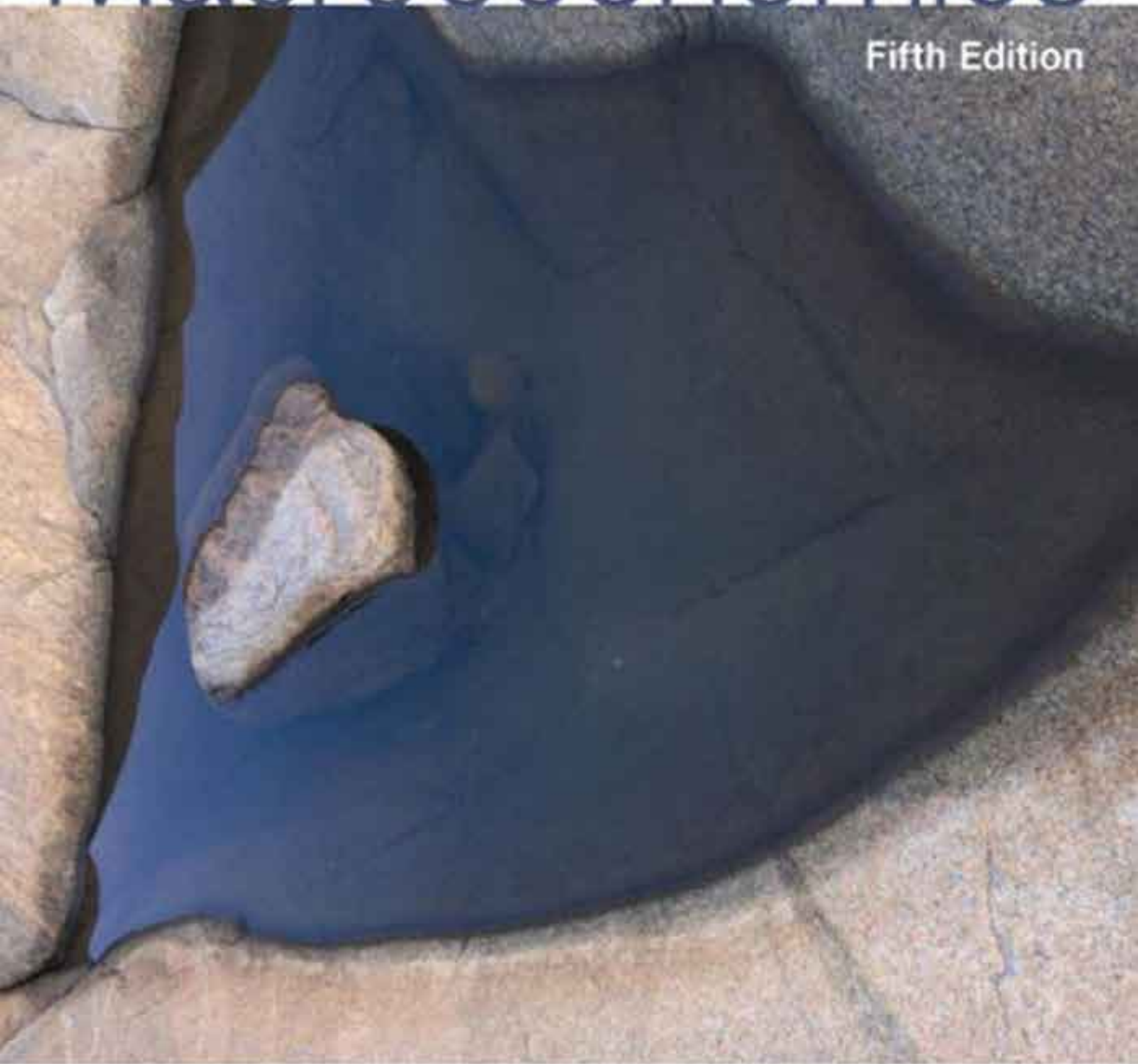# Macroeconomics

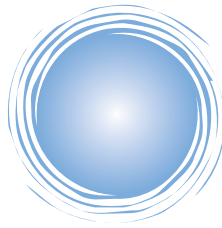**Fifth Edition**

Stephen D. Williamson

Macroeconomics

Fifth Edition

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Washington University in St. Louis

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CONTENTS

PREFACE

This book follows a modern approach to macroeconomics by building macroeconomic models from microeconomic principles. As such, it is consistent with the way that macroeconomic research is conducted today.

This approach has three advantages. First, it allows deeper insights into economic growth processes and business cycles, the key topics in macroeconomics. Second, an emphasis on microeconomic foundations better integrates the study of macroeconomics with approaches that students learn in courses in microeconomics and in field courses in economics. Learning in macroeconomics and microeconomics thus becomes mutually reinforcing, and students learn more. Third, in following an approach to macroeconomics that is consistent with current macroeconomic research, students will be better prepared for advanced study in economics.

What's New in the Fifth Edition

The first four editions of *Macroeconomics* had an excellent reception in the market. In the fifth edition, I build on the strengths of the first four editions, while producing a framework for students of macroeconomics that captures all of the latest developments in macroeconomic thinking, applied to recent economic events and developments in macroeconomic policy. The financial crisis in 2008–2009, the resulting worldwide recession, and the responses of monetary and fiscal policy to these events have introduced a rich array of macroeconomic issues that have been addressed in the fourth edition, and further in this revision. The book has been adapted to show how existing macroeconomic theory allows us to organize our thinking about the recent financial crisis and recession. As well, new material has been added to deepen the student's knowledge of the financial market factors that were important in recent events, and to examine and critically evaluate some of the unusual recent policy interventions by the U.S. government and the Federal Reserve System.

