowdown has been more severe outside than inside the United States. While the growth rate of output per worker in the United States slowed by 1.4 percentage points per year comparing the 1950-73 with the 1973-90 period, productivity growth has slowed by 4.5 percentage points per year in Japan, 4.2 percentage points per year in Germany, and by 1.9 percentage points for the Organization for Economic Cooperation and Development (OECD) countries as a whole.

This paper addresses the role of macroeconomic policies in determining long-run rates of productivity growth. We begin by highlighting aspects of the interspatial and intertemporal variation in productivity growth which suggest that much of what is important for raising growth rate lies in the domain of structural policy, since macroeconomic policies are less than dominant in determining rates of productivity growth. We then take up what we regard as the two fundamental macroeconomic decisions any society makes: how aggregate demand (or its near-equivalent nominal income) will be managed, and how total output will be allocated between consumption and various forms of investment. Our policy conclusions can be stated succinctly:

> Much of the variation in productivity growth rates cannot be traced to macroeconomic policies and must be attributed to structural and external factors. It is implausible that the deterioration in productivity performance between the 1970s and 1980s is the result of macroeconomic policies that were inferior in the 1980s. Bad macroeconomic policies can insure dismal performance. But good macroeconomic policies, while necessary, are not sufficient for outstanding productivity performance.
>
> Monetary policy that either encourages high inflation or permits large-scale financial collapse can inflict severe damage on productivity growth. Countries in which workers, investors, and entrepreneurs have confidence in the political independence of an inflation-fighting central bank have attained significantly more price stability. There is some evidence, however, of productivity costs from excessively zealous anti-inflation policies.
>
> Even substantial increases in investments that yield social returns of even 15 percent per year will have only modest effects on observed rates of productivity growth. Only increases in specific investments with very high social returns well in excess of private returns have a prospect of arresting any substantial part of the productivity slowdown.
>
> International comparisons suggest a special role for equipment investment as a trigger of productivity growth. This suggests that neutrality across assets is an inappropriate goal for tax policies, and that equipment investment should receive special incentives.

The paper is organized as follows. The first section examines the productivity growth record, focusing on the extent of variations in productivity growth across countries and across decades. The second section considers the role of nominal demand management policy. The third section examines the relationship between rates of investment and rates of return. It highlights the difficulty of raising growth rates by magnitudes comparable to the extent of the productivity slowdown through general increases in investment, and emphasizes the importance of strategic high-return investments. The fourth section highlights the special role of equipment investment in spumng growth. The final section concludes by commenting further on the policy implications of our analysis.

The growth record

The slowdown in productivity growth

The principal information that is available for making judgments about the determinants of productivity and the role of policies is the historical record. Table 1 reports rates of output per worker growth by decade for the United States, other major OECD economies, and other industrial economies. In the United States, gross domestic product (GDP) per worker as estimated by Summers and Heston (1991)[1] grew at 2.0 percent per year in the decade from 1950 to 1960, by 2.5 percent per year in the decade from 1960 to 1969,[2] and by only 0.5 percent per year in the decade from 1969 to 1979. It has only partially recovered to 1.4 percent per year in the decade from 1979 to 1990. Comparing the past two decades to the two decades beginning in 1950, the rate of growth of output per worker has fallen by 60 percent. A doubling of output per worker took 31 years at the pace of growth seen over 1950-69; it would take 73 years at the pace of growth of 1969-1990.

While the American productivity slowdown has been pronounced, Table 1 demonstrates that it has been relatively mild by international standards: the slowdown of 1.3 percentage points per year experienced by the United States comparing the 1970s and 1980s to the 1950s and 1960s has been smaller than the slowdown in the average OECD, or industrial economy. Rates of growth throughout the industrial world in recent decades have been far below the rates seen in the first few post-World War II decades that workers, managers, and politicians then took for granted. From 1950 to 1960, GDP per worker in the OECD grew at a rate of 3 percent per year, and from 1960 to 1969, growth was 3.5 percent per year. But from' 1969 to 1979, average growth in output per worker in the OECD was only 1.8 percent per year, and over 1979 to 1990, only 1.6 percent per year.

Table 1
Rates of Productivity Growth by Decade

Economy	1950-60	1960-69	1969-79	1979-90	1985-91
United States	2.0	2.5	.5	1.3	1.2
Japan	6.7	8.4	4.4	3.0	3.8
Germany	6.4	4.1	2.5	1.6	2.9
France	4.3	4.8	2.8	1.1	1.9
U.K.	2.5	2.3	2.1	1.7	1.8
Canada	1.8	2.6	.7	1.2	1.0
Italy	6.0	5.2	3.7	1.9	2.3
Total OECD*	3.0	3.5	1.8	1.6	
Industrial Pacific Rim Economies+	6.7	6.2	4.4	3.6	
Industrial Latin American Economies++	2.7	2.8	2.1	-1.7	
Average Industrial Economy	3.3	3.7	2.4	1.0	

* Total OECD product divided by number of OECD workers.

+Our list of industrialized Pacific Rim economies initially includes only Japan. Hong Kong and Singapore join the list in 1960. Korea, Malaysia, and the economy of the Taiwan province are added to the list in 1979.

++ Argentina, Chile, Colombia, Costa Rica, Mexico, Uruguay, and Venezuela.

In light of the fact that productivity growth has declined much more rapidly outside than inside the United States, it may seem surprising to foreign observers that concerns about future living standards and about competitiveness are so especially pronounced in the United States. Part of the explanation may lie in the increasing openness of the American economy over the last decade, and in the emergence of large trade deficits. Another part of the explanation is surely that other countries continue to grow more rapidly than the United States, albeit by a smaller margin even as they approach U.S. productivity levels. Relatively slow U.S. productivity growth was much less of a concern when American standards of living were far ahead of standards of living abroad than it is today, as foreign standards of living approach American levels. We, therefore, turn to a consideration of the extent to which the patterns of growth illustrated in Table 1 can be explained by the convergence hypothesis—the idea that the further a country is behind, the more rapidly it can grow by importing technology in order to catch up.

Cyclical adjustment

Chart 1 plots centered five-year moving averages of annual growth in cyclically adjusted output per worker[3] since 1950 in the three largest OECD economies: the United States, Japan, and West Germany.[4]

Chart 1
Cyclically Adjusted Real GDP Per Worker Growth
Centered Five-Year Moving Averages

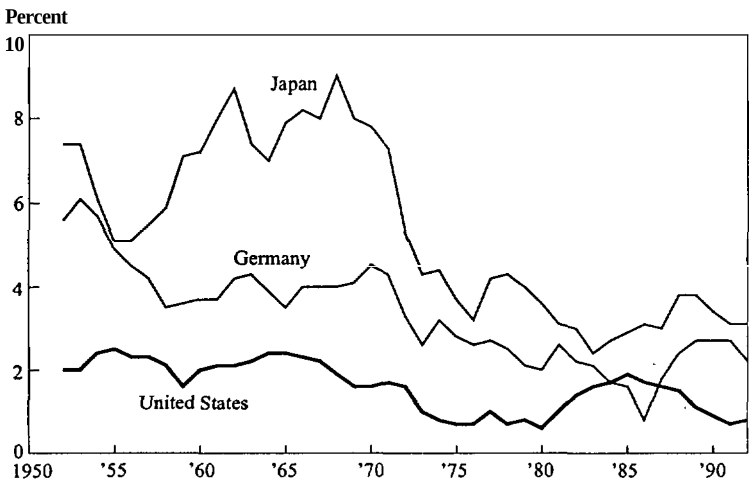


Chart 2 plots a centered five-year moving average of output per worker growth in the OECD. The cyclical adjustment makes no significant difference to the pattern of productivity growth. The 1980s see a marked productivity growth slowdown relative to the 1950s and the 1960s—the United States is the only economy in which the 1980s appear better than the 1970s. And the late 1980s show signs of a deterioration of cyclically-adjusted productivity growth in the United States back to the rates of the 1970s.

Chart 2
Cyclically Adjusted Real GDP Per Worker Growth
Five-Year Moving Average for the OECD

Even after an adjustment for the business cycle, it appears clear that productivity growth in the industrialized world is much slower than it was two decades ago. And for the industrialized world as a whole, productivity growth appears to have declined further in the 1980s from its relatively disappointing level in the 1970s. It is apparent that for the OECD as a whole, for Japan, and for Germany that cyclically adjusted productivity growth has become markedly slower in the 1980s than it was even in the 1970s. The United States is an outlier in experiencing faster trend productivity growth in the 1980s than in the 1970s. And U.S. underlying productivity growth is noticeably slower in the late than in the mid-1980s.

Growth and 'convergence'

When World War II ended, there was an enormous gap in technology, organization, and productivity between the United States and other industrial economies. This gap had widened over the preceding quarter century, as Europe served as the battleground for two extraordinarily destructive wars punctuated by an era of instability and slow growth. This has led many to attribute fast post-World War II growth in the non-U.S. OECD to "catch-up" or a "rubber-band effect" as other industrial economies quickly covered the ground the United States had broken in the 1920s and 1940s.[5] Some have attributed the larger productivity growth slowdown outside than inside the United States to the reduced opportunities for catch-up and technology transfer left after the successful growth of the first post-World War II generation.

A substantial literature has by now examined the convergence hypothesis. A typical conclusion is that within the set of relatively well-to-do economies, there is evidence of a convergence effect, though such an effect is not present when very poor economies are added to the sample unless additional control variables are included in the analysis. Chart 3 presents a scatter plot of 10-year growth rates against initial relative incomes for all industrial economies for which data were available.[6] A negative relationship is apparent with the data suggesting that a percentage point increase in the gap between a country's relative income and the United States is associated with an 0.036 percentage point increase in its annual productivity growth rate. This estimate is relatively large compared to others in the literature on convergence.[7]

Given this estimate of the magnitude of the convergence effects, it is a simple matter to construct estimates of convergence-adjusted growth rates. For example, Germany in 1960 was at 52 percent of the U.S. productivity level, so convergence effects are estimated to account for 0.036*(1-0.52), or 1.7 percentage points' per year worth of its productivity growth between 1960 and 1970. By 1980, German relative productivity had risen to 73 percent of U.S. productivity so convergence accounted for much less-only 0.9 percentage'points' worth of German productivity growth.

Chart 3
Inverse Relationship between Output Per Worker Levels and Growth Rates in the Post-World War II Era

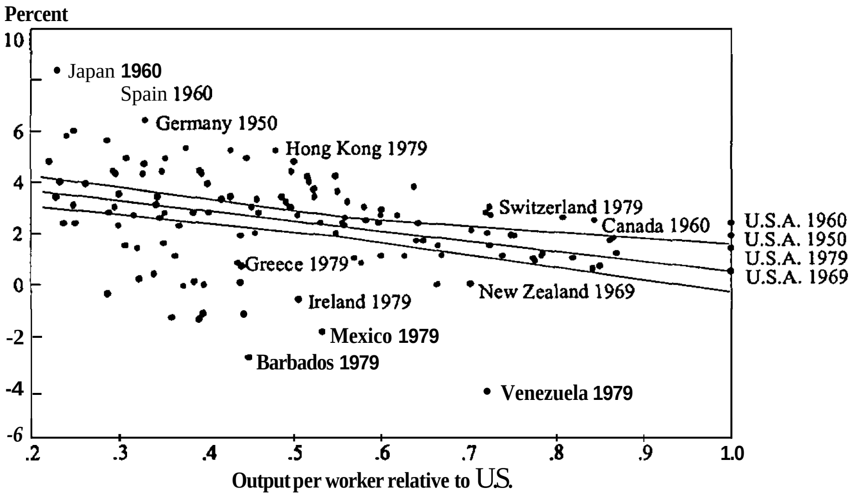


Table 2 reports estimates of convergence-adjusted productivity growth rates. Since the United States is always the most productive country according to these estimates, its convergence-adjusted growth rate is always just equal to the raw growth rate reported in Table 1. Comparing Tables 1 and 2, it is apparent that convergence accounts for much of America's relatively slow productivity growth compared to other OECD nations. But growth performance was poor in the 1970s and the 1980s even after adjusting for convergence effects. And even the convergence-adjusted slowdown has been greater outside the United States and Canada.

Causes and consequences

The principal lesson that emerges from this brief review of productivity growth experience is that no simple macroeconomic explanation is likely to account for a large part of the variations in productivity growth. Much of the problem for simple macro arguments comes from the slowdown between the 1970s and 1980s outside the United States. The very broad extent and long duration of the slowdown suggests that broad, general explanations are in order—not explanations that

Table 2
Convergence-Adjusted Rate of Productivity Growth by Decade

Economy	1950-60	1960-69	1969-79	1979-90	1985-91
United States	2.0	2.5	.5	1.4	1.2
Japan	3.7	5.7	2.3	1.8	3.0
Germany	4.0	2.4	1.1	.7	2.1
France	2.2	3.0	1.4	.3	1.0
U.K.	.8	.7	.5	.3	.5
Canada	1.3	2.1	.2	.7	.5
Italy	3.6	3.1	2.1	1.0	1.6
Total OECD	1.5	2.0	.6	.4	
Industrial Pacific Rim economies	3.3	3.1	1.4	1.5	
Industrial Latin American economies	.0	.3	-.4	-3.6	
Average industrial economy	.9	1.6	.5	-.5	

are limited in scope to particular economies in particular years. It is tempting to attribute the productivity slowdown to the rise of OPEC, and to conclude that the rapid rise in oil prices in the 1970s had longer-lasting and more damaging effects on industrial economies than people at the time realized. A major difficulty with this explanation is that although the 1970s see rapidly rising real oil prices, the 1980s see falling real oil prices. Yet growth does not appear to have recovered.

It is also tempting to attribute responsibility to mistakes in monetary and exchange rate policy in the inflationary 1970s. Inflation harms the ability of the economy to allocate resources to appropriate uses, and interacts with the tax systems of industrial economies in important ways that threaten to significantly derange the market mechanism. Nevertheless, it is once again difficult to attribute much responsibility for the productivity slowdown to the long-run consequences of the inflation suffered in the 1970s, because the 1980s have not seen faster growth.[8]

To the extent that the 1980s did see deterioration in macroeconomic policy in individual nations, those nations were not the nations in which the slowdown gathered strength. It is the United States where macroeconomic policy is most often thought to have taken a seriously wrong turn. Yet the magnitude of the growth slowdown in the United States, whether adjusted for convergence and for the business cycle or not, is less than in many other OECD nations.

Yet another possibility is that the engine of growth is slowing down because we are reaching the limits of the technologies of the industrial revolution. All previous bursts of human technological creativity have eventually run into limits. Why should industrialization be different? Herman Kahn was perhaps the most prominent thinker to expect that in the end the industrial revolution would produce a rise in living standards and productivity levels that would follow not an exponential but a logistic curve.[9] Perhaps we are seeing the inflection point. This possibility should be kept in mind.

Even if changes in macroeconomic policies do not account for the bulk of variations in growth rates, it does not follow that they are irrelevant. We therefore turn in the next three sections to scrutinizing the relationship between macroeconomic policies and long-run growth. We consider in the second section, the role of demand management policy in creating the framework of price stability and high capacity utilization necessary for the market system to work well. In the third and fourth sections, we consider the impact of policies on the savings and investment mix, and the influence of the savings and investment mix on growth.

The management of nominal income

Despite the overwhelming importance of productivity growth as a determinant of living standards, most macroeconomic textbooks concentrate on cyclical fluctuations in output and employment, and on inflation.[10] To use slightly dated parlance, most of the emphasis is on stabilization rather than growth policies. This emphasis reflects broader social priorities. The media everywhere track unemployment fluctuations much more attentively than productivity fluctuations. Job creation is much more prominent in political debates than productivity enhancement.

Since the end of the Second World War, governments in most industrialized countries most of the time have felt an obligation to use the tools of monetary and fiscal policy to mitigate recessions and avoid depressions without allowing inflation to reach unacceptable levels. The textbook view has been that the macroeconomic objectives of output stabilization and inflation control are essentially independent of the objective of rapid long-run growth. As the textbooks tell the story, cyclical fluctuations of an economy around its potential or full employment level of output depend on aggregate demand and its determinants. Long-run growth depends on supply factors such as the accumulation of physical and human capital and technological progress. It is now generally accepted that while inflationary policies can impact levels of output in the short run, they cannot raise and run the risk of reducing long-run levels of output.

Given the importance attached by policymakers to mitigating cyclical fluctuations and maintaining low inflation rates, it is worthwhile to inquire whether there are important connections between stabilization policies and productivity growth that are not reflected in the textbook model. Two potentially important connections stand out. First, as many monetarists argue, countries that are more credibly committed to price stability have as a consequence less inflation, and as a result, the market system functions better.

Second, as many Keynesians argue, policymakers who are too willing to accept recessions may do semi-permanent damage to their economies. Recessions mean less investment in human and physical capital. When recessions lead to prolonged unemployment, human capital atrophies.[11]

Central banks and stable price levels

The extent to which a country chooses to allow monetary policy to be made without political control is probably a good proxy for its relative commitment to price stability as opposed to actively combating recessions. Here we extend some earlier work on central bank independence by considering its relationship to productivity growth.

To varying degrees, post-World War II industrial economies have delegated the management of nominal income to central banks. In some countries—like Italy, New Zealand, and Spain—the central bank is subject to relatively close control by the executive. In other countries—like Germany and Switzerland, with the United States relatively close behind—the central bank has substantial independence from the executive. The degree to which central banks are independent, and have the freedom to shape their own demand management policy safe from strong short-run political pressures, changes only slowly over time as institutions, attitudes, and operating procedures change.[12]

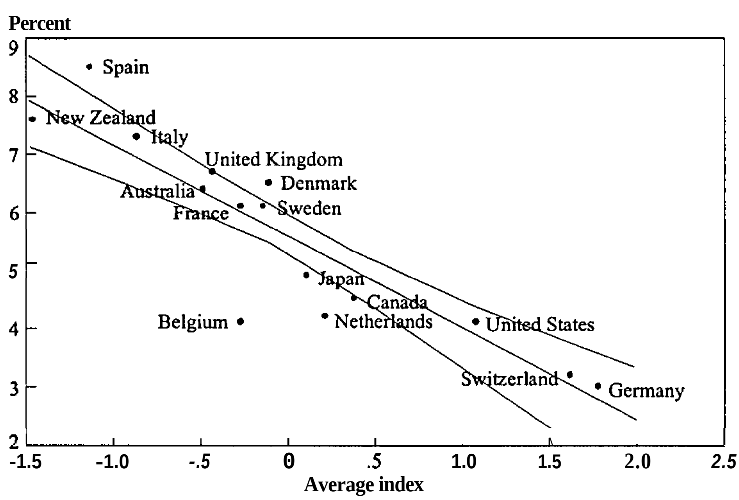
The strong inverse correlation between central bank independence and inflation has been highlighted by a number of authors, including Alesina (1988), and Grilli, Masciandaro, and Tabellini (1991): These authors consider two different ways of measuring central bank independence: the first, the index constructed and used by Alesina (1988),[13] and the second, an index constructed by Grilli, Masciandaro, and Tabellini (1991). Alesina's (1988) index rates the political independence of the central bank on a scale of 1 to 4 as determined by the institutional relationship between the central bank and the executive and the frequency of contacts between central bankers and executive branch officials. Grilli, Masciandaro, and Tabellini's (1991) index considers a wider range of considerations, of which the most important is the ability of the government to force the central bank to finance its deficits.[14]

Here we reproduce and extend Alesina and Summers' (1991) analysis of the relationship between central bank independence and real aspects of economic performance. Alesina's (1988) index covers 16 OECD nations.[15] Grilli, Masciandaro, and Tabellini calculate index values for 14 of these nations. We interpolated values of the GMT index for the two missing OECD nations, Norway and Sweden, from a linear regression of the GMT index on the Alesina index. We then scaled both indexes to have a mean of zero and a unit standard deviation, and averaged them to obtain a single overall index of "central bank independence." A higher value of the index corresponds to a more independent central bank: In our sample the two most independent central banks are those of Switzerland and Germany, followed by the United States. The least independent are New Zealand, Spain, and Italy.

Chart 4 plots the average inflation rate, in percent per year, experienced by an OECD economy over 1955-90 on the vertical axis and the value of the central bank independence measure on the horizontal axis. This graph shows a near-perfect inverse correlation between central bank independence and average inflation rates.[16] In this sample, four-fifths of the variation in average inflation rates over the 1955-90 generation can be accounted for by the Alesina-Grilli, Masciandaro, and Tabellini measure of central bank independence. Given that the index was constructed without reference to inflation outcomes by examining the institutional structure of the central bank-government relationship, this is a remarkably high correlation.

The institutional independence of the central bank, as measured by the Alesina and by other indexes, is usefully thought of as determined before and independently of the macroeconomic shocks and policies of the post-World War II era. Central bank laws and traditions change

Chart 4
Inflation and Central Bank Independence



only slowly, and do not in the short run reflect the relative aversion of individual governments or finance ministers for inflation. In the long run, periods of high inflation do appear to trigger reform of the central banking laws in a way to grant the bank more independence.[17] But in the short run, it is difficult to think that the association between low inflation and central bank independence reflects anything but central bankers' willingness to act according to their own aversion to inflation, whenever the institutional structure allows them freedom to do so.[18]

Do independent, inflation-averse central banks buy low rates of price increase at the price of high unemployment, or low growth? Alesina and Summers (1991) report no association–either substantively or statistically significant — between central bank independence and high unemployment or slow growth — and conclude that "the monetary discipline associated with central bank independence reduces the level and variability of inflation, but does not have either large benefits or costs in terms of real macroeconomic performance." Here we make an even stronger case for the positive effects of central bank independence. Alesina and Summers (1991) examined the correlation between central bank independence and GDP per worker growth, and found no relation, as is shown in Chart 5.

Here we regress GDP per worker growth over 1955-90 on both the degree of central bank independence and also on the initial level of GDP per worker, to pick up the convergence effects discussed in the preceding section. Chart 6 plots the partial scatter of output per worker growth and central bank independence. The difference between a point's vertical location and the dotted horizontal line in the middle of the graph measures the difference between the actual output per worker growth rate over 1955-90 and the level of growth that would have been predicted, given the correlation between initial GDP per worker levels and subsequent growth, if central bank independence had no association with growth. The horizontal axis scale is determined by the difference between the actual measure of central bank independence and what one would have expected central bank independence to be given the correlation of independence and the initial GDP per worker level.[19] A partial scatter plot shows the relationship between a pair of variables after each has been adjusted by the relationship it has with the other factors included in the analysis.

Chart 5
Output Per Worker Growth and Central Bank Independence

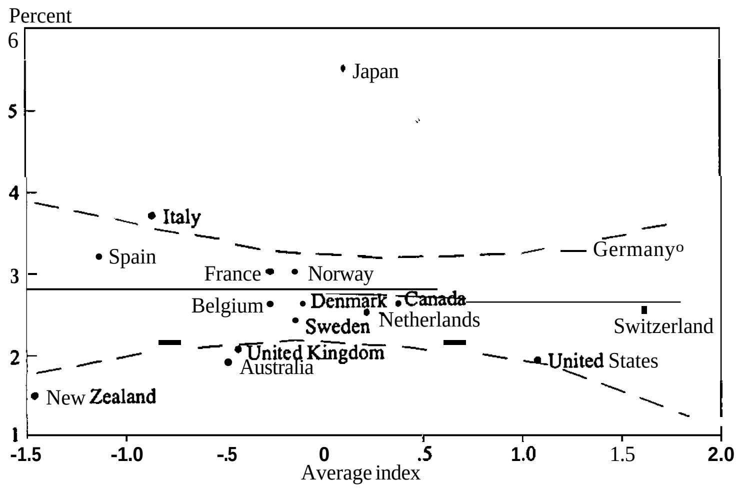
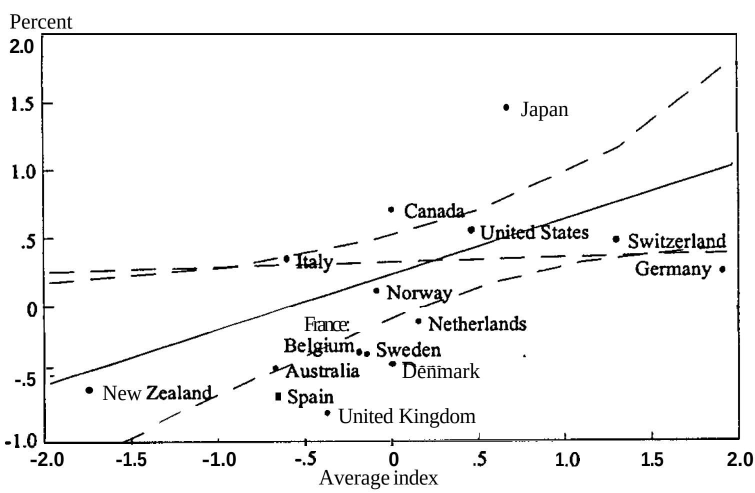


Chart 6
Central Bank Independence and Economic Growth, Controlling for Initial GDP Per Worker Levels



Economies that were relatively rich in 1955 tend to have independent central banks. But such economies also have smaller opportunities for rapid growth through technology transfer. Chart *6* shows that, holding constant initial output per worker levels, a shift in degree of independence from that possessed by Italy's central bank to that possessed by the U.S. Federal Reserve—an increase of 2 units in the Alesina-Grilli, Masciandaro, and Tabellini index—is associated with an increase in the rate of GDP per worker growth of 0.8 percentage points per year.

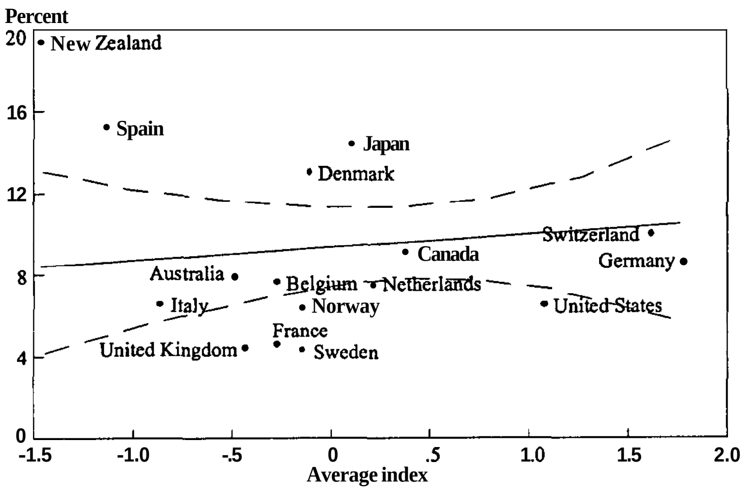
Chart *6* cannot be interpreted as a structural relationship, showing that independent central banks are the key to very rapid growth. All of the other determinants of economic growth are omitted from the regression. The inclusion of some of these other determinants, such as investment, greatly attenuates the significance and magnitude of the central bank independence variable. Furthermore, it may be that the association between central bank independence and rapid growth is spurious. Both may reflect organized, disciplined, and market-committed governments.

Nevertheless, the strong partial correlation between growth and central bank independence is striking. There is surely no reason to suspect that inflation-averse central banks have significantly lowered growth rates in the OECD over the past generation: anyone wanting to make such a case would have to make the unconvincing argument that the negative effects of central bank independence on growth have been overbalanced by other factors that by coincidence just happened to also be present in economies with independent central banks. Some portion of the positive association between central bank independence and economic growth may well arise because an independent central bank and a low-inflation environment allow the price system to work more effectively.

Can there be too much pursuit of price stability?

The evidence in the preceding subsection provides no support for the idea that a more politically driven and therefore recession-sensitive monetary policy increases long-run productivity growth. And there is some weak suggestion in the data that it may even reduce productivity growth. This should not be too surprising. As Chart **7,** based on Alesina and Summers (1991) demonstrates, there is no evidence that more politically responsive monetary policies actually mitigate cyclical variability in output. And there is no sign that they lead to lower rates of unemployment. Hence, they do not reap any benefits from avoiding recessions.

Chart 7
The Variance of Real GDP Growth and Central Bank Independence



In light of the zero inflation targets that have been set in a number of countries, periodic proposals for a zero inflation target in the United States, the very low rates of inflation now prevailing in much of the industrialized world, and the commitment of many traditionally inflationary economies to fixed exchange rates, it seems worthwhile to ask: can austerity be overdone? At the grossest level, the answer to the question is surely "yes." Monetary policies in the early years of the Depression in the United States by allowing a deflation that penalized debtors at the expense of creditors surely contributed to the depth of the Depression. As historians of the Great Depression like Friedman and Schwartz (1962) and Temin (1990) have long emphasized, the U.S. Federal Reserve allowed the money stock to contract in the Depression in large part because they feared the inflationary consequences of being seen to move away from the operating procedures they believed had been traditional under the gold standard.

Even leaving dramatic instances of policy failure like the Depression aside, we suspect it would be a mistake to extrapolate the results on the benefits of central bank independence too far. On almost any theory of why inflation is costly, reducing inflation from 10 percent to 5 percent is likely to be much more beneficial than reducing it from 5 percent to zero. So austerity encounters diminishing returns. And there are potentially important benefits of a policy of low positive inflation. It makes room for real interest rates to be negative at times, and for relative wages to adjust without the need for nominal wage declines. It may also be more credible than a policy of zero inflation and therefore it may require smaller output losses as the public overestimates the monetary authority's willingness to meet nominal demands. More generally, a policy of low inflation helps to avoid the financial and real costs of a transition to zero inflation.

OECD experience does not permit a judgment of the merits of very low inflation, since the two countries with the lowest average inflation rates after 1955, Switzerland and Germany, have inflation rates that have averaged **3** percent per year, a rate at which prices double every generation. As Chart 6 illustrated, these two countries have growth records that are less than what one would have predicted on the basis of convergence effects and an assumption that each additional point on the central bank independent indexes carries the same growth benefits.

