ECONOMIC AND BUSINESS FORECASTING

ANALYZING AND INTERPRETING ECONOMIC RESULTS

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Economic and Business Forecasting

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To Tiffani Kaliko, Penny and Sherman
Shahkora and Mohammad Iqbal, Nargis, Saeeda, Shahid and Noreen
And to the family and friends who remain our wellsprings of inspiration

If a man will begin with certainties,
he shall end in doubts,
but if he will content to begin with doubts,
he shall end in certainties.

—Francis Bacon, *The Advancement of Learning*, 1605

Contents

Preface

Due to the Great Recession (2007–2009) and the accompanying financial crisis, the premium on effective economic analysis, especially the identification of time series and then accurate forecasting of economic and financial variables, has significantly increased. Our approach provides a comprehensive yet practical process to quantify and accurately forecast key economic and financial variables. Therefore, the timing of this book is appropriate in a post-2008 world, where the behavior of traditional economic relationships must be reexamined since many appear out of character with the past. The value proposition is clear: The framework and techniques advanced here are the techniques we use as practitioners. These techniques will help decision makers identify and characterize the patterns of behavior in key economic series to better forecast these essential economic series and their relationships to other economic series.

This book is for the broad audience of practitioners as well as undergraduate and graduate students with an applied economics focus. This book introduces statistical techniques that can help practitioners characterize the behavior of economic relationships. Chapters 1 to 3 provide a review of basic economic and financial fundamentals that decision makers in both the private and public sectors need to know. Our belief is that before an analyst attempts any statistical analysis, there should be a clear understanding of the data under study. Chapter 4 provides the tools that an analyst will employ to effectively characterize an economic series. One relationship of interest is the ability of leading indicators to predict the pattern of the business cycle, particularly the onset of a recession. Another way to characterize economic relationships is to reflect on the current trend of any economic series of interest relative to the average behavior over prior cycles. In a third approach, we may be interested in identifying the possibility of a structural change in an economic time series to test if the past history of a variable would be different over time.

Different economic and financial variables exhibit differential behavior over the business cycle and over time. In this book we focus on a select set of major economic and financial variables, such as economic growth, final sales, employment, inflation, interest rates, corporate profits, financial ratios, and the exchange value of the dollar.

Our analysis then extends the text into the relationships between different time series. This analysis begins with Chapter 5, and then in Chapters 6 and 7 we take a look at the SAS® software employed in our analysis. We also examine these variables' patterns over the business cycle, with an emphasis on their recent history, using econometric techniques and the statistical software SAS as a template for the reader to apply to variables of interest. These variables form the core of an effective decision-making process in both the private and public sectors. Chapter 8 provides techniques that an analyst can employ and contains numerous examples of our techniques in action.

Our approach has several advantages. First, effective decision making involves an analysis of the behavior of select economic and financial variables. By choosing a small set of economic factors, we provide a template for decision making that can be easily applicable to a broader set of variables for future study in many economic fields. Our focus is on the importance of a limited, but central, set of select economic and financial variables that provide special insights into economic performance, along with the empirical evidence of their vital role to the economy and financial markets.

Second, using a small set of simple data descriptors and econometric techniques to characterize and describe the behavior of economic variables provides value in a number of contexts. We can examine the behavior of any particular economic series in numerous ways so that the analysis is less subject to personal beliefs and biases. This helps overcome the confirmation bias of many decision makers who *search* for the results they want to see from any analysis. Many analysts may search for the comfortable, familiar historical statistical relationships in a post-2008 era when, in fact, many of those relationships have vanished.

Third, our detailed discussion about SAS and its applications creates a valuable starting point for researchers. We provide a practical forecasting framework for important everyday applications. Finally, our work discusses SAS results and identifies econometric issues and solutions that are of interest to addressing a number of economic and business issues. One outgrowth of our experience with many of these issues is reviewed in Chapter 9, where we focus on our 10 commandments of applied time series forecasting. Chapters 10 and 11 build on these commandments with a focus on single equations in Chapter 10 and multiple equations in Chapter 11.