In more detail, the key changes in the fifth edition are:

- Chapter 6, "Search and Unemployment," is entirely new. This chapter presents an accessible version of the search and matching model for which Peter Diamond, Dale Mortensen, and Christopher Pissarides received the Nobel Prize in 2010. This basic search model has become a workhorse for research in labor economics and macroeconomics over the last 30 years. This model allows us to understand the determinants of unemployment, and to successfully address some puzzles regarding the recent behavior of labor markets in the United States, following the financial crisis.

- Chapter 11, "A Real Intertemporal Model with Investment," contains a new section, "Sectoral Shocks and Labor Market Mismatch," which is important for understanding some features of the 2008–2009 recession and the recovery from the recession.

- In Chapter 12, "Money, Banking, Prices, and Monetary Policy," the approach to money demand has been simplified, and new material has been added on monetary policy rules, the liquidity trap, and quantitative easing. This material is critical for understanding monetary policy in the United States and other countries during and since the financial crisis.

- In Chapter 13, "Business Cycles with Flexible Prices and Wages," a new section is included on "A New Monetarist Model: Financial Crises and Deficient Liquidity," which captures some causes of the financial crisis and explores the appropriate policy responses.

- Chapters 15 and 16, which cover international economics, have been revised extensively. In particular, an addition to Chapter 16 is the treatment of a New Keynesian sticky-price open economy model.

- New end-of-chapter problems have been added.

- New "Theory Confronts the Data" and "Macroeconomics in Action" features have been added to cover recent macroeconomic events and macroeconomic policy issues, particularly as they relate to the financial crisis, and the 2008–2009 recession.

- The "Working with the Data" sections at the end of each chapter have been revised extensively so students can use the FRED database, provided by the Federal Reserve Bank of St. Louis.

Structure

The text begins with Part I, which provides an introduction and study of measurement issues. Chapter 1 describes the approach taken in the book and the key ideas that students should take away. It previews the important issues that will be addressed throughout the book, along with some recent issues in macroeconomics, and the highlights of how these will be studied. Measurement is discussed in Chapters 2 and 3, first with regard to gross domestic product, prices, savings, and wealth, and then with regard to business cycles. In Chapter 3, we develop a set of key business cycle facts that will be used throughout the book, particularly in Chapters 13 and 14, where we investigate how alternative business cycle theories fit the facts.

Our study of macroeconomic theory begins in Part II. In Chapter 4, we study the behavior of consumers and firms in detail. In the one-period model developed in Chapter 5, we capture the behavior of all consumers and all firms in the economy with a single representative consumer and a single representative firm. The one-period model is used to show how changes in government spending and total factor productivity affect aggregate output, employment, consumption, and the real wage, and we analyze how proportional income taxation matters for aggregate activity and government tax revenue. In Chapter 6, a one-period search model of unemployment is studied, which can capture some important details of labor market behavior in a macroeconomic context. This search model permits an understanding of the determinants of unemployment, and an explanation for some of the recent unusual labor market behavior observed in the United States.

With a basic knowledge of static macroeconomic theory from Part II, we proceed in Part III to the study of the dynamic process of economic growth. In Chapter 7 we discuss a set of economic growth facts, which are then used to organize our thinking in the context of models

of economic growth. The first growth model we examine is a Malthusian growth model, consistent with the late-eighteenth century ideas of Thomas Malthus. The Malthusian model predicts well the features of economic growth in the world before the Industrial Revolution, but it does not predict the sustained growth in per capita incomes that occurred in advanced countries after 1800. The Solow growth model, which we examine next, does a good job of explaining some important observations concerning modern economic growth. Finally, Chapter 7 explains growth accounting, which is an approach to disentangling the sources of growth. In Chapter 8, we discuss income disparities across countries in light of the predictions of the Solow model, and introduce a model of endogenous growth.

In Part IV, we first use the theory of consumer and firm behavior developed in Part II to construct (in Chapter 9) a two-period model that can be used to study consumption–savings decisions and the effects of government deficits on the economy. Chapter 10 extends the two-period model to include credit market imperfections, an approach that is important for understanding the recent global financial crisis, fiscal policy, and social security. The two-period model is then further extended to include investment behavior and to address a wide range of macroeconomic issues in the real intertemporal model of Chapter 11. This model will then serve as the basis for much of what is done in the remainder of the book.

In Part V, we include monetary phenomena in the real intertemporal model of Chapter 11, so as to construct a monetary intertemporal model. This model is used in Chapter 12 to study the role of money and alternative means of payment, to examine the effects of changes in the money supply on the economy, and to study the role of monetary policy. Then, in Chapters 13 and 14, we study theories of the business cycle with flexible wages and prices, as well as New Keynesian business cycle theory. These theories are compared and contrasted, and we examine how alternative business cycle theories fit the data and how they help us to understand recent business cycle behavior in the United States.

Part VI is devoted to international macroeconomics. In Chapter 15, the models of Chapters 9 and 11 are used to study the determinants of the current account surplus, and the effects of shocks to the macroeconomy that come from abroad. Then, in Chapter 16, we show how exchange rates are determined, and we investigate the roles of fiscal and monetary policy in an open economy that trades goods and assets with the rest of the world.

