Lectures on Macroeconomics

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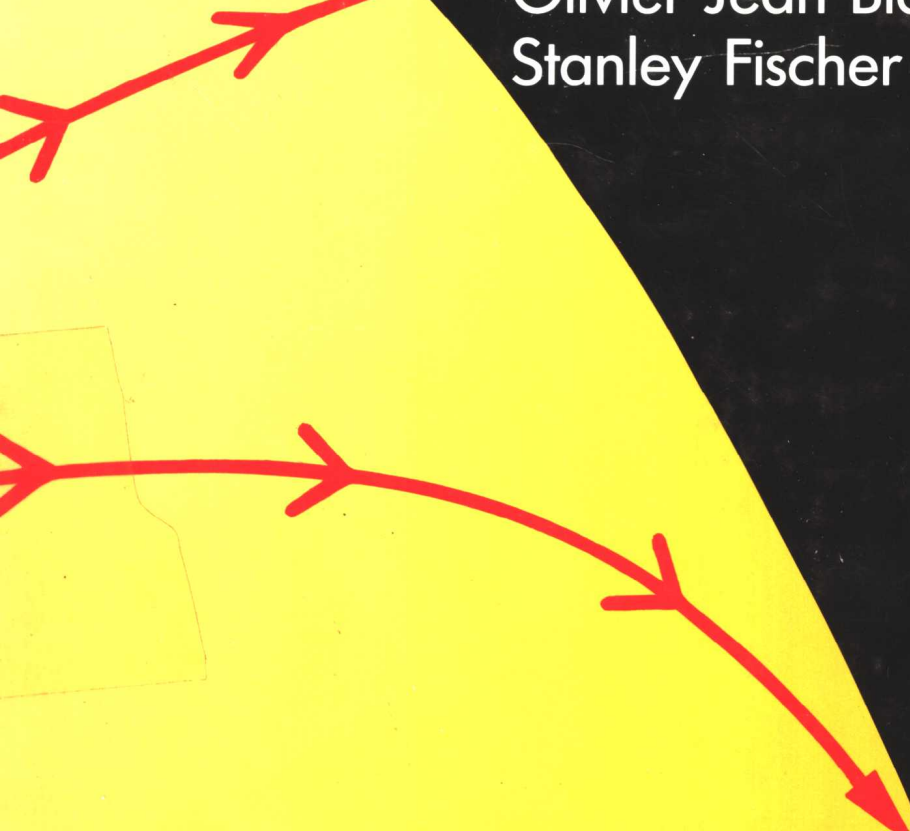

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Preface

On the surface, macroeconomics appears to be a field divided among schools, Keynesians, monetarists, new classical, new Keynesian, and no doubt others. Their disagreements, which often appear to be as much about methodology as about results, leave outsiders bewildered and skeptical.

This is not our assessment of the field. Behind the public relations gimmicks and the strong incentives that exist in academia to differentiate products, macroeconomics shares many basic models and views. We believe that macroeconomics exists as a science, an admittedly young, hesitant, and difficult one. Its inherent difficulties stem from the need to draw from all branches of microeconomics, deal with aggregation, make contact with data, and eventually make policy recommendations.

We have written this book to accomplish two goals. The first is to present the common heritage, the conceptual framework and the sets of models that are used and agreed upon by the large majority of macroeconomists. The second is to present life at the frontier, showing the various directions in which researchers are currently working. Because of the nature of research, it is at the frontier where disagreements are strongest and the debate most vocal. But even there, we see a scientific debate in which hypotheses are examined, tested, and, if they do not pass the test, eventually rejected.

We start in chapter 1 with the basic facts that need to be explained, the existence and persistence of economic fluctuations and their characteristics.

We then present in chapters 2 through 4 the workhorses of modern macroeconomics, the Ramsey growth model and the overlapping generations model, with or without money. These models serve as building blocks in much of modern macroeconomics. Even without additions, they shed light on the fundamental issues of the determinants of saving, the role of fiscal policy in affecting capital accumulation, and the difference between barter and monetary economics. We use them in chapter 5 to discuss issues of bubbles, multiple equilibria, and deterministic cycles. In chapters 6 and 7 we

extend these basic models to allow for the presence of uncertainty and stochastic fluctuations.

