AI RFI Responses, October 26, 2018

Update to the 2016 National Artificial Intelligence Research and Development Strategic Plan RFI Responses

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A Rapid Learning System for Economics

By

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I. Overview

To speed the growth of AI methods and secure economic and national security benefits, I forward an idea that you might be able to use. I suggest that your initiative build a national capacity for rapid learning economics. The project will design, pay for, and develop new methods to analyze expanded R&D data systems. It will be designed to discover the behavioral variables and mechanisms that affect economic performance and that are missing from current data systems.

Competitive, multi-year, renewable grants will create Centers for Rapid Learning Economics to engage stakeholders and address different dimensions of the problem. Although the Centers will conduct their own research, their first goal will be to design, purchase (or create) the new R&D data systems that include a wide range of potential causal variables nominated by behavioral science advisers and stakeholders. These data systems will be curated, placed in the public domain, and will be available online (with analysis tools and supercomputer capacity) for software development and fast discovery research

by all stakeholders. Centers also will be crossroads for research ideas, new discoveries, and strategy discussions: they will have funds for lecture series and conferences that will be videocast (e.g., NIH's www.videocast.nih.gov) to national and global audiences to accelerate the creative process.[1] [2]

The strategy of the new system will build upon NIH's fast discovery strategy for genetics-based biomedical research that has been transforming thinking about cancer and other diseases. Achieving a similar design to their "Everything

[1] For-profit companies and coalitions of institutions will be eligible to apply for Center grants. The Centers may build partnerships and develop further financial support from stakeholders.

[2] Concerning the design of Centers and a national system: The Administration's commitment to free inquiry is useful to state. (Otherwise, there may be alert players who may seek to politicize this learning system.) As a further safeguard, there should be a clear expectation that the entire system will provide Honest Broker inclusion and evaluation of the full range of perceptions and ideas in the political process. Although it will not censor or bias the process, a national advisory process can add lines of investigation and funds to assure balance.

Included" R&D data systems is an open-ended challenge for the behavioral sciences. However, there already are growing data resources that Centers can purchase and include quickly. (For example, rather than rely upon the aggregate quarterly data of national income accounting, Centers might use Mastercard International's daily time series to study the causal pathways of recessions and recoveries.) [3]

- Another attractive new database to include is the global investment by Google to digitize all news in 100 languages, with reliable translation and online analysis tools, and sophisticated psychological software for the analysis of emotions and events (www.gdeltproject.org). Daily historical data now are available from January 1, 1979. Psychological variables such as confidence, mistrust, anger, and fear in mass publics can be more reliably measured and explored at early stages of the new research.

[3] AI methods analogous to AlphaGo Zero might build useful reclassifications of data and improve current variables crudely defined by accountants and the tax code into optimum data systems for behavioral prediction. (For example: households with young and growing children, may think about consumption and investment differently from other consumers.)

II. Two Priorities

As first projects, I recommend two priorities for rapid learning (and multi-disciplinary) economic science. The first project will a.) Create early warnings for recessions (and improved standby options for prevention and early, precision treatment) in the US and (later) all major economies.

This priority is merited by the current absence, from government data systems in major economies, of the variables that cause and reliably forecast turning points (recessions, crises, and recoveries). Statistically, the US and other major economies are overdue for the next downturn. However, countercyclical fiscal and monetary policy options since 2008 are dangerously limited by the steep rise of national deficits, debt, and future interest charges and the already-near-zero interest rates. Unless a new R&D learning system can work quickly, there may be unnecessary economic hardship and greater political instability ahead when recessions occur without swift, new, and precise remedies.

The second project will b.) Improve economic science for all countries so that the intelligence community can make more reliable forecasts of political stress and national security challenges. Behavioral science has found that in advanced countries, and even more so in UDCs, prolonged economic hardship, and especially high levels of youth unemployment, predict to political instability –

including recruitment to terrorism, ethnic conflict, the rise of demagogues and violent oppression, civil and gang violence, and – now – growing and urgent immigration for safety and opportunity. [4] The domestic and national security problems that any US Administration faces are made worse by the poor economic performance since the unforeseen 2008 crisis and the failure of traditional policy tools to work as well in a changing world

Both priorities will require AI methods beyond the first-generation Big Data analysis tools used by NIH. Olivier Blanchard, a Chief Economist at the IMF after 2008, said of traditional policy tools "How reliable are these tools? They work, but they don't work great. People and institutions find a way around them." Thus, AI modeling will need to move beyond earlier fixed coefficient models to discover evolving strategies and allow for conflicting interests and learning in a global system. By the same logic, one of Barack Obama's first instructions to Leon Panetta and the intelligence community was that he did not want to be blind-sided by another 2008: today, this will require AI methods that can reverse

[4] AI methods may (like AlphaGo Zero) evolve new paradigms and pathways for targeted investments that support faster economic growth and political stability.

engineer fast-trade computer algorithms and forecast risks of unforeseen interactions and remedies.

III. Supporting Analysis

Six appended documents support the case for this national initiative:

1. **Attachment A.** The Congressional Budget Office Forecasting Record: 2017 Update compares (p. 16, Box 2) two-year GDP forecasts of government models and the (about 50) leading Blue Chip private sector and academic forecasting models from 1976 through 2014. Forecasting is a highly competitive business that uses the government data system. For decades, the same data have been reworked and, as Box 2 illustrates, the models track one another closely. There is not much to be improved by remaining within these datasets.

- There is widespread professional agreement about error rates and several kinds of suspected missing variables. CBO reports (pp. 10-14) the professional agreement that "turning points" (recessions and recoveries) are caused by variables that are not yet in the US government's data system. Also, any new, consequential, and fundamental changes in the world are missing and obscured by forecasting and data analysis based on the linear regression analysis of quarterly time series data.

2.) Attachment B. "Proposal: A Rapid Learning System for G-20 Macroeconomics: From Greenspan to Shiller and Big Data" (Draft, 2014) reviews a universe of new psychological and cultural metrics recently recommended by Alan Greenspan. Their absence often produces unproductive disagreement with liberal economists, in part because the absence of needed metrics allows unresolved arguments about interpretation. (This 2014 draft proposal was far beyond the budget that NSF felt able to provide and would have taken too long without a high-level commitment.) It is possible that libertarian thinktanks will extend Greenspan's thinking to propose a universe of metrics.

3.) Attachment C. "The Capitalist's Dilemma, Whoever Wins on Tuesday" (2012) by Harvard's Clayton Christensen illustrates the potential learning and transformation of forecasting and monetary policy by greater inclusion of psychological observations of the real world. Monetary policy tools making Interest rate adjustments might have worked with CEO's like Henry Ford and Thomas Edison whose scientific and business focus was industrial innovation. However today's CEO's may come from finance or marketing and, thus, pursue

maximum profit (or short-term stock price) by other business strategies that are insensitive to interest rate changes: global supply chain development, international marketing, boosting accounting and legal departments to profit Centers in a high-yield global game, mergers and acquisitions a low-risk R&D strategy that relies on investments only by venture capitalists, and (now) buying back their stock. As Christensen predicted in 2012, the world has been awash in capital, and his forecast of prolonged and slow recoveries US and global that were unresponsive to standard monetary policy was more accurate than government forecasts. New metrics, following up his ideas to observe actual behavior, may build new frameworks for more effective governments.

4) <u>Attachment D.</u> “The Optimistic Case for Rapid Learning Economics” provides a further discussion of competing theories and psychological and other variables that theorists have proposed for evaluation. An appendix by Larry Summers "The Global Economy is in Serious Danger" (2015) began the current agenda to explore a rapid learning system to improve economic science.

5.) Attachment E. Martin Wolf's recent "How to Avoid the Next Financial Crisis" in the Financial Times (October 2018) concurs (p. 4) that someone should organize a learning system to anticipate, prevent, or mitigate the next recession.

6.) Attachment F. The last attachment is a supporting Op-Ed by Robert Shiller, "Why Our Beliefs Don't Predict Much About the Economy" (October 12, 2018): *"The more we learn about how people really think, the more we must rethink economic theory."* He has been a strong advocate for adding a new universe of economic variables, but we do not yet have a national system that is designed to do this. His article reviews several recent studies indicating that known psychological mechanisms have been creating false beliefs and unfortunate consequences for policy and the economy. Such research can be accelerated by R&D data systems that free scientists from the tasks of seeking individual grants and building piecemeal and personal data systems. Current AI methods allow computers to assume that there are missing variables and make inferences about them. It may be worthwhile to add such possibilities to applications of emerging AI techniques like AlphaGo Zero.

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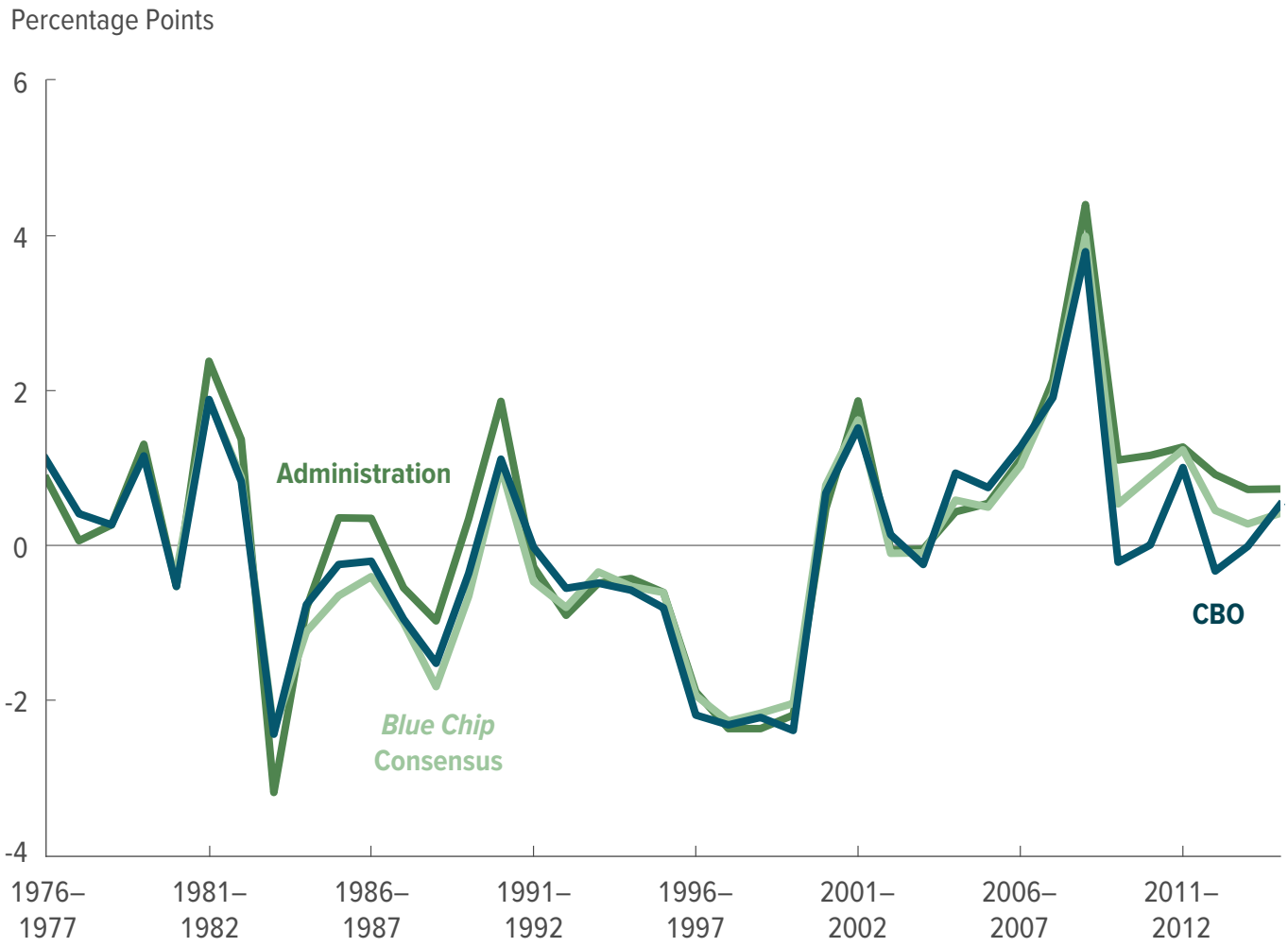
CONGRESS OF THE UNITED STATES
CONGRESSIONAL BUDGET OFFICE

CBO

CBO's Economic Forecasting Record: 2017 Update



Forecast Minus Actual Growth of Inflation-Adjusted Output: Two-Year Forecasts

OCTOBER 2017

Notes

Many of the figures and the two tables show data from the *Blue Chip* consensus, which is an average of about 50 private-sector forecasts published in *Blue Chip Economic Indicators*.

Supplemental data, including an interactive graphic, are posted along with this report on CBO's website (www.cbo.gov/publication/53090).

Contents

CBO's Economic Forecasting Record: 2017 Update

Summary

For four decades, the Congressional Budget Office has prepared economic forecasts to use in making its projections for the federal budget. Forecasts of output, inflation, interest rates, and wages and salaries, in particular, play a significant role in CBO's budget analysis. For example, to project receipts from individual income taxes, CBO uses its forecasts of wages and salaries.

CBO regularly evaluates the quality of its economic forecasts for several reasons.[1] One is to determine if it needs to change its forecasting methods. For example, partly in response to past forecast errors, CBO has changed the way it forecasts productivity growth and interest rates in recent years. Another reason for evaluating past forecasts is to calculate the errors in those forecasts, which in turn can be used to approximate the range of errors or uncertainty in the agency's current forecasts. Finally, publishing such evaluations gives readers a tool to assess the usefulness of the agency's projections and is thus one way in which CBO demonstrates its commitment to transparency.

To evaluate its economic forecasts, CBO compares them with the economy's actual performance and with the Administration's forecasts, which are published in the Office of Management and Budget's annual budget documents, and the *Blue Chip* consensus—an average of about 50 private-sector forecasts published in *Blue Chip Economic Indicators*. Such comparisons can indicate the extent to which imperfect information and analysis may have caused CBO to miss patterns or turning points in the economy. They can also help the agency identify areas where it has tended to make larger errors than other analysts. This report evaluates CBO's economic forecasts over two-year and five-year periods. The span of years that CBO examined for this evaluation differs by variable and by forecast period on the basis of data availability.

How Does CBO's Forecasting Record Compare With Those of the Administration and the *Blue Chip* Consensus?

CBO's forecasting record is comparable in quality to those of the Administration and the *Blue Chip* consensus. When CBO's projections were inaccurate by large margins, the other two forecasters' projections tended to have similar errors because all forecasters faced the same challenges. For example, all three sets of forecasts of inflation were relatively inaccurate during the late 1970s and early 1980s but generally became more accurate as inflation stabilized in more recent decades.

Do CBO's Forecasts Exhibit Statistical Bias?

Statistical bias is the tendency of a forecaster's projections to be too low or too high over a period of time. A simple and widely used indicator of bias is the mean error. By that measure, CBO's forecasts of most economic indicators examined here have tended to be too high by small amounts, but the agency's two-year forecasts of real (inflation-adjusted) output were slightly too low, on average.

After evaluating the mean errors of its forecasts, CBO reached two conclusions:

- CBO's two-year forecasts of output growth and inflation have been less biased than its two-year forecasts of interest rates and the growth of wages and salaries, which exhibit a sizable upward bias—that is, they have tended to be higher than actual values by a larger amount (see Figure 1).[2]

- For most economic indicators, the mean errors of CBO's five-year forecasts (which are discussed in the second half of the report) have been slightly larger than those of the agency's two-year forecasts. That pattern shows that CBO has a tendency to overestimate economic trends over the longer term.

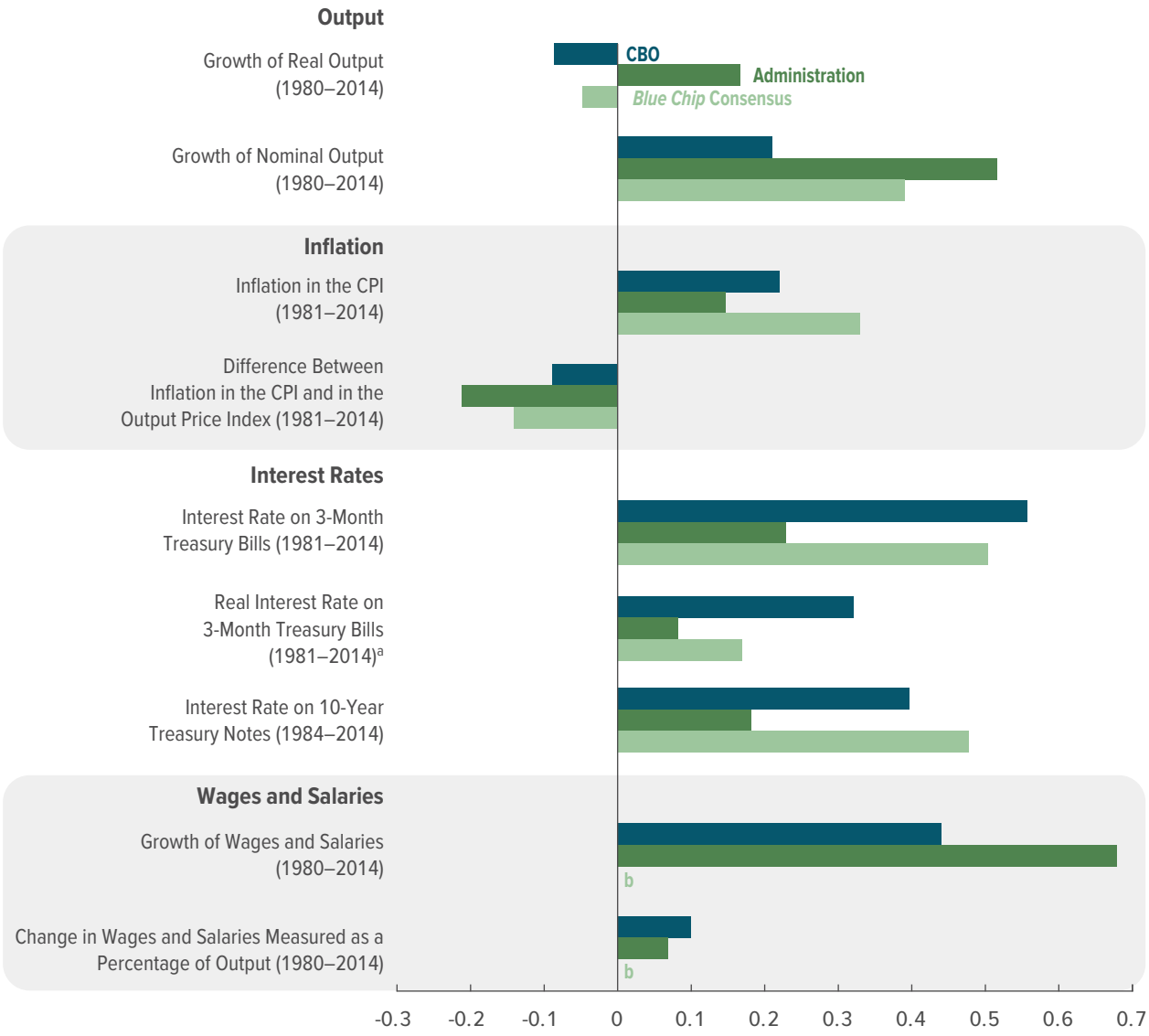
1. CBO has also evaluated its revenue forecasts. See Congressional Budget Office, *CBO's Revenue Forecasting Record* (November 2015), www.cbo.gov/publication/50831. The agency is currently analyzing its past projections of outlays.

2. Forecast errors throughout this report were calculated as projected values minus actual values; thus, a positive error is an overestimate.

Figure 1.

Mean Errors of Two-Year Forecasts

Percentage Points



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Economic Analysis; Bureau of Labor Statistics; Federal Reserve.

Forecast errors are projected values minus actual values; thus, a positive error is an overestimate. The mean error is the arithmetic average of the forecast errors.

Date ranges refer to the years in which the forecasts were made. For details on the data underlying the summary measures presented here, see the appendix.

Output is either GDP or (before 1992) GNP. Real output is nominal output adjusted to remove the effects of inflation.

CPI = consumer price index; GDP = gross domestic product; GNP = gross national product.

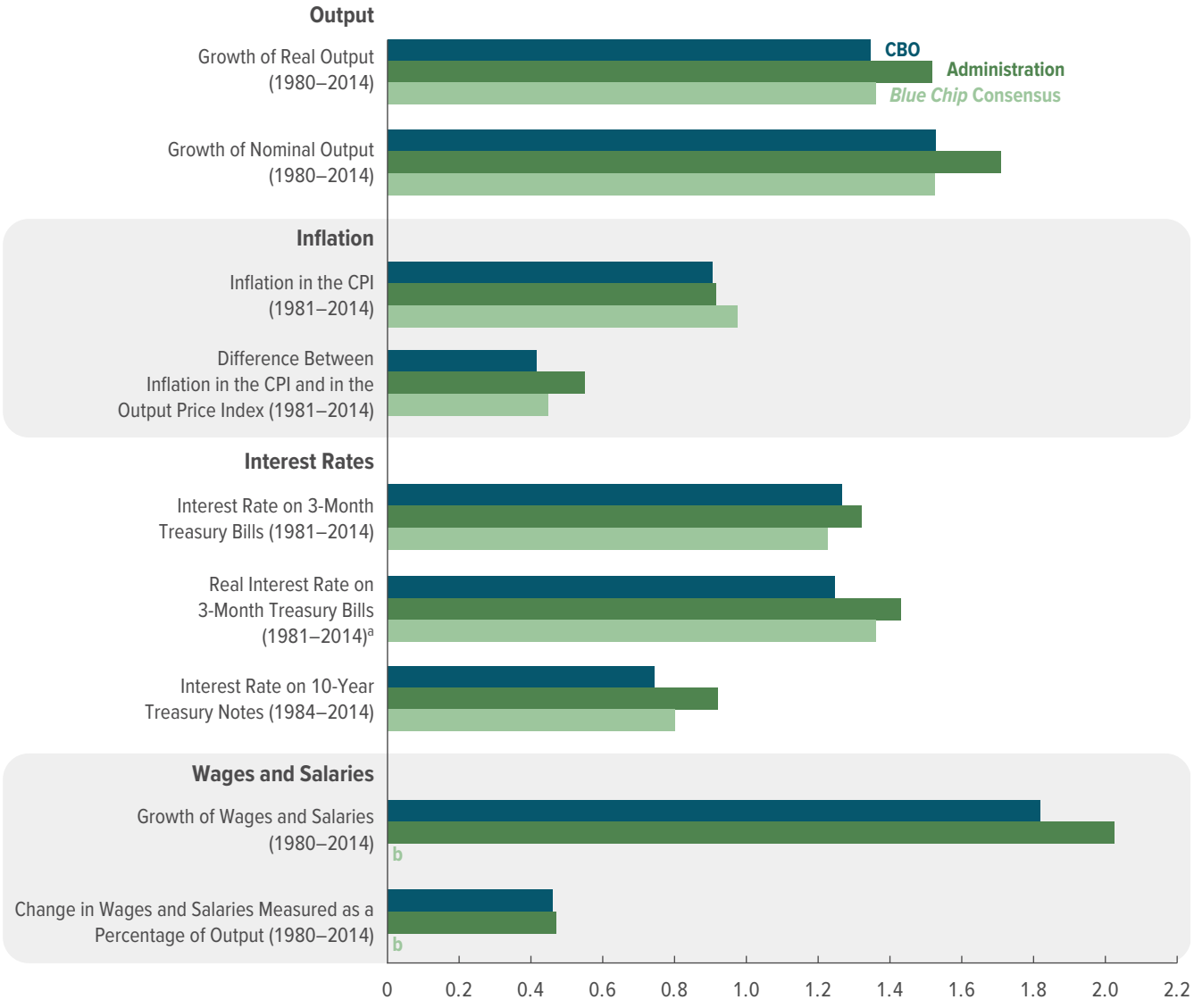
a. The real interest rate is the nominal interest rate deflated by the projected rate of growth in the CPI.

b. The *Blue Chip* consensus does not include forecasts of wages and salaries.

Figure 2.

Root Mean Square Errors of Two-Year Forecasts

Percentage Points



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Economic Analysis; Bureau of Labor Statistics; Federal Reserve.

Forecast errors are projected values minus actual values. The root mean square error is calculated by squaring the forecast errors, averaging those squares, and taking the square root of that average.

Date ranges refer to the years in which the forecasts were made. For details on the data underlying the summary measures presented here, see the appendix.

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Other forecasters' projections generally exhibited bias of a similar magnitude and in the same direction. The mean errors of the *Blue Chip* consensus forecasts were very similar to those of CBO's forecasts. The Administration's forecasts of the growth of real output had larger mean errors than CBO's forecasts and the *Blue Chip* consensus, but its forecasts of inflation and interest rates exhibited less upward bias than did the other two forecasters'.

How Accurate Are CBO's Forecasts?
Accuracy is the degree to which forecast values are dispersed around actual outcomes. One widely used measure of accuracy is the root mean square error (RMSE). By that measure, CBO's two-year forecasts are generally as accurate as those of the *Blue Chip* consensus and, for most economic indicators, slightly more accurate than the Administration's two-year forecasts (see Figure 2). The accuracy of all three sets of five-year forecasts is comparable.

Comparing the accuracy of its two-year and five-year forecasts, CBO observed the following:

- CBO's five-year forecasts of output and inflation are more accurate than its two-year forecasts of those variables, in part because long-term forecasts rest more on underlying trends in the economy than on short-term cyclical movements, which are very difficult to predict.
- CBO's five-year interest rate forecasts are less accurate than its two-year forecasts of those rates because of the large and unexpectedly persistent decline in long-term interest rates that began in the early 1980s.
- For its forecasts of wages and salaries, CBO's findings are less clear-cut. The agency's two-year and five-year forecasts of the growth of wages and salaries are equal in terms of accuracy, but its five-year forecasts of the change in wages and salaries measured as a percentage of output are more accurate than the corresponding two-year forecasts.

What Are Some Sources of Forecast Errors?
CBO's and other forecasters' largest forecast errors often stem from the difficulties of anticipating three key developments:

- Turning points in the business cycle—that is, the beginning and end of recessions;
- Changes in trends in productivity; and
- Changes in crude oil prices.

How Do Assumptions About Fiscal Policy Affect Forecast Errors?
Fiscal policy refers to the federal government's policies on taxes and spending. Assumptions about fiscal policy are an important ingredient of an economic forecast because such policy affects output, inflation, interest rates, and wages and salaries. To provide lawmakers with a benchmark against which they can assess potential changes in the law, CBO constructs its economic forecasts under the assumption that federal fiscal policy will generally remain the same as under current law. By contrast, the Administration's forecasts reflect the assumption that the policies in the President's proposed budget will be adopted. Forecasters in the private sector (such as those who contribute to the *Blue Chip* consensus) form their own projections about the future of federal fiscal policy, so their forecasts reflect changes in law that they anticipate will be made.

Those different assumptions about fiscal policy account for some of the variation among forecasts and thus in forecast errors. Assumptions about fiscal policy can be particularly significant when policymakers are considering major changes to current law. For example, in 2009 and 2010, CBO's two-year forecasts of real output growth diverged noticeably from the Administration's forecasts and the *Blue Chip* consensus because of the different fiscal policy assumptions underlying the forecasts.

What Are the Limitations of This Evaluation?
This evaluation has three limitations. First, all forecasters change their procedures over time, which makes it hard to draw inferences about future errors. Second, because forecasters make different assumptions about future fiscal policy, it is difficult to compare the quality of forecasts without considering the role of expected changes in laws. Finally, the historical data (on output and income, for example) that forecasters use to make economic projections are often revised, which can complicate the task of interpreting forecast errors.

CBO's Methods for Evaluating Forecasts

CBO evaluates the quality of its forecasts by examining its past forecast errors and comparing them to the errors in the Administration's forecasts and the *Blue Chip* consensus. The *Blue Chip* consensus is particularly useful

for comparisons because it incorporates a variety of forecasts and therefore reflects a broader blend of sources and methods than any single forecaster would use. Over time, composite forecasts like the *Blue Chip* consensus often provide better estimates than any projection made by a single forecaster or using a single method.[3]

This report evaluates CBO's economic forecasts over the first two years and over the first five years of CBO's 10-year baseline projection period. The forecasts are made at the beginning of a calendar year, and the errors are calculated by subtracting the average actual value over the forecast period from the average projected value. The two-year forecasts include the full period that is used to prepare the baseline budget for the upcoming fiscal year. The five-year forecasts are used to examine the accuracy of longer-term projections of several variables that are important for CBO's baseline budget projections.[4]

The span of years evaluated differs by economic indicator and by forecast horizon depending on the data available. CBO's and the Administration's forecasts published in the early months of the years 1976 to 2014 were examined, but those published in early 2015 were not, because actual data for all of 2016—which are necessary to evaluate the two-year forecasts made in 2015—were not available when the analysis for this report was completed. To ensure that differences in the availability of forecast data did not affect the interpretation of forecast errors, the ranges of years covered by the comparisons were determined by the earliest possible year for which data from the *Blue Chip* consensus were available. The first two-year *Blue Chip* consensus forecast that CBO examined for this evaluation was released in 1980 and included projections of real and nominal output. In 1981, forecasts of inflation and 3-month interest rates were also included. *Blue Chip* first published five-year forecasts of real and nominal output in 1979, of inflation and the 3-month interest rate in 1983, and of the 10-year Treasury note rate in 1984.[5]

This report updates CBO's 2015 *Economic Forecasting Record* with additional forecasts and new and revised historical data.[6] This evaluation adds two years of CBO's, the Administration's, and *Blue Chip*'s forecasts that were not included in the previous report—the two-year forecasts published in 2013 and 2014 and the five-year forecasts published in 2010 and 2011. It also includes a few additional forecasts from the early years of the *Blue Chip* consensus and revisions to previously published historical data that have been made since the last report was released. The additional data and revisions to older data did not significantly alter the main findings from the previous report—namely, that the quality of CBO's two-year and five-year forecasts is similar to that of other organizations' forecasts.

Another difference between this report and previous versions is that this report analyzes five-year forecasts of interest rates. In the past, CBO analyzed only two-year forecasts of interest rates.

Calculation of Forecast Errors

For this report, CBO measured forecast errors as the difference between the average forecast value and the average actual value over each forecast period. (See Box 1 for an example of how CBO calculates its forecast errors.) The actual values are based on the latest available data from the Bureau of Economic Analysis (BEA) and other statistical agencies. A positive error indicates that the actual value of the indicator was lower than CBO expected, and a negative error indicates that it was higher than expected.

The method used to calculate the forecast errors for this report differs slightly from that used in CBO's evaluation

3. See Allan Timmermann, "Forecast Combinations," in Graham Elliott, Clive W. J. Granger and Timmermann, eds., *Handbook of Economic Forecasting*, vol. 1 (North Holland, 2006), pp. 135–196, https://doi.org/10.1016/S1574-0706(05)01004-9; Andy Bauer and others, "Forecast Evaluation with Cross-Sectional Data: The *Blue Chip* Surveys," *Economic Review*, vol. 88, no. 2 (Federal Reserve Bank of Atlanta, 2003), pp. 17–31, http://tinyurl.com/yb6bj9dq; Henry Townsend, "A Comparison of Several Consensus Forecasts," *Business Economics*, vol. 31, no. 1 (January 1996), pp. 250–261, www.jstor.org/stable/23487509; and Robert Clemen, "Combining Forecasts: A Review and Annotated Bibliography," *International Journal of Forecasting*, vol. 5, no. 4 (1989), pp. 559–583, https://doi.org/10.1016/0169-2070(89)90012-5.

4. CBO's baseline projection period is currently 10 years, but in the past, it has been as short as 5 years.

5. See the appendix for further details on the choice of historical time-series data and on the sources of the forecast data used in the comparisons.

6. See Congressional Budget Office, *CBO's Economic Forecasting Record: 2015 Update* (February 2015), www.cbo.gov/publication/49891.

Box 1.

How CBO Calculates Economic Forecast Errors

The Congressional Budget Office calculates forecast errors by subtracting the average actual value of an economic indicator over a two-year (or five-year) period from the average projected value of that indicator over the same period. For example, to calculate the error for the two-year forecast of the growth of real (inflation-adjusted) gross domestic product (GDP) that was published in the January 2000 *Budget and Economic Outlook*, CBO first calculated the geometric average of the projected growth rates of real GDP for calendar years 2000 and 2001, which was 3.2 percent.[1] The agency then calculated the average actual growth rate of real GDP for those two years, which was 2.5 percent. Finally, it subtracted the average actual rate of 2.5 percent from the average projected rate of 3.2 percent, resulting in an error of 0.7 percentage points. To determine the error for the five-year forecast made that same year, CBO took the averages of projected and actual output growth rates for calendar years 2000 through 2004.

1. The geometric average is the appropriate measure for averaging growth rates. It was used to calculate the average for all indicators except the change in wages and salaries as a percentage of output. Because that indicator is a ratio rather than a growth rate, the appropriate measure for averaging is the arithmetic average.

Example: Calculating the Error in the Two-Year Forecast of the Growth of Real GDP That CBO Published in January 2000

	CBO's Forecast Rate	Actual Rate
2000	3.3%	4.1%
2001	3.1%	1.0%

Calculate the Two-Year Average

3.2% – 2.5% = **0.7** percentage points

The error for the two-year forecast made in 2000 is . . .

Sources: Congressional Budget Office; Bureau of Economic Analysis.

GDP = gross domestic product.

of errors in revenue projections.[7] In that evaluation, projection errors were calculated for a single fiscal year. For example, the error in CBO's two-year revenue projection for 2007 is the percentage difference between the actual amount of revenues received in fiscal year 2007 and the revenues projected for that year in January 2006.[8]

7. Congressional Budget Office, *CBO's Revenue Forecasting Record* (November 2015), www.cbo.gov/publication/50831.

8. In CBO's evaluation of its revenue projections, the agency calculated errors as the percentage difference (rather than the simple difference used in this report) between the projected and actual values because revenues are expressed as dollar amounts. If the errors in revenue projections were measured as simple differences in dollar amounts, they would be difficult to compare over time. (A $5 billion error in 1992, for example, would be significantly larger than a $5 billion error in 2014.) The simple difference is more appropriate here because this report evaluates errors in forecasts of economic indicators that are expressed as rates or percentages—growth rates, interest rates, and changes in wages and salaries as a percentage of output. Forecast errors in this report are thus percentage-point differences between forecast and actual values.

Assessment of Forecasts

Like CBO's previous studies of its economic forecasts, this evaluation focuses on two indicators of quality:

statistical bias and accuracy. Other characteristics of forecast quality—such as whether forecasters optimally incorporate all relevant information when making their projections—are harder to assess.[9]

Statistical Bias. Statistical bias indicates the tendency of a set of forecasts to err in a certain direction. To measure bias, CBO used the mean error—that is, the arithmetic average of the forecast errors—which is the simplest and most widely used measure. CBO measures bias to determine whether its forecasts are systematically too high or too low. The agency's goal is to provide forecasts of economic indicators that represent the middle of the distribution of possible outcomes. The presence of bias might indicate that the forecast methods should be modified to eliminate persistent error.

The mean error does not, however, provide a complete characterization of the quality of a forecast. Because positive and negative errors are added together to calculate the average, underestimates and overestimates offset one another. A small mean error might indicate that all the forecasts had only small errors, but it could also result from large overestimates and large underestimates that offset one another. Experimenting with alternatives to the mean error measure, several analysts outside of CBO have used more elaborate techniques to test for bias in the agency's forecasts.[10]

Accuracy. The accuracy of a set of forecasts is the degree to which forecast values are dispersed around actual outcomes. Narrower dispersion indicates greater accuracy. Generally, the more accurate CBO's economic forecasts are, the more accurate its forecasts of revenues and outlays will be.

Two commonly used measures of accuracy are the mean absolute error and the root mean square error. The mean absolute error is the arithmetic average of the forecast errors without regard to the direction of the errors (that is, the negative signs are removed from underestimates before averaging). Thus, unlike in the mean error, in the mean absolute error, underestimates and overestimates do not offset one another. The RMSE—the calculation of which involves squaring the errors (thus removing the negative signs)—also shows the size of the error without regard to direction, but it places a greater weight on larger deviations.[11]

9. Several studies that have examined how well relevant information has been incorporated into CBO's economic forecasts—a characteristic referred to as forecast efficiency—have found that the agency's forecasts are relatively efficient. See, for example, Robert Krol, "Forecast Bias of Government Agencies," *Cato Journal*, vol. 34, no. 1 (Winter 2014), pp. 99–112, https://tinyurl.com/y7cmapw3 (PDF, 88 KB); Stephen M. Miller, "Forecasting Federal Budget Deficits: How Reliable Are US Congressional Budget Office Projections?" *Applied Economics*, vol. 23, no. 12 (December 1991), pp. 1789–1799, http://doi.org/10.1080/00036849100000168; and Michael T. Belongia, "Are Economic Forecasts by Government Agencies Biased? Accurate?" *Review*, vol. 70, no. 6 (Federal Reserve Bank of St. Louis, November/December 1988), pp. 15–23, http://tinyurl.com/ychze7ah. Although statistical tests can identify sources of inefficiency in a forecast after the fact, they generally do not indicate how such information could be used to improve forecasts when they are being made.

10. One such alternative approach to testing a forecast for bias is based on linear regression analysis of actual values compared with forecast values. For details of that method, see Jacob A. Mincer and Victor Zarnowitz, "The Evaluation of Economic Forecasts," in Jacob A. Mincer, ed., *Economic Forecasts and Expectations: Analysis of Forecasting Behavior and Performance* (National Bureau of Economic Research, 1969), pp. 3–46, www.nber.org/chapters/c1214. Studies that have used that method to evaluate CBO's and the Administration's short-term forecasts have not found statistically significant evidence of bias over short forecast horizons. See, for example, Robert Krol, "Forecast Bias of Government Agencies" *Cato Journal*, vol. 34, no. 1 (Winter 2014), pp. 99–112, https://tinyurl.com/y7cmapw3 (PDF, 88 KB); Graham Elliott and Allan Timmermann, "Economic Forecasting," *Journal of Economic Literature*, vol. 46, no. 1 (March 2008), pp. 3–56, https://doi.org/10.1257/jel.46.1.3; George A. Krause and James W. Douglas, "Institutional Design Versus Reputational Effects on Bureaucratic Performance: Evidence from U.S. Government Macroeconomic and Fiscal Projections," *Journal of Public Administration Research and Theory*, vol. 15, no. 2 (April 2005), pp. 281–306, https://doi.org/10.1093/jopart/mui038; and Michael T. Belongia, "Are Economic Forecasts by Government Agencies Biased? Accurate?" *Review*, vol. 70, no. 6 (Federal Reserve Bank of St. Louis, November/December 1988), pp. 15–23, http://tinyurl.com/ychze7ah. For more elaborate studies of bias that included CBO's forecasts among a sizable sample, see J. Kevin Corder, "Managing Uncertainty: The Bias and Efficiency of Federal Macroeconomic Forecasts," *Journal of Public Administration Research and Theory*, vol. 15, no. 1 (January 2005), pp. 55–70, https://doi.org/10.1093/jopart/mui003; and David Laster, Paul Bennett, and In Sun Geoum, "Rational Bias in Macroeconomic Forecasts," *Quarterly Journal of Economics*, vol. 114, no. 1 (February 1999), pp. 293–318, https://doi.org/10.1162/003355399555918.

11. The RMSE is calculated by squaring the forecast errors, averaging those squares, and taking the square root of that average. The mean square forecast error is equal to the square of the bias in the errors plus the variance (that is, the square of the standard deviation) of the errors.

For this evaluation, CBO focused primarily on the RMSE, which can be used to gauge the uncertainty surrounding future forecasts. A smaller RMSE suggests that a forecaster's projections have less uncertainty surrounding them than they would if the RMSE was larger. Each time CBO produces a forecast, it does so with the expectation that the forecast will be unbiased, which implies that the RMSE of CBO's past forecasts approximates the standard deviation associated with the new forecast. In general, when the errors of a given set of forecasts are normally distributed around a mean error of zero—that is, if the misestimates are roughly symmetrically distributed around zero and there are more relatively small errors than large ones—about two-thirds of the forecasts will have misestimates within a range of plus or minus one RMSE. For example, the RMSE of CBO's two-year forecasts of the growth of real output is 1.3 percentage points (see Table 1). An RMSE of that value indicates that there is about a two-thirds chance that the actual average growth rate over the next two years will be within 1.3 percentage points of the rate in CBO's current forecast.[12]

Limitations of the Forecast Evaluations

There are three reasons to be cautious when interpreting the results of this forecast evaluation: Forecasting methods change over time, different forecasters make different assumptions about future fiscal policy, and many of the actual values of the projected variables are periodically revised.

Over time, CBO and other forecasters have changed the procedures that they use to develop economic forecasts—partly in response to changes in the economy and partly in response to advances in forecasting methods. Although such changes are aimed at improving the quality of forecasts, they make it difficult to draw inferences about future errors.