Finally, Part VII examines some important topics in macroeconomics. In Chapter 17, we study in more depth the role of money in the economy, the effects of money growth on inflation and aggregate economic activity, banking, and deposit insurance. Then, in Chapter 18, we see how central banks can cause inflation, because they cannot commit themselves to a low-inflation policy. We also study in this chapter how inflation has been reduced over the last 25 years in the United States, and how current monetary policy exposes the U.S. economy to the risk of future inflation.

Features

Several key features enhance the learning process and illuminate critical ideas for the student. The intent is to make macroeconomic theory transparent, accessible, and relevant.

Real–World Applications

Applications to current and historical problems are emphasized throughout in two running features. The first is a set of "Theory Confronts the Data" sections, which show how macroeconomic theory comes to life in matching (or sometimes falling short of matching) the characteristics of

real-world economic data. A sampling of some of these sections includes consumption smoothing and the stock market; productivity, unemployment, and real GDP in the United States and Canada; the 2008–2009 recesssion; and interest rate spreads and aggregate economic activity.

The second running feature is a series of "Macroeconomics in Action" boxes. These real-world applications relating directly to the theory encapsulate ideas from front-line research in macroeconomics, and they aid students in understanding the core material. For example, some of the subjects examined in these boxes are the natural rate of unemployment and the 2008–2009 recession; business cycle models and the Great Depression; and New Keynesian models, the zero lower bound, and quantitative easing.

Art Program

Graphs and charts are plentiful in this book, as visual representations of macroeconomic models that can be manipulated to derive important results, and for showing the key features of important macro data in applications. To aid the student, graphs and charts use a consistent two-color system that encodes the meaning of particular elements in graphs and of shifts in curves.

End–of–Chapter Summary and List of Key Terms

Each chapter wraps up with a bullet-point summary of the key ideas contained in the chapter, followed by a glossary of the chapter's key terms. The key terms are listed in the order in which they appear in the chapter, and they are highlighted in bold typeface where they first appear.

Questions for Review

These questions are intended as self-tests for students after they have finished reading the chapter material. The questions relate directly to ideas and facts covered in the chapter, and answering them will be straightforward if the student has read and comprehended the chapter material.

Problems

The end-of-chapter problems will help the student in learning the material and applying the macroeconomic models developed in the chapter. These problems are intended to be challenging and thought-provoking.

"Working with the Data" Problems

These problems are intended to encourage students to learn to use the FRED database at the St. Louis Federal Reserve Bank, accessible at http://research.stlouisfed.org/fred2/. FRED assembles most important macroeconomic data for the United States (and for some other countries as well) in one place, and allows the student to manipulate the data and easily produce charts. The problems are data applications relevant to the material in the chapter.

Notation

For easy reference, definitions of all variables used in the text are contained on the end papers.

Mathematics and Mathematical Appendix

In the body of the text, the analysis is mainly graphical, with some knowledge of basic algebra required; calculus is not used. However, for students and instructors who desire a more rigorous treatment of the material in the text, a mathematical appendix develops the key models and

results more formally, assuming a basic knowledge of calculus and the fundamentals of mathematical economics. The Mathematical Appendix also contains problems on this more advanced material.

Flexibility

This book was written to be user-friendly for instructors with different preferences and with different time allocations. The core material that is recommended for all instructors is the following:

Chapter 1. Introduction

Chapter 2. Measurement

Chapter 3. Business Cycle Measurement

Chapter 4. Consumer and Firm Behavior: The Work–Leisure Decision and Profit Maximization

Chapter 5. A Closed-Economy One-Period Macroeconomic Model

Chapter 9. A Two-Period Model: The Consumption–Savings Decision and Credit Markets

Chapter 11. A Real Intertemporal Model with Investment

Some instructors find measurement issues uninteresting, and may choose to omit parts of Chapter 2, though at the minimum instructors should cover the key national income accounting identities. Parts of Chapter 3 can be omitted if the instructor chooses not to emphasize business cycles, but there are some important concepts introduced here that are generally useful in later chapters, such as the meaning of correlation and how to read scatter plots and time series plots.

Chapter 6 is a chapter new to this edition, and introduces a search model of unemployment. This is a one-period framework, which fits with the emphasis of Part II on static models, but the model allows for an explicit treatment of the determinants of unemployment by including a search friction. The model allows for an interesting treatment of labor market issues, but it is possible to skip this chapter if the instructor and students prefer to focus on other topics.

Chapters 7 and 8 introduce economic growth at an early stage, in line with the modern role of growth theory in macroeconomics. However, Chapters 7 and 8 are essentially self-contained, and nothing is lost from leaving growth until later in the sequence—for example, after the business cycle material in Chapters 13 and 14. Though the text has an emphasis on microfoundations, Keynesian analysis receives a balanced treatment. For example, we study a Keynesian coordination failure model in Chapter 13, and examine a New Keynesian sticky price model in Chapter 14. Keynesian economics is fully integrated with flexible-wage-and-price approaches to business cycle analysis, and the student does not need to learn a separate modeling framework, as for example the New Keynesian sticky price model is simply a special case of the general modeling framework developed in Chapter 12. Those instructors who choose to ignore Keynesian analysis can do so without any difficulty. Instructors can choose to emphasize economic growth or business cycle analysis, or they can give their course an international focus. As well, it is possible to deemphasize monetary factors. As a guide, the text can be adapted as follows:

Focus on Models with Flexible Wages and Prices. Omit Chapter 14 (New Keynesian Economics: Sticky Prices).