By the end of chapter 7, we have in effect written a text on equilibrium economics. By then we are also at the frontiers of current research, where various groups of macroeconomists part company. Some believe that the equilibrium approach can explain the basic macroeconomic facts. Others, including us, believe that deviations from the competitive equilibrium paradigm are central to a full understanding of macroeconomic fluctuations. The proposition that goods, labor, and financial markets differ in important ways from the simple competitive paradigm is not controversial. What is controversial is whether those deviations can explain important aspects of aggregate fluctuations. This is the subject of chapters 8 and 9, which cover what is sometimes called new Keynesian economics. Developments in those chapters are sometimes tentative and not yet fully integrated, but we have little doubt that this is where the future lies.

Working macroeconomists, like doctors treating cancer, cannot wait for all the answers to analyze events and help policy. They have to take guesses and rely on a battery of models that cannot be derived from first principles but have repeatedly proved useful. We present such models in chapter 10, showing how they can be and have been used, and what shortcuts they implicitly take. The book concludes with chapter 11 on economic policy, which presents both traditional and game-theoretic analyses of monetary and fiscal policy.

Lectures on Macroeconomics is intended as a text and reference book both for graduate students in macro and monetary economics and for our fellow professionals. The earlier chapters can be and have been used in a first graduate course in macroeconomics, whereas the later chapters are more suited to advanced courses. We believe that the book presents a comprehensive view of modern macroeconomics and an objective view of the field.

The book requires some mathematics. We are tempted to make the usual claim that high school algebra will suffice, but that would have to be a good high school. We use statistics and econometrics sparingly, primarily in chapter 1. We have not been systematic in presenting proofs of results, presenting those we believe important and in other cases referring the reader to alternative sources.

We owe thanks to students and colleagues. Primarily, we thank successive generations of students at MIT, and some at Harvard, who have attended our courses, suffered through the drafts of the chapters, pointed out errors, and suggested expositional changes. Teaching those students is one of the

great rewards of academic life. Although it would be invidious to single out particular students, we would like to mention those who have at different times worked as research assistants on the book and as teaching assistants for our courses in monetary economics in which it was used: among them Ricardo Caballero, Jordi Gali, Takeo Hoshi, Anil Kashyap, Athanasios Orphanides, John Shea, and David Wilcox.

Our colleagues at MIT and elsewhere have been generous in their willingness to read, to comment on, and to help improve the book. We thank in particular Laurence Ball, Robert Barro, Roland Benabou, Peter Diamond, Rudi Dornbusch, Peter Howitt, Nobu Kiyotaki, Mervin King, Richard Layard, N. Gregory Mankiw, Steve Nickell, Jim Poterba, Danny Quah, Christina Romer, David Romer, Julio Rotemberg, José Scheinkman, Dick Startz, Larry Summers, Lars Svensson, John Taylor, Jean Tirole, Mark Watson, and Philippe Weil. We are indebted too to Richard Layard and the Centre for Labour Economics at the London School of Economics for their hospitality, which enabled us to push the book over the hump in the summer of 1987.

Finally, we thank Thomas M. Dolan for his superb editorial assistance, and The MIT Press for a splendid all-around job.

Contents

1 Introduction

Underlying the existence of macroeconomics as a separate field of study are the phenomena of economywide movements in output, unemployment, and inflation. Although developed economies are characterized by growth, this growth is far from steady. Expansions and recessions alternate over time, associated with movements in unemployment. Occasionally, recessions turn into depressions, such as the U.S. depression from 1873 to 1878, the Great Depression of the 1930s, and the long period of high unemployment in Europe in the 1980s. Periods of price deflation, such as the prolonged price level decline in the last two decades of the nineteenth century, the recession of 1920–21, and the Great Depression, appear to be something of the past: most economies now alternate between periods of low and high, sometimes very high, inflation. It is the main purpose of macroeconomics, and of this book, to characterize and explain these movements of output, unemployment, and prices.