Another limitation of this analysis is that the forecasters considered here make different assumptions about future changes in fiscal policy, and it can be impossible to isolate those assumptions from each forecaster's overall economic analysis. CBO is required by statute to assume that future fiscal policy will generally reflect the provisions in current law, an approach that derives from the agency's responsibility to provide a benchmark for lawmakers as they consider proposed changes in law.[13] When the Administration prepares its forecasts, however, it assumes that the fiscal policy in the President's proposed budget will be adopted. The private forecasters included in the *Blue Chip* survey make their own assumptions about fiscal policy, but the survey does not report them. Forecast errors may be driven by those different assumptions, especially when forecasts are made while policymakers are considering major changes to current fiscal policy.[14]

A third reason to be cautious when interpreting the results of this forecast evaluation is that the historical values of many of the data series that CBO and other analysts forecast are periodically revised by the agencies that compile those data. BEA and other agencies use various methods and statistical definitions to estimate gross domestic product (GDP) and other economic indicators on the basis of data that they and others collect. Those agencies periodically revise their published estimates of economic indicators for past years as more information becomes available and as definitions and methods improve. Not all series—the consumer price index (CPI) and interest rates, for example—are revised.

Revisions to historical data can affect the calculations of forecast errors. For example, the RMSE of CBO's two-year forecasts of the growth of real output is 1.2 percentage points if calculated using the data that were available immediately after the two-year horizon of each forecast. But the RMSE is 1.3 percentage points if the most recently available data are used in the calculation.

12. For a similar approach to measuring uncertainty that uses the RMSE, see David Reifschneider and Peter Tulip, *Gauging the Uncertainty of the Economic Outlook Using Historical Forecasting Errors: The Federal Reserve's Approach*, Finance and Economics Discussion Series Paper 2017-020 (Board of Governors of the Federal Reserve System, February 2017), https://doi.org/10.17016/FEDS.2017.020 (PDF, 404 KB). For a visual representation of the uncertainty in CBO's forecasts of real gross domestic product, see Congressional Budget Office, *The Budget and Economic Outlook: 2017 to 2027* (January 2017), Figure 2-11, www.cbo.gov/publication/52370.

13. For further discussion of why CBO assumes that current laws generally remain in place when preparing its economic forecasts, see Congressional Budget Office, *What Is a Current-Law Economic Baseline?* (June 2005), www.cbo.gov/publication/16558.

14. Different assumptions about monetary policy can also make it difficult to compare CBO's forecasts with other forecasts. CBO assumes that monetary policy will reflect the economic conditions that the agency expects to prevail under the fiscal policy specified in current law.

Table 1.

Summary Measures for Two-Year Forecasts

Percentage Points

	CBO	Administration	*Blue Chip* Consensus
		Output	
Growth of Real Output (1980–2014)			
Mean error	-0.1	0.2	*
Mean absolute error	1.0	1.2	1.1
Root mean square error	1.3	1.5	1.4
Growth of Nominal Output (1980–2014)			
Mean error	0.2	0.5	0.4
Mean absolute error	1.1	1.3	1.1
Root mean square error	1.5	1.7	1.5
		Inflation	
Inflation in the CPI (1981–2014)			
Mean error	0.2	0.1	0.3
Mean absolute error	0.7	0.7	0.8
Root mean square error	0.9	0.9	1.0
Difference Between Inflation in the CPI and the Output Price Index (1981–2014)			
Mean error	-0.1	-0.2	-0.1
Mean absolute error	0.3	0.4	0.4
Root mean square error	0.4	0.6	0.4
		Interest Rates	
Interest Rate on 3-Month Treasury Bills (1981–2014)			
Mean error	0.6	0.2	0.5
Mean absolute error	0.9	1.0	1.0
Root mean square error	1.3	1.3	1.2
Real Interest Rate on 3-Month Treasury Bills (1981–2014)[a]			
Mean error	0.3	0.1	0.2
Mean absolute error	1.0	1.1	1.0
Root mean square error	1.2	1.4	1.4
Interest Rate on 10-Year Treasury Notes (1984–2014)			
Mean error	0.4	0.2	0.5
Mean absolute error	0.7	0.8	0.7
Root mean square error	0.7	0.9	0.8
		Wages and Salaries	
Growth of Wages and Salaries (1980–2014)			
Mean error	0.4	0.7	b
Mean absolute error	1.3	1.5	b
Root mean square error	1.8	2.0	b
Change in Wages and Salaries Measured as a Percentage of Output (1980–2014)			
Mean error	0.1	0.1	b
Mean absolute error	0.4	0.4	b
Root mean square error	0.5	0.5	b

Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Economic Analysis; Bureau of Labor Statistics; Federal Reserve.

Forecast errors are projected values minus actual values; thus, a positive error is an overestimate. The mean error is the arithmetic average of the forecast errors. The mean absolute error is the average of the errors with the negative signs removed from the underestimates. The root mean square error is calculated by squaring the forecast errors, averaging those squares, and taking the square root of that average.

Date ranges refer to the years in which the forecasts were made. For details on the data underlying the summary measures presented here, see the appendix.

Output is either GDP or (before 1992) GNP. Real output is nominal output adjusted to remove the effects of inflation.

CPI = consumer price index; GDP = gross domestic product; GNP = gross national product; * = between –0.05 percentage points and zero.

a. The real interest rate is the nominal interest rate deflated by the projected rate of growth in the CPI.

b. The *Blue Chip* consensus does not include forecasts of wages and salaries.

Researchers have found that in some cases, such as when comparing the performance of models over time, it may be more appropriate to use earlier estimates of data than to use the more recent updates.[15]

Data revisions also make it difficult to identify the source of forecast error. For example, BEA made several downward revisions to estimates of real GDP growth during the 2007–2009 recession (see Figure 3). When CBO prepared its baseline forecast in January 2009, real GDP had reportedly fallen by an annualized rate of 0.5 percent during the third quarter of 2008; however, revised data now show a 1.9 percent drop that quarter. Similarly, the latest revisions show that average annual growth of real GDP was nearly one-half of a percentage point lower during the recession than BEA initially reported in January 2010. Had CBO and other forecasters known the true state of the economy at that time, their projections probably would have been different. It is therefore difficult to identify how much of the forecast error (measured using current data) is due to the fact that forecasters based their projections on contemporary data that has since been revised and how much of the error is attributable to other sources, such as unforeseen economic developments.

Changes to definitions and methods also affect the comparability of current versions of historical data series with past forecasts. For example, business and government spending on computer software was once treated as spending for an intermediate good—that is, an input into the production process—and thus did not count as a component of GDP. But in 1999, BEA reclassified such spending as investment. That same year, BEA adopted new methods for calculating the price indexes for various categories of consumption. Largely as a result of those changes, BEA increased its estimates of growth in real GDP for the 1980s and 1990s. In particular, BEA's estimates of average annual growth in real GDP from 1992 to 1998 rose by 0.4 percentage points, and inflation in the GDP price index for those years was revised downward by 0.1 percentage point per year.[16] Forecasters cannot anticipate such changes when making their projections; they rely on the definitions and methods that exist at the time.

Some Sources of Forecast Error

Forecast errors often stem from the difficulties of anticipating three key economic developments—turning points in the business cycle, changes in productivity trends, and changes in crude oil prices.

Turning Points in the Business Cycle

Turning points—peaks and troughs in the business cycle—mark the beginning and end of recessions, which are periods of significant contraction in economic activity. Between 1976 and 2014, the years covered in this evaluation, there were five recessions—in 1980, from 1981 to 1982, from 1990 to 1991, in 2001, and from 2007 to 2009. CBO's, the Administration's, and *Blue Chip*'s forecasts of the growth of real output made around each recession since 1981 were substantially less accurate than those made in other years (see Figure 4).

Forecast errors tend to be large around business cycle peaks for a number of reasons. First, recessions are sometimes prompted by events or shocks that forecasters cannot predict. For example, in August 1990, the Iraqi invasion of Kuwait led to a spike in oil prices and a drop in consumer confidence, which probably contributed to the recession that followed.

Another reason errors in forecasts made near the start of a recession tend to be larger is that economists cannot be sure that a recession has begun until sufficient data are available, typically many months after the fact. For example, the Business Cycle Dating Committee of the National Bureau of Economic Research did not announce the December 2007 business cycle peak until 11 months later. For that reason, forecasters may not account for a recession in their projections even after it has started because they may not yet be aware of it.

Further complicating the forecasting process is that turning points in the business cycle often occur during periods of high uncertainty. For example, in January 2008, one month after the business cycle peak, CBO reported, "The economic outlook this year is particularly vulnerable to uncertainty about the degree to which

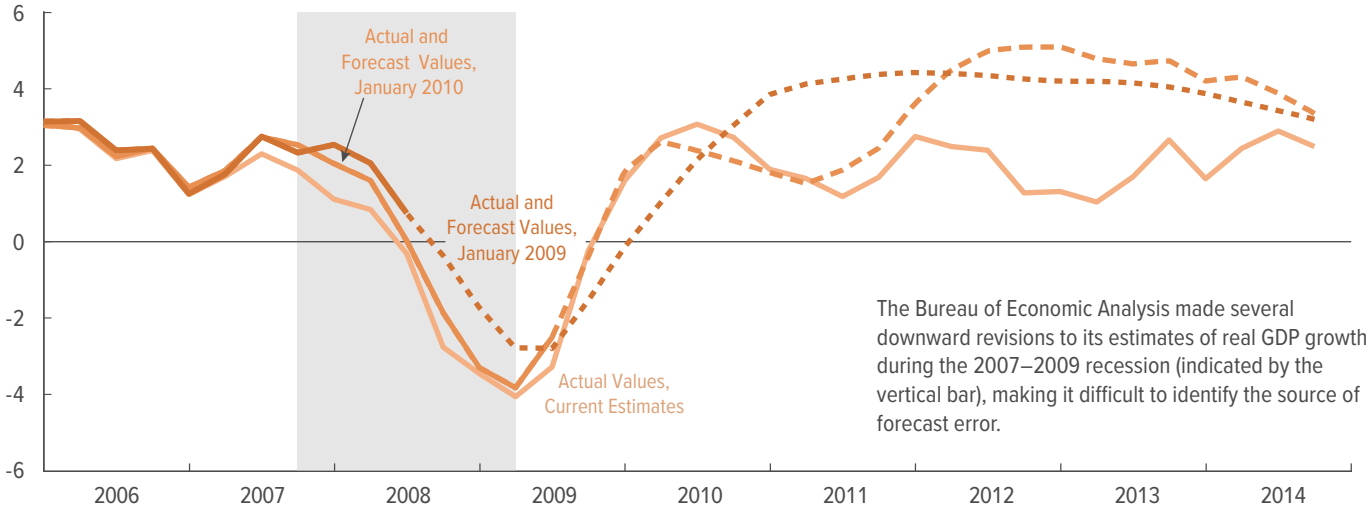
15. See, for example, Tom Stark and Dean Croushore, "Forecasting With a Real-Time Data Set for Macroeconomists," *Journal of Macroeconomics*, vol. 24, no. 4 (December 2002), pp. 507–531, https://doi.org/10.1016/S0164-0704(02)00062-9.

16. See Eugene P. Seskin, "Improved Estimates of the National Income and Product Accounts for 1959–98: Results of the Comprehensive Revision," *Survey of Current Business* (December 1999), pp. 15–43, www.bea.gov/scb/pdf/national/nipa/1999/1299niw.pdf (PDF, 392 KB).

Figure 3.

CBO's Forecasts and Actual Growth Rates of Real GDP

Percentage Change From Previous Year



Sources: Congressional Budget Office; Bureau of Economic Analysis.

Solid lines represent the estimates of actual values that were available at the time each forecast was prepared. Dashed lines represent forecast values.

Real GDP is nominal GDP adjusted to remove the effects of inflation.

Data are quarterly and are plotted through the fourth quarter of 2014.

GDP = gross domestic product.

the problems in the housing and financial markets will spill over to affect other sectors of the economy. Growth in 2008 could be weaker than CBO expects if the turmoil in the financial markets leads to a more severe economy-wide curtailment of lending than CBO anticipates."[17] Under such uncertain conditions, widely different outcomes can appear equally probable, making it difficult to gauge whether an economic downturn is imminent.

Finally, the nature of business cycles has changed over time. Until the early 1990s, the U.S. economy typically grew rapidly for several quarters after a recession ended. Since then, however, recoveries have been much slower. Failing to anticipate the changing nature of business cycles has been one source of forecast error.

Changes in Productivity Trends

Forecasts of productivity growth play a critical role in forecasting potential output, which is an estimate of the maximum sustainable level of production. CBO's forecast of potential output is a measure of how much the economy can sustainably grow during periods of expansion and determines the trajectory of GDP in the later years of the agency's 10-year forecasts.

Labor productivity is the average real output per hour of work. Thus, by definition, real output equals labor productivity times the total number of hours worked. The following are some of the sources of growth in labor productivity:

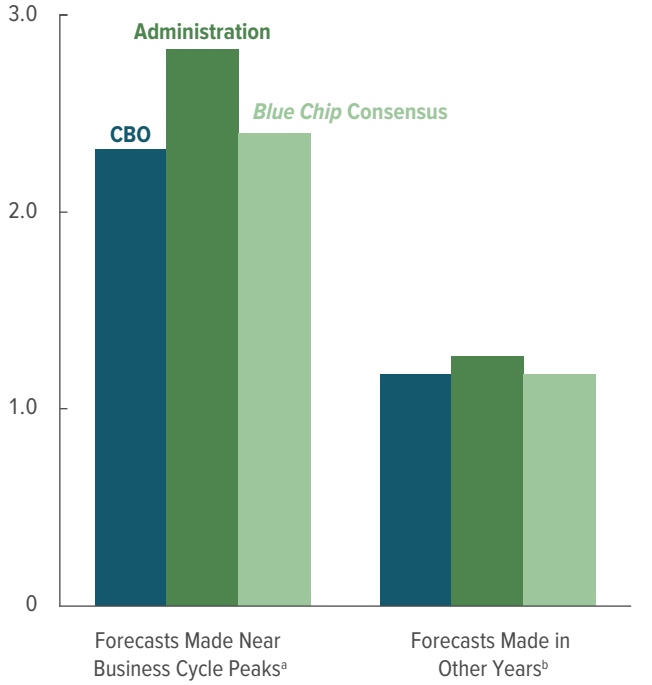
- Capital accumulation (the change in the amount of equipment, structures, software, and infrastructure in use),
- Education and skills development (also called investment in human capital), and
- Innovation (the greater efficiency achieved through better tools, systems, or methods).

17. Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2008 to 2018* (January 2008), p. 21, www.cbo.gov/publication/41661.

Figure 4.

Root Mean Square Errors of Two-Year Forecasts of the Growth of Real Output Made Near Business Cycle Peaks

Percentage Points



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Economic Analysis.

Real (inflation-adjusted) output is either real GDP or (before 1992) real GNP.

Forecast errors are projected values minus actual values. The root mean square error is calculated by squaring the forecast errors, averaging those squares, and taking the square root of that average.

GDP = gross domestic product; GNP = gross national product.

a. Calculations are for forecasts made near business cycle peaks—those published in 1981, 1990, 2001, and 2008.

b. Calculations are for all forecasts made between 1981 and 2014 except for the four made near business cycle peaks.

When forecasting productivity growth, CBO considers historical trends in capital accumulation, educational attainment, and the effects of public policy on incentives to invest. Shifts in such trends may be difficult to identify until several years after the fact. Consequently, forecasters may make incorrect inferences about the trajectory of productivity growth and, therefore, potential output growth.

Since the early 1970s, there have been three shifts in the trend of productivity growth—in 1973, 1996, and 2005 (see Figure 5). When the recession began in late 1973, labor productivity growth in the nonfarm business sector dropped precipitously. Whereas productivity had previously grown at a rate of 2.7 percent per year, it grew by only about 1.5 percent per year through the mid-1990s. At least in part because most forecasters in the 1970s expected that the productivity trend of the previous decades would prevail, their forecasts of real output in the mid- to late 1970s turned out to be too optimistic. That expectation also helps explain why forecasters repeatedly underestimated inflation in their projections for the late 1970s.

In 1996, growth in labor productivity in the nonfarm business sector accelerated, averaging more than 3 percent per year for nearly a decade. For several consecutive years, forecasters underestimated the trend of productivity growth, which partly explains why their projections of the economy's growth rate were too low and their projections of inflation in the output price index were too high.[18] The acceleration in labor productivity stemmed from a pickup in technological progress (especially in information technology) and an increase in the amount of capital per worker as firms invested heavily in the new technology.

Since 2005, the growth of labor productivity has been noticeably slower than it was previously for reasons that are not fully understood. The slowdown partly reflects cyclical factors related to the severe recession that occurred from 2007 to 2009 and the ensuing weak recovery. In addition, the growth of the labor force decelerated, which in turn slowed the growth of capital services and possibly reduced the rate at which businesses could bring new technologies into the production process. Some research suggests that such problems might be exacerbated by other, longer-term structural problems that might be impeding the rate at which new technologies diffuse through industries.[19] The unexpected

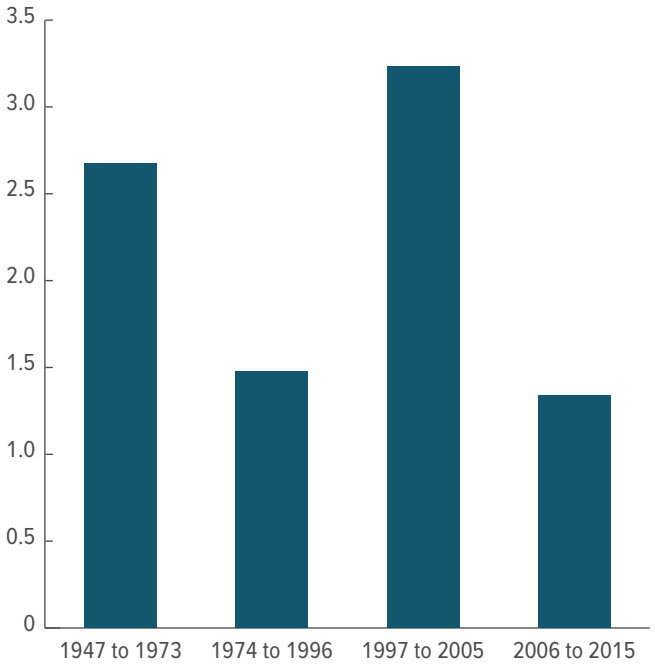
18. See Spencer Krane, "An Evaluation of Real GDP Forecasts: 1996–2001," *Economic Perspectives*, vol. 27, no. 1 (Federal Reserve Bank of Chicago, 2003), pp. 2–21, http://tinyurl.com/y8wadllm; and Scott Schuh, "An Evaluation of Recent Macroeconomic Forecast Errors," *New England Economic Review* (Federal Reserve Bank of Boston, January/February 2001), pp. 35–56, http://tinyurl.com/ych7zk8d.

19. See Ryan A. Decker and others, *Declining Business Dynamism: Implications for Productivity?* Hutchins Center Working Paper 23 (Brookings Institution, September 2016), http://tinyurl.com/lv9cs9h; and Dan Andrews, Chiara Criscuolo, and Peter N. Gal, *The Global Productivity Slowdown, Technology Divergence, and Public Policy: A Firm Level Perspective*, Hutchins Center Working Paper 24 (Brookings Institution, September 2016), http://tinyurl.com/km6942w.

Figure 5.

Trends in Labor Productivity

Average Annual Percentage Change



Source: Congressional Budget Office, using data from the Bureau of Labor Statistics.

Data show the average annual growth of labor productivity in the nonfarm business sector. Labor productivity equals real (inflation-adjusted) output divided by the total number of hours worked. The periods shown correspond with the significant shifts in the average annual growth of productivity that occurred in 1973, 1996, and 2005.

slowdown in labor productivity that began in 2005 contributed to forecasters' overestimating interest rates in recent years.

The trend of productivity growth is also one determinant of long-term interest rates. Thus, the difficulties forecasters have had projecting that trend have also contributed to forecasters' persistently overestimating interest rates. Other unanticipated trends, such as the increased foreign demand for Treasury securities and the declining term premium—that is, the compensation that bondholders require for the extra risk associated with holding longer-term securities—also contributed to errors in forecasting interest rates.

Changes in Crude Oil Prices

Prices for crude oil have fluctuated widely over the past 40 years, creating sizable shifts in the price of petroleum imports and sometimes in overall consumer prices (see Figure 6). The effect of those fluctuations on overall inflation largely stems from the fact that crude oil is an important energy source. In the United States, petroleum accounts for more than one-third of total energy consumption.[20]

The reason that there are such large movements in crude oil prices is that producers and consumers have only limited capacity to adjust supply and demand quickly in response to changing market conditions.[21] Fluctuations in oil prices are often difficult to forecast because markets for petroleum products can be sensitive to developments that forecasters cannot reasonably be expected to predict. In particular, sudden price changes have occurred because of political decisions or instability in oil-producing countries. During the 1973–1981 period, for example, oil prices spiked at the time of the oil embargo imposed by the Organization of Arab Petroleum Exporting Countries (1973 to 1974), the Iranian Revolution (1979), and the start of the Iran–Iraq War (1980). Political factors remain a source of uncertainty, but they appear to have become less important in explaining volatility. Recently, oil prices rose steeply leading up to the 2007–2009 recession and fell sharply in 2014 and 2015 because of shifts in global supply and demand as well as technological changes.

In large part, CBO bases its forecasts of oil prices on the prices implied by oil futures contracts, adjusted to account for the agency's forecasts of economic conditions. Although futures markets provide some predictive power, they are imperfect indicators of actual prices in the future.

CBO's Two-Year Forecasts

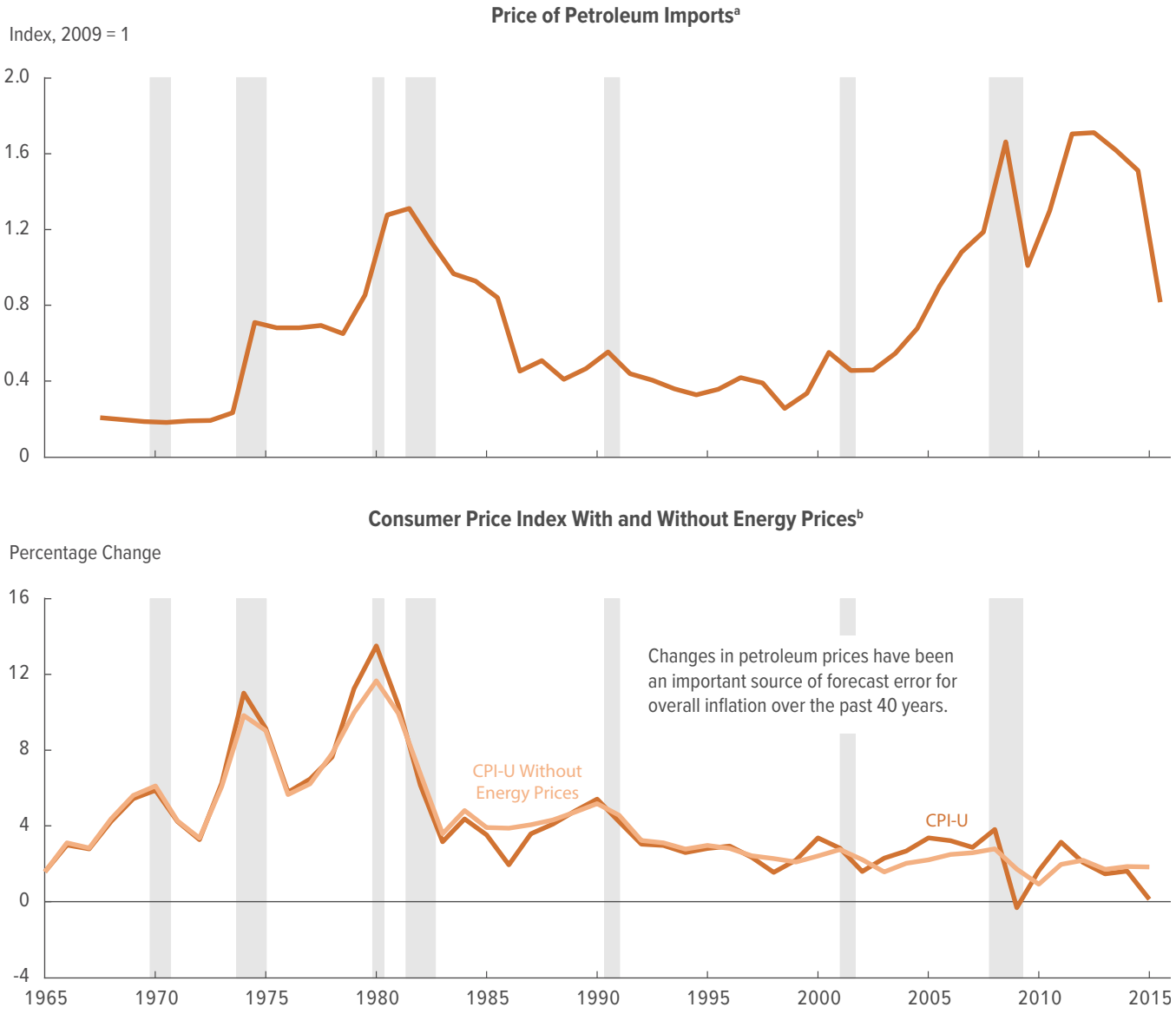
CBO's forecast errors have generally been similar to those of the Administration and the *Blue Chip* consensus. (For a comparison of CBO's two-year forecasts with those of the Federal Reserve, see Box 2 on page 16.) To evaluate the forecasts, CBO looked at various economic indicators, including the growth of output, inflation, interest

20. See Energy Information Administration, *Monthly Energy Review* (January 2017), Table 1.3, https://go.usa.gov/xNFE6 (PDF, 5.48 MB).

21. In the near term, consumers are constrained by the existing energy efficiency of their homes, places of work, and modes of transportation; producers are constrained by their equipment, technology, and the availability and accessibility of natural resources. For further discussion, see Congressional Budget Office, *Energy Security in the United States* (May 2012), www.cbo.gov/publication/43012.

Figure 6.

Price of Petroleum Imports and Consumer Price Inflation



Sources: Congressional Budget Office; Bureau of Labor Statistics; Bureau of Economic Analysis.

The vertical bars indicate the duration of recessions, which extend from the peak of a business cycle to its trough.

Data are annual and are plotted through 2015. The first year for which data on the price of petroleum imports are shown is 1967.

CPI-U = consumer price index for all urban consumers.

a. The price of petroleum imports is the price index for petroleum imports divided by the price index for personal consumption expenditures, excluding prices for food and energy.

b. The major components of energy prices in the CPI-U are motor fuel (which is primarily composed of petroleum products), electricity, and natural gas purchased from utilities.

rates, and changes in wages and salaries (a significant part of taxable income).[22] For most economic indicators, all three sets of forecasts exhibited an upward bias (see Figure 1 on page 2). On average, CBO and the *Blue Chip* consensus slightly underestimated real output growth, and the Administration overestimated it. Compared with the Administration's forecasts, CBO's forecasts of nominal output growth were less biased, but its forecasts of interest rates were more biased. Measured on the basis of the RMSE, CBO's two-year forecasts were about as accurate as the *Blue Chip* consensus (see Figure 2 on page 3). They were also comparable, in terms of accuracy, to the Administration's forecasts, though for some economic indicators, CBO's forecasts were slightly more accurate.

CBO's forecasts of the growth of output (real and nominal) and of inflation show less upward bias than its forecasts of interest rates and of the growth of wages and salaries. However, the output forecasts were less accurate than the forecasts of long-term interest rates, despite the fact that the interest rate forecasts exhibit a sizeable upward bias. Forecaster accuracy is affected by a variety of factors, and indicators are difficult to project for a variety of different reasons. For example, the errors in forecasts of output are particularly sensitive to cyclical movements in the economy, whereas those for inflation are influenced by sudden movements in prices for crude oil.

Output

CBO's forecasts of real and nominal output growth were similar to the *Blue Chip* consensus forecasts in terms of both bias and accuracy; although they were similar to the Administration's forecasts in terms of accuracy, they differed in terms of bias.[23] CBO and the *Blue Chip* consensus underestimated real output growth, on average, whereas the Administration tended to overestimate it. All three forecasters overestimated nominal output growth, on average, but the Administration did so to a greater degree. The accuracy of all three sets of forecasts of the growth of real and nominal output was similar.

Errors in projecting real output growth reveal forecasters' difficulty anticipating turning points in the business cycle and changing trends in productivity growth. Forecasts of nominal output growth are subject to those same difficulties and are affected by errors in projecting inflation as well.

Growth of Real Output. CBO and the *Blue Chip* consensus tended to underestimate the growth of real output, whereas the Administration tended to overestimate it. Nonetheless, the accuracy of all three forecasters was similar. They all tended to significantly overestimate real output around recessions. All three forecasters made their largest forecast errors during the 2007–2009 recession, although CBO did a better job than the other two did of predicting the relative weakness of the recovery that followed (see Figure 7).

Errors in forecasts of real output growth primarily arise from two sources: cyclical movements in the economy and changes in the growth rate of productivity. Cyclical movements are difficult to anticipate, so forecasters typically generate larger errors when the economy is entering a recession. Changes in the trend of productivity growth contribute to persistent misestimates of future real output growth because forecasters are able to detect such changes only well after they have occurred.

In the late 1970s, CBO and the Administration appear to have expected productivity growth to move back toward its earlier post–World War II trend. That expectation contributed to their overly optimistic forecasts of the growth of real output. Early in 1980, CBO, the Administration, and the *Blue Chip* consensus anticipated the coming recession, and consequently, they produced relatively accurate forecasts that year. They did not, however, anticipate that a second recession would follow so soon thereafter. They missed the beginning of the 1981–1982 recession and were unaware of how deep it would be, so the forecasts of real output they made in those two years were too high.

In 1983 and 1984, the economy recovered quickly from the 1981–1982 recession, and real output grew faster than CBO, the Administration, or the *Blue Chip* consensus expected. In forecasts prepared during the 1983–1989 expansion, CBO and the *Blue Chip* consensus underestimated real output growth by roughly 1 percentage point per year, on average; the Administration also underestimated real output growth, but by notably

22. Tables showing the errors of each forecast are available as supplemental material on CBO's website (www.cbo.gov/publication/53090).

23. Before 1992, CBO, the Administration, and the *Blue Chip* consensus forecast output as measured by gross national product (GNP); since 1992, they have forecast output as measured by GDP. Unlike the more commonly cited GDP, GNP includes the income that U.S. residents earn abroad and excludes the income that foreigners earn in this country.

Box 2.

Comparison of CBO's and the Federal Reserve's Two-Year Forecasts

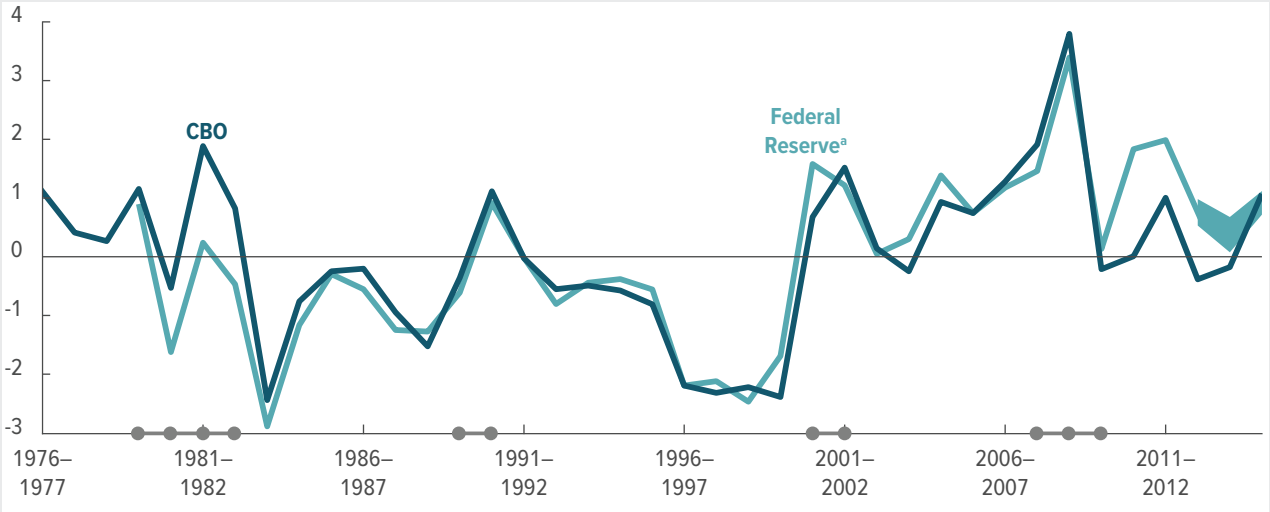
Like the Administration's forecasts and the *Blue Chip* consensus, the Federal Reserve's forecasts provide an informative point of comparison when evaluating the Congressional Budget Office's forecasts. But the Federal Reserve does not release forecasts of Treasury interest rates or of wages and salaries, nor does it publish any five-year forecasts. Therefore, CBO did not include the Federal Reserve's forecasts in the principal analysis for this report. The Federal Reserve does, however, publish timely two-year forecasts of real output growth and inflation rates, which can be compared with CBO's forecasts of those variables.

The Federal Reserve's forecasts differ from CBO's forecasts in two ways.[1] First, the Federal Reserve's forecasts include the effects of anticipated changes in fiscal policy, whereas CBO's forecasts reflect the assumption that current laws governing fiscal policy will remain generally unchanged. Second, the Federal Reserve's forecasts published in recent years are modal forecasts—that is, they represent the single most likely outcome for the economy. By contrast, CBO's forecasts represent the middle of a range of possible economic outcomes. In periods when the range of possible outcomes is highly skewed, the Federal Reserve's forecasts will differ from CBO's. For example, Federal Reserve officials might view the most likely outcome for the economy to be rapid growth, but if there is considerable risk that actual growth might be significantly less than projected, CBO's forecast—represents the middle of the distribution of possible outcomes—might be for slower growth than the Federal Reserve's modal forecast.

CBO's and the Federal Reserve's two-year forecasts of the growth of real output have, for the most part, been similar (see the figure below). The most notable divergences were in forecasts made in the early 1980s and between 2010 and 2012. Before the 1980 recession, CBO produced a fairly accurate forecast of real output growth, whereas Federal

1. For a detailed description of the Federal Reserve's forecasts, see David Reifschneider and Peter Tulip, *Gauging the Uncertainty of the Economic Outlook Using Historical Forecasting Errors: The Federal Reserve's Approach*, Finance and Economics Discussion Series Paper 2017-020 (Board of Governors of the Federal Reserve System, February 2017), https://doi.org/10.17016/FEDS.2017.020 (PDF, 404 KB).

Errors in Forecasts of the Growth of Real Output



Sources: Congressional Budget Office; Federal Reserve; Bureau of Labor Statistics; Bureau of Economic Analysis.

The date ranges on the horizontal axis refer to the two-year forecast period; each forecast was issued in the first year of that period. The dots shown on the horizontal axis indicate that the two-year forecast period overlapped a recession by six months or more.

Forecast errors are projected values minus actual values; thus, a positive error is an overestimate. In the left panel, errors are shown for forecasts of the average annual growth rate of real (inflation-adjusted) output over the two-year forecast period. Output is either GDP or (before 1992) GNP. In the right panel, errors are shown for forecasts of the average annual growth rate of consumer prices over the two-year forecast period. The CPI was forecast through 2011; the price index for personal consumption expenditures has been forecast since 2012. For details on the underlying data, see the appendix.

Continued

Box 2. Continued

Comparison of CBO's and the Federal Reserve's Two-Year Forecasts

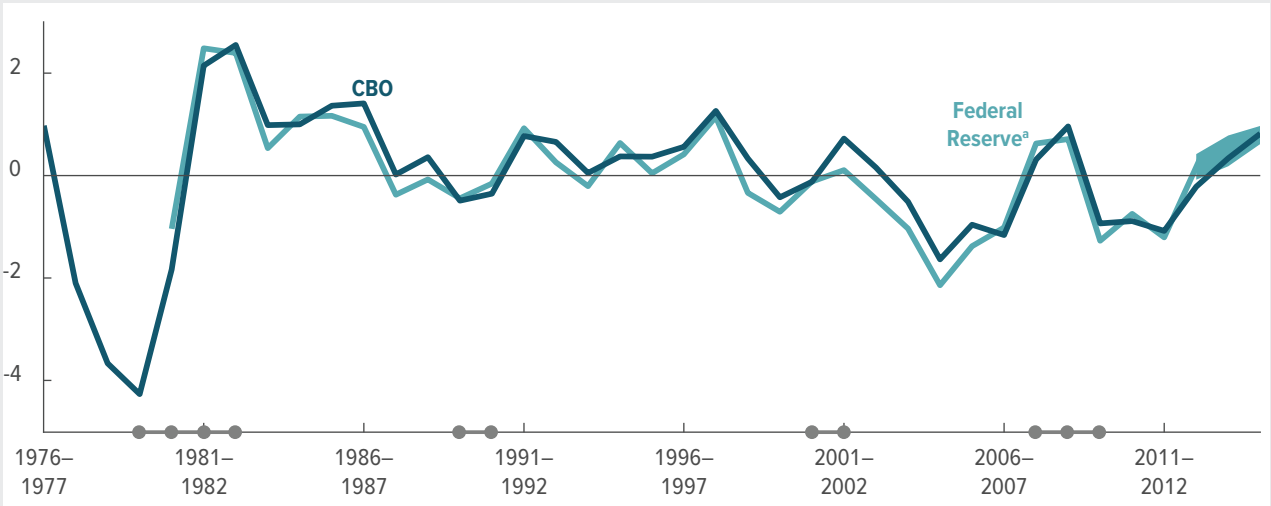
Reserve officials overestimated the depth of the coming recession. However, because CBO failed to anticipate the start of the 1981–1982 recession and, after it had begun, how deep it would be, the agency overestimated growth in real output in its 1981 and 1982 forecasts. Federal Reserve officials more accurately forecast the downturn. In 2010, CBO correctly anticipated that the economic recovery following the 2007–2009 recession would continue to be slow; however, as required by law, the agency assumed that certain tax provisions scheduled to expire would do so and add to fiscal restraint, but those provisions were subsequently extended.[2] By contrast, Federal Reserve officials considerably overestimated growth. The underestimate of output growth in CBO's 2012 forecast reflects, in part, the extension of certain expiring tax provisions, which significantly reduced the amount of fiscal restraint below the amount reflected in CBO's current-law projection. Federal Reserve officials, by contrast, overestimated growth in 2012. In 2013 and 2014, CBO's and the Federal Reserve's forecast errors were similar.

In general, CBO and the Federal Reserve also had similar forecasts of inflation (see the figure below). Forecasts prepared between 2001 and 2005, however, were exceptions. In early 2001, CBO overestimated growth in consumer prices in its two-year forecast, largely because it did not anticipate the 2001 recession. The Federal Reserve's forecast from that year showed little error. Between 2003 and 2005, both forecasters underestimated inflation rates, but the Federal Reserve's errors were somewhat larger. From 2006 to 2011, the two agencies' inflation forecasts were once again similar. For forecasts made between 2012 and 2014, errors in CBO's estimates of inflation were comparable to the smallest errors produced by the Federal Reserve's central tendency—that is, the range of estimates formed by removing the three highest and three lowest estimates made by Federal Reserve officials.

2. When CBO prepared its forecast in early 2010, several tax provisions were set to expire at the end of the calendar year. Most of those provisions were originally enacted in the Economic Growth and Tax Relief Reconciliation Act of 2001 and the Jobs and Growth Tax Relief Reconciliation Act of 2003.

Errors in Forecasts of Consumer Price Inflation

Percentage Points



Beginning with 1986 for inflation and 2012 for output, growth rates are based on the quarterly growth rates over the two-year forecast period.