Focus on Economic Growth. Include Chapters 7 and 8, and consider dropping Chapters 12, 13, and 14, depending on time available.

Focus on Business Cycles. Drop Chapters 7 and 8, and include Chapters 6, 12, 13, and 14.

International Focus. Chapters 15 and 16 can be moved up in the sequence. Chapter 15 can follow Chapter 11, and Chapter 16 can follow Chapter 12.

Advanced Mathematical Treatment. Add material as desired from the Mathematical Appendix.

Supplements

The following materials that accompany the main text will enrich the intermediate macroeconomics course for instructors and students alike.

Instructor's Manual/Test Bank

Written by the author, the Instructor's Manual/Test Bank provides strong instructor support. The Instructor's Manual portion contains sections on Teaching Goals, which give an aerial view of the chapters; classroom discussion topics, which explore lecture-launching ideas and questions; chapter outlines; and solutions to all Questions for Review and Problems found in the text. The Test Bank portion contains multiple-choice questions and answers. The Test Bank is also available in Test Generator Software (TestGen-EQ with QuizMaster-EQ). Fully networkable, this software is available for Windows and Macintosh. TestGen-EQ's friendly graphical interface enables instructors to easily view, edit, and add questions; export questions to create tests; and print tests in a variety of fonts and forms. Search and sort features let the instructor quickly locate questions and arrange them in a preferred order. QuizMaster-EQ automatically grades the exams, stores results on a disk, and allows the instructor to view or print a variety of reports. The Instructor's Manual and Test Bank can be found on the instructor's portion of the Web site accompanying this book at www.pearsonhighered.com/williamson.

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Stephen Williamson is Robert S. Brookings Distinguished Professor in Arts and Sciences, Washington University in St. Louis, a Research Fellow at the Federal Reserve Bank of St. Louis, and an academic visitor at the Richmond Federal Reserve Bank. He received a B.Sc. in Mathematics and an M.A. in Economics from Queen's University in Kingston, Canada, and his Ph.D. from the University of Wisconsin–Madison. He has held academic positions at Queen's University, the University of Western Ontario, and the University of Iowa, and has worked as an economist at the Federal Reserve Bank of Minneapolis and the Bank of Canada. Professor Williamson has been an academic visitor at the Federal Reserve Banks of Atlanta, Cleveland, Kansas City, Minneapolis, New York, Philadelphia, the Bank of Canada, and the Board of Governors of the Federal Reserve System. He has also been a long-term visitor at the London School of Economics; the University of Edinburgh; Tilburg University, the Netherlands; Victoria University of Wellington, New Zealand; Seoul National University; Hong Kong University; Queen's University; and the University of Sydney. Professor Williamson has published scholarly articles in the *American Economic Review,* the *Journal of Political Economy,* the *Quarterly Journal of Economics,* the *Review of Economic Studies,* the *Journal of Economic Theory,* and the *Journal of Monetary Economics,* among other prestigious economics journals.

PART 1

Introduction and Measurement Issues

Part I contains an introduction to macroeconomic analysis and a description of the approach in this text of building useful macroeconomic models based on microeconomic principles. We discuss the key ideas that are analyzed in the rest of this text as well as some current issues in macroeconomics. Then, to lay a foundation for what is done later, we explore how the important variables relating to macroeconomic theory are measured in practice. Finally, we analyze the key empirical facts concerning business cycles. The macroeconomic theory developed in Parts II to VII is aimed at understanding the key ideas and issues discussed in the introduction, and in showing the successes and failures of theory in organizing our thinking about empirical facts.

chapter 1

Introduction

This chapter frames the approach to macroeconomics that we take in this text, and it foreshadows the basic macroeconomic ideas and issues that we develop in later chapters. We first discuss what macroeconomics is, and we then go on to look at the two phenomena that are of primary interest to macroeconomists—economic growth and business cycles—in terms of post-1900 U.S. economic history. Then, we explain the approach this text takes—building macroeconomic models with microeconomic principles as a foundation—and discuss the issue of disagreement in macroeconomics. Finally, we explore the key lessons that we learn from macroeconomic theory, and we discuss how macroeconomics helps us understand recent and current issues.

What Is Macroeconomics?

Macroeconomists are motivated by large questions and by issues that affect many people and many nations of the world. Why are some countries exceedingly rich while others are exceedingly poor? Why are most Americans so much better off than their parents and grandparents? Why are there fluctuations in aggregate economic activity? What causes inflation? Why is there unemployment?

Macroeconomics is the study of the behavior of large collections of economic agents. It focuses on the aggregate behavior of consumers and firms, the behavior of governments, the overall level of economic activity in individual countries, the economic interactions among nations, and the effects of fiscal and monetary policy. Macroeconomics is distinct from microeconomics in that it deals with the overall effects on economies of the choices that all economic agents make, rather than on the choices of individual consumers or firms. Since the 1970s, however, the distinction between microeconomics and macroeconomics has blurred in that microeconomists and macroeconomists now use much the same kinds of tools. That is, the **economic models** that macroeconomists use, consisting of descriptions of consumers and firms, their objectives and constraints, and how they interact, are built up from microeconomic principles, and these models are typically analyzed and fit to data using methods similar to those used by microeconomists. What continues to make macroeconomics distinct, though, is the issues it focuses on, particularly **long-run growth** and **business cycles**. Long-run growth refers to the increase in a nation's productive capacity and average standard of living that occurs over a long period

of time, whereas business cycles are the short-run ups and downs, or booms and recessions, in aggregate economic activity.