In this chapter we introduce the major issues of macroeconomics by characterizing the basic facts that call for explanation. We then provide a preview of the book, and end by stating some of our goals and choices in writing it.

1.1 Macroeconomic Facts

Growth, Employment, and Productivity

The dominant macroeconomic fact in developed economies in the last two centuries is that of output growth.[1] Figure 1.1 shows the behavior of U.S. real GNP from 1874 to 1986.[2] Using Maddison's first estimate of U.S. real GNP, U.S. growth averaged 3.7% per year for the period 1820 to 1986. The average rate of growth has been 3.4% since 1874, 3.0% since 1919, and 3.2% since 1950. Equivalently, real GNP is about 37 times larger than it was

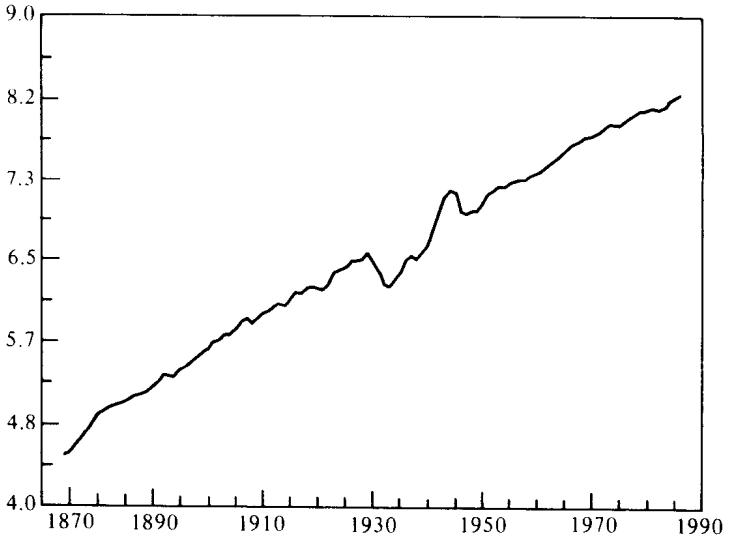

Figure 1.1
Logarithm of real GNP (1982 dollars). Sources for GNP: 1874–89, Romer (1986b, table 3); 1890–1908, Romer (1986b, table 5); 1909–28, Romer (1987, table 5); 1929–47, Commerce Dept. (1986, table 1.4); 1948–86, Economic Report of the President (1987).

in 1874, 7 times larger than in 1919, and 3 times larger than in 1950. Extrapolating backward leads to the well-known conclusion that economic growth at these rates cannot have been taking place for more than a few centuries.

What are the sources of this growth? Here are the stylized facts as laid out by Solow in 1970. First, output growth reflects growth in both the labor force and labor productivity: total labor hours have increased 1.4% per year and output per hour by 2.0% per year since 1874. Thus output growth has come more from increasing labor productivity than from increases in the labor force; this is shown in figure 1.2 which gives total man-hours and output per man-hour for the private domestic sector (i.e., excluding the government) since 1874.[3] Growth in output per man-hour, labor productivity, has been 2.1% since 1919 and 2.1% since 1950; output per man-hour is now nine times higher than it was in 1874, and double its 1950 level.[4]

Where does this growth in living standards, reflected in output per man-hour, come from? How much of it is due to increases in capital and applied knowledge, and to increased specialization? Solow (1957) suggested