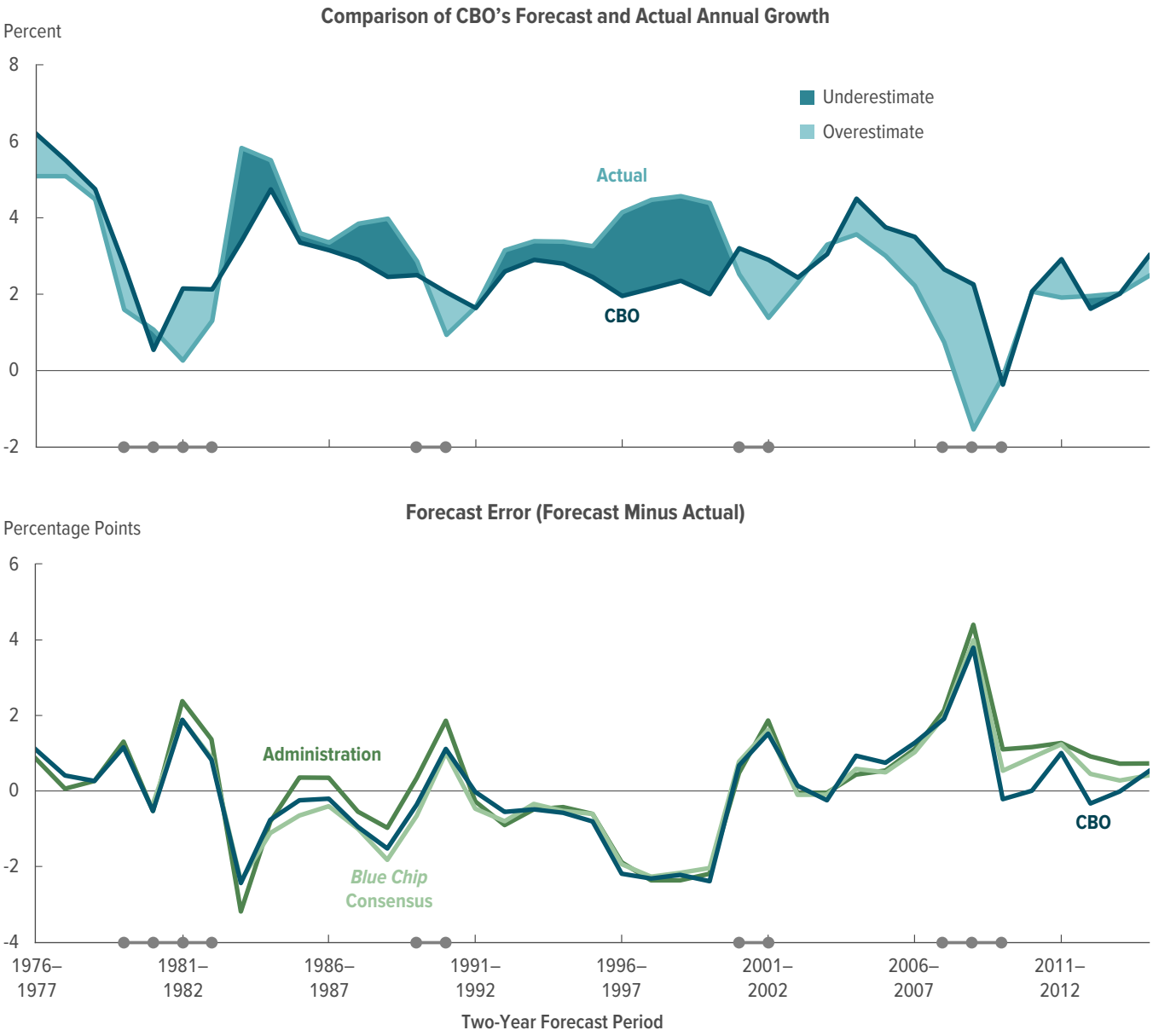
The most recent forecasts included are those published in 2014. The Federal Reserve first published a two-year forecast of real output in 1979 and of consumer prices in 1980.

CPI = consumer price index; GDP = gross domestic product; GNP = gross national product.

a. Forecasts prepared by the staff of the Board of Governors of the Federal Reserve System are reported with a five-year lag and are therefore available only through 2011. For the forecasts made between 2012 and 2014, the shaded area represents the central tendencies of Federal Reserve officials' forecasts—that is, the range of estimates formed by removing the three highest and three lowest forecasts reported by the members of the Board of Governors and the presidents of the Federal Reserve Banks.

Figure 7.

Growth of Real Output: Two-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators;* Bureau of Economic Analysis.

The date ranges on the horizontal axis refer to the two-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the two-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual growth rate of real (inflation-adjusted) output over the two-year forecast period. Output is either GDP or (before 1992) GNP.

The most recent forecasts included are those published in 2014. The first two-year *Blue Chip* consensus forecast of real output was published in 1980.

GDP = gross domestic product; GNP = gross national product.

smaller amounts, particularly during the latter half of the decade.

The 1990–1991 recession resulted in the forecasters' overestimating real output growth in their 1990 forecasts. Even so, the errors by CBO and the *Blue Chip* consensus that year were actually smaller than the RMSEs for the forecasts made between 1980 and 2014. By contrast, the Administration's forecast error that year was considerably larger than its RMSE for the whole period.

In every year between 1992 and 1999, all the forecasters underestimated two-year growth in real output. The errors were particularly large for the two-year forecasts made between 1996 and 1999. About one-fourth of the magnitude of those errors is attributable to subsequent revisions—including important changes to definitions—that BEA made to the national income and product accounts (NIPAs). Those revisions aside, the significant underestimates made between 1996 and 1999 resulted from forecasters' failure to anticipate several important economic developments. One such development was the investment boom of the late 1990s, which increased capital stock and thereby boosted labor productivity and real output more than many forecasters had expected.

When preparing their projections in 2001, forecasters did not anticipate the recession that occurred later that year. CBO and the *Blue Chip* consensus overestimated the growth of real output by similar amounts, and the Administration overestimated it by a slightly larger amount. Following the recession, the economy underwent an unusually slow recovery and weak expansion.

Between 2004 and 2006, all three forecasters' expectations for real output growth proved to be too optimistic; however, the errors in the Administration's forecasts and *Blue Chip* consensus forecasts were smaller than those in the forecasts that CBO made during those years. Perhaps contributing to the overestimates, rising energy prices (unanticipated by many forecasters) dampened the growth of real GDP by roughly a quarter of a percentage point in 2004, by less than half of a percentage point in 2005, and by about a quarter of a percentage point during the first half of 2006.[24]

In 2007 and 2008, forecasters failed to appreciate the effect of the growing imbalances in the housing and financial markets. During the early 2000s, real output growth was partly supported by a boom in residential construction, which was fueled by a growing bubble in house prices. By 2007, a downturn in the housing market was apparent, and tensions in financial markets began to rise. Despite those tensions, in early 2008 forecasters expected that the U.S. economy would avoid falling into recession. For example, in January 2008, CBO stated, "If a severe credit crunch did occur, it would drive the economy into recession by significantly curbing financial activity and consumer spending. However, CBO assumes in its forecast that the Federal Reserve will implement policies to prevent such a crunch and that the financial sector is capable of absorbing most of the losses it faces."[25] Those expectations proved to be incorrect: In 2008, forecasts by CBO, the Administration, and the *Blue Chip* consensus overestimated real output growth by at least 3¾ percentage points.

Despite the unusually weak recovery from the 2007–2009 recession, the two-year forecasts of real output growth that CBO made from 2009 to 2013 were relatively accurate compared with the Administration's projections and the *Blue Chip* consensus forecasts from those years and compared with the agency's own forecasts made over the entire 1980–2014 period. Whereas the Administration and the *Blue Chip* consensus consistently overestimated future growth in real output during the recovery, CBO's projections were relatively close to actual growth, with one notable exception—in 2011, CBO significantly overestimated real output growth, though even then, it did so by less than the other forecasters.

One source of divergence between CBO's forecasts and the other forecasts during the years immediately following the most recent recession was the forecasters' different fiscal policy assumptions. In early 2009, contributors to the *Blue Chip* consensus reported that they expected additional fiscal stimulus, which implied stronger output growth than would be expected under current law.[26] CBO's growth projections were thus tempered by the requirement that its forecasts reflect current law. In the end, fiscal stimulus was weaker than those private forecasters had predicted—as was the underlying momentum in the economy—making CBO's forecast more

24. See Congressional Budget Office, *The Economic Effects of Recent Increases in Energy Prices* (July 2006), p. 6, www.cbo.gov/publication/17984.

25. See Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2008 to 2018* (January 2008), p. 23, www.cbo.gov/publication/41661.

26. See Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2009 to 2019* (January 2009), pp. 10–11, www.cbo.gov/publication/41753.

accurate than the *Blue Chip* consensus. When preparing its forecast in 2010, CBO assumed that expiring tax provisions would result in additional fiscal restraint, but those provisions were subsequently extended.[27]

The forecasts that CBO made in 2012 and 2013 were fairly accurate, especially compared with the Administration's, but in 2014, all forecasters overestimated real output growth by a moderate amount.

Growth of Nominal Output. Differences between errors in forecasts of the growth of real and nominal output reflect inaccuracies in projections of inflation in the output price index. (The two indexes that CBO uses to measure inflation are discussed in the next section.) Because all the forecasters overestimated future inflation, their forecasts of nominal output growth exhibit more upward bias, as measured by the mean error, than do their projections of real output growth. All the forecasters' projections of nominal output growth were slightly less accurate than their projections of real output growth (see Figure 8).

During the 1980s and 1990s, CBO, the Administration, and the *Blue Chip* consensus tended to overestimate inflation, partially offsetting their underestimates of real output growth. Consequently, their forecasts of nominal output growth exhibited less bias over that period than did their forecasts of real output growth.

During much of the 2000s, all the forecasters tended to underestimate inflation rates. Those underestimates generally offset their overestimates of real output growth. However, the forecasts prepared in 2008 were a notable exception. Early that year, all the forecasters expected that a recession would be avoided, and they therefore overestimated both inflation and real output growth. As a result, in that year's forecasts, estimates of nominal output growth were between 4 percentage points and 5 percentage points too high. Since the recession, CBO has slightly underestimated nominal output, on average, because it has underestimated inflation. By contrast, the *Blue Chip* consensus and the Administration's forecasts of nominal output have consistently erred on the high side throughout that same period, mostly because the *Blue Chip* consensus and the Administration anticipated that real output growth would be higher than it was.

27. At the time, several tax provisions—most of which were originally enacted in the Economic Growth and Tax Relief Reconciliation Act of 2001 and the Jobs and Growth Tax Relief Reconciliation Act of 2003—were due to expire at the end of December 2010. See Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2010 to 2020* (January 2010), p. 1, www.cbo.gov/publication/41880.

Inflation

Inflation is the increase in the average price of a broad basket of goods or services and is measured as the percentage change in a general price index. From 1981 to 2014, inflation forecasts were relatively accurate and exhibited only a small upward bias. But during the unusually volatile period of the late 1970s (before the first full *Blue Chip* consensus forecast was published), CBO and the Administration substantially underestimated inflation. Since the mid-1980s, inflation has stabilized, and forecasting accuracy has improved.

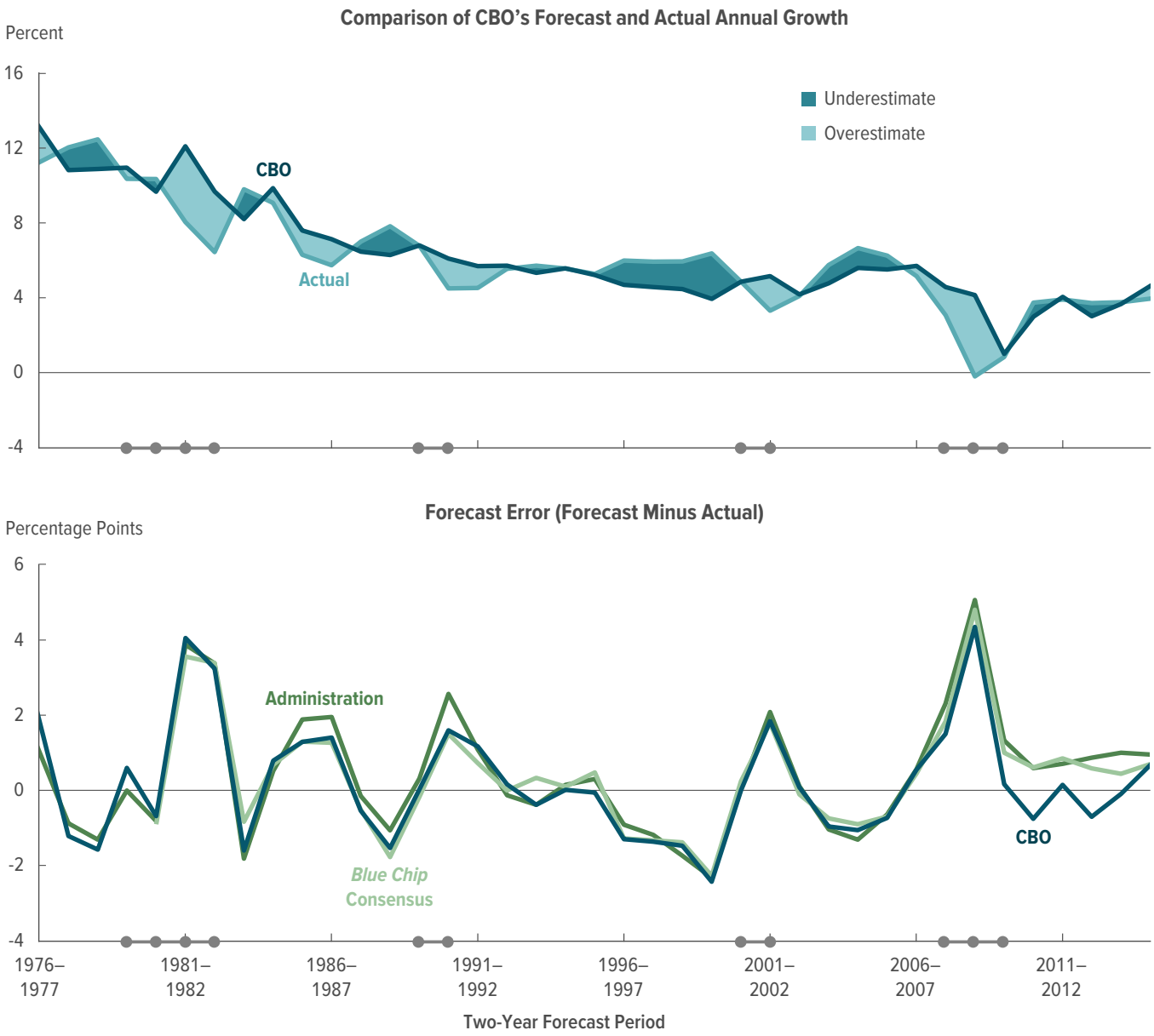
CBO's evaluation of inflation forecasts focuses on two measures: the percentage change in the CPI and the difference between that measure and the percentage change in the price index for output. The CPI measures inflation in the prices of a fixed group of consumer goods and services.[28] The output price index measures the prices of all goods and services that make up GDP (or, before 1992, gross national product [GNP]).

Inflation in the CPI and inflation in the output price index affect federal outlays and revenues differently. All else being equal, higher inflation in the CPI implies faster growth in outlays and slower growth in revenues. Inflation in the CPI increases federal outlays because the index is used to adjust payments to Social Security beneficiaries as well as payments made under other programs, such as civil service retirement. Since the mid-1980s, elements of the individual income tax—including the tax brackets—have also been indexed to the CPI, so inflation in the index reduces revenues. By contrast, growth in the output price index, which is closely linked to growth in nominal income subject to federal taxes, implies faster

28. In most of the years examined here, the inflation forecasts are for the CPI-U, which measures inflation in the prices of goods and services consumed by all urban consumers. Some forecasts, however, were for the CPI-W, which measures inflation in the prices of goods and services consumed by urban wage earners and clerical workers. CBO forecast the CPI-W from 1976 to 1978 and again from 1986 to 1989; the Administration forecast the CPI-W through 1991. For the purpose of this evaluation, the distinction between the two measures was most consequential in 1984, when inflation in the CPI-U and CPI-W diverged by 0.9 percentage points.

Figure 8.

Growth of Nominal Output: Two-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Economic Analysis.

The date ranges on the horizontal axis refer to the two-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the two-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual growth rate of nominal output over the two-year forecast period. Output is either GDP or (before 1992) GNP.

The most recent forecasts included are those published in 2014. The first two-year *Blue Chip* consensus forecast of nominal output was published in 1980.

GDP = gross domestic product; GNP = gross national product.

growth in revenues. Consequently, if the output price index was forecast to grow more slowly than the CPI, the projected deficit would generally be larger than if the reverse was forecast.

The errors in forecasts of inflation—particularly those of inflation in the CPI—have generally reflected turbulence in crude oil prices. For example, rapidly rising oil prices contributed to forecasters' significantly underestimating inflation when making their projections in the late 1970s and mid-2000s. The dramatic (and largely unexpected) decline in inflation that began during the deep recession in the early 1980s also contributed to errors in inflation forecasts. Forecasters only gradually recognized the extent of that decline and thus drastically overestimated price growth during much of the decade.

Inflation in the CPI. Although errors in forecasts of most economic indicators were largest during recessions, that pattern is not as pronounced for inflation forecasts. After the volatile period of the late 1970s and early 1980s, inflation was relatively stable, and the accuracy of all three sets of forecasts of inflation improved. Errors in inflation forecasts have been relatively small in the past two decades compared with errors in earlier projections of inflation and with those in forecasts of most other indicators.

During the late 1970s, CBO and the Administration made large errors when forecasting CPI inflation (see Figure 9). Primarily because of the spike in crude oil prices in 1979 and 1980, they underestimated inflation in the forecasts they prepared in 1978 and 1979 by about 4 percentage points, on average.

In the forecasts they made between 1981 and 1986, CBO and the Administration overestimated inflation in the CPI by 1.5 percentage points, on average, whereas the *Blue Chip* consensus overestimated it by an average of 1.8 percentage points. The overestimates largely stemmed from the fact that forecasters did not anticipate the sharp and lasting decline in the rate of inflation that followed the 1981–1982 recession. They also did not foresee the drop in crude oil prices that occurred in early 1986.

Between 1987 and 2003, CBO, the Administration, and the *Blue Chip* consensus made relatively small errors: The RMSE of each set of forecasts was roughly one-half of a percentage point. Inflation forecasts probably benefited from the relatively benign economic environment—in contrast to the turbulent late 1970s and early 1980s—that existed during most of that period. Growth in the CPI remained within a narrow range during those years, particularly after 1990.

Between 2004 and 2007, the forecasters persistently underestimated inflation in the CPI, largely because of the unexpected rise in crude oil prices. The two-year forecasts of inflation were about 1 percentage point below actual rates, on average.

In 2008, CBO, the Administration, and the *Blue Chip* consensus failed to anticipate the 2007–2009 recession and the downward pressure that it would place on consumer price growth. As a result, CBO and the Administration overestimated inflation slightly, and the *Blue Chip* consensus overestimated it by a slightly larger amount.

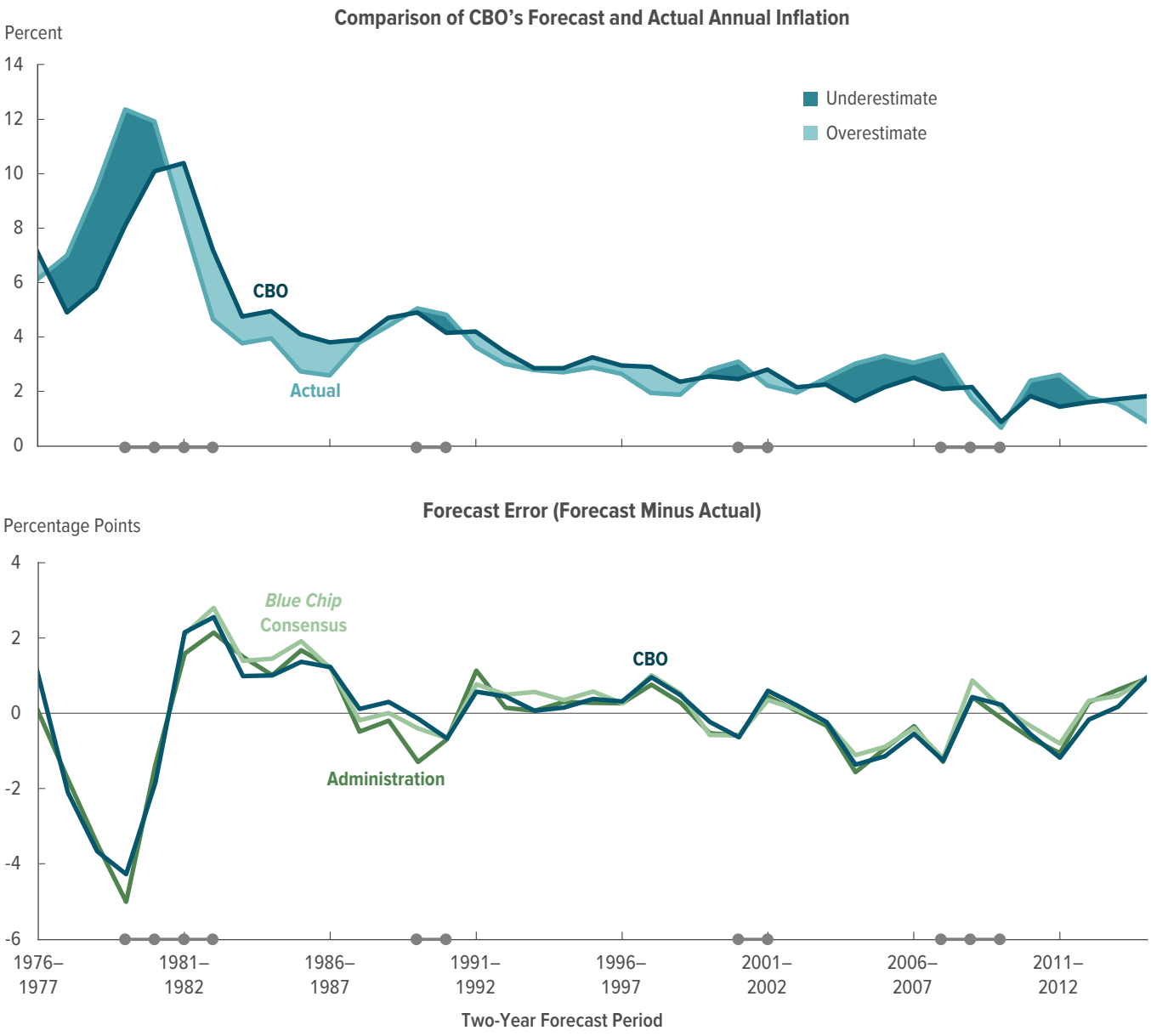
All of the forecasters' 2009 projections showed a decline in inflation close to what actually occurred, but the estimates of inflation in their 2010 and 2011 projections were too low, partly because of an unexpected increase in the price of energy. The inflation forecasts that CBO made in 2012 and 2013 were relatively close to the actual inflation rates. In their 2014 forecasts, CBO, the Administration, and the *Blue Chip* consensus significantly overestimated inflation because of the sudden drop in oil prices that occurred in 2014 and 2015.

Difference Between Inflation Measures. Errors in forecasts of the difference between inflation measures follow a pattern somewhat similar to that of the CPI forecast errors. But because the output price index is more directly related to projections of output than the CPI is, the errors in forecasts of the output price index tend to increase more during recessions than the errors in CPI forecasts do. All three sets of forecasts of the difference between the two measures tended to be too low, meaning that CPI actually grew faster in relation to the output price deflator than projected.

In the forecasts they made between 1978 and 1980, CBO and the Administration underestimated the difference in inflation measures by more than 2 percentage points, on average (see Figure 10). In 1979 and 1980, the difference between inflation in the CPI and the GNP price index spiked to its highest levels since the end of World War II. A significant portion of the divergence can be explained by the oil price shock. A surge in oil prices has a larger effect on the CPI than on the output

Figure 9.

Inflation in the Consumer Price Index: Two-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Labor Statistics.

The date ranges on the horizontal axis refer to the two-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the two-year forecast period overlapped a recession by six months or more.

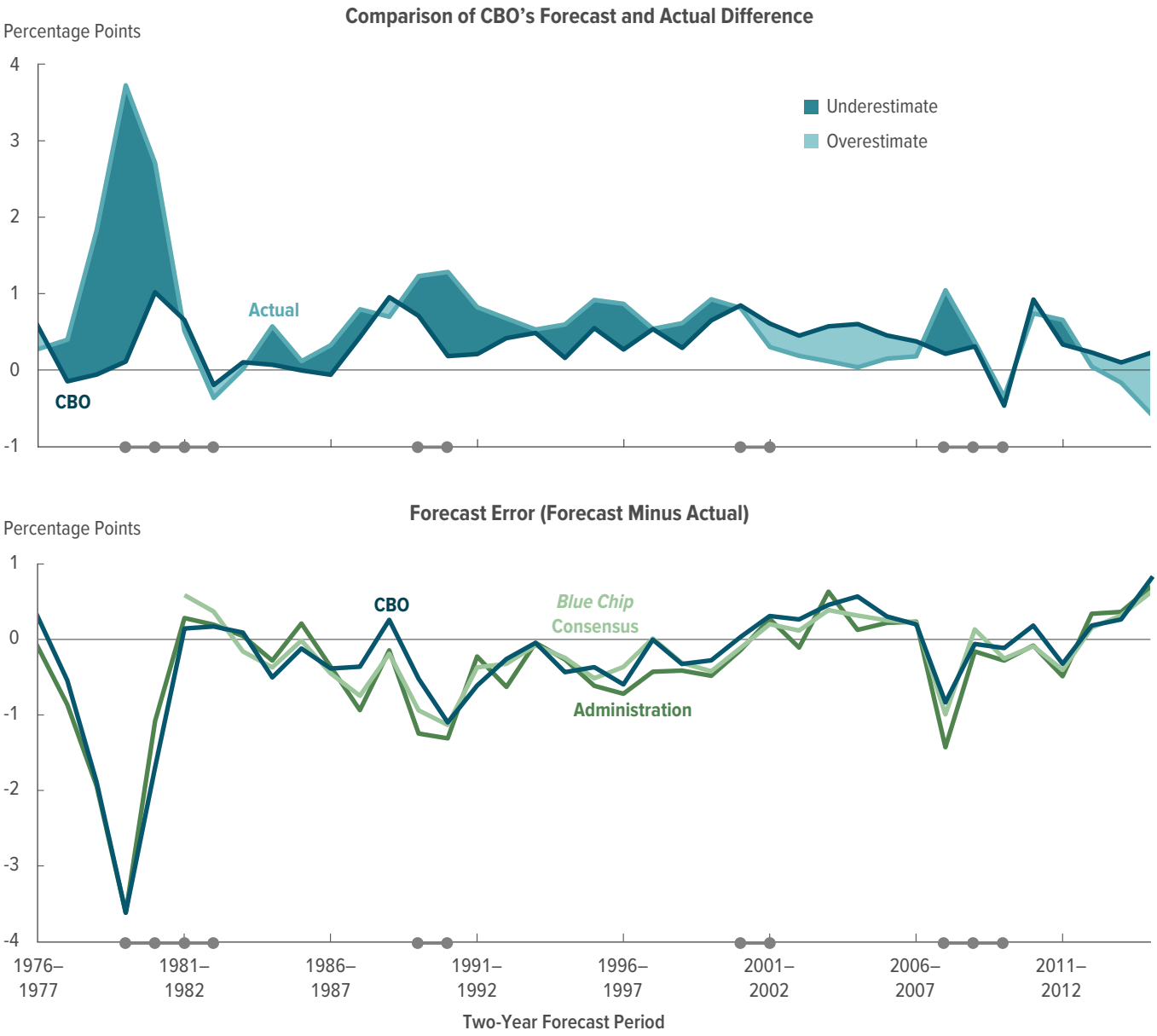
Forecast and actual data show the average annual growth rate of the CPI over the two-year forecast period. Most of the forecasts represented here were for the CPI-U, but some were for the CPI-W. For details on the underlying data, see the appendix.

The most recent forecasts included are those published in 2014. The first two-year *Blue Chip* consensus forecast of the CPI was published in 1981.

CPI = consumer price index; CPI-U = consumer price index for all urban consumers; CPI-W = consumer price index for urban wage earners and clerical workers.

Figure 10.

Difference Between Inflation in the CPI and in the Output Price Index: Two-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Labor Statistics; Bureau of Economic Analysis.

The date ranges on the horizontal axis refer to the two-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the two-year forecast period overlapped a recession by six months or more.

Forecast and actual data show average annual growth in the CPI over the two-year forecast period minus average annual growth in the output price index over that period. In most of the forecasts represented here, the CPI-U was projected, but in some, the CPI-W was forecast. The output price index measures the prices of all goods and services that make up either GDP or (before 1992) GNP. For details on the underlying data, see the appendix.

The most recent forecasts included are those published in 2014. The first two-year *Blue Chip* consensus forecast of the CPI was published in 1981.

CPI = consumer price index; CPI-U = consumer price index for all urban consumers; CPI-W = consumer price index for urban wage earners and clerical workers; GDP = gross domestic product; GNP = gross national product.

price index because petroleum products are a much larger share of households' out-of-pocket expenditures than of total output in the economy.

Underestimates of the difference between inflation measures in forecasts made before 2000 partly reflect the methodological change to the national income and product accounts that BEA made in 1999. That year the agency began to treat business and government purchases of software as investment and thus to include such spending in its calculations of GDP. Because the price of software grew much less rapidly, on average, than other prices, the change in the classification of spending on software resulted in a downward revision to the historical data on the growth in the output price index. Hence, the forecasts made before 2000 were based on a pattern of historical growth in the output price index that was higher than such growth is currently reported to have been. That difference probably accounts for about 0.2 percentage points—or two-fifths—of the apparent bias in forecasts from that period.

In 2000, all three forecasters' projections of the difference between the inflation measures were very accurate, but between 2001 and 2006, their forecasts were typically too high. Forecasters did not anticipate the large declines in the difference between the measures that occurred in 2001 and 2002. The declines stemmed from two developments—the slowdown in inflation in energy prices and the reduction in inflationary pressures that followed the 2001 recession. Those two developments caused growth in the CPI to slow more than growth in the output price index through 2002. From 2003 to 2006, forecasters continued to overestimate the difference between the measures.

The sharp increase in the difference between the inflation measures in 2008 caught CBO, the Administration, and the *Blue Chip* consensus by surprise. As a consequence, the absolute values of the errors in their 2007 forecasts were among the largest of the forecast errors since the late 1970s. Despite the volatility in the difference between measures in 2009 and 2010, forecasts made in those years were fairly accurate. Errors were slightly larger in the next three years' forecasts, but not notably so. In 2014, CBO and other forecasters failed to anticipate that the output price index would continue to grow faster than the CPI—an unusual trend that was related to the sudden drop in oil prices in 2014 and 2015.

Interest Rates

Between 1981 and 2014, CBO's and the Administration's projections of interest rates, along with the *Blue Chip* consensus forecasts, were too high, on average. Of the three sets, the Administration's forecasts were the least biased over the period because large negative errors in the forecasts that it prepared in the late 1980s partly offset positive errors in its forecasts from other periods, particularly the 2000s. Measured by the RMSE, CBO's interest rate forecasts were about as accurate as those of the Administration and the *Blue Chip* consensus. The forecasts of interest rates produced by CBO and the *Blue Chip* consensus have, however, tended to be more biased than their forecasts of other economic indicators. In general, forecasters have been surprised by the persistent decline in interest rates over the past three decades.

CBO's forecasts of interest rates on Treasury securities underlie its projections of payments on federal debt and other components of the budget. The forecasts evaluated here are for two key rates—a short-term rate (the rate on 3-month Treasury bills) and a long-term rate (the rate on 10-year Treasury notes).[29] CBO evaluated forecasts of the interest rate on 3-month Treasury bills in both nominal and real terms. The nominal rate of interest is the rate quoted in the secondary market. The real interest rate equals the nominal rate minus inflation in the CPI. Errors in forecasts of the real interest rate reflect errors in forecasts of both the nominal interest rate and the inflation rate.

For forecasts of the 3-month Treasury bill rate, the largest errors have tended to occur during downturns in the business cycle. Short-term interest rates tend to move down when the economy enters a recession. Just as recessions are difficult to anticipate, so too are movements in short-term interest rates. Changes to monetary policy

29. Forecasters have projected different interest rates through the years, so the specific rates used for this evaluation vary slightly in some years. The Administration forecast the rate on newly issued bills through 2000, and the *Blue Chip* consensus forecast the rate from 1982 to 1985 and from 1992 to 1997. In 1981, the only short-term rate available for the *Blue Chip* consensus was the 6-month commercial paper rate. CBO did not forecast the rate on 10-year notes in 1984 or 1985, and the *Blue Chip* consensus did not include forecasts of the rate between 1984 and 1995. However, for the sake of simplicity, this report refers to the rate on 10-year Treasury notes even when discussing those years' forecasts. Forecasts of the Moody's Aaa corporate bond rate were used as a substitute for forecasts of the 10-year Treasury note rate in the years when the Treasury rate was not forecast.

made in response to recessions are a primary contributor to errors in forecasting short-term interest rates. Typically, when the economy enters a recession, inflation falls and unemployment rises, prompting the Federal Reserve to stimulate demand by lowering short-term interest rates.

The errors in forecasting the 10-year Treasury note rate have tended to be less related to turning points in the business cycle than to the gradual and mostly unanticipated decline in long-term interest rates that began in the early 1980s. Several factors have contributed to the decline in long-term interest rates, including slowdowns in labor force and productivity growth and a decline in the term premium.[30]

In addition, changes in expectations of inflation, stronger than anticipated demand for Treasury securities by foreign purchasers, and changes in the amount of federal debt held by the public have contributed to errors in forecasting both short-term and long-term interest rates.

Interest Rate on 3-Month Treasury Bills. Between 1981 and 2014, forecasts of nominal interest rates on 3-month Treasury bills exhibited notable upward bias. CBO and the *Blue Chip* consensus overestimated nominal interest rates, on average; the Administration did as well, but its forecasts had slightly less of an upward bias. In part, that bias stemmed from forecasters' tendency to overestimate inflation rates between 1981 and 1998. All three sets of forecasts were comparable in terms of accuracy; the Administration's forecasts were less biased only because large underestimates in the late 1980s somewhat offset overestimates in other periods. Errors in forecasts of real interest rates follow a pattern similar to that of errors in nominal interest rates, but they are further affected by errors in projecting growth in the CPI. Sometimes the two types of errors worked in opposite directions, making the forecast of the real interest rate more accurate, and sometimes errors in forecasts of growth in the CPI exacerbated errors in forecasts of the nominal interest rate.

In the forecasts they prepared in 1978 and 1979, both CBO and the Administration underestimated the nominal interest rate on 3-month Treasury bills by about 2½ percentage points, on average (see Figure 11). Those errors stemmed entirely from the forecasters' underestimating inflation rates during that period. In fact, CBO and the Administration *overestimated* real interest rates by more than 1¼ percentage points, on average, in those years (see Figure 12). Those overestimates may be the result of the forecasters' overly optimistic projections of real output growth during the period.

During the early 1980s, the Federal Reserve raised interest rates, which contributed to two recessions in close succession and, ultimately, to a sharp and lasting reduction in the rate of inflation. In 1980 and 1981, many forecasters did not fully anticipate that prolonged period of restraint in monetary policy or its impact on price growth. In their 1980 forecasts, CBO and the Administration underestimated both nominal and real interest rates, suggesting that monetary policy proved to be tighter than either expected over the next two years. In 1981, CBO overestimated nominal interest rates, but because it also overestimated inflation, the agency underestimated real interest rates; the Administration and the *Blue Chip* consensus underestimated both nominal and real interest rates that year.

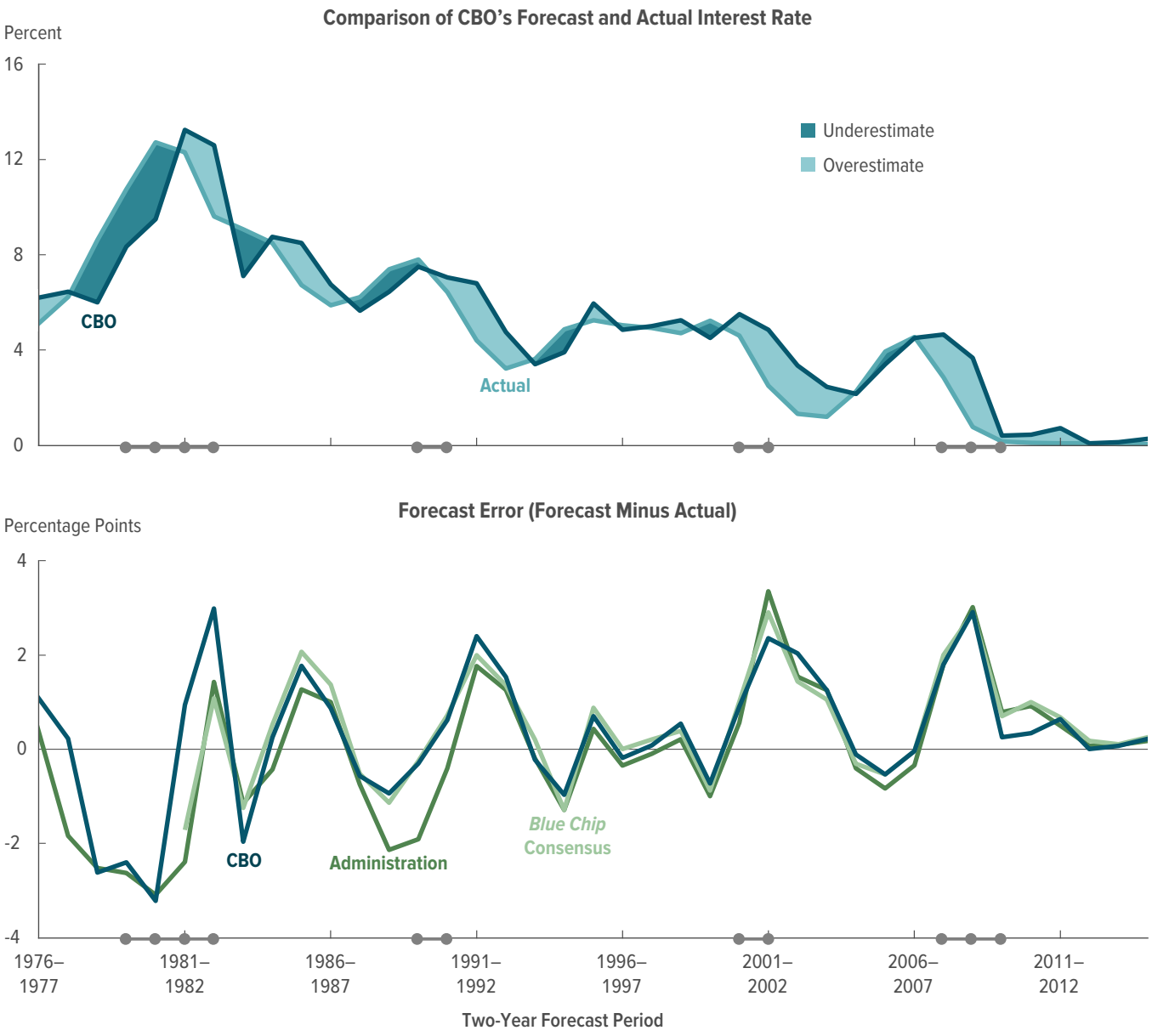
Although all three sets of forecasts were less biased during the rest of the 1980s, they exhibited a notable upward bias after 1990, mainly because in the wake of a recession, forecasters tend to underestimate the extent and duration of the easing of monetary policy. In early 1991 and 1992, forecasters expected interest rates to begin rising as the economy recovered from the 1990–1991 recession, but the recovery was unexpectedly weak, and inflation remained low. In response, the Federal Reserve continued to ease monetary policy for several years, pushing down the nominal interest rate on 3-month Treasury bills from nearly 8 percent in the first half of 1990 to 3 percent in 1993. In the forecasts published between 2000 and 2011, CBO, the Administration, and the *Blue Chip* consensus overestimated real interest rates by more than 1¼ percentage points, on average, and nominal interest rates by slightly less. Some of that bias can be attributed to the 2001 and 2007–2009 recessions and the surprisingly sluggish recoveries that followed them. But some of that bias is due to the largely unanticipated persistent downward trend in interest rates.

CBO's 2012 and 2013 forecasts of negative real interest rates proved to be fairly accurate, but the estimated rate

30. For more on factors contributing to the decline in long-term interest rates, see Congressional Budget Office, *The Budget and Economic Outlook: 2017 to 2027* (January 2017), www.cbo.gov/publication/52370.

Figure 11.

Interest Rate on 3-Month Treasury Bills: Two-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Federal Reserve; Bureau of the Public Debt.

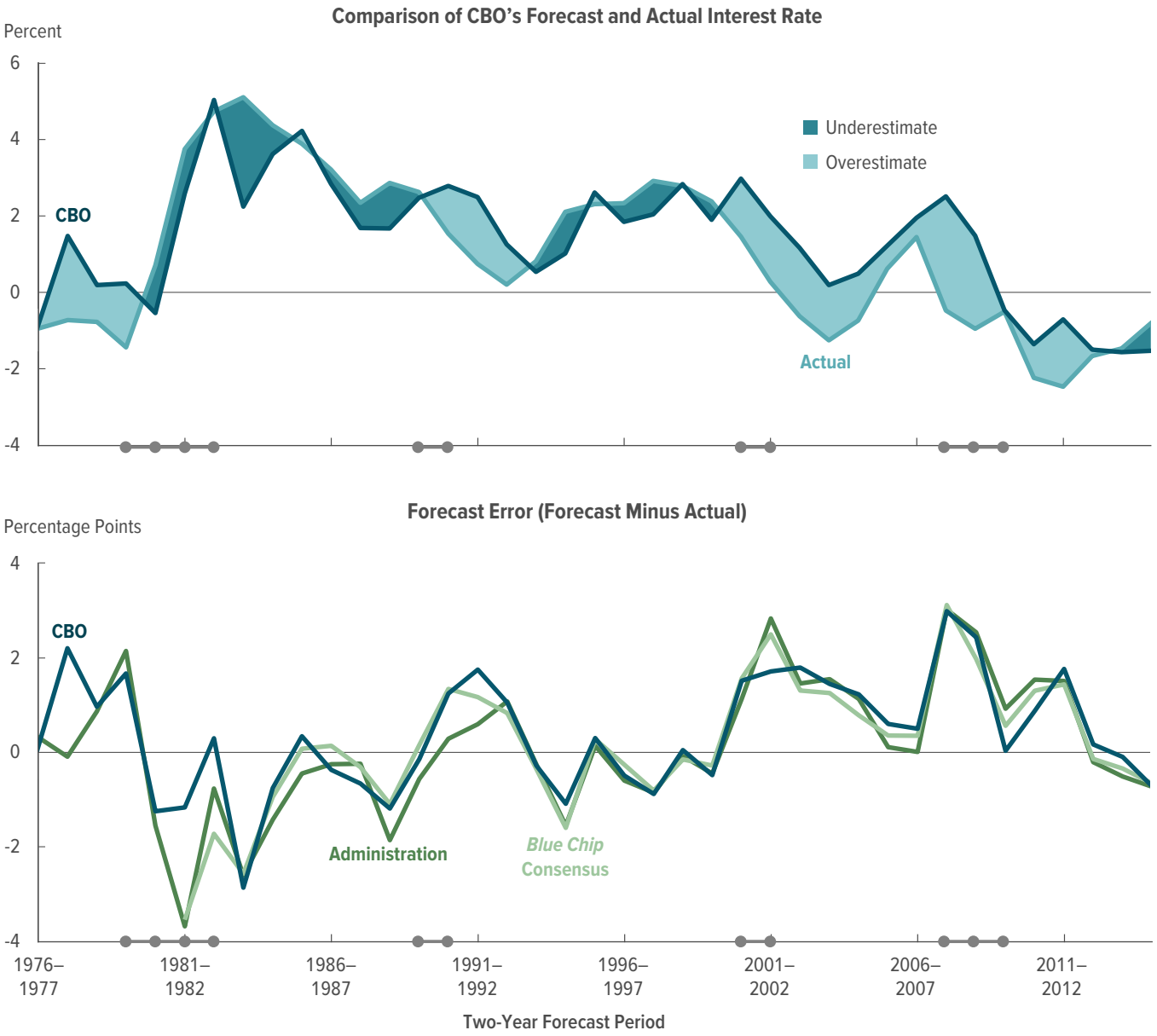
The date ranges on the horizontal axis refer to the two-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the two-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual interest rate over the two-year forecast period. Most of the forecasts represented here were for the secondary-market interest rate, but some were for the rate on newly issued bills or for the 6-month commercial paper rate. For details on the underlying data, see the appendix.