An important goal in this text is to consistently build up macroeconomic analysis from microeconomic principles. There is some effort required in taking this type of approach, but the effort is well worth it. The result is that you will understand better how the economy works and how to improve it.

Gross Domestic Product, Economic Growth, and Business Cycles

To begin our study of macroeconomic phenomena, we must first understand what facts we are trying to explain. The most basic set of facts in macroeconomics has to do with the behavior of aggregate economic activity over time. One measure of aggregate economic activity is **gross domestic product (GDP)**, which is the quantity of goods and services produced within a country's borders during some specified period of time. GDP also represents the quantity of income earned by those contributing to domestic output. In Figure 1.1 we show real GDP per capita for the United States for the period 1900–2011. This is a measure of aggregate output that adjusts for inflation and population growth, and the unit of measure is thousands of 2005 dollars per person.

The first observation we can make concerning Figure 1.1 is that there has been sustained growth in per capita GDP during the period 1900–2011. In 1900, the average income for an American was $4,793 (2005 dollars), and this grew to $42,733 (2005 dollars) in 2011. Thus, the average American became almost nine times richer in real terms over the course of 111 years, which is quite remarkable! The second important observation from Figure 1.1 is that, while growth in per capita real GDP was sustained over long periods of time in the United States during the period 1900–2011, this growth was certainly not steady. Growth was higher at some times than at others, and there were periods over which per capita real GDP declined. These fluctuations in economic growth are business cycles.

Two key, though unusual, business cycle events in U.S. economic history that show up in Figure 1.1 are the Great Depression and World War II, and these events dwarf any other twentieth-century business cycle events in the United States in terms of the magnitude of the short-run change in economic growth. During the Great Depression, real GDP per capita dropped from a peak of $8,016 (2005 dollars) per person in 1929 to a low of $5,695 (2005 dollars) per person in 1933, a decline of about 29%. At the peak of war production in 1944, GDP had risen to $14,693 (2005 dollars) per person, an increase of 158% from 1933. These wild gyrations in aggregate economic activity over a 15-year period are as phenomenal, and certainly every bit as interesting, as the long-run sustained growth in per capita GDP that occurred from 1900 to 2011. In addition to the Great Depression and World War II, Figure 1.1 shows other business cycle upturns and downturns in the growth of per capita real GDP in the United States that, though less dramatic than the Great Depression or World War II, represent important macroeconomic events in U.S. history.

Figure 1.1, thus, raises the following fundamental macroeconomic questions, which motivate much of the material in this book:

Figure 1.1 Per Capita Real GDP (in 2005 dollars) for the United States, 1900–2011

Per capita real GDP is a measure of the average level of income for a U.S. resident. Two unusual, though key, events in the figure are the Great Depression, when there was a large reduction in living standards for the average American, and World War II, when per capita output increased greatly.
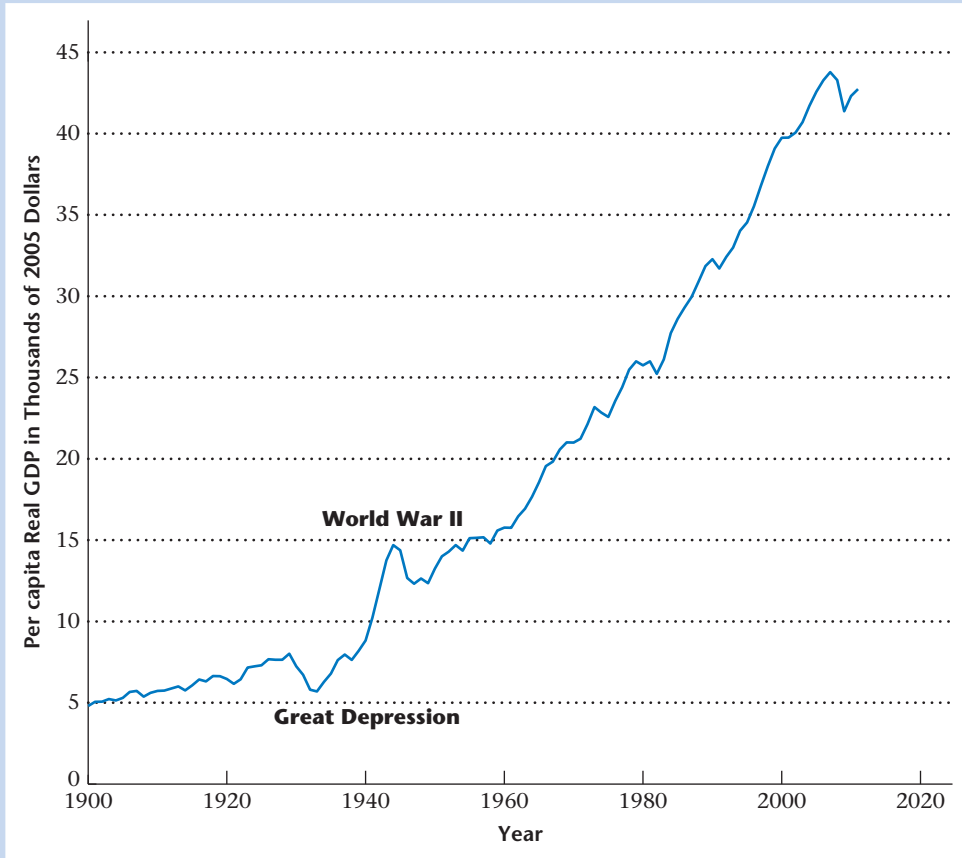
1. What causes sustained economic growth?
2. Could economic growth continue indefinitely, or is there some limit to growth?
3. Is there anything that governments can or should do to alter the rate of economic growth?
4. What causes business cycles?
5. Could the dramatic decreases and increases in economic growth that occurred during the Great Depression and World War II be repeated?
6. Should governments act to smooth business cycles?