The net result is the application of econometrics in a way that contributes to effective decision making in both the private and public sectors. In Chapter 12 we focus on model-based forecasting applied to make long-term forecasts for the next five to 10 years, which reflects the reality of determining the real sustainability of projects and their profitability overtime. Chapter 13 then highlights the risks and challenges of such forecasting. Finally in Chapter 14 we illustrate some of the lessons we have learned in

recent years as we identify and understand the changes that are ongoing in the twenty-first-century economy. As an additional resource, there is a test bank to accompany this text.

This book is dedicated first to young professional economists and aspiring students who wish to provide a thoughtful statistical basis for better decision making in their careers, whether it is in the public or the private sector. This book is also aimed to serve professional analysts who wish to provide statistical support for effective decision making. This work reflects the years of experience of the authors whose work contains a focus on simple yet practical techniques needed for efficient decision making without extensive theoretical and mathematical refinements that are ancillary to effective decision making. That we leave for authors with the luxury of time and tenure. The techniques in the text are being used in our work every day. They have brought us numerous forecasting awards and published papers that reflect the practical undertakings required of young professionals who wish to add value to the decision-making process in their organizations.

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We would like to thank all the people who have supported us through the writing and publication of this book. Special thanks to Larry Rothstein and Zachary Griffiths, for without their help this book would not have been possible. We also wish to express our gratitude for the many people at Wells Fargo who have supported this project, including Diane Schumaker-Krieg and John Shrewsberry, as well as the technical support staff at Wells Fargo. Thank you Robert Crow, editor of *Business Economics*, and the referees of that journal as well as the referees of articles that have appeared in other journals; you have improved the quality of our research over the years. We are grateful for the instructors and students who have come into our lives and taught and inspired us (Nuzhat Ahmad, M. S. Butt, Kajal Lahiri, Asad Zaman, Adil Siddique, Ambreen Fatima, Hasan N. Saleem, Jon Schuller, and Anika Khan).

CHAPTER 1

Creating Harmony Out of Noisy Data

By the spring of 2012, the economic performance of the United States was operating at a much different pace from what many analysts had expected. Decision makers in both private and public sectors faced a set of mixed and unclear economic and financial indicators that offered a confused picture of the state of the economic recovery, the pace of that recovery, and the character of the structural challenges facing the economy.

Three major trends characterized the confusion. First, top-line economic growth had been unusually low and uneven relative to past economic recoveries since World War II. During the recovery, the economy accelerated after an initial stimulus but then lost momentum as the stimulus generated no follow-on growth. Decision makers had the difficult challenge of identifying what the true trend in the economy was and what the cycle around that trend was. Had trend economic growth downshifted in the United States?

Second, job growth had become the number one political issue. But the lack of job growth appeared out of line with traditional economic models on a cyclical basis. Further, weak job growth intimated a sharp structural break in both private and public sector decision makers' preconceived understanding of the relationship between employment and population growth. Had there been a structural break between employment and population growth, and/or between employment and output growth? Why have exceptionally low mortgage interest rates not spurred a pickup in housing, as in prior recoveries? Had this relationship experienced a structural break as well?

Third, corporate profits, business equipment spending, and industrial production had improved in this cycle in a way reminiscent of prior recoveries despite the overall perception that the economic recovery had been subpar. How can we identify economic series that appear to be behaving in typical cyclical fashion compared to those that are not?

In this book, we test whether certain series, such as output, employment, profits, and interest rates, exhibit a steady pace of growth over time, or if that pace has drifted. In statistical terms, is the series stationary or not? If not, then oft-used statistical tools cannot be employed to evaluate the behavior of an economic series without introducing statistical bias.

To address these issues effectively, we examine many economic and business series and pursue alternative statistical approaches to make effective decisions based on the application of simple economic and statistical methods. Our work here is in contrast to two common approaches: econometric-only approaches or economic theory-only approaches. Our work returns to an earlier tradition of applied research rather than mathematical elegance, which is an alternative to econometrics that uses all technique with little to no real-world application or all-theory approaches with no technique and only hypotheses about the real world.

EFFECTIVE DECISION MAKING: CHARACTERIZE THE DATA

The first task for many analysts is to characterize the behavior of a particular time series. For example, is there a cyclical component to the data? Many economic data series show some cyclicality, but, alternatively, some are driven more by secular changes in our economy—for example, the labor force participation rate trended steadily higher between the early 1960s and late 1990s as women joined the workforce. Yet often a time series, such as employment, is influenced by both cyclical and secular factors, where the cyclical element may change the pace but not derail longer-term secular shifts in the economy.