The most recent forecasts included are those published in 2014. The first two-year *Blue Chip* consensus forecast of short-term interest rates was published in 1981.

Figure 12.

Real Interest Rate on 3-Month Treasury Bills: Two-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Labor Statistics; Federal Reserve; Bureau of the Public Debt.

The date ranges on the horizontal axis refer to the two-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the two-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average nominal annual interest rate over the two-year forecast period deflated by the growth in the CPI over that period. Most of the forecasts represented here were for the secondary-market interest rate, but some were for the rate on newly issued bills or for the 6-month commercial paper rate. In most cases, the CPI-U was used as the deflator, but in some, the CPI-W was used. For details on the underlying data, see the appendix.

The most recent forecasts included are those published in 2014. The first two-year *Blue Chip* consensus forecast of short-term interest rates was published in 1981.

CPI = consumer price index; CPI-U = consumer price index for all urban consumers; CPI-W = consumer price index for urban wage earners and clerical workers.

in its 2014 forecast—like the rates in the Administration's forecast and the *Blue Chip* consensus that year—was slightly below the actual rate.

Interest Rate on 10-Year Treasury Notes. Between 1984 and 2014, CBO and the *Blue Chip* consensus tended to overestimate the nominal interest rate on 10-year Treasury notes by similar amounts; the Administration's forecasts were slightly less biased (see Figure 13). Large negative errors in the forecasts that the Administration made in the late 1980s and early 1990s offset positive errors in the forecasts it prepared during other periods, particularly the 2000s. As measured by the RMSE, all the forecasters had a similar degree of accuracy.

Between 2000 and 2008, CBO, the Administration, and the *Blue Chip* consensus persistently overestimated the nominal interest rate on 10-year Treasury notes (by 0.7 percentage points, on average). To some extent, those errors were related to the recessions in 2001 and from 2007 to 2009. However, even during the expansion that occurred between the two recessions, long-term interest rates continued to decline because of slow growth in the labor force, a declining term premium, strong foreign demand for Treasury securities, and, toward the end of that period, a slowdown in productivity growth. All three forecasters were largely surprised by the effect of those trends on interest rates.

By 2009, all of the forecasters had revised their expectations for interest rates downward. For that reason, the forecasts of the rate for 10-year Treasury notes that they made that year were relatively accurate, deviating from actual interest rates by less than one-quarter of a percentage point.

After the 2007–2009 recession ended, forecasters expected long-term interest rates to rise, but they continued to decline over the next two years, especially in 2011. From 2010 to 2012, CBO overestimated the interest rate on 10-year Treasury notes by 0.8 percentage points, on average; the Administration and the *Blue Chip* consensus overestimated that rate by 1.1 percentage points, on average. CBO's 2013 forecast of long-term interest rates was relatively accurate, but the agency's 2014 forecast proved too high when, contrary to expectations, interest rates stayed low.

Wages and Salaries

Between 1980 and 2014, CBO and the Administration overestimated the growth of wages and salaries, on average. (Because the *Blue Chip* consensus does not include forecasts of wages and salaries, only CBO's and the Administration's forecasts are discussed in this section.) CBO's forecasts were less biased than those of the Administration, but that is mostly due to bias in the Administration's forecasts of nominal output growth—both forecasters' projections of wages and salaries measured as a percentage of output were essentially unbiased. The two forecasters' accuracy was similar for projections of the growth of wages and salaries and projections of the change in wages and salaries as a percentage of output. Projections of federal revenues depend significantly on forecasts of wages and salaries, which are a major component of taxable income.[31] Errors in forecasts of wages and salaries may result from inaccurate forecasts of these items:

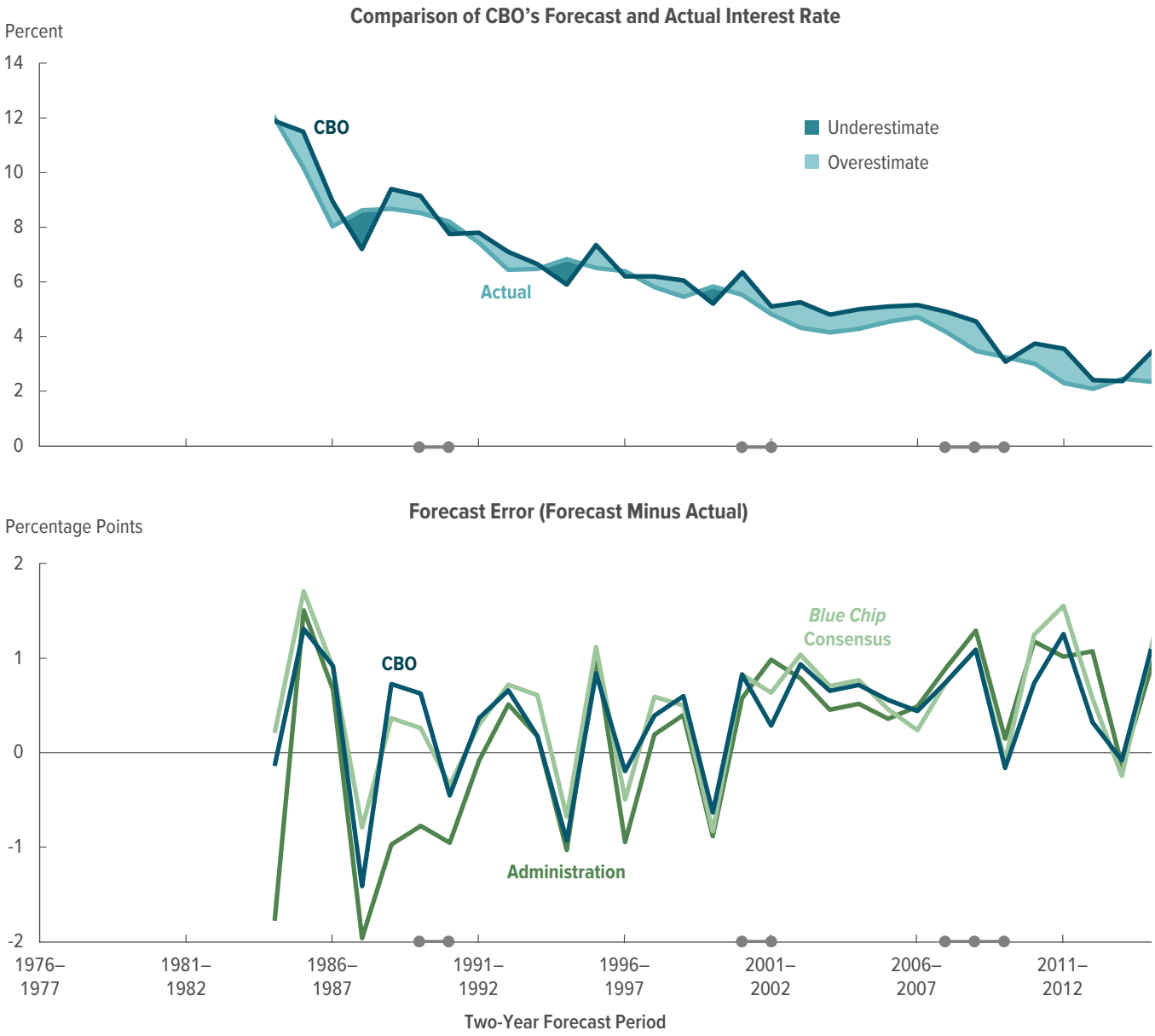
- *Output*. Wages and salaries generally grow with overall economic activity and inflation. A forecaster that failed to anticipate a downturn in output growth would probably overestimate growth in wages and salaries as well.

- *The statistical discrepancy between GDP and gross domestic income* (GDI, the income earned in the production of GDP). In principle, GDP and GDI should be equal, but in practice, they differ because BEA uses a different set of primary sources to estimate each of them. To project GDI, of which wages and salaries is the largest component, forecasters must also project the statistical discrepancy, which is difficult to do because the discrepancy stems from imperfect methods of data collection and estimation. As a result, unexpected swings in the discrepancy may raise or lower wages and salaries in relation to GDP.

31. In some earlier editions of this report, CBO included an analysis of its forecast of a broader category of taxable income: the sum of wages and salaries and corporate book profits. That sum has been dropped from this analysis because legislative changes to the tax rules governing corporations can affect book profits, and they have increasingly done so, which makes it difficult to identify the economic forecast errors. Wages and salaries are less directly affected by legislation.

Figure 13.

Interest Rate on 10-Year Treasury Notes: Two-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Federal Reserve.

The date ranges on the horizontal axis refer to the two-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the two-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual interest rate over the two-year forecast period. CBO did not forecast the interest rate on 10-year Treasury notes in 1984 or 1985, and the *Blue Chip* consensus did not include forecasts of the rate from 1984 to 1995. In those cases, the forecaster's projections of the Moody's Aaa corporate bond rate were used as a substitute.

Data are for forecasts made between 1984 and 2014.

- *Income shares*. Income shares refer to the percentage of each type of income in GDI.[32] Unexpected shifts in the composition of income may cause sizable errors in forecasts of wages and salaries.

Growth of Wages and Salaries. Between 1980 and 2014, CBO and the Administration slightly overestimated the growth of wages and salaries, on average, and the accuracy of their forecasts was similar (see Figure 14). The directions of the errors in the forecasts of the growth of wages and salaries followed a pattern similar to those of the errors in forecasts of nominal output, indicating that the errors stemmed in part from errors in projecting the growth of both real output and prices.

Particularly since 2001, CBO and the Administration have tended to overestimate growth in wages and salaries. To some extent, the fact that forecasters did not anticipate the 2001 and 2007–2009 recessions accounts for that tendency. In addition, starting in the early 2000s, wages began to grow more slowly than productivity. The unexpected departure from the historically close relationship between those two growth rates probably contributed to the overestimates of wage growth since the early 2000s. Both CBO and the Administration also were surprised by the unusually sluggish recovery in wages and salaries relative to output following the two recessions.

Change in Wages and Salaries Measured as a Percentage of Output. To isolate the errors that were unique to the forecasts of wages and salaries, evaluating those forecasts as a percentage of nominal output is helpful (see Figure 15). Two notable historical patterns emerge from such an analysis:

- Measured as a percentage of output, wages and salaries typically move in a cyclical pattern, falling during periods of high unemployment and rising when labor markets tighten.

- Since the early 1970s, wages and salaries have been declining as a percentage of output. In part, that is because employers and employees have substituted untaxed noncash, or fringe, benefits (such as employer-paid health insurance premiums and pension contributions) for taxable wages and salaries.[33] Other factors, such as technological change and globalization, also appear to have contributed to the decline during the past two decades.[34]

Two-year forecasts of the average annual change in wages and salaries measured as a percentage of output that were made over the entire 1980–2014 period exhibited a very small upward bias, but both CBO and the Administration overestimated the change in that percentage by a larger amount after 2000.[35] Both forecasters had a similar degree of accuracy as measured by the RMSE.

During the first half of the 1980s, wages and salaries fell markedly as a percentage of GNP. CBO and the Administration correctly anticipated that decline, but they overestimated the magnitude of the reduction in most years.

Following a slight rebound in the mid-1980s, wages and salaries generally declined as a percentage of output through the early 1990s. To some extent, that decline derived from a large increase in the statistical discrepancy between GDP and GDI—the measure of total output grew faster than the measure of total income during those years. The increase in that discrepancy probably explains why CBO and the Administration tended to overestimate wages and salaries as a percentage of output during the period.

In the late 1990s, wages and salaries grew rapidly as a percentage of GDP, and CBO and the Administration significantly underestimated the magnitude of that growth. Three factors probably contributed to the rise in wages and salaries relative to output:

- The statistical discrepancy between GDP and GDI generally declined during that period because the output measure grew more slowly than the income measure.

32. The types of income included in GDI are wages and salaries, domestic economic profits, employee benefits, proprietors' income, rental income, net interest payments, taxes on production and imports, the surplus of government enterprises, business current transfer payments, and depreciation—all minus subsidies.

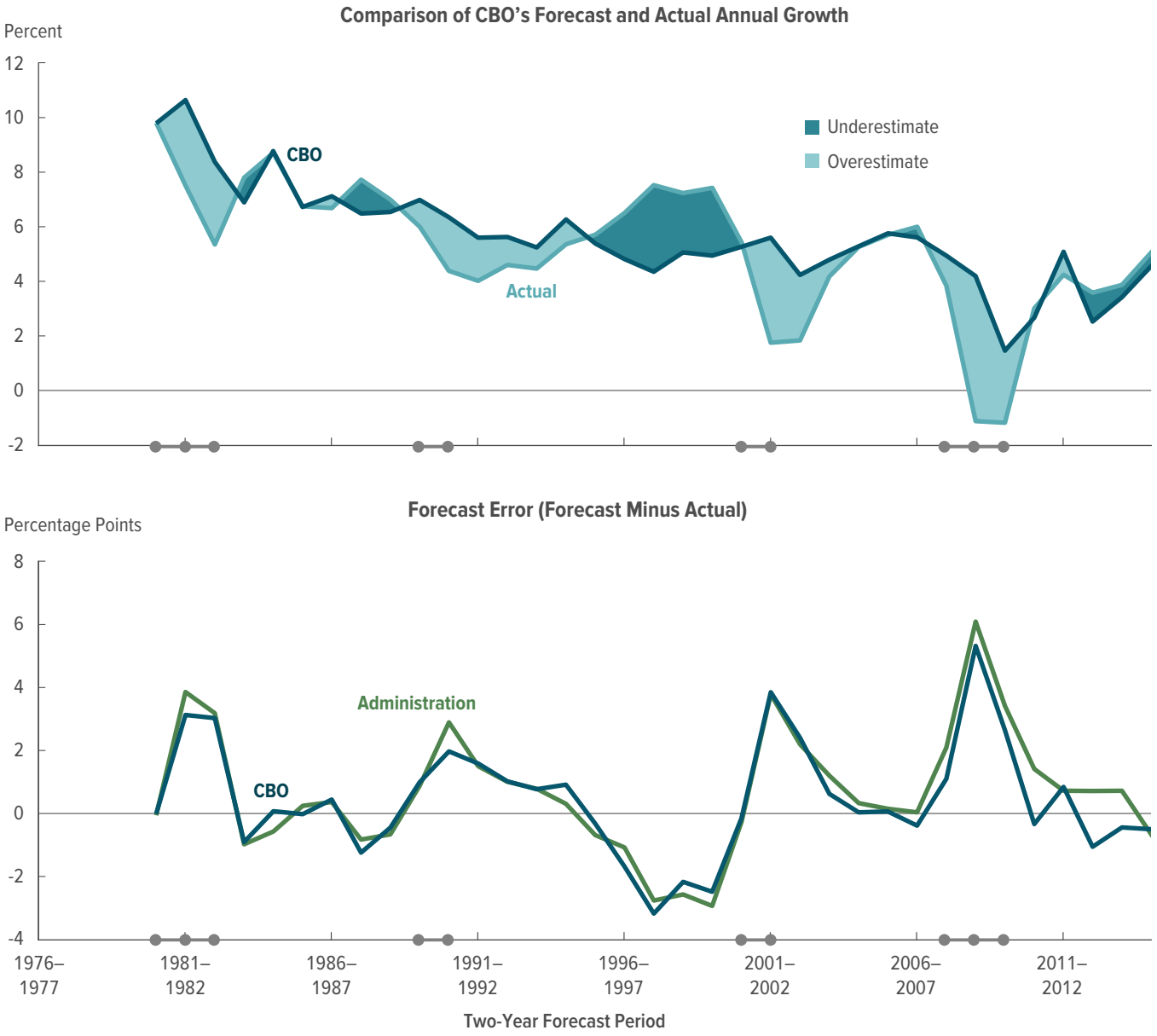
33. For more on employers' contributions to defined-benefit pension plans, see Congressional Budget Office, *The Budget and Economic Outlook: An Update* (August 2005), Box 2-2, pp. 32–33, www.cbo.gov/publication/17091.

34. See Congressional Budget Office, *How CBO Projects Income* (July 2013), p. 15, www.cbo.gov/publication/44433.

35. For forecasts made before 1992, wages and salaries were measured as a percentage of GNP; since 1992, they have been measured as a percentage of GDP.

Figure 14.

Growth of Wages and Salaries: Two-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Bureau of Economic Analysis.

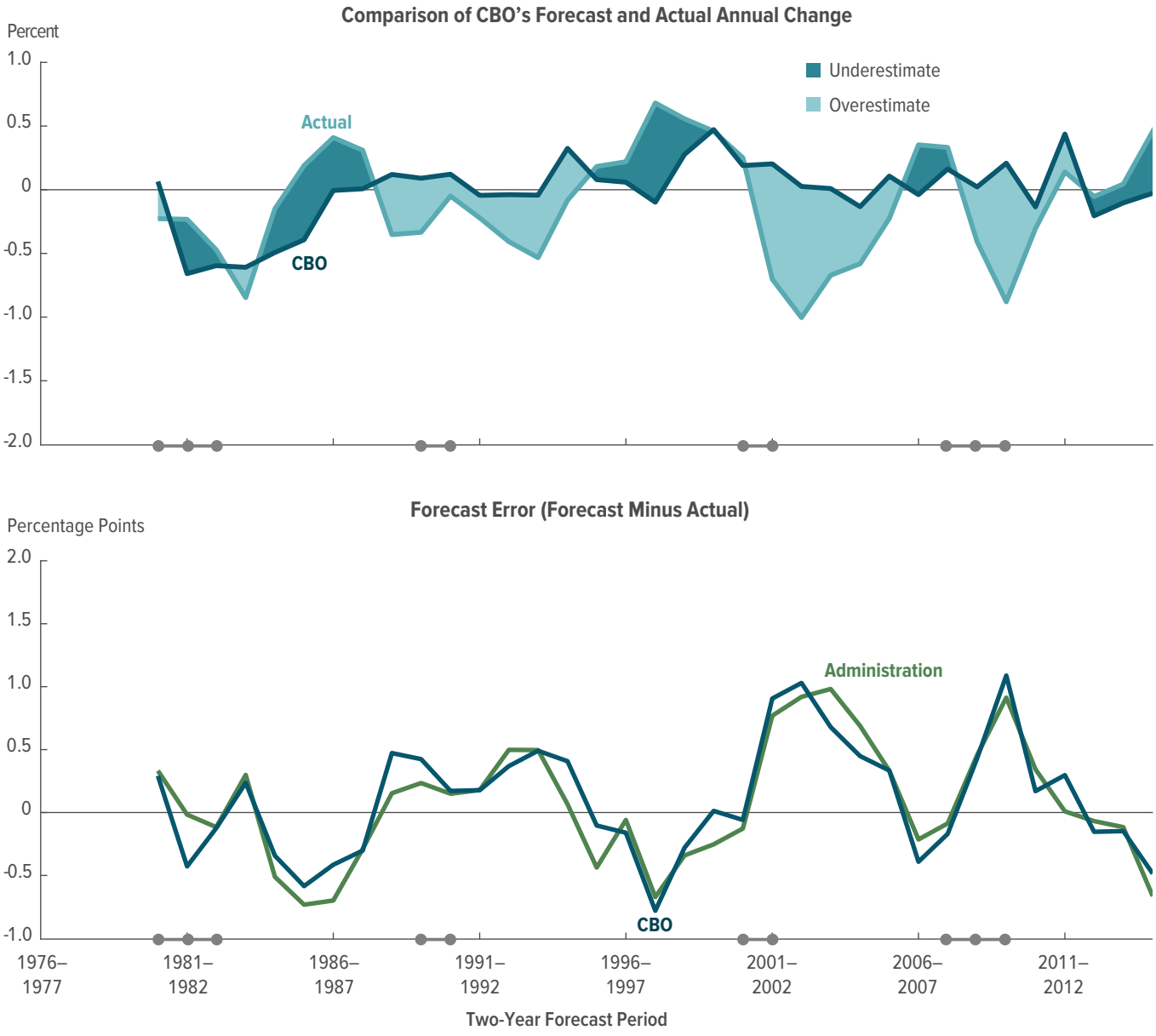
The date ranges on the horizontal axis refer to the two-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the two-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual growth rate of wages and salaries over the two-year forecast period.

Data are for forecasts made between 1980 and 2014. The *Blue Chip* consensus does not include forecasts of wages and salaries.

Figure 15.

Change in Wages and Salaries Measured as a Percentage of Nominal Output: Two-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Bureau of Economic Analysis.

The date ranges on the horizontal axis refer to the two-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the two-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual change in wages and salaries as a percentage of nominal output over the two-year forecast period. Output is either GDP or (before 1992) GNP.

Data are for forecasts made between 1980 and 2014. The *Blue Chip* consensus does not include forecasts of wages and salaries.

GDP = gross domestic product; GNP = gross national product.

- Although labor compensation has increasingly been paid in the form of nontaxable benefits in the years since World War II, that trend was temporarily reversed in the late 1990s as employers' contributions to employees' pension funds and health insurance premiums fell as a share of compensation.[36]

- Employee stock options became more prevalent during the 1990s, and gains from exercising stock options count as wage and salary income in the NIPAs. Changes in wages and salaries as a percentage of GDP generally corresponded to movements in the stock market in those years.[37]

During the first half of the 2000s, forecasters expected wages and salaries measured as a percentage of GDP to either rise or remain roughly unchanged, but instead they fell sharply. In part, the decline resulted from the shift in labor compensation toward nontaxable benefits. The 2001 recession and sluggish recovery in the labor market also contributed to the decline. However, the recession had only modest effects on output growth and the rate of unemployment, so the decline in wages and salaries as a percentage of GDP appears to be unusually large relative to the severity of the recession.

In the forecasts they made between 2008 and 2010, CBO and the Administration underestimated the effects of the severe 2007–2009 recession on wages and salaries relative to GDP. In early 2008, neither forecaster anticipated the onset of the recession, which reduced wages and salaries as a percentage of GDP, so both expected that measure to change very little over the following two years. By early 2009, the recession led both forecasters to significantly lower their projections of real output growth; however, they did not anticipate the effects that slower growth would have on wages and salaries relative to GDP. Toward the end of 2010—in anticipation of tax policy changes scheduled to take effect in 2011 and on the basis of the assumption that fiscal policy would follow current law—CBO overestimated the increase in wages and salaries relative to GDP.[38]

For the forecasts prepared in 2011 and 2012, CBO's errors were slightly larger than the Administration's. In 2011, CBO expected the cyclical rebound in wages and salaries measured as a percentage of GDP to be greater than it actually was, and the next year, it anticipated a slightly larger decline than actually occurred; the Administration's errors were negligible in both years. In the 2013 and 2014 forecasts, CBO and the Administration underestimated the change in wages and salaries as a percentage of output.

CBO's Five-Year Forecasts

As with the two-year forecasts, the five-year forecasts made by CBO and the *Blue Chip* consensus show similar degrees of bias and accuracy, and both sets of forecasts are slightly more accurate than the Administration's forecasts (see Table 2). Although the patterns of accuracy and bias are similar, the five-year forecasts have some characteristics that are distinct from those of the two-year forecasts:

- The five-year forecasts rely more heavily on underlying trends in the economy. CBO, for example, does not usually forecast fluctuations in the economy after the first few years of the projection period. Instead, in the agency's projections, output growth returns to its historical relationship with potential output growth, and other variables move to their estimated long-term values. As a result, errors in five-year forecasts often reveal inaccurate projections of the long-term growth of the economy.

- The five-year forecasts may be less likely to produce large errors that are attributable to relatively brief or small shifts in economic activity. For example,

36. For information about changes in employers' contributions to health insurance during the late 1990s, see David Cutler, *Employee Costs and the Decline in Health Insurance Coverage*, Working Paper 9036 (National Bureau of Economic Research, July 2002), www.nber.org/papers/w9036.

37. See Hamid Mehran and Joseph Tracy, *The Impact of Employee Stock Options on the Evolution of Compensation in the 1990s*, Working Paper 8353 (National Bureau of Economic Research, July 2001), www.nber.org/papers/w8353; and David Lebow and others, *Recent Trends in Compensation Practices*, Finance and Economics Discussion Series Paper 1999-32 (Board of Governors of the Federal Reserve System, July 1999), https://go.usa.gov/xNkbV.

38. In early 2009, CBO's fiscal policy assumptions were consistent with the scheduled expiration of major provisions of the Economic Growth and Tax Relief Reconciliation Act of 2001 and the Jobs and Growth Tax Relief Reconciliation Act of 2003. Those provisions were subsequently extended. The implications for the agency's baseline forecasts of subsequent legislative changes are discussed in Congressional Budget Office, *What Is a Current-Law Economic Baseline?* (June 2005), www.cbo.gov/publication/16558.

Table 2.

Summary Measures for Five-Year Forecasts

Percentage Points

	CBO	Administration	*Blue Chip* Consensus
		Output	
Growth of Real Output (1979–2011)			
Mean error	0.2	0.4	0.1
Mean absolute error	0.9	1.1	0.9
Root mean square error	1.2	1.3	1.1
Growth of Nominal Output (1979–2011)			
Mean error	0.8	0.9	0.9
Mean absolute error	1.1	1.2	1.1
Root mean square error	1.4	1.5	1.4
		Inflation	
Inflation in the CPI (1983–2011)			
Mean error	0.2	*	0.4
Mean absolute error	0.4	0.5	0.5
Root mean square error	0.6	0.6	0.8
Difference Between Inflation in the CPI and the Output Price Index (1983–2011)			
Mean error	-0.2	-0.3	-0.2
Mean absolute error	0.3	0.4	0.4
Root mean square error	0.4	0.5	0.4
		Interest Rates	
Interest Rate on 3-Month Treasury Bills (1983–2011)			
Mean error	1.2	0.8	1.3
Mean absolute error	1.4	1.3	1.5
Root mean square error	1.7	1.7	1.8
Real Interest Rate on 3-Month Treasury Bills (1983–2011)[a]			
Mean error	1.0	0.7	0.9
Mean absolute error	1.4	1.4	1.3
Root mean square error	1.7	1.7	1.6
Interest Rate on 10-Year Treasury Notes (1984–2011)			
Mean error	0.8	0.3	0.9
Mean absolute error	1.0	1.1	1.0
Root mean square error	1.1	1.3	1.1
		Wages and Salaries	
Growth of Wages and Salaries (1980–2011)			
Mean error	1.0	1.2	b
Mean absolute error	1.5	1.6	b
Root mean square error	1.8	1.9	b
Change in Wages and Salaries Measured as a Percentage of Output (1980–2011)			
Mean error	0.1	0.1	b
Mean absolute error	0.3	0.3	b
Root mean square error	0.3	0.3	b

Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Economic Analysis; Bureau of Labor Statistics; Federal Reserve.

Forecast errors are projected values minus actual values; thus, a positive error is an overestimate. The mean error is the arithmetic average of the forecast errors. The mean absolute error is the average of the errors with the negative signs removed from the underestimates. The root mean square error is calculated by squaring the forecast errors, averaging those squares, and taking the square root of that average.

Date ranges refer to the years in which the forecasts were made. For details on the data underlying the summary measures presented here, see the appendix.

Output is either GDP or (before 1992) GNP. Real output is nominal output adjusted to remove the effects of inflation.

CPI = consumer price index; GDP = gross domestic product; GNP = gross national product; * = between zero and 0.05 percentage points.

a. The real interest rate is the nominal interest rate deflated by the projected rate of growth in the CPI.

b. The *Blue Chip* consensus does not include forecasts of wages and salaries.

because CBO did not anticipate that a recession would occur later in the year when it made its forecast in early 2001, the agency overestimated the average two-year growth rate of real output by about 1½ percentage points but overestimated the average five-year growth rate by about one-half of a percentage point.

- On the other hand, the error in the five-year forecast prepared in a given year can be larger than the error in the two-year forecast made that same year if a recession occurs after the second year of the forecast period. For example, the two-year forecast of real output growth made in 2005 was relatively accurate because it was unaffected by the recession that began at the end of 2007, just after the forecast period ended. The error in the five-year forecast made that year, however, was over three times as high because it included the effects of that recession.

Output

All the forecasters' five-year projections of output growth (both real and nominal) exhibited similar bias and accuracy. Compared with the two-year forecasts, the five-year forecasts had slightly more upward bias but were roughly as accurate.

Growth of Real Output. Errors in forecasting real output growth over five-year periods are generally due to unexpected shifts in the growth rate of productivity. Recessions and cyclical factors tend to have less of an effect on the longer-term forecasts, although the 2007–2009 recession remains a significant source of error in the five-year forecasts.

In the forecasts they made between 1976 and 1979, CBO and the Administration overestimated the five-year average growth rate of real GNP by more than 2 percentage points, on average (see Figure 16). In part, those errors reflect the slowdown in productivity growth that followed the 1973–1975 recession (see Figure 5 on page 13). Because the forecasters did not expect that slowdown, they overestimated the trend in output growth during the late 1970s. When preparing their forecasts in early 1978 and 1979, CBO and the Administration did not anticipate the two recessions that occurred during the early 1980s, which contributed to the errors made in those forecasts.

The five-year forecasts of the growth of real output that CBO, the Administration, and the *Blue Chip* consensus made during the early 1980s were relatively accurate despite the severe 1981–1982 recession. Real output rebounded very quickly after the recession, so average growth during the recession and the subsequent recovery slightly exceeded the growth projected before the recession. As economic conditions stabilized after the turbulent early 1980s, CBO and the *Blue Chip* consensus made accurate forecasts in the second half of the decade. The Administration, however, slightly overestimated real output growth in those years.

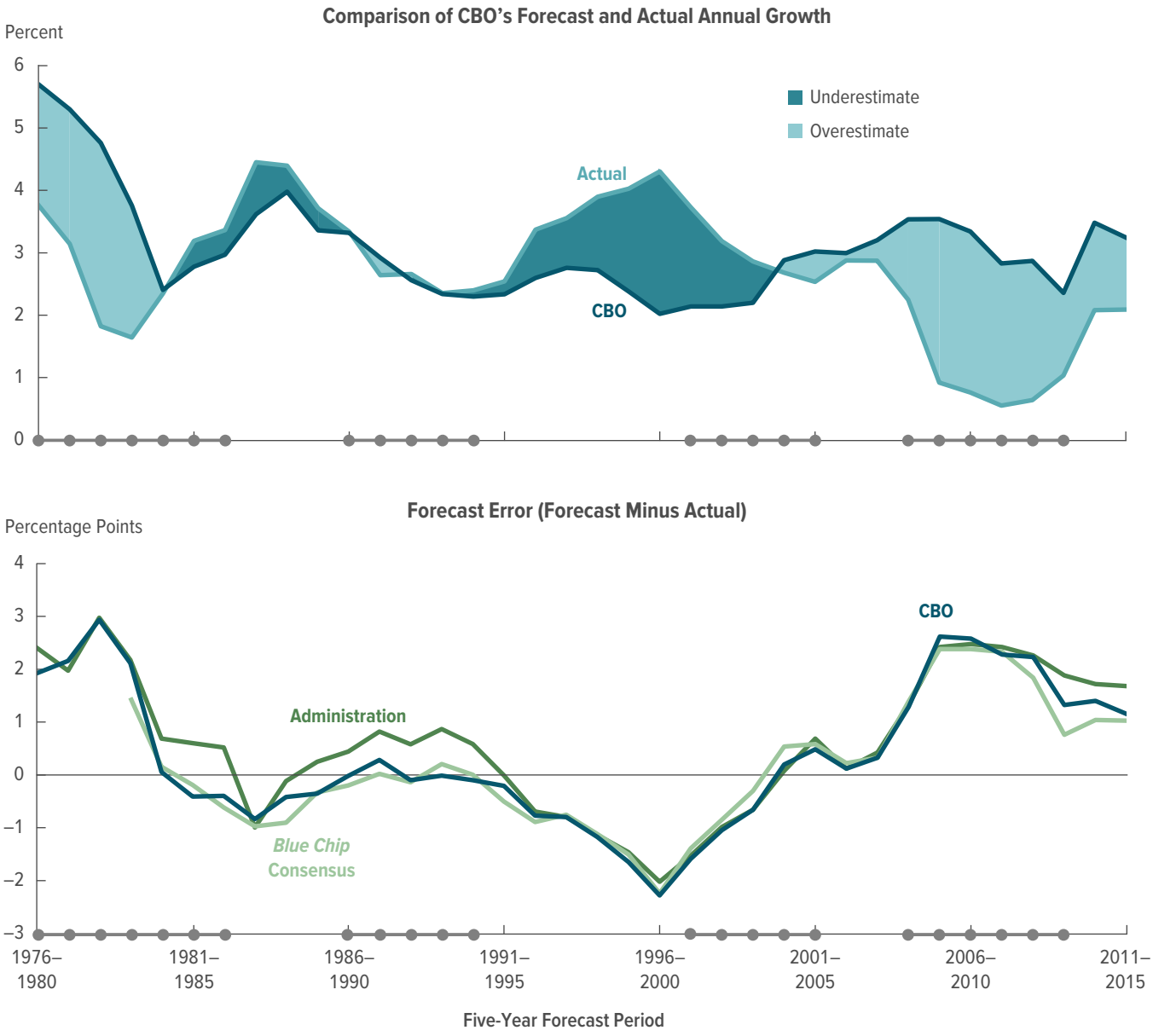
Five-year forecasts of the growth of real GDP made between 1991 and 1999 were too pessimistic. On average, actual growth exceeded all three forecasts' projections of growth by more than a percentage point. Those errors largely resulted from the investment boom of the late 1990s, which increased the capital stock and thereby boosted labor productivity and potential output. Methodological revisions made by BEA in 1999 also contributed to underestimates in forecasts prepared near the end of the period.

In the forecasts they made between 2000 and 2003, CBO, the Administration, and the *Blue Chip* consensus slightly overestimated the five-year average growth rate of real GDP (by less than one-half of a percentage point, on average). A portion of the errors probably stemmed from overestimates of potential output. For example, in early 2002, CBO projected that potential output would grow at an average annual rate of 3.0 percent over the next five years. However, the agency now estimates that potential output grew at an average rate of 2.4 percent per year between 2002 and 2006. That revision reflects an emerging consensus that productivity growth slowed for structural reasons even before the deep recession started at the end of 2007.[39] Because estimates of potential output underpin the medium-term projections, errors in forecasts of potential output carry through to forecasts of other variables.

39. The revisions to CBO's estimates of potential output reflect updated historical data and analytical methods. For further discussion of the sources of those revisions, see Congressional Budget Office, *The Budget and Economic Outlook: 2017 to 2027* (January 2017), pp. 64–65, www.cbo.gov/publication/52370, and *Revisions to CBO's Projection of Potential Output Since 2007* (February 2014), www.cbo.gov/publication/45150.

Figure 16.

Growth of Real Output: Five-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Economic Analysis.

The date ranges on the horizontal axis refer to the five-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the five-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual growth rate of real (inflation-adjusted) output over the five-year forecast period. Output is either GDP or (before 1992) GNP.

The most recent forecasts included are those published in 2011. The first five-year *Blue Chip* consensus forecast of real output was published in 1979.

GDP = gross domestic product; GNP = gross national product.

The unexpectedly severe and prolonged effects of the 2007–2009 recession account for most of the errors in the five-year forecasts of real GDP growth that were prepared from 2004 to 2011. Forecasts made between 2005 and 2008, in particular, were much too optimistic. On average, during that period, CBO's and the Administration's forecasts exceeded actual growth by 2.4 percentage points, and the *Blue Chip* consensus forecast exceeded actual growth by 2.2 percentage points.

In the aftermath of the 2007–2009 recession, forecast errors remained high because of the economy's unusually slow recovery. Forecasters expected the pace of the recovery to quicken as it had following most previous recessions. The slowdown in the growth of productivity—which started in the mid-2000s but was not immediately recognized by forecasters—contributed to the sluggish recovery and to forecasters' continuing to overestimate real output growth in 2010 and 2011. CBO was more accurate than the Administration but less accurate than the *Blue Chip* consensus in those two years.

Growth of Nominal Output. Differences between forecast errors for real and nominal output growth indicate inaccuracies in forecasts of inflation in the output price index.[40] For the entire 1979–2011 period covered in this evaluation, all three sets of forecasts overestimated the five-year growth rate of nominal output by more than three-quarters of a percentage point, on average. Overall, errors in forecasts of nominal output tend to be more pronounced around turning points in the economy than errors in forecasts of real output because they depend on forecasts of two cyclical components—real output growth and growth in the output price index.

In the 1980s and 1990s, forecasters' tendency to overestimate inflation contributed to overestimates of nominal output growth (see Figure 17). By contrast, between 2000 and 2005 forecasters tended to underestimate inflation rates, which partially offset their overestimates of real output growth. All the forecasters had large errors in the lead-up to the 2007–2009 recession, and they continued to overestimate economic growth during the recovery.

40. As noted above in the discussion of the two-year forecasts, the forecasters projected GNP before 1992 and have projected GDP since then.

Inflation

In the five-year forecasts they made between 1983 and 2011, CBO, the Administration, and the *Blue Chip* consensus slightly overestimated inflation in the CPI and underestimated the difference between inflation in the CPI and the output price index, on average. (The average error in forecasts of inflation in both indexes is positive, but it is larger for forecasts of inflation in the output price index). The RMSE of the inflation forecasts is roughly similar for all forecasters, indicating that they were all about equally accurate.

Inflation in the CPI. By far, the largest errors in five-year forecasts of inflation in the CPI were made during the late 1970s and early 1980s; projections became more accurate as inflation stabilized starting in the mid-1980s (see Figure 18). Between 1976 and 1979, CBO and the Administration underestimated the inflation rate in their five-year forecasts by an average of 3.2 percentage points and 3.9 percentage points, respectively. As the inflation rate fell during and after the 1981–1982 recession, forecasters gradually lowered their five-year estimates. On average, between 1980 and 1984, CBO overestimated the inflation rate by 2.1 percentage points, and the Administration overestimated it by 1.6 percentage points.