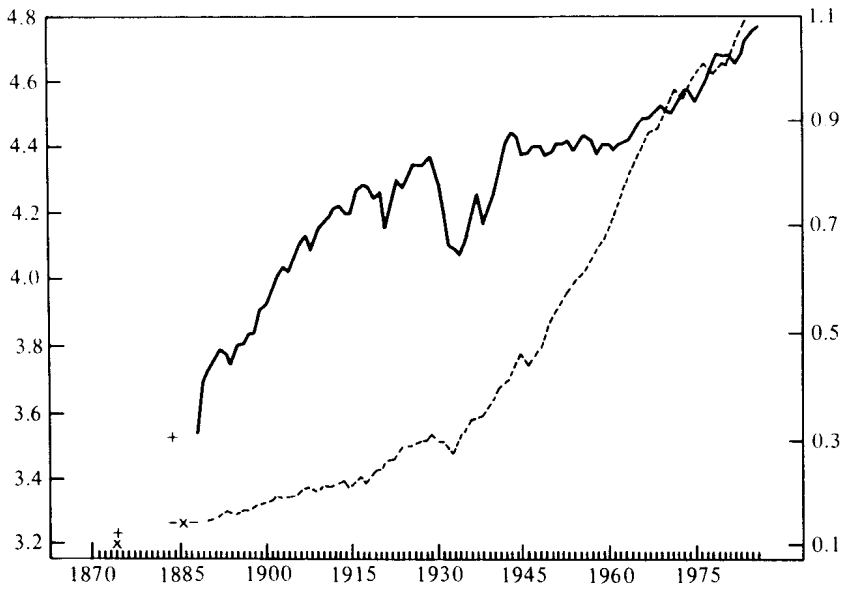

Figure 1.2
Logarithm of man-hours (solid line, left-hand scale) and output per man-hour (dashed line, right-hand scale, 1977 ≡ 1.0). Crosses indicate annual data not available. Sources for GPDP: 1870–1928, Commerce Dept. (1973, LTEG, series A13); 1929–47, Commerce Dept. (1973, LTEG, series A14); 1948–86, Commerce Dept. (1987, table 1). For man-hours: 1870–1947, Commerce Dept. (LTEG, series A59); 1948–86, Commerce Dept. (1987, table 1).

a simple decomposition that, though not theory-free, provides a useful description of the data. Under the assumptions of constant returns to scale and competitive markets, the rate of growth of output can be written as

$$g_y = ag_n + (1 - a)g_k + q,$$

where g_y, g_n, and g_k are the growth rates of output, labor, and capital, respectively, and a is the share of labor in output; q then measures that part of growth that cannot, under the maintained assumptions, be explained by either growth of labor or growth of capital.[5] This term has been dubbed *multifactor productivity growth*, or less formally, the Solow residual.

The data suggest that the Solow residual plays an important role in growth. We can rewrite the above equation as

$$(g_y - g_n) = \left(\frac{1 - a}{a}\right)(g_k - g_y) + \left(\frac{1}{a}\right)q.$$

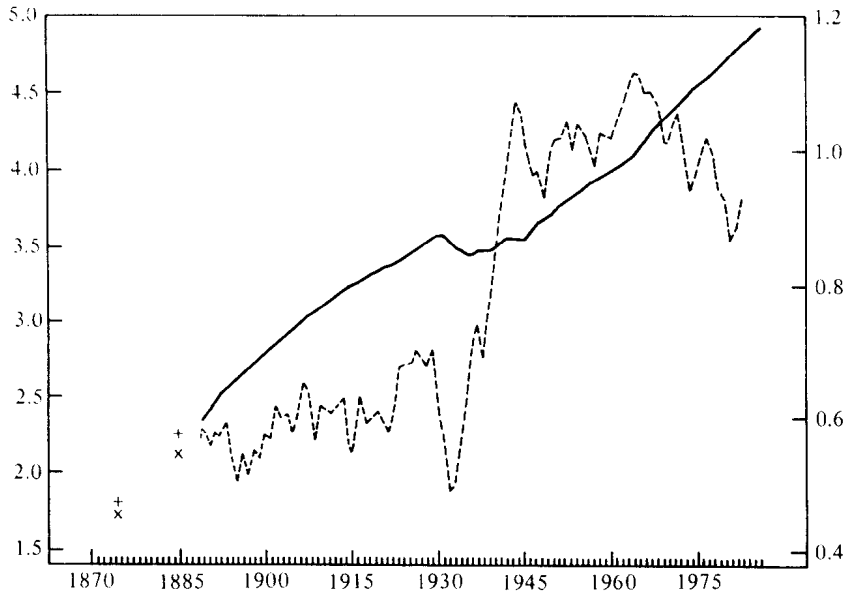

Figure 1.3
Logarithm of capital services (solid line, left-hand scale) and output per unit of capital (dashed line, right-hand scale, 1977 ≡ 1.0). Crosses indicate annual data not available. Sources for GPDP: see figure 1.2. For capital: 1870–1947, Commerce Dept. (1973, series A59); 1948–86, Commerce Dept. (1987, table 1).