If a time series does display a cyclical component, how does it behave as we move through the business cycle? Does the data in the time series decline when the economy is in a recession, or is it countercyclical and increase during a recession, such as the saving rate for households? How distinguishable are turning points in the series? If the series is volatile on a period-to-period basis, a large move in one direction or another may not be enough to signify a turning point, but instead care must be taken with a few recent data points in order to smooth out any volatility and distinguish the true trend. Moreover, do turning points in the time series lead or lag those of other series? Is the time series linear or nonlinear over the period of study?

Part IA: Identifying Trend in a Time Series: GDP and Public Deficits

Throughout the recovery from the Great Recession of 2007 to 2009, the pace of economic growth has been below par, and public sector deficits have persisted. This has led to a greater problem of public debt than many policy makers anticipated when the recovery began. Today, perceptions of the effectiveness

of fiscal policy actions and the competitiveness of the U.S. economy have been brought into question. Both are critically dependent on the estimates of the underlying trend in essential economic variables like growth, inflation, interest rates, corporate profits, and the dollar exchange rate as well as other financial variables. For example, one key issue since the recession of 2007 to 2009 has been to identify the trend pace of economic growth, which, in turn, reflects the influence of underlying economic forces, such as productivity growth and labor force participation. Identifying the trend of these series helps to characterize the pattern of sustainable federal, state, and local revenues that will make for better budgeting in government and help guide policy makers over time.

The question is: What is the trend pace of economic growth, and has that pace downshifted in the United States over recent years? This issue is critical at both federal and state levels of government as well as for the strategic vision of private sector firms when they estimate their top-line revenue growth. Trend growth in the United States is a primary driver of tax revenues and thereby influences the outlook for budget deficits—a key focus of policy today. The ability of federal and state policy makers to balance their budgets depends critically on the pace of economic growth. Trend growth reflects the underlying influence of productivity and labor force participation rates at the national level.

But unfortunately, many decision makers suffer from an anchoring bias.[1] They base decisions on estimates anchored on historical growth rates without consideration that the model of economic growth they are using may have been altered. Nor do they consider that the potential growth of the economy, and therefore federal revenues, has downshifted compared to past estimates.

It is also important to distinguish whether the pace of economic growth, for example, can be described as a linear trend or as a nonlinear trend. If it is a linear trend, then the average pace of growth would provide a useful benchmark for anticipating revenues over time and thereby improve budget forecasts. If the trend is nonlinear, however, then estimating the growth of public revenues becomes more difficult, as will forecasting top-line revenue for private sector businesses. It is also important to know whether the average rate of economic growth has changed over time and whether its volatility has altered as well. Interpreting econometric issues of trend and volatility in a useful context is vital to practical decision making. For example, if the average rate of economic growth has downshifted, private firms are likely to become more cautious in hiring and equipment spending while also increasing oversight on inventories. Similarly, rising volatility for any series suggests a heightened sense of risk in using that series, which will also alter the behavior of decision makers toward an emphasis on avoiding risk.

[1] For a review of the role of bias in decision making, see John E. Silvia (2011), *Dynamic Economic Decision Making* (Hoboken, NJ: John Wiley & Sons).

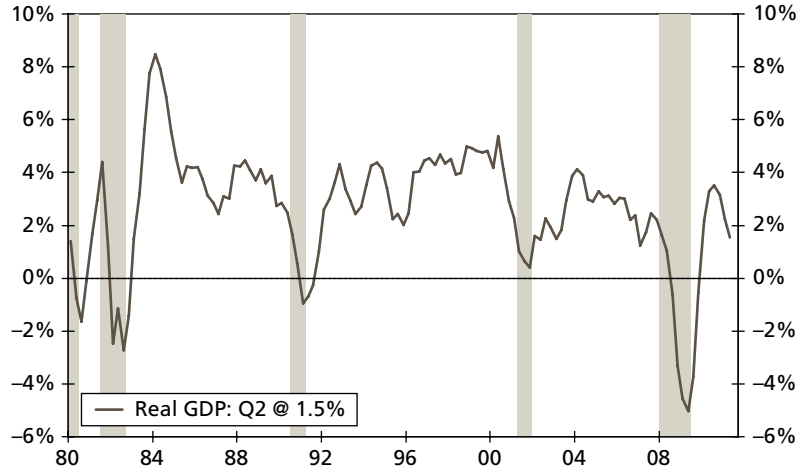

FIGURE 1.1 Real GDP (Year-over-Year Percentage Change)
Source: U.S. Bureau of Economic Analysis