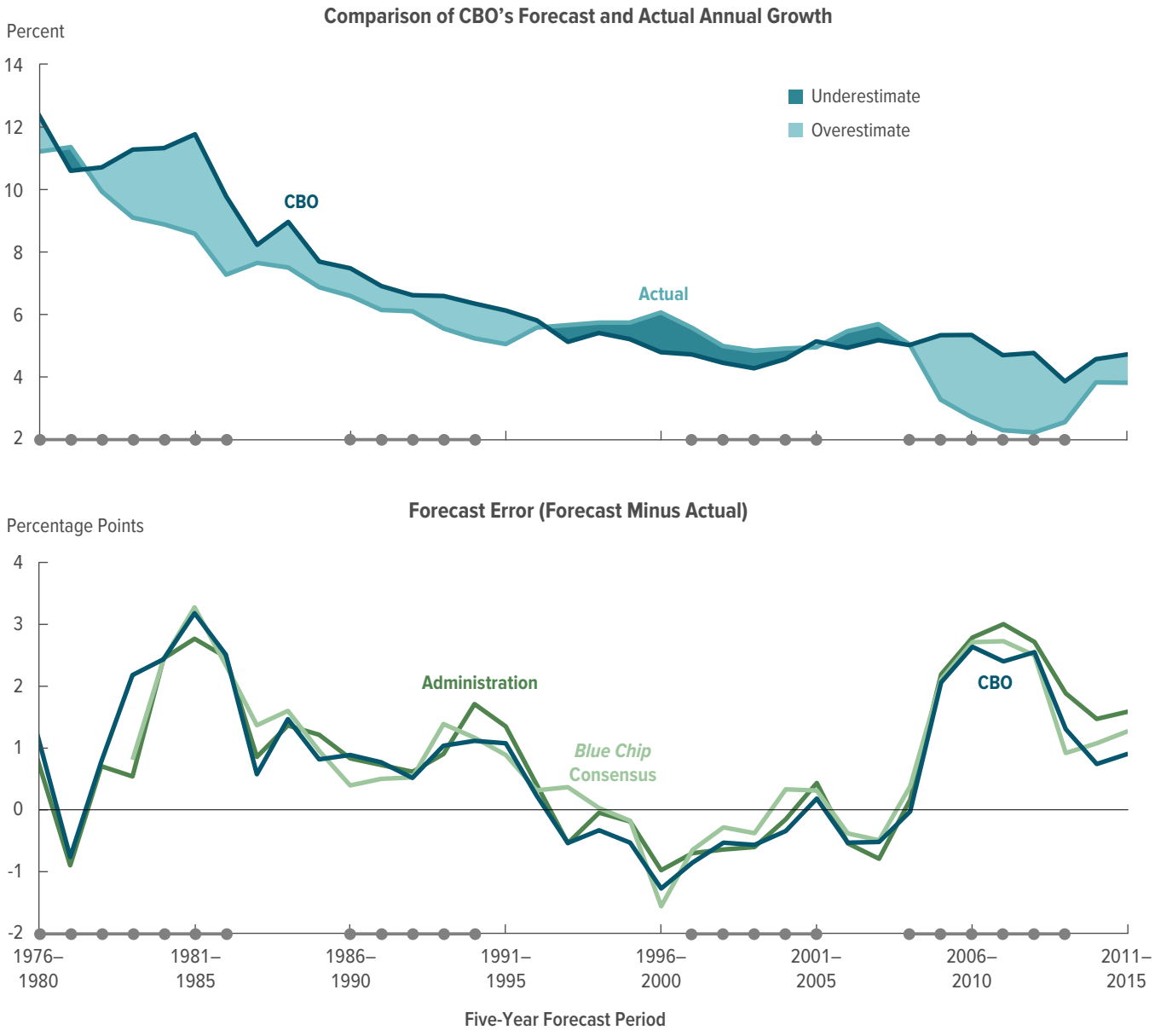
As inflation rates moderated after the early 1980s, errors in the five-year forecasts diminished. Between 1985 and 1999, CBO and the *Blue Chip* consensus overestimated the inflation rate by about one-half of a percentage point, on average, whereas the Administration overestimated the rate by a negligible amount. Nevertheless, all three sets of forecasts had the same mean absolute error over the 1985–1999 period.

All the forecasters made only small errors in projecting the five-year average rate of inflation in 2000 and 2001, but they failed to anticipate the rise in that rate after 2001. As a result, they all underestimated inflation significantly in the forecasts they made from 2002 to 2004.

Errors in forecasts of inflation were generally small from 2005 to 2009. All the forecasters correctly anticipated a fall in inflationary pressures as a result of the 2007–2009 recession and the subsequent slowdown in the growth of output. In 2010, CBO underestimated inflation by one-half of a percentage point, but the next year it accurately forecast inflation. The *Blue Chip* consensus overestimated inflation in both those years, whereas the

Figure 17.

Growth of Nominal Output: Five-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Economic Analysis.

The date ranges on the horizontal axis refer to the five-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the five-year forecast period overlapped a recession by six months or more.

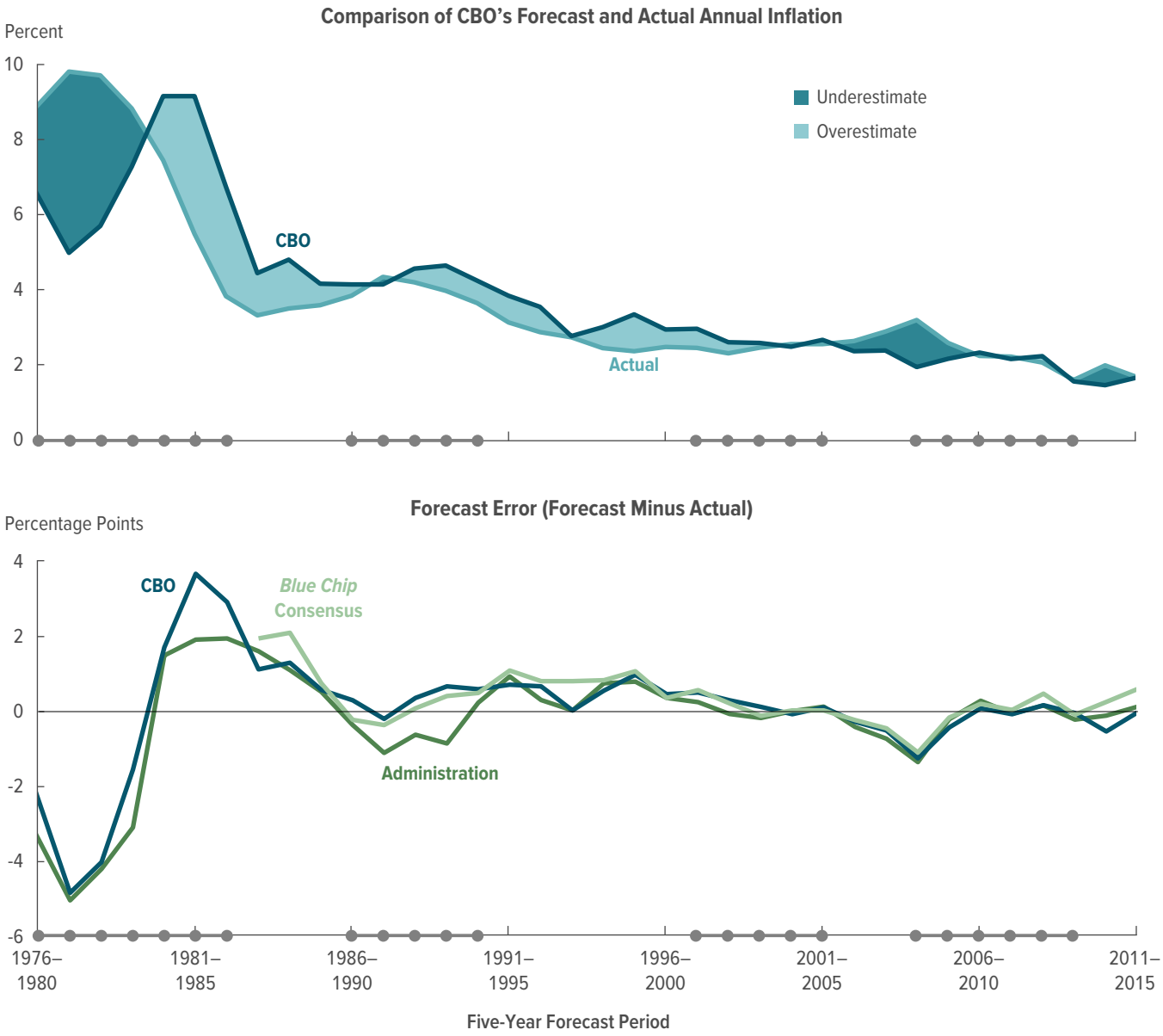
Forecast and actual data show the average annual growth rate of nominal output over the five-year forecast period. Output is either GDP or (before 1992) GNP.

The most recent forecasts included are those published in 2011. The first five-year *Blue Chip* consensus forecast of nominal output was published in 1979.

GDP = gross domestic product; GNP = gross national product.

Figure 18.

Inflation in the Consumer Price Index: Five-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Labor Statistics.

The date ranges on the horizontal axis refer to the five-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the five-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual growth rate of the CPI over the five-year forecast period. Most of the forecasts represented here were for the CPI-U, but some were for the CPI-W. For details on the underlying data, see the appendix.

The most recent forecasts included are those published in 2011. The first five-year *Blue Chip* consensus forecast of the CPI was published in 1983.

CPI = consumer price index; CPI-U = consumer price index for all urban consumers; CPI-W = consumer price index for urban wage earners and clerical workers.

Administration made fairly accurate forecasts. Compared with their two-year forecasts from the same period, all of the forecasters' five-year projections of inflation made from 2005 to 2011 were more accurate.

Difference Between Inflation Measures. In the forecasts they prepared between 1976 and 1980, CBO and the Administration underestimated the difference between the five-year average inflation rates measured by the CPI and the output price index by 1.4 percentage points, on average (see Figure 19). The widening of the gap between the two inflation rates was mostly due to the increase in the price of oil in 1979. Between 1983 and 1998, CBO, the Administration, and the *Blue Chip* consensus consistently underestimated the difference between the inflation rates—CBO, by an average of 0.4 percentage points; the Administration, by an average of 0.6 percentage points; and the *Blue Chip* consensus, by an average of 0.5 percentage points. In each of those cases, about 0.2 percentage points of the bias resulted from downward revisions to inflation in the GDP price index that were made following the comprehensive revision to the NIPAs in 1999.

When preparing their projections between 2000 and 2003, none of the forecasters anticipated that the difference between the two inflation measures would decline significantly. They all moderately overestimated the difference in those years.

After 2003, forecast errors were generally small. On the whole, CBO made slightly more accurate forecasts during the 2007–2009 recession than the Administration or the *Blue Chip* consensus did. In 2010 and 2011, all the forecasters slightly overestimated the difference between inflation measures.

Interest Rates

Between 1984 and 2011, CBO, the Administration, and the *Blue Chip* consensus tended to overestimate interest rates on 3-month Treasury bills and 10-year Treasury notes. Five-year forecasts of interest rates exhibited roughly twice as much upward bias as the comparable two-year forecasts and were less accurate than those forecasts as well. That is primarily because interest rates, particularly long-term rates, have declined more persistently since the early 1980s than they were expected to and they have not returned to the levels reached in the 1970s and 1980s.

Like those in the agency's two-year forecasts, the errors in CBO's five-year forecasts of short-term interest rates were largest around recessions. Errors tend to occur then partly because the demand for borrowing typically falls during recessions, which causes short-term interest rates to decline, and partly because the Federal Reserve generally responds to recessions by acting to reduce short-term interest rates.

CBO's tendency to overestimate long-term interest rates over five-year periods is less related to recessions than it is to the largely unanticipated decline in long-term interest rates that began in the early 1980s. CBO overestimated long-term interest rates in most years between 1984 and 2011 because it made those forecasts using models that were based on the assumption that interest rates would move back toward their historical levels. Unexpected trends, such as growing foreign demand for Treasury securities and the declining term premium, as well as factors that affect the long-term growth rates of output, such as the size of the labor force and productivity, add to the uncertainty of the five-year forecasts of interest rates.

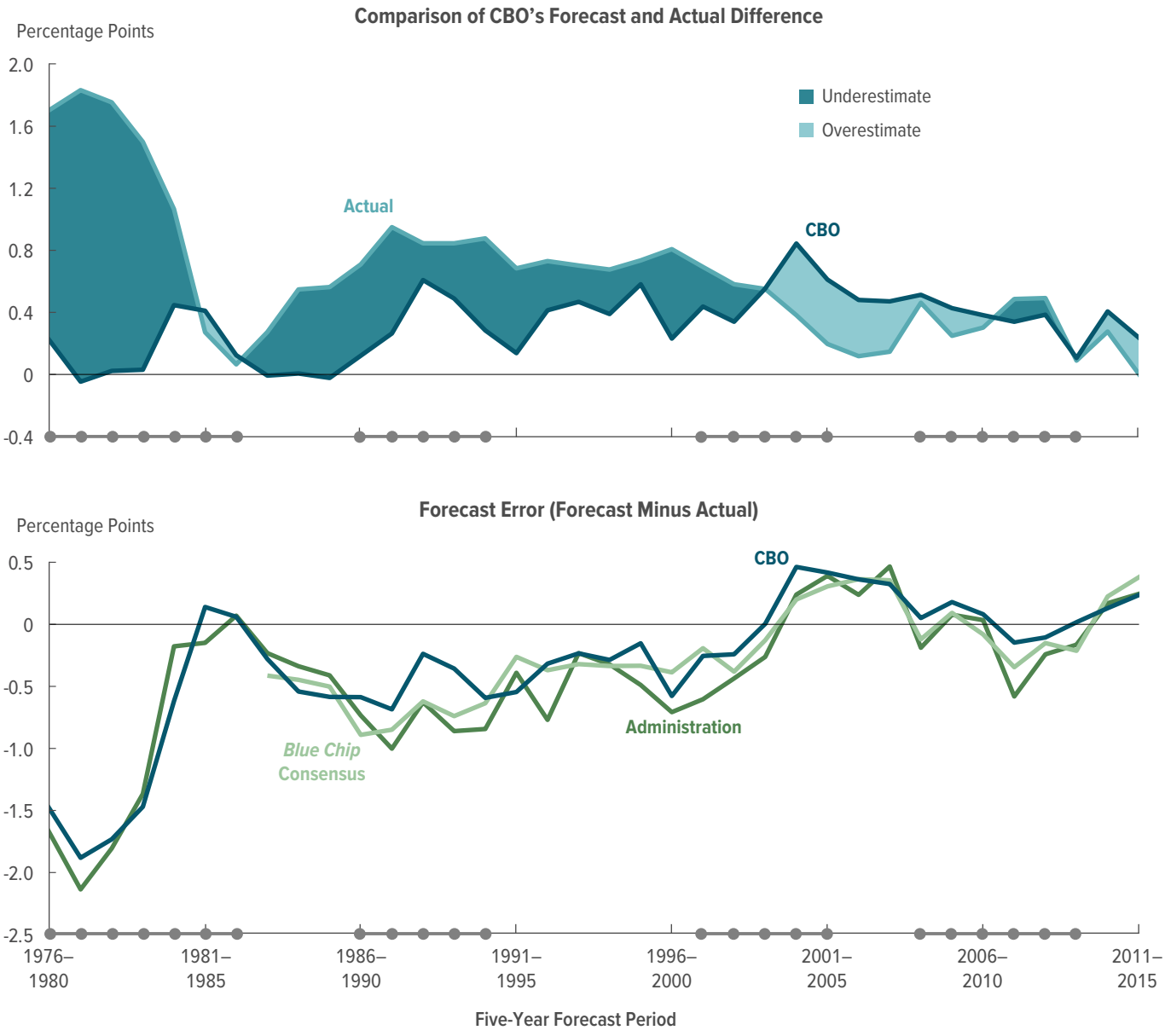
Interest Rate on 3-Month Treasury Bills. On average, between 1983 and 2011, CBO and the *Blue Chip* consensus overestimated nominal interest rates by about 1¼ percentage points, whereas the Administration overestimated them by three-quarters of a percentage point. The Administration's smaller mean error was mostly a consequence of the offsetting effect of larger underestimates rather than of more accurate forecasts overall.

Forecasts of nominal interest rates prepared between 1983 and 2011 were not very accurate (see Figure 20). Forecasts of real interest rates were slightly less biased than the forecasts of nominal interest rates, but they had a similar degree of accuracy (see Figure 21). The difference between errors in projections of nominal and real interest rates stems from errors in projecting inflation. That difference was substantial during the late 1970s and early 1980s but became less pronounced as inflation stabilized.

From 1976 to 1980, CBO and the Administration underestimated nominal interest rates mainly because of surprisingly high inflation during those years. Overestimates of the real interest rate in the forecasts from the first two of those years improved the accuracy of the nominal rate projections, whereas underestimates of the

Figure 19.

Difference Between Inflation in the CPI and in the Output Price Index: Five-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Labor Statistics; Bureau of Economic Analysis.

The date ranges on the horizontal axis refer to the five-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the five-year forecast period overlapped a recession by six months or more.

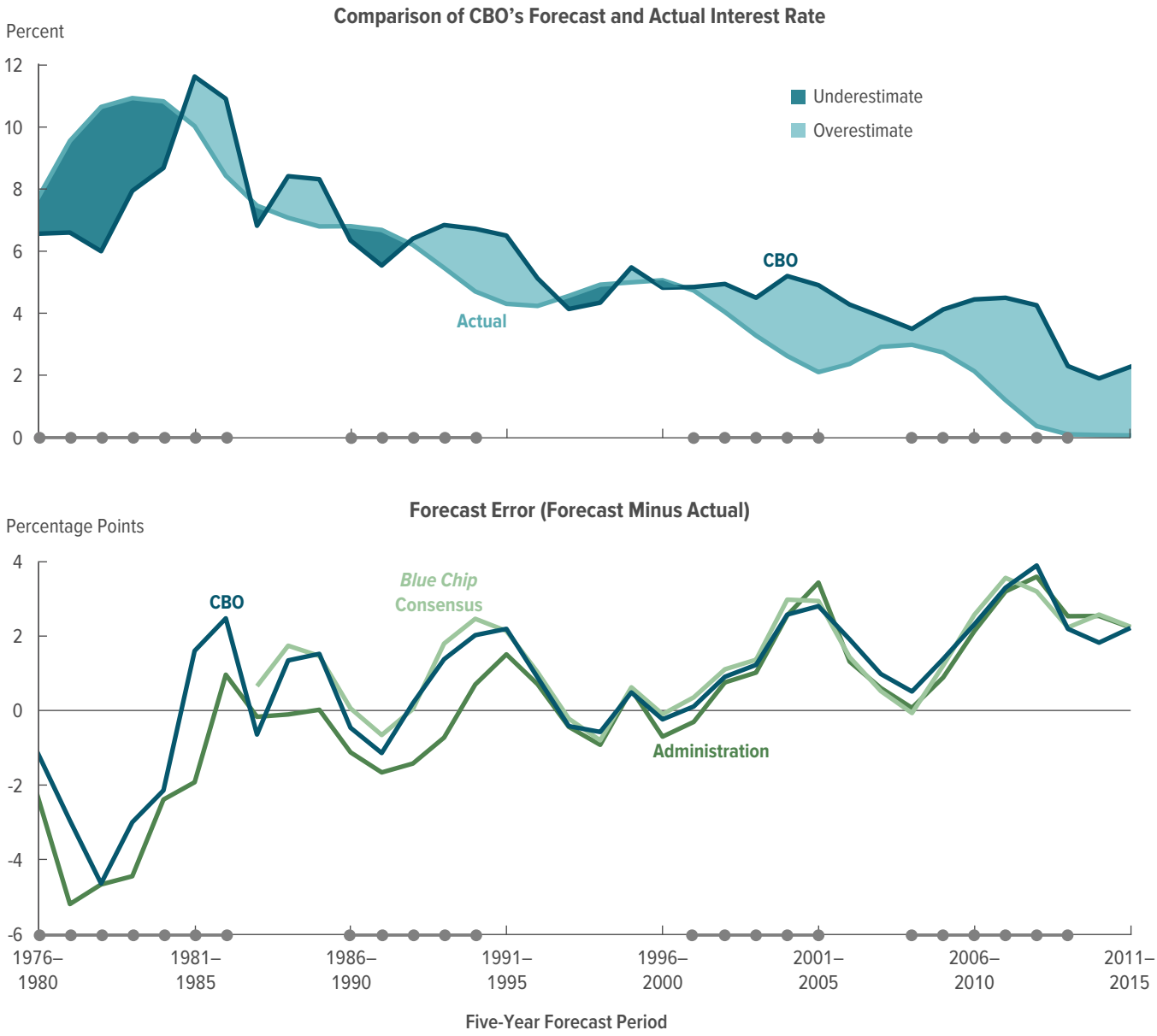
Forecast and actual data show average annual growth in the CPI over the five-year forecast period minus average annual growth in the output price index over that period. In most of the forecasts represented here, the CPI-U was forecast, but in some, the CPI-W was forecast. The output price index measures the prices of all goods and services that make up either GDP or (before 1992) GNP. For details on the underlying data, see the appendix.

The most recent forecasts included are those published in 2011. The first five-year *Blue Chip* consensus forecast of the CPI was published in 1983.

CPI = consumer price index; CPI-U = consumer price index for all urban consumers; CPI-W = consumer price index for urban wage earners and clerical workers; GDP = gross domestic product; GNP = gross national product.

Figure 20.

Interest Rate on 3-Month Treasury Bills: Five-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Federal Reserve; Bureau of the Public Debt.

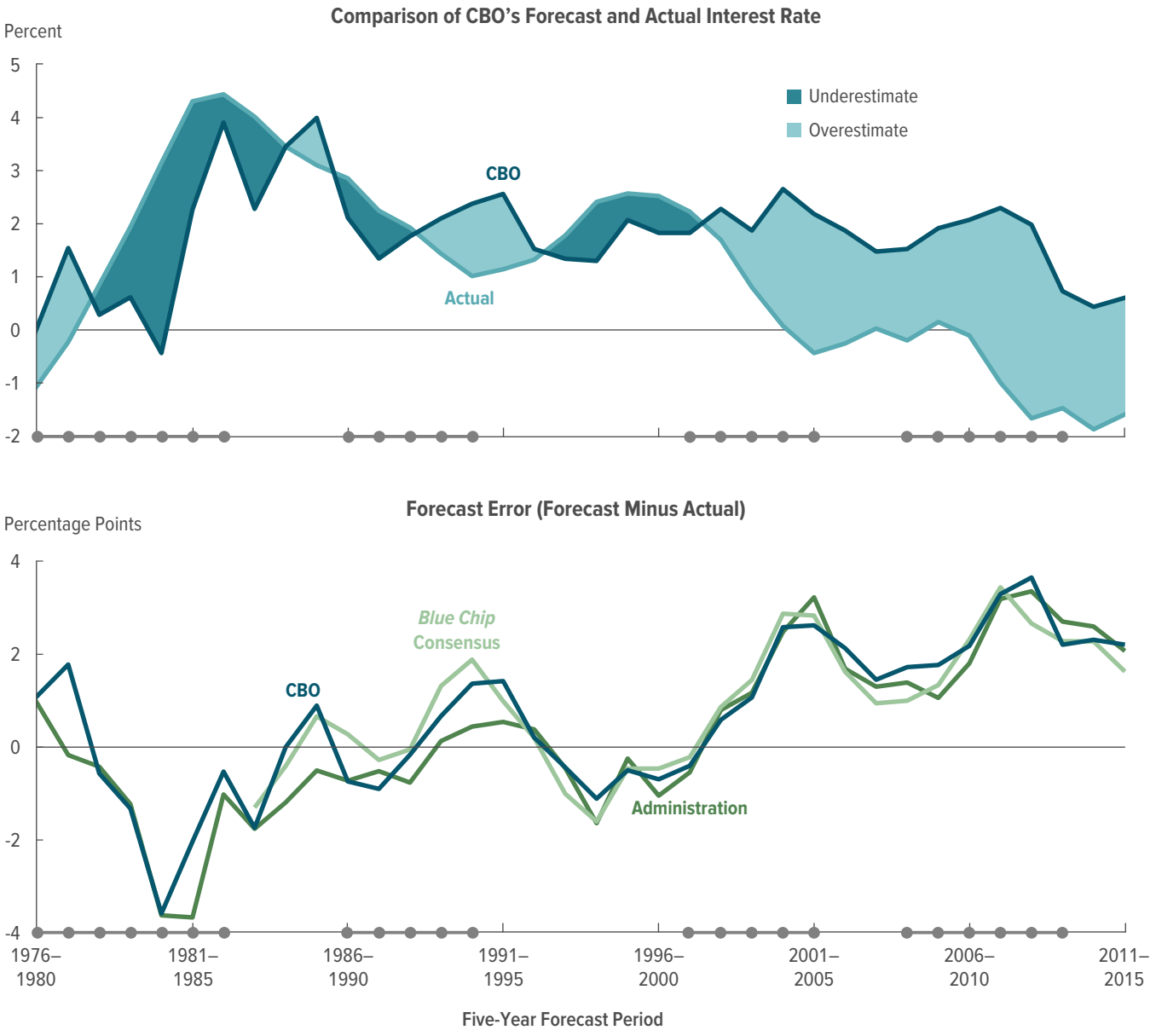
The date ranges on the horizontal axis refer to the five-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the five-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual interest rate over the five-year forecast period. Most of the forecasts represented here were for the secondary-market interest rate, but some were for the rate on newly issued bills or for the 6-month commercial paper rate. For details on the underlying data, see the appendix.

The most recent forecasts included are those published in 2011. The first five-year *Blue Chip* consensus forecast for short-term rates was published in 1983.

Figure 21.

Real Interest Rate on 3-Month Treasury Bills: Five-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Bureau of Labor Statistics; Federal Reserve; Bureau of the Public Debt.

The date ranges on the horizontal axis refer to the five-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the five-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average nominal annual interest rate over the five-year forecast period deflated by the growth in the CPI over that period. Most of the forecasts represented here were for the secondary-market interest rate, but some were for the rate on newly issued bills or for the 6-month commercial paper rate. In most cases, the CPI-U was used as the deflator, but in some, the CPI-W was used. For details on the underlying data, see the appendix.

The most recent forecasts included are those published in 2011. The first five-year *Blue Chip* consensus forecast for short-term interest rates was published in 1983.

CPI = consumer price index; CPI-U = consumer price index for all urban consumers; CPI-W = consumer price index for urban wage earners and clerical workers.

real interest rate in the 1979 and 1980 forecasts contributed to the errors in projections of the nominal rate.

CBO generally overestimated short-term nominal interest rates in its forecasts from 1981 to 1992, particularly in those it made around the 1990 recession. Notably, the Administration forecast significantly lower nominal interest rates over that period, resulting in underestimates of those rates that were larger than the other forecasters' through the 1980s but in overestimates that were smaller than the others' in the early 1990s.

Errors in projections of interest rates were relatively small between 1993 and 1997 for all forecasters, but they started rising again in the late 1990s. During the 2001 and 2007–2009 recessions, errors increased dramatically, partly because the forecasters failed to anticipate the recessions and the subsequent drop in interest rates and partly because rates remained unusually low during the recovery from both recessions. Over the past 15 years, all the forecasters have made fairly accurate projections of inflation, so nominal and real interest rate errors have tracked each other closely. The one notable exception to that pattern was the period from 2003 to 2005, when underestimates of inflation led to more accurate projections of nominal interest rates for all three sets of forecasts.

In the wake of the 2007–2009 recession, unusually accommodative monetary policy reduced short-term interest rates to near zero. Forecasters did not anticipate that shift, which led them to overestimate both nominal and real interest rates. In addition to monetary policy, low foreign interest rates and concerns about foreign growth led to an increase in demand for Treasury securities that CBO and other forecasters did not foresee in the years after the recession. Forecasters also failed to anticipate the persistence of the downward trend in interest rates.

Interest Rate on 10-Year Treasury Notes. Between 1984 and 2011, CBO and the *Blue Chip* consensus overestimated the nominal interest rates on 10-year Treasury notes, on average. The Administration also overestimated the nominal interest rate on 10-year Treasury notes, on average, but only by about one-third as much as CBO and the *Blue Chip* consensus did. That lower mean error partly reflects the fact that the Administration underestimated the long-term interest rates in the early years of the period, and those underestimates offset the large overestimates it made later (see Figure 22). As measured by the RMSE, the accuracy of all three forecasts was similar.

Forecasters have consistently overestimated interest rates since the early 2000s. The mean errors of forecasts prepared since then were roughly three times larger than mean errors of forecasts made between 1984 and 1999. The unusually slow recoveries from the 2001 and 2007–2009 recessions contributed to the recent increase in forecast error—forecasters continued to overestimate interest rates on 10-year Treasury notes long after the recessions had ended.

Several factors in addition to those slow recoveries account for CBO's and other forecasters' persistently overestimating interest rates since the mid-2000s. The rate of growth in productivity—which is an important determinant of interest rates—has been lower than CBO and other forecasters expected. Additionally, low foreign interest rates, heightened concern about global growth, and increased demand (by both foreign and domestic investors) for Treasury securities as a hedge against possible adverse economic outcomes have further contributed to low interest rates, especially since 2009, when the most recent recession ended. The Federal Reserve's policy of quantitative easing—that is, the direct purchase of long-term Treasury securities, mortgage-backed securities, and agency debt—also contributed to the unusually low long-term interest rates since 2009. Additionally, forecasters failed to anticipate the persistence of the long-term downward trend in interest rates.

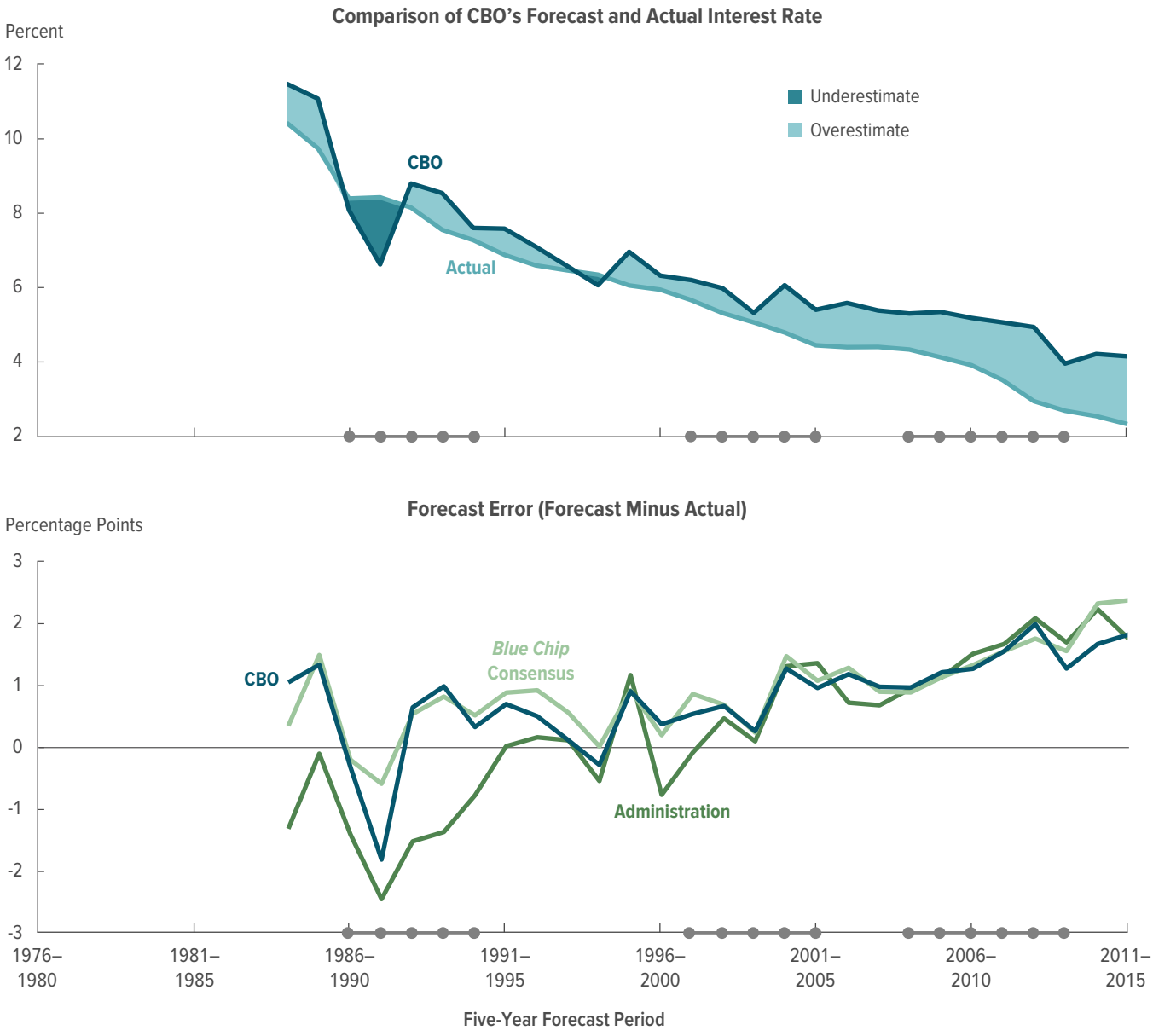
Wages and Salaries

In their forecasts made between 1980 and 2011, CBO and the Administration tended to overestimate the growth of wages and salaries as well as the change in wages and salaries measured as a percentage of output. Forecast errors varied widely over time, however, and included substantial underestimates by both CBO and the Administration between 1995 and 1997.

Growth of Wages and Salaries. Between 1980 and 2011, CBO's and the Administration's forecasts of the five-year average growth rate of wages and salaries exhibited notable upward bias and similar degrees of accuracy (see Figure 23). Compared with the two-year forecasts, they had slightly more upward bias but were nevertheless just as accurate. Like those in the two-year forecasts, the

Figure 22.

Interest Rate on 10-Year Treasury Notes: Five-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Wolters Kluwer, *Blue Chip Economic Indicators*; Federal Reserve.

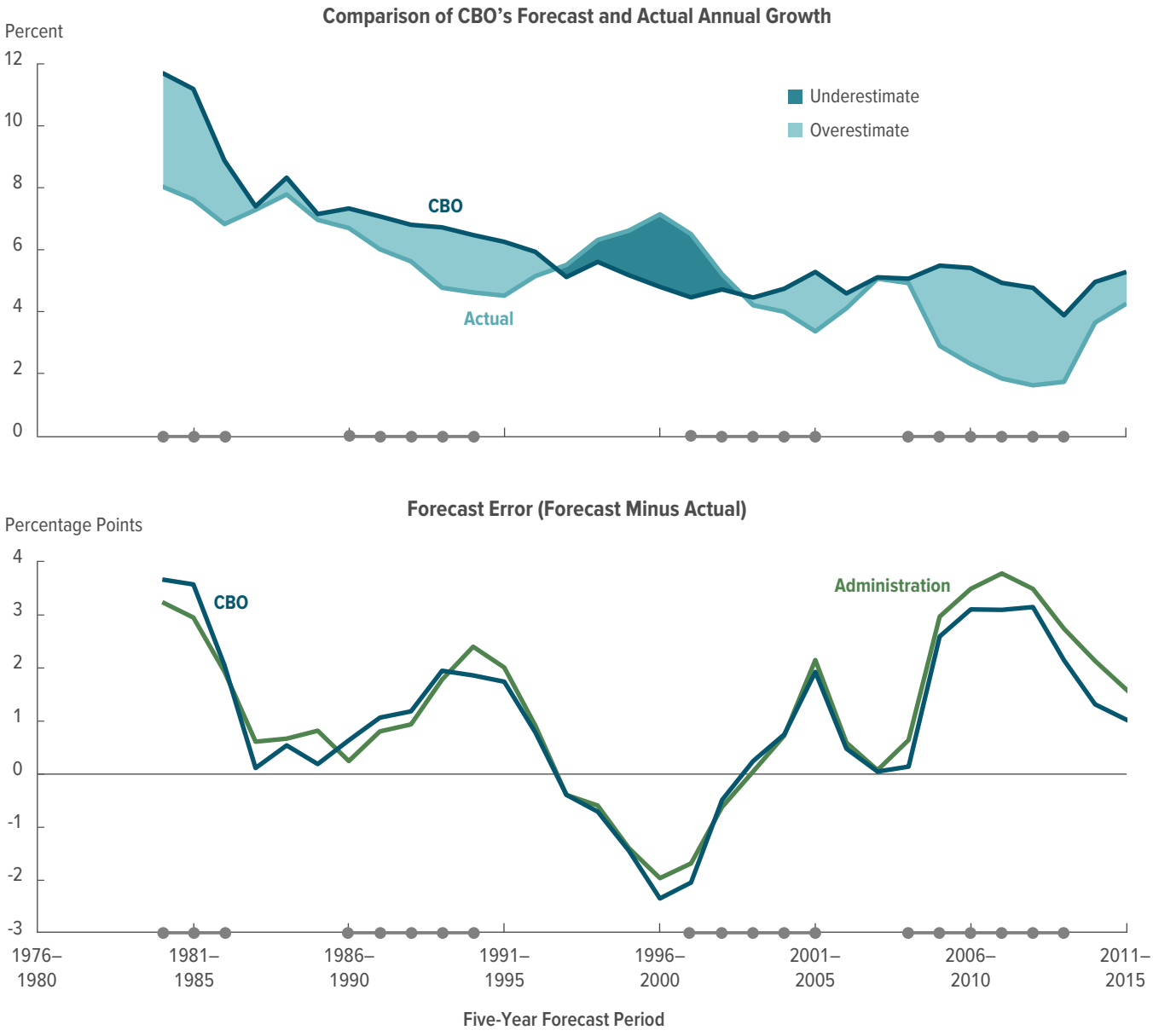
The date ranges on the horizontal axis refer to the five-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the five-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual interest rate over the five-year forecast period. CBO did not forecast the interest rate on 10-year Treasury notes in 1984 or 1985, and the *Blue Chip* consensus did not include forecasts of the rate from 1984 to 1995. In those cases, the forecaster's projections of the Moody's Aaa corporate bond rate were used as a substitute.

Data are for forecasts made between 1984 and 2014.

Figure 23.

Growth of Wages and Salaries: Five-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Bureau of Economic Analysis.

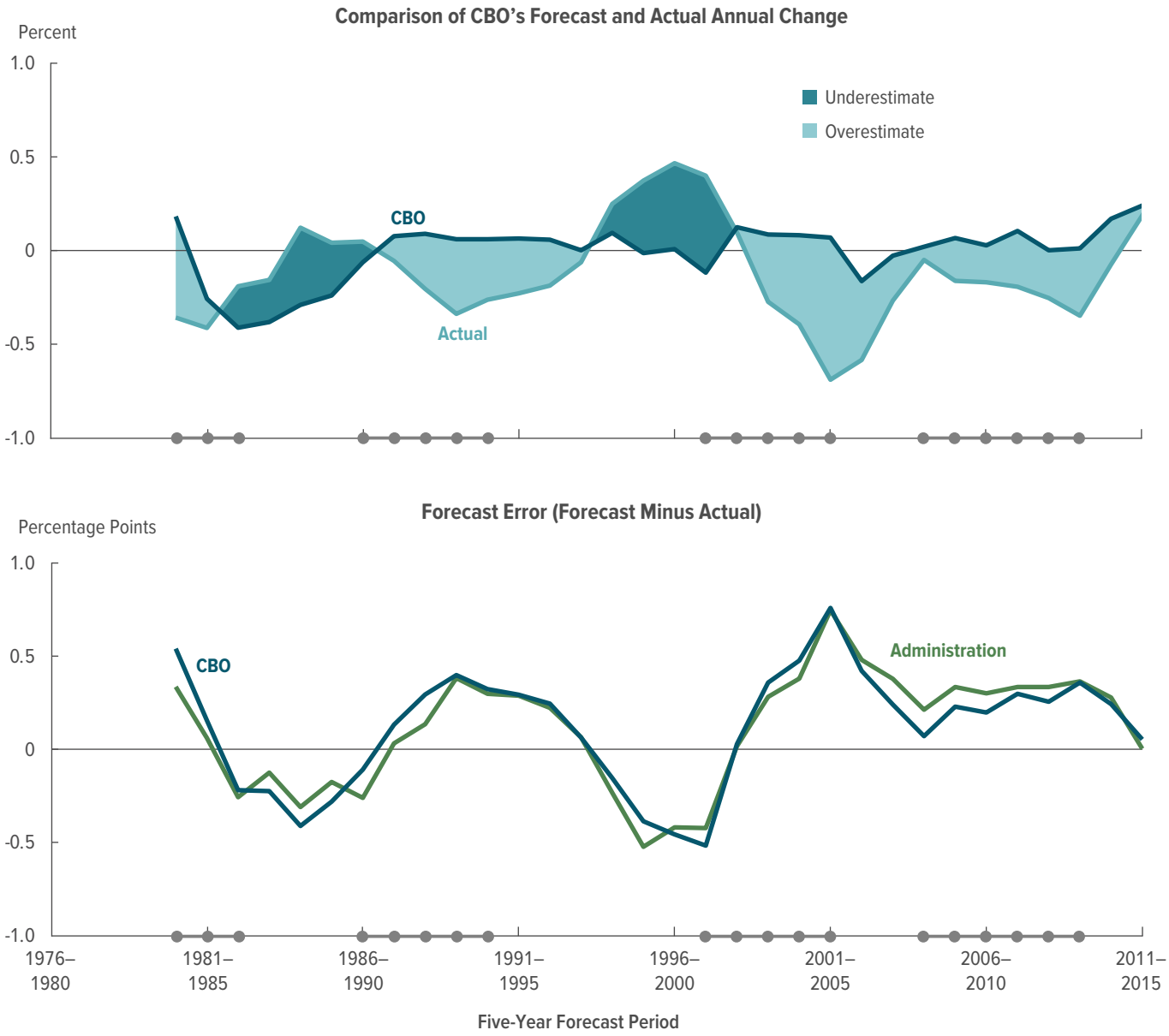
The date ranges on the horizontal axis refer to the five-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the five-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual growth rate of wages and salaries over the five-year forecast period.

Data are for forecasts made between 1980 and 2011. The *Blue Chip* consensus does not include forecasts of wages and salaries.

Figure 24.

Change in Wages and Salaries Measured as a Percentage of Nominal Output: Five-Year Forecasts



Sources: Congressional Budget Office; Office of Management and Budget; Bureau of Economic Analysis.

The date ranges on the horizontal axis refer to the five-year forecast period; each forecast was issued in the first year of that period. The dots indicate that the five-year forecast period overlapped a recession by six months or more.

Forecast and actual data show the average annual change in wages and salaries as a percentage of nominal output over the five-year forecast period. Output is either GDP or (before 1992) GNP.

Data are for forecasts made between 1980 and 2011. The *Blue Chip* consensus does not include forecasts of wages and salaries.

GDP = gross domestic product; GNP = gross national product.

errors in the five-year forecasts of the growth of wages and salaries followed a cyclical pattern.