The rate of growth of output per man-hour depends positively on the rate of growth of the capital–output ratio and on the Solow residual. There can be labor productivity growth, even if q is equal to zero, as long as the capital–output ratio increases. Existing measures of capital suggest, however, that capital has grown at a rate roughly similar to that of output, so that $g_k - g_y$ has been close to zero. This can be seen in figure 1.3, which shows the evolution of capital as well as the output–capital ratio for the private domestic sector since 1874.[6] The average rate of growth of capital has been 2.8% since 1874, 2.1% since 1919, and 3.4% since 1950.

The relative constancy of the output–capital ratio implies a positive Solow residual, equal roughly to the labor share times the rate of growth of labor productivity. Multifactor productivity, for the private domestic sector, is plotted in figure 1.4. Its rate of change averages 1.9% since 1874, 2.0% since 1919, and 1.7% since 1950, accounting for approximately half of the growth in the private economy over the whole period. Despite the detailed

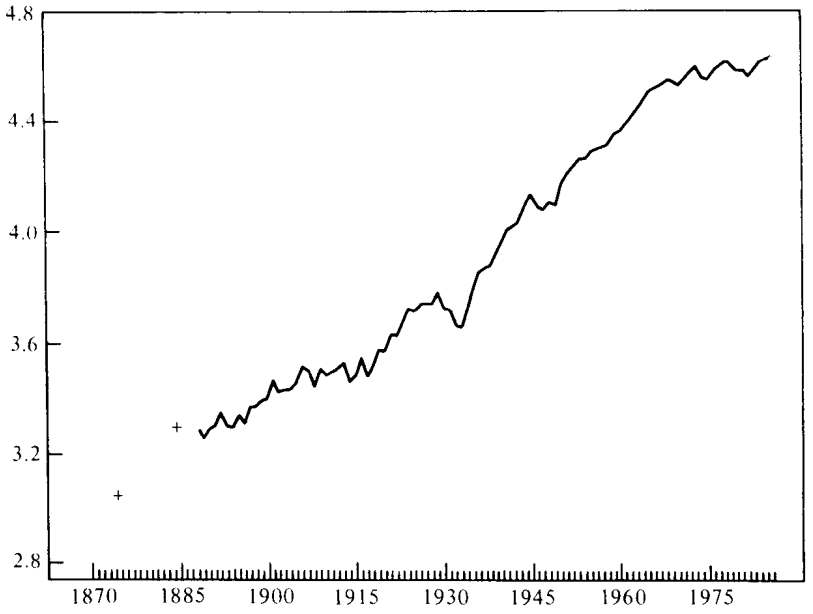

Figure 1.4
Logarithm of multifactor productivity. Crosses indicate annual data not available. Sources for GPDP: see figure 1.2. For total input: 1870–1947, Commerce Dept. (1973, series A59); 1948–86, Commerce Dept. (1987, table 1).

work of Denison and others, we have only a limited understanding of where this residual comes from, and of why it is higher in some countries than in others, or higher during some periods than during others. In seeking to explain the interactions among output, employment, and capital accumulation, we shall for the most part take as given the long-term movements in multifactor productivity.

Both the figures and the data we have presented emphasize the most important fact of modern economic history: persistent long-term growth. But, as the large fluctuations in figures 1.1 to 1.4 make clear, this growth is far from steady. We turn now to the fluctuations.