    In analyzing economic data to study economic growth and business cycles, it often proves useful to transform the data in various ways, so as to obtain sharper insights. For

economic time series that exhibit growth, such as per capita real GDP in Figure 1.1, a useful transformation is to take the natural logarithm of the time series. To show why this is useful, suppose that y_t is an observation on an economic time series in period t; for example, y_t could represent per capita real GDP in year t, where $t = 1900, 1901, 1902$, etc. Then, the growth rate from period $t - 1$ to period t in y_t can be denoted by g_t, where

$$g_t = \frac{y_t}{y_{t-1}} - 1.$$

Now, if x is a small number, then $\ln(1 + x) \approx x$, that is, the natural logarithm of $1 + x$ is approximately equal to x. Therefore, if g_t is small,

$$\ln(1 + g_t) \approx g_t,$$

or

$$\ln\left(\frac{y_t}{y_{t-1}}\right) \approx g_t,$$

or

$$\ln y_t - \ln y_{t-1} \approx g_t.$$

Because $\ln y_t - \ln y_{t-1}$ is the slope of the graph of the natural logarithm of y_t between periods $t - 1$ and t, the slope of the graph of the natural logarithm of a time series y_t is a good approximation to the growth rate of y_t when the growth rate is small.

In Figure 1.2, we graph the natural logarithm of real per capita GDP in the United States for the period 1900–2011. As explained above, the slope of the graph is a good approximation to the growth rate of real per capita GDP, so that changes in the slope (e.g., when there is a slight increase in the slope of the graph in the 1950s and 1960s) represent changes in the growth rate of real per capita GDP. It is striking that in Figure 1.2, except for the Great Depression and World War II, a straight line would fit the graph quite well. That is, over the period 1900–2011 (again, except for the Great Depression and World War II), growth in per capita real GDP has been "roughly" constant at about 2.0% per year.

A second useful transformation to carry out on an economic time series is to separate the series into two components: the growth or **trend** component, and the business cycle component. For example, the business cycle component of real per capita GDP can be captured as the deviations of real per capita GDP from a smooth trend fit to the data. In Figure 1.3, we show the trend in the natural log of real per capita GDP as a colored line,[1] while the natural log of actual real per capita GDP is the black line. We then define the business cycle component of the natural log of real per capita GDP to be the difference between the black line and the colored line in Figure 1.3. The logic behind this decomposition of real per capita GDP into trend and business cycle components is that it is often simpler and more productive to consider separately the theory that explains trend growth and the theory that explains business cycles, which are the deviations from trend.

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[1] Trend GDP was computed using a Hodrick–Prescott filter, as in E. Prescott, Fall 1986. "Theory Ahead of Business Cycle Measurement," *Federal Reserve Bank of Minneapolis Quarterly Review* 10, 9–22.

Figure 1.2 Natural Logarithm of Per Capita Real GDP

Here, the slope of the graph is approximately equal to the growth rate of per capita real GDP. Excluding the Great Depression and World War II, the growth rate of per capita real GDP is remarkably close to being constant for the period 1900–2011. That is, a straight line would fit the graph fairly well.
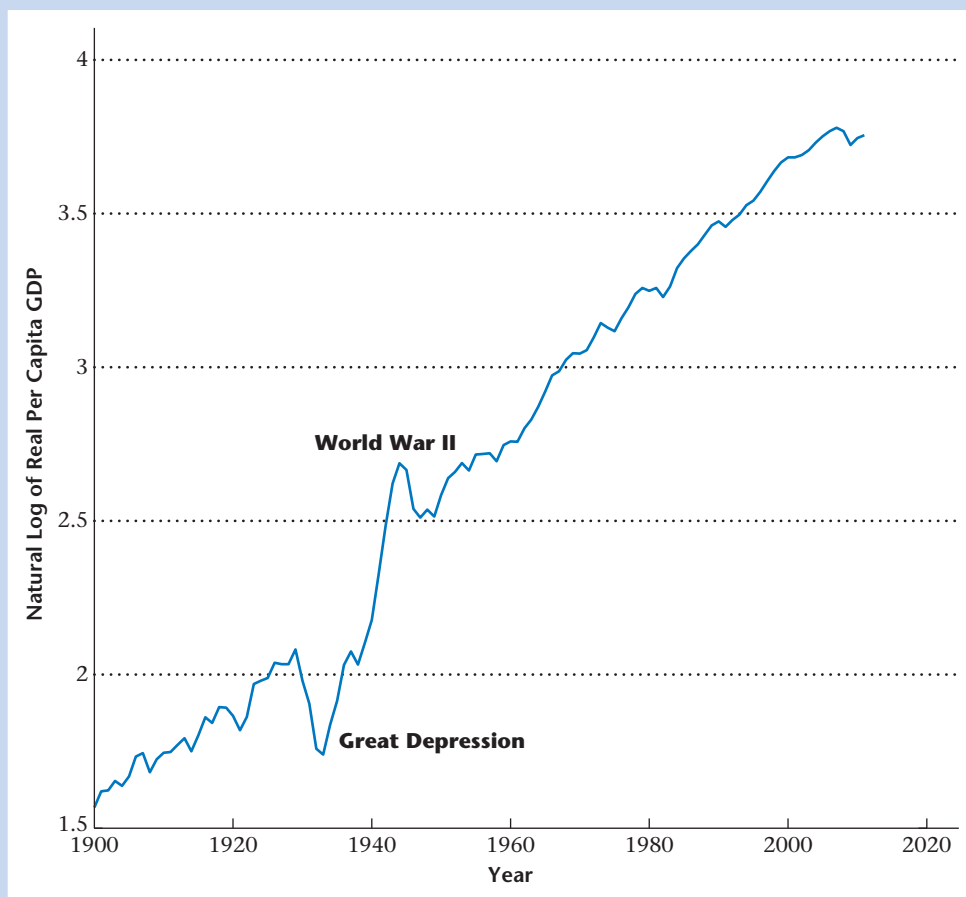
In Figure 1.4, we show only the percentage deviations from trend in real per capita GDP. The Great Depression and World War II represent enormous deviations from trend in real per capita GDP relative to anything else during the time period in the figure. During the Great Depression the percentage deviation from trend in real per capita GDP was close to −20%, whereas the percentage deviation from trend was about 20% during World War II. In the period after World War II, which is the focus of most business cycle analysis, the deviations from trend in real per capita GDP are at most about ±5%.[2]