Change in Wages and Salaries Measured as a Percentage of Output. Between 1980 and 2011, CBO's and the Administration's forecasts of changes in wages and salaries measured as a percentage of output exceeded the actual changes by the same average amount (see Figure 24). Errors in forecasting the change in wages and salaries measured as a percentage of output were related to unexpected trends in the economy.

From 1982 to 1986, CBO and the Administration underestimated the change in wages and salaries measured as a percentage of output in their five-year projections. They may have overestimated the depth and duration of the cyclical decline in labor compensation relative to output following the 1980 and 1981–1982 recessions. Another possibility is that the forecasters overestimated the extent to which labor compensation would shift away from wages to nontaxable benefits.

In the five-year forecasts they made between 1987 and 1993, CBO and the Administration estimated only small changes in wages and salaries measured as a percentage of output, but the actual percentage declined significantly over the years covered by those forecasts. The 1990 recession probably contributed to that unexpected decline.

From 1994 to 1997, CBO and the Administration forecast relatively small changes in wages and salaries measured as a percentage of output over each five-year projection period, but the actual changes exceeded the forecasters' estimates. As with the two-year forecasts, the following three factors probably contributed to the increase during those years:

- Measures of income grew more quickly than GDP;
- Labor compensation temporarily shifted away from nontaxable benefits to wages; and
- Employee stock options became more prevalent, and the value of the stock market rose.

In almost all the forecasts they made between 1999 and 2010, CBO and the Administration projected that in relation to GDP, wages and salaries would either remain roughly flat or rise slightly over the five-year horizon. However, the average five-year change in wages and salaries measured as a percentage of GDP was negative during the 2000s, particularly in the wake of the 2001 and 2007–2009 recessions. As wages and salaries have risen in relation to GDP in recent years, CBO and other forecasters have made more accurate forecasts.

Appendix: Forecast and Historical Data Used in This Evaluation

This appendix provides an overview of the data that the Congressional Budget Office used to evaluate its forecasting record. The evaluation covers forecasts of the growth of real (inflation-adjusted) and nominal output, inflation, interest rates, and changes in wages and salaries. The historical data for output and the output price index used were the current series available from the Bureau of Economic Analysis (BEA). Historical data for inflation and interest rates varied because CBO, the Administration, and the *Blue Chip* consensus used slightly different measures in some years.

Forecasts Included in This Evaluation

CBO evaluated the forecasts that it published between 1976—the first year that the agency made economic projections—and 2014.[1] (Two-year forecasts published in early 2015 were not included because when this analysis was completed, the latest full-year historical data did not extend beyond 2015.) For comparison, the agency also evaluated the Administration's forecasts from those same years. In all but one case, the Administration's forecasts were taken from its annual budget documents; the forecast made in early 1981 by the Reagan Administration, which was based on revisions of the Carter Administration's last budget, came from a separate document.[2]

The *Blue Chip* consensus forecasts included in this evaluation were those published closest to the date on which CBO's forecasts were released. The first two-year forecast by the *Blue Chip* consensus that CBO examined was published in early 1980; however, that forecast did not include all variables. For those indicators that were not included in the 1980 forecast, the earliest possible forecast was used—for inflation measures and interest rates on 3-month Treasury bills, the 1981 forecast, and for long-term interest rates, the 1984 forecast. Although the *Blue Chip* consensus is published monthly, only those forecasts published in March and October extend beyond two years. All but one of the five-year forecasts from the *Blue Chip* consensus used in this evaluation were published in March; the forecast of real output for the 1980–1984 period was published in May 1980. The *Blue Chip* consensus does not include forecasts of all the economic variables that underlie CBO's baseline projections. Most notably, it does not provide forecasts of wages and salaries.

Since 1979, the staff of the Board of Governors of the Federal Reserve System has regularly prepared detailed two-year economic forecasts for the Federal Open Market Committee (FOMC), the body responsible for conducting monetary policy. Those forecasts are released to the public on a delayed schedule, typically five years after they are made. In conjunction with certain meetings of the FOMC, members of the committee—the members of the Board of Governors and the presidents of the regional Federal Reserve Banks—compile their own forecasts for selected economic indicators. The ranges and central tendencies of those forecasts have been published in the minutes of the meetings since late 2007. For forecasts of real output and of inflation in consumer prices made between 1979 and 2011, CBO compared its projections with those prepared by the staff of the board; for those made from 2012 to 2014, the central tendencies of the FOMC members' forecasts were used for comparison. All of the Federal Reserve's forecasts analyzed here were issued in January or February of

1. Because CBO has published forecasts of wages and salaries on a regular basis only since 1985, this analysis used some unpublished forecasts of wages and salaries that the agency made in earlier years.

2. CBO's corresponding forecast was taken from the agency's analysis of President Reagan's budgetary proposals. That forecast presented the agency's baseline projections and did not include the economic effects of the new Administration's fiscal policy proposals. But it did reflect the assumption that the tax and spending policies of the Second Concurrent Resolution on the Budget for Fiscal Year 1981, including accelerated depreciation of investment and a 10 percent cut in personal income taxes, would continue. Another exceptional case occurred in early 1993, when the Clinton Administration adopted CBO's economic assumptions as the basis for its budget. As a result, the errors from the early 1993 forecast are the same for CBO and the Administration.

the initial year of the forecast period or in December of the preceding year.

Output

Historical average growth rates of nominal output are based on calendar-year averages of the most recent quarterly values of gross national product (GNP) and gross domestic product (GDP) published by BEA. In 1991, BEA changed its featured measure of output from GNP to GDP. GNP differs from GDP in that GNP includes the income that U.S. residents earn abroad and excludes the income that foreigners earn in this country.

Growth rates of real output were calculated using calendar-year averages of the most recent quarterly data on real GNP and real GDP published by BEA. Over the years covered in this analysis, BEA made several benchmark revisions to real GNP and GDP. Such revisions make comparing forecasts with actual data difficult.

For example, from 1976 to 1985, forecasters published projections of real GNP growth that reflected BEA's current measure of such growth at the time, which was based on 1972 prices. In late 1985, however, BEA discontinued the series presented in 1972 dollars and began to publish figures for GNP in 1982 dollars. As a result, no official data for GNP growth in 1972 dollars are available for the years after 1984, meaning that the actual two-year average growth rates that would be used to evaluate the forecasts made in 1984 and 1985 are unavailable.

Moreover, from 1986 to 1991, forecasters published projections of the growth of real GNP that were based on 1982 prices. In the second half of 1991, BEA made another benchmark revision and began publishing estimates of GNP in 1987 dollars. Today, the historical annual series for GNP in 1982 dollars is available only through 1990, so no actual two-year average growth rates are available for comparison with the forecasts made in 1990 and 1991. Late in 1995, BEA made another switch—to a chain-weighted measure of GDP. The historical annual series for GDP in 1987 dollars ends with the value for 1994; thus, there are no corresponding actual two-year average growth rates available for the forecasts made in 1994 and 1995.

By periodically updating the series to reflect recent prices, BEA ensures that its benchmark for real output is relevant for analyzing contemporary movements in real growth. But that practice makes it difficult to evaluate forecasts of real output growth that are produced over several years on the basis of a series that is later discontinued. Consequently, comparisons in this evaluation use BEA's chain-type annual-weighted index of real GNP or GDP for all historical values.

Inflation

CBO calculated averages of inflation in the consumer price index from calendar-year averages of monthly data published by the Bureau of Labor Statistics. Before 1978, the bureau published only one consumer price index series, now known as the CPI-W (the price index for urban wage earners and clerical workers). In January 1978, however, the bureau began to publish a second, broader consumer price index series, the CPI-U (the price index for all urban consumers).

Until 1992, the Administration published its forecasts for the CPI-W, the measure used to index most of the federal government's spending for entitlement programs. By contrast, CBO based all but four of its forecasts of inflation published since 1979—those released from 1986 to 1989—on the CPI-U, which is the measure of inflation now used to index federal income tax brackets. The *Blue Chip* consensus and the Federal Reserve have always included forecasts for the CPI-U. Although annual fluctuations in the CPI-U and CPI-W are virtually indistinguishable, the indexes differ in some years.

As part of its analysis, CBO also evaluated forecasts of the difference between CPI inflation and inflation in the price index for output. The agency used the implicit price deflator for GDP (or, before 1992, GNP) available from BEA to measure the price index for output.

Interest Rates

CBO used data published by the Board of Governors of the Federal Reserve System and the Department of the Treasury to calculate two-year averages of short-term and long-term interest rates.

CBO's comparison of forecasts of short-term interest rates relied primarily on historical values for two measures of the interest rate on 3-month Treasury bills: the new-issue rate and the secondary-market rate. Before 2001, the Administration forecast the new-issue rate, which corresponds to the price of 3-month bills auctioned by the Department of the Treasury. The new-issue rate thus reflects the interest that would be earned by

an investor who purchased a bill at auction and held it to maturity. Since mid-2001, the Administration has forecast the secondary-market rate, which corresponds to the price of 3-month bills traded outside of Treasury auctions. Such transactions occur continually in markets that involve many more traders than there are bidders in Treasury auctions. Thus, the secondary-market rate provides a better measure of conditions in financial markets.

Unlike the Administration, CBO has only ever forecast the secondary-market rate. The *Blue Chip* consensus, by contrast, has alternated between the two rates, and, in 1981, it even projected a third—the 6-month commercial paper rate. The *Blue Chip* consensus forecast the new-issue rate from 1982 to 1985, the secondary-market rate from 1986 to 1991, and the new-issue rate again from 1992 to 1997. Since March 1997, the *Blue Chip* consensus has forecast the secondary-market rate. There is no reason to expect the rates to differ persistently; indeed, the differences between their calendar-year averages are minuscule.

CBO likewise compared the various forecasts of long-term interest rates with historical values for two measures of long-term rates: the 10-year Treasury note rate and Moody's Aaa corporate bond rate. A comparison of forecasts made before 1984 is not possible because not all of the forecasters published forecasts of long-term interest rates then. In 1984 and 1985, CBO projected the Aaa corporate bond rate. Since then, however, CBO has projected the 10-year Treasury note rate. The Administration has always published forecasts for the 10-year Treasury note rate. The *Blue Chip* consensus forecast the Aaa corporate bond rate until January 1996, when it switched to the 10-year Treasury rate.

CBO calculated separate historical values for real short-term interest rates using the nominal interest rate and the inflation rate appropriate for each forecaster. In each case, the average interest rate was deflated by the average growth rate of the consumer price index. The resulting real short-term interest rates were similar among forecasts.

Wages and Salaries

The data on wages and salaries used in this report come from the National Income and Product Accounts published by the Department of Commerce's Bureau of Economic Analysis. Wages and salaries are by far the biggest component of national income. CBO evaluates errors in forecasting wages and salaries because, given their share of personal taxable income, they are a key determinant of overall tax receipts.

List of Tables and Figures

Tables

Figures

About This Document

The Congressional Budget Office regularly evaluates the accuracy of its economic forecasts by comparing them with the economy's actual performance and with others' forecasts. Such evaluations help guide CBO's efforts to improve the quality of its forecasts and, as background information, are also intended to assist Members of Congress in their use of the agency's estimates. In keeping with CBO's mandate to provide objective, impartial analysis, the report makes no recommendations.

Edward Gamber and Claire Sleigh wrote the report with guidance from Kim Kowalewski. Robert Arnold, Mark Booth, Jeffrey Holland (formerly of CBO), and Jeffrey Werling provided helpful comments. Mark Lasky and Adam Staveski fact-checked the report.

Wendy Edelberg, Jeffrey Kling, and John Skeen reviewed the report. Bo Peery edited it, and Jorge Salazar prepared it for publication. The report is available on CBO's website (www.cbo.gov/publication/53090).

Keith Hall
Director
October 2017

Proposal

A Rapid Learning System for G-20 Macroeconomics:

From Greenspan to Shiller and Big Data

by

Lloyd S. Etheredge

March 6, 2014
(Draft)

Proposal

A Rapid Learning System for G-20 Macroeconomics: From Greenspan to Shiller and Big Data

by
Lloyd S. Etheredge[1]

Abstract

There is a growing agreement that there are missing variables in economic science. Robert Shiller (2014) believes that needed progress can be achieved by creating, and then drawing upon, an inclusive behavioral science framework that "accounts for actual human behavior." [2] Independently, Alan Greenspan has started to build this expansion. He draws upon a lifetime of experience, and reflections on the recent economic crisis and recovery, to recommend the behavioral variables that, with appropriate metrics, should be added to the world's data systems and forecasting equations.[3] The purpose of this project is to build upon Greenspan's outline and Shiller's vision and use them as a stimulus for expanded, multi-disciplinary, and inclusive R&D data systems that can be deployed internationally to create a rapid learning system for macroeconomics. [4] [5]

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[1] Lloyd Etheredge is Director, Government Learning Project, at the Policy Sciences Center, Inc., a public foundation; URL: http://www.policyscience.net. Contact: (301)-365-5241 lloyd.etheredge@policyscience.net. This is a draft grant proposal. Comments welcome: Please do not circulate without permission.

[2] Robert Shiller, "The Rationality Debate: Simmering in Stockholm," The New York Times, January 14, 2014.

[3] Alan Greenspan, The Map and the Territory: Risk, Human Nature, and the Future of Forecasting (New York: The Penguin Press, 2013).

[4] The columnist Robert Samuelson reported a disciplinary pessimism about finding new and better policy ideas in current models and data systems at the invitation-only IMF summit last year: Robert J. Samuelson, "The End of Macro Magic," Washington Post, April 21, 2013. Concerning new variables, see also Lawrence Summers, "Lessons Can be Learned from Reinhart-Rogoff Error." Washington Post. May 5, 2013: "In retrospect, it was folly to believe that with data on about 30 countries it was possible to estimate a threshold beyond which debt became dangerous. Even if such a threshold existed, why should it be the same in countries with

The project is timely. Global economic recovery is lagging and established models and data systems have not worked reliably. The addition of new variables (each, likely influenced by several pathways) raises the possibility of a new set of effective policy tools (for example, to restore confidence and accelerate economic recovery). There is exciting and creative thinking among economists that will be captured by the project (i.e., and these upgrade ideas can disappear unless they evolve into metrics and are included in new R&D data systems of the G-20). There are very few problems in the world that cannot be made better by a speedier return to economic health and adding another 1%/year to long-term GDP/capita growth. And in February 2014 the G-20 governments made a public commitment to better results. They promised to *"develop ambitious but realistic policies with the aim to lift our collective GDP by more than 2 percent above the trajectory implied by current policies over the coming five years."* [6] More inclusive economic models and data systems should help to improve economic science and get these results for the G-20 and other nations.

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and without their own currency, with very different financial systems, cultures, degrees of openness and growth experiences?" Summers also recommends surrendering the comfortable dream of "returning to normal" and a world already charted by established equations and data systems: "the presumption that normal economic and policy conditions will return at some point cannot be maintained." ("Economic Stagnation is Not Our Fate - Unless We Let It Be," Washington Post, December 18, 2013). A consulting project for China, with leadership by the Nobelist Michael Spence, concludes that the ideas that must guide China's next phase of growth "step outside well-known economic models" and require tasks of adding metrics and variables into formal models that are "very much on economist's 'to do' list:" Jonathan Schleferfeb, "Nobel Winner's Frank Advice to China's Leadership." The New York Times, February 17, 2014.

[5] The commitment of the policy sciences tradition is to develop inclusive frameworks to guide democratic decision making. See Harold D. Lasswell and Abraham Kaplan, Power and Society: A Framework for Political Inquiry (1950) (New Brunswick, NJ: Transaction Publishers, 2013), reprint with an Introduction by Ronald Brunner; the behavioral sciences made impressive steps toward this goal, even several decades ago: Lloyd S. Etheredge, The Case of the Unreturned Cafeteria Trays (Washington, DC, 1976) and the "Map" (attached as an Appendix to this proposal) and *idem.*, "Wisdom in Public Policy" in Robert Sternberg and Jennifer Jordan (Eds.) A Handbook of Wisdom: Psychological Perspectives (New York: Cambridge University Press, 2005), pp. 257-328; William Ascher, Bringing in the Future: Strategies for Farsightedness and Sustainability in Developing Countries (Chicago: University of Chicago Press, 2009).

[6] Jamie Smyth, "G20 Aims to Add $2 Trillion to Global Economy," Financial Times, February 23, 2014.

Table of Contents

I. Scientific Plan

A Project Director and an Advisory Group will identify specific topics to be addressed in three steps and invite leading researchers to participate in a planning group (N=12-14) for each step. The planning groups will be asked to do justice to the thinking of Greenspan and other theorists. To bring their own creativity to the task. And to assure that the new variables and metrics will, in the spirit of the Michelson-Morley experiment in physics, be politically fair and support the competitive evaluation of variables, pathways, and claims that are civically relevant.

The three steps will be:

1.) Greenspan's List of (known or suspected) missing variables and recommended metrics;

2.) Inclusive Social Science Lists to capture (known or suspected) missing variables and metrics from other theorists and researchers;

3.) Finding Unknown Variables and Organizing Rapid Learning Systems.

- Greenspan is a professional economist and a libertarian. [His mentor and lifelong friend was Ayn Rand (author of Atlas Shrugged, an entry pathway to these policy views for many college students.)] He has taken the unusual step of recommending rapid scientific evaluation of his new economic ideas and these (what others would call) ideological beliefs. He expects these new scientific equations will improve economic forecasts *and,* in the competition of ideas in the political marketplace, prove that libertarians are right.

The Project Director will prepare an initial outline of issues for each planning group, meet with each member for a discussion, prepare a draft paper for a 1 ½ day group meeting, and author a summary report of recommended variables and metrics and next steps from each group. Each of the three Reports will address:

1.) Recommended variables and metrics that are on the shelf and that can be deployed immediately;

2.) Recommended metrics that can become available soon, with additional work;

3.) Important areas where further R&D is needed before metrics can be recommended.

Here (for the three steps, and with three examples for each step) are new variables and clusters of metrics that will be addressed, with my initial commentary about how I believe the discussions of social science advisers will develop and refine the analysis.[7]

A. Greenspan's List

> "We are driven by a whole array of propensities - most prominent, fear, euphoria, and herd behavior."
>
> - Alan Greenspan [8]

Greenspan recommends adding variables to provide a more inclusive account of human nature. Thinking internationally, he also recommends including cultural variables in the new equations because he believes that cultures exert (often) fixed causal forces on economic behavior.

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[7] Greenspan suggests "an apparently inbred upper limit to human IQ" may limit productivity growth in America and other advanced economies to 3%/year (pp. 165-166, 296). The phenomenon is worth investigating and forecasting, but I am skeptical about this explanation.

[8] Also, a capacity for human rationality should be measured in the new equations: The new behavioral variables (fear, euphoria, and herd behavior) can be "broadly subject to reasoned confirmation," *op. cit.*, p. 299. [Including different (and sometimes opposing) logics and mechanisms (like rationality) in different parts of the human brain may seem logically contradictory and unacceptable but an emerging view of human nature, informed by neuroscience, is comfortable with this theoretical upgrade.]

Greenspan adds that "much of animal spirits are heavily tempered by rational oversight. Markets, even in their most euphoric or fear-driven state, do not expect global stock market averages to double or triple overnight, or wheat prices to fall to five cents a barrel" *op. cit.*, p. 35.

1.) Motivation 1 - Fear, Confidence, "Animal Spirits"

> "[T]he world economy is pregnant with multiple equilibria - self-fulfilling outcomes of pessimism or optimism."
>
> - Olivier Blanchard [9]

a.) Fear. An early, simplified mathematics of economics assumed human motivation to be fixed and seeking maximum economic profit, and that knowledge of the world was limited to economic variables (e.g., the prices and other current behavior of markets). Greenspan begins by adding an instinct for survival, risk-aversion, and a hardwired, fast, and compelling response to fear: "fear induces a far greater response than euphoria."[10] [Thus the boom phase of economic crises build across several years while the financial collapses will be sudden panics as these primitive, "fast" brain mechanisms are activated.] [11]

b.) Restoring confidence has emerged as one of the high policy priorities for economic recovery. Greenspan's wider model (discussed below, based on Keynes), includes the genetic endowment of human nature with natural "animal spirits" and a non-rational optimism about the

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[9] Dr. Olivier is Chief Economist at the International Monetary Fund and, for many years, was a member of the MIT Economics Department. Olivier Blanchard, "2011 in Review: Four Hard Truths." Online at http://blog-imfdirect.imf.org/2011/12/21/2011-in-review-four-hard-truths/

[10] *op. cit.*, p. 280.

[11] To psychologists, pain is a physical sensation with specific measurements. Thus, pain-avoidance can be different than risk-avoidance. [Greenspan probably means to include pain-avoidance in his theory: he discusses "the propensity of policy makers to seek the least politically painful solution to a problem . . . We see it everywhere." (p. 224).] The distinction between pain and risk will sometimes be nit-picking, but it helps to distinguish which brain pathways actually might be involved, for whom. While a new breed of Wall Street financiers may instinctively wish to avoid pain, they might be thrilled by the excitement of high risk gambling.

future.[12] [Thus, human nature is on the side of economic health, which will return as soon as we can understand the fear mechanisms and reduce or remove the fear and restore confidence.]

What are the pathways and metrics to model the neuroscience of fear and confidence? The fast "fight/flight" panic mechanism appears, at this point, to be linked to other mechanisms that continue to suppress or inhibit animal spirits and economic confidence. The actual combinations will have different implications for optimal recovery policies.

For example: The conventional remedy of economic pump-priming imagines that 1.) economic reality must be changed and become reliably reassuring (e.g., by reducing interest rates to stimulate investment and by increased government (deficit) spending). As flows of income increase to individuals and businesses, and as they slowly and repeatedly test the waters, confidence gradually is restored, their own spending and/or hiring increases, and the recovery process becomes self-sustaining. Another possibility is 2.) calendar time may be required for healing and recovery, and this might also require outreach steps (recognizing the additional psychological mechanisms involved) for people who have been injured personally or become discouraged. Or 3.) if the fear was activated in the context of a perceived catastrophic failure of trust and/or betrayal by governments and financial institutions who had a moral obligation to be trustworthy, these institutions may be required to restore confidence in themselves and have not done so. [These psychological ideas are consequential: the Federal Reserve systems of the world can spend hundreds of billions of dollars believing that there is a Liquidity Trap and they must keep interest rates low. Yet they will waste the money if the current problem is a Confidence Trap linked to deficient trust in major institutions and guarantors, and a dispiriting anomie.] [13]

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[12] Kahneman agrees with Greenspan and Keynes: "the optimistic bias may well be the most significant of the cognitive biases." Quoted in Greenspan, *op. cit.*, p. 32.

[13] Adding new and direct confidence metrics about governments and political systems is an innovation implied by Olivier Blanchard: "Markets have become more skeptical about the ability of governments to stabilize their public debt" in his "Strong Policy Action - The Essence of Restoring Global Economic Hope" blog, September 20, 2011. Online at http://blog-imfdirect.imf.org/2011/09/20/strong-policy-action-the-essence-of-restoring-global-economic-hope/

Alternatively, there may be 4.) a news-media perpetuation of fear and anger by (for profit) companies (like Fox News) or (with huge campaign contributions) by the Tea Party. [Once, three centrist television networks and sober, professional journalists (NBC, ABC, CBS) conveyed reality to, and constructed reality for, the American people.][14]

A wider set of metrics may allow other confidence-restoring or -building variables, possible brain mechanisms, and policy options to come into focus. For example, leadership-induced confidence: 5.) Experiments by McClelland and Winter found that videos of dramatizing leaders, with speeches rich in achievement images (like President Kennedy), energized people for economic achievement. [Thus: new metrics may show that President Obama and a world of rationalist economists and prosaic politicians are contributing to the current slow rates of economic recovery by the uninspiring public drama that they create.] [15] Or 6.) FDR used yet another set of (*de facto*) psychological theories of fear and brain mechanisms: Declaring that "the only thing we have to fear is fear itself," he presented himself as a confident, cheerful, and even jaunty role model (in a scary and troubled time); and, by using his position as a leader, and new mass communications technology, to *name* emotions he may have created new brain pathways in his listeners that helped them to be self-starting in an internal world that began to bracket fear.[16]

c.) "Animal Spirits." Greenspan's (psychological, political, and economic) theory of

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[14] New capabilities for quantitative analysis of communication flows would provide an interesting cross-national set of metrics. See Robert Harris, The Fear Index (NY: Vintage, 2012). Reprint; Ithiel de Sola Pool, "Content Analysis and the Intelligence Function," reprinted on Lloyd S. Etheredge (Ed.), Humane Politics and Methods of Inquiry: Selected Papers of Ithiel de Sola Pool, vol. 2 (New Brunswick, NJ: Transaction Publications, 2000), chapter 2.

[15] David McClelland and David Winter, Motivating Economic Achievement: Accelerating Economic Development Through Psychological Training (New York: Free Press, 1969).

[16] The G-20 appear to be using, at this point, 7.) a straightforward goal-setting theory of leadership and induced motivation. However the degree of repetition that is needed may be under-estimated. It may be necessary for leaders to communicate goals a hundred times more than they initially believe should be necessary

"animal spirits," borrowed from Keynes, imagines that the success of the capitalist system is the expression of this restless and even joyful human energy and natural optimism (that is not derived from cold, rational calculations), typically channeled into activities with others. Keynes' phrase was used of British students in boarding schools in late Victorian and Edwardian England: the "animal spirits" find natural expression in the freedom of the playing field and, sometimes, in an irreverent, youthful independence and instinct for challenging the rules that enjoined vigilance by headmasters. [17]

Greenspan's theory is a strategic move on a political chessboard. The "animal spirits" of human beings - not the profit-seeking of economic robots programmed for maximum rationality - drive capitalism and economic growth.[18] However these human "animal spirits" are suppressed by regulations and Greenspan's scientific prediction is that the new equations will prove libertarian claims: If we want the capitalist package to work, we should limit government and its regulation and other interference. The *laissez-faire* freedom from regulation that is required for the animal spirits of capitalism to create a better future [and also for the growth of strong, healthy, self-starting entrepreneurs as they move from competition on the playing fields to the

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[17] For further discussion: George Akerlof and Robert Shiller, Animal Spirits: How Human Psychology Drives the Economy, and Why it Matters for Global Capitalism (Princeton, NJ: Princeton University Press, 2009) and Robert Shiller, "Animal Spirits Depend on Trust: The Proposed Stimulus Isn't Enough to Restore Confidence," Wall Street Journal, January 27, 2009.

[18] As a side issue: Greenspan believes that "*To the extent that any human action is at least partially driven by 'spirits,' the material outcomes are less satisfactory in purely economic terms than they would be under the hypothetical presumption that animal spirits did not exist and that human beings' economic behavior was wholly rational.*" Greenspan, *op. cit.*, p. 35. However computer simulations may show Greenspan's view to be untrue: a sociobiology theory might predict that, while irrational over-confidence may increase death rates of individuals or many entrepreneurial firms, this trait could, when there is random variation and changing environments, facilitate adaptation and success of the species. In the study of emerging infectious diseases, for example, millions of individual virus particles may die in the continuing assaults on new antibiotics but, with random variation, the continuing assaults eventually include breakthroughs by resistant mutations and survival and new population growth for the species.

corporate offices - LE] also means that political systems should accept that cycles of boom and bust are an inevitable part of the global capitalist system.

Greenspan's political deductions mandate a careful attention to measurement. There is a distinction between subjectivity (how reality is perceived, interpreted and wired-up in the brain) and Greenspan's almost definitional theory that regulations restrict freedom. There will be abundant challenges for the scientific planning groups to sort out but (to make the points briefly): 1.) actually, the youthful athletic contests on the playing fields of Eton, with their genuine and energetic freedom and competition, also are exquisitely created and affected by rules and regulations, depend upon honest and competent referees and agreed-upon penalties, and the activities are sustained by a moral universe of respect, fairness, and sportsmanship, and norms that distinguish acceptable competitive strategies (e.g., of misdirection) from cheating. Thus, it is not obvious that indexes of financial or environmental regulations *necessarily* will show inhibiting brain/psychological impacts on businessmen that erode their economic motivation and lower the growth rate of GDP. [However, 2.) once the new subjectivity-recognizing metrics are created, Greenspan might be right. In part, the truth depends upon the subjectivity of capitalists - although complaining about government regulations is not compelling evidence that regulations actually do inhibit their economic motivation: some of the most regulated and supervised industries in the world (e.g., the pharmaceutical industry) are the most profitable and innovative.] [19]

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[19] Economists are accustomed to use the hard numbers of conventional economic data. This methodological point about including measures of subjectivity (more easily accepted in other social sciences) is one of the "four hard (*sic*) truths" to improve econometric forecasting recommended in 2011 by Blanchard: "*Perception molds reality.*" *op. cit.* A second-level measurement issue for a planning group, also flagged by Blanchard, is that perceptions can change: "[F]inancial investors are schizophrenic . . . they react positively to news of fiscal consolidation but then react negatively later. . ." *ibid*. A related measurement issue is the contextual principle in behavioral science - i.e., the effect of a variable can depend upon the context in which it occurs. Thus President Kennedy's tax cut may have produced an unusually strong effect on economic growth because it occurred in the frame of his achievement-oriented (N-Ach in the technical language of psychologists) rhetoric and leadership. If so, the Reagan-era

Also, *pace* Greenspan and Keynes, 3.) Social scientists might discover that actual economic motivation can be much greater than the baseline animal spirits of human nature. For example, motivation might be increased by (external) political leadership (see above) or by a non-rational manipulation that, via the visual cortex, activates long-term motivation with vivid images of vast, guaranteed profit. Greenspan's *laissez-faire* utopia of natural, animal spirits may actually achieve only a fraction of what psychologically astute G-20 policies (to design a fully incentivized global capitalist system) could empower capitalism to achieve in the future. [20]

2.) Motivation 2 - The Herd Instinct

"Euphoria will always periodically produce extended bull markets that feed off

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tax cuts would have produced a diminished effect because his Presidential rhetoric was low on N-Ach imagery. For a further discussion: Lloyd S. Etheredge, "President Reagan's Counseling" in Political Psychology, 5:4 (1984), pp. 737-40, online at www.policyscience.net at II. C.

Political combat in the Ayn Rand tradition has used her Objectivist philosophy which (i.e., it is a somewhat closed system) can interpret other people's differing perceptions as a "false consciousness." Greenspan may not readily accept a political philosophy or economic policy based on people's "unthinking" subjective experience of whether they are regulated.

[20] To secure the benefits of new technologies, the American government energized the national capitalist system and built a trans-continental railway system in the 19th century, very quickly, by offering government payments and bonuses (and vivid, high profits) of $16,000, $32,000 or $48,000/mile and assuring land grants, to competing companies who started building westward, and another that started eastward from California.

Similarly, the actual "herd instincts" motivations of Wall Street portrayed in the Academy Award-winning Inside Job and The Wolf of Wall Street appear to have been fueled by vivid images of fabulous profits and cocaine-like drug addiction and pleasure centers in the brain. Greenspan's partly exculpatory theory of human nature notwithstanding, only a very small percentage of self-selecting human beings may actually become involved in high-stakes gambling addictions.

herd behavior, followed by rapid fear-induced deflation of the consequent bubbles."

- Alan Greenspan [21]

"I see no way of removing periodic irrational exuberances without at the same time significantly diminishing the average rate of economic growth and standards of living."[22]

- Alan Greenspan [23]

Greenspan's new "herd instinct" variable moves economic analysis beyond the mathematical assumption that the motivation of human beings is only to maximize selfish economic profits. The herd ("social") instincts have their own aims, expressions and rewards (including contributing to the lives of others).[24] They are expressed in a nonprofit sector of the economy that is capable of astonishing gains in productivity and human benefit (e.g., MOOCs that can make a curriculum equal to the best in the world available to everyone on the planet, without charge) and, also, stunning and baffling inefficiency (e.g., the American health care system). The American media focus on the quarterly performance metrics of the for-profit economy but Greenspan's conceptual and pro-metrics upgrade will engage a planning group to think about

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[21] *op. cit.*, p. 292.

[22] Greenspan predicts that periodic irrational exuberances may grow worse as a result of social media, *op. cit.*, p. 25: "fear and euphoria . . . are contagious processes exaggerated by herding." It is an important prediction, made possible by including the herd instinct set of variables, that should be evaluated for G-20 forecasting.

[23] *op. cit.*, p. 301.

[24] Greenspan includes a propensity to compete in games and for status (p. 26) and power (p. 34).

equivalent quarterly performance metrics for the nonprofit sector.[25]

Adding a "herd instinct" variable also is a strategic move on a political chessboard. Here is the background: The term was introduced (with cross-species examples) by the social psychologist (and neurosurgeon) Wilfred Trotter in 1908.[26] It refers to many human phenomena, including altruism and compassion, standards of fairness, marriage and friendship, the nonprofit sector, all social and mass movement participation - including financial bubbles (and skewing risk-aversion judgments to the mean of a group) - and enlisting in wars, seeking status and power, conformity and followership, the quests for self-esteem, copycat behavior exploited by advertising and marketers, etc. During the 1930s and the Cold War, "herd instinct" became a pejorative term. Alan Greenspan, Ayn Rand, and many allies believed that the herd instinct dangerously drew political supporters to the seductions of collectivism, with the reality of a soul-crushing tyranny (and mistaken economic ideas) of America's mortal enemy, Russia and a global

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[25] I am not sure how far this initial project can go to develop metrics and forecasting equations for the nonprofit sector of the G-20 economies. However, the economics profession and society may benefit in several ways from Greenspan's conceptual upgrade. Typically, doctrinaire economic analysts recommend improving nonprofit institutions by turning them into for-profit hospitals, for-profit public schools, universities with Profit Centers, outsourcing the work of government agencies to the private sector, etc. Greenspan's "herd instinct" variable allows there to be legitimate, different, and important motive instincts that sustain the nonprofit sector and that can used and organized for the common good. (A motivation to maximize economic profit is not required for efficiency: the management consultant Peter Drucker thought that the Girl Scouts of America, with their commitment to "help each girl reach her own highest potential," was better run than Fortune 500 companies.) See also the variables affecting productivity in well-managed public sector and nonprofit institutions identified by the Baldrige awards, www.apqc.org. A discussion of conceptual implications of allowing different motives in models of human nature is Howard Margolis, Selfishness, Altruism and Rationality (Chicago, IL: University of Chicago Press, 1984).

[26] His later popular book influenced the application of scientific method to develop modern advertising and analyze the mass movements of the 1930s, accelerated by the new mass media technologies. W. Trotter, Instincts of the Herd in Peace and War (London: T. F. Unwin, 1916).

Communist movement. In Greenspan's tradition the "herd" (social) instincts also contribute to the well-intentioned, spiritually-eroding, collectivist welfare state (eroding the personality of 47% of Americans, according to the Republican-individualist Presidential candidate, Mitt Romney). The mass psychology of society and human imagination are zero-sum: even when governments enlarge their prominence and hold the high ground as benevolent planners of welfare states (and *de facto* regulators), they restrict and erode the open spaces and zones of freedom that are required for the full development of strong, healthy, self-starting individuals (who become entrepreneurs). [27]

Again, these are moves on a political chessboard and two measurement cautions are in order: a.) Political, educational, social, spiritual, and psychological theorists since Plato's analogy of the Cave and Buddha's teaching of a path to Enlightenment have thought about issues of freedom, liberation, and growth. Many psychologists have researched causal ideas about the growth of healthy, strong, free, responsible, self-starting, enlightened individuals who can become the "entrepreneurs of their own lives" and ethical, civic and business leaders and organizers.[28] Thus, there are likely to be different pathways and coefficients and a package of societal metrics that need to be put on the table; b.) As I indicated above, the Honest Broker scientific refereeing of ideological political arguments requires the measuring of subjectivities: a society with a psychology of "entitlements" *might* be unhealthy, but the appropriate metrics for Sweden may show that "entitlements" are healthy when they are wired-up differently and express and strengthen mutual respect and democracy and provide resources for the genuine personal freedom to grow and prosper. Similarly, constructing a "dependency index" for macroeconomics

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[27] I.e., rather than become victims, or pawns, or the drone employees of others, or people who look to governments and vote for a welfare state.

[28] Etheredge, "Wisdom . . . ," *op. cit.*. E.g., Lawrence Kohlberg, The Philosophy of Moral Development: Moral Stages and the Idea of Justice (San Francisco: Harper and Row, 1981); Jane Loevinger, Ego Development: Conceptions and Theories (San Francisco: Jossey Bass, 1976); see also David Winter, David McClelland, and Abigail Stewart, A New Case for the Liberal Arts (San Francisco: Jossey Bass, 1981).

(as some libertarian think tanks have proposed), equating (almost by definition) the public sources of individual income with an unhealthy, hierarchical, psychological relationship, begs an important measurement question; and c.) Once we see the numbers for a particular culture or subgroup, Greenspan and other libertarians may nevertheless be right.

3.) Culture

> "A specific brand of culture - populism - has been particularly debilitating to economic progress. . . . Capitalism and socialism are specific about the conditions they deem necessary for the creation of wealth and rising standards of living. Populism [for example, in 20th and 21st century Latin America] is not. It is a shout of pain."
>
> "For those economies that seek maximum economic growth, it appears that abstinence and prudence are necessary (although not sufficient) virtues for prosperity."
>
> - Alan Greenspan [29] [30]

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[29] *op. cit.*, pp. 226-227.

[30] Abstinence and prudence are used by Greenspan as economic terms to refer to the percentage of income that is saved and invested for future returns, although there may be other behavioral (e.g., Puritan) correlates that he has in mind.

Concerning other variables, Greenspan writes: "Producing a fully detailed model is beyond the scope of this book. But such a model would include a number of variables reflecting those verities of human nature [or culture - LE] that reveal long-term economic stabilities. Among them are time preference (and interest rates), equity premiums, corporate earnings-price yields, and, since the 19th century, the private savings rate. They reflect the outer limits to fear and euphoria that define the dynamics of the business cycle. For forecasting purposes they can be assumed to continue trendless [unchanged - LE] in the future. . . . In addition there are those stabilities that are not inbred, such as the sum of social benefits and gross domestic savings as a percent of

> "Innovative (thinking outside the box) entrepreneurship and prudence are largely, if not wholly, culturally-driven traits."[31]
>
> - Alan Greenspan [32]

Greenspan recommends cultural characteristics and metrics be included in the new era of 21st century economic forecasting models.[33] His relatively brief and topical discussion includes savings and investment rates (abstinence, forbearance and prudence), cultural differences in entrepreneurial risk-taking, and in the rule of law and corruption.[34] His primary examples are Euro-North countries v. Euro-South countries: Greenspan believes that "becoming more like Germany" (e.g., forbearance, prudence, a work ethic, a commitment to legal economic activity and paying taxes) is (in the abstract) the cultural solution to improve economic forecasts for Greece, Italy, Spain, and Portugal. [35]

Since Greenspan's book went to press there is growing agreement that national and cultural differences must be included in forecasting models. Although these still are, to a degree, a "black

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GDP. Other forecast stabilities include the size of the workforce - those potentially in the workforce have already been born - and average hours worked." p. 292.

[31] China and Japan are cited as cultures that restrict innovation (p. 231).

[32] *op. cit.*, p. 231.

[33] Adherence to the rule of law can be proxied by the share of illegal activity in GDP. Other national/cultural characteristics include social harmony and communications and a functional political system. (p. 231).

[34] Note that there are opposite elements in Greenspan's model of economic growth - prudence (for savings) and risk-taking entrepreneurs.

[35] See also Lewis's observations that include Ireland and Iceland (different peoples with different reasons) that took the cheap credit to the point of disaster: Michael Lewis, Boomerang: Travels in the New Third World (New York: W. W. Norton, 2011).

box," the scientific failure to include them apparently has led to serious policy mistakes during the recent recovery, with (sometimes) opposite national effects of austerity from those that were forecast by economists. [36]

- Again, Greenspan may be right in his list, but there are political implications to these equations and the social science package will need to be robust. For example, a.) Asian cultures with traditions of hierarchy, combined with obligations for moral, benevolent, responsible and competent leadership, may develop a group-based psychology that is a source of competitive economic strength. In Japan, a psychology of dependency within firms (a hated characteristic, in the terms of Ayn Rand or Governor Romney's analysis of American economic performance) may be consistent with a highly competitive global automobile industry; [37] b.) Porter's work on

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[36] Howard Schneider, "An Amazing *Mea Culpa* from the IMF's Chief Economist on Austerity" Washington Post, January 3, 2013 concerning a (still, somewhat mysterious) set of differences that imposed remarkable damage on the Greek recovery and that can change over time. For European recovery, pro-austerity recommendations were based on a forecast of a fiscal multiplier of 0.5 when the actual multiplier sometimes was 1.5, meaning that a dollar reduction in government expenditures actually produced a $1.5 dollar reduction in GDP. Concerning other national/cultural variables that have emerged on the "to do" list to include in forecasting equations, see also Lawrence Summers, "Lessons Can be Learned from Reinhart-Rogoff Error." Washington Post. May 5, 2013 (discussed at footnote 4 above): ". . . [W]hy should it be the same in countries with and without their own currency, with very different financial systems, cultures, degrees of openness and growth experiences?"