The Stochastic Behavior of Output and Unemployment

Figure 1.1 shows substantial fluctuations in GNP growth over time. Associated with these movements in output are movements in unemployment, which are plotted for the period since 1890 in figure 1.5. There is little

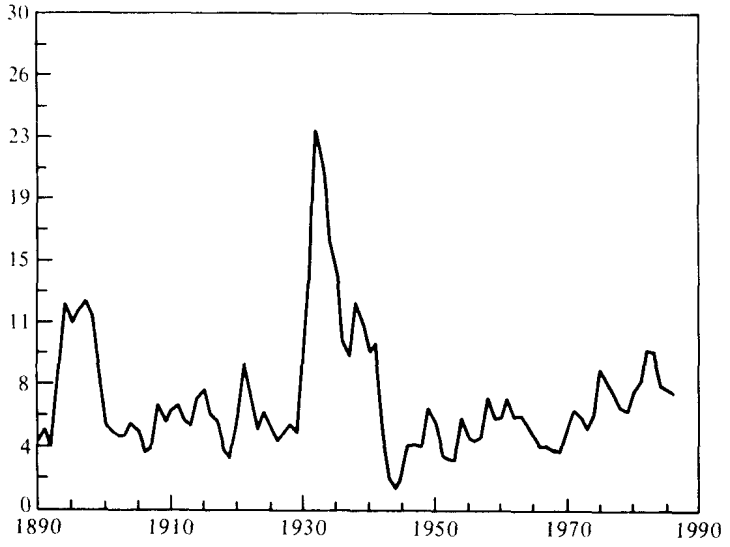

Figure 1.5
Unemployment rate. Sources: 1890–1930, Romer (1986a, table 9); 1931–40, Darby (1976, p. 8); 1940–86, Economic Report of the President (1987).

question that these movements are associated with fluctuations in welfare: periods of boom, expansion, and declining unemployment are widely perceived as happy times in which governments win reelection; periods of recession and depression are often times of crisis and despair.

Explaining booms and recessions will be the object of several chapters of this book, but at this stage we limit ourselves to describing them.[7] Although it is of interest to look at actual movements in output and to see whether fluctuations can be related to specific events or policies, our goal is to describe the general characteristics of fluctuations rather than to study specific episodes. We want to know, for example, how long typical recessions or expansions last, whether fluctuations in output are largely transitory or largely permanent. To do so, we must look at the series for output and other variables as time series with well-defined characteristics and thus use time series methods to uncover those characteristics.

Macroeconomists are, and should be, schizophrenic about the use of time series methods. On the one hand, there is no hope of discovering empirical regularities unless variables follow stable stochastic processes over time. On the other, it is clear that there are episodes, such as depressions or hyperinflations, during which some variables behave abnormally and where

a straightforward use of time series methods would be inappropriate. (Even if there existed a stable Kondratieff process that generated depressions on average every 50 years, this would not help us much given the average length of our macroeconomic time series.) The intellectually uncomfortable attitude of most macroeconomists has been to study these episodes separately, and to use time series methods for times when the assumption that variables follow some stable process is not obviously unacceptable. This is what we do below by focusing on the U.S. postwar period, thus ignoring the Great Depression.

The first systematic time series study of business cycles was that of Burns and Mitchell (1946). Their approach was to treat each cycle as a separate episode, terminating and starting at a trough and going from trough to peak through an expansion, and from peak to trough through a contraction. The typical business cycle was then characterized by the mean lengths of expansions and contractions, the amplitude of fluctuations, and the behavior of economic variables relative to the business cycle chronology. This business cycle chronology was used creatively by researchers in the NBER tradition, for instance, by Friedman and Schwartz (1963) in their monumental *Monetary History*.

Most macroeconometricians, however, have abandoned the Burns-Mitchell methodology. This is because the approach is partly judgmental and the statistics it generates do not have well-defined statistical properties. Much of the recent work has proceeded, instead, under the assumption that variables follow linear stochastic processes with constant coefficients. As we shall see later in the book, this has had the advantage of allowing for a better integration of macroeconomic theory and econometrics. In return for this integration and for well-understood statistical properties, some of the richness of the Burns-Mitchell analysis, such as its focus on asymmetries between recessions and expansions or its notion of business cycle time (as opposed to calendar time) may well have been lost.[8] For the postwar United States, however, the assumption that major economic variables follow linear (or loglinear) stochastic processes does not appear too strongly at variance with the data.

Trends versus Cycles, Permanent and Transitory Shocks

The main problem macroeconomists have struggled with in characterizing output fluctuations has been that of separating trend from cycle. This decomposition can be seen as a purely statistical issue devoid of economic significance.[9] Most economists, however, believe that, behind short-run