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[2]The extremely large deviation from trend in real per capita GNP in the late 1920s is principally a statistical artifact of the particular detrending procedure used here, which is akin to drawing a smooth curve through the

Figure 1.3 Natural Logarithm of Real Per Capita GDP and Trend

Sometimes it is useful to separate long-run growth from business cycle fluctuations. In the figure, the black line is the natural log of per capita real GDP, while the colored line denotes a smooth growth trend fit to the data. The deviations from the smooth trend then represent business cycles.
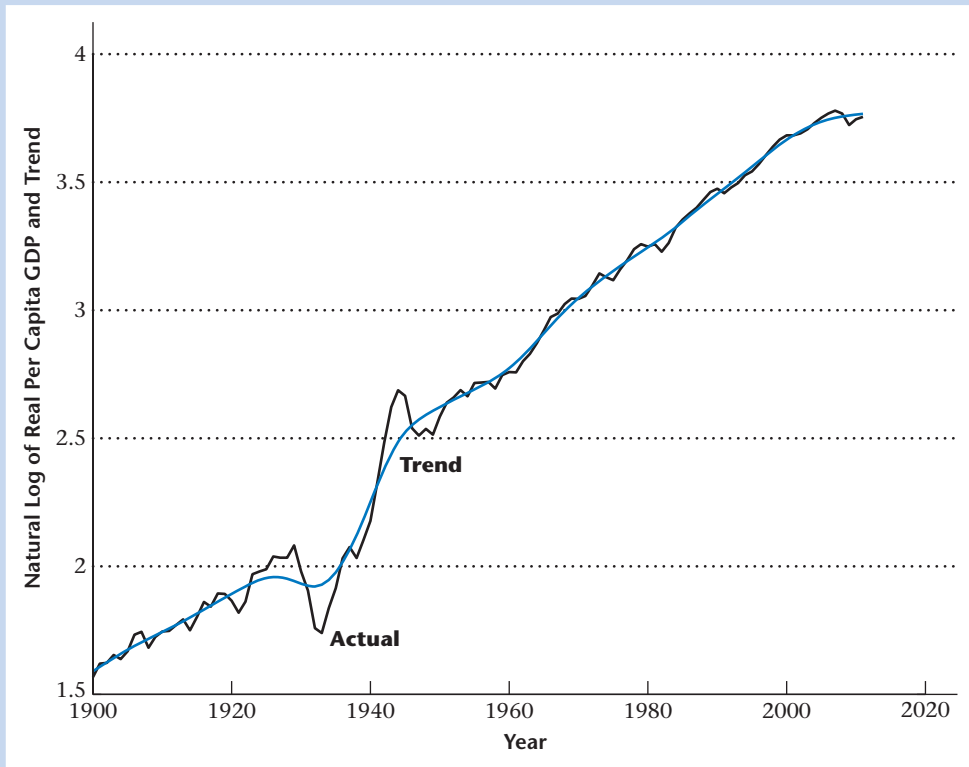
Macroeconomic Models

Economics is a scientific pursuit involving the formulation and refinement of theories that can help us better understand how economies work and how they can be improved. In some sciences, such as chemistry and physics, theories are tested through laboratory experimentation. In economics, experimentation is a new and growing activity, but for most economic theories experimental verification is simply impossible. For example, suppose an economist constructs a theory that implies that U.S. output would drop by half if there were no banks in the United States. To evaluate this theory, we could shut down all U.S. banks for a year to see what would happen. Of course, we know in advance that banks play a very important role in helping

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time series. The presence of the Great Depression forces the growth rate in the trend to decrease long before the Great Depression actually occurs.