[37] Concerning dependency inside a benevolent hierarchy: The allegedly growing American trait cited by Governor Romney as dysfunctional and true of 47% of Americans in a "too generous" welfare state may, as part of a package, be a successful feature of Japanese culture and many of its economic organizations: see Frank Johnson, Dependency and Japanese Socialization: Psychoanalytic and Anthropological Investigations of *Amae* (New York: NYU Press, 1995). The possibilities of cross-cultural learning and of culturally appropriate public policies are explored in Nicolas Berggruen and Nathan Gardels, Intelligent Governance in the 21st Century: A Middle Way Between West and East (New York: Polity, 2012).

international competitiveness suggests a wider set of nation-state metrics.[38]

There are many new cultural and sub-cultural groupings (e.g., c.) the economic behavior and causal dynamics of youth cultures) that might be the units of analysis, especially in countries with high and uncorrected rates of prolonged youth unemployment. Concerning the psychology of lower status individuals and their cultures: There may be d.) a Primate Subordination Syndrome that - even in objectively similar circumstances - reduces motivation, affects stress and endocrine levels and health, inhibits educational achievement, and is pervasively destructive of lower status primates.[39] The comparative neuroscience of lower status cultures may reveal a new universe of unrecognized causes (via the visual cortex and hierarchical imagination) of limitations in human economic potential. e.) The changing (post-deregulation) cultures (supported by changed recruitment and self-recruitment) of Wall Street and the financial world may be critical variables for economic forecasting.[40] f.) There are important (known) sub-cultural differences in

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[38] Michael Porter, Competitive Advantage (New York: Free Press, 1985).

[39] Studies of the Primate Subordination Syndrome may clarify a parallel inhibiting factor in regulations - i.e., if they also are perceived as establishing a status and dominance hierarchy. Subjectivities are important in the measurement of the inhibition of economic motivation by status ranking: Sub-cultures may provide inoculating effects (e.g., strong religious identities with the vividly experienced assurance of love and respect from a Supreme Deity and social support) and perceptions of economic opportunity also may mitigate these effects. See Lloyd S. Etheredge, "Neuropsychology and Rapid Learning Systems About Social Problems," unpublished, January 2010 and October 25, 2012 (online at www.policyscience.net at II. A. For some of the emerging correlates of subjective inequality on health and economic and social participation and (possibly) social problems see Moises Velasquez-Manoff, "Status and Stress," The New York Times, July 27, 2013.

[40] Tom Wolfe, The Bonfire of the Vanities (New York: Picador, 2008), reprint. The new "Masters of the Universe" status psychology may view members of Congress and political leaders (by judging their annual salaries) as (at best) hired middle management. The global political manipulation and exploitation of tax laws and regulations reflect a subjective change. In the 1960s most American businessmen felt poorly informed about the world beyond the water's edge

the motivation for economic achievement, and problems of structural discrimination and limited economic opportunities for different groups, that effect economic performance. (Euro-South and other cultures that discriminate against women or that limit access to good schools and higher education for their youth (to cite obvious examples) may inhibit their own economic growth). [41]

B.) Inclusive Social Science Lists

In Step 2 a planning group will reach out to include known (or suspected) R&D variables and metrics from other economists and disciplines. These ideas, like Greenspan's, are at risk of disappearing unless they evolve into metrics and their contribution can be evaluated by inclusion in R&D data systems.[42] At this point, we can measure almost any variable once we agree what they are.

4.) Behavioral Economics and Neuroscience

Researchers in behavioral economics often complain (rightly) that they are constrained to use small N experimental studies and do not yet have national data systems to allow the relevance of

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and were hesitant to become involved in political lobbying: Raymond Bauer, Ithiel de Sola Pool, and Lewis Dexter, American Business and Public Policy: The Politics of Foreign Trade (New York: Atherton, 1963). For the historic evolution of accounting and legal departments (from "just pay what we owe") into major profit centers with global strategic plans and lobbying see, for example, David Kocieniewski, "GE's Strategies Let It Avoid Taxes Altogether," The New York Times, March 24, 2011.

[41] Max Weber, The Protestant Ethic and the Spirit of Capitalism (New York: Penguin Classic, 2002) reprint; David McClelland, Human Motivation (New York: Cambridge University Press, 1988), Charles Murray, Human Accomplishment (New York: Harper Collins, 2009), and the work of Dean Keith Simonton.

[42] For a range of emerging diagnoses about missing variables see the IMF Rethinking Macro Policy II: First Steps and Early Lessons conference of April 2013, with papers online: http://www.imf.org/external/np/seminars/eng/2013/macro2/

their discoveries to be evaluated. This planning project will be their chance. [43] [44] [45]

Among other theorists, David Brooks has started to map a universe of fresh thinking about social and economic policy based on neuroscience discoveries. There is a new Society for Neuroeconomics (neuroeconomics.org) and emerging doctoral programs in neuroeconomics, and neurobiology and social science, whose members might suggest metrics for panel studies with genetics and brain data.[46] Full genomic mapping has fallen to $1,000 per individual and is heading toward $100 per individual: already genetic data (with some behavioral, social, and environmental data and electronic health records) are available in research databases (e.g., N=500,000 for the www.rpgeh.kaiser.org project).

An exciting challenge for this fourth task is to evaluate the possibility of genetic diversity in

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[43] Daniel Kahneman, Thinking, Fast and Slow (New York: Farrar, Straus, and Giroux, 2011). The growth of behavioral economics with support from the Sloan and Russell Sage Foundations is addressed in Floris Heukelom, Behavioral Economics: A History (New York: Cambridge University Press, 2014).

[44] This step also will include metrics to explain and forecast innovation rates. Greenspan believes that it is the role of the financial sector to assemble and channel needed funds. However, a wider list of metrics is needed: innovation systems are much wider than a financial system. See Robert D. Atkinson and Stephen J. Ezell, Innovation Economics: The Race for Global Advantage (New Haven: Yale University Press, 2012).

[45] Olivier Blanchard posits a new behavioral variable: "adjustment fatigue . . .which is leading to maybe less reforms than would be desirable." Transcript of a Press Briefing World Economic Outlook, October 8, 2013. International Monetary Fund, online.

[46] Concerning new funding, metrics and data systems: James Gorman, "The Brain's Inner Language," The New York Times, February 24, 2014. Investments include the EU's decade-long $1 billion Human Brain Project and the Obama Administration's $100 million startup.

the most important aspects of human nature relevant to economic behavior.[47] Only a very small number of people participate in creating financial booms and catastrophes and they may be atypical.

5.) Human and Social Capital

At the beginning of the 21st century most of the world has decided that market capitalism is the best engine for the future. There is a powerful and reciprocal relationship between the human and social capital of a society and the performance and outcomes (intended and unintended) of the economic system.

a.) Education. Especially in an emerging age of information technology and skills, investments in human beings are probably the most powerful contributions to economic growth. An exciting cluster of measurements can help to understand new, transformative opportunities for MOOCs and global education. We can bring a curriculum, equal to the best in the world, to the desktops of everybody in the world, virtually without charge. There is much experimentation to be done, and many additional investments required to turn online resources into a truly powerful education.[48] The second planning group will be asked to address the question: What should we measure?

STEM education has been proposed as a global metric, but one of the best areas for R&D research may be the psychological package of attainments that allows individuals to flourish as

[47] Greenspan believes that human nature is homogenous with respect to the major characteristics affecting economic behavior and performance. However high IQ is an exception: higher IQ increases capacities for abstraction and forethought, self-control, and delayed gratification, and thereby supports successful entrepreneurship and capitalism.

[48] U.S. President's Council of Advisers on Science and Technology (PCAST), Memorandum to President Obama concerning economic mobility, higher education, and MOOCs. December 2013. Online at www.whitehouse.gov.

"entrepreneurs" in their own lives and in the freer and more individualist societies implied by the system of market capitalism.[49] [50] A neuroscience snapshot of this larger "future-imagining-and-realization" or "taking responsibility for projects" cluster might include developing: 1.) capacities to be self-starting; and 2.) to create clear goals in which there is a genuine personal stake and that call forth commitment; 3.) to relate to aspects of realities as socially- and personally- created and changeable; 4.) learning how to identify or create alternatives; and 5.) how to decide upon and develop plans of action, assemble resources and enroll people and support (sometimes, including coaching); 6.) new brain mechanisms linking together abstraction, foresight and self-management (to achieve goals); 7.) a growing capacity to persevere (for short periods in doing elementary school assignments to several years when writing a Ph. D. thesis or book, and, then, even decades; 8.) growing cognitive capacities to manage integrated complexity and live and work with uncertainties and open-ended lines of thinking; 9.) capacities to persevere through a possible roller coaster of emotions along a path; 10.) to be self-reflective and able to think honestly and with integrity about what is working or not working; 11.) to be responsible about outcomes and breakdowns; and 12.) bring self-initiated projects to completion at a level of excellence.

In many areas of the world, formal educational systems (K-12 and college- even formal business schools) are not focused on doing the best job that they can to support this cluster and the future health that they imply for the world's economic systems. STEM education may support this growth, but it is a narrow idea and, in the wrong hands, any content-specific curriculum and testing program can become the use of authority and peer pressure to motivate

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[49] This educational cluster also will work for nonprofit institutions. The achievement/competitive drive for market capitalism is a separate psychological dimension: see McClelland and Winter, *op. cit.*

[50] The sociology of the G-20 education system and its relationship to G-20 economics involves a much wider set of issues. Mass production technologies may only have required mass production classrooms, with the goal of producing socialized students who were certified as willing to sit at desks for long periods and perform tasks assigned by authority, to reasonable standards, even if these were boring. Unless there are the right G-20 measurements, STEM education also can develop in this model.

behavior and produce diligent and mechanistic equation-solving or memorization. In truth, thoughtful measurement will be required from a planning group because the "being the entrepreneur and organizer of your own future" cluster might grow in many ways and from different sources: learning how to write academic papers and plan research, how to go step by step in your head to solve an algebra or geometry problem, practicing and achieving excellence in a competitive sport or playing the cello, or being a leader in student government, or (perhaps) an evolution of MOOCs, capstone projects, and new ways of teaching.[51]

b.) Moral breakdowns of institutions (including moral betrayal) may slow economic recovery, even if the issues are not discussed in public. David Brooks writes: "Moreover, it is harder to accept that psychological factors like uncertainty and anxiety really are a mirage . . . It has been harder to dismiss morality as a phantom concern, too. Maybe in a nation of [economic] robots the government can run a policy that offends the morality of the citizenry, but not in a nation of human beings."[52]

c.) The possibility that we are destroying social capital (without being fully aware of the

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[51] Comparative metrics for the performance of educational systems may be revealing: Greenspan's (Euro-South) cultural critique of Italy, Greece, Spain and Portugal suggests that serious limitations of their authority-oriented and conventional K-12 educational systems also may exist. Public policy research in the US has found that first-rate schools (and graduation from high school) works. Good K-12 schools is emerging as one of the best societal investments for the economic and personal success of individuals. See Ron Haskins and Isabel Sawhill, Creating an Opportunity Society (Washington, DC: Brookings, 2009).

[52] David Brooks, "The Two Cultures," The New York Times, November 15, 2010. Online. See also Robert Fogel's AEA Presidential Address "Catching Up with the Economy," American Economic Review, 89:1 March, 1999), pp. 1-21 about "commodities that lack material form" and his The Fourth Great Awakening and the Future of Egalitarianism (Chicago: University of Chicago Press, 2000). Anomie in the former Soviet Union (a case that Greenspan does not discuss) is a striking example of perceived moral breakdowns that illustrates their devastating effects on many aspects of life.

process) is raised by Charles Murray and other writers.[53] 1.) High divorce rates and single parent families may (especially without compensating investments) be a bad idea for children with long term costs to themselves and to society. 2.) There may be a vital degree of now-eroding social capital, and trust, that depend upon the experience of people that good values and hard work and social responsibility are appreciated and rewarded. Politicians across the US political spectrum now run for office and address a perception that "playing by the rules" is not working in America. 3.) In Europe, astonishing and uncorrected rates of youth unemployment are accompanied by a politically dangerous and demoralizing public discussion of "a lost generation" that ultimately may not accept its fate.[54] 4.) The expectation (and reality) of social mobility may be part of social capital: variables associated with social mobility, across regions in the US and abroad, are likely to be revealing of partial blockage in causal pathways for economic health.[55] 5.) The Spence *et al.* consultation process addressing Chinese economic growth predicts that greater inequality in society is corrosive and becomes dysfunctional: inequality creates different interests and erodes a political process; it also fuels political combat and redirects energies that could be used more productively.[56]

- d.)The Psychological Economy. The broader agenda for the planning group will be to

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[53] Charles Murray, Coming Apart: The State of White America, 1960-2010. (New York: Crown Forum, 2012).

[54] For forecasting equations illustrating potential destabilizing effects of prolonged high unemployment for different groups, see Alan de Bromhead *et al.*, "Right-wing Political Extremism in the Great Depression." Unpublished working paper online at www.voxeu.org.

[55] See the geographic variations in social mobility within the US and new variables identified by by Raj Chetty and his associates: http://www.equality-of-opportunity.org/

[56] Edwin Lim, Ian Porter, Paul Romer, and Michael Spence, "Medium and Long Term Development and Transformation of the Chinese Economy: A Synthesis Report." March 2011 (online at www.cairncrossfund.org): "If not addressed such disparities risk fueling greater social conflict and instability," p. 69. See also their lesson for new models: "social policymaking must be tightly integrated with economic policymaking," *op. cit.*, p. 71.

advance the sensitive and respectful measurement of the "psychological economy" - which I define (following Fogel) as all aspects of the economy - its input and functioning, and its "commodity" outputs and effects - that lack a material form. Coming from the metrics and the limited concerns of national income accounting (and independent and dependent variables defined by accountants and the tax code) and the physical realities of nation-state, steel plant economies, these new metrics will help us to grasp a changing world of complex, sometimes interdependent, systems and subsystems whose outputs shape the quality of our lives and the material-form economy.[57] One of the leading edge questions (likely to be flagged as "important, but needing further research before metrics can be recommended") is a refined understanding of the social recognition and status economy and the production systems that societies link to what Greenspan calls the "herd' (social) instincts. Competition for recognition and status can be as important as competition for economic rewards. And institutions and societies create status scarcities and competitions that function as motivators. (Arguably, one of the most important reforms that Margaret Thatcher brought to the UK was to make it socially acceptable for higher status people to become successful entrepreneurs.)

6.) Political Variables

> "Shadow banking is a form of financial intermediation whose funding is not supported by the traditional banking safety nets . . . the shadow banking system remained slightly more than half the size of the regular banking system throughout the 2002 to 2011 period . . . In the United States alone, shadow banking constituted $23 trillion in assets at the end of 2011, by far the largest constituent of the global network of

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[57] See, *inter alia*, Lasswell and Kaplan, *op. cit*.; Robert E. Lane's pioneering The Market Experience (New York: Cambridge University Press, 1991) and The Loss of Happiness in Market Democracies (New Haven: Yale University Press, 2001); Robert Putnam, Bowling Alone: The Collapse and Revival of American Community (New York: Simon and Schuster, 2001); Fogel, "Catching Up" and The Fourth . . ., *op. cit.*

nonbank credit intermediaries."

-Alan Greenspan [58]

"Institutional flaws are best prevented, because they are hard to fix. Once an institutional structure is in place, people quickly acquire a vested interest in its preservation. The flawed structure then becomes surprisingly resistant to reform, as the US health-care system clearly demonstrates."

- Lim, Porter, Romer and Spence [59]

"Our highest priority going forward is to fix our broken political system."

- Alan Greenspan [60]

Every societal goal has a production function: most desired outcomes can be produced several ways and by different mixes of inputs. In turn, politically, each input mix may allocate new economic income, status, power and control differently, to different beneficiaries and constituencies. To improve scientific knowledge and (with a genuine Honest Broker intent) to build political support, step six also will seek input from a full range of think tanks, activists, and others to expand upon Greenspan's list.

Greenspan has a wide range of personal observations about dysfunctional political systems, ranging from a theory that an *angst* caused by American political schism and conflict is reducing long-term business investments and slowing recovery, to genuine puzzlement about why Washington leaders cannot sit down (as they did in earlier days) for drinks after hours and reach

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[58] *op. cit.*, pp. 40-41.

[59] Edwin Lim, Ian Porter, Paul Romer, and Michael Spence, "Medium and Long Term Development and Transformation of the Chinese Economy: A Synthesis Report." March 2011 (online at www.cairncrossfund.org), p. 71. Discussed in footnote 4.

[60] *op. cit.*, p. 302.

compromises.[61] This initial project cannot do full justice to the range of these conceptual, theoretic, and measurement issues, which have extensive literatures in several social science disciplines. However, several key political system issues can be reviewed by the second planning group.

a.) Is "Human Nature" a Political Misdirection?

Social scientists will instinctively ask whether Greenspan's ("it's human nature!") ideas are a political misdirection and *mea culpa* that focus attention away from the real (political) variables that should be included in the world's macroeconomic prediction equations. Yes, the Tulip Mania of the 1630s and many of the financial bubbles and panics of history may have been produced by primitive emotions and people who stumbled through history to a catastrophe and did not understand the eventual behavior of the system and their fate.[62] However, the world's "shadow" banking systems [whose size is indicated by Greenspan in the quotation at the beginning of this section] and their international lobbying expenditures and political largesse did not arise by accident.[63] And the first edition of Kindleberger's Manias, Panics, and Crashes: A History of Financial Crises (now in its sixth edition) was published in 1978.[64] Of course Kindleberger did not intend to write a handbook, but subgroups in generations of financial analysts, by now, may have gone to school on the amounts of money that they can make if they

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[61] Greenspan has a list of observations about how the American political system (and the Latin American political systems, and the Chinese political system, and the Euro-South political systems, etc.) are dysfunctional. Some of the problems might benefit from a greater degree of agreement in economic science: Greenspan may be right that Latin American Populism is a "shout of pain" and can be shown to lack a coherent and effective economic theory.

[62] However see CW and AJKD, "Was Tulipmania Irrational?" The Economist, October 13, 2013.

[63] See also Sebastian Mallaby, More Money Than God: Hedge Funds and the Making of a New Elite (New York: Penguin Press, 2011).

[64] (New York: Basic Books, 1978).

activate asset bubbles, and then manipulate the irrationalities and deceive the trust of others and, thus, outsmart the system. In the recent crisis, brilliant hedge fund managers hyped asset bubbles, falsified or obscured credit ratings, and also bought insurance (e.g., through AIG) to cover themselves when the asset bubbles finally burst. *Pace* Greenspan, perhaps the instincts that society has to blame, or worry about, are not homogenous endowments of animal spirits or shared herd (social) instincts of people drawn into the irrational exuberance of competitive games, but brilliantly rational, realistic, strategic (gratification-deferring) predators at the atypical upper tail of statistical distributions? In a phrase of the psychologist William James, "the beaked and taloned predators," with an absence of social instincts?

b.) Politics can be the continuation of economic competition by another name. The news media can draw audiences by creating a drama that implies, ultimately, that governments are in charge of societies. However some businessmen do not live inside this media-created drama. The possibility that some wealthy entrepreneurs might relate to national government and politics as dependent variables (to be manipulated and managed) is a possibility that may be especially important to explore for G-20 nations since assertive (and, ultimately, poorly regulated) actors in a subset of G-20 countries may collude and act across national boundaries. There is indirect evidence to suggest that growing asymmetries of brainpower and concentrations of wealth are deployed against (penetrated) political systems to induce deregulation and achieve other benefits. Specifically, the world had, from the late 1970s through 2003 (according to IMF data) 117 crises of banking systems in 93 countries in which much or all of the capital of the system was exhausted. In Martin Wolf's assessment of these cases, the banking industries developed strategies of privatizing their gains during the upside of financial bubbles, then secured government bailouts from taxpayers as losses during the crisis phase became large enough to wipe-out remaining bank equity and destroy the economy. In 27 of the earlier crises, taxpayers were stuck with added public debt equal to, or greater than, 10% of GDP, often much more. When similar, highly strategic people continue to win ["privatize the gains"], with a similar *modus operandi,* the better, new forecasting models might be based on the classic dynamics of predator-prey

ecosystems described by the Lotka-Volterra equations.[65] If this theory proves to be correct, and the G-20 nations want to improve economic forecasting, the best question suggested by upgraded social science forecasting could be: "What are *they* [the alpha predators] planning next?" And every chief of state might ask that the best (public) economic forecasting models be accompanied by secret reports and forecasts from his intelligence agencies based on massive penetration of the national and global financial sectors and especially the "shadow" sector.

By contrast with Greenspan, it is interesting to consider the perspective of David Stockman, a former OMB Director for President Reagan who later made a fortune on Wall Street. In Stockman's view, the major players always are trying to outsmart each other - and the same instincts are directed against governments as on the economic playing fields; in his analysis, few governments, including the American government, can play in this new game and win.[66]

C. Finding Unknown Variables and Organizing Rapid Learning Systems

"We are confronted with . . . 'unknown unknowns' . . . "

- Olivier Blanchard [67]

The third planning step will develop methods to find unknown variables and causal relationships and organize rapid learning systems.

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[65] Martin Wolf, Fixing Global Finance (Baltimore, MD: Johns Hopkins University Press, 2008), pp. 32-33. Lloyd S. Etheredge, "Predator-Prey Models: Forecasting a Global Financial System with Asymmetries of Brainpower and Money," Memorandum # 17 for the Fischhoff (NRC) Committee on Behavioral and Social Science Research to Improve Intelligence Analysis for National Security. Online at www.policyscience.net at II. D.

[66] David Stockman, The Great Deformation: The Corruption of Capitalism in America (New York: Public Affairs, 2013).

[67] David Wessel, "Olivier Blanchard's Five Lessons for Economists from the Financial Crisis," Wall Street Journal, April 1, 2013.

The model for Step 3 will be the new rapid learning systems of international biomedical research that use "Everything Included," large N, curated databases partly underwritten at public expense. Until recently, cancers were classified by their site of occurrence (e.g., breast cancer, lung cancer). Now, with "Everything Included" databases (100,000++ variables per patient, and tens of millions of patients and their genetic information and electronic health records being linked in international networks), new machine learning algorithms have established themselves as a disruptive, breakthrough technology. They brilliantly help human researchers to replace old paradigms more quickly than traditional systems of single investigator awards. An investigator is not limited to imagine (ahead of time) the specific hypothesis to be tested and, then, fated to discover unknown variables only by accident.

With this powerful investment in new scientific technology, the biomedical world is changing. It now appears that there may be 10 or more different types of cancer that appear in the breast or the lung (etc.), each with its own complex causal pathway (linked to the genetics of the specific individual). Each type has its own universe of newly emerging treatment possibilities and the exciting future that humanity is facing is a new *precision* medicine also tied to genetic and other unique characteristics of each patient. [68]

Discovering unknown variables and relationships is becoming an automated science. This could be G-20 macroeconomics!

For this third planning group I think that the challenges to develop "Everything Included" research strategies are: What constitutes Everything? (For example, when you include psychology and neuroscience and when the social sciences do not yet have the equivalent of the periodic table and the human genome?) How fast do we want to learn? And what G-20 priorities to recommend? It is an open-ended question, and the powerful machine-learning Big Data, paradigm-busting methods may be sensitive to initial omissions of variables or error rates in

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[68] B. Vogelstein *et al.*, "Cancer Genome Landscapes," Science, March 29, 2013, pp. 1546 - 1558, attached to this proposal.

metrics.

7.) Big Data and Private Sector Partnerships

The seventh planning project will map how the startup of "Everything Included" R&D economic data systems can be linked together in international partnerships with the private sector. A useful initial global project might be data mining and rapid, cumulative learning concerning consumer/household behavior and marketing.[69] Just as 11,000 individual Walmart store managers in 27 countries are currently expected to run three to five experiments each week, so a R&D consortium of interested global corporations could be linked with leading business schools in rapid learning systems.

For example, it might be easy for these partnerships to organize large N, randomized cross-cultural experiments of advertising and marketing for all demographic groups and all nations and cultures.[70] Companies like Mastercard or Google would have incentives to contribute data to an initial R&D data system, since discoveries of how their data can be combined with other data make the business case for why their future data should be purchased to improve economic models and forecasting, worldwide.[71]

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[69] See Liran Einav and Jonathan Levin, "The Data Revolution and Economic Analysis." Unpublished manuscript, May 1, 2013 prepared for the NBER Innovation Policy and the Economy conference.

[70] Concerning steep cost reductions by designing collaborative global rapid learning systems, see Michael S. Lauer and Ralph D'Agostino, "The Randomized Registry Trial - The Next Disruptive Technology in Clinical Practice?" The New England Journal of Medicine, October 24, 2013, pp. 1579 - 1581.

[71] Academic social science might benefit from this project. American social psychologists typically have used their undergraduates as experimental subjects, and there are sparse discussions in standard textbooks about how human beings in other cultures might behave differently than American undergraduates in the late 20th and early 21st centuries. A discovery by American

8.) New Methods

> "How reliable are these tools? . . . They work but they don't work great. People and institutions find ways around them."
>
> - Olivier Blanchard [72]

The third planning group also will consider recommendations for faster and better learning cycles in the US and G-20 nations. For example:

a.) Data collection and analysis should be faster and supplemented by new methods to estimate coefficients. Traditional forecasting uses quarterly time series data and regression equations, but this clearly is too slow and unable to detect changing coefficients in a timely fashion. A new universe of real-time sampling and monitoring will be useful: Walmart has global data on sales, by store and product, online within 24 hours and the global banking system clears most of the transactions of the world economy within several days. Soon, it could be possible to monitor economic behavior and track the effects of economic policies in real time.

b.) To work through, and master, the integrated complexity that economic science must face requires new methods for modeling and display. These are large, living, complex and (sometimes) adaptive systems composed of large, living, complex and (sometimes) adaptive subsystems that may be loosely or tightly coupled or even partly inconsistent with each other. The biomedi-

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Express [informal communication] that social media effects (e.g., knowledge of a friend's purchase) have 3- to 5- times greater impact to influence purchasing decisions of Egyptian teenagers (compared to American teenagers) may stimulate thinking for a wider universe of new and informative discoveries about cross-cultural social psychology.

[72] Wessel, *op. cit.*. Blanchard's five lessons emphasize the need for analytic tools with much more "plumbing" detail: "We do macro on the assumption that we can look at aggregates in some way and then just have them interact in simple models. I still think that's the way to go, but [experience] shows the limits of that approach. When it comes to the financial system, it's very clear that the details of the plumbing matter."

cal world has been evolving new and sophisticated computer simulation models of the human body (beginning at the molecular level) - with extensions to medical practice decisions, public health and government policy - that will be worth evaluating for their applications to macroeconomics and G-20 forecasting.[73]

c.) Cross-walking past economic policy mistakes and forecasting errors in G-20 countries may be useful: A new, meta-learning strategy in biomedical research is to analyze the eventual discovery of lethal side-effects of approved drugs and to calculate how much larger new rapid-learning data systems should become if we want to catch such types of mistakes in the future in three months, or six months, or two years (etc.).[74]

d.) Panel studies are another useful innovation, especially to achieve the "Everything Included" vision for R&D. [Traditionally, economists have correlated independent and dependent variables (defined by accountants or tax laws) and told (without an independent examination of the mechanisms) a rational choice, profit-maximizing story to explain the links. Now, with alternative explanations and pathways, panel studies can, using multiple methods, provide much more information, and in depth, to compare different theories.] Especially with compensation, many people might be willing participants. In addition to formal guarantees of privacy, the panel membership could be limited to several years and, thereby, reduce concerns about broader invasions of privacy. There are multiple groups of actors in economies, and a diverse range of these panels are likely to be recommended by the planning group.

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[73] For example David Eddy's Archimedes Project originally developed for Kaiser Permanente: http://archimedesmodel.com/ . The model and its mathematical methods recently have been acquired for international medical practice, pharmaceutical research, and public health advising by STG, a global venture capital company.

[74] See Larry Norton's overview of the wider rapid learning system for cancer, https://www.ecri.org/Video/2013_TA_Conf/4-Session-1-Norton.mov. See Blanchard (2011) *op. cit.*

e.) Computer-assisted content analysis (discussed in footnote 14) may help to understand public moods and the emotional component of recovery processes.

f.) Empirically-defined variables (rather than accounting-defined variables) might be useful experiments. Greenspan's forecasting ideas place great weight on the (alleged) very high rate of consumption (and low savings) in American households, but most families may view many of their expenditures differently, as investments contributing long-term benefits to their lives and the lives of their children.

g.) To libertarians, except for the contributions of a minimal government (e.g., national defense), most public sector expenditures can be just political shell games and "theft" (transfer payments). Greenspan does not use this term: However a current lack of analysis methods skews his analysis into a story of how the financial sector, securing private savings, plays the leading role in the economy by assembling and allocating funds for the new investments that increase productivity and the possibility of higher standards of living. Yet all sectors (including governments) actually make investments. The broader measurement challenge for forecasting equations is to measure what investments are good investments, not who makes them. Whether society is "investing enough" cannot be calculated, as Greenspan does, by the percentage of the average household income that is saved: the public sector investments (paid through taxes or deficits) also must be measured and evaluated.

h.) Weighted scenarios and game-theoretic methods (even war games) may be useful to forecast the emerging national and global financial systems with asymmetries of wealth and brainpower. In testimony to draft laws and regulations, some economists already systematically analyze loopholes and vulnerabilities and forecast how these will be exploited.[75]

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[75] Charles Calomoris and Alan Meltzer, "How Dodd-Frank Doubles-Down on 'Too Big to Fail,'" Wall Street Journal, February 12, 2014. See also Sheila Blair's answer to the questions: "Can regulators ever be as nimble as the regulatees?" and "Given the cat and mouse game between regulators and regulatees, do we have to live with regulatory uncertainty?" In her "Everything the IMF Wanted to Know About Monetary Regulation and Wasn't Afraid to Ask"

9.) Rapid Learning Systems

> "With a century and half of clear, detailed information on crisis after crisis, the burning question is not How did this happen? but How did we ignore that long history, and think that we had solved the problems with the business cycle?"
>
> - Joseph Stiglitz [76]

An evolving design of a global rapid learning system for macroeconomics needs a self-reflective theory of itself - and metrics. The practical realities of the system, and the speed of its learning cycles in the G-20 (and beyond), will depend upon the evolving design of a complex (sometimes) adaptive system composed of complex (sometimes adaptive) subsystems. Once, the focus of philosophers was to discover how a single individual could become wise: Today, we recognize wider problems, especially in democratic systems: How, in Stiglitz's terms (in the quotation above) do we get *other* people (and systems) to listen and to remember?[77]

Creating a rapid learning system also will depend upon recognizing that it is in the self-interest of each G-20 nation, in a world of globalizing economies, that other nations (and private sector decision makers) adopt realistic and evidence-based policies and that everybody prospers. Upon a news media that support the system. And upon funding, honesty and reliability, and institutional homes, and much else. What are the variables to measure, the theories to test, who are the allies, where is the funding, what are the disruptive technologies to deploy?

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online at http://www.imf.org/external/np/seminars/eng/2013/macro2/pdf/sb.pdf

[76] Joseph Stiglitz, "The Lessons of the North Atlantic Crisis for Economic Theory and Policy," http://blog-imfdirect.imf.org/2013/05/03/the-lessons-of-the-north-atlantic-crisis-for-economic-theory-and-policy/

[77] See also Etheredge, "Wisdom . . ." *op. cit.*; Ascher, *op cit.*

II. Work Plan – May 1, 2014 – June 30, 2017

The project will organize an Advisory Committee to develop initial plans. Next, it will complete three steps in three years (each step taking about a year, with three areas of focus). Each step will have a planning group (N=12-14 members, with a degree of overlap) and will produce a Report.

Each planning group will produce a report (i.e., the grant will deliver three Reports) to the sponsors with recommendations of variables and metrics to produce a state-of-the-art international rapid learning system for macroeconomics. Each of the three Reports will address: 1.) Recommended variables and metrics that are on the shelf and that can be deployed immediately; 2.) Recommended metrics that can become available soon, with additional work; 3.) Important areas where further R&D is needed before metrics can be recommended.[78]

The budget supports a full time Principal Investigator with part-time assistance and expenses. Expenses include honoraria and travel for Advisory Committee and planning group members, initial discussions between the PI and each working group member, and a 1 ½ day meeting of each planning group.

The Advisory Committee (five members) will be the joint responsibility of the PI and [the home institution for the project]. The project is envisioned as part of a long term research program at [the home institution] devoted to achieving a rapid learning (international) system for macroeconomics. [The home institution] may seek additional funds for Fellowships, research to analyze new data, and additional, concurrent conferences and lecture series.

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[78] This initial project will focus on macroeconomics of the G-20 system. Additional data systems and better forecasting equations may benefit all countries.

III. Budget and Budget Narrative (to be added)

IV. Attachments

Bert Vogelstein *et al.*, "Cancer Genome Landscapes," Science, March 29, 2013, pp. 1546 - 1558.

Lloyd S. Etheredge, The Case of the Unreturned Cafeteria Trays (Washington, DC: American Political Science Association, 1976).

Lloyd S. Etheredge, Brief Biography and *Curriculum Vitae.*

A Capitalist's Dilemma, Whoever Wins on Tuesday

By CLAYTON M. CHRISTENSEN NOV. 3, 2012

WHATEVER happens on Election Day, Americans will keep asking the same question: When will this economy get better?

In many ways, the answer won't depend on who wins on Tuesday. Anyone who says otherwise is overstating the power of the American president. But if the president doesn't have the power to fix things, who does?

It's not the Federal Reserve. The Fed has been injecting more and more capital into the economy because — at least in theory — capital fuels capitalism. And yet cash hoards in the billions are sitting unused on the pristine balance sheets of Fortune 500 corporations. Billions in capital is also sitting inert and uninvested at private equity funds.

Capitalists seem almost uninterested in capitalism, even as entrepreneurs eager to start companies find that they can't get financing. Businesses and investors sound like the Ancient Mariner, who complained of "Water, water everywhere — nor any drop to drink."

It's a paradox, and at its nexus is what I'll call the Doctrine of New Finance, which is taught with increasingly religious zeal by economists, and at times even by business professors like me who have failed to challenge it. This doctrine embraces measures of profitability that guide capitalists away from investments that can create real economic growth.

Executives and investors might finance three types of innovations with their capital. I'll call the first type "empowering" innovations. These transform complicated and costly products available to a few into simpler, cheaper products available to the many.

The Ford Model T was an empowering innovation, as was the Sony transistor radio. So were the personal computers of I.B.M. and Compaq and online trading at Schwab. A more recent example is cloud computing. It transformed information technology that was previously accessible only to big companies into something that even small companies could afford.

Empowering innovations create jobs, because they require more and more people who can build, distribute, sell and service these products. Empowering

investments also use capital — to expand capacity and to finance receivables and inventory.

The second type are “sustaining” innovations. These replace old products with new models. For example, the Toyota Prius hybrid is a marvelous product. But it’s not as if every time Toyota sells a Prius, the same customer also buys a Camry. There is a zero-sum aspect to sustaining innovations: They replace yesterday’s products with today’s products and create few jobs. They keep our economy vibrant — and, in dollars, they account for the most innovation. But they have a neutral effect on economic activity and on capital.

The third type are “efficiency” innovations. These reduce the cost of making and distributing existing products and services. Examples are minimills in steel and Geico in online insurance underwriting. Taken together in an industry, such innovations almost always reduce the net number of jobs, because they streamline processes. But they also preserve many of the remaining jobs — because without them entire companies and industries would disappear in competition against companies abroad that have innovated more efficiently.

Efficiency innovations also emancipate capital. Without them, much of an economy’s capital is held captive on balance sheets, with no way to redeploy it as fuel for new, empowering innovations. For example, Toyota’s just-in-time production system is an efficiency innovation, letting manufacturers operate with much less capital invested in inventory.

INDUSTRIES typically transition through these three types of innovations. By illustration, the early mainframe computers were so expensive and complicated that only big companies could own and use them. But personal computers were simple and affordable, empowering many more people.

Companies like I.B.M. and Hewlett-Packard had to hire hundreds of thousands of people to make and sell PC’s. These companies then designed and made better computers — sustaining innovations — that inspired us to keep buying newer and better products. Finally, companies like Dell made the industry much more efficient. This reduced net employment within the industry, but freed capital that had been used in the supply chain.

Ideally, the three innovations operate in a recurring circle. Empowering innovations are essential for growth because they create new consumption. As long as empowering innovations create more jobs than efficiency innovations eliminate, and as long as the capital that efficiency innovations liberate is invested back into empowering innovations, we keep recessions at bay. The dials on these three innovations are sensitive. But when they are set correctly, the economy is a magnificent machine.

For significant periods in the last 150 years, America’s economy has operated this way. In the seven recoveries from recession between 1948 and 1981, according to the McKinsey Global Institute, the economy returned to its prerecession employment peak in about six months, like clockwork — as if a spray of economic WD-40 had reset the balance on the three types of innovation, prompting a recovery.

Clayton Christensen, author of “The Innovator’s Dilemma,” says the winner of the presidential election must face “the capitalist’s dilemma." Victo Ngai

In the last three recoveries, however, America’s economic engine has emitted sounds we’d never heard before. The 1990 recovery took 15 months, not the typical six, to reach the prerecession peaks of economic performance. After the 2001 recession, it took 39 months to get out of the valley. And now our machine has been grinding for 60 months, trying to hit its prerecession levels — and it’s not clear whether, when or how we’re going to get there. The economic machine is out of balance and losing its horsepower. But why?

The answer is that efficiency innovations are liberating capital, and in the United States this capital is being reinvested into still more efficiency innovations. In contrast, America is generating many fewer empowering innovations than in the past. We need to reset the balance between empowering and efficiency innovations.

The Doctrine of New Finance helped create this situation. The Republican intellectual George F. Gilder taught us that we should husband resources that are scarce and costly, but can waste resources that are abundant and cheap. When the doctrine emerged in stages between the 1930s and the ‘50s, capital was relatively scarce in our economy. So we taught our students how to magnify every dollar put into a company, to get the most revenue and profit per dollar of capital deployed. To measure the efficiency of doing this, we redefined profit not as dollars, yen or renminbi, but as ratios like RONA (return on net assets),

ROCE (return on capital employed) and I.R.R. (internal rate of return).

Before these new measures, executives and investors used crude concepts like "tons of cash" to describe profitability. The new measures are fractions and give executives more options: They can innovate to add to the numerator of the RONA ratio, but they can also drive down the denominator by driving assets off the balance sheet — through outsourcing. Both routes drive up RONA and ROCE.

Similarly, I.R.R. gives investors more options. It goes up when the time horizon is short. So instead of investing in empowering innovations that pay off in five to eight years, investors can find higher internal rates of return by investing exclusively in quick wins in sustaining and efficiency innovations.

In a way, this mirrors the microeconomic paradox explored in my book "The Innovator's Dilemma," which shows how successful companies can fail by making the "right" decisions in the wrong situations. America today is in a macroeconomic paradox that we might call the capitalist's dilemma. Executives, investors and analysts are doing what is right, from their perspective and according to what they've been taught. Those doctrines were appropriate to the circumstances when first articulated — when capital was scarce.

But we've never taught our apprentices that when capital is abundant and certain new skills are scarce, the same rules are the wrong rules. Continuing to measure the efficiency of capital prevents investment in empowering innovations that would create the new growth we need because it would drive down their RONA, ROCE and I.R.R.

It's as if our leaders in Washington, all highly credentialed, are standing on a beach holding their fire hoses full open, pouring more capital into an ocean of capital. We are trying to solve the wrong problem.

Our approach to higher education is exacerbating our problems. Efficiency innovations often add workers with yesterday's skills to the ranks of the unemployed. Empowering innovations, in turn, often change the nature of jobs — creating jobs that can't be filled.

Today, the educational skills necessary to start companies that focus on empowering innovations are scarce. Yet our leaders are wasting education by shoveling out billions in Pell Grants and subsidized loans to students who graduate with skills and majors that employers cannot use.

Is there a solution? It's complicated, but I offer three ideas to seed a productive discussion:

CHANGE THE METRICS We can use capital with abandon now, because it's abundant and cheap. But we can no longer waste education, subsidizing it in fields that offer few jobs. Optimizing return on capital will generate less growth than optimizing return on education.

CHANGE CAPITAL-GAINS TAX RATES Today, tax rates on personal income are progressive — they climb as we make more money. In contrast,

there are only two tax rates on investment income. Income from investments that we hold for less than a year is taxed like personal income. But if we hold an investment for one day longer than 365, it is generally taxed at no more than 15 percent.

We should instead make capital gains regressive over time, based upon how long the capital is invested in a company. Taxes on short-term investments should continue to be taxed at personal income rates. But the rate should be reduced the longer the investment is held — so that, for example, tax rates on investments held for five years might be zero — and rates on investments held for eight years might be negative.

Federal tax receipts from capital gains comprise only a tiny percentage of all United States tax revenue. So the near-term impact on the budget will be minimal. But over the longer term, this policy change should have a positive impact on the federal deficit, from taxes paid by companies and their employees that make empowering innovations.

CHANGE THE POLITICS The major political parties are both wrong when it comes to taxing and distributing to the middle class the capital of the wealthiest 1 percent. It's true that some of the richest Americans have been making money with money — investing in efficiency innovations rather than investing to create jobs. They are doing what their professors taught them to do, but times have changed.

If the I.R.S. taxes their wealth away and distributes it to everyone else, it still won't help the economy. Without empowering products and services in our economy, most of this redistribution will be spent buying sustaining innovations — replacing consumption with consumption. We must give the wealthiest an incentive to invest for the long term. This can create growth.

Granted, mine is a simple model, and we face complicated problems. But I hope it helps us and our leaders understand that policies that were once right are now wrong, and that counterintuitive measures might actually work to turn our economy around.

November 19, 2015

To: Interested Colleagues

From: Lloyd Etheredge [1]

Re: **The Optimistic Case for Rapid Learning Economics**

This memorandum outlines, from three perspectives, an optimistic scientific case that a rapid learning system for macroeconomics is possible. Such an achievement, by using the best scientific methods, is likely to provide a better future for billions of people. The three perspectives are: 1.) The existence of "upgrade" variables, widely acknowledged by the profession; 2.) The existence of competing theories that will produce scientific learning about important challenges as new data systems allow them to be tested; 3.) The existence of improved scientific methods for data analysis and fast machine-assisted learning, developed by NIH and the biomedical sciences, that can yield rapid discoveries for US and other G-20 economies.

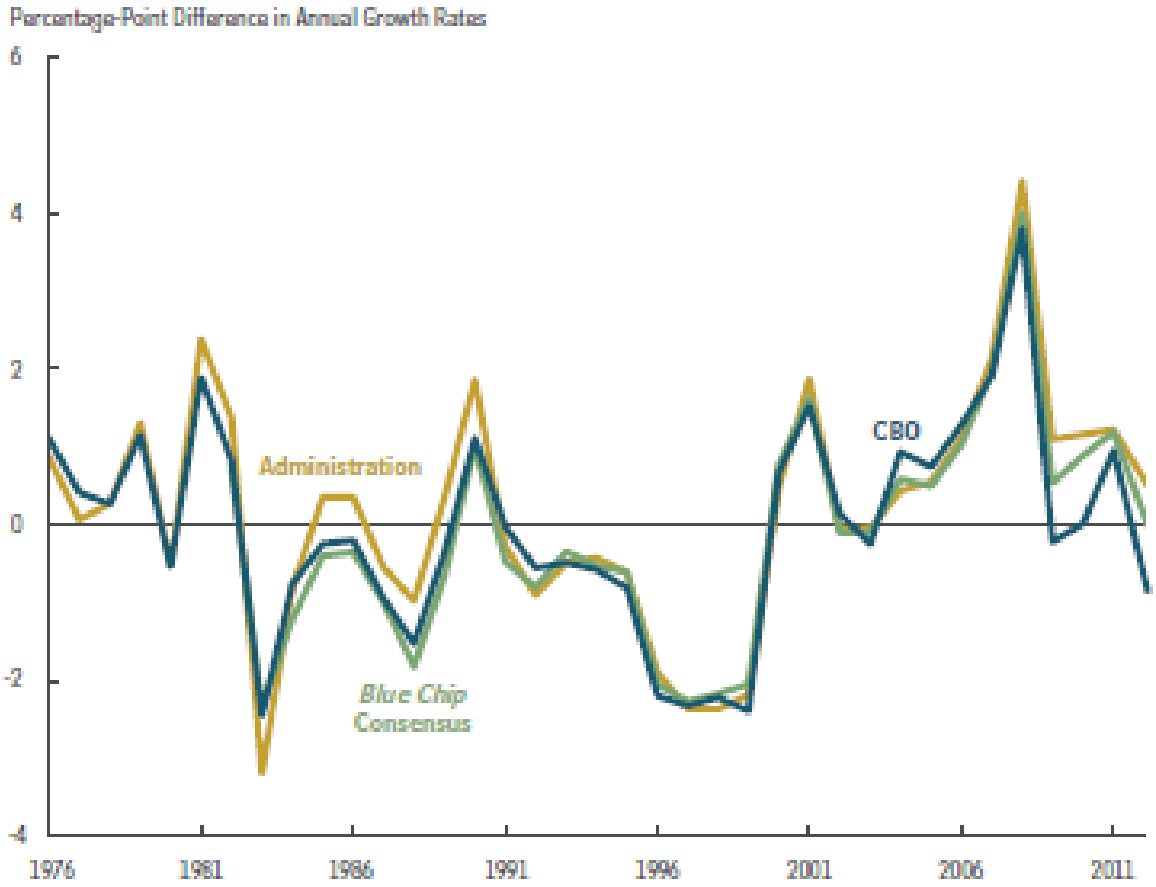
I. Missing "upgrade" variables acknowledged by professionals

The following graph compares the two-year GDP forecasting errors of the Congressional Budget Office, Administration, and about 50 private sector "Blue Chip" models since 1976.[2] They closely track one another. This is a highly competitive business. Almost everybody uses the same government data, traditional

[1] Director, Government Learning Project, Policy Sciences Center, Inc., a public foundation. URL: URL: www.policyscience.net; lloyd.etheredge@policyscience.net; 301-365-5241.

[2] Congressional Budget Office, CBO's Economic Forecasting Record: 2015 Update (Washington, DC: Congressional Budget Office, February 2015). Online. Comparing Federal Reserve two-year forecasts produces similar results.

Table 1



Forecast Minus Actual Growth in Inflation-Adjusted Output: Two-Year Forecasts

Source: Congressional Budget Office, CBO's Economic Forecasting Record, 2015 Update, (Washington, DC: Congressional Budget Office, February 2015), p. 16. The Blue Chip Consensus is based on about 50 private forecasting models.

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conceptual frameworks, and linear regression analysis of quarterly time series data. We should not wait for further progress from the current data system. [3]

[3] The average (root mean square) forecasting error of 1.8, compared to an actual growth rate that might be 3.0, is large for scientific models in most fields, perhaps another reason to be optimistic.

There is professional agreement that there are several types of missing variables:

1.) The "mystery" variables that cause recessions/collapses and recoveries are missing: as CBO reports, forecasting equations miss "turning points";[4]

2.) By design, the predictable nonrational psychological mechanisms and societal forces (discovered by the other social sciences) that might affect economic behavior are missing. [Macroeconomic forecasting uses aggregate variables defined by accountants and the tax code; the coefficients are (without independent verification) *interpreted* as rational choices, although they might be compounds of several individual cognitive processes and emotions or organizational or cultural characteristics;

3.) New structural or systemic changes in the world – e.g., information age technologies and technologies (plus other factors) that change oil prices, sociological/cultural changes, and a globalizing economy - are missing. The analysis of standard quarterly time series data, with coefficients averaged across history, slows learning, limits reliability, and this also (as we will see below, in Larry Summers's argument) might be dangerous.

Other recognized limitations and upgrade opportunities might be discussed. However, for current purposes, this inventory makes the point: The message is

[4] *Op cit.*, pp. 7-11.

optimistic. Although nobody can know the results of new scientific research in advance, there already is broad professional agreement about several types of plausible variables for a To Do list and scientific upgrade.

II. Competing Theories and Policy Disagreements to Establish Initial Priorities

The second perspective that gives optimism for rapid learning is that there already are well-structured disagreements, with policy relevant implications, that can be tested quickly to improve economic science in the US and other G-20 nations. For example, here are five controversies:

A. "The Global Economy is in Serious Danger."

The attached Op Ed piece (last month) by former Harvard President and former Treasury Secretary Larry Summers, "The Global Economy is in Serious Danger," argues that there have been fundamental global changes.[5] The coefficients have changed and there are new variables. Thus, it is dangerous to use conventional economic models and rely upon current economic science. The global economic recovery (that already has taken twice as long as estimated by conventional equations) will take much longer and the future could be surprisingly worse than we expect. [This argument requires that missing variables be identified, coefficients re-estimated, and deeper causes of changed coefficients (if they are found) be understood – and much sooner than the analysis of historical time series can achieve].

[5] Larry Summers, "The Global Economy is in Serious Danger," Washington Post, October 7, 2015.

B.) Economic science doesn't need further learning. Governments only need to listen to economists.

The attached Op Ed piece (earlier this month) by Nobelist Paul Krugman, "Austerity's Grim Legacy," argues that there are no missing variables of consequence.[6] Economic recovery has been delayed, in the US and abroad, simply because governments stopped listening to the equations and sound policy advice.

This is a challenging counter-factual argument. A task for Krugman's thesis is to explain apparently unreliable equations that scared people. G-20 governments listened when the crisis began but, after initial success, the fiscal stimulus policies also faltered in their prediction of recovery. Economic forecasters had no reliable estimates of how much time and money would be required to achieve the turning point. If we should renew the large fiscal stimulus solutions, can there be rapid learning to address the risk of new failure + massive national debts without achieving healthy growth?

C.) Linear equation models are giving the wrong result.

"How reliable are these tools? They work, but they don't work great. People and institutions find ways around them." - Olivier Blanchard [7]

The International Monetary Fund's former Chief Economist, Olivier Blanchard, implies that global economic science can become more realistic by upgrading from physics-like linear regression forecasting models to game-theoretic models.

[6] The New York Times, November 6, 2015. Online.

[7] Cited in Lloyd S. Etheredge, "A Rapid Learning System for G-20 Macroeconomics: From Greenspan to Shiller and Big Data." Unpublished, online at www.policyscience.net at I. A., p. 29.

Today, smarter people, with growing asymmetries of brainpower and funds for lobbying, can outsmart many national governments. The force of his argument is backed by IMF data (not widely known to the public) that the world, from the late 1970s to 2003, had 117 banking crises in 93 countries in which much or all of the banking capital was exhausted. Many financial institutions developed strategies for privatizing the gains (during the upside of the bubbles) then secured government bailouts during the crisis phase. In 27 of the cases, they dumped onto governments and taxpayers added national debt equal to 10% of GDP, often much more.[8] This is not Tulipmania anymore. The problems are not "irrational exuberance" of mass investors but brilliant strategies by alpha predators who can penetrate political systems and shape policy, a phenomenon hidden by missing variables and averaged-coefficient equations.

The better prediction equations of the new domestic and global reality may be the Lotka-Volterra predator-prey equations.

D.) <u>The Ayn Rand novel model of life and the economy has valuable insights</u>.

Former Federal Reserve Chairman Alan Greenspan has challenged the academic members of his profession to improve their forecasting by including a priority list of psychological and cultural variables.[9] Specifically: although Greenspan has mastered the data and ideas in economic forecasting models he also believes that all of us (and the economy) live inside an Ayn Rand novel, a drama in rela-

[8] Etheredge, *Op. cit.*, p. 25. Drawn from a discussion by Martin Wolf.
[9] <u>The Map and the Territory</u> (NY: Penguin Press, 2013).

tionship to government and other institutions. The list of variables should recognize basic psychological truths about life, taking responsibility, the work ethic, relations to government (and all authority) and the goal of healthy self-starting, motivated individuals. His views are similar to Governor Romney's psychological diagnosis of 47% of Americans and to the psychological counseling of Reaganomics and Margaret Thatcher, and to the defining economic/psychological truths believed by Paul Ryan, the new Republican Speaker of the House of Representatives. [These views – the "Ayn Rand novel" model – have been acknowledged as a coherent and serious model, held by intellectual leaders of Republicans in Congress, by Paul Krugman (although he thinks that they are dangerous fools).]

It is sometimes alleged that people like Greenspan or Paul Ryan are ideologues who "ignore data." Although the Krugman's of the world may eventually prove them wrong, this is partly unfair. Sometimes, their data comes from personal experience and truths that shape their identity. And, while it may have been an historical artifact, econometric modeling evolved from a conventional national accounting system of variables that excluded their ideas from the databases and any Honest Broker estimates from the forecasting models.[10] [11]

[10] Lloyd S. Etheredge, "President Reagan's Counseling," Political Psychology (1984), online at www.policyscience.net.

[11] Civic optimism also might be possible. Rapid learning about these Republican-model missing variables, with Honest Broker testing, might shift votes, at the margin, to produce creative legislative compromise and improve agreement in Washington. The simple step of including a consumer "mandate" for individual responsibility to buy health insurance – a provision derived from Governor Romney's compromise health plan In Massachusetts – preserved an essential element of moral and civic health (in the Republican model) and achieved passage of Obamacare.

E.) Breakdowns of Moral Credibility and Trust in Major Institutions

I also derive optimism because there are new theories (that I have suggested) to explain why policies derived from conventional equations (e.g., low interest rates and fiscal stimulus) misdiagnosed the current breakdowns and do not restore confidence reliably. The current crisis was a sudden and frightening breakdown of trustworthiness and moral credibility by major institutions - governments, political systems, and financial institutions. Confidence in the future cannot be restored by traditional remedies alone because these major institutions have not restored confidence in themselves.[12] If true, science-based learning can help to invent better options.

III.) New Rapid Learning Technology

A third perspective also gives optimism about the possibility of a rapid learning system for economics, which might swiftly benefit economic recovery and the future well-being of billions of people.

Specifically: We have new supercomputer-assisted learning technologies that can be applied to Everything Included databases and produce unexpected discoveries quickly. NIH has shown the new rapid learning systems to be stunningly successful and that they can be routinely applied even to 100,000+ variables/case

[12] Lloyd Etheredge, "'Animal Spirits' and Economic Recovery: Reading the Lessons Correctly," online at www.policyscience.net at I. A. See also Robert Shiller: "I suspect that there is a real, if still unsubstantiated, link between widespread anxieties and the strange dynamics of the economic world we live in today" in his "Anxiety and Interest Rates: How Uncertainty is Weighing on Us," The New York Times, February 7, 2015. Online.

and tens of millions of cases: for many centuries cancers were classified by the site of occurrence – now we know, from genetic markers, that there might be ten types of cancer that occur in the breast, each with its own causal pathway and possibility of new, precision treatment. The cost of genetic analysis has dropped more than a million-fold.[13] Last week, similar initial discoveries of three types of Type II diabetes were announced.[14] And we are just at the beginning of the new rapid learning system.'

The new NIH computer and Big Data strategy also has invented a faster global discovery system. For example, initial discovery thresholds can be set at 0.70 confidence (rather than 0.95) and the results "published" to computer memory for fast further analysis with new samples and without delays for academic publication. Supercomputing analysis for discovery can operate 24x7 at almost the speed of thought, rather than the speed of an NIH or NSF grant process.

The Nobelist Robert Shiller (although without invoking supercomputers, machine-assisted discovery, and Big Data) has recommended this kind of strategy: an inclusive conceptual and data framework that builds economic theory and reliable economic policy on a foundation of how people actually behave. (I am in Shiller's

[13] 'David Reshef et al, "Detecting Novel Associations in Large Sets of Data," Science, 334, (December 16, 2011), pp. 1518-1524; Vogelstein et al., "Cancer Genome Landscapes," Science, 339, (March 29, 2013), pp. 1546-1558.

[14] Francis Collins, "Big Data Study Reveals Possible Subtypes of Type II Diabetes" NIH Director's blog, posted online November 10, 2015.

camp)[15] . . . There are no guarantees, but the possibility of rapid learning economics is more optimistic than if these technologies did not exist.

Attachments

- Larry Summers, "The Global Economy is in Serious Danger," Washington Post, October 7, 2015.

- Paul Krugman, "Austerity's Grim Legacy," The New York Times, November 6, 2015.

- Lloyd S. Etheredge, "President Reagan's Counseling," Political Psychology, 5:4 (1984), pp. 737-740.

- Francis Collins, "Big Data Study Reveals Possible Subtypes of Type II Diabetes" NIH Director's blog, posted online November 10, 2015.

[15] Etheredge, "A Rapid Learning System . . ." *op. cit.*; NIH's Everything Included /machine-assisted learning strategy also allows an empirical redefining of all variables and classifications.

The global economy is in serious danger

By Lawrence Summers October 7, 2015. The Washington Post.

As the world's financial policymakers convene for their annual meeting Friday in Peru, the dangers facing the global economy are more severe than at any time since the Lehman Brothers bankruptcy in 2008. The problem of secular stagnation — the inability of the industrial world to grow at satisfactory rates even with very loose monetary policies — is growing worse in the wake of problems in most big emerging markets, starting with China.

This raises the specter of a global vicious cycle in which slow growth in industrial countries hurts emerging markets, thereby slowing Western growth further. Industrialized economies that are barely running above stall speed can ill afford a negative global shock.

Policymakers badly underestimate the risks of both a return to recession in the West and of a period where global growth is unacceptably slow, a global growth recession. If a recession were to occur, monetary policymakers would lack the tools to respond. There is essentially no room left for easing in the industrial world. Interest rates are expected to remain very low almost permanently in Japan and Europe and to rise only very slowly in the United States. Today's challenges call for a clear global commitment to the acceleration of growth as the main goal of macroeconomic policy. Action cannot be confined to monetary policy.

There is an old proverb: "You do not want to know the things you can get used to." It is all too applicable to the global economy in recent years. While the talk has been of recovery and putting the economic crisis behind us, gross domestic product

forecasts have been revised sharply downward almost everywhere. Relative to its 2012 forecasts, the International Monetary Fund has reduced its forecasts for U.S. GDP in 2020 by 6 percent, for Europe by 3 percent, for China by 14 percent, for emerging markets by 10 percent and for the world as a whole by 6 percent. These dismal figures assume there will be no recessions in the industrial world and an absence of systemic crises in the developing world. Neither can be taken for granted.

We are in a new macroeconomic epoch where the risk of deflation is higher than that of inflation, and we cannot rely on the self-restoring features of market economies. The effects of hysteresis — where recessions are not just costly but also stunt the growth of future output — appear far stronger than anyone imagined a few years ago. Western bond markets are sending a strong signal that there is too little, rather than too much, outstanding government debt. As always when things go badly, there is a great debate between those who believe in staying the course and those who urge a serious correction. I am convinced of the urgent need for substantial changes in the world's economic strategy.

History tells us that markets are inefficient and often wrong in their judgments about economic fundamentals. It also teaches us that policymakers who ignore adverse market signals because they are inconsistent with their preconceptions risk serious error. This is one of the most important lessons of the onset of the financial crisis in 2008.Had policymakers heeded the pricing signal on the U.S. housing market from mortgage securities, or on the health of the financial system from bank stock prices, they would have reacted far more quickly to the gathering storm. There is also a lesson from Europe. Policymakers who dismissed market signals that Greek debt would not be repaid in full delayed necessary adjustments — at great cost.

Lessons from the bond market

It is instructive to consider what government bond markets in the industrialized world are implying today. These are the most liquid financial markets in the world and reflect the judgments of a large group of highly informed traders. Two conclusions stand out.

First, the risks tilt heavily toward inflation rates below official targets. Nowhere in the industrial world is there an expectation that central banks will hit their 2 percent targets in the foreseeable future. Inflation expectations are highest in the United States — and even here the market expects inflation of barely 1.5 percent for the five-year period starting in 2020. This is despite the fact that the market believes that monetary policy will remain much looser than the Fed expects, as the Fed funds futures market predicts a rate around 1 percent at the end of 2017 compared with the Fed's most recent median forecast of 2.6 percent. If the market believed the Fed on monetary policy, it would expect even less inflation and a real risk of deflation.

Second, the prevailing expectation is of extraordinarily low real interest rates, which is the difference between interest rates and inflation. Real rates have been on a downward trend for nearly a quarter-century, and the average real rate in the industrialized world over the next 10 years is expected to be zero. Even this presumably reflects some probability that it will be artificially increased by nominal rates at a zero bound — the fact that central banks cannot reduce short-term interest rates below zero — and deflation. In the presence of such low real rates, there can be little chance that economies would overheat.

Many will argue that bond yields are artificially depressed by quantitative easing (QE) and so it is wrong to use them to draw inferences about future inflation and real rates. This possibility cannot be ruled out. But it is noteworthy that bond yields are now lower in the United States than their average during the period of quantitative easing and that forecasters have been confidently — but wrongly — expecting them to rise for years.

The strongest explanation for this combination of slow growth, expected low inflation and zero real rates is the secular stagnation hypothesis. It holds that a combination of higher saving propensities, lower investment propensities and increased risk aversion have operated to depress the real interest rates that go with full employment to the point where the zero lower bound on nominal rates is constraining.

There are four contributing factors that lead to much lower normal real rates:

●First, **increases in inequality — the share of income going to capital and corporate retained earnings — raise the propensity to save.**

●Second, an expectation that growth will slow due to a smaller labor force growth and slower **productivity growth reduces investment and boosts the incentives to save.**

●Third, increased friction in financial intermediation caused by more extensive regulation and increased **uncertainty discourages investment**.

●Fourth, reductions in the price of capital goods and in the quantity of physical capital needed to operate a business — think of Facebook having more than five times the market value of General Motors.

Emerging markets

Until recently, a major bright spot has been the strength of emerging markets. They have been substantial recipients of capital from developed countries that could not be invested productively at home. The result has been higher interest rates than would otherwise obtain, greater export demand for industrial countries' products and more competitive exchange rates for developed economies. Gross flows of capital from industrial countries to developing countries rose from $240 billion in 2002 to $1.1 trillion in 2014. Of particular relevance for the discussion of interest rates is that foreign currency borrowing by the nonfinancial sector of developing countries rose from $1.7 trillion in 2008 to $4.3 trillion in 2015.

has now gone into reverse. According to the Institute of International Finance, developing country capital flows fell sharply this year — marking the first such decline in almost 30 years, as the amount of private capital leaving developing countries eclipsed $1 trillion.

What does this mean for the world's policymakers gathering in Lima? This is no time for complacency. The idea that slow growth is only a temporary consequence of the 2008 financial crisis is absurd. The latest data suggest growth is slowing in the United States, and it is already slow in Europe and Japan. A global economy near stall speed is one where the primary danger is recession. The most successful macroeconomic policy action of the past few years was European Central Bank President Mario Draghi's famous vow that the ECB would do "whatever it takes" to preserve the euro, uttered at a moment when the single currency appeared to be on the brink. By making an unconditional commitment to providing liquidity and supporting growth, Draghi prevented an incipient panic and helped lift European growth rates — albeit not by enough.

Any discussion has to start with China, which poured more concrete between 2010 and 2013 than the United States did in the entire 20th century. A reading of the recent history of investment-driven economies — whether in Japan before the oil shock of the 1970s and 1980s or the Asian Tigers in the late 1990s — tells us that growth does not fall off gently.

China faces many other challenges, ranging from the most rapid population aging in the history of the planet to a slowdown in rural-to-urban migration. It also faces issues of political legitimacy and how to cope with hangovers of unproductive investment. Even taking an optimistic view — where China shifts smoothly to a consumption-led growth model led by services — its production mix will be much lighter. The days when it could sustain global commodity markets are over.

The problems are hardly confined to China. Russia struggles with low oil prices, a breakdown in the rule of law and harsh sanctions. Brazil has been hit by the decline in commodity prices but even more by political dysfunction. India is a rare exception. But from Central Europe to Mexico to Turkey to Southeast Asia, the combination of industrial growth declines and dysfunctional politics is slowing growth, discouraging capital inflows and encouraging capital outflows.

No time for complacency

What is needed now is something equivalent but on a global scale — a signal that the authorities recognize that secular stagnation, and its spread to the world, is the dominant risk we face. After last Friday's dismal U.S. jobs report, the Fed must recognize what should already have been clear: that the risks to the U.S. economy are two-sided. Rates will be increased only if there are clear and direct signs of inflation or of financial euphoria breaking out. The Fed must also state its

readiness to help prevent global financial fragility from leading to a global recession.

The central banks of Europe and Japan need to be clear that their biggest risk is a further slowdown. They must indicate a willingness to be creative in the use of the tools at their disposal. With bond yields well below 1 percent, it is doubtful that traditional quantitative easing will have much stimulative effect. They must be prepared to consider support for assets such as corporate securities that carry risk premiums that can be meaningfully reduced and even to recognize that by absorbing bonds used to finance fiscal expansion they can achieve more.

Long-term low interest rates radically alter how we should think about fiscal policy. Just as homeowners can afford larger mortgages when rates are low, government can also sustain higher deficits. If a debt-to-GDP ratio of 60 percent was appropriate when governments faced real borrowing costs of 5 percent, then a far higher figure is surely appropriate today when real borrowing costs are negative.

The case for more expansionary fiscal policy is especially strong when it is spent on investment or maintenance. Wherever countries print their own currency and interest rates are constrained by the zero bound, there is a compelling case for fiscal expansion until demand accelerates to the point where interest rates can be raised. While the problem before 2008 was too much lending, many more of today's problems have to do with too little lending for productive investment.

Inevitably, there will be discussion of the need for structural reform at the Lima meetings — there always is. But to emphasize this now would be to embrace the macroeconomic status quo. The world's largest markets are telling us with ever-

increasing force that we are in a different world than we have been accustomed to. Traditional approaches of focusing on sound government finance, increased supply potential and avoidance of inflation court disaster. Moreover, the world's principal tool for dealing with contraction — monetary policy — is largely played out and will be less effective if contraction comes. It follows that policies aimed at lifting global demand are imperative.

If I am wrong about expansionary fiscal policy and such measures are pursued, the risks are that inflation will accelerate too rapidly, economies will overheat and too much capital will flow to developing countries. These outcomes seem remote. But if they materialize, standard approaches can be used to combat them.

If I am right and policy proceeds along the current path, the risk is that the global economy will fall into a trap not unlike the one Japan has been in for 25 years, where growth stagnates but little can be done to fix it. It is an irony of today's secular stagnation that what is conventionally regarded as imprudent offers the only prudent way forward.

Austerity's Grim Legacy

NOV. 6, 2015. by Paul Krugman, The New York Times

When economic crisis struck in 2008, policy makers by and large did the right thing. The Federal Reserve and other central banks realized that supporting the financial system took priority over conventional notions of monetary prudence. The Obama administration and its counterparts realized that in a slumping economy budget deficits were helpful, not harmful. And the money-printing and borrowing worked: A repeat of the Great Depression, which seemed all too possible at the time, was avoided.

Then it all went wrong. And the consequences of the wrong turn we took look worse now than the harshest critics of conventional wisdom ever imagined.

For those who don't remember (it's hard to believe how long this has gone on): In 2010, more or less suddenly, the policy elite on both sides of the Atlantic decided to stop worrying about unemployment and start worrying about budget deficits instead.

This shift wasn't driven by evidence or careful analysis. In fact, it was very much at odds with basic economics. Yet ominous talk about the dangers of deficits became something everyone said because everyone else was saying it, and dissenters were no longer considered respectable — which is why I began describing those parroting the orthodoxy of the moment as Very Serious People.

Some of us tried in vain to point out that deficit fetishism was both wrongheaded and destructive, that there was no good evidence that government debt was a problem for major economies, while there was plenty of evidence that cutting spending in a depressed economy would deepen the depression.

And we were vindicated by events. More than four and a half years have passed since Alan Simpson and Erskine Bowles warned of a fiscal crisis within two years; U.S. borrowing costs remain at historic lows. Meanwhile, the austerity policies that were put into place in 2010 and after had exactly the depressing effects textbook economics predicted; the confidence fairy never did put in an appearance.

Yet there's growing evidence that we critics actually underestimated just how destructive the turn to austerity would be. Specifically, it now looks as if austerity policies didn't just impose short-term losses of jobs and output, but they also crippled long-run growth.

The idea that policies that depress the economy in the short run also inflict lasting damage is generally referred to as "hysteresis." It's an idea with an impressive pedigree: The case for hysteresis was made in a well-known 1986 paper by Olivier Blanchard, who later became the chief economist at the International Monetary Fund, and Lawrence Summers, who served as a top official in both the Clinton and the Obama administrations. But I think everyone was hesitant to apply the idea to the Great Recession, for fear of seeming excessively alarmist.

At this point, however, the evidence practically screams hysteresis. Even countries that seem to have largely recovered from the crisis, like the United States, are far poorer than precrisis projections suggested they would be at this point. And a new paper by Mr. Summers and Antonio Fatás, in addition to supporting other economists' conclusion that the crisis seems to have done enormous long-run damage, shows that the downgrading of nations' long-run prospects is strongly correlated with the amount of austerity they imposed.

What this suggests is that the turn to austerity had truly catastrophic effects, going far beyond the jobs and income lost in the first few years. In fact, the long-run damage suggested by the Fatás-Summers estimates is easily big enough to make austerity a self-defeating policy even in purely fiscal terms: Governments that slashed spending in the face of depression hurt their economies, and hence their future tax receipts, so much that even their debt will end up higher than it would have been without the cuts.

And the bitter irony of the story is that this catastrophic policy was undertaken in the name of long-run

responsibility, that those who protested against the wrong turn were dismissed as feckless.

There are a few obvious lessons from this debacle. “All the important people say so” is not, it turns out, a good way to decide on policy; groupthink is no substitute for clear analysis. Also, calling for sacrifice (by other people, of course) doesn’t mean you’re tough-minded.

But will these lessons sink in? Past economic troubles, like the stagflation of the 1970s, led to widespread reconsideration of economic orthodoxy. But one striking aspect of the past few years has been how few people are willing to admit having been wrong about anything. It seems all too possible that the Very Serious People who cheered on disastrous policies will learn nothing from the experience. And that is, in its own way, as scary as the economic outlook.

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737-740

The Forum

President Reagan's Counseling

Lloyd S. Etheredge[1]

President Reagan's psychological model of economic behavior is a very different idea of how society operates than the individual rational choice models used by economists. It would be a major contribution to American public policy to develop direct measures of imagination and determine whether people do relate to government, as a higher presence, from within a larger-than-life drama.

KEY WORDS: political economy; mass psychology; leadership; imagination therapy.

For decades, economic policy has been the territory of economists, governed by their idea that we are a nation of rational choices. President Reagan has changed the assumptions. He is using ideas familiar to psychoanalysts and clinical psychologists to diagnose the problems of the American economy and design a course of treatment. He has posed a set of problems which political psychologists can solve with great benefit to the intelligence of national policy.

The president's idea is simple. He says our economy's lack of vitality is produced because government has become a powerful, substantial presence "above" us here in America. Over the past 30 years as, in our national imagination government became "bigger," we grew subjectively smaller to develop a national dependence. There was a "zero-sum" effect on each person's mind: As "it" (government) assumed more responsibility in national life, "we" (the people) took less. The work ethic disintegrated; productivity increases stopped; the economy stalled.

The president's economic policy follows logically. It is intellectually serious and urgent: He must provide national psychotherapy for a depressed, passive nation that expects its therapist to have a prompt and magical solution.

To effect the change he desires, our president-psychiatrist has designed a national psychodrama to inspire us, to create open space, and to reduce our idealized illusions. He is warm and supportive. He is cutting taxes and expenditures to make government above us "smaller." It may not be a cure we like, and there will be painful withdrawal symptoms, but we must again take responsibility for our own lives.

From personal experience, Dr. Reagan knows he is right. The dire predictions of his theory, made 30 years ago, appear correct to him. And in his autobiography, *Where's the Rest of Me?*, he sketches how he, too, was once dependent, in his case on the Hollywood studio system. He was well paid but unhappy, reading scripts written by others, never getting the leading dramatic roles he wanted to play. But then he became more assertive, struck out on his own. Once he became his own man, life started to work for him. He made a successful second marriage. Speaking his own ideas, he was elected Governor of California. Now he has *the* leading role in the country.

Other aspects of the president's life and experience confirm the same intuitive truth. He enjoys exhilaration, and a sense of freedom, when he rides the open range on horseback, the experience of the open range for free entrepreneurship he has told us we will regain in our national psychology by cutting back that "big government" in the sky. When he escapes to California from Washington and clears brush on his ranch, he feels recharged. He knows we will feel that way too, as the American Congress "stays the course" to effect the psychological transformation he wants.

To be sure, this is a closed system of beliefs. Evidence is always interpreted in the light of what the president calls his "basic principles." If the economic recovery is slow, it only means problems of dependency and addiction to big government are deep in our national psyche. So he is under an even greater obligation to persevere until we regain our independence and self-confidence and restart the economy. He has no choice.

From the president's perspective there is likely a second cause of a slow recovery, a cause psychoanalysts and clinical psychologists often cite: We are resisting. To an unprecedented degree, American news media refuse to discuss a national problem in the language a president uses. He has been stonewalled. *CBS News* has run nightly stories about the sufferings imposed by Reaganomics but has not yet discussed the real national problem, our psychology of dependency. It is as though the Eastern liberal news media are so addicted to the drama of an activist government, so psychologically dependent, so accustomed to demand that the president *do* something, that they will never admit even the possibility he could be profoundly right.

If Reagan is right, these skeptics slow the cure. The president can cut taxes and expenditures; these are actions in physical reality. But the stakes

are *psychological* reality. For the therapy to work we must agree—that the diagnosis of dependency is right, that big government is receding, that the therapist knows what he is doing.

It is also possible our actor-president is wrong. A powerful bond to government may be true of only 2% of the population: actors, intellectuals, reporters, the people who give money to political causes or end up in Washington. How can we tell?

The president has profoundly challenged the discipline of economics. His idea about how the economy works does not come from the hundreds of complex equations of their mathematical models. The basic problem, in his view, is simple: The economy is deeply *political*; we orient ourselves dependently toward government in a larger-than-life drama.

Lacking objective evidence, we now are adrift and debates about economic policy are decoupled, without intellectual integrity. Administration economists have given no evidence to support the intuitive psychological ideas about the economy the president uses to set policy. They have developed no national indicators for the substantiality of images of a "big" government in the sky, for changes in achievement motivation, for the alleged zero-sum allocations of responsibility.

Now, as we "stay the course," we navigate blind, on faith alone. Congress has applied no rules of evidence. The *Report* of the U.S. government's Council of Economic Advisers is intellectually irrelevant; it would be rejected as a test of the president's theories by any psychology department.

If the president is right, good national psychological indicators will tell us. And, refining our understanding, they might improve the president's policy. John F. Kennedy cut taxes and the economy leaped ahead—but Kennedy also talked about achievement—a New Frontier, a man on the moon by 1970. If psychodrama is needed, perhaps these are the themes to emphasize.

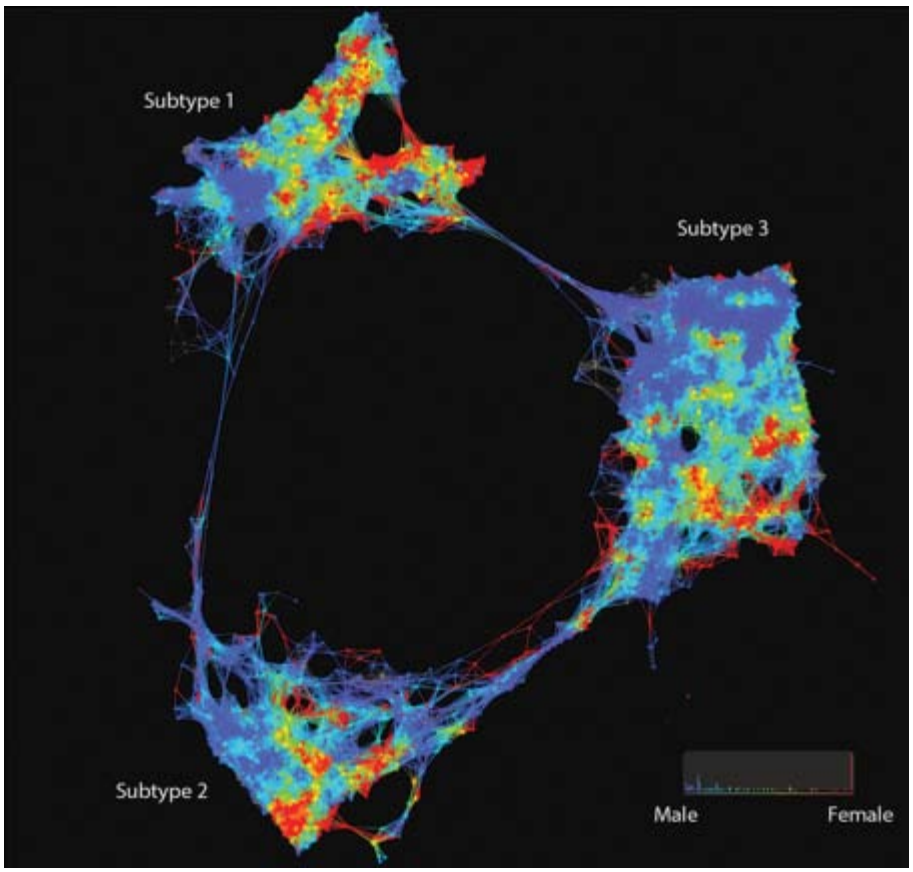
The president is not speaking in metaphors. He believes he is talking about our reality: solid, strong constituents of a national imagination, constituents so powerful in their effects as to destroy the health of a multitrillion dollar economy and our national spirit. His theories reflect ideas many psychologists have voiced seriously in the past: Psychoanalysts have told us that, via transference, many people relate to government authority, in our "mass psychology," the way as children they regarded their magically powerful parents; David McClelland of Harvard explained the economic rise and fall of civilizations by changes in the imaginations of citizens.

Currently, empirical evidence bearing upon the president's fundamental assumption is indirect and inconsistent. Self-report attitude measures seem to deny his model: Americans say they blame *themselves* for economic hardship. Yet macrolevel studies of election results, and individual-difference measures of self-interested and "socio-tropic" voting, suggest Reagan is correct and responsibility for management of the economy is assigned to the party in power.

Such measures of attitudes and voting are open to different interpretations as reflecting either rational and secular or psychodramatic processes. Alone, they cannot dispel the fog. The deeper question is the psychological nature of American government, and what is needed is that our public debates begin to be informed by evidence, from appropriate, clinically derived measures, of the location and substantiality of citizens' experience of government and the nature of the emotional bonds to it.

Big Data Study Reveals Possible Subtypes of Type 2 Diabetes

Posted on November 10, 2015 by Dr. Francis Collins



Caption: *Computational model showing study participants with type 2 diabetes grouped into three subtypes, based on similarities in data contained in their electronic health records. Such information included age, gender (red/orange/yellow indicates females; blue/green, males), health history, and a range of routine laboratory and medical tests.*
Credit: *Dudley Lab, Icahn School of Medicine at Mount Sinai, New York*

In recent years, there's been a lot of talk about how "Big Data" stands to revolutionize biomedical research. Indeed, we've already gained many new insights into health and disease thanks to the power of new technologies to generate astonishing amounts of molecular data—DNA sequences, epigenetic marks, and metabolic signatures, to name a few. But what's often overlooked is the value of combining all that with a more mundane type of Big Data: the vast trove of clinical information contained in electronic health records (EHRs).

In a recent study in *Science Translational Medicine* [1], NIH-funded researchers demonstrated the tremendous potential of using EHRs, combined with genome-wide analysis, to learn more about a common, chronic disease—type 2 diabetes. Sifting through the EHR and genomic data of more than 11,000 volunteers, the researchers uncovered what appear to be three distinct subtypes of type 2 diabetes. Not only does this work have implications for efforts to reduce this leading cause of death and disability, it provides a sneak peek at the kind of discoveries that will be made possible by the new Precision Medicine Initiative's national research cohort, which will enroll 1 million or more volunteers who agree to share their EHRs and genomic information.

In the latest study, a research team, led by Li Li and Joel Dudley of the Icahn School of Medicine at Mount Sinai, New York, started with EHR data from a racially and socioeconomically diverse cohort of 11,210 hospital outpatients. Of these volunteers, 2,551 had been diagnosed with type 2 diabetes, which is the most common form of diabetes.

Without focusing on any particular disease or condition, the researchers first sought to identify similarities among all participants, based on their lab results, blood pressure readings, height, weight, and other routine clinical information in their EHRs. The approach was similar to building a social network with connections forged, not on friendships, but medical information. When the resulting network was color-coded to reveal participants with type 2 diabetes, an interesting pattern emerged. Instead of being located in one, large clump on this "map," the points indicating people with type 2 diabetes were actually grouped into several smaller, distinct clusters, suggesting the disease may have subtypes.

To take a closer look, the researchers rebuilt the network to include only participants with type 2 diabetes. They then reanalyzed the EHRs based on 73 clinical characteristics, including gender, glucose levels, and white blood cell counts. That work confirmed that there were three distinct subtypes of type 2 diabetes among study participants.

Type 2 diabetes is associated with potentially serious complications, including nerve damage, vision problems, kidney disease, and an increased risk for cardiovascular disease. The study found differences in the distribution of such complications among the three subtypes of type 2 diabetes. People with subtype 1 were more likely to be diagnosed with microvascular complications, including blindness/vision defects. This group of participants was also the youngest and most likely to be obese. People with subtype 2 showed the greatest risk for tuberculosis and cancer. As for subtype 3, such people were more likely than others to be HIV positive, have high blood pressure, and develop arterial blood clots. Both subtypes 2 and 3 displayed a greater risk for heart disease than subtype 1.

Next, the researchers performed a genomic analysis, identifying hundreds of genetic variants that were enriched non-randomly in each of the three groups. Interestingly, some of the genetic variants linked to each subgroup were associated with genetic pathways that appeared relevant to the distinguishing clinical features of those subgroups.

These findings suggest that some of the clinical differences observed between the different type 2 diabetes subtypes are rooted in lifestyle or environment, and others may be influenced by inherited factors. Still, more research needs to be done to replicate and expand upon these findings. The hope is that by gaining a more nuanced understanding of type 2 diabetes, we may be able to identify more precise ways of helping to detect, manage, and, ultimately, prevent this serious, chronic disease that currently affects about 1 out of every 11 Americans [2].

References:

[1] Identification of type 2 diabetes subgroups through topological analysis of patient similarity. Li L, Cheng WY, Glicksberg BS, Gottesman O, Tamler R, Chen R, Bottinger EP, Dudley JT. Sci Transl Med. 2015 Oct 28;7(311):311ra174.

[2] Diabetes Latest Fact Sheet. 2014 June 17. (Centers for Disease Control and Prevention)

How to avoid the next financial crisis

ft.com by Martin Wolf.

Updated Oct 26th