Therefore, the first step in an econometric analysis is to identify the character of a trend in a time series—that is, whether a time series follows a linear or a nonlinear trend. A linear trend indicates a constant growth rate in a series and a nonlinear trend represents a variable growth rate. For trend selection, we will employ different types of methods, including t-value, R-squared, Akaike Information Criteria (AIC), and Schwarz Information Criteria (SIC).[2] A complete estimation process to identify the time in a time series is discussed in Chapter 6, and the U.S. unemployment rate is used as a case study.

Here we focus on the real gross domestic product (GDP) growth rate and determine the type of trend. The results indicate that the real GDP growth rate follows a nonlinear—more likely inverted U-shaped—time trend since 1980. The nonlinear trend implies that the average growth rate of real GDP is not constant over time, and it increases at a faster rate for some periods than others (see Figure 1.1). Since the average growth rate is not constant over time, it is therefore not an easy task to forecast the future real GDP trend.

Another way to characterize the rate of GDP growth is to calculate the mean, standard deviation, and stability ratio for different business cycles. Using a trough-to-trough definition of a business cycle, there were three business cycles between 1982 and 2009. As shown in Table 1.1, the average growth rate for the entire sample is 2.98 percent and the standard deviation is 2.1 percent, which is smaller than the mean. The stability ratio—the standard deviation relative to the mean—is 70.47 percent. However, when we break the series down into periods of individual business cycles, the stability ratio changes. For

[2]The AIC and SIC are information criteria, which help users to choose a better model among their competitors. See Chapter 5 of this book for more details about AIC and SIC.

TABLE 1.1 Real Gross Domestic Product (Year-over-Year Percentage Change)

Period	Mean	Std. Dev.	Stability Ratio	Trend
1982:Q4–1991:Q1	3.71	2.14	57.68	Nonlinear, more similar to to an inverted U-shape
1991:Q1–2001:Q4	3.20	1.61	50.31	
2001:Q4–2009:Q2	1.66	2.24	134.94	
1982:Q4–2009:Q2	2.98	2.10	70.47	

instance, the highest average growth rate during 1982 to 2009 is attached to the 1982 to 1991 business cycle; after that, the average growth rate declined in each subsequent business cycle. The most volatile business cycle is the 2001 to 2009 cycle, as this period experienced the smallest average growth rate along with the highest standard deviation.

Both trend and business cycle analysis reveal that the average real GDP growth varies over time, with some periods having a higher average growth rate than others, as shown in Table 1.1. Moreover, the average growth rate has a decreasing trend over time, while swings in GDP growth—evidenced by the stability ratio—have gotten larger. Note the growth rate for the 2001 to 2009 period is far below the pace of 1982 to 1991 and 1991 to 2001 periods. Meanwhile, the stability ratio for the 2001 to 2009 period exceeds that of the two earlier periods.

Part IB: Identifying the Cycle for a Time Series

In recent years, decision makers have been challenged to identify the changes in the stage of the business cycle—recession, recovery, expansion, slowdown—in the U.S. economy along the lines of the stylized economic cycle pictured in Figure 1.2 using industrial production. This identification is essential for business management in terms of planning production schedules, adjusting inventories and ordering inputs for the production process. In government, identifying the stage of the economic cycle will allow for better preparation for the cyclical rhythms of revenues and spending flows. Here again we see the importance of simple data description to improve decision making.