Figure 1.4 Percentage Deviation from Trend in Real Per Capita GDP

The Great Depression and World War II represent extremely large deviations from trend relative to post–World War II business cycle activity and business cycles before the Great Depression.
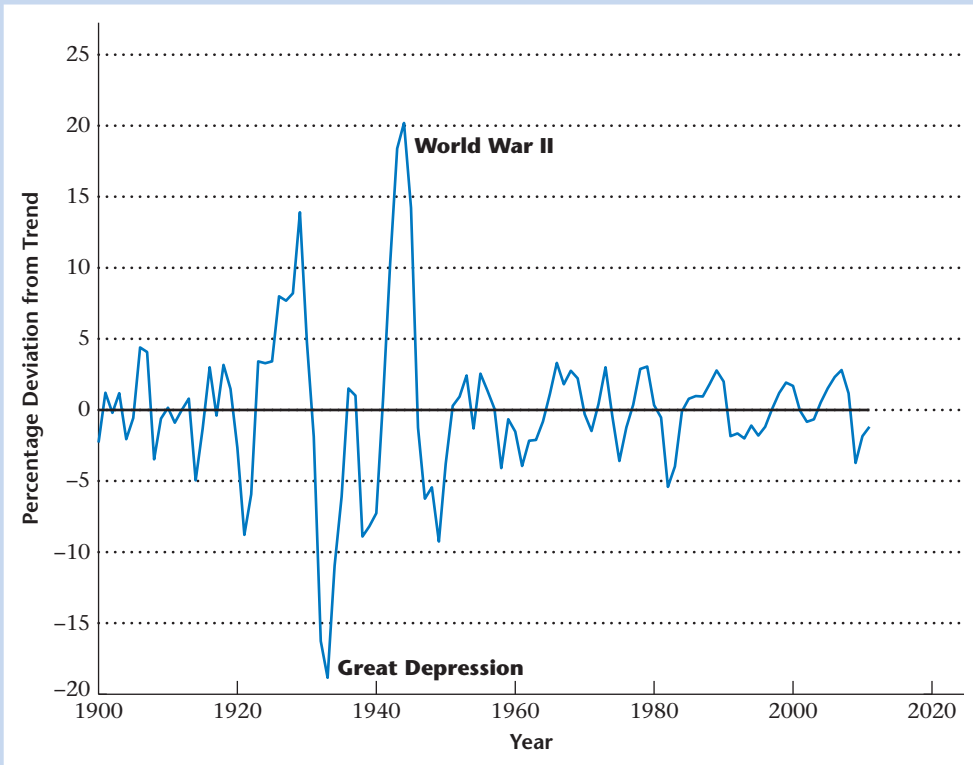
the U.S. economy function efficiently, and that shutting them down for a year would likely cause significant irreparable damage. It is extremely unlikely, therefore, that the experiment would be performed. In macroeconomics, most experiments that could be informative are simply too costly to carry out, and in this respect macroeconomics is much like meteorology or astronomy. In predicting the weather or how planets move in space, meteorologists and astronomers rely on **models**, which are artificial devices that can replicate the behavior of real weather systems or planetary systems, as the case may be.

Just like researchers in meteorology or astronomy, macroeconomists use models, which in our case are organized structures to explain long-run economic growth, why there are business cycles, and what role economic policy should play in the macroeconomy. All economic models are abstractions. They are not completely accurate descriptions of the world, nor are they intended to be. The purpose of an economic model is to capture the essential features of the world needed for analyzing a particular economic problem. To be useful then, a model must be simple, and simplicity requires

that we leave out some "realistic" features of actual economies. For example, a roadmap is a model of a part of the earth's surface, and it is constructed with a particular purpose in mind, to help motorists guide themselves through the road system from one point to another. A roadmap is hardly a realistic depiction of the earth's surface, as it does not capture the curvature of the earth, and it does not typically include a great deal of information on topography, climate, and vegetation. However, this does not limit the map's usefulness; a roadmap serves the purpose for which it was constructed, and it does so without a lot of extraneous detail.

To be specific, the basic structure of a macroeconomic model is a description of the following features:

1. The consumers and firms that interact in the economy
2. The set of goods that consumers wish to consume
3. Consumers' preferences over goods
4. The technology available to firms for producing goods
5. The resources available

In this text, the descriptions of the above five features of any particular macroeconomic model are provided in mathematical and graphical terms.

Once we have a description of the main economic actors in a model economy (the consumers and firms), the goods consumers want, and the technology available to firms for producing goods from available resources, we want to then use the model to make predictions. This step requires that we specify two additional features of the model. First, we need to know what the goals of the consumers and firms in the model are. How do consumers and firms behave given the environment they live in? In all the models we use in this book, we assume that consumers and firms **optimize**, that is, they do the best they can given the constraints they face. Second, we must specify how consistency is achieved in terms of the actions of consumers and firms. In economic models, this means that the economy must be in **equilibrium**. Several different concepts of equilibrium are used in economic models, but the one that we use most frequently in this book is **competitive equilibrium**. In a competitive equilibrium, we assume that goods are bought and sold on markets in which consumers and firms are price-takers; they behave as if their actions have no effect on market prices. The economy is in equilibrium when market prices are such that the quantity of each good offered for sale (quantity supplied) is equal to the quantity that economic agents want to buy (quantity demanded) in each market.

Once we have a working economic model, with a specification of the economic environment, optimizing firms and consumers, and a notion of equilibrium, we can then begin to ask the model questions.[3] One way to think of this process is that the economic model is an experimental apparatus, and we want to attempt to run experiments using this apparatus. Typically, we begin by running experiments for which we know the answers. For example, suppose that we build an economic model so that we can study economic growth. The first experiment we might like to run is to determine, by

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[3]The following description of macroeconomic science is similar to that provided by Robert Lucas in "Methods and Problems in Business Cycle Theory," reprinted in *Studies in Business Cycle Theory*, 1981, MIT Press, pp. 271–296.