Furthermore, the macroeconomic strain associated with strong disinflation in New Zealand and Canada in recent years, and the extraordinary strains imposed on European countries as the exchange rate mechanism (ERM) forced rapid disinflation up to its recent suspension, both point up the potential transition costs of moving to regimes of strict price stability.

These arguments gain further weight when one considers the recent context of monetary policy in the United States. A large easing of monetary policy, as measured by interest rates, moderated but did not fully counteract the forces generating the recession that began in 1990.

The relaxation of monetary policy seen over the past three years in the United States would have been arithmetically impossible had inflation and nominal interest rates both been three percentage points lower in 1989. Thus a more vigorous policy of reducing inflation to zero in the mid-1980s might have led to a recent recession much more severe than we have in fact seen.

Reversing the productivity slowdown: higher investment

One of the most fundamental economic decisions that any society makes is the decision as to how resources are to be allocated between the present and the future, or equivalently between consumption and investment. Strategies for increasing the rate of growth in living standards invariably emphasize in some way increasing investment in the future, while sometimes recognizing that this will mean reduced consumption in the present, at least in a fully-employed economy. Here we examine briefly the potential contribution of increased investment to economic growth. We highlight some relatively dismal scientific arithmetic demonstrating that only very high-return investments or huge increases in investment rates have the potential to dramatically alter growth rates.

A very simple arithmetic relationship, Equation (1), is useful in thinking about the relationship between investment and growth:

$$(1)\quad \Delta g = r\Delta(I/Y)$$

In words, the equation says that the instantaneous increase in an economy's growth rate from an increase in its investment share is the product of two things: the increase in the share of output that is invested, and the social rate of return on the investment. For example, if an economy increases its investment share by **3** percent of GDP and the investment yields a 10 percent rate of return, its instantaneous output growth rate will rise by 0.30 percentage points.

For the purpose of thinking about long-run growth rates, the instantaneous growth rates of Equation (1) exaggerate significantly the potential of increased investment for two reasons. First, as more and more capital of any given type is accumulated, diminishing returns are likely to set in. Second, capital depreciates and so an increase in the investment rate ultimately leads to a higher capital stock, but not one permanently increasing at faster than the long-run output growth rate. Calculations presented in De Long and Summers (1991) suggest that for standard growth models calibrated to the U.S. experience, a given boost to investment would increase growth rates over a 20-year period by approximately half of the boost's initial effect on the growth rate.

Equation (1) has dismal implications for both efforts to explain variations in growth rates on the basis of differences in investment rates, and efforts to increase growth rates by increasing investment shares. In the first section of this paper, we noted that productivity growth in the OECD as a whole has fallen by 1.8 percentage points per year comparing the 1960s to the 1980s. To boost long-run growth back up to its earlier, higher level through increasing investment shares—even investments that yielded 15 percent per year—would, on the basis of De Long and Summers' (1991) calculations. require an increase of 24 percentage points in the investment share of national product. It is logic of this type that explains why growth-accounting exercises in the tradition of Solow (1957) typically assign so small a role to capital accumulation in accounting for productivity growth.

With respect to living standards, the arithmetic is even more discouraging. If investments earn even a 15 percent return, it will be seven years before permanent increases in investment begin to pay off by generating higher levels of consumption: for the first six years, the increase in output generated by past higher investment is more than offset, in terms of current consumption. by the deduction necessary to finance this year's higher investment.

What are the policy implications? The first obvious implication is that raising the *quality* of investment is very important relative to raising the quantity of investment. With most economies investing in excess of a quarter of GDP in private capital, schooling, infrastructure, and research and development, relatively small percentage-point changes in the rate of return on investment can induce large increases in growth. Finding the highest return investments, and managing public investments as efficiently as possible, is therefore crucial.

Second, it appears very unlikely that there are many investments left open that have ex-ante private returns far above 10 percent per year. Take as an example investing in going to college. At present, the average gap in earnings between young *(25* to 34) white males with no college and with B.A.s is about 70 percent. This is a huge gap: in today's America, going to college is one of the best investments anyone can make. But spending four years in college has substantial costs: the four years' worth of wages not earned while the student is out of the labor force, and perhaps half again as much in the direct cost of education. Comparing the 70 percent increase in wages accruing to those with B.A.s to the roughly six years' worth of income that the B.A. costs to acquire reveals that investments in higher education promise a rate of return of about 10 percent per year. Thus even an investment as worthwhile for an individual, and as attractive for society, as college, is in the class of investments that cannot be expected to lead to large boosts in the growth rate.

In order to identify investments with high enough social returns to have a substantial impact on growth, it is necessary to find investments with substantial external benefits not captured by the entity undertaking the investment. Identifying and promoting such strategic investments is a critical way in which public policy can promote growth. Much of this involves policy with a structural or microeconomic dimension, which lies outside the scope of this paper. We do present some evidence in the next section suggesting that policies promoting equipment investment can have large external benefits.

Third, it appears that in the United States today deficit reduction can have, at most, a minor impact on long-run growth rates. It is surely worthwhile to reduce the deficit: from the point of view of the country as a whole, deficit reduction has no cost—what we would pay now in increased taxes we would save in lowered future taxes—and promises significant benefits by evening out the cross-generational tax burden and removing a source of uncertainty about the long-run commitment of the United States to low inflation. But deficit reduction is not a policy that would reverse the productivity slowdown. Since one percentage point of GDP's worth of deficit reduction would not induce a full percentage point's increase in national savings, the effect of each percentage point of deficit reduction on long-run growth would, in all likelihood, be smaller than even the modest increases calculated above.

We are led to conclude that policies to boost the share of output devoted to investment in general are worth undertaking on their own terms: they do promise benefits worth more than their costs. But they are not going to advance the ball very far in the game of economic growth. "Three yards and a cloud of dust" is what they will produce. Only "long ball" investments that have large external benefits and promise extremely high social returns will have the potential to significantly accelerate growth.

The observations that economies do exhibit substantial differences in their rates of productivity growth, and that these differences must be a consequence of decisions about resource allocation suggest that such high-return investments do exist. The challenge for economic research and policy is to find them.

Supernormal returns: investment in equipment

The cross-section correlation of growth and equipment investment

Is there, in fact, reason to believe that shifts in rates of investment, especially of particular kinds of investment, might have large effects on economic growth rates? In earlier work, De Long and Summers (1991),[20] we argued that the cross-sectional distribution of growth rates across economies in the post-World War II period strongly suggests that investments in machinery and equipment are a strategic factor in growth, and do carry substantial external benefits.

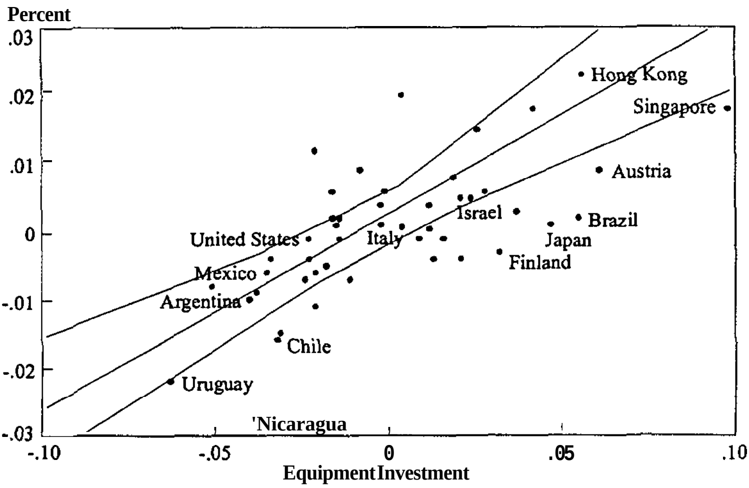
The idea that machinery investment might be necessary for rapid productivity growth is not new. Economic historians have written of the close association of machinery investment and economic growth since the beginning of the Industrial Revolution. New technologies have been ***embodied*** in new types of machines: at the end of the eighteenth century, steam engines were necessary for steam power, and automatic textile manufacture required power looms and spinning machines; in the early twentieth century, assembly line production was unthinkable without heavy investments in the new generations of high-precision metal shaping machines that made parts interchangeable and assembly lines possible. Recent innovations fit the same pattern: basic oxygen furnace and continuous-casting steel-making technologies need oxygen furnaces and continuous casters. "Flexible system" implementations of mass production need numerically controlled machine tools.

Here we document the close association of equipment investment and economic growth. We present regressions of economic growth on equipment investment, and on other factors that are plausible determinants and correlates of growth, over a period 1960-85 chosen to maximize the number of economies in our sample. We restrict our attention to that group of economies, whose growth we tracked in an earlier section, that had already proceeded relatively far along the road of industrialization by 1960.[21] Our sample is further restricted by data availability.

Since we study the correlation of growth not with just total investment but with the different subcomponents of investment, our sample is restricted to nations that were surveyed in one of the U.N. International Comparison Project (ICP) benchmarks, and for which we have relatively detailed information on relative price and quantity structures, at least for benchmark years. In the end, our sample consists of 47 economies.[22] An important additional advantage of our ICP data is that it takes account of differences across countries in the relative prices of capital goods. Other comparisons of investment across countries measure "investment effort"—how much of consumption is foregone as a result of the investment decisions made in an economy. Since relative prices of capital goods vary widely, investment effort can be a poor guide to the actual quantity of new capital purchased and installed. We believe that this is one reason why the conventional wisdom is that the cross-nation investment-growth relationship is weak. ICP data are sensitive to this potential difficulty, allowing us to study not the association between growth and investment effort but the association between growth and investment.

Chart 8 and Equation (2) below[23] show the strong association between differences in machinery investment rates and differences in economic growth rates that we typically find. Equation (2) below

Chart 8
Partial Scatter of 1965-80 Growth and Machinery Investment



(2) GDP/Wkr Growth = 0262 (Eq. Inv) + 0.069 (Non-Eq Inv.) + 0 032 (Prod. Gap) - 0 082 (Lab Fce. Gr) - 0 004 (Sec.Ed.)
(0 048) (0 028) (0 007) (0 169) (0 010)

$R^2 = 0.654$ SEE = 0 0079 n = 47

Chart 8 reports the estimated equation from a regression of growth in GDP per worker over 1960-85 on five factors. First comes the 1960 productivity gap vis-à-vis the United States. This factor is included to account for the potential gains from acquiring and adapting the technologies of the industrial West open to poorer economies. Because of this factor, we would expect poorer economies to grow faster than richer ones if other things were equal. The second factor is the rate of labor force growth. A faster rate of growth of the labor force implies that a greater share of national product must be devoted to investment—both in physical capital and in education—simply to keep the average level of skills and the amount of physical capital used by the average worker constant.

The third factor is the average secondary school enrollment rate over the sample. This is a proxy for the rate of investment in human capital through formal education. However, it is not a very good proxy (Schultz, 1992). In our regressions, the secondary school education rate does not appear to be a strong and significant independent correlate of growth. But it is premature to conclude that education is not important: education almost surely is important. Instead, the lack of significance of our human capital investment proxies in our cross-national regressions should most likely be attributed to the large divergence between measured schooling and actual skills learned. The fourth factor is the average rate of investment over 1960-85 in machinery and equipment. This factor is a measure not only of accumulation but also a proxy for a number of ways in which investment might lead to higher productivity through technology transfer, and through learning by doing.

The fifth and last factor is the rate of investment in categories other than machinery and equipment. This factor measures the importance of capital accumulation in general, for there is no special reason to believe that nonmachinery investment should be especially fruitful either as a carrier of new technologies or as a major source of informal education through learning-by-doing.

The data used are a later vintage of those used in De Long and Summers (1991).[24] Not suprisingly, the results are similar. Equipment investment has a very strong association with output per worker growth. In this sample, each extra percentage point of total output devoted to investment in machinery and equipment is associated with an increase of 0.26 percentage points per year in economic growth. Nonmachinery investment has a statistically significant association with growth, but the magnitude of the coefficient is only one-quarter as large as for machinery investment—and is not out of line with what one would predict from the "standard model" discussed above. The difference between the equipment and the nonequipment investment coefficient is highly significant, with a t-statistic on the difference of more than three.[25]

Chart 8 shows the partial scatter of growth and machinery investment. Important observations in generating the high machinery investment coefficient include Singapore, Japan, Israel, and Brazil—all with high machinery investment rates and high growth rates—and Argentina, Chile, Jamaica, .Nicaragua, and Uruguay with low growth and low rates of machinery investment. For the United States vs. Japan though, the difference in equipment investment accounts for two percentage points of the U.S.-Japan growth gap.

Nonmachinery investment plays a much smaller role in accounting for differences in output per worker growth. And labor force growth and the school enrollment rate do not have any significant effect—although as noted above, this may tell us more about the inadequacy of the secondary school enrollment proxy than about the true relationship between schooling and growth.

Equipment investment and ***growth:*** *causation*

The strong correlation between machinery investment and economic growth does not necessarily imply that a boost in machinery investment shares is the best road to a growth acceleration. It could be that machinery and growth are correlated not because an ample *supply* of machinery leads to fast growth, but because fast growth leads to a high *demand* for machinery. Even if a high rate of machinery investment is a cause and not a consequence of rapid growth, it is not necessarily the case that the entire estimated coefficient on machinery investment in our cross-nation regressions can be interpreted as measuring the growth boost that would be produced by a policy-induced shift in the machinery investment share. A high rate of machinery investment might well be a signal that an economy has a climate favorable to growth, and that a number of other growth-causing factors omitted from the list of independent variables are favorable as well. In this case, the high coefficient on machinery investment would reflect both the direct effect of machinery investment on growth and the extra correlation arising because a high rate of machinery investment is a proxy for the presence of other growth-producing factors.

The first possibility—that machinery is more effect of rapid growth than cause—we dismissed in De Long and Summers (1991) because a high rate of machinery investment and pace of growth were correlated not with relatively high, but with low machinery prices.[26] If machinery were the effect of fast growth, it would be because fast growth would shift the demand for machinery outward, and move the economy up and out along its machinery supply curve. Thus we would see fast growth and high machinery investment correlated with high machinery prices. Instead, we see fast growth and high machinery investment correlated with low machinery prices. To us, this supply-and-demand argument is powerful evidence that fast growth is not a cause but an effect of a high rate of machinery investment.

There remains the possibility that the high equipment investment coefficient arises in part because machinery investment is a good proxy for other, hard-to-measure factors making for economic growth. In such a case the association between equipment investment and growth would not be a "structural" one, and policy-induced boosts in rates of investment in machinery and equipment would be unlikely to raise output growth rates as much as the cross-nation correlations suggest.

In general, the assertion that the strong association between machinery investment and growth reflects a structural causal relationship running from machinery to growth is a claim that a given shift in machinery investment—however engineered—will be associated with a constant shift in growth. The next best thing to direct experimental evidence is the examination of different dimensions of variation in machinery to see whether dimensions of variation in machinery investment driven by different factors have the same impact on growth. To do this, we examine the relationship between growth and various components of equipment investment associated with different aspects of national economic policies.[27]

Table 3 reports such regressions of growth on different dimensions of variation in machinery investment. The estimated machinery investment coefficient measures the association between output growth and that portion of machinery investment that is correlated with the particular instrumental variable. In addition to the baseline case without any instruments, four sets of instrumental variables are used: the average nominal savings share of GDP over 1960-85, Aitken's (1991) estimates of the deviation of the real relative price of machinery and equipment from its value expected given the economy's degree of development, and World Bank estimates of tariff and nontariff barriers to imports of machinery and equipment.

As Table 3 shows, no matter which of these dimensions of variation in machinery investment we examine, the association of machinery investment and growth remains approximately the same. Estimated coefficients range from 0.196 to 0.271. The similarity of the association with growth of these different dimensions of variation in machinery investment provides powerful evidence that the machinery-growth nexus is "structural," and does not arise in any large part because a high rate of machinery investment is a signal that other growth-related factors are favorable.

Table 3
Instrumental Variables Regressions of Growth on Machinery Investment

Instrument	Machinery Investment	Other Investment	Labor force growth	Productivity gap	R^2 (2d stage)	SEE	n
No instruments	.250	.070	-.030	.034	.652	.008	47
	(.040)	(.028)	(.126)	(.006)			
Savings rate	.224	.079	-.037	.031	.507	.009	46
	(.059)	(.034)	(.151)	(.008)			
Relative price of machinery	.210	.092	-.103	.040	.610	.008	31
	(.086)	(.045)	(.164)	(.011)			
Tariffs and nontariff barriers on capital goods	.196	.077	.016	.027	.309	.011	39
	(.136)	(.048)	(.208)	(.011)			

In spite of the similarity of the estimated machinery investment coefficients, the different instrumental variables regressions do capture different aspects of the variation in machinery investment. In the second line of Table 3—which shows the effect on growth of that component of machinery correlated with aggregate nominal savings rates—the most influential observations are the Asian trio of Japan, Singapore, and Hong Kong with high, and Ecuador, Uruguay, and Switzerland with low savings, equipment investment, and growth rates. The third line—showing the effect of that component of equipment investment correlated with a low real price of machinery—has fewer data points and a somewhat different set of influential observations: the three most influential high-growth high-investment low-price economies are Japan, Israel, and Greece.

The different regressions in Table 3 do, indeed, examine different components of the variation of equipment investment rates across countries. Yet all of the estimated coefficients are very similar. We think it very unlikely that the association of growth with each of these components of equipment investment would be equally strong if equipment investment were merely a signal, and not an important cause, of growth.

The point made in this section—that there are some investments, investments in machinery and equipment, that have the potential to boost total factor productivity directly by sparking technology transfer and learning-by-doing—is far from new. It was a centerpiece of the analysis of Kennedy's Council of Economic Advisers, which blamed what they saw as slow productivity growth in the 1950s on a falling and misallocated share of investment (Tobin and Weidenbaum 1988). The 1962 *Economic Report of the President* called for increased investment in plant and equipment, subsidized by accelerated depreciation and an investment tax credit. In their view, productivity growth and capital accumulation were closely linked:

> [When] investment was more rapid, there was an accompanying acceleration of productivity gains. . . Investment in new equipment serves as a vehicle for technological improvements and is perhaps the most important way in which laboratory discoveries become incorporated into the production process. Without their embodiment in new equipment, many new ideas would lie fallow. . . This interaction between investment and technological change permits each worker to have not only more tools, but better tools as well.[28]

This section has focused on equipment investment almost exclusively, because unlike other forms of potentially strategic high-return investment, like research and development or education, it is substantially influenced by macroeconomic policy tools. The policy instruments with the potential to increase equipment investment are clear enough, and are those identified by the Kennedy Council of Economic Advisers in its 1962 reports: high rates of national saving by making possible looser monetary policy reduces the cost of capital and encourages equipment investment. Increased national saving caused by tighter fiscal policy or increased private saving raises equipment investment. Tax incentives, such as the American investment tax credit, that favor equipment investment are particularly desirable because they are well-targeted. Trade policies that ensure that capital goods imports are not penalized are important in making sure that a high investment effort is translated into a high rate of equipment effort.

Conclusion

In concluding this paper in 1992, it is worth recalling the observation with which we began. The productivity slowdown is not just an American phenomenon. It is a worldwide event that has occurred in countries with widely varying micro- and macroeconomic policies. This suggests that even with all the political courage in the world, there is no macroeconomic magic bullet that has the potential to reverse the productivity slowdown. Better, more responsible macroeconomic management is surely helpful. And increases in national saving that flow into general increases in investment surely can make a contribution.

If public policy in the industrialized world does succeed in reversing any large part of the productivity slowdown, its success will have an important microeconomic component. Policy will succeed either by changing incentives in such a way that average returns on investment significantly increase, or by successfully raising the share of national output that is devoted to forms of investment that have large external benefits and therefore very high social returns.

In keeping with this paper's macroeconomic perspective and some of our own earlier research, we have highlighted equipment investment as a class of investment that is likely to have especially large social returns by supporting the development and introduction of new technologies. Certainly cases can also be made for strategically selected investments in infrastructure and in education. These cases must rely on external benefits of a kind that are difficult to measure. Studies of the travel time savings from highways, or the wage increases from better schooling do not suggest the kind of extraordinary returns or externalities that are necessary if increases in these categories of investment are to offset a large part of the productivity slowdown. The quantification of the possible external benefits of various forms of public investment should be a critical research priority. And even in the absence of compelling evidence of external benefits, there is a case for increasing public investment in those countries where investment rates have lagged and are low by international standards.

A crucial remaining issue is the apparent conflict between our emphasis on support for critical strategic investments and conventional policy wisdom that reductions in budget deficits and increases in national saving are desirable in the United States and in Europe. In fact there is no conflict. Reductions in budget deficits over the medium term are desirable on stabilization policy grounds apart from any effect that they might have on iong-run growth prospects. And, assuming strategic investments with very high returns can be identified, there is no reason why they should be financed out of reductions in other investment rather than out of consumption. Reducing budget deficits is good macroeconomic policy. But it is unrealistic to hold out the hope that reduced budget deficits alone will restore the magic of an earlier era, when standards of living in the industrialized world doubled in one generation rather than in two or more.

Appendix

Table 1A
Regressions of 1960-85 Growth on Equipment Investment and Different Sets of Additional Variables for Industrial Economies

Equipment investment	Other investment	Productivity gap	Labor force growth	Secondary education rate	Govern consump expend	Public investment	Continent	R	SEE
.262	.069	.032	-.082	-.004				.65	.008
(.048)	(.028)	(.007)	(.169)	(.010)					
.255	.059	.034	-.025					.63	.008
(.039)	(.027)	(.006)	(.127)						
.256	.060	.034	-.028		-.027			.65	.008
(.040)	(.027)	(.006)	(.126)		(.020)				
.240	.059	.035	-.083			.041		.67	.008
(.036)	(.025)	(.006)	(.118)			(.076)			
.206	.042	.029	.107				Continent: Prob(F) = ,320	.68	.008
(.048)	(.030)	(.007)	(.181)						
							Africa = ,026		
							(.005)		
							Asia = ,027		
							(.004)		
							Europe = ,027		
							(.003)		
							North America = .020		
							(.003)		
							Oceana = .017		
							(.008)		
							South America = .019		
							(.003)		

Endnotes

[1]Throughout this paper we use the Summers and Heston (1991) estimates of GDP per worker levels (the most current version of the cross-country database also discussed in Summers and Heston (1988 and 1984)), extended from 1988 to 1991 using OECD estimates of real growth rates. The Summers and Heston estimates have the merit of paying close attention to accurately measuring purchasing power panties, and have the further merit of assessing growth rates at a constant set of prices. However, analyses using World Bank or OECD estimates of relative GDP per worker growth rates do not lead to significantly different conclusions as long as we restrict our attention to relatively rich and industrialized economies.

[2] We end the decade of the 1960s in 1969 so as not to distort long-run growth estimates by having one of our periods end during the trough of the 1970 recession. Similarly, we end the decade of the 1970s at the peak of 1979, and we end the 1980s at the peak of 1990 so as not to conflate shifts in long-run growth with the effects of the transitory recessions.

[3]In calculating our centered moving averages for the most recent years 1990-92, we use OECD forecasts of output and employment growth rates over 1992-94 .

[4]Our cyclical adjustment procedure is based on a regression of year-to-year productivity growth on the change in the unemployment rate separately for each economy. It allows for a one percentage point rise in the natural rate of unemployment in Germany as a result of reunification.

[5]For example. see Wallich (1955) and Abramovitz (1986), which contain very good analyses of the post-World War II German *Wirtschaftswunder* and of long-run cross-country productivity growth, respectively. De Long and Eichengreen (1991) argue that *rapid* post-World War II Western European growth was too fast to be attributed to a "rubber-band effect."

[6]We define an industrial economy as one in which GDP per worker levels as estimated by Summers and Heston exceed a quarter of the United States for more than one of the benchmark years demarcating decades. The industnal economies plotted in Chart 1 are the same set included in Table 1

[7]See De Long (1988), Baumol and Wolff (1988), Dowrick and Nguyen (1989), and Baumol, Blackman, and Wolff (1989).

[8]It may be that we are simply too impatient, that few believed until the later 1980s that inflation would remain below the 4 percent per year where it had been pushed over 1979-1983, that as a result few of the benefits of predictable low inflation were gained in the 1980s, but that the 1990s will see rapid growth as resources finally flow out of their low social return Inflation havens and into activities where they yield high social rates of return but were in the past heavily taxed by inflation. To date we see few signs of such beneficial adjustment and reallocation in response to today's low-inflation environment. But we hope that we are wrong in our skepticism.

[9]See Kahn, Brown, and Martel (1976). The one of their arguments that we find most interesting is their belief that the technologies of the industnal revolution are of limited value in boosting productivity in the tertiary sector of non-agricultural, non-extractive, andnon-industrial activities. They expected the pnmary and secondary sectors to shnnk to such a small portion of the economy that even rapid continued technological progress in agriculture and industry would have only limited effects on living standards.

[10]With the exception of Mankiw (1990).

[11]Thus the rise in European unemployment in the early 1980s appears to have had long-lasting detrimental effects on European economies' productive capacities far beyond any expected at the start of this decade. See Blanchard and Summers (1986).

[12]See Rogoff (1985) As Alesina and Grilli (1991) make the argument, the median voter, the one whose preferences are decisive in elections, would want the management of nominal demand and the control of monetary policy to be in the hands of those who are more inflation averse than she is—though *ex post* such a voter would wish that monetary policy were more expansionary and that inflation were higher.

[13]Based on the index of Bade and Parkin (1982).

[14]For a more detailed explanation of the differences between the two indexes, see Alesina and Summers (1991).

[15]Including the 12 nations considered in Bade and Parkin (1982). The 16 nations in Alesina's (1988) sample are Australia, Belgium, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, New Zealand, Spain, Sweden. Switzerland, the United Kingdom, and the United States.

[16]As Alesina and Summers report, there is a strong correlation between central bank independence and low inflation variability as well.

[17] The most striking example is the Independence of German central bankers since the 1923 hyperinflation. As Alesina and Summers (1991) note, disappointment with relatively high inflation in Canada and New Zealand has recently triggered increases in the independence of their central banks. Cukierman, Webb, and Neyapti (1991) discuss how this generation's Inflation shapes next generation's central banking laws.

[18] Italy, for example, had in 1950 a tradition of aversion to inflation: it had used its Marshall Plan aid to pay off its government debt, and before the Great Depression the Fascist government had thought it willing to deflate internal prices by one-third to re-establish the exchange rate at the quanta *novanta.* Yet since 1955 with a central bank largely dependent on the executive, Italian inflation has been the third highest in our OECD sample.

[19] The R^2 from the regression of average GDP per worker growth on initial level and central bank independence is 0.72, with a standard error of the estimate of 0.53 percent per year. On average, a unit increase in the index is associated with an Increase in growth rates of 0.408 percentage points per year, and this coefficient has an estimated *t*-statistic of 2.51.

[20]See also De Long (1992), Jones (1992), or De Long and Summers (forthcoming).

[21]We eliminate the poorest economies from our sample because we are not certain that their experience contains useful lessons for the analysis of growth in the rich OECD.

[22]The data underlying the cross-sectional regressions are a later vintage of the data used in De Long and Summers (1991). See De Long and Summers (1992) for more details.

[23]An appendix table provides results for a number of different specifications, showing that the strong association of machinery investment and growth holds true for the inclusion or

exclusion from the analysis of a number of different alternative sets of growth factors.

[24]The major changes are the use of the trade data from Lee (1992) to sharpen estimates of the proportion of investment devoted to machinery and equipment, and a fuller exploitation of OECD real investment component estimates.

[25]De Long and Summers (1991) consider a number of alternative breakdowns of investment. The bifurcation into equipment and nonequipment is most successful at accounting for cross-national differences in productivity group.

[26]De Long and Summers (1991) examined the robustness of our conclusions by performing a number of additional tests as well. In addition to instrumental variables estimates like those reported below, we also examined the differential associations of extensive and intensive growth and machinery investment, and examined shifts in growth and machinery investment rates across subperiods of the post-World War II era.

[27]By examining the coefficient produced by different two-stage least squares regressions of growth on equipment investment with different sets of instruments. This procedure can be viewed as an informal Hausman-Wu test of the proposition that the equipment-growth relationship is a structural one uncomplicated by omitted variables or simultaneity.

[28]Tobin and Weidenbaum (1988), p. 215.

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Commentary: Macroeconomic Policy and Long-Run Growth

C. Fred Bergsten

The Competitiveness Policy Council that I chair is a national commission created by the Congress to recommend action programs to improve America's performance in all the areas we are talking about at this conference. We basically define competitiveness as productivity and our effort is very deeply embedded in the framework of this discussion.

The commission has 12 members, four each appointed by the President, the Senate and the House. Each group of four comprises one corporate CEO, one labor union president, one top government official, and one public interest person. It's totally bipartisan. Unlike most commissions, it is quasi-permanent. Our hope is to be as successful as Alan Greenspan was when he chaired the Social Security Commission a decade ago.

When we did our unanimous first report to the Congress and President earlier this year, we took the view that the United States faces a very serious competitiveness problem. What the Japanese now call "the America problem" is not just slow growth and foreign catch-up. It's the fact that our productivity has expanded less than 1 percent per year for about 20 years and that our real wages are flat or down over that 20-year period. The attainment of our educational system is flat or, on some counts, worse than it was 20 years ago. (That, incidentally, raises questions about whether enrollment data are adequate proxies for measuring the output of our education system.)

We have had huge external deficits—nearly a trillion dollars over the last decade. This is significant, contrary to what Siebert implied, because the United States is now as open an economy as Japan or the European Community taken as a group. As Alan Greenspan said at the start of today's discussion, there is deep dissatisfaction in the American public concerning the state of our economy and our commission is trying to come up with suggestions on what to do about it.

Our first report echoed both the old and new growth theories. It echoed what Kumiharu Shigehara said earlier this morning: that one must have a broad-based effort. He and we call for a comprehensive competitive strategy for the United States. That strategy would include large macroeconomic policy changes, particularly to raise the low levels of savings and investment. Major structural reforms are needed in four key areas: education and training, health care costs, technology commercialization, and corporate governance/financial markets. We also need a new mechanism to develop thoughtful, sector-specific policies rather than reacting in the destructive and often protectionist way that we have in the past.