To identify a cycle in an economic or financial time series, we recognize first that many, but not all, macroeconomic time series follow a predictable pattern over the business cycle and, as such, can be characterized by certain statistical properties. In this sense, econometrics can provide a solution to identifying changes in a series over the economic cycle and can allow decision makers to anticipate those changes and alter their business plans accordingly. We employ a number of techniques to identify and characterize a cycle, such

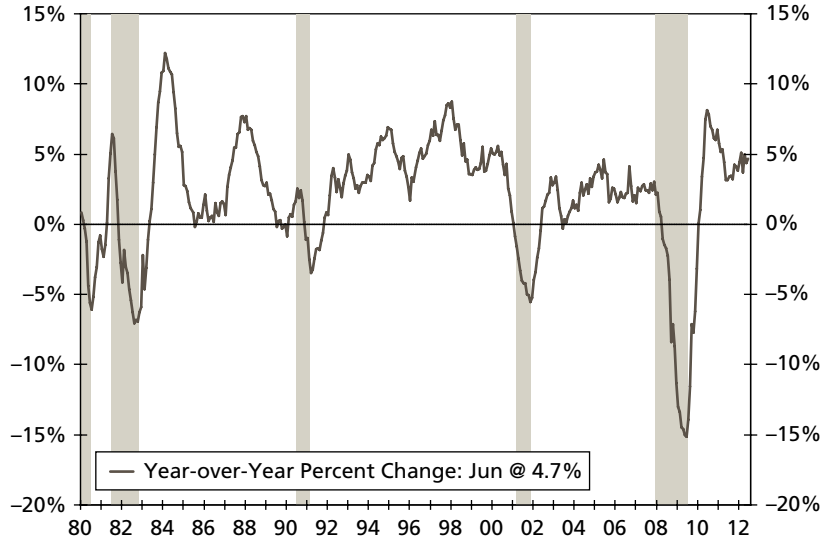

FIGURE 1.2 Total Industrial Production Growth (Output Growth by Volume, Not Revenue)
Source: Federal Reserve Board

as the mean, variance, autocorrelation, and partial autocorrelation. A complete econometric analysis to identify the cyclical elements in a time series is presented in Chapter 6. Other important macroeconomic variables with cyclical properties are GDP growth, the consumer price index (see Figure 1.3), corporate profits (see Figure 1.4), productivity (see Figure 1.5), employment (see Figure 1.6), federal budget deficit/surplus (see Figure 1.7), the yield curve (10 year/2 year, see Figure 1.8), and the credit spread (AA/5 year, see Figure 1.9).

In the following section we characterize nonfarm payrolls growth using autocorrelations and partial autocorrelations functions.[3] A simple plot of the payrolls growth (see Figure 1.10) suggests that it may not contain an explicit (linear) time trend, but it does contain a strong cyclical element. During an economic expansion, the rate of employment growth is greater than zero, and during a recession, the rate of employment growth turns negative. To confirm the cyclical behavior of payrolls growth, we plot autocorrelations and partial autocorrelations along with two-standard deviation error bands (standard errors). A good rule of thumb to determine whether a series contains a cyclical element is to check whether: (1) autocorrelations are large relative to their standard errors, (2) autocorrelations have a slow decay, and (3) partial autocorrelations spike at first few lags and are large compared to their standard errors.

[3]We provide a detailed discussion about autocorrelation and partial autocorrelation functions in Chapter 4 and application of the process in Chapter 6.

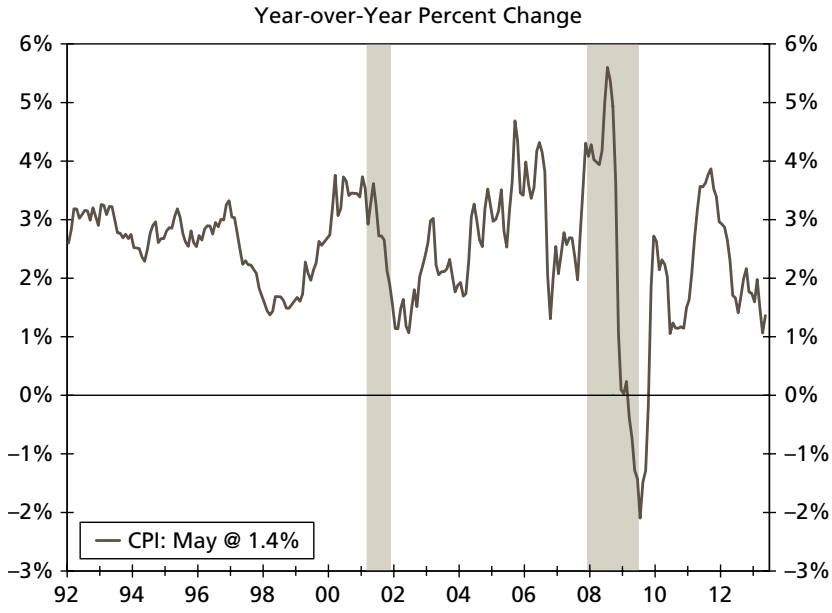

FIGURE 1.3 U.S. Consumer Price Change
Source: U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis

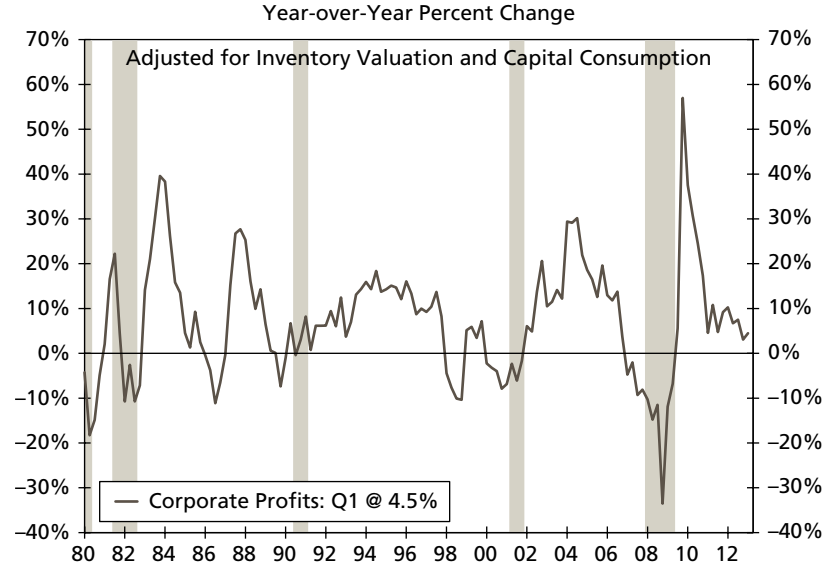

FIGURE 1.4 Corporate Profits Growth
Source: U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis

As shown in Table 1.2, the autocorrelations (column 3) for nonfarm payroll growth are large compared to their standard errors. The autocorrelations display slow, one-sided decay, which is represented by asterisks in column 4. The partial autocorrelations (Table 1.3) show a spike at lag-one, and this spike is large for first four lags relative to their standard errors. Taken together, both