Our commission set up eight sub-councils which are now working out detailed blueprints in each of these areas. They include about 250 top people, many of whom are in this room. Our full council intends to submit a detailed competitiveness program to the President and Congress in early 1993.

To pick up on the discussion of a moment ago with Larry Summers, and some of the earlier papers, we are inclined to propose a very ambitious goal for the United States: doubling the rate of national productivity growth by the end of the century, from the 1 percent of the last few decades to 2 percent. "Doubling productivity growth sounds ambitious while "raising it by 1 percent" sounds less ambitious. But they amount to the same thing.

As Larry said in his paper, increased investment would have to be done in ways that have super-normal rates of return in order to get the kind of productivity increase we want. As we quantify our effort, we conclude that the actual investment rate would have to increase by something like 8 percent of GNP, as suggested in both Larry's paper and Alan Auerbach's paper.

In addition, we do not want to increase the external deficit. In fact, we would like to eliminate it. Hence, national savings would have to go up by more than 8 percent of GNP over the rest of the decade. So we will make a proposal that, over the remaining years of this decade/century and the next two presidential terms, the U.S. national saving and investment rates need to rise by about 1 percentage point per year to achieve the desired goal of doubling annual productivity growth.

Once we agree on such a goal, how do we achieve it? I don't pretend that we have a full program yet. The papers and discussions from this conference will help us enormously in doing that. I obviously haven't time to go through the entire program that we do have at the moment. But a big part of it, at the macro level, is the old faithful — converting the budget deficit not just into balance but into surplus. We would take it from the current level of deficit, 3 to 4 percent of GNP, to a surplus of 2 to 3 percent of GNP (including the trust funds). We would get a large part of the total increase in resources that we need with that kind of budget correction.

The rest of those resources would need to come from an increase in private saving. The key question, of course, is how to do that? We observe a structural change in the American economy in the 1980s. Historically, as you all know, there has been an inverse coalition between public and private saving in the United States. The national saving rate stayed more or less constant. Public saving went up when private saving went down and vice versa.

But both went down in the 1980s, undermining the availability of resources for productivity increases. That raises the question of whether the United States has become a nation of target savers. Are we aiming for a steady stream of investment income growth particularly as, on the institutional side, corporate pension plans come to dominate the saving picture and defined benefit plans become a major portion of saving by individuals? If we are a nation of target savers, then of course higher interest rates mean ***less*** saving. Better tax treatment of investment income means ***less*** saving. The result would be perverse in terms of the experience we have had in the past.

If that were true, then I find no other way to reverse the correlation of the 1980s than budget correction. This would take pressure off interest rates and boost private as well as public saving, helping to generate the resources that we need. There may be ways for policy to promote private saving directly as well, like mandating defined benefit pension plans for all companies.

The next and equally critical question is how to channel the investment that would then be available into high productivity and strategic payoffs. The obvious positive answer to Al Wojnilower's question is that the allocation of capital does make a difference. In our view, some of that needs to be done by the government itself with public infrastructure investment at a much higher rate than it has been.

Additional means to these ends would include much stronger education and training programs. Our view is that the fundamental problem of U.S. primary and secondary education is that the students have no incentives to work. Students can get into colleges and universities as long as they can pay, and in most cases even if they cannot pay. (They cannot get into Harvard or MIT but they can get into some college or university whatever their attainment in high school.) Their ability to get jobs also has very little to do with their attainment in secondary school. Therefore we want to create major new incentive systems based on national standards that are required for graduation from high school and entry to college. Federal funding of higher education should, in turn, be conditioned on application of those standards.

We have a number of ideas on commercialization of technology, and tax incentives to private investment. We agree with Larry Summers' paper, and with Alan Auerbach's paper, that the government can do better in promoting investment than in promoting saving. Marginal incentives pay off. Targeted marginal incentives pay off. A new equipment tax credit makes sense.

All this must be done consistently with bringing the budget into surplus over the time period I mentioned. Corrections in the budget position will have to total more than 100 percent of the current deficit level because a few new expenditures, including tax expenditures, will be needed. On the tax side itself we want to kill two birds with one stone: any new revenue increases ought to be achieved with tax measures that provide incentives to save and disincentives to consume. In our initial report, we already suggested the possibility of shifting from income-based taxation to consumption-based taxation--or at least going partly down that road to a value-added tax or a wide-based energy tax.

This is a very broad brush of a number of directions we are leaning toward to suggest how the United States can sharply improve its productivity performance and its competitiveness over the coming decade. Everything that I've mentioned sounds pretty ambitious. The question is whether it is doable. Our commission concluded there was no chance for extensive policy reform in election year 1992. Therefore, we did not present a detailed program or specific proposals for this year but rather laid out broad strategies and tried to help focus attention on the problem.

However, we concluded that there might be a chance of major policy action in 1993. We know that the U.S. government moves dramatically only in two circumstances. One is when there is a crisis. However, in some senses unfortunately, the competitiveness problem is not a crisis as much as "termites in the woodwork."

The other time the United States tends to move is in the first year of a new administration so we concluded that 1993 might be the year for action. Moreover, we know that the United States is in its fourth year of economic stagnation without much prospect of picking up sharply. We compare rather poorly with the rest of the world, as just suggested in the question by Stanley Fischer. There's not much prospect for early recovery, in part because the United States has no available policy tools. With the budget deficit at this level, we can't use fiscal policy. Nor is there much impact from monetary easing with the financial system still under strain, even with significant reductions in interest rates and all that the Federal Reserve has done to stimulate the monetary side.

As we look at the world, the prospect is for very sluggish and inadequate medium-term growth. The Germans are struggling with their version of Reaganomics and the European countries are all striving to bring their policies into conformity with the Maastricht standards for economic and monetary union—lower inflation, lower budget deficits, further disinflation. In addition, the seeming structural downshift in Japan presages slower economic growth in Asia as well.

So our conclusion is that the best, perhaps only, short-term strategy for now is to start coming to grips with the long-term fundamental underlying problems. It was fascinating that all members of our commission agreed that no quick fixes or jump-starts were possible. We had to begin an early attack on the underlying problems to get the American economy back on track. In the current political campaign, some of these issues are being discussed—but not the tough ones comprising saving and investment, the budget, and the like.

We have come to a final judgment that, when the new President wakes up on November 4 after having been elected, he really will have only two choices. One is to try to skate through the next four years without dealing with the fundamentals. Jimmy Carter did that in the late 1970s. George Bush has done that over the last four years. The result is stagnation, poor economic performance, and continued deterioration. The alternative is to take ambitious measures, recognizing they will require taking some political heat early. That's what Ronald Reagan did, taking a recession—the biggest since the 1930s—in his first year-and-a-half but with nobody remembering that recession when his re-election was approaching. A sweeping victory was the result.

So even in terms of short-term politics, there may be a case that correlates with dealing 'with the real problems of the economy. The fact that Paul Tsongas and Ross Perot did very well this year indicates to us that there is an enormous undercurrent of sentiment in the American public that would support an effort to deal with the fundamental problems, and a recognition that jump-starts and quick fixes aren't available and won't work. Thus we believe the time has come to try to deal with these issues.

Commentary: Macroeconomic Policy and Long-Run Growth

Lawrence A. Kudlow

I'm going to talk a little more about some of the things that Larry Summers said in his paper.

I certainly agree with Larry's point about independent central banks and inflation. I also agree, at least in part, on the issue of equipment spending and equipment investment. I do, however, want to point out some numbers in the 1980s. Larry mentioned that productivity rates declined somewhat less in the United States than in some of the other countries, and that the U.S. decline is mostly a function of the long-term deterioration in American productivity. I'm not sure I agree with that. Certainly on the equipment side, the United States had quite a burst of investment according to numbers in the national income and product accounts. During the expansion from 1982 to 1990, equipment was up 46 percent in real terms—5.6 percent at an annual rate. The other point I'd make is on equipment as a share of the overall economy—we were talking about gross national product (GNP) or gross domestic product (GDP) shares in the earlier panel. From 1980 to 1984, equipment as a share of GNP was 7 percent and, from 1985 to 1989, equipment as a share of GNP was 7 1/2 percent. From 1959 to 1990, the average was only 6.3 percent, so the 1980s saw quite a surge in equipment spending in relation to most of the postwar period.

What did trouble me about Larry's paper; and troubled me even more about Fred Bergsten's remarks, is what I think is a not-too-veiled support for targeted investment, ideally targeted by the government, and presumably by people in this room who would be the targeters.

As someone who was a former targeter, I don't think that works. I much prefer, of course, free market economics and letting rates of return and relative costs and prices determine the allocation of resources--even an important resource allocation, such as investment in new equipment. So I certainly have a problem with targeting investment, and I think we would be in great error to run back to a more planned economic approach.

By the way, I don't think the Germans and Japanese are doing so fabulously right now, to the extent that they have embodied some of these proposals. I will note that the U.S. economy is the only one in the G7 which is expanding. I admit it is expanding at a slow pace. I'm not here to defend the last four years. But we are growing. Nobody else is really growing in the G7. So to some extent, we may be too hard on ourselves. As I listened to Charlie Plosser's paper, I agreed with a lot of what he said. Low inflation is good for economic growth, lower taxes are good for economic growth, and lower government spending is good for economic growth. To some extent, Larry Summers overlapped at least on the inflation parts, so we can agree about that.

I want to use the remainder of my time, however, to make a different point. We talked a lot about physical capital and we talked a lot about human capital--education. Robert Barro is going to talk more about that tomorrow along with Kumiharu Shigehara and others. I'm interested, of course, in financial capital, since 1 work in the marketplace, at least part of the time, and since I think it is a very important issue. To the extent that the U.S. economy has been in a four-year slump—I don't disagree with that view—I think part of it stems from a less hospitable, even hostile, environment which macroeconomic policies have generated for financial capital. I want to stop and talk about this for a couple of moments. It seems to me that we must have a decent supply of capital to invest in equipment, to invest in new technologies, and even to create the prosperity necessary to build the schools and buy the children the right equipment and supplies. We have to focus extensively on this issue—the supply of financial capital.

I think one of the great mistakes stems from tax and regulatory policy in the last few years, going back to 1986, but also clear through the late 1980s and the early 1990s. We raised our capital gains tax rate. We have lengthened depreciation schedules. We have given the banking system a very rough go with regulatory policy. We have also experienced income and payroll tax increases. And on top of that, we have had a splendid increase'in the rate of government spending—really a staggering increase—and, not surprisingly, in the government budget deficit as well. Many people I talk to in the private sector—business people, investors, and so forth—are concerned that rising budget deficits will cause tax rates to go up in the next few years, thus making the environment for financial capital investment even worse rather than better.

My view is that the policy prescription needs to promote economic growth, to increase productivity, and to accumulate physical capital at a faster rate. I think we have to pay some attention to the incentive structure for financial capital: how it will appreciate in value, whether or not it will be properly channeled into new investments, higher risks, and so forth. A couple of studies from Switzerland, just in the last few months, have suggested that in the wake of the 1986 tax bill, U.S. capital formation now ranks 22nd of the 24 Organization for Economic Cooperation and Develeopment (OECD) countries. Perhaps even more interesting, Stanford Professor John Shoven has estimated that in the wake of the 1986 tax bill, the cost of capital in the United States has now moved to a level which is 63 percent higher than it is in Japan, 26 percent higher than in Germany, and 80 percent higher than in Great Britain.

Now I agree that debt is a problem, and I agree that the last stages of the 1980s' expansion created too much debt. But I also think assets became a problem. Asset values have been declining in recent years, which is making debt far more onerous, simply because the rate of return on investments has been reduced by inappropriate tax and regulatory policy. Capital cost has gone up. That has rendered the assets less valuable, hence the debt is increasingly onerous. Also, U.S. tax policy—partly the 1986 bill and the bills in 1987, 1989, and 1990—still, after all these years, has not resolved the problem of double taxation of dividends, surely an issue related to capital formation. Neither has it solved the problem of the double taxation of retained earnings, surely another issue related to capital formation.

Nor has it reduced incentives which still favor debt finance over equity finance, surely another issue related to capital formation. Nor have we resolved the problems of the tax treatment of capital gains and the depreciation allowances. Neither is indexed for inflation. Surely, these affect capital cost and investment return, and hence long-run productivity and economic growth.

Nor have we, I think, properly addressed the issues of the tax burdens on saving, particularly on the steady and significant increases in the **U.S.** payroll tax rate, which has surely been one of the major factors in the decline of the narrowly defined saving rate. Nor has **U.S.** policy dealt adequately with the regulatory costs and treatments in a number of areas all related to business performance, financial capital, and overall capital formation. We still have significant bottlenecks and barriers to investments—investment disclosure, registrations, security offerings, so-called insider trading (which has come up in recent years and may be even murkier now)—to add to the trials and tribulations and the issues relating to corporate governance. To me, all of these create barriers: barriers to economic growth, barriers to capital formation, and barriers to capital investment. This was, of course, the backbone of the supply-side view which emerged in the government in the early 1980s.

I would also raise a point about the federal budget. It seems to me if the budget continues to grow at 11 percent a year, which is what it has done in the past 3.75 fiscal years, we are going to continue to have a major problem. This spending increase, which is partly a function of the stagnant economy and partly a function of the state of policies, has created a budget deficit which was 3 percent of GNP as recently as 1989—$130 billion. At the end of this fiscal year, according to the Office of Management and Budget (OMB) and the Congressional Budget Office (CBO), it's going to come in--even excluding deposit insurance—at about $325 billion, which is about 5 1/2 percent of GDP. That is a quantum jump in four years. You actually change the handle on the deficit from a one to a two to a three. I think this itself has created an inhibiting effect on capital formation and the various incentives.

Nor has this spending, which is a form of government targeting on infrastructure, done much to stimulate our economy. Since we all agree, the conservatives and the not-so-conservatives, that the economy hasn't performed well in the last four years, I ask, "If spending were the answer, why haven't we done better?" Indeed, we did a little drill in my shop that looked at infrastructure spending and what I call "human resource spending," what one presidential candidate called "government investment." Covering all the accounts—transportation, education, employment, employment training, employment services, and so forth—I find, most interestingly, that George Bush has actually done pretty much what his opponent asked him to do. President Bush very significantly expanded federal spending in these areas, by about $35 billion or roughly 8 percent a year, in the last four years. Now since the economy has grown less than 1 percent, presumably there is not as strong a linkage between this government direct investment and retraining, education, and so forth, as one might believe by listening to some of the other analyses. We've had it for four years and it has had no palpable effect on economic expansion nor productivity. Maybe we need to spend more—perhaps we should double it from 8 percent to 16 percent. We would have to wait four to 12 more years. But as a trial run, we have not done very well in establishing the benefits of government spending.

I also know as a former green eyeshade at OMB, on the question of building roads, bridges, and tunnels as an employment solution, the experience of the 1930s is relevant. Even assuming for a moment that some of the government spending in the 1930s worked some of the time, let me be the first to advise this group that the situation in the federal bureaucracy, the state bureaucracies, and the local and city bureaucracies is completely different now than it was 50 or 60 years ago. There is very little trickle-down to the local level of this kind of infrastructure spending. You have to get through very aggressive bureaucracies, most of which are heavily unionized, you've got to get through Davis-Bacon laws, you've got to get through the minority set-asides. Each takes a little cut as you get down to rebuilding the FDR Drive in Manhattan or whatever it is.

Finally, I must disagree a little bit with Larry Summers on the very low inflation scenario. I'll take this opportunity to commend the Federal Reserve on maintaining this consistent and successful strategy of low inflation and long-term price stability. Let me note not just the tax cost of capital, but also the interest rate cost of capital. The difference between 4 to 5 percent inflation and 2 to 3 percent inflation is very significant. Four to 5 percent inflation in 1987, 1988, and 1989 generated an average 10-year government-note yield of about 9 percent. But as that actual inflation rate has dropped, and expectations have dropped to 2 to **3** percent, that same 10-year government note is now yielding 6 1/2 to 7 percent, which is a 200 to 250 basis-point differential. That is a lot of money for corporations, both large and small. So I would submit, for lower interest-rate costs, very low inflation—however you define it, zero or two—is a big plus.

So let me summarize my view now that my time has run out. I'm all for equipment spending and equipment investment. Don't get me wrong—I think it is terrific. We had a lot of it in the 1980s, and I wish we could get more of it in the 1990s. But I think we need to pay more attention to policies across the board which will stimulate larger and predictable supplies of financial capital so that we can undertake the direct business investment, the high risk-taking direct investment, and the new technologies for innovation, creativity, and so forth. This is where the jobs payoff comes from. This is where the productivity payoff comes from. We need to look at capital cost and capital return on a tax and regulatory adjusted basis. Then we need to combine that with stronger restraints for government spending and as low an interest rate structure as possible. These to me are the kinds of sensible macroeconomic policies which will provide the necessary capital to finance the economy, new businesses, productivity, and the education, or human capital, which Robert Barro will be discussing.

Commentary: Macroeconomic Policy and Long-Run Growth

Allan H. Meltzer

DeLong and Summers' paper covers three principal topics. First, they document the international character of the decline in productivity growth during the past 20 years. Second, they look for macroeconomic causes of the slowdown, particularly the effect of inflation. Third, they present some evidence suggesting that the growth rate rises much more in response to investment in plant and equipment spending than for other types of investment. DeLong and Summers conclude that subsidies or incentives for equipment investment are desirable. I begin by commenting on each of these points and on their conclusion before turning to some related issues.

Measured productivity growth

The international character of the decline in productivity growth is well-known. The authors present the salient facts and emphasize that the slowdown is greater abroad in absolute or percentage terms than in the United States. They may wish to note that, in their Table 1, the United States and Canada are the only countries showing higher productivity growth in 1979-90 than in 1969-79, a fact that is often overlooked in discussions about international competition.

What should we make of these data? I have two comments.

First, by comparing measured growth rates for a decade they mix one-time changes to the level of output with underlying maintained rates of change. Short-term data are often misleading when interpreted as growth rates. For example, France in the 1980s, and the United States and Canada in the 1970s, reported comparatively low productivity growth. Productivity growth was negative for industrial Latin America in the 1980s. These numbers tell us much more about cyclical adjustment and one-time changes than about long-term productivity growth rates. Productivity is typically measured as a residual. We should not put much weight on reported productivity growth rates for periods as short as a decade unless we have supporting evidence from another source.

Second, DeLong and Summers (and many others) take their problem to be one of explaining why productivity growth rates have fallen in recent decades from the higher rates reported for the 1950 and 1960s. They speculate that we may have reached the limits of technological progress.

I believe they get the wrong answer because they ask the wrong question. A much more plausible interpretation of the data for the advanced industrial countries is that the period from 1950 to 1969 (in their table) is the aberration that asks to be explained. As Table 1 shows, recent productivity growth in six of the leading industrial countries is not very different from the long-term growth rates of per capita income computed by Simon Kuznets. The Kuznets data average over 80 to 120 years. Four of the countries are close to their long-term path in the 1980s. France is one exception. France suffered from the socialism and regulation of the early Mitterand years, then paid the costs of using a fixed exchange rate to force disinflation of wages and prices. Once this adjustment is completed, French productivity growth should be expected to increase toward its historic value, if the world economy continues to grow.

The simple average growth rate for the six industrial countries in 1979-90 is 1.67 percent. For the longer period covered by Kuznets' data, the simple average growth rate is 1.85 percent. Is this difference significant economically and statistically? We are unlikely to have either measurements or models that are sufficiently accurate to be confident that a 0.2 percentage point difference in growth occurred. Nevertheless, the power of compound interest is such that a difference in growth rate of approximately 0.2 percent makes incomes almost 20 percent greater in the country with 0.2 percent faster average growth after 100 years.

I believe that DeLong and Summers (and many others) are concerned about the wrong problem. The problem as usually posed is to explain why the growth rate slowed after the mid- or late-1960s. I suggest that there is a good case to be made for the proposition that the relatively high growth rates of the early postwar years include many positive one-time changes that are unlikely to be repeated by the major industrial countries.

Table 1
Rates of Growth

	Kuznets*		
Country	Period	Growth Rate Per Capita Product	Delong & Summers Growth Rate 1979-90 Productivity
United States	1839 to 1960-62	1.7	1.4
Japan	1879-81 to 1959-61	2.6	3.0
Germany	1871-75 to 1960-62	1.8	1.6
France	1841-50 to 1960-62	1.8	1.1
United Kingdom	1855-59 to 1957-59	1.4	1.7
Canada	1870-74 to 1960-62	1.8	1.2

* S. Kuznets, ***Modern Economic Growth: Rate, Structure und Spread. New*** Haven, 1965, Table 2.5.

Inflation, growth and independence

DeLong and Summers devote almost one-third of their paper to the possible effects of inflation and lack of policy independence on the decline in average growth rates. They find a negative relation between growth rates and inflation once central bank independence is taken into account. They are convinced enough by this finding to conclude that Italy could raise its average growth rate of per capita output by 0.8 percent per year if it gave the Banca d'Italia independence at the level of the Federal Reserve.

This inference is implausible. The relation on which it is based implies that the United States, the United Kingdom, or other countries would increase their normal or average annual growth rate of per capita output to 3.5 percent by adopting the same degree of independence as the Bundesbank.

Would that it were so! A 3.5 percent growth rate of per capita income would double per capita income about every 20 years. We could have lower inflation and higher growth simply by passing and following the Bundesbank law.

There is no historical evidence to support a long-run, positively sloped Phillips curve of this kind. First, before 1971, Germany did not have an independent monetary policy. For most of this period of relatively high growth, German inflation was above U.S. inflation. During the years of monetary independence, German growth is about 2 percent on average. Second, the United States and Britain were on the gold standard for part of the period included in Kuznets' calculations. Their commitments were strong and durable; both countries had accepted severe deflation to restore the gold standard at the historic price of gold. The United States did not even have a central bank for part of the period and fought at least three elections in which the monetary standard was a central issue. These defeats for William J. Bryan's populism and inflation should have established the credibility of non-inflationary policy. Yet there is no sign that credible commitment to low average inflation under the gold standard produced the results implied by the relation shown in DeLong and Summers' Figure 6. Nor would they be likely to now. Even the proponents of European currency make less exuberant claims.

The last two sections of the paper discuss investment and present evidence supporting the authors' main conclusion: increased investment in equipment (relative to GDP) can raise the growth rate. The authors propose subsidies for investment, particularly an investment tax credit to target investment in machinery.

I accept the authors' finding about the role of equipment investment, but I question their policy conclusion. A more effective policy would shift spending from government consumption to private investment. I would allow the market to choose the type of investment. The results in Robert Barro's paper suggest that reductions in government consumption spending (for example on medicare) would have a potent effect on the growth rate. For each one-percentage point reduction in the share of government consumption spending (net of defense and education) accompanied by a one-percentage point increase in the share of gross investment, real per capita GDP growth would increase permanently by about one-quarter of one percent.[1,2]

A moral of this story is that growth depends on resource use. Based on the evidence they produce, the evidence in Barro's paper, and the very tenuous evidence about long-term effects of the U.S. budget deficit found by many researchers, I am surprised that DeLong and Summers end their paper by reciting the deficit reduction mantra. **A** more appropriate recommendation, based on their evidence, would be a reduction in subsidies to housing as a means of reducing the budget deficit and shifting investment to more productive uses.

The clear implication of the Barro and DeLong and Summers papers is that policy can change the growth rate. DeLong and Summers write as if what can be done, should be done. I would distinguish actions that subsidize growth from actions that remove current distortions.

DeLong and Summers do not explain why the present generation should subsidize growth or capital accumulation. The growth rate that results from private decisions to save and invest is the rate that consumers and producers choose as a by-product of their market decisions. I remind you that **U.S.** productivity growth for the past decade is not very different from its historic average. Even if the productivity growth rate remains lower, however, there is no economic reason for subsidizing growth. Today's generation is richer than past generations but poorer than future generations. It may wish to consume more or take more leisure.

I recognize that one of the widely repeated fallacies of our era is that our children will be poorer than we are, that they will not be able to buy houses, that progress in living standards has ceased. For the average **U.S.** resident, these claims are nonsense. Productivity growth is positive. Total **U.S.** real private net worth rose 30 percent, an average of 3 percent a year from 1979 to 1990, and real tangible net worth of households rose 21 percent, or 2 percent a year, in the same period. Despite declines in some property values at the end of the period, that contributed to a nearly $700 billion decline in real private net worth in 1991, real wealth continues to rise on average and we have every reason to expect that wealth and income will continue to rise. Our children will inherit this wealth along with the stock of knowledge, human capital, and technology that continues to increase.

One of the brakes on growth is that many people choose leisure, early retirement, and consumption over work and saving. Subsidizing investment and growth attempts to override these decisions. I doubt that policies of this kind, even an investment tax credit believed to be permanent, would succeed for long.

The final issue I want to discuss is the extent to which the postwar experience is a reliable guide for the future. The remarkable growth of the early postwar years and the recent growth rates in Asia owe much to the effort and saving of local populations. They also owe much to the greater stability"economic and political stability"of the postwar years. Reductions in barriers to trade permitted countries to choose policies such as export-led growth that are not available in a more protectionist world. Trade blocs like the European Community (EC) or the North American Free Trade Area (NAFTA), if they become or remain protectionist, reduce incentives and opportunities for countries inside and outside the bloc.

I propose that, to encourage efficiency, Article 24 of the General Agreement on Tariffs and Trade (GATT) be revised to require that when trading blocs form they must commit to a reduction of external barriers over time. Unless the countries in the bloc form a political union, external barriers would be reduced gradually until perhaps after ten or fifteen years, trade restrictions would once again be the same for members and non-members.

Reduction of trade barriers was one of the principal factors that encouraged trade and promoted postwar progress and efficiency. U.S. leadership in organizing the defense and police function permitted many countries to concentrate on peaceful pursuits, and to encourage trade and industry instead of wars and weaponry. As I noted here last year, by providing these public goods and encouraging others to share in the effort, the United States assisted the market economies of the world to achieve an unprecedented rise in living standards for more people in more places than at any previous time. (Meltzer, 1991).

These public goods are not part of most of the models or analyses we consider here. Unless the major developed countries share in the cost of providing an institutional framework that maintains reasonable political stability, stable rules for trade and open markets, and low inflation, growth rates will remain below the long-term averages for the industrial countries and below the hopes or dreams of the less developed countries.

The future living standards of the United States, Western Europe, Japan and most others will depend much less on subsidies to investment in machinery than on a common willingness to open markets in agriculture, textiles, steel, investment, and many other items now restricted by quotas. The countries of Central and Eastern Europe and elsewhere can contribute to their own and our growth if we are wise enough to offer them open markets. In exchange, we should expect to get open markets for investment and trade. Trade, much more than aid, provided the impetus for the rise in standards of living a generation ago. It will continue to do so, if we have the wisdom to renew the institutional framework that is now unraveling.

Endnotes

[1]For the U.S. at present, the order of magnitude of the adjusted government consumption and gross investment are similar, so I have not adjusted the calculation for the difference in shares.

[2]Barro's coefficient on the Investment share is consistent with DeLong and Summers estimates for equipment if the share of equipment to total Investment is about one-third. This is approximately correct for the United States.

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Economic Reorganization as a Prerequisite to Growth

Domingo F. Cavallo

When this century began, Argentina was poised to become one of the most important Western nations. Now that the century is drawing to a close, we look back in disappointment over how far we are from realizing those dreams.

Until 1930, Argentina obtained substantial rewards from an economy that was oriented toward international trade. But in the two decades that followed, world trade declined as a result of the Great. Depression and World War II. This resulted in a policy trend toward isolating the Argentine economy that had serious consequences for economic growth in general, and each sector in particular.

Despite the fact that the unfavorable external factors had disappeared by 1950 and a new era of growing worldwide prosperity based on international trade was under way, the Argentine economy remained closed and experienced very slow growth compared with other countries that were able to solidify their development at that time. The economy experienced some growth in the 1950s that accelerated somewhat in the 1960s, but in the 1970s, especially after 1973, this growth was first interrupted and then reversed—a truly unusual case since the country did not suffer any serious natural calamities.

The economic point of departure

Imagine a stagnant economy where the rules of the game that govern relations among the different economic agents are very highly complex and unstable. The economy is so complicated that not even specialists can understand what is happening and each day they discover a new hidden subsidy, a new regulation that hinders private initiatives in one area or another, and that results in a redistribution of resources of which only the beneficiary is aware.

In this economy, the public budget has been characterized by a) the absorption of a steadily larger number of activities, including the production of goods and services that are clearly for private benefit and that should be financed through the price system rather than taxes; and b) steadily disappearing transparency and order resulting in disorderly decisions and insufficient information.

Excessive government intervention in the activities of the private sector tends to delay necessary adjustments to correct erroneous business strategies and the economy loses its agility to correct disequilibria between supply and demand. Productive resources are retained in activities of low productivity, bottlenecks become more persistent, and resources are diverted from sectors facing greater demand. Government intervention mistakenly transforms private goods and services into public goods and services.

This highly distorted and complicated economy is characterized by what we call "voluntarismo irracional," an easy solution that is appealing to politicians even if it defies basic economic laws. It generally results in acontinuous expansion of administrative intervention by the government in economic decisions. Policies are implemented that, even from the outset, are known to be impossible to control. The final effect of "voluntarismo irracional," is a loss of respect for the capacity of the government to implement and control its decisions and consequently, to comply with its role as organizer of the overall economy.

This has serious effects on the policy credibility: No one believes announcements made relative to the future unless they are very reasonable and there are forces that will be put into action rapidly in order to support the announcement and to ensure that it will be carried out.

As a counterpart, a distinctive characteristic of the public debate over economic issues is that each important economic agent, or group of economic agents with common interests, has proposals about nearly all individual economic decisions. It is as if the society as a whole is capable of deciding what each economic agent can do, virtually regardless of their individual assent or interest. As a result of this type of public debate of economic issues, the economic rules of the game tend to be set aside and become unclear as well as unstable.

They are unclear due to inattention to defining the frameworks for assigning responsibilities for decisionmaking, information, and risk taking. They are also very unstable because they have not been sufficiently understood and accepted, and because experience has taught each economic agent or pressure group that it is more profitable to dedicate their efforts to changing the rules in their favor rather than doing things better within the existing framework.

Economists usually also fall into "voluntarismo irracional." We often know very little about the dilemmas that businesses must face but, nevertheless, we try to instruct them concerning the areas in which to invest or we believe that we are able to convince them to choose the most appropriate technology or to discover the most promising markets. This leads to bad policies and, even worse, to a poor economic structure.

One of the worst examples of "voluntarismo irracional," is inflation, which is basically the product of a government that wants to spend more than it is capable of earning through legally mandated taxes—it wants to obtain something for nothing. Since that is impossible, the result is reflected in a tax that lacks legal legitimacy, namely, inflation.

Thus, this form of economic organization imposes a sort of surcharge on economic activity, whether in the form of its organization or the resulting effects. This surcharge blocks the realization of potential development in two ways: it impedes the development of activities and, in the case of productive activities already under way, it imposes an unproductive allocation of resources since resource allocation adjusts to the existing economic structure.

The sources of growth

As is well-known from Solow's neoclassical growth model, the sources of economic growth include:

1) increases in the labor force;

2) accumulation of physical capital, including the effective utilization of natural resources having economic value; and

3) increases in productivity — the increases in production that are reached beyond the increase in the workforce and the accumulation of physical capital through taking on underexploited business opportunities, the introduction of more advanced technology, and through improved organization and administration of existing resources.

These three sources of growth are normally found together and are complementary. But history shows that emphasis is sometimes placed on increases in the factors of production while, at other times, it is placed on increasing productivity.

In the economy that we described earlier, the factors of production do not generate the output they are potentially able to produce. The economic structure of this economy generates a form of "negative productivity." Given the inefficiency in resource utilization and the resulting low level of productivity, a vicious circle can appear in which investment is discouraged, leading to stagnation, or worse, economic backwardness.

Changing the rules of the game

Under these conditions, a reorganization of the economy becomes the basic prerequisite to the recovery of economic growth. This reorganization can be associated with an increase in the overall productivity of the economy or the elimination of the "negative productivity" to which we referred. It is the first spark to economic growth.

It is necessary to speak of a comprehensive economic and social reorganization that would ensure greater transparency and better planning in the public sector as well as greater competition and improved performance in everything related to the private sector.

Therefore, it is necessary that the entire private area of the economy accept the rules of competition and the market while the public sector accepts the role of planning and budgeting. At the same time, it must be recognized that mixed areas should be avoided because the degree to which an overlapping of private and public sector functions is avoided will determine the degree to which confusion and the risks of corruption are reduced.

The adoption of this new policy environment reveals a high dosage of realism and the consequent abandonment of the "voluntarismo irracional" to which we referred earlier.

Economic reorganization to realize potential growth: The case of Argentina

Until about a year ago, the Argentine economy had the same organizational characteristics as those of the economy we described above. With this analysis in mind, the need to change the rules of the game that govern the Argentine economy was evident.

The program under way in Argentina is advancing toward an economy of clear and simple rules that are as automatic as possible in order to create a situation where private initiative and entrepreneurial capacity can fully emerge. In order to reach this objective, a reorganization of the public sector, a reallocation of business activities to the private sector, and an increase in the effectiveness of the tax administration in order to increase tax collection and eliminate the fiscal deficit were indispensable.

The main policies implemented (and under way) to achieve these objectives are:

1) trade liberalization including the elimination of nearly all taxes on exports, the reduction and simplification of import

duties, the elimination of nontariff barriers on imports, the simplification of related paperwork requirements, the elimination of restrictions and discriminatory treatment of foreign investment, and the incorporation of technology;

2) reform of the state and the re-creation of a market economy based on a substantial reduction in public expenditure and the fiscal deficit; rapid and effective progress in the privatization of state companies; the elimination of controls on prices, wages, interest rates, and foreign exchange transactions; and the elimination of a complex network of subsidies and hidden taxes that distort the operations of a market economy;

3) enforcement of the Convertibility Program that requires the local currency to be backed entirely by foreign reserves and gold at a fixed exchange rate, prohibits indexation, requires contracts to be denominated and enforced in foreign currency, and allows wages to be increased only in line with increases in productivity;

4) reform of fiscal and tax policies to simplify the tax system, reorganize the tax administration, and substantially reduce non-social expenditure by the federal government;

5) restructuring of the internal and external debt as well as the conclusion of agreements with the International Monetary Fund (IMF) in 1991 (Standby Loan) and 1992 (Extended Fund Facility). The most recent agreement with the IMF paved the way toward accession to a Brady Plan agreement with commercial banks. Debt services to creditors that are members of the Paris Club were restructured in 1991 and 1992.

The results have been highly encouraging. Inflation has fallen substantially. Interest rates have also fallen. The increase in the market value of Bonex and rising deposits in foreign currencies are indicators of the credibility of the program under way. Industrial production has increased while unemployment has fallen. The level of exports has been maintained while imports have grown strongly. Tax revenues have risen substantially and the advances made in the privatization of state companies are highly significant: the national telephone company, the national airline, central and secondary oil fields, the electric power company in Greater Buenos Aires, petrochemical companies, railroad lines, tourist facilities, shipyards, and radio and television stations.

The main objectives are to maintain inflation at international levels, reach substantial levels of economic growth (annual rates of 6 to 7 percent), re-enter the international voluntary credit markets, and solidify efforts to eliminate overregulation and state intervention in the econony.

In conclusion, we can say that the change in the rules of the game has permitted an improved utilization of the productive potential of the Argentine economy. This has been manifested in the utilization of existing idle capacity. Now that this obstacle to economic growth has been overcome, increased investment will permit the achievement of the objective of economic growth.

Investment Policies to Promote Growth

Alan J. Auerbach

Investment in physical capital has been accorded several important roles in the economic drama: as a major source of business cycle instability, the primary channel through which monetary policy influences the real economy, the subject of public sector projects to foster economic development, and an engine of economic growth.

This conference emphasizes the last of these roles, reflecting developments in economic theory and concerns over recent macroeconomic performance, notably in the United States. But in considering the design of investment policies to promote growth, and evaluating policies that have been tried in the past, it is helpful to keep investment's other "roles" in view. Policies alleged to promote growth may really be aimed at some other objective, such as providing economic stimulus; even if growth is a policy's main objective, its other effects should be kept in mind.

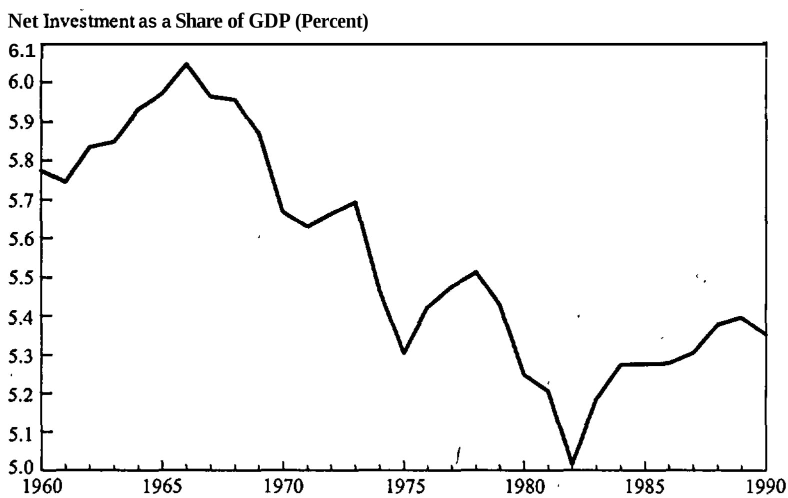
My goal in this paper is to review the arguments that we can stimulate economic growth through the accumulation of fixed capital, and to evaluate different policy options aimed at doing so, in terms of how well they achieve their aim, at what revenue cost, and with what undesirable (or desirable) economic side effects. Not all policies considered have been labeled as "investment incentives," but labeling is less relevant than the underlying effects a policy may have on capital accumulation. Some policies have been tried, in the United States or elsewhere, and have a record we can examine. Others exist, as yet, only in theory, and require careful inspection lest we assume they can be introduced without the administrative difficulties often found in existing programs.

Because of the breadth of the topic, I will focus primarily on tax policy options, rather than financial market reforms and other complementary measures. Except where noted, the, discussion relates to private, nonresidential fixed investment.

Encouraging investment: Why do we care?

Since Keynes' ***General Theory*** and before, investment has been viewed as an important source of macroeconomic instability. More recently, emphasis has shifted toward the longer-run consequences of investment, as well as the difficulty in distinguishing long-run trends from short-run cycles. Chart 1 shows that net fixed investment in the United States, as a share of GDP, has been lower during recessions than expansions during the past three decades, but that this share has also generally fallen over' the period. Current concern about investment reflects not only the relative weakness of investment during the recent recession. but also this downward trend.

Chart 1
Net U.S. Fixed Investment, Share of GDP (1960-1990)



Beyond the issue of short-run stabilization, why should we be concerned about the level of domestic investment?

One answer is that the income tax discourages private saving by distorting household decisions regarding present versus future consumption. This distortion of private behavior reduces individual welfare. Therefore, policies aimed at alleviating the distortion can increase welfare.

This is a complex argument, for one must pay attention to the impact that such policies have on other distortions, as well as their distributional consequences. However, regardless of its merits, this is an argument for more saving, not necessarily more domestic fixed investment. While there is likely to be a relationship between private saving and domestic investment, even in an open economy, the argument offers no reason why we should be more interested in encouraging saving in the form of domestic fixed investment than, say, through purchases of foreign assets. We should simply make sure that domestic capital formation does not face a higher rate of tax than investment elsewhere. There must be more to the story, something different about domestic capital formation.

What is different? Domestic assets do increase labor productivity and, presumably, real wages. The traditional method of growth accounting[1] suggests that real income growth g_y equals the sum of three components: capital stock growth, g_k, multiplied by capital's share in production, say α; labor force growth, g_l, multiplied by labor's share $(1-\alpha)$; and the growth rate of the level of technology, say e. That is,

$$g_y = \alpha g_k + (1-\alpha) g_1 + e$$

Hence, an increase in the growth rate of the capital stock of one percentage point per year increases the growth rate of output by α, or about 0.3 percentage points per year.

While this expression does identify a connection between investment and growth, the connection does not provide a strong argument for promoting domestic investment. First of all, the growth is of

domestic output, GDP, but not ***national*** output, GNP. The latter represents a better measure of the income of a nation's residents. If investment abroad yields the same rate of return to domestic residents as domestic investment does, then GNP would be no lower if a given level of saving were invested abroad, rather than at home—the added income would appear as a factor income earned abroad, rather than domestically. For that matter, even GDP would be unaffected if investment occurred in the form of inventories rather than fixed assets, as long as the projects were equally profitable. This leads us once again to the position of seeking more saving, rather than more domestic fixed investment.

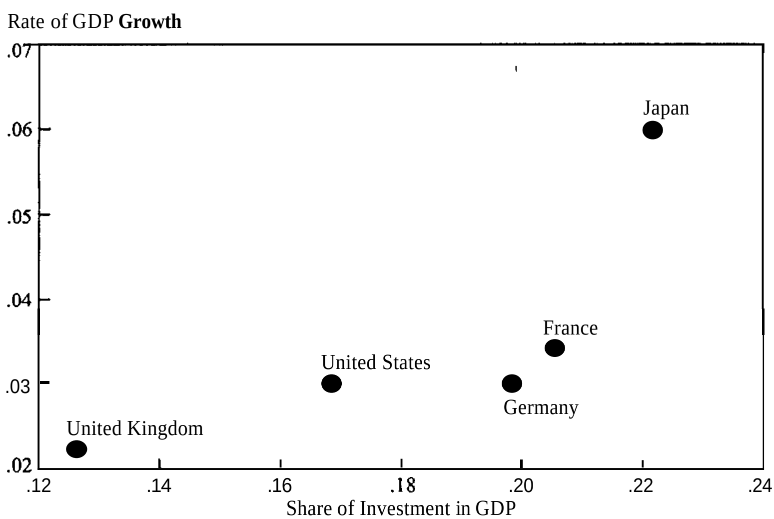
From the viewpoint of particular groups of domestic residents, of course, domestic and foreign investment are different. Capital deepening domestic investment will tend to raise wages (perhaps producing "good jobs at good wages"), but to depress returns to the existing capital with which it competes. Overall, though, standard competitive analysis tells us that the level of national wealth accumulation will be the same regardless of the location of the new assets yielding the same rate of return.

Beyond the fact that domestic investment may make no special contribution to GNP growth, even the increase in GDP growth predicted by the above equation is likely to be fairly modest. Increasing the growth rate of GDP by one percentage point per year seems like a reasonable goal. After all, real GDP in the United States grew annually by 3.84 percent in the 1960s, compared to just 2.68 percent during the 1970s and 1980s. Increasing the annual growth rate by one percentage point would not even recover this drop. But growth accounting suggests that it would not be easy to accomplish through domestic capital accumulation. An increase in g_y of one percentage point would require an increase in the capital-stock growth rate of about 3.3 percentage points. Given a capital-output ratio of about 2.5, this translates to an increase in the investment-GDP ratio of more than 8 percentage points—a roughly 50 percent increase in the investment-GDP ratio. Such a jump would be unprecedented even for a single year, not to mention a much longer period.

What sense, then, can we make of the argument that domestic fixed investment is important for growth? The answer must lie in a relationship between capital accumulation and the growth of the technology residual term, ***e*,** in the above expression. Put simply, one must argue that capital accumulation leads not simply to increased worker productivity, but to increased total factor *productivity*—that investment induces innovation, or at least the more rapid adoption of new technology.

Even if investment and productivity growth are correlated, this need not represent an argument for government intervention. It may simply be the case that technological advances make capital deepening profitable—that capital and the level of technology are complementary factors in production.[2] If this is so, then the form of saving that occurs is largely irrelevant, as long as the highest rate of return is pursued.

Chart 2
GDP Growth Versus Investment (1963-1990)



Ultimately, an emphasis on domestic investment to spur growth requires that such investment produce significant "spillovers," social returns to investment that are not captured by individual investors. This possibility has been explored in the recent "endogenous growth" literature.[3] As Chart 2 shows, there is a clear relationship across countries between rates of economic growth and the share of GDP devoted to investment, a stronger one than would be predicted by simple growth accounting alone. More specifically, there is some suggestive evidence of an empirical association across countries between economic growth and investment in machinery and equipment.[4] However, these empirical relationships fall short of demonstrating a causal link from investment to growth. They demonstrate correlation more than causality, and alternative explanations exist for the strength of the correlation, such as the unmeasured effects of human capital accumulation.[5]

While a firm relationship between fixed investment and technological progress has yet to be demonstrated, this is the link one needs in order to make sense of pursuing more investment in a search for faster growth. We can posit such a relationship, but not knowing its precise form leaves us at a disadvantage in designing investment incentives. For example, does all investment contribute equally to growth, or are some types of investment (such as machinery and equipment) more productive than others (say, structures)? Are spillovers provided by increases in the capital stock, net investment, or additions of new capital, gross investment? Is equipment utilizing new technologies more important to the growth process than that which does not? These are not easy questions to answer. Without evidence of such externalities, we would generally expect to observe higher social returns to investments discouraged by unusually high tax burdens. Selective investment incentives might then be justified primarily to equalize tax burdens and make the allocation of capital efficient, perhaps to reduce the tax advantage currently enjoyed by owner-occupied housing—to "level the playing field," not increase growth.

Public versus private investment

Although the preceding discussion relates to private investment, similar questions arise with respect to government investment. We are by now very familiar with arguments in favor of reducing government deficits—increasing government saving—to speed national wealth accumulation. Without addressing the question of how much we would benefit from reducing the deficit, one can still ask, again, whether it is saving or investment with which we should be concerned.

In this case, the issue is whether it matters if the government chooses to save more by investing in additional government capital, rather than repurchasing some of its national debt (or any other security). While the issue may be clouded by deficit calculations that ignore the contribution of such investments to national saving, the real issue is whether government capital yields a higher social rate of return than other potential investments.

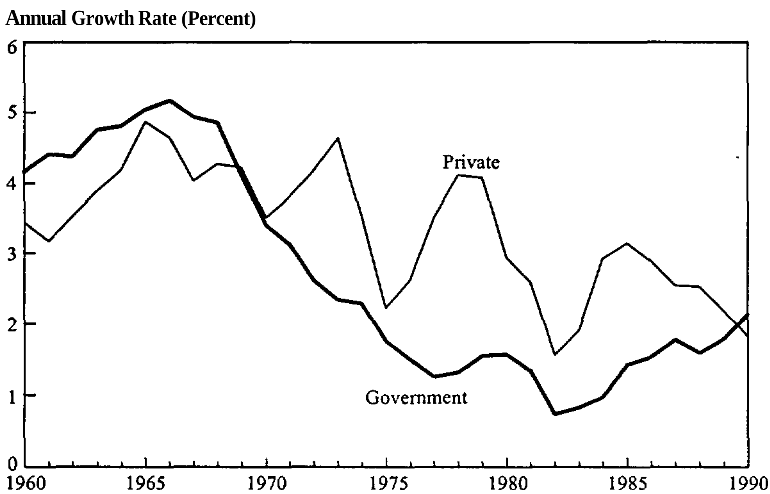
As just discussed, one expects to find assets with high social rates of return in the private sector where investors have been denied a significant share of total investment returns, either because of unfavorable taxation or positive spillover benefits. In the case of government investment, the search for high social returns is more difficult. There is rarely a market-driven choice of investment, and in many cases the government's involvement occurs ***because*** of the absence of a private market, traditionally associated with public-good type spillovers.

The existence of spillovers allows one to conceive of enormous social benefits arising from the procurement of public capital goods. But it is also easy to imagine the government investment process, not constrained by market forces, as being wasteful and misdirected.

Addressing the question empirically using the production function-growth accounting framework described above has led to some very large estimates of the productivity of public investment, suggesting that marginal U.S. public investment is much more productive than private investment, yielding a social return several times as large.[6] However, these findings are controversial, both because the results are so striking and the methodology relatively basic.[7] What is evident is the trend in U.S. public investment spending. Chart 3 shows the net investment-capital ratios for private and public (excluding military) capital in the United States since 1960.[8] Through 1968, public capital grew more quickly every year. From 1969 through 1989, the opposite was true. The cumulative effect is striking. Over the entire period 1960-90, the ratio of public to private capital fell from 0.28 to 0.23.[9]

As with private investment, we remain unsure of the importance of public capital in fostering growth. The significance of government capital formation for growth undoubtedly depends on a country's stage of development and political structure, and the level of government of which we speak. But we do know that, at least in the United States, government capital has declined relative to other capital in recent years. Presumably, the evaluation of any program to encourage private investment should, at the very least, consider any effects that financing new tax expenditures has on the availability of funds for government investment. But beyond this, government capital spending may play a direct role in the program itself.

Chart 3
Real Growth Rates, Net Capital Stocks (1960-1990)



Relevant aspects of private investment behavior

Whatever the linkage between investment and growth, effective policy design also requires an understanding of how policy affects investment. Here, too, there is a degree of uncertainty about the economic relationship.

The basic neoclassical model

It is customary to analyze the impact of tax policy on investment with the ***user cost of capital*** or the ***effective tax rate*** facing that investment.[10] These measures reflect the impact of tax policy in a model of firms with access to capital markets. The investing firm invests until the marginal revenue product of capital equals the cost of capital,

$$c = q\left[\frac{(r+\delta)(1-\Gamma)}{(1-\tau)}\right] = q\left[\frac{r}{(1-t)}+\delta\right]$$

where q is the relative price of capital goods, r the real, required rate of return, 6 the rate of economic depreciation, τ the corporate tax rate, and Γ the present value of investment tax credits and depreciation allowances. The effective tax rate, t, is defined implicitly in the above expression as the tax rate that, if applied to properly measured economic income, would produce the same user cost of capital as the combination of existing tax provisions.

While a helpful and widely-used concept, the user cost/effective tax rate framework has a number of limitations as a tool for predicting the impact of tax policy on investment.

Adjustment to changes in the tax law

Perhaps ironically (given their use in analyzing tax policy changes), these measures typically ignore changes in the tax system, applying only in the "long run" when the tax system is "in place" and investors have had time to adjust their capital stock to the desired level dictated by this tax system. In the shorter run, investors must take account of prospective changes in the tax system over a horizon dictated by the durability of their investment and the speed with which this investment responds to changes in taxation. Moreover, they will adjust only gradually to such changes.

Under such realistic circumstances, it is still possible to relate investment to a variant of the above user cost expression that incorporates anticipated changes in taxation over the relevant planning horizon.'[1] This revised measure may imply rather different incentives to invest than the basic ones. For example, just before the Tax Reform Act of 1986, investors in machinery and equipment anticipating a removal of the investment tax credit and a reduction in corporate tax rates had a much higher incentive to invest than the basic user cost formula implies.[12] As I will discuss further below when reviewing different types of incentives, current investment should depend not only on the tax treatment of investment today, but on how this treatment will evolve in the future, and whether prospective changes relate to capital already in place.

How investors react to the prospect of future tax changes is essentially an empirical matter. Some evidence suggests forward-looking behavior consistent with the extended user cost model,[13] but this issue is not clearly resolved. One might minimize the relevance of such effects to the design of long-run policy, but in truth there is no such thing as long-run policy. Investors will form their own judgments about the stability of the tax system, taking account of today's policy actions — regardlessof whether they are deemed "permanent" or "temporary." This aspect of private behavior should, in turn, play a role in the design of tax policy to encourage investment. Not only can a lack of credibility make effective policy change difficult, but the climate of uncertainty associated with frequent tax changes can, itself, increase the risks and reduce the attractiveness of long-lived investment.

Irreversibility

Even taking account of adjustment costs, the neoclassical investment model presumes that firms can alter investment in response to changes in the user cost of capital. But what if these desired changes are negative? Although investment-is always positive in the aggregate, some firms may wish to disinvest in some types of capital. Used asset sales may in some cases be difficult, or the desire to unload assets may be quite general. Some economists have argued that this inability to disinvest — investment's irreversibility-could be a significant factor in determining aggregate investment behavior.[14]

If irreversibility played an important role (which really has yet to be demonstrated), how would this influence the impact of tax incentives on investment? First of all, firms doing no investment at all are likely not to respond to minor tax incentives that simply reduce the amount they wish to disinvest. Second, even firms that do currently invest must take account of the possibility that future conditions may leave them at zero investment, wishing to disinvest but unable to do so. Unless the after-tax profitability of investment is sustained in the future, a current reduction in the user cost of capital may not have a very large effect on investment.

As just discussed, both of these effects (sluggish adjustment and the importance of future conditions) are also associated with general costs of adjustment. However, by its nature, irreversibility is likely to matter relatively more in recessions, when the capital stock may exceed its desired level, and more generally in environments of low capital stock growth in which assets are not easily marketed.

Understanding the marginal impact of tax provisions

The user-cost approach, even with account taken of tax changes, measures the *marginal* incentives faced by investors—the additional tax burden associated with new investment. But the interaction of different tax provisions can be so complicated as to make this measurement difficult. It is not always easy to determine the impact of a particular tax policy on the incentive to invest. The following examples are illustrative but not exhaustive.

Asymmetries and parallel tax systems. Measures of the tax burden on new investment are typically based on the assumption that a single corporate tax rate applies. While this may formally be true, additional provisions cause many companies to find themselves effectively subject to a different tax rate, and different tax rules, in certain years. The possibility of being subject to an alternative regime, and of switching among regimes, alters the incentives that firms face.

Two examples in the United States are the treatment of tax losses and the alternative minimum tax. As in most countries, companies generally pay taxes on their income but do not receive tax refunds for their losses, which must be carried forward without interest and subject to expiration. This asymmetry in the tax code has affected many U.S. corporations in recent years, particularly smaller firms.[15] Constraints on losses may blunt the impact of certain types of investment incentives, such as investment credits and accelerated depreciation, if many firms must simply carry forward the right to receive these extra tax expenditures. Indeed, the firm not currently subject to tax many actually face a higher user cost of capital than its taxable counterpart.

In addition to its basic tax system, the United States also has an "alternative minimum tax" that businesses and individuals must pay if their tax burden calculated under this scheme is higher than under the primary tax system. Since changes were introduced in 1986, many U.S. firms have found themselves subject to the minimum tax. Its impact on investment incentives is similar, though less pronounced, than that of asymmetric loss treatment: when it is in force, it taxes income at a lower rate (but not zero) and permits less generous (but some) depreciation allowances.[16]

By their nature, the asymmetric treatment of losses and the minimum tax bind the most when profitability is low. Like irreversibility, this weakens the power of investment incentives during periods when investment may already be weak. To the extent that investment incentives are aimed not simply at increasing the level of investment but also dampening (or at least not contributing to) its volatility, one must take account of the limitations imposed by these tax system characteristics. One solution used in the past has been to encourage the transfer of tax benefits through leasing. But reliance on such indirect tax benefit transfer presents problems of its own, and begs the question of why the tax asymmetries are present in the first place, if they lead to tax policies aimed at circumventing them.

Abroad, one interesting example of the difficulty of calculating marginal incentives in the presence of alternative tax rules is the Swedish system of investment funds, under which firms are permitted to deduct from taxable income fund contributions earmarked for investment. Investments financed in this way essentially receive immediate expensing, normally thought to be equivalent to a zero effective tax rate. However, the actual incentive to invest depends on whether firms have reached the limit on the contributions they can make to the funds, whether they can finance all their desired investment from existing balances of the funds, what the situation will be in the future regarding these two questions.[17] A broad range of effects is plausible and, as with the minimum tax and limited loss offset, not necessarily consistent with any rational government policy toward investment.

Corporate financial policy. The majority of U.S. business investment, and the preponderance of investment in machinery and equipment, is done by corporations. Unlike most other developed countries, the United States imposes a purely "classical" income tax system under which .corporations and their shareholders are independently taxed. This results in the "double taxation" of corporate dividends, at the corporate level when earned and at the shareholder level when distributed. This double taxation is one of the arguments for corporate tax integration proposals.

Yet, there is considerable dispute over whether reducing the tax on dividends has a significant impact on the corporate cost of capital among mature firms using retained earnings as a primary source of equity capital. Under certain circumstances, one can view the tax on dividend distributions of funds already in corporate form as an unavoidable tax that must ultimately be paid when cash leaves corporations. This view suggests that the dividend tax is essentially a lump-sum tax that affects corporate values but not corporate retention and investment decisions.[18] It is interesting to note that for some countries this general analysis can extend beyond dividend taxation to the corporate tax itself.[19]

A related question concerns the advantages of debt finance under a classical system. Given the deductibility of interest payments and the double taxation of equity, one might think that debt is tax-favored. However, the "new view" of dividend taxation just discussed and the full taxation of interest payments to recipients (compared to the favorable treatment of capital gains) act in the opposite direction.

While some have argued that there is no net tax benefit to debt,[20] perhaps a more generally accepted view is that the tax advantages of interest deductibility are only partially offset, and that nontax costs of leverage (increased bankruptcy risk, loss of control by managers, and so on) further limit borrowing. In the latter case, an important issue is whether the market environment allows some assets to be financed with a greater share of debt than others. Such assets would be indirectly tax-favored by the greater use of interest deductions. The example usually cited is commercial structures. Debates over whether structures investments receive tax benefits that are too generous or not generous enough relative to "neutral" treatment often hinge on assumptions about the use and advantages of debt finance.

The impact of cash flow

The neoclassical model of investment assumes that firms have access to funds at some required rate of return, r, and invest as long as they can earn such a return. However, empirical investment studies suggest that investment, particularly by smaller firms, also relates to internal cash flow.[21] This has both tax and nontax explanations. Firms may find internal funds a cheaper source of finance than debt and new equity issues because retention avoids the dividend tax, or because information asymmetries make outside investors skeptical of firms seeking an outside infusion of funds. Either way, investment incentives that provide cash in the present rather than the future may reduce firms' effective user cost of capital more than simple discounting with a market rate of return suggests.

Summary

Just as we are unsure what type of investment best stimulates growth, the literature leaves us with some uncertainty about the nature of the investment process in general and the role of tax policies in particular. Keeping these questions in mind, one can still draw certain conclusions about which policies are more likely to work, at least under certain circumstances, to achieve the goal of greater investment.

Tax policies to encourage investment

The following discussion focuses on tax policies to reduce the user cost of capital by reducing the tax wedge between the return to savers and the marginal product of capital. There are, of course, other ways in which fiscal policy might reduce the user cost, most obviously through a reduction in interest rates that might be associated with increased government saving.

The high real interest rates of the 1980s are often cited as an example of what a reduction in government saving can do to real interest rates, although the picture is clouded by several factors.[22] However, increasing government saving involves considerably more than shifting tax instruments. It requires a large-scale shift in the burden of taxation among generations. The question of whether such a shift is worthwhile extends beyond the scope of my discussion of how the tax structure can be altered to encourage private investment and growth. It is worth pointing out, though, that to whatever extent private capital accumulation is retarded by government dissaving, the costs to future generations will be that much higher if such accumulation would have generated positive growth spillovers.

Tax policies to promote capital accumulation vary in a number of ways. Exploring these differences through a series of questions provides a framework that is useful for comparing the policies themselves.

Investment or saving?

As I indicated in my initial comments, we must address the very basic question of why we wish to stimulate capital formation before deciding whether it is a particular type of domestic investment, rather than national saving, that we wish to encourage. It would appear that a sensible argument based on seeking increased growth must relate to domestic investment. Unless there are no capital flows at all, this points toward encouraging investment rather than saving; toward investment incentives that stimulate the demand for capital by firms, rather than saving incentives, that stimulate its supply, primarily by households.

In the user cost of capital discussed above, investment incentives work directly through the tax terms in the expression, while saving incentives work indirectly by increasing available funds and lowering the required return, r. The investment tax credit and accelerated depreciation allowances are examples of investment incentives, while a reduced rate of tax on household interest income is one saving incentive.

Investment incentives, to the extent that they are available to foreign investors, will be enhanced by an economy's openness; the opposite will be true of saving incentives, as increased saving may leak abroad.[23] The distinction between saving and investment incentives can be reduced somewhat by provisions either limiting the availability of a saving incentive to funds not directed to domestic uses or restrictions facing foreign investors wishing to take advantage of our domestic investment incentives.

How much of a difference, in terms of domestic investment undertaken, does it ultimately make whether we choose investment or saving incentives? Possibly a lot, particularly if the desired increase in investment is of a particular type. Then, saving incentives are weakened not only by leakages abroad, but also by increased domestic investment in assets other than the type intended. Though we may, for example, wish to stimulate investment in machinery and equipment, a general saving incentive that increases funds for investment, and thereby reduces real interest rates and the user cost of capital, will be spread across all assets, including housing and nonresidential structures—recently about half of all U.S. fixed investment, and historically, even more than that.

In my initial discussion above, I noted that arguments for encouraging saving rather than investment relate to the intertemporal distortions imposed by existing tax systems. However, there are some distortions that increase, rather than decrease saving. Changes that alleviate these distortions would normally be viewed as a way to increase household welfare—but not if there are special reasons for wanting to encourage capital formation. If investment, itself, provides positive externalities, we might wish to keep saving (and presumably, the type of investment we desire) up, even at the expense of preserving the distortions of household behavior.

A classic example of this case is the provision of social security annuities. When private annuity markets are absent or do not work well, individuals must engage in precautionary saving, to have funds available if they exceed their life expectancy. The lack of annuities is a distortion of their behavior, in that individuals are being prevented from concentrating their resources in the periods when they are alive, in most instances being forced to leave bequests even if they have no intended heirs. Government provision of social security retirement annuities may reduce or eliminate this distortion, but also reduces precautionary saving, even if the social security system itself is fully funded.[24] The same would be true of any government program aimed at providing insurance for which precautionary saving may be a surrogate, such as medical expenses.

Another example from the realm of more explicit saving incentives is a reduction in capital gains taxes, which would lessen the distortion of new saving by reducing the tax wedge imposed on some of the future income from that saving. A capital gains tax reduction would also decrease the distortionary "lock-in" effect that discourages individuals wishing to avoid or defer the capital gains tax from rebalancing their portfolios. While each of these effects represents a reduction in the distortion of household behavior, the first encourages saving, while the second discourages it. Being able to allocate its assets more efficiently allows the household to save less and still meet future contingencies.[25] If there is no reason for encouraging capital formation beyond the desire to alleviate tax-induced distortions, this second effect provides another reason for reducing capital gains taxes. If capital accumulation, itself, provides positive spillovers to growth, then distorting policies that increase saving, such as an increase in the lock-in effect or a reduction in the level of social security annuities, need not be welfare-reducing.

In conclusion, investment incentives are likely to be more useful than saving incentives for achieving growth through domestic capital formation. Reducing distortions of individual saving behavior need not even point in the right direction, if a higher level of domestic capital formation itself is the object of policy design.

Targeted or broad?

The same issue of distortions versus growth arises in choosing among investment incentives. Traditional analysis suggests that there is a large deadweight loss from the differential tax treatment of assets (as measured by differences in effective tax rates), because investors will opt for lower social returns in order to qualify for the favorable treatment given certain assets. Such analysis during the 1980s provided support for the repeal of the investment tax credit by the Tax Reform Act of 1986,[26] and subsequent studies have confirmed that the act's gains from reduced interasset distortion were significant when measured against the losses from an increased cost of capital.[27]

However, these studies are subject to two types of criticisms. First, they typically do not take full account of all tax provisions relevant to calculating the marginal costs of funds. As I discussed above, one cannot incorporate minimum taxes, limited loss offsets and the tax advantages of debt in the calculation without considerable difficulty and dispute. Second, and perhaps more important, the distortions are measured based on the assumption that there are no externalities to different types of investment—none of the possible growth-inducing spillovers that might justify investment incentives.

If the social returns to particular types of investment are really 30 percent,[28] then the distortions caused by ***not*** favoring these investments would swamp the gains associated with achieving more neutral tax treatment. On the other hand, one can imagine each industry group being able to produce empirical evidence that the investment it undertakes generates unusually large social externalities. It is easy to envision a search for spillover effects—attempting to pick "winners" —turning into an orgy of rent-seeking.

Marginal or average?

If one type of investment faces a higher effective tax rate, or provides more positive externalities, than another, it is a candidate for an investment incentive. But how should this incentive be provided, to achieve the greatest increase in investment for a given loss of tax revenue? In common parlance, what approach yields the greatest "bang for the buck?" Traditionally, the desire to minimize revenue losses has led to the crafting of more "marginal" investment incentives, those aimed primarily at reducing taxes faced by new investment, rather than simply lowering the tax rate on all existing sources of income, the "average" tax rate.

The logic of this approach can be demonstrated by comparing the effects of an investment tax credit to those of a reduction in the corporate tax rate. Both reduce the user cost of capital facing new investment. But a cut in the corporate tax rate also reduces the tax on profits from existing capital, and from other sources as well (such as returns earned as the result of imperfect competition in an industry). This reduction in the taxes levied on income from existing sources does reduce the average tax rate faced by corporate income, and does lose tax revenue, but does not reduce the user cost of capital faced by marginal investment. Hence, for a given reduction in the user cost of capital, the investment tax credit loses less tax revenue overall. Thus, one could raise the corporate tax rate and the investment tax credit at the same time, keeping the user cost of capital the same through the offsetting effects of the two provisions, and raise revenue — essentially a capital levy on existing sources of income.

Why not? A one-time capital levy is nondistortionary—the first time. Even if it is used only once, the amount is so large — effectively the corporate tax rate multiplied by the stock of existing capital — that it can have a considerable impact on the economy's long run condition.[29] But its use might lead investors to expect its reuse. Once anticipated, a capital levy has the same dampening effect on investment as a capital income.tax. In prospect, an investment tax credit represents a far less attractive alternative for current investment, which does not qualify, than does a cut in the corporate tax rate, which will benefit the income from investment made today. Still, one might expect each new government in need of some quick, nondistortionary cash to use the capital levy embodied in investment incentives "just once more," promising not to do so again.

However, the United States has shown no obvious pattern of relying on repeated capital levies using the investment tax credit, or other investment incentives limited to new capital, such as accelerated depreciation. If it had, we should have observed an upward drift in the combined after-tax value of the credit and depreciation allowances over time. Indeed, the most recent change, in 1986, was in the opposite direction. A reduction in the credit to zero coupled with a cut in the corporate tax rate presented investors with a *negative* capital levy.[30]

Aside from the issue of investor expectations, some might argue that a reduced tax on existing profits provides immediate cash flow to business. To the extent that business investment depends on internal cash flow (as discussed above, an empirically plausible view), a reduction in taxes on existing income may itself provide an added impetus for investment, even though it does not affect the standard measure of the user cost of capital. Thus, the windfalls to existing capital do have some impact on investment.

However, providing windfalls is just one of the ways of increasing business cash flow. It is also possible to do so *without* giving windfalls, by speeding up the investor's receipt of a marginal tax incentive. The investment tax credit is the clearest example of this: the investor receives the entire tax benefit when the investment is made, much more than if the returns to new investment were taxed less heavily in the future. Indeed, an investment tax credit may lower current tax payments by even more than a corporate rate cut having the same impact on the user cost of capital.[31]

The advantage of marginal investment incentives also depends on the ability of firms to use them. The benefit that comes from the concentration of a tax reduction in the year of an investment is diluted if a taxpayer is in a situation of tax limitation. For example, providing accelerated depreciation allowances to a firm that currently is subject to the minimum tax or is not taxable at all forces that firm to wait until it transits to a fully taxable state to use the allowances, thus undoing the initial acceleration—the firm gets neither the tax benefit of deferred tax, nor the associated up-front cash flow. This represents an obstacle to generating growth through investment, particularly (as some believe) if smaller firms represent the channel through which new technology is introduced. As discussed above, solutions to this problem, such as leasing or even direct sale of benefits, beg the question of why such tax limitations exist.

Tailoring marginal incentives: how marginal? Policies may vary considerably in the extent to which they provide windfalls to existing assets. At one extreme are tax changes that do not affect marginal decisions at all. While few investment or saving incentives are introduced with this intent, the outcome may still occur. As discussed above, it is sometimes difficult to know the marginal impact of particular tax schemes. For example, the integration of corporate and individual income taxes normally proceeds through a business deduction for dividends paid or a shareholder imputation credit for dividends received.[32] However, to the extent that investment is financed by retained earnings, integration may not reduce the user cost of capital it faces. Integration may provide an investment incentive only to the extent that new equity is issued.

A related question arises with respect to the design of saving incentives, such as the Individual Retirement Accounts (IRAs) in the United States. These accounts may provide a considerable reduction in the marginal tax rate on new saving—if such saving occurs through the accounts. For taxpayers saving considerably more than the maximum permitted (or borrowing to make the maximum contribution), the account provides nothing more than an income effect. As in the case of the investment funds system discussed above, one must know the regime a taxpayer is in to calculate that individual's marginal tax rate.

Why not alter policies to reduce the extent of windfalls? Indeed, there have been attempts to tailor investment incentives in this way. In the case of corporate dividends, for example, this would mean keeping track of new versus old equity.[33] An example from actual practice in the United States is the Research and Experimentation (R&E) Credit, which applies only to expenditures in excess of a base level determined by the firm's history of R&E expenditures prior to the legislation. The idea has also frequently been suggested for the investment tax credit itself.

The advantages of this approach are clear--even less revenue cost for a particular cost-of-capital reduction. But there are some additional problems, as well. A lesson from the experience is that designing a marginal incentive requires that we distinguish marginal investment from that which would have taken place without any special investment incentive, usually a difficult task. First, defining the base is difficult. One cannot use a firm's own past investment behavior as a base without dampening the impact on that investment—firms'will take account of the fact that current investment reduces future tax credits. This was a problem with the R&E credit's original design.[34] On the other hand, using a measure like sales as a predictor imperfectly identifies the "normal" level of a firm's investment for which a credit is unnecessary. The more of this "normal" investment we try to disqualify from the credit, the more firms will not qualify for the credit at all. This problem may be exacerbated during recessions, when investment drops more precipitously than other components of GDP. Rather than simply being constrained by tax limitations in their ability to use tax credits, firms may simply not qualify for the credits at all.

In addition to the problems of implementing a truly "marginal" investment incentive, there is another potential hazard to be confronted were we to succeed in doing so. In a competitive industry, firms will invest until their marginal investments yield zero profits, over and above a normal market rate of return. But what if only their marginal investments receive an investment incentive, say an investment tax credit? Then other, "normal" investment could very well produce a net loss, and the firm could find it more profitable simply not to invest at all.[35] As some firms choose not to invest, others already over the threshold might invest even more. By providing a reduction in costs only beyond a certain level of capital expansion, the marginal incentive simulates the effects of decreasing production costs, a standard case in which competitive markets may be difficult to sustain.

Temporary or permanent?

Investment incentives are never really permanent. The U.S. investment credit was reinstituted "permanently" in the mid-1970s. Its "permanent" repeal in 1986 has not prevented discussion of its being used again. Government may be limited in its ability to distinguish "permanent" incentives from "temporary" ones, but there is probably some content in the designation. There has been considerable political support for a temporary investment incentive, albeit a very modest one, during the current recession. Temporary investment incentives are normally viewed as a tool of stabilization policy, although there is little evidence that they have been used successfully toward that end in the United States.[36]

To the extent that credibility about the permanence of a government policy is weak, there are advantages to using investment incentives that deliver their entire package "up front." The prospect of the reversal of a corporate tax rate reduction will mute the current incentive to invest. However, the investor receiving an investment tax credit perceived to be of temporary duration not only gets his money before the government changes its mind, but has the added incentive to invest produced by the knowledge that subsequent, competing capital investment may be lower once the investment incentive is removed.

A different role of changes in tax policy could be the implicit provision of insurance, for example the smoothing of future after-tax returns from investments through variations in the corporate tax rate. However, it is difficult to see a role for fluctuating tax instruments in encouraging growth, unless the government were able to use them to absorb and spread investment risks more efficiently than private businesses. This might be an issue in less developed countries, or among risky new ventures in the United States, but does not seem relevant for most business investment that is financed through capital markets. Moreover, the nature of countercyclical marginal investment incentives is to increase, rather than dampen swings in after-tax profitability. If they are introduced during recessions, when profits are already low, their stimulus of new investment will simply lower the returns to existing capital, which do not directly benefit from the tax incentives, still further.

Summary

If there really is some special connection between fixed capital and economic growth, then investment incentives are more suited to the task than saving incentives, which leak abroad and into other assets. The logic that investment drives growth through externalities also argues for targeting particular types of investment--once we know which type.

Even when we are concerned with long-run outcomes, marginal incentives seem more attractive than those that spend most of their initial revenue loss providing windfalls to existing assets. However, given the complicated nature of existing tax systems, it is not always evident what effects a provision may have on the marginal incentive to invest. As incentives become more "marginal" in nature, they save tax revenue but introduce other problems.

Do the policies work? There are really two questions here: does capital lead to growth, and do tax incentives speed capital accumulation? I cited some preliminary evidence on the first question above. On the second question, there is considerably more evidence that tax provisions do affect the level and the allocation of business fixed investment,[37] though, even here, there are dissenting views.[38]

Concluding comments

Policy discussions often connect capital to growth, but standard economic models provide little assistance in identifying the path from more investment to sustained higher growth. If the growth comes from positive spillover effects, we have just begun to consider how this comes about, and which types of investment deserve our attention.

The capital-growth connection does point toward investment incentives as opposed to saving incentives. The literature provides guidance with respect to the design of these incentives but offers us little as to which types of capital investment should be encouraged or, for that matter, whether first priority should be given to private rather than public capital, the latter of which has grown relatively slowly during the past two decades. While I have focused on changes in tax structure, rather than the burden of taxation, the logic that causes us to focus on investment as a vehicle for growth also suggests that the social costs of government dissaving to the welfare of future generations may be higher than is normally assumed.

Endnotes

[1]As used by Solow (1957) and Denison (1967).

[2]See Jorgenson (1988).

[3]See, for example, Romer (1989).

[4]See DeLong and Summers (1991)

[5]Mankiw and others (1990).

[6]See Aschauer (1989) and Munnell (1990)

[7]See, for example, the comments of Henry Aaron in Munnell (1990). More recent empirical findings for the United States (Holtz-Eaken 1992) dispute claims of such high returns. A more general estimation approach applied to Sweden finds the opposite result, that the country has an excess of public capital. See Berndt and Hansson (1991).

[8]Some might think of military capital as playing an indirect role in the advancement of productivity, through the development of new technologies. Including military capital in the calculation simply reinforces the overall trend, since (despite the build-up during the 1980s), the stock of military capital grew proportionately less than other government capital between 1960 and 1990.

[9]Musgrave (1992). An even larger decline in the ratio occurs if residential capital is excluded from the private capital stock. from .59 in 1960 to .44 in 1990.

[10]For an early such application, see Hall and Jorgenson (1967). For further discussion of the cost of capital and effective tax rate concepts themselves, see Auerbach (1983) King and Fullerton (1984) provide an oft-cited effective tax rate analysis of four countries' tax systems.

[11]See Auerbach (1989b).

[12]See Auerbach and Hines (1988).

[13]Auerbach and Hassett (1992) find that a user cost based on expected future tax parameters is a superior predictor of investment behavior than one based on the "myopic expectations," the basic user cost formula

[14]See, for example, Bertola and Caballero (1991).

[15]See Altshuler and Auerbach (1990).

[16]See Lyon (1990)

[17]See Sodersten (1989).

[18]See Auerbach (1983) and Poterba and Summers (1985) for further discussion

[19]In Sweden and Finland, for example, firms have had various incentives available to reduce their taxable Income, such as the investment funds discussed above. At the same time, they are

allowed under law to pay dividends only from income that has been declared for tax purposes. As a result, they are essentially in a position where their taxable income in any given year can be set at whatever level is necessary to meet the level of dividends chosen. See Kanniainen (1986) and Sodersten (1989).

[20]See Miller (1977).

[21]See Fazzan, Hubbard and Peterson (1988).

[22]See Blanchard and Summers (1984)

[23]Since the work of Feldstein and Horioka (1980) finding a close relationship between domestic saving and investment across countries, there has been considerable debate about how closely connected these two aggregates are, and the implications concerning how much new domestic investment would result from an increase in domestic saving.

[24]See Abel (1985).

[25]In Auerbach (1992), 1 present simulations showing that delaying the implementation of a capital gains tax reduction may simultaneously increase national saving and reduce household welfare.

[26]See U.S. Treasury (1984).

[27]See, for example, Jorgenson and Yun (1991) and Auerbach (1989a).

[28]This number is suggested by DeLong and Summers (1991), based on their cross-country empirical investigation.

[29]For example, in a traditional growth model, Auerbach and Kotlikoff (1987) present simulations showing that a move from income taxation to consumption taxation may be welfare-increasing, while a shift from income taxation to labor income taxation may be welfare-decreasing. The difference between consumption taxation and labor income taxation is a tax on consumption financed from existing wealth:

[30] In an empirical investigation, Judd (1989) accepts the hypothesis that the capital levies implicit in the relative treatment of new and existing assets have had a zero mean and been uncorrelated over time in the United States.

[31]At the current U.S. corporate tax rate of 34 percent, a I percent investment tax credit would lower the user cost of capital by about the same amount as a .66 percentage point decline in the corporate tax rate Hence, a firm that reinvests at least two-thirds of its profits will receive a larger increase in after-tax cash flow from the investment capital.

[32]The recent U.S. Treasury (1992) study provides a fuller discussion of these and other alternatives.

[33]For one such proposal. see American Law Institute (1982).

[34]See Altshuler (1988)

[35]See Gravelle (1992).

[36]Auerbach and Hassett (1992) find that variations in the user cost of capital attnbutable to changes in tax policy during the postwar penod actually Increased the variance of U.S. fixed nonresidential investment (relative to the capital stock). Taylor (1982) finds somewhat more positive evidence for the countercyclical use of investment funds in Sweden.

[37]See, for example, Hall and Jorgenson (1967). Feldstein (1982), or Auerbach and Hassett (1991).

[38]See, for example, Bosworth and Burtless (1992).

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Commentary: Investment Policies to Promote Growth

Martin Feldstein

Several papers at this conference have stressed the favorable effect on economic growth of increases in business investment, especially investment in machinery and equipment. The authors of these papers have reminded us that such investment does more than increase the capital stock. Investment also embodies new technologies and may involve externalities that cause the national return to private investment to be greater than the private return to the firm that does the investing.

Such externalities would justify substantial tax subsidies to investment in machinery and equipment. The existence of externalities would also help to explain the substantial differences in short-run growth rates among countries that appear to be associated with differences in their rates of investment (although it would not explain persistent differences in growth rates over very long periods of time).

It would be a mistake, however, to conclude that the case for tax incentives to increase investment rests on the existence of these externalities. Investment in new plant and equipment can be worthwhile even if there are no externalities and its contribution to growth is small in the short run and negligible in the long run.

Alan Auerbach has given us a fine paper, emphasizing the complex ways in which tax rules distort the incentives to save and to invest. In my limited time, I will focus on three issues. I will begin with the fundamental issue of why tax incentives to saving and investment are justified. I will then discuss the importance of incentives to increase saving as well as incentives to increase investment. Finally, I will turn to the interaction between tax rules and inflation.

The case for investment and saving incentives

The desirability of increasing the level of investment depends not on investment's contribution to long-run growth but on whether the pretax rate of return to the nation is high enough to compensate for postponing consumption. I believe that the traditional estimates of pretax returns of 10 percent to 15 percent are high enough to justify foregoing current consumption in order to increase private investment in new plant and equipment. The nation now invests less than the optimal amount because taxes impose a substantial wedge between this 10 to 15 percent pretax return and the net return that individual savers receive.

Several speakers at this conference have argued for "leaving investment to the free market" and against incentives for investment. In theory I would agree with them (unless there are substantial externalities that raise the national rate of return on investment above the private rate of return). But in practical terms there is a strong case for special rules to encourage saving and investment to offset the distortions in the existing tax system.

Tax policies to "encourage" saving and investment are really just attempts to offset the distortions caused by our existing tax system. If we had a consumption tax instead of an income tax and either no corporate tax or a cash-flow corporate tax, there would be no case for saving incentives. Similarly, incentives for business investment neutralize the current (and politically untouchable) tax bias in favor of investment in owner-occupied housing. Because homeowners are permitted to deduct mortgage interest but are not required to pay tax on the value of the housing services produced, the current system is more generous than would be permitted under either a classical income tax system (that would tax the imputed service income) or a classical consumption tax (that would not permit the interest deduction).

Any reduction in taxation of business plant and equipment only helps to reduce the current distortion in favor of owner-occupied housing, an important point that was ignored by the 1986 tax reform in the effort to establish a "level playing field" among different types of business investment.

Encouraging saving vs. encouraging investment

Alan Auerbach accepts the importance of incentives for capital formation but advocates emphasizing "investment incentives . . . rather than saving incentives." Such investment incentives would seek to shift existing investment from housing and commercial structures to expenditures on machinery and equipment. Investment incentives might also induce a greater inflow of funds from abroad.

I think both of these goals are desirable and that there is a strong case for investment incentives like the investment tax credit and accelerated depreciation for machinery and equipment.

I would add a further reason for special tax incentives for investment in machinery and equipment. Current tax laws encourage firms to make intangible investments like advertising and marketing that are expended immediately. Traditional investment incentives like the investment tax credit for machinery and equipment help to redress the current imbalance in favor of such intangible investments.

But I think it would be a mistake for the United States to focus on providing investment incentives to the exclusion of saving incentives. Increased business investment—and perhaps investment in machinery and equipment in particular—is the goal but raising the level of saving contributes to that goal to the extent that a portion of the induced increase in saving goes into business investment.

The optimal mix of saving incentives and investment incentives depends on the ultimate increase in the targeted type of investment per dollar of revenue loss due to each type of tax incentive. On that basis, I believe that it is important for the United States to increase saving incentives. Let me explain why.

First, the United States has such a low net national saving rate that

even if all net saving went into machinery and equipment, the level of such investment would still be too low. The total net private saving of households, corporations and state/local governments is now only about 5 percent of gross domestic product (GDP). The structural deficit of the federal budget--excluding deposit insurance as well as the cyclical component—is now 3 percent of GDP. Net national saving is thus only 2 percent of GDP. Even if all national saving were invested in machinery and equipment, thus forcing the per capita stock of housing and other buildings to decline, the amount of investment in machinery and equipment would still be too low in the sense that the resulting marginal product of such capital exceeded 10 or 15 percent.

Policies to shift available saving into business plant and equipment would be much more useful if the saving rate were significantly higher than it is now. There is simply not much to be gained by refocusing the use of the 2 percent of GDP that is now saved.

The second reason for wanting to stimulate saving is that in the long run, U.S. domestic investment is constrained by our domestic saving. There is surprisingly little cross-border capital flows. High saving countries have high investment rates. Thus Japan, with a net national saving rate that is nearly three times that of the United States, also has a net investment rate that is nearly three times that of the United States.

Research that I did with Charles Horioka several years ago (Feldstein and Horioka, 1980) showed that, among the Organization for Economic Cooperation and Development (OECD) countries, those countries with sustained high domestic saving rates (based on the average saving rate for a decade or longer) have had correspondingly higher domestic investment rates. More specifically, each additional percentage point of GDP devoted to domestic saving has been associated with a 0.8 percent of GDP increase in domestic investment. A number of studies since then have supported this estimate of an 80 percent marginal saving retention ratio (see, for example, Frankel [1991] and Feldstein and Bacchetta [1991]).

Recent experience in the United States confirms this long-run dependence of domestic investment on domestic savings. During the 1980s the sharp increase in the budget deficit and decline in domestic savings led to a temporary capital inflow (and corresponding current account deficit) that reached 3.5 percent of GDP in 1986. But over the next five years, the size of the capital inflow declined until by 1991, it was less than 1 percent of GDP (even excluding the payments to the United States by other governments in connection with the Desert Storm operations). The gap between domestic investment and domestic saving has been essentially eliminated. As the United States moves from trade deficit to trade surplus during the 1990s, the current account deficit and capital inflow will decline even further.

A third reason to enact savings incentives is that they are not costly in terms of lost tax revenue. Savings incentives are essentially reductions in the personal income tax on interest, dividends and capital gains. In the United States, this has been done through pension plans and Individual Retirement Accounts (IRAs), (both of which are taxed on what is essentially a consumption tax basis with the contributions and subsequent investment returns excluded from taxable income until the funds are withdrawn).

The Bush Administration and key members of Congress in both parties have proposed expansions of the IRAs to stimulate additional saving. Steven Venti and David Wise, in a number of studies with different data sets (see, for example, Venti and Wise [1990] and [1992]), have shown that IRAs substantially raise savings. Their findings have been confirmed by other researchers (for example, Feenberg and Skinner [1992]). Although controversy remains, I have examined this research and find the results quite convincing.

What is the revenue cost of increasing savings through expanded IRAs? The government loses personal income tax revenue because (1) IRA contributions are excluded from taxable income until they are subsequently withdrawn; and (2) some of the investment income in IRAs would otherwise have been taxed as it is earned instead of when it is withdrawn.

Revenue estimates based on these two effects leave out something very important. The government also gains additional corporate tax revenue on the extra capital stock that results from higher savings. The government's official revenue estimates ignore this increase in corporate tax receipts.

I have done some calculations (Feldstein 1992) that show that the increased corporate tax revenue offsets a large share of personal income tax losses. Indeed, a "back-loaded" IRA (in which contributions are made from after-tax income but no taxes are paid on withdrawals) does not have any net revenue loss when the effect on corporate tax payments is taken into account.

For these three reasons, I think that a strategy aimed at increasing investment in business plant and equipment should include savings incentives as well as investment incentives. If we can get net national savings up from 2 percent of GDP to 10 percent, policies to encourage business investment can then achieve a significant rise in business investment.

Effects of inflation on saving and investment

Because this is a Federal Reserve conference, something should be said about the effect of inflation on investment. In keeping with Alan Auerbach's emphasis on taxation, I will discuss the interaction of inflation and tax rules.

Several previous speakers commented on the adverse effect of inflation on growth. An important reason for this is that the interaction of inflation and tax rules reduces the return on saving and business investment. This occurs because tax rules are based on nominal interest income and expenses, nominal depreciation, and so on.

Consider what happens if there is a one percentage point increase in inflation and interest rates. Although the real pretax interest rate is unchanged, the additional 1 percent of nominal inflation is subject to tax. With a marginal tax rate of 40 percent, the real net rate of interest declines by 0.4 percentage points.

With that mechanism in mind, look at the experience of the 1970s when the typical marginal tax rate was 40 percent. Inflation rose from 4 percent in the late 1960s to 8 percent in the late 1970s. Short-term interest rates rose from 7 percent to 10 percent. Thus the real pretax interest rate fell from **3** percent to 2 percent.

Consider an individual with a 40 percent marginal tax rate during those years. In 1969, the 7 percent pretax interest rate corresponded to a 4.2 percent net rate. With inflation of 4 percent, the net real rate was approximately zero. In 1979, the 10 percent pretax interest rate corresponded to a 6 percent net rate. With inflation of 8 percent, the net real rate was approximately a **negative** 2 percent. Thus the real net rate fell by 2 percent.

Inflation discourages saving by reducing the real net return to savers. Note that even though the marginal tax rate was 40 percent, the interaction of inflation and tax rules made the effective tax rate on real interest income 100 percent in 1969 and even higher in 1979.

The same type of arithmetic implies a bigger subsidy to owner-occupied housing when inflation raises nominal tax rates and therefore increases the value of the mortgage interest deduction. The real net cost of funds for owner-occupied housing is even lower when inflation is high.

In contrast to owner-occupied housing, business investment is discouraged because depreciation for tax purposes is not adjusted for inflation. Between 1965 and 1980, the rise in the nominal interest rate to corporate borrowers reduced the present value of 15-year straight line depreciation by more than 40 percent. The effect of inflation on business investment is complex because it depends on the combined impact on depreciation, on debt, and on inventories. More than a decade ago, Larry Summers and I (Feldstein and Summers 1980) put all of the pieces together and concluded that in 1977, the interaction of inflation and tax rules increased the effective tax rate on corporate income from 41 percent to 66 percent.

I conclude from this analysis that the reduction of inflation in the 1980s will mean a higher real net return to savers and a more favorable net return to business investment. These will help increase capital accumulation and growth in the 1990s.

Ironically, the transition to lower inflation may actually have hurt savings and capital formation. The decline of inflation in 1982 caused the stock market boom that raised share prices by 300 percent in a decade. The rise in wealth caused a decline in personal saving and corporate pension contributions. The resulting fall in private saving has had a larger adverse effect on national saving than the increase in the budget deficit. But that is only a transition problem and the long-run effect of low inflation on capital formation will be favorable for the 1990s.

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Commentary: Investment Policies to Promote Growth

Norbert H. Walter

With his comprehensive and well-founded paper, Alan Auerbach has made it difficult for me to add anything of a comparable level. The radical demand that if you don't know what you are talking about you should keep your peace was made by Ludwig Wittgenstein. If we were to follow this maxim, human communication and scientific progress would largely come to a standstill. For this reason, I have generously interpreted Wittgenstein's call for silence as a call for moderation and would like to make only a few selective comments.

For this purpose, let me sum up the central points made by the previous speaker:

> There is certain empirical evidence that countries with higher investment ratios also generate higher growth rates. But at the same time, there are well-performing countries (such as Hong Kong and Singapore) with widely differing investment shares in GNP (Singapore much higher, that is, less efficient investment). Even if these results demonstrate shaky correlation more than stark causality, there still is reason to ask about the possibilities of stimulating capital spending and growth.
>
> An initial analysis has a sobering effect. The precise correlation between capital spending and technical progress is unknown. There are no operational criteria for particularly growth-intensive types of investment (public or private investment, expenditure on machinery and equipment, or expenditure on building

and inventories). And, finally, the widely used concept of the user cost of capital has a number of limitations in predicting the impact of tax policy on investment.

Nevertheless, Mr. Auerbach believes that some general statements can be made on the adequate design of a growth-promoting tax policy. For one thing, it should, in his view, consist of investment incentives rather than of saving incentives. In order to lose less tax revenues, he prefers selective and marginal investment incentives to general investment incentives.

My remarks will primarily concentrate on the associated policy options and the aspects which Alan Auerbach deliberately did not mention.

Growth as an objective of economic policy

Economic growth is the result of an economic process based on millions of single decisions. The question is whether such a heterogenous and highly abstract aggregate can be taken as an appropriate goal of economic policy and whether it is possible, and sensible, to steer growth. Let there be no doubt: growth is highly desirable. We need growth to alleviate distribution conflicts in our affluent societies, to finance environmental protection as well as the required transfer of resources to the East and the South and, above all, to satisfy the understandable wish for a continuing increase in living standards. But what you want isn't always what you get. Achieving a pre-determined growth rate is beyond the scope of economic policy based on a free-market economy. The government can improve the conditions for economic growth. It can create the regulative framework but cannot fix the time preference for individuals and "organize" private creativity. In the words of the German Minister of Economics Karl Schiller, it can "lead the horse to water but cannot make him drink;" the government has no influence on whether "the horse drinks or not." The government can also—via public expenditure—bring about an economic flash in the pan through a quick fix, so to speak. The results are well known. They are counter-productive for both stabilization (forecasting problems; asymmetry in the behavior of economic policymakers because of elections) and growth. It would be preferable if the government—under the pressure of public opinion—did not have to make more promises than it can keep, that is, if it were responsible only for its *contribution* to growth (public goods, stable and useful regulatory framework) and not for growth in general.

Selective investment incentives—a wrong way

At first sight, the promotion of capital spending, not indiscriminately but by concentrating on particularly growth-promising investment, sounds convincing. At a closer look, however, the pitfalls of this concept become obvious. In fact, we do not know and cannot know what kind of capital spending—under consideration of all direct and indirect growth effects—is particularly fostering growth. It would ask too much of any bureaucracy and group of experts to select "good investments. It is still the market—that unparalleled mechanism for collecting and assessing decentral information—which is in the best position to detect growth-intensive and promising investments. But for this purpose—apart from the establishment of a competitive system—no state support, but rather government restraint is required in order not to distort market signals through subsidies and taxes.

An important exception, which is also mentioned several times by Alan Auerbach, is investments with high externalities, that is, investments that can be expected to generate high social returns which can only insufficiently be internalized by private investors. The education system or basic research are examples of this. Here, government promotion is undisputed because goods in these sectors are public goods or at least merit goods. Apart from such more or less typical tasks of government, the externalities concept is unlikely to be of much help in growth policy. The imagination of those interested in government financial aid with regard to inventing positive externalities is probably more than a match for the perseverance and expertise of policymakers (spillover effects being seen as a means of securing special concessions).

Dangerous overcharging of the tax system

The main purpose of the tax system is to raise state revenue. It ought to be simple and fair and interfere as little as possible with the work incentives. As if this task were not difficult enough, tax law has always been perceived as an appropriate vehicle for all kinds of interventionist measures. All sectors—be it family, social, environmental, energy, competition, or structural policy—try to anchor incentives for their specific targets in tax law. The consequences are well known: the many, partly conflicting, objectives and measures render the tax system non-transparent, complicated, unfair, and make it impossible to calculate its full effect on both distribution and allocation. Hence, the alternatives are either a spiraling intervention or a radical clean-up. The U.S. tax reform concept—flat rates on a comprehensive tax base—has therefore been closely observed and copied many times in Europe.

Therefore, you will be hardly surprised that I do not show much sympathy for a growth policy using selective investment incentives. My objections are partly theoretical (it is impossible to solve the selection problem as this would require the state to have higher knowledge than all market participants taken together) and partly political (if tax law is seen as an instrument for all kinds of ends this arouses desires among lobbies of all kinds). They refer, however, only to the idea of encouraging selected investments through tax incentives. They do not appertain to the proposition of my colleague, Alan Auerbach, to increase the neutrality and allocation efficiency of the tax system by reducing distortions. Neither are they directed against the desirable concept of a tax system that is generally investment-friendly. I would doubt though, whether one ought to go as far as to cling to tax policy mistakes simply because they encourage saving: you can fool some of the people some of the time, but not all the people all of the time. On the other hand, I would favor it if, under a tax regime like a general spending tax, growth were to settle at a sustainable higher level—as is likely. The process of saving, investing, and taking risks (that is, eventually growth and employment) can then be fostered without interfering with individual investment decisions in a rewarding or discriminating way. This would also vote against discrimination of investment abroad and against discrimination of foreign investors (at home), which is, in the end, rarely more efficient; in most cases, the opposite is true.

Example: Europe

To conclude, I should like to quote two examples from my immediate environment which show that generally good framework conditions for competition and open markets are more important for growth than specially designated growth programs.

Europe did not have a good start to the 1980s; key words like Eurosclerosis and Europessimism dominated the picture. This has changed radically with the conception of the single market program. Annual fixed capital formation in European Community (EC) countries increased by 50 percent in the second half of the 1980s, not least due to Europe '92. This dynamic is not due to the efficiency of special incentives but purely to vested interests on the part of companies. For the single market program stands for deregulation, intensification of competition as well as the redefinition and redistribution of markets. The modified environment with its greater opportunities and greater risks forces businesses to put capital into adjustment—not one-time changeover investments but investments to secure longer-term positioning in the new single market. It can therefore be assumed that the realization of a North American free trade zone will trigger a significantly higher growth impetus than any tax program.

The other—negative-example refers to experience with German unification. After it turned out that the state of East Germany's economy and environment was much more deplorable than even pessimists had predicted, the task to start a self-sustaining growth process is of crucial importance. In its most recent monthly report, the Bundesbank quotes more than 40 support measures offered by the federal government alone in order to boost investment activities in the new federal states. In addition, there will be further aid schemes on both state and EC level. The entire range of support measures is offered—from investment subsidies, tax relief, and interest rebates to special guarantee programs.

So far the enormous input of funds did not have the desired success. The reasons for this are, on the one hand, the reserved attitude that is usual in a phase of economic uncertainty and, on the other, the absence of major complementary investments in the public sector. Although work has started on the development of public infrastructure, the organization of a functioning public administration, and the creation of legal security (especially in ownership matters), they will take their time. East Germany is therefore a typical example for exorbitant yields (including spillovers) on public investments, and a horrifying example of the low efficiency of strong tax incentives or spending programs. We can only hope that a lesson will be learned from this experience for the much larger "testing ground" of Eastern Europe. Legal, institutional, and financial infrastructure has to come before physical infrastructure. Only then can private investments get off the ground.

Alan Auerbach's analysis thus needs to be extended in time and geographically. The special case of the postwar United States is interesting but not too helpful for the particularly "urgent cases."

Human Capital and Economic Growth

Robert J. Barro

Many theoretical models of economic growth, such as those of Nelson and Phelps (1966); Lucas (1988); Becker, Murphy, and Tamura (1990); Rebelo (1992); and Mulligan and Sala-i-Martin (1992), have emphasized the role of human capital in the form of educational attainment. Empirical studies of growth for a broad cross-section of countries, such as those by Romer (1990a), Barro (1991), Kyriacou (1991), and Benhabib and Spiegel (1992), have used proxies for human capital. These studies have, however, been hampered by the limited educational data that were available on a consistent basis for a large number of countries.

Recent research by Barro and Lee (1992) through the World Bank has provided better estimates of educational attainment for a large number of countries over the period 1960 to 1985. Hence, these data make it possible to use a broad sample of experience across countries and over time to assess the interplay between human capital and economic growth. This paper summarizes preliminary empirical results that use these data. These results provide empirical support for economic theories that emphasize the role of human capital in the growth process.

A new data set on educational attainment

Barro and Lee (1992) have used the census-survey data from the United Nations and other sources for more than 100 countries. These figures were combined with information about school-enrollment ratios to construct a panel data set on educational attainment at five-year intervals from 1960 to 1985. Roughly 40 percent of the cells in this data set correspond to direct census-survey observations. The remaining 60 percent of the cells are estimates constructed by a perpetual-inventory method that uses the census-survey values as benchmark stocks and the school-enrollment ratios as investment flows.

The numbers in the data set indicate educational attainment at four levels—no formal schooling, some elementary school, some secondary school, and some higher education—for the population aged 25 and over. This population group, rather than the labor force or the population aged 15 and over, was dictated by the availability of data. The figures have been used to estimate the average years of school attainment at the primary, secondary, and higher levels. This estimation takes account of the varying duration of primary and secondary schools across the countries and uses rough estimates of completion percentages at these schools. It should be stressed that the estimates do not consider variations across countries or over time in the quality or intensity of education. The rough quality measures that are available for a large group of countries—like measures of public spending on education and pupil-teacher ratios—have turned out not to contribute to the explanatory value of the human-capital variable for economic growth or other variables.

Table 1 summarizes some major features of the data set on educational attainment. The table separates the OECD countries (22 with data) from the developing countries, which are classed into five regions: Middle East/North Africa (14 countries), Sub-Saharan Africa (27 countries), Latin America/Caribbean (23 countries), Pacific Area (10 countries), and Other Asia (7 countries). The population figures shown are for the overall population of the region, although the schooling data apply to those 25 and over. The figures on educational attainment show the average years of schooling at the primary, secondary, and higher levels, and the total of these three categories. The regional averages were formed as unweighted means of the individual country observations.

Table 1
Trends of Educational Attainment by Region

Region/Group	Year	Total Population (millions)	Average years of schooling in primary	secondary	higher	total
OECD	1960	636	4.83	1.14	.17	6.15
(22 countries)	1965	676	4.89	1.25	.20	6.34
	1970	710	4.97	1.56	.27	6.80
	1975	745	5.07	1.83	.35	7.25
	1980	775	5.20	2.27	.43	7.90
	1985	803	5.35	2.45	.49	8.29
Middle East/	1960	82	1.49	.38	.09	1.96
North Africa	1965	94	1.62	.44	.10	2.15
(14)	1970	108	1.83	.58	.13	2.53
	1975	124	2.24	.90	.18	3.32
	1980	144	2.45	.99	.23	3.67
	1985	166	2.82	1.21	.27	4.30
Sub-Saharan	1960	124	1.10	.10	.01	1.22
Africa	1965	141	1.13	.11	.01	1.25
(27)	1970	162	1.25	.16	.02	1.44
	1975	186	1.45	.20	.02	1.68
	1980	214	1.71	.26	.03	2.00
	1985	250	1.88	.29	.03	2.21
Latin America/	1960	207	2.65	.50	.05	3.20
Caribbean	1965	238	2.71	.51	.07	3.29
(23)	1970	272	2.87	.70	.09	3.66
	1975	309	3.08	.83	.13	4.04
	1980	348	3.30	.94	.19	4.44
	1985	388	3.49	1.12	.26	4.88
Pacific	1960	201	2.53	.71	.09	3.33
Area	1965	229	2.68	.74	.11	3.53
(10)	1970	260	2.95	.85	.13	3.94
	1975	293	3.31	.95	.17	4.42
	1980	327	3.44	1.14	.22	4.79
	1985	362	3.72	1.33	.26	5.31
Other	1960	596	.89	.28	.03	1.20
Asia	1965	668	.98	.31	.03	1.32
(7)	1970	752	1.10	.45	.05	1.61
	1975	844	1.23	.48	.06	1.77
	1980	942	1.39	.57	.07	2.03
	1985	1059	1.92	.71	.08	2.71

Note: Attainment applies to the population aged 25 and older, but the population figures shown are for total population. The regional values are unweighted means of the average number of years of schooling in each country.

The table shows that the OECD group had the highest school attainment, beginning with 6.2 total years in 1960 and reaching 8.3 years in 1985. The developing regions have, however, all grown faster in proportionate terms and have therefore been catching up in average years of schooling to the OECD countries. The lowest attainment is in Sub-Saharan Africa, with a range from 1960 to 1985 of 1.2 to 2.2 years, whereas the highest is in the Pacific area, with a range of 3.3 to 5.3 years.[1] (Some of the countries in this group—Hong Kong, Singapore, Korea, and Taiwan—now have sufficiently high per capita income so that they no longer warrant the designation of developing country.)

Human capital in theories of economic growth

Various theoretical models include human capital as a factor of production and assess the accumulation of human capital as an element of the growth process. I consider first the role of human capital in the familiar neoclassical growth model, then examine the implications of theories that allow for imbalances between human and physical capital. Human capital is also important in models that allow for international capital mobility and in theories of the diffusion of technology. Finally, I assess the interplay between human capital and choices of fertility rates.

The convergence rate in the neoclassical growth model

The standard framework that often guides economists' thinking about economic growth is the neoclassical growth model of a closed economy, due to Ramsey (1928), Solow (1956), Cass (1965), and Koopmans (1965). The long-run per capita growth rate in this model depends entirely on the exogenous rate of technological progress. In the short run—that is, in the transition to the steady state—the growth rate depends inversely on the gap between economy i's per capita product or income, denoted by y_i, and its long-run or steady-state position, denoted by y_i^*.[2] This result is often referred to as conditional convergence: economy i grows faster the lower its initial income, y_i, conditional on its long-run target, y_i^*. In the standard model, y_i^* depends positively on the economy's willingness to save and level of productivity and negatively on the population growth rate. In extended versions of the model, the effective level of productivity can be interpreted to include not only the access to technology, but also government policies in regard to taxation, maintenance of property rights, provision of infrastructure services, and so on.

The transitional dynamics can be summarized by the rate of convergence: how much of the gap between y_i and y_i^* is eliminated in one year? Empirical evidence discussed by Barro and Sala-i-Martin (1991, 1992a) for the U.S. states (from 1880 to 1988), regions of seven Western European countries (from 1950 to 1985), and a cross-section of about 100 countries (from 1960 to 1985) indicates that the rate of convergence is on the order of 2 percent per year. That is, if the differences across economies in y_i^* are held constant, then about 2 percent of the gap between the typical poor and rich economy is eliminated in one year. This slow rate of convergence means that it takes 35 and 115 years, respectively, for 50 percent and 90 percent of the initial gap to vanish.

For the regions of the United States and Western Europe, the steady-state values, y_i^*, appear to be similar, and hence, conditional convergence corresponds to the poor economies catching up to the rich ones. For the broad group of countries, however, the variations in the y_i^* appear to be substantial, partly because of persisting differences in government policies. In this context, therefore, conditional convergence does not imply that the poor countries would tend to grow faster per capita than the rich countries.

In the neoclassical growth model, the convergence rate depends mainly on the speed with which diminishing returns to capital set in. If y_i is well below y_i^*—so that the ratio of capital to labor, k_i, is well below its steady-state value, kf—then the rate of return on capital is high and the economy tends to grow rapidly. As the economy develops, y_i and k_i rise, the rate of return on capital falls, and the growth rate tends to decrease.

If capital is viewed narrowly—say to include machines and buildings but to exclude human capital—then the share of capital in income would be low, diminishing returns to capital would set in quickly, and the convergence rate would be high.[3] It therefore turns out to be infeasible (if we assume plausible values for the various parameters in the model) to reconcile the neoclassical growth model with a narrow concept of capital. The model fits much better with the empirical estimates of convergence speeds if we take the appropriately broad view of capital to include huinan components. A capital share of about three-quarters—a reasonable figure if human capital is included—gives a slow enough onset of diminishing returns so that the theory can generate a convergence rate of about 2 percent per year. Thus, the slow observed rates of convergence provide indirect evidence for the importance of human capital accumulation in the process of development.

Imbalances between physical and human capital

Extensions of the neoclassical growth model have distinguished the sector that produces goods—consumables and physical capital—from an education sector that produces new human capital (see, for example, Lucas [1988] and Mulligan and Sala-i-Martin [1992]). The assumption in these models is that the education sector is relatively intensive in human capital: it takes human capital embodied in teachers to produce human capital in students.

One finding stressed by Mulligan and Sala-i-Martin (1992) concerns imbalances between human and physical capital, that is, departures of the ratio of human to physical capital from the ratio that prevails in the long run. The key result is that a higher ratio of human to physical capital and hence, a higher ratio of human capital to output raises the growth rate. A country with an abundance of human capital tends also to focus its investment on physical capital; that is, a high ratio of human to physical capital results in a high ratio of physical investment to gross domestic product.

The conclusions about imbalances between human and physical capital are reinforced if the accumulation of human capital involves adjustment costs that are much higher than those applicable to physical capital. (Machines and buildings can be assembled quickly, but people cannot be educated rapidly without encountering a sharp falloff in the rate of return to investment.) An economy with a high ratio of human to physical capital is then like an economy that is described by the transitional dynamics of the usual neoclassical growth model. The economy effectively starts with a quantity of physical capital per worker that is substantially below its steady-state position, that is, far below the amount that matches the large quantity of human capital. The usual convergence effect implies that the growth rate of output exceeds its steady-state value in this situation.

A high ratio of human to physical capital applies, as an example, after a war that destroys large amounts of physical capital, but which leaves human capital relatively intact. Japan and Germany after World War II are illustrative cases. The theory accords with the empirical observation that countries in this situation tend to recover rapidly.[4]

Capital mobility

The discussion thus far assumes a closed economy: goods do not move across borders, and the residents or government of one economy cannot borrow from or lend to those in another economy. This assumption is unrealistic for countries, but is especially troubling for the analysis of regions of the United States or the Western European countries.

It is possible to extend the neoclassical growth model to allow for international trade in goods and assets (see, for example, Barro and Sala-i-Martin [1992b, Ch.2]). One result from this extension is that the opening up of the economy to world credit markets speeds up the predicted rate of convergence to the steady state. This speeding up applies especially to forms of physical capital that are not subject to adjustment costs and that can be financed by international borrowing (or are amenable to direct foreign investment). If all capital were of this form and if international credit markets were perfect, then a small country's capital stock and production would converge essentially instantaneously to the steady state.

Human capital provides little collateral for lenders and therefore typically cannot be financed by borrowing (or direct foreign investment). Hence, even in an open economy, the accumulation of human capital must be financed primarily with domestic savings. This linkage between domestic investment and domestic saving restores the key assumption of the standard neoclassical growth model for a closed economy: capital is subject to diminishing returns and at least part of the capital stock must be financed by domestic savings. The bottom line turns out accordingly to be that the open-economy model with human capital generates rates of convergence that are only slightly higher than those of the standard neoclassical model. If the share of broad capital—physical plus human—is around three-quarters, then the predicted rates of convergence can still match the observed values of about 2 percent per year.

The diffusion of technology

The most interesting aspect of the recent literature on endogenous economic growth, represented by Romer (1990b) and Grossman and Helpman (1991, Chs. 3,4), concern theories of technological progress in the leading economies. In these models, a technological advance shows up either as the discovery of a new type of product (a new kind of productive input or a new variety of final good) or as an improvement in the quality or productivity of an existing product. These advances require purposive research effort, although the output from the research sector may involve random elements.

The incentive to commit resources to research requires a reward for success. In the models, the rewards take the form of monopoly rentals on product innovation. That is, a successful innovator's monopoly position lasts for awhile because of first-mover advantages, secrecy, and possibly formal patent protection.[5]

Growth can be sustained in these models if diminishing returns do not apply, that is, if the returns from new discoveries do not decline in relation to the costs of making the discoveries. One reason that diminishing returns may not apply is that the potential supply of new ideas and products is effectively unlimited.

For a single economy, the endogenous technological progress generated in recent theoretical models substitutes for the exogenous technological progress that is assumed in the standard neoclassical growth model. For studying convergence across economies, the interesting application of the new theories is to the pirocess of adaptation or imitation by followers of the innovations that were made by leaders. The cost of imitation for a follower can be modeled as similar to the cost of discovery for a leader, except that the cost of imitation is likely to be smaller and subject to less uncertainty. These considerations suggest that a follower would grow faster than a leader and thereby tend to catch up to the leader. This conclusion may not hold, however, if the follower country's environment is hostile to investment (in the form here of expenses for technological adaptation) because of poorly defined property rights, high rates of taxation, and so on.

Although innovation in the world economy may not be subject to diminishing returns, the process of imitation by a single country would encounter diminishing returns as it exhausts the pool of innovations from abroad that are readily adaptable to the domestic context. This consideration leads to the usual convergence property: a follower country tends to grow faster the larger the stock of potential imitations and hence, the further its per capita income is from that of the leaders. The convergence result is again conditional on aspects of the domestic economy—such as government policies, attitudes about saving, and intrinsic levels of productivity—that affect the returns from technological adaptation.

Nelson and Phelps (1966) pointed out that a country with more human capital would be more adept at the adaptation of technologies that were discovered elsewhere. Thus, the higher the stock of human capital for a follower country, the higher the rate of absorption of the leading technology and hence, the higher the follower country's growth rate.[6] This conclusion resembles the one that we got from imbalances between the stocks of human and physical capital; each model predicts a positive relationship between the initial stock of human capital per person and the subsequent per capita growth rate.

Human capital and fertility

In the standard neoclassical growth model, a higher rate of population growth reduces the steady-state value of capital per worker and thereby lowers the steady-state value of per capita income, y_i^*. The decrease in y_i^* implies that the economy grows in the transition (for a given value of y_i) at a slower rate. The rate of population growth is exogenous in this model, and the effect on the steady-state level of capital per worker involves the flow of new capital that has to be provided to accompany the flow of new workers.

Richer theories, such as the one by Becker, Murphy, and Tamura (1990), include the resources expended on children and allow fertility to be a choice variable of families. A key result is that a larger stock of human capital per person raises the wage rate and therefore the time cost of raising children. (The assumption is that the productivity in the sector that raises children does not rise as fast as that in the sectors that produce goods and new human capital.) A higher stock of human capital motivates families to choose a lower fertility rate and to raise the investment in human capital for each child (that is, to substitute quality for quantity in children). These responses of population growth and human capital investment tend to raise the growth rate of output. This model therefore provides another channel through which a larger stock of human capital results in a higher subsequent rate of economic growth.

Empirical evidence on human capital and growth across countries

Table 2 contains a sample of empirical results from ongoing research on the effects of a number of variables on the growth rate of real per capita GDP. (The data on GDP are the purchasing-power-parity adjusted values constructed by Summers and Heston [1988].) The estimates apply to a panel data set for 73 countries—those with a full set of data—over five-year periods from 1960 to 1985. There are 365 observations in total, five time observations for 73 countries. The estimation is by the seemingly unrelated (SUR) technique, which allows the error term for each country to be correlated over time.

The independent variables include the logarithm of real per capita GDP at the start of each period, $\log(y_{it})$, a number of variables including government policies that can be interpreted as determinants of a country's steady-state position, y_i^*, and the educational-attainment variable. See the notes to Table 2 for details.

Table 2
Panel Regressions for Growth Rate of Real Per Capita GDP, 5-Year Intervals from 1960 to 1985

Independent Variable	Estimated Coefficients & Standard Errors			
log (Initial GDP)	-.0167 (.0027)	-.0196 (.0024)	-.0202 (.0026)	-.0217 (.0023)
log (School)	.0232 (.0041)	.0109 (.0041)	.0193 (.0039)	.0092 (.0038)
(G/Y)	-.140 (.031)	-.159 (.027)	-.074 (.031)	-.091 (.027)
Openness*log (1+Tarriff Rate)	-.201 (.101)	-.050 (.085)	-.239 (.091)	-.145 (.078)
log (1+Black-Market Premium)	-.0226 (.0054)	-.0208 (.0049)	-.0246 (.0051)	-.0235 (.0047)
Freq. of Revols. and Coups	-.0147 (.0074)	-.0107 (.0062)	-.0127 (.0066)	-.0092 (.0055)
I/Y	--	.120 (.021)	--	.121 (.019)
FERT	--	-.0037 (.0012)	--	-.0019 (.0011)
Sub-Saharan Africa	--	--	-.0310 (.0055)	-.0265 (.0047)
Latin America	--	--	-.0124 (.0039)	-.0066 (.0033)
R^2, indiv. periods	.05, .38, .22, .31, .08	.07, .52, .26, .44, .22	.19, .33, .28, .43, .21	.24, .45, .33, .52 .25

Notes to Table 2

The dependent variable is the annual growth rate of real per capita GDP over each period (1960-65, 1965-70, 1970-75, 1975-80, 1980-85). These data are from Summers and Heston (1988). Standard errors are shown in parentheses. There are 365 observations (73 countries and 5 time periods). Coefficients are estimated by seemingly unrelated (SUR) technique, which allows a country's error term to be correlated over time. Separate constants are estimated for each time period. Other coefficients are constrained to be the same for all periods.

Initial GDP is real per capita GDP at the start of each 5-year interval.

School is *1* plus the average number of years of educational attainment for the population aged 25 and over at the start of each 5-year period.

G/Y is the period average of the ratio of real government consumption, exclusive of education and defense, to real GDP.

Openness is an estimate of "natural" openness, based on area and distance measures. This variable is a constant for each country.

Tariff rate is an average of official tariff rates on capital imports and intermediates, weighted by shares in imports. Only one observation per country was available for the tariff rate.

Black-market premium is the period average of the black-market premium on foreign exchange.

Frequency of revolutions and coups is the number of revolutions and coups per year, averaged over the full sample, 1960-85.

I/Y is the ratio of real gross domestic investment to real GDP, averaged over each period.

FERT is the total fertility rate, averaged over each period.

Sub-Saharan Africa is a dummy for countries in sub-Saharan Africa.

Latin America is a dummy for countries in Latin America.

For given values of the other variables, the estimated coefficient on $\log(y_{it})$, in the first regression is -.0167, s.e. = .0027. Thus, this coefficient differs significantly from zero (t-value = 6.2), and the magnitude indicates a rate of convergence to the steady-state position of 1.7 percent per year.[7]

The determinants of y_i^* contained in the first regression of Table 2 are *G/Y*, the ratio of government consumption exclusive of education and defense to GDP, a measure of distortions due to tariffs,[8] the black-market premium on foreign exchange — intended as a proxy for distortions in foreign trade,[9] and the frequency of revolutions and coups—intended as a proxy for political stability. These variables affect growth in the expected manner in the first regression: all have negative effects on the growth rate. Since these variables are not the major concern of the present paper, I will not provide a detailed assessment of these results.

The schooling variable is entered as log(1+total years of school attainment), where the years of attainment apply to the start of each period. The parameter 1 in the above expression can be viewed as the effective number of years obtained without formal schooling.[10] The estimated coefficient on the schooling variable in the first regression, .0232, s.e. = .0041, is positive and highly significant (t-value = 5.7). Thus, for a given value of $\log(y_{it})$, and for given values of the determinants of y_i^*, countries grew faster if they began each period with a greater amount of educational attainment. As a quantitative example, if average educational attainment begins at two years—the average value prevailing in Sub-Saharan Africa in 1980—theri an increase by 0.3 years would raise the quantity, 1+ years of attainment, by 10 percent and thereby increase the predicted growth rate by 0.2 percentage points per year. (The effect diminishes gradually over time because $\log(y_{it})$ then follows a higher path than it would have otherwise.)

The second regression shown in Table 2 adds *I/Y*, the ratio of real gross domestic investment to real GDP, and the total fertility rate. (These variables are measured as averages over each period.) In the Solow version of the neoclassical growth model, the investment ratio (or the saving rate) and the fertility rate (or the growth rate of population) are exogenous variables. These variables do not influence the long-run growth rate, but do affect the steady-state level of per capita output, y_i^*. An increase in *I/Y* raises y_i^*, whereas a rise in fertility lowers y_i^*. Therefore, for a given value of $\log(y_{it})$, an increase in *I/Y* would raise the growth rate, whereas an increase in the fertility rate would lower the growth rate.

From an econometric standpoint, the exogeneity of *I/Y* and the fertility rate with respect to the growth rate are questionable.[11] In any event, the second regression in Table 2 shows that the estimated coefficient of *I/Y* is positive and highly significant (.120, s.e. = .021), whereas that for fertility is negative and significant (-.0037, s.e. = .0012). These results are consistent with the Solow model of economic growth.

For present purposes, the most interesting finding from the second regression is that the inclusion of the investment ratio and the fertility rate roughly halves the estimated coefficient on the schooling variable: the estimated value is now .0109, s.e. = .0041. This result suggests that a good deal of the effect of initial human capital on the growth rate works through its effects on investment and fertility. These channels of effect are examined below.

The third and fourth regressions shown in Table 2 include dummy variables for Sub-Saharan Africa and Latin America. Both continent dummies are significantly negative, substantially so for Sub-Saharan Africa. The main inference from these results is that the variables considered thus far—including the estimate of educational attainment—are insufficient to explain a significant part of the poor growth performances in these regions. One possibility is that the measures of educational attainment in Sub-Saharan Africa, although low (see Table 1), do not fully capture the low levels of human capital in this region.

Table 3 shows regressions in the same form as Table 2 for the investment ratio, I . , and the total fertility rate. These variables are measured as averages over the periods considered. For present purposes, the important findings are that the schooling variable has a significantly positive effect on *I/Y* in the first two regressions and a significantly negative on the fertility rate in the last two regressions. Thus, these results confirm the idea that part of the influence of initial human capital on the growth rate involves the positive interaction with investment in physical capital and the negative interaction with the fertility rate. The interaction with physical investment would occur, for example, in the model of imbalances between human and physical capital that was worked out by Mulligan and Sala-i-Martin (1992). The interplay with fertility arises in the theory of Becker, Murphy, and Tamura (1990).

The results shown in the second regression of Table 2 showed that the effect of the school-attainment variable on the growth rate remained significantly positive even after holding constant the investment ratio and the fertility rate. A possible interpretation, along the lines of Nelson and Phelps (1966), is that this effect of human capital reflects the enhanced ability to adapt new technologies.

Concluding observations

Economic theory suggests that human capital would be an important determinant of growth, and empirical evidence for a broad group of countries confirms this linkage. Countries that start with a higher level of educational attainment grow faster for a given level of initial per capita GDP and for given values of policy-related variables. The channels of effect involve the positive effect of human capital on physical investment, the negative effect of human capital on fertility, and an additional positive effect on growth for given values of investment and fertility.

Ongoing research is considering the possibilities for improving the measures of educational attainment, especially by using better data on enrollment ratios and more information about school dropouts. The possibilities for measuring the quality of school input, in addition to the quantity, are also being considered.

School attainment is, in any event, only one aspect of human capital. Another dimension is health status. Measures of life expectancy—a proxy for health status—turn out to have substantial explanatory value for economic growth and fertility; life expectancy at birth enters in a way similar to educational attainment in the regressions reported in Tables 2 and **3.** The interplay between health capital and educational capital is currently being investigated.

Table 3
Panel Regessions for Ratio of Real Investment to Real GDP and Total Fertility Rate, 5-Year Intervals from 1960 to 1985

	I N		Fertility Rate	
Independent Variable	Estimated Coefficients and Standard Errors			
log (initial GDP)	.0256	.0177	-.386	0.280
	(.0067)	(.0070)	(.080)	(.083)
log (School)	.0303	.0259	-.331	-.283
	(.0109)	(.0106)	(.118)	(.116)
(G/Y)	.049	.071	-.55	-.57
	(.061)	(.061)	(.47)	(.46)
Openness*log (1+Tariff Rate)	.036	.106	27.0	20.7
	(.296)	(.277)	(7.2)	(6.4)
log (1+Black-Market Premium)	-.0095	-.0127	.022	.037
	(.0074)	(.0071)	(.048)	(.046)
Freq. of Revols. and Coups	-.0033	.0088	1.32	1.58
	(.0210)	(.0196)	(.56)	(.50)
Sub-Saharan Africa		-.0511		2.15
		(.0163)		(.36)
Latin America		-.0430		.43
		(.0119)		(.31)
R^2, indiv. periods.	.34, .35, .30, .39, .36	.30, .32, .27, .43, .41	.47, .53, .55, .56, .57	.39, .51, .59, .66, .70

Note: The dependent variable for the first two regressions is the average over each period of the ratio of real gross domestic investment to real GDP (data from Summers and Heston [1988]). For the last two regressions, the dependent variable is the average over each period of the U.N. estimate of the total fertility rate (average number of live births per woman over her lifetime). See also the notes to Table 2.

Endnotes

[1]Table 1 does not cover the formerly centrally-planned economies. These countries had average years of schooling that were similar to the OECD countries.

[2]The quantities y_t and y_t^* have to be Interpreted as values filtered for the effects of exogenous technological progress. The usual procedure is to compute output per unit of effective labor. where effective labor is the aggregate amount of work effort multiplied by the cumulative effect from labor-augmenting technological change.

[3]The convergence rate depends also on whether the saving rate falls or rises as an economy develops. If a poor economy saves a lot and then lowers its saving as it grows, then the convergence rate would be higher, and vice versa. Solow (1956) assumed aconstant saving rate, and the optimizing models (of Cass [1965] and Koopmans [1965]) that allow for a varying saving rate make no clear predictions about whether the rate will fall or rise as an economy develops. (The falling rate of return suggests that the saving rate would decline, but the rise in income toward its permanent level suggests the opposite.)

[4]An Imbalance in the other direction"a high ratio of physical to human capital, perhaps as a consequence of an epidemic"can also lead to a growth rate that exceeds the steady-state growth rate. The effect of this kind of imbalance on the growth rate would be relatively weak, however, if the accumulation of human capital were subject to large adjustment costs.

[5]This paper focuses on the role of these models as positive theories of economic growth and abstracts from the Inferences that have been drawn for desirable governmental policies. The policy implications derive from positive or negative gaps between social and private rates of return. Positive gaps can reflect uncompensated spillover benefits in research and production, the consequences of monopoly pricing of the existing goods, and the disincentive effects from taxation. Negativegaps can come from the seeking of existing monopoly rentals by new entrants or from congestion effects (negative spillovers from economic activity).

[6]The stock of human capital would also tend to reduce the cost of innovation in leading economies. Hence, more human capital can speed up the rate of innovation, an effect that raises the growth rate in leading and following economies.

'More precisely, because the estimation is carried out at five-year intervals, the coefficient, .0167, has to be adjusted slightly to compute the instantaneous rate of convergence (see Barro and Sala-i-Martin [1992a]). The implied convergence coefficient turns out in this case to be 1.8 percent per year.

[8]The tariff rate enters as an interaction with an estimate of natural openness, the country's ratio of imports to GDP that would have occurred in the absence of trade distortions. This openness was estimated to be a negative function of the country's area and its weighted-average distance from major markets The idea is that distortions due to tariffs have a larger adverse influence on growth for countries that are naturally more open (small countries and countries that are close to major potential trading partners). See Lee (1992) for a discussion

[9]The black-market premium may also proxy more broadly for otherdistortionary policies and for macroeconomic instability.

[10]The value 1.0 is close to the non-linear, maximum-likelihood estimate of this parameter in

the form of the first regression shown in Table 2. The value was then restricted to 1.0 and was not reestimated for the various regressions shown. The logarithmic form used in the regressions turned out to fit slightly better than a linear form in attainment.

[11]The empirical results are similar, however, if lagged values of *I/Y* and ***FERT*** are used as instruments. The exogeneity of other variables in the regressions, such as revolutions and coups and the black-market premium, can also be questioned.

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Commentary: Human Capital and Economic Growth

Lawrence F. Katz

Robert Barro has written an extremely informative paper that explores the role played by human capital as proxied by educational attainment in explaining cross-country differences in economic growth rates. Previous research has been hampered by the lack of comparable data on educational attainment for a large sample of countries. Barro's innovation in this paper is to use improved data on educational attainment to compute a measure of the average years of schooling of the adult population for a large number of countries for the 1960-85 period. This new data, constructed by Barro and Jong-Wha Lee, allow him to more carefully examine the links between human capital and growth than has previous research.

The major empirical finding is that the educational attainment of a country's adult population is strongly positively related to that country's subsequent growth rate of per capita gross domestic product (GDP). A 10 percent increase in educational attainment is associated with an increase in the growth rate of 0.2 percent a year. Barro finds that increased educational attainment increases growth by three primary routes. First, education has a direct effect on growth even after controlling for measures of a nation's fertility rate and rate of investment in physical capital. This direct effect is likely to reflect a positive effect of a more educated labor force on a nation's ability to adopt and develop new technologies. Second, increased educational attainment is associated with increased physical capital investment. This factor may be of greater importance in the future since the skills of a nation's labor force are likely to be crucial in attracting internationally mobile capital in an increasingly globalized economy. Third, a more educated population tends to have a lower fertility rate and plausibly more intensive parental investment in each child.

These findings are quite similar to those of previous research using enrollment rates for primary and secondary schools as crude proxies for more direct measures of adult educational attainment (for example, Barro [1991], Mankiw, Romer, and Weil [1992]). The evidence is potentially consistent both with the standard neoclassical growth model and with endogenous growth models, such as the model developed by Lucas (1988), that emphasize the importance of human capital externalities. The cross-country data basically imply that human capital and physical capital investment tend to go together and are both associated with faster national growth conditional on initial income. Although the positive association of educational attainment and growth seems robust, one must be somewhat cautious in providing a causal interpretation to this relationship since national educational policies are almost certainly strongly related to many omitted variables likely to be related to economic growth.

I will attempt to make three primary points in the remainder of my discussion. First, rnicroeconomic and macroeconomic research on the links between education and productivity appear quite consistent with each other and are strongly suggestive of a causal interpretation of Barro's finding of positive effects of educational investments on economic growth. Second, rnicroeconomic evidence on neighborhood effects on educational attainment provide some support for the view that human capital externalities may play a role in the strong empirical relationship between education and growth. Third, widespread investments in education appear not only to be associated with faster growth but also with a more egalitarian distribution of the fruits of economic growth.

How productive are educational investments? Microeconomic evidence

Much microeconomic research by labor economists has attempted to find plausible empirical approaches to determine the extent to which formal education improves worker productivity and the extent to which the productivity effect of education depends on the inputs in the educational system (school quality). A huge empirical literature exists documenting a strong positive relationship between years of schooling and earnings. More educated workers earn more, and the implied rate of return is as large as estimates for investments in physical capital. Nevertheless, the usual cross-section regressions do not necessarily answer the causal question of whether education increases productivity and earnings. It has often been argued that the results are driven by selection: the more able get more education and would earn more than others even in the absence of more education. Education is often portrayed as a signal rather than as an investment that increases productivity. The major problem in micro empirical work is that it is difficult to completely control for worker ability.

There has been a recent revolution in micro empirical work on education and earnings that uses *credible natural experiments* to assess effects of education on earnings and hence productivity. This work attempts to get around the ability bias problem by using variation in education that can plausibly be argued to be uncorrelated with innate worker ability.

One excellent example is work by Angrist and Krueger (1992) using the Vietnam-era draft lottery as a natural experiment to estimate the return to education. In the early 1970s, priority for military service was randomly assigned to draft-age men in a series of lotteries. Many who were at risk of being drafted managed to avoid military service by enrolling in school and attaining an educational deferment. Thus variation in an individual's draft-lottery number generated variation in incentives for additional educational investment that is almost certainly not correlated with underlying worker ability since draft numbers were drawn at random. Angrist and Krueger find that an extra year of schooling acquired in response to the lottery is associated with a substantial increase in earnings similar to standard cross-section estimates of the returns to schooling.

Other plausible recent approaches taken to identifying the effects of education on earnings include the use of the differential constraints imposed on individuals born in different months of the year by compulsory schooling laws (Angrist and Krueger [1991]) and the use of twins to control for unmeasured family background factors (Ashenfelter and Krueger [1992]). The new studies all seem to find large effects of schooling on earnings that appear best explained by a human capital interpretation that schooling directly raises worker productivity. In fact, estimates of the returns to schooling are greater from new natural experiment approaches than from traditional ordinary least square estimates of earnings functions.

Another area where the new research approach has made progress is the analysis of the effects of school quality on the outputs of the education system. The traditional view is that there is no solid evidence that inputs into public schooling improve student performance and outcomes (for example, Hanushek [1986]). Family background variables and school quality measures tend to be highly collinear so that the independent effects of school quality are difficult to determine. Better designed new evidence examining both earnings and test scores as output measures shows strong, plausible effects of inputs (pupil/teacher ratios, teacher quality, length of school year) on earnings, educational achievement, and test scores.

For example, Card and Krueger (1992) use arguably exogenous variation in educational inputs, arising from segregated schools in the South in the first half of the twentieth century and mandated improvements in the relative school quality of black schools, to assess the effects of school quality on earnings. They find that reduced pupil/teacher ratios, increased term lengths, and higher relative wages of teachers are associated with increased economic returns to education for students. Furthermore, a large-scale randomized study of class sizes in Tennessee finds that reductions in the pupil/teacher ratio for elementary school students significantly increase test scores on reading and math tests (Finn and Achilles [1990]).

The micro evidence and macro evidence appear consistent. Schooling appears to increase productivity and earnings at the individual level, and thus can plausibly be related to increased growth at the national level. The cross-country evidence also indicates that one of the routes by which education increases national growth rates is by facilitating increased greater investment in physical capital and new technologies. The micro cross-section evidence again is consistent with this inference since industries and firms that invest more in new technologies (especially computer-based technologies) are also those that tend to have highly-educated labor forces (for example, Berman, Bound, and Griliches [1992]).

Human capital externalities

Robert Lucas (1988) and other contributors to the "new" growth theory have developed models of economic growth with human capital externalities that help explain some aspects of international capital flows and factor ratio differences that are puzzling for the standard Solow growth model. The basic idea is that the productivity of a worker at any skill level is increased by working in an environment where other workers have greater human capital.

The microeconomic counterparts of the aggregate human capital externalities emphasized by the new growth theorists are the "neighborhood effects" emphasized by sociologists such as William Julius Wilson and the "social capital" concept associated with James Coleman. Recent empirical research using data sets that combine information on individuals with the socioeconomic characteristics and behaviors of their residential neighbors, family members, and schoolmates provides fairly strong empirical support for the notion of significant neighborhood effects in educational attainment and other measures of human capital accumulation and labor market performance (for example, Case and Katz [1991] and Crane [1991]).

Although one must worry whether strong findings of spillovers in neighbor's outcomes and investments could be the spurious result of the mechanisms by which families get selected into residential neighborhoods, a recent natural experiment provides some evidence that causal factors may be at work. The Gatreaux program in Chicago helps low-income black families move from public housing to low-income private-market housing in the Chicago metropolitan area. The program provides no counseling, training, or services; it simply helps families move from public housing to new neighborhoods. Some families get moved to neighborhoods in the central city; others get moved to more affluent neighborhoods in the suburbs. Because participants usually take the first apartment offered and unit availability usually provides no choice of geographic location, there are essentially no systematic differences between suburban and city movers. Evaluations of this program find that relocation to suburban neighborhoods rather than city neighborhoods has significant benefits for mothers and their children (Rosenbaum and Popkin [1991] and Jencks [1992]). Since this natural experiment provides essentially random assignment to neighborhoods, it provides strong evidence of the potential importance of neighborhood effects.

The existence of human capital externalities suggest that education, health, and other human capital investments may have quite high social returns and are supportive of acausal interpretation of the strong link between education and growth uncovered by Barro.

Education, growth, and distribution

Broad-based investments in mass education not only appear to be associated with rapid economic growth but also with a widespread distribution of the benefits of economic growth.

A stylized fact from development economics is the "Kuznets curve" relationship in which industrialization initially leads to widening income inequality and eventually leads to a narrowing of income inequality. But recent work by Juan Luis Londoño (1990) indicates that a key factor in the link between economic development and income inequality is the rate of investment in schooling. A rapid increase in the supply of more educated workers tends to narrow wage differentials by skill. Industrialization can be associated with a more equal distribution of economic resources if accompanied by increased access to education. Countries that invest heavily in widespread education, such as Taiwan and South Korea, appear to grow extremely rapidly and to generate much more equal income distributions than do countries that industrialize in a more unbalanced manner with heavy investments in physical plant and equipment and less emphasis on education. Thus increased investments in education have the potential to produce a "win-win" situation of strong economic growth and a more equitable distribution of economic resources.

The relative earnings of college graduates and other measures of educational wage differentials have expanded substantially in many Organization for Economic Cooperation and Development (OECD) countries during the last decade (Katz, Loveman, and Blanchflower [1992] and Davis [1992]). These increases in skill differentials are associated with a strong secular shift in relative labor demand favoring more educated workers and workers with problem-solving skills (Katz and Murphy [1992]). This shift in labor demand is driven by two primary forces. The first is the increased globalization of OECD economies and the ability to transfer many production and routine clerical tasks abroad. The second is skill-biased technological changes largely arising from the "computer revolution." Countries, such as Germany and Japan, that invest heavily in the education and training of large segments of their labor forces, including non-college workers, appear to have been able to adjust to these changes without the sharp increases in wage inequality observed in the United States.

The relative wage trends and employment shifts observed in most OECD nations strongly suggest that the returns to increased educational investments are currently very high. One approach, at which the United States has been successful, is increasing the fraction of young people that get college educations. Nonetheless, we need to invest more heavily and more wisely in the education and training of those that don't go to college to make sure the benefits of economic growth are broadly shared in the future.

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Commentary: Human Capital and Economic Growth

James C. Miller III

Most of us in this room—I dare say most adult Americans—were challenged as children to "make something of ourselves," specifically to "get an education." The fervor of the plea in my own case may have been a bit unusual—you see, unlike Senator Joe Biden, I am the first in my immediate family to get a college education. But I doubt very many haven't heard somewhere along the way the clarion call for educational attainment.

Such calls, I believe, reflect more than the private returns from an education, as in "I want my children to get good jobs," or even pride, as in "Let me tell you about my daughter who's just graduated from Reed and plans to go to medical school." It reflects, I think, a general recognition that education creates some social values—as we economists would say, some positive externalities. Whether this hypothesis is true, I cannot say. After all, if people are paid their marginal products and there are constant returns to scale, private returns to education exhaust the contribution to output, and hence there is no social "surplus." Moreover, education leads to higher incomes and therefore envy—a cost that's highly relevant as is obvious from recent political demagoguery.

Professor Barro, in this and previous papers, concludes that education—more specifically the stock known as human capital—contributes to economic growth, ceteris paribus.[1] Thus, distribution aside, education in the aggregate generates benefits—almost surely ***net*** benefits—to society. One implication of Professor Barro's impressive and extensive work is that it would be highly desirable to design and implement public policies to promote education.

I shall get to that. But first, I want to make a few observations about the issue of economic growth.

The first observation is that I am glad to see relatively little public anxiety over the fact that some of our international commercial competitors, not to mention our (former) international security competitors, have higher growth rates than we have—in the aggregate or on a per capita basis. Remember the clamor over the Soviet growth rate in the late 1950s and early 1960s? As Warren Nutter pointed out at the time, a less developed country can forever grow at a rate exceeding the growth rate of a developed one and never overtake the latter. As Nutter explained with an analogy, each year a child grows in age a greater portion of his or her age than does the parent, yet the child will never be as old as the parent.

Second observation: the rate of economic growth is mightily important, not only in terms of real incomes but in terms of the stability of the social fabric. Professor Barro points out that the rate of economic growth and simple measures of political stability are inversely related. His hypothesis is that, with instability, property rights are at jeopardy and thus people have less incentive to invest. But he also offers the reverse causation as a possible explanation for the correlation—that an economy with a low growth rate is prone to political instability.

In a ***much*** less attenuated form, we see evidence of this latter hypothesis here in this country, in this political season. Does anyone here really doubt that if the economy had been growing at 4 percent annually the past three years President Bush would be a shoo-in and that far fewer members of Congress would be in jeopardy? On a more general scale, it has been my observation that social unrest, ranging from general dissatisfaction to riots, is more common when the economic growth rate is low than when it is high. Also, I merely mention that a recent issue of a publication by the Federal Reserve Bank of Dallas, now headed by my good friend and conference participant, Bob McTeer, notes that: "Major oil companies' interest in foreign prospects is becoming stronger because of increasing political risk at home and decreasing political risk abroad."[2]

Third, small differences in the rate of economic growth make for big differences in future income levels. For example, if we were able to raise the annual growth rate in per capita income from 2 percent to 4 percent, the first generation would be about half-again better off, and the second generation would be about twice as well off.

So, economic growth is important. How do we raise the rate of growth? Let me address two specifics before getting to education. I was intrigued with Professor Barro's result that, ceteris paribus, government consumption (not counting defense and education) as a proportion of total output *reduces* the rate of growth (also, that government investment has no significantly-different-from-zero effect on growth). I would suggest that he look into the possible effects of government-impelled *redistribution* on growth. Although redistribution, as well as consumption, is related to government tax policies, it is possible to conceive of their effects differently—taxes being a net reduction from the rewards of increased effort, and redistribution being a reward for reduced effort.

To my knowledge—and admittedly it is limited—no one has quantified the extent to which, if any, that redistribution adversely affects the rate of economic growth. Yet the issue is of some importance. In an unpublished paper, Gordon Tullock shows that even small negative effects of redistribution on the rate of economic growth can lead to present-day recipients of redistribution being worse off after a few generations.[3] That is, even though redistribution may make recipients wealthier now, the institution of redistribution can so slow growth that the time comes that even with redistribution they are worse off (that is, have lower incomes) than if there had been no redistribution. And, given reasonable rates of discount, it is even possible that present-day recipients of redistribution are *worse off* than they would be in the absence of redistribution, or a lesser degree of redistribution, or maybe a better designed system of redistribution. Again, this is an empirical issue, but it is one that I think deserves careful study.

On a related issue, *spending* is just one way in which governments obtain control over resources. (Spending, of course, is financed with taxes and debt.) The other major control is conscription, the major form of which falls under the rubric, regulation. In terms of relative magnitudes, recently Professor Tom Hopkins of Rochester Institute of Technology estimated that the gross costs of thefederal portion of regulation amounts to approximately $400 billion annually.[4] That's an amount equal to about one-quarter of federal spending. What I'm suggesting—and I realize how hard it is to come by good numbers in this area—is that consideration be given to exploring the effect, if any, of this aspect of government on the rate of economic growth.

My final observation is that we can, of course, go overboard with respect to formulating and implementing policies to increase the rate of economic growth. One could easily imagine draconian measures by government to increase savings and investment, and hence growth, far beyond that which would obtain in a more neutral policy framework. I, personally, would not favor so limiting individual freedom in pursuit of a narrow growth objective. Sometimes governments get carried away with worthy goals and push them to excess. In the commercial areas, the premature development of a U.S. supersonic transport comes to mind, as well as the launching of a publicly funded space station.

Let me turn now to public policies to improve education—and thereby increase the rate of economic growth. The element on which I wish to focus is how to increase the quality of lower education in this country—that is, kindergarten through 12th grade. And, I start with the assumption that, by and large, lower education will continue to be publicly financed.

The first point I wish to make is that though there has been a well-publicized decline in standard test scores and deterioration in the rankings of U.S. student performance relative to students in other developed countries; the problem would not appear to be money. First, as is well known, spending per pupil in the United States has risen steadily while student performance has fallen.[5] Second, for 15 developed countries other than the United States for which we have comparable data, the average expenditure per pupil was $2,370 in 1985, whereas the U.S. expenditure per pupil was $3,314—nearly $1,000 more.[6] The only country with a higher per-pupil expenditure was Switzerland, which spent a lower portion of its GNP on lower education but had a significantly lower portion of its population enrolled.' Third, cross-section analyses of student performance typically show little effect of spending on quality. For example, recently I had some regressions run using data from the 100-plus school districts in Virginia. Variations in per-pupil spending were positively correlated with student performance, but spending explained only 6 percent of the variation.[8]

What's the problem? I ask rhetorically, why is it that U.S. higher education is the envy of the world, whereas **U.S.** lower education is an international laughing stock? There are many reasons, but two in particular stand out: one, there is much more ***competition*** for students among institutions in higher education than in lower education, and two, to a greater degree higher education in the **U.S.** is ***privately*** (or quasi-privately) produced, whereas lower education is dominated by public production.

For an audience of persons with economics expertise, I need not waste time persuading you of the superiority of competition over monopoly and the superiority of private over public production where both are feasible. Yet, production of what Professor Barro identifies as a key determinant of economic growth—human capital—is terribly encumbered by an extraordinarily inefficient system that appears incapable of reform. The notion of ***choice*** in education--even vouchers—is popular, but change is very slow. I have very little confidence that the federal government will make much progress on this score, even though both presidential candidates support ***some*** measure of school choice (Governor Clinton ***only*** for choice among ***public*** schools, President Bush for choice among public ***and*** private schools). However, I am hopeful that various local experiments with school choice—in New York, in Wisconsin, in Minnesota, and in other states—will be so successful that they will win a growing bandwagon of converts and will lead to long-overdue reform of U.S. education. An increase in the rate of economic growth would be but one of the major benefits.

Endnotes

[1]See, for example, Robert J. Barro, "Economic Growth in a Cross-Section of Countries," ***Quarterly Journal of Economics*** (May 1991), pp. 407-43 and other papers cited therein.

[2]***The Southwest Economy*** (July/August 1992), p. 6.

[3]Gordon Tullock, "Thoughts on Redistribution," unpublished (1992).

[4]Thomas D. Hopkins, ***Cost of Regulation,*** Rochester Institute of Technology Working Paper (December 1991).

[5]U.S. Department of Education, ***Digest of Education Statistics, 1991,*** pp. ***123*** and 157.

[6]***Statistical Abstract of the United Smtes, 1991,*** p. 840.

[7]*Ibid.* Switzerland had the lowest enrollment—14.2 percent (vs. 19.7 percent for the United States). Its expenditure per pupil was $3,683.

[8]As reported in Dana C. Joel, ***Education Choice: Closing the Gap in Student Performance*** Washington: Citizens for a Sound Economy, 1991, p. 9.

Overview: The Conventional Wisdom and the New Growth Theory

Stanley Fischer

Since the 1970s, the World Bank and the International Monetary Fund (IMF) have been dispensing economic advice and loan conditionality around the world. The advice seems old-fashioned and obvious:

- keep budget deficits small
- keep inflation low
- don't overvalue the exchange rate
- open your economy: liberalize trade and integrate with the world economy
- deregulate
- with increasing emphasis, privatize
- keep the tax system simple *and* collect taxes
- invest in physical capital
- invest in infrastructure
- invest in human capital,

and more along these lines.

This advice is based on the static theory of resource allocation, which shows that distortions reduce output below potential; on the distilled wisdom of day.-to-day experience; and on more formal econometric work.

The most important impact of the New Growth Theory, which is the banner under which the revived interest of macroeconomists in growth advances, has been to confirm this advice—and to add some refinements, such as the De Long-Summers argument that machinery and equipment investment is the most productive part of investment in physical capital.

It is interesting, though, to note that the major theoretical contribution of the New Growth Theory, which is to emphasize the possibility of differences in long-term growth rates among countries, has drawn little support from the data.

The policy advice that flows from these empirical results is straightforward. Then why isn't it followed? Greg Mankiw gave us one important reason: that increasing growth requires current sacrifice, and that the offer of blood, sweat, and tears may help win wars but not elections.

Another response was offered by Allan Meltzer, who argued that the sacrifice makes no intergenerational sense, since our children will be richer than we are. Or, in Joan Robinson's words, "What has posterity ever done for you?' While that is an interesting philosophic issue, there is no question that most people would vote for policies that lead to investments with rates of return of 20 to 30 percent—the range that De Long and Summers offer—purely in terms of the benefits they would receive in their own lifetimes. After all, the payback period on an investment that returns 20 percent is less than five years.

There is another explanation for the failure to follow this simple advice: the advice is too general, and too macroeconomic.

I will focus on three of the big growth issues: human capital creation, technical change, and macroeconomic policy.

Human capital

The general advice to create human capital leaves all the detailed questions of educational reform to be settled. First, financing: individuals reap most of the returns of investment in human capital themselves, and investment in human capital is already heavily subsidized. Should more government money be invested in education across the board? Or should existing financing be redistributed?

Second, what precisely should we be doing in reforming education? Is the problem that American children attend school only 180 days per year rather than 240 days, as in Japan? Should they be doing more math and science? Should the government reduce the subsidies for liberal arts colleges and raise them for institutes of technology? Should the United States try to develop apprenticeship programs, as in Germany? And if so, should the government do that? The comments by Larry Katz and Jim Miller gave us a peek at the work that is now going on to try to answer these questions.

Third, do we have the political skills and will to bring about the needed changes? Should we try to leave all the improvement to the market, through vouchers, or will more direct intervention be needed? If the latter, how is the education gridlock to be broken?

As we academics in higher eduction think through the issues, we should be sobered by the fact that, among the three leading economic powers, the country with the best tertiary educational system has the worst growth record; and the two countries — Germany and Japan— with the better growth records, have better primary and especially secondary educational systems.

Technical change

There was surprisingly little discussion at this conference of the causes of the productivity slowdown, and of policies to promote technical progress. Michael Darby presented the only explanation for the decline in productivity growth in the United States, arguing that as much as one full percentage point of the decline could be accounted for by measurement problems.

Much of what he said resonated with those of us who use computers, wear digital watches with built-in calculators, and watch teenagers with Walkmen on their heads and blissful expressions on their faces. But the problems of measuring computer output that he emphasized raise another issue, which is that computers are by and large an input rather than an output, and that we should see their productivity impact on measures of final product, such as consumption. I am not aware that this has been done, but it would be worth doing.

We do not yet have an adequate explanation of the decline in multifactor productivity growth in the world economy. Trends in research and development (R&D) do not do the trick, for while civilian R&D spending has been declining as a share of gross domestic product (GDP) in the United States, R&D spending in other leading industrial countries has been increasing faster than GDP.

The technology question is crucial, for after all the shouting, the implications of the New Growth Theory are precisely the same as Solow's: technological progress is the wellspring of economic growth. Growth at the economic frontier comes more from technological progress than from the accumulation of factors of production.

What should we be doing about that? Does the United States need an industrial policy, and if so, of what sort? Should the United States support R&D activities in national laboratories? Or should we privatize the National Institutes of Health? Do we need more DARPAs and Sematechs? Should R&D spending by firms be subsidized even more than in the current tax code?

These are already issues in the 1992 United States presidential election. They are of surpassing importance, and will remain central throughout the 1990s.

Macroeconomic policy

There is a considerable body of work on both developing and industrialized countries that shows that long-term growth is lower in countries where budget deficits and inflation are higher. While important questions remain to be settled about the direction of causation in this relationship, and the mechanisms relating inflation and deficits to growth, I believe the evidence supports the view that, over the long run, cautious fiscal policy and conservative monetary policies are good for growth.

Of course, in the long run, none of us will be here. And there is a real conflict between the short and long-run growth-inflation and growth-deficit tradeoffs. In the short run, there is a Phillips curve. In the short run, tightening fiscal policy reduces growth. How then do we reconcile the short-run and long-run relationships between inflation and growth, and fiscal policy and growth?

It is sometimes argued that the short-run relationships are irrelevant, and that the long-run relationships should guide policy. In that view, the faster a government deals with an inflationary shock, the more rapidly it gets back to the path of real GDP it would otherwise have been on, and the lower the accumulated loss of output.

But no one believes that in practice. Faced with an inflationary problem, the Bundesbank did not drive money growth to zero or less immediately, even though that would have reduced inflation more rapidly than its current policies. Faced with a recession, Japan was willing to raise the deficit in the short run, even though small deficits are better for long-run growth.

The alternative view is that the long-run tradeoff should be reflected in the basic stance of fiscal and monetary policy. When times are good, the fiscal deficit and inflation should be reduced, so that expansionary policy can be used when it is needed. On that view, which I believe, the current U.S. growth slowdown owes as much to the U.S. failure to deal with the fiscal deficit in the halcyon years of 1987 and 1988, as with the slow response of monetary policy to the gathering recession in 1990.

On this view, short-term policy mistakes can have impacts over the long term, defined as a decade. Lyndon Johnson's failure to raise taxes in 1965 or 1966 had impacts that lasted well into the next decade. Arthur Burns' monetary excesses had an impact on growth through the 1970s.

When one takes this view, the prospects for the first half of the 1990s are cause for great concern. In the United States, fiscal policy has been immobilized by the deficit, and by everyone's failure to deal with entitlement programs. In Japan, fiscal policy has been held back far too long, hostage to the long-run view that deficits are bad. One has to hope that the recently announced Japanese fiscal package turns out to be as large in practice as has been announced.

The prospects in Europe are especially problematic. France, the United Kingdom, and Italy are in or heading for recession. Germany failed to use fiscal policy as much as needed to pay the costs of unification, and threw the burden to monetary policy. The Bundesbank responded as it had to, with tight monetary policy. But monetary policy is a blunt tool, with long and variable lags, and excessive application of tight policies risks creating a recession. Thanks to the European Monetary System, and the insistence of the rest of Europe on fixed exchange rates, that recession will be Europewide.

The 1990s started out as the beginning of a new era. The macroeconomic policies of the major economic powers will play an important role in determining whether the 1990s fulfill the promise of the end of the Cold War, of German unification, of Europe 1992, and of the worldwide shift to market-friendly economic policies.

Overview

Jacob **A.** ***Frenkel***

This conference, in contrast with many of the previous conferences in this marvelous series, deals with the long run. We are all familiar, of course, with the dictum of Keynes about what happens to us in the long run. We are also familiar with what Joan Robinson told him: "Yes, master, but not all pass at the same time." We are also familiar with what Bob Solow has to say about this: "Keynes was always good at long-term forecasting." The ability to forecast the long run with more precision than our ability to forecast the short run is, of course, very limited. This may be testimony to the fact that our policies are not always capable of altering, in a fundamental way, the long-run trends of the economy. Having said this, the purpose of this conference is to discuss ways to alter the long-run trend in the economy. We have had an extraordinary range of arguments raised during the past two days.

What have we learned? As I look through the various prescriptions, points and counterpoints, points that were left up in the air, and those that will come down, there was one important dictum that was left completely uncontroversial: the secret for growth is to start from behind and keep population growth low. These two statements were uncontroversial. However, they do not seem to be a very dynamic formula for getting ahead. There were also various arguments for equipment investment, and whether we should target or subsidize various activities.

We have seen a slowdown in productivity. The debate was whether it was unusual when you look at it from a longer-term perspective, or whether it was just measurement bias. We know that the capital share does not explain much. However, by redefining the capital share to include human capital, the theory explains much more. And then ultimately, what was left open was the real test that brought about the new theories of growth. If you will recall, it was always the first paragraph in the new theories of growth that stated: these are the stylized facts that our old theory does not explain and therefore we are in search of a new theory. We are still left with the question of which empirical irregularities are not explained by the new theories. I'm not sure that we got a complete list, but I'm sure that it will come out.

There was an intriguing discussion of convergence that was not included in the written record. On the one hand, from the debate on the Maastricht Treaty and European Monetary Union, we know that convergence is important for a successful move to monetary union, which allegedly provides a link to growth. Then Roger Brinner raised a question of whether convergence is also the key for obsolescence. As we move toward convergence, maybe there is a once-and-for-all obsolescence and we are pushed behind. And this raises another set of questions. Do we run faster to avoid obsolescence? Or do we become discouraged because the rate of return on new innovation is so much lower so that it is likely the innovation will quickly become obsolete?

There is also the question of who should do what. What is the role of government? And many in this group, which I am sure is not randomly selected, believe there is an important role for the public sector. But I still think the world's basic instinct is correct: we should be suspicious about government involvement in the economy. Remember, there are the three lies that people always speak about when discussing the public sector. Two of them are irrelevant to the debate today, but the third is relevant. The two that are irrelevant are: when you are told "The check is in the mail," don't believe it; and when you are told "Don't call us, we'll call you," don't believe it. And the third one, which is relevant, is that when you are told that somebody is knocking on the door and says "I'm from the government; I'm here to help you," don't believe it. With this suspicion in mind, we still face the question of the role of the public sector as we are trying to promote policies for growth.

Except for some brief remarks here and there, the role of the exchange rate was not mentioned. And it is telling to anyone who remembers the theme of the conference seven years ago: "the rocky dollar on the Rocky Mountains." But even though the dollar is no less rocky today, it was not mentioned here today. We know that several of the G-7 deputies are meeting in Paris to talk about the dollar, mark, and yen; we know that the Maastricht Treaty deals with exchange rates; we know how much time we spend discussing the exchange rate in our personal and professional lives. Should we, therefore, conclude that it is all in vain when it comes to growth? Or irrelevant? Or, perhaps it is captured through some other mechanisms. And indeed, some mechanisms were mentioned in the debate. The exchange rate may enter through the inflation rate; Plosser, De Long-Summers, and Shigehara talked about inflation and its variability. De Long-Summers spoke about the independence of the central bank, apparently raising in the background the question of exchange rate regime. But the exchange rate was not in the forefront.

Except for the very interesting luncheon speech by Domingo Cavallo, most of the discussion in the papers concerned the industrialized countries. But Dorningo Cavallo reminded us that there is another part of the world, the part that is still struggling with the aftermath of stabilization, and is searching for the way to transform stabilization into growth. As we talk about the process of stabilization and growth, we must remember that although we have two options, only one is correct. The one that is correct is to think about the process as a two-stage rocket, where the first stage is stabilization and the second stage is growth. You cannot speak about stabilization without having in mind the second stage, because otherwise you will not take off. The second option, the one that has guided many countries in the wrong way, is to think about the process as two separate chapters that are unrelated. De Long-Summers reminded us that recessions do have lasting effects on growth and that distorted relative prices—a consequence of wrong stabilization policies40 have long-term effects on growth.

Everyone who has had to deal with stabilization programs recognizes four Achilles' heels. First, there is political impatience. Politicians would prefer to declare victory over stabilization and then move to the phase of growth prematurely. Some of us were together in a meeting with the prime minister of a country that I will leave unnamed. Three weeks after the start of stabilization, the prime minister asked us whether he could declare victory and move on to growth. The second Achilles' heel is that typically countries that are stabilizing find themselves with extremely high real interest rates. Third, countries that use the nominal exchange rate as an instrument for stabilization find that there is a real appreciation of their currency, which is not always conducive to growth. And finally, when told to cut spending, they typically cut spending on infrastructure investment. But this is the kind of spending needed for growth. Therefore, I subscribe very strongly to the De Long-Summers notion of the two-stage rocket.

Domingo Cavallo also told us that you must have a big leap. As you are changing the political process, and the political system is changing in a dramatic way, the economic system cannot adjust gradually. The economic system must also take a big leap. Operationally, this is what is needed to shake the tree that the political environment speaks so much about.

If one wants a theme that would combine many of the arguments that came up in the past two days, I would focus on the word "composition." In short-run macroeconomic stabilization programs, we speak about macroeconomic aggregates: budget deficits, spending, investment, consumption, and the like. However, if we want to think in terms of stabilization on the way to growth, we must look at the composition. For example, it is not enough to speak about the budget deficit. What is the composition of government spending? How much of'it is on investment goods? consumption goods? What kind of taxes are being levied? Does tax policy promote production and supply? Or does it promote consumption and absorption? Likewise, who is the spender: the government or the private sector? All of these issues are, of course, the key as we look at the theme of the composition.

In looking at the major themes in the debate about what produces growth, I heard people talking about transparency, about preannounced objectives and policies, and about permanent policies. And also, Salvatore Zecchini mentioned the importance of social safety nets. I subscribe to social safety nets, not as a mechanism to ensure equity in society, but as a mechanism to secure the political consensus and support that is necessary to prevent stop-and-go policy.

Let me conclude with one important remark about the competitive environment. You can grow in the wrong way, or you can grow in the right way. If you grow in the wrong way, you will require a diet, and then you don't know whether you are better or worse off after discounting. And what's the right way? The right way, of course, is the competitive way. But many countries start the growth process after having a distorted economy for many years. As a result, they do not really know true relative prices or the right allocation of resources. And that's why opening to trade and trade liberalization is such a critical element in the creation of a competitive environment and in the effective elimination of interest groups.

Overview: The Contribution of Monetary Policy

Otmar Issing

Monetary policy and growth

Whoever investigates the contribution of monetary policy to economic growth — and what is invariably involved in this connection are not short-term influences, but rather medium- to long-term developments — first of all asks the basic question: Does money matter?

For the central bank, this is translated into concrete problems: how do monetary conditions affect economic developments? What are the consequences of the level of and variations in the inflation rate for growth? What roles are played by credibility and, where appropriate, a change in the monetary policy regime?

Regarding the link between inflation and growth, there is an extensive empirical literature, the overall findings of which are highly unsatisfactory: high as well as low real rates of growth can be registered both in the event of monetary stability and in that of by no means insignificant rates of inflation.

There is broad agreement only about the fact that pronounced monetary instabilities — such as extremely high inflation rates, but also sharp contractions of the money supply[1] — severely affect economic growth. Basically, however, it seems to me that unambiguous empirical analyses of the issue are very difficult to carry out, above all, because the influence of monetary conditions, or monetary policy, can hardly be adequately isolated from the other factors, except in the case of extremes.

In answering the age-old controversy expressed in the question, "Does money matter?", economists currently appear to agree more widely than before on the basic issue of whether it does so. In something of a post-Keynesian-post-monetarist consensus, most economists now probably consider it highly likely, at least if there are unexpected changes in the monetary policy stance, that money has real effects in the short run, but that the long-term impact of monetary policy on employment and the gross national product (GNP) is actually relatively insignificant as a rule, or—to put it in other words—that the long-term Phillips curve is vertical.[2]

Money and growth--or: what can we learn from economic theory?

But should a monetary policy geared to the findings of economic thkory not go deeper if, first of all, it wants to correctly understand its contribution to growth and finally to translate this knowledge into an adequate policy?

Anybody with this objective in mind who tries to work his way through the stack of literature available on the subject of "growth" will not repeat this for a long time. In many, probably most, of the approaches, money does not figure at all. But, to be sure, this alone does not permit the conclusion to be drawn that the specific stance of monetary policy is irrelevant for growth.

But even those models which explicitly introduce money prove to be of little practical help. Tobin's (1965) contribution, for instance, which is regarded as classical by many quarters in this respect, shows that a higher inflation rate will, in certain circumstances, lead to a higher real capital stock. This effect is ultimately due to the fact that higher inflation means less real demand for money. The corresponding losses in the form of a reduced exchange or production efficiency are not taken into account, however. Real income is then, at a given savings ratio and higher inflation, increasingly invested in real capital—the real demand for money has fallen accordingly. *Real* capital formation rises; the real rate of interest declines. In the final analysis, however, this Tobin effect—the positive impact of inflation on capital formation—seems to be based on a trick. Money does not provide any explicit increase in efficiency or utility in the Tobin model. Money is neither included directly in the utility function nor does it lead indirectly, through an increase in the productivity of production or exchange processes, to a utility increase. In Tobin's model, economic agents demand—one is tempted to add incomprehensibly—this actually worthless paper—and act as though it yields a real rate of return, precisely as real capital does. In such a case it comes as no surprise, of course, that a higher rate of inflation, which reduces demand for this asset, money, can increase real capital formation and hence output. Here, inflation has the function, in the essence, of making money unattractive as an investment asset so that economic agents will no longer (foolishly) allocate such a large part of their stock of wealth to this actually useless asset.

This problem of Tobin's analysis was very soon recognized and solved insofar as money was considered to have an explicit function. The new generation of models explicitly takes into account the intertemporal maximization and the function of money. Ultimately, however, it proved impossible to provide a more precise answer to the question as to whether a higher (and rationally anticipated) inflation rate does, indeed, lastingly increase or reduce the capital stock and output.

The intertemporal models—be they either of the type based on infinitely living individuals or families, or the overlapping generations models—indicate very clearly that the impact of the (steady or rationally anticipated) inflation on capital formation and output ultimately depends, in particular, on two crucial factors in almost all approaches. Specifically, it depends, for one thing, on how money is substantiated and introduced into the model and, for another, on the question of how the seigniorage is used.

In this context, the distribution of seigniorage is of significance, in particular, when government debt is not neutral in the sense of Ricardo's theory.[3] In this case, one can boost capital through the higher inflation tax all the more, the higher the share in the seigniorage received by the young generation or the share used to reduce the government debt. The growth or even welfare effects of different rates of inflation, however, can hardly be evaluated on the basis of such models with the certainty or general validity that is necessary for practical purposes of monetary policy.

There are basically two solutions to the problem of how money is justified in the models. If money is written into the utility function of an overlapping generations model, a higher rate of inflation will enable the capital stock and output to be increased. In formal terms, this is once again due to the use of the seigniorage. The result is the same as the Tobin effect, but it is now also seen that a higher rate of inflation reduces the consumer's surplus to those demanding money. It is therefore doubtful whether the really relevant target variable, that is, welfare or utility, increases as a result of higher inflation. If, however, money is introduced in such a way that it increases production efficiency and hence the marginal efficiency of capital, a higher rate of inflation may well lead to a lower capital stock and lower level of output or, in an endogenous growth model, also to a lower rate of economic growth.[4]

As money undoubtedly helps reduce transaction costs, this approach probably has some foundations. The theoretical or macroeconomic justification for a high rate of inflation to promote growth is hence—to put it cautiously—built on sand. For practical purposes it is also decisive that monetary policy's contribution to the promotion of growth in these models—at the expense of monetary stability—will basically be the same as that of fiscal policy when the latter varies government expenditure and the path of indebtedness.

It is unlikely for anybody to read these approaches, and any others,[5] as an instruction for the course of action to be taken by monetary policymakers. It would be fatal, however, if one were to take the theoretical literature in this connection to support the view that a little inflation (if necessary, also a little more?) could by no means harm growth. There is a temptation to observe that the gap between this model world of heroic assumptions and the central bank's .concrete functions can be measured in light years only. At any rate, even an article on the subject "Why does money affect output?" contains the warning that "all the models we have seen impose long-run neutrality as a maintained assumption. This is very much a matter of faith, based on theoretical considerations rather than on empirical evidence."[6]

Monetary policy and growth — institutions and political process

Lenin is said to have stated that "in order to destroy the bourgeois society, one must destroy its monetary system." Whether this quotation is right or wrong, it, at all events, addresses the fundamental importance to be attached to monetary stability in a free society. Confidence in the stability of the value of money is more than a purely economic phenomenon, it is an integral part of confidence in the stability of the political system as such.

The higher the rate of inflation, the greater the uncertainty about future monetary developments. An uncalculable monetary policy, in the wake of unexpected inflations, disinflations, or deflations, will more or less inevitably also trigger, or at least aggravate, serious financial crises with the danger of permanent adverse effects on the gross national product.[7]

Even if the tradeoff between inflation and employment cannot be expected to have any permanent positive effects, a possible indirect and permanent effect of an unexpected rise in inflation through capital formation on the gross national product in specific circumstances is not infrequently stressed in justification of a corresponding growth orientation of monetary policy. In theory, this opens up a wide field: if the "winners" of a redistribution of wealth caused by unexpected inflationary trends have a higher propensity to save than the "losers," overall capital formation will indeed increase, at least ceteris paribus.

But also in discussions of monetary policy, and even in recommendations to the central bank, there is sometimes the (implicit) motive of reducing the real debt burden of enterprises and the government by an unexpected sharp acceleration of inflation in order, on the one hand, to avoid insolvencies of firms and, on the other, to stabilize overall capital formation and economic activity.[8]

Is it thus, after all, possible to increase capital and growth by means of an unexpected acceleration of inflation? Certainly not! The risk, the problems which would be associated with such a policy would basically be the same as those associated with a monetary policy aimed at short-term traditional demand effects or a higher inflation tax. In the long run, such a strategy, which ultimately is built on deception, would become stuck in the marshy ground of credibility crises and time consistency problems, of accelerating inflation, of rising capital market rates, and increasing uncertainty especially among investors. Eventually, monetary policymakers will be able to free themselves from this situation only at a very high cost in the shape of a painful process of disinflation to overcome the "legacy" of their previously wrong policy.

Deception is not a tested prescription for an economic policy geared to long-term objectives in a market system and can certainly not serve as a basis for a stability-oriented monetary policy. Of course, in the short term, such surprise effects can have a real positive impact. In the long term, however, a loss of credibility and the costs of inflation and disinflation weigh much more heavily. A policy which is aimed at promoting capital formation and growth must be highly credible, reliable, and predictable. Attempted deception and stop-and-go policies aimed at short-term demand effects are the best way of undermining investors' and savers' confidence in monetary policy, and hence also in economic policy as a whole. The capital which the central bank possesses in the form of a high credibility is thus thoughtlessly and, ultimately, uselessly put at risk. Less, rather than more, capital would be the long-run consequence in this case as well.

The indirect casual connection identified in some more recent publications, notably within the framework of overlapping generation models, according to which a more expansionary monetary policy can, through a higher seigniorage, reduce government debt? budget deficits (at a given level of government expenditure), or distorting taxes, and thus encourage capital formation, are interesting, but, from a practical point of view, largely useless, it might even be said dangerous, theoretical curiosities. The chief reason for this is that the indirect effects on growth and welfare that emanate from a change in the inflationary process and the associated amendment of the monetary policy regime are not, or only very inadequately, analyzed.[10]

Were the central bank to indicate that it intended to participate more actively in budget financing through the inflation tax—the purported boost to growth would surely be a welcome argument for some supporters—this would in many cases fling the door wide open for the growth of government expenditure and, in particular, also budget deficits. Eventually, the effect would be the complete reverse of that assumed by the seigniorage models, namely a lax, inflationary monetary policy—in fact even the rational anticipation of such a stance by politicians—which will lead to higher government debt, and thus to lower real growth.

The political process-distribution struggles, group egotism, rent seeking, to mention but a few of the current buzzwords—would take the announcement of a monetary policy which would in future be geared primarily to financing the government budget rather than to monetary stability and hence, ultimately, an inflationary monetary policy, to be the signal for a massive run on the public budgets, which politicians-even if they wanted to—would find difficult not to become caught up in.

Such a run is driven by the fear of being done out in the "negative sum game" of a distribution struggle financed by inflation and thus of being forced onto the losing side by more aggressive groups.

A crucial means available to the central bank to promote capital formation and growth hence consists of the disciplinary effect which a monetary policy geared strictly and credibly to price stability can exert directly and indirectly on fiscal policy and wage policymakers. The scope for bringing such influence to bear hinges on the reputation, and thus also on the independence of the central bank. Of course, this can hardly be verified empirically with an adequate degree of certainty. This may be why virtually no attention is given to this "transmission path" in most theoretical analyses of the impact of monetary policy on capital formation.

It is precisely a fiscal policy geared to long-term objectives and growth which must be interested in the "division of power" in economic policy as manifested by these two pillars of the central bank institution. If it is accepted that fiscal policy in a democracy, as driven by the political process, has a tendency toward excessive government debt—a thesis which can hardly be contested in view of the trend of public debt in most industrial countries over the past two decades—there would appear to be a point in—indeed, even a need for—the central bank to provide some counterweight, that is, to seek directly or indirectly to contribute to a low and sustainable level of government debt as part of its stability mandate. Besides these two pillars, that is, independence and monetary stability as a priority objective, particular importance must be attached to corresponding public relations efforts by the central bank to inform the general public about the risks and dangers of government debt, as well as to a monetary policy geared to medium-term objectives and potential output.

Sooner or later, higher government debt, as measured as a percentage of the gross national product, will, broadly speaking, lead to higher taxation. This, and the demand effect of deficit spending, will have a positive impact on the level of prices and inflation. **A** central bank which is committed to monetary stability will therefore have to check the extent to which its policy stance is responding adequately and timely to these developments.

Hence, it is not an expansionary monetary policy that is needed so as to encourage overall capital formation and economic growth. Quite the contrary is true: a strictly anti-inflationary central bank policy is the best way of ensuring not only that monetary stability is largely maintained but also that distribution struggles and excessive budget policies will come up to the limits set by monetary policy. In the absence of a consensus among all those responsible, however, the central bank, too, will ultimately be able to achieve little.

Concluding remarks

Compared with the period of "cheap money," there has been an outright change of paradigms in the optimum allocation of roles to the central bank and fiscal policymakers. The quintessence of the research conducted in the past few decades is that a lastingly high rate of economic growth cannot be achieved through large budget deficits and a passive monetary policy which tries to keep central bank interest rates low. On the contrary, a disciplined fiscal policy which keeps government debt within narrow limits and a counter-inflationary policy are the decisive cornerstones of a successful economic policy geared to long-term objectives.

Endnotes

The author wishes to thank Klaus Masuch for his active assistance in the preparation of this paper.

[1]See, for Instance, Milton Friedman's statement: ". . .the U.S monetary authorities followed highly deflationary policies. The quantity of money in the United States fell by one-third in the course of the contraction.. .The Great Contraction is tragic testimony of the power of monetary policy . . . " Friedman (1968), p. 3.

[2]See, for instance, Gregory Mankiw: "The very phrase 'zero inflation unemployment rate' presumes the existence of a long-run tradeoff between inflation and unemployment. Most economists today doubt that such a tradeoff exists. On this issue, Milton Friedman (1968) has won the heartsand minds of my generation: in most new Keynesian models, the long-run Phillips curve is vertical." Mankiw (1992), p. 563.

[3]See, for instance, Alogoskoufis and Van der Ploeg (1991)

[4]See, for instance, De Gregorio.

[5]In thisconnection, one would have to think, above all, of models which Incorporate hysteresis effects

[6]Blanchard (1990), p. 828.

[7]In his analysis of the great shocks experienced by the U.S. financial system in the 1980s, Martin Feldstein comes to the following conclusion: "My analysis of these problems also suggests that the major source of the increased risk in oureconomy has been a series of seemingly well-intentioned government policies A primary culprit Identified in each of the four cases has been the rising inflation rate that resulted from the monetary and fiscal policies of the late 1960s and the second half of the 1970s. Inflation distorted real Interest rates, led to excessive borrowing by LDCs, caused thrift institutions with fixed rate mortgages to become insolvent, and created fundamental changes in the commercial banking sector. All too often during the period of rising inflation, economists misunderstood the serious and far-ranging adverse effects of inflation A stable and low rate of inflation would have avoided many of the problems that have increased the risk of economic crisis." Feldstein (1991), p. 17.

[8]See, for instance, Benjamin Friedman: "In the absence of a response by the Federal Reserve, the risk of a debt crisis, as suggested by much of the recent discussion, might be a plausible outcome under any of several sets of circumstances. But there is no reason to presume that the

Federal Reserve would not respond to such a prospect, should those circumstances arise . . . Given the importance of monetary policy in either tolerating or arresting pnor episodes of accelerating price inflation, the more likely end result of a continuation of current trends in business borrowing is therefore higher Inflation " Fnedman. B. (1990), p. If.

[9] Here, and below. it is assumed that government debt shifts burdens into the future and reduces overall capital formation. Ricardo equivalence is thus not'presumed.

[10] .. In particular, the hypotheticalexperiment of changing the inflation rate while holding other effects on economic welfare unchanged is neither practically nor theoretically feasible.". Grossman (1991), p 334.

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Closing Remarks

Willem F. Duisenberg

I am grateful to the organizers of this symposium for their invitation to chair this session on "investing in growth." I would like to take this opportunity to conclude with a brief comment on policies to promote economic growth. The general subject of this symposium, "Policies for Long-Run Economic Growth," is important not only for the development of economic theory itself, but even more so for its practical relevance. The subject is both timeless and universal, relating to all countries, be they industrialized countries, developing countries, or the former centrally planned economies. In view of the current need for policies of a structural scope in many countries around the world, the renewed interest of academic economists in the issues of long-run growth, which characterizes the so-called "endogenous growth models" developed since the late 1980s, is likely to receive a warm welcome from policymakers as well. And I think it fully deserves such a welcome as the new research efforts could produce valuable insights and advice concerning the prerequisites for securing long-run economic growth and the kind of policies that are most likely to contribute to it.

The relation between policy and economic growth performance is not yet firmly established in the economic literature. Moreover, in the recent past, there has been far more emphasis on stabilization policies than on policies concerned with long-run economic growth. This partial neglect of long-run growth issues in the policy-oriented literature has most probably been reinforced by the dominance of short-run issues in the actual policymaking process from the mid-1960s to, say, the mid-1980s in many countries. I consider it to be a fortunate development that, after a period of quiescence, the economics profession, or at least a significant part of it, has resumed the study of economic growth.

The new research leaves more scope for policy to influence the long-run growth rate of the economy than the earlier literature. To a large extent, this is due to the development of various growth models in which the long-run growth rate is endogenous, and related to intentional investment in human capital, physical capital, and research and development as well as other factors such as trade distortions. Consequently, policies have the potential to influence long-run growth rates through these factors. This feature intuitively appeals to the imagination of many economists and policymakers, and perhaps endows the new growth theories with a higher degree of plausibility than the old models, in which the long-run growth rate is fixed. Extending and reconstructing growth theory to allow for the main empirical regularities is yet another notable feature of the new growth literature. These regularities are that growth rates of per capita income differ across countries, and that there is no worldwide convergence of countries' per capita income levels in the course of time.

Despite the importance of these empirical regularities for research, I should like to focus primarily on the relationship between policy and economic growth. What does the new research tell us about the driving forces of economic growth? The new theory suggests that the process of accumulating human capital and of accumulating and implementing technological knowledge is an important determinant of long-run economic growth. Formal empirical evidence corroborates this theoretical result in showing a fairly robust positive relationship between economic growth on the one hand, and investment in physical capital and either the level or the rate of change of human capital on the other. Additional evidence suggests that, of all types of physical investment, equipment investment is the main driving force of economic growth. This result is not surprising since technological progress is embodied in machinery in particular. Also, a negative impact on economic growth of proxies for trade and market distortions has been reported in various studies.

Given the central role of investment in human capital and equipment in stimulating economic growth, specific policies aimed directly at these types of investment by changing the incentives of individual households, firms, and banks in a way conducive to economic growth, are likely to be the focus of interest. The speakers at today's sessions have provided some interesting examples of such policies.

Professor Auerbach has focused primarily on tax policies and argues that, if there is a special relationship between fixed capital and growth, policies should preferably encourage investment itself rather than savings. His contribution suggests that at present there is no hard evidence revealing the exact types of investment which are most important in driving economic growth. Moreover, due to the complexity of existing tax systems, no definite conclusions can be drawn as to the impact and success of the various policy options discussed. I fully agree with Professor Auerbach's observation that the stability of the tax system should play a role in the design of tax policies to promote investment.

Professor Barro has provided new evidence to support the view that human capital is an important determinant of economic growth. In particular, his contribution shows that countries starting with a higher level of educational attainment grow faster. Although the implications for policy were not discussed, Professor Barro's results of course call for sensible educational policies.

Though I am certainly not hostile to the idea of stimulating investment in both physical and human capital by means of economic policy, we should take account not only of the potential benefits but also of the costs of such policies. In particular, there is the danger of trying to do too much, of overshooting the mark. In my opinion, the emphasis of government policy should be on establishing general conditions conducive to economic growth rather than on specific issues.

This brings me to the subject of macroeconomic stability. For central bankers like myself, being primarily concerned with achieving price stability and establishing sound monetary conditions, the connection between economic growth and broad macroeconomic stability is a principal focus of attention. Macroeconomic stability has many aspects. An important one is that macroeconomic policies must be sustainable in the long run with a minimum risk of sudden policy changes or reversals. This will contribute to an economic environment in which uncertainty with respect to the course of major macroeconomic variables is reduced to a minimum. Up till now, the contribution of macroeconomic stability to long-run growth performance has not been a very frequent subject of research, at least not in the growth literature itself, and seems to be somewhat neglected. Experience with structural reforms and development strategies, for example in the newly industrializing countries such as South Korea, has indicated that macroeconomic stability is an important factor in bringing about economic growth by reducing uncertainty and raising the credibility of a solid policy stance. If we accept that creating macroeconomic stability brings about economic growth, there must also be a case for securing growth in the long run by maintaining macroeconomic stability.

There can be no macroeconomic stability without price stability. Although inflation is attended to some extent by a shift from liquid assets to more productive investments, the overall impact of inflation on economic growth is very likely to be negative. Higher inflation rates are commonly attended by a larger inflation variability, thus increasing uncertainty and hampering optimal decisions on savings and investment. Relative price signals, intratemporal as well as intertemporal, are distorted by inflation, harming the efficiency of resource allocation and production, and therefore depressing economic growth. Moreover, the inflation rate may, correctly or incorrectly, serve as a proxy for the ability of the authorities to control the economy. If that is the case, higher inflation reduces the credibility of policymakers, forcing private agents to reconsider their investment plans or engage in profitable investment projects elsewhere. Recent empirical evidence, such as that presented in Professor Fischer's paper, "Growth, Macroeconomics and Development" (a National Bureau of Economic Research working paper of May 1991), supports the view held by central bankers all over the world that inflation is indeed negatively related to economic growth.

Our understanding of the interdependence of policy and long-run growth, though increasing, is as yet far from perfect. In the current growth literature, the role of macroeconomic stability seems to be underestimated. The potential causal links between macroeconomic stability and economic growth are poorly worked out in our current theories, and pose an important challenge for future research. Let me finish my remarks by pointing out yet another challenge for growth theory: the incorporation of environmental issues. These issues, although very topical and a matter of deep concern, have not yet obtained the prominent place they deserve in the thinking of economists and policymakers about economic growth. In my opinion, we should be concerned with sustainable growth, which also includes sustainability from an environmental perspective.

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