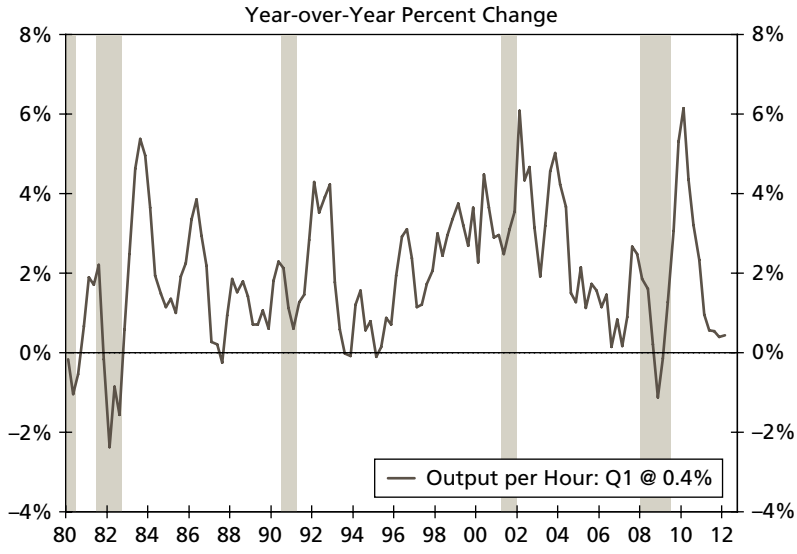

FIGURE 1.5 Nonfarm Productivity
Source: U.S. Bureau of Labor Statistics

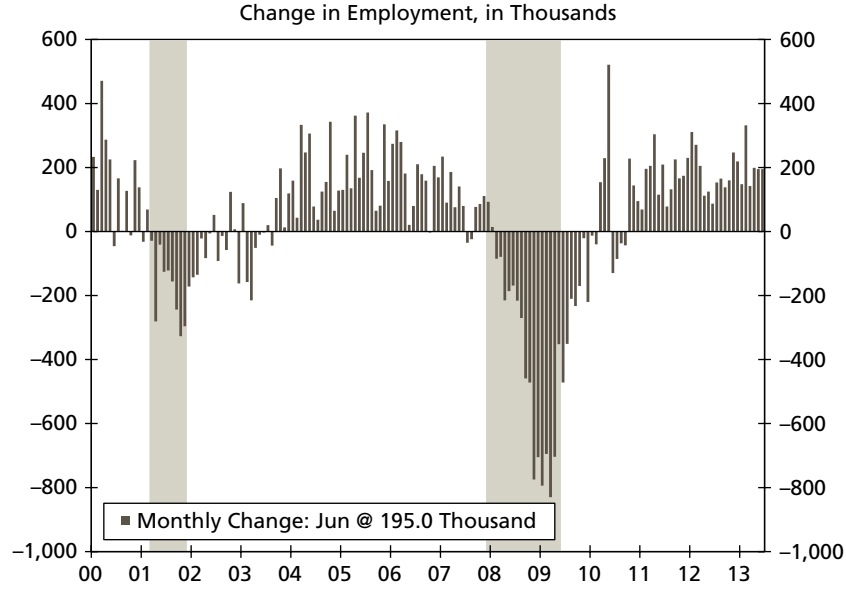

FIGURE 1.6 Nonfarm Productivity Change
Source: U.S. Bureau of Labor Statistics

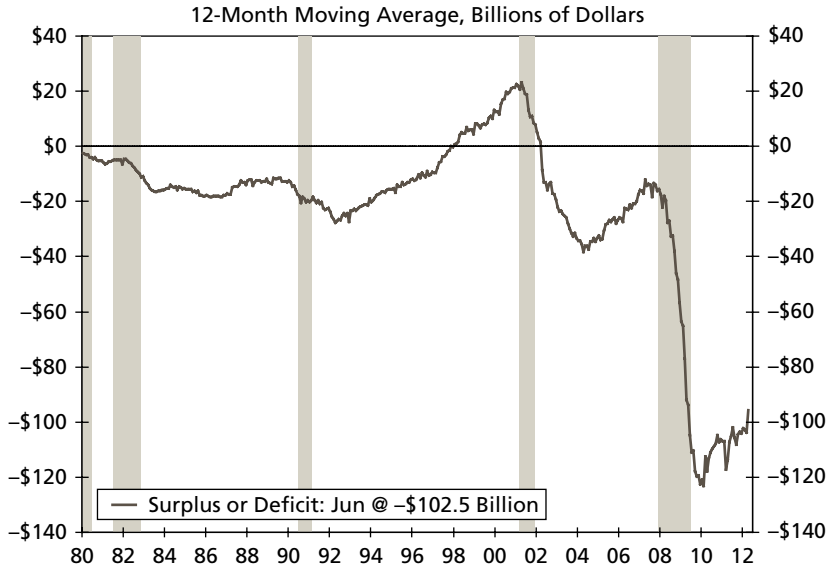

FIGURE 1.7 Federal Budget Surplus or Deficit
Source: U.S. Department of the Treasury and Federal Reserve Board

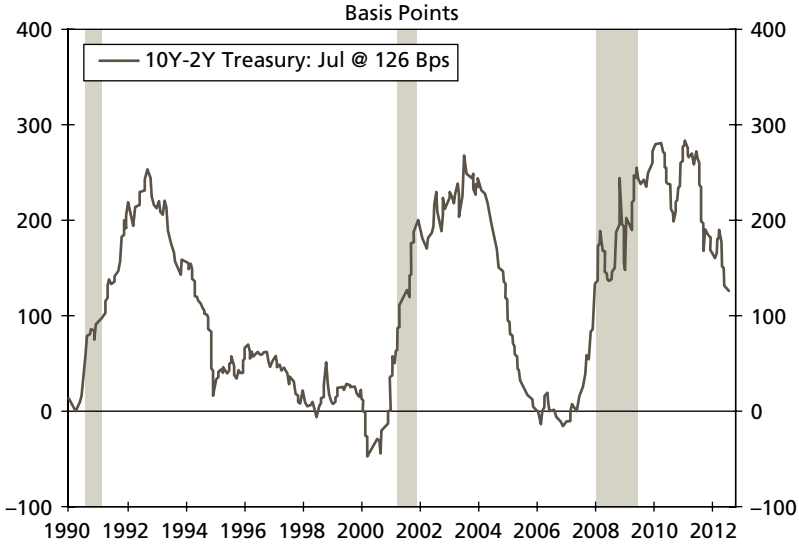

FIGURE 1.8 Yield Curve Spread
Source: U.S. Department of the Treasury and Federal Reserve Board

autocorrelations and partial autocorrelations suggest that nonfarm payroll growth has a strong cyclical behavior.

However, while the cyclical character of the economy is evident, we also recognize that often decision makers fall for recency bias in their thinking. That is, many decision makers in the midst of an economic expansion see that expansion as the most recent experience of the business cycle and thereby project that experience into the future. In contrast, when facing a recession,

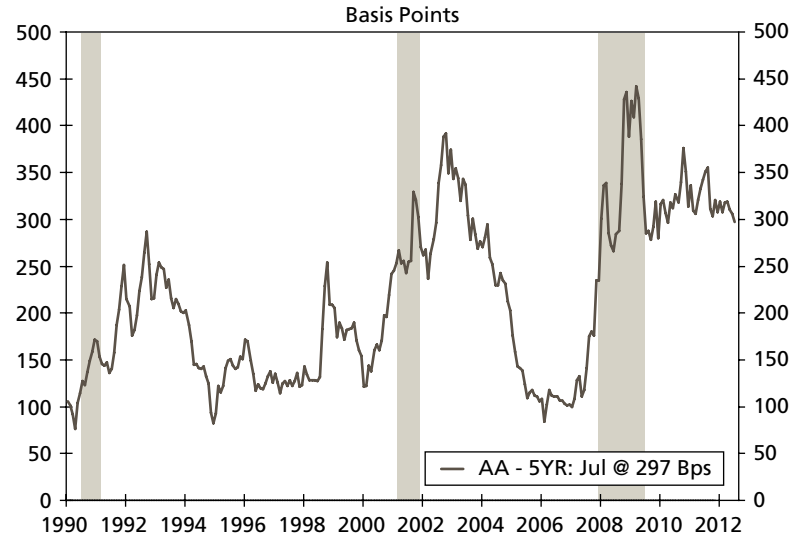

FIGURE 1.9 AA Five-Year Spread
Source: Federal Reserve Board and IHS Global Insight

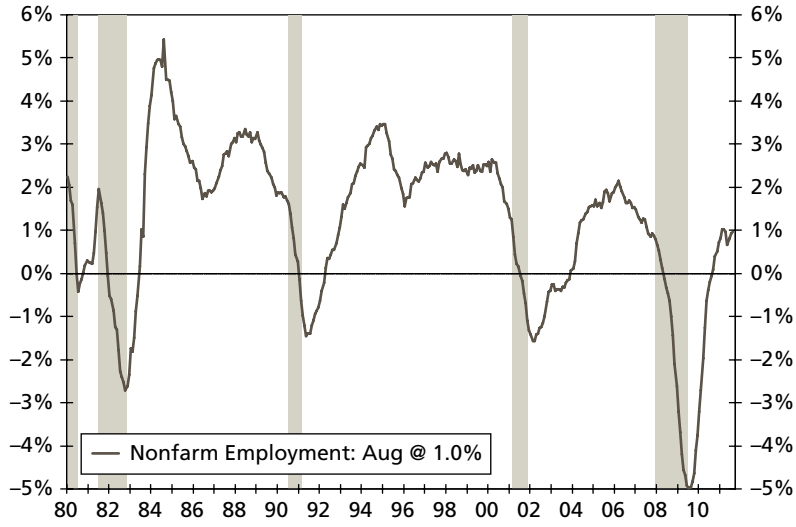

FIGURE 1.10 Nonfarm Employment Growth (Year-over-Year Percentage Change)
Source: U.S. Bureau of Labor Statistics

decision makers project that the recession will continue for the foreseeable future. The recency bias then leads decision makers to project the most recent experience into the future and thereby fail to recognize that the cyclical pattern within the economy actually changes over time, as we have seen with the employment series in Figure 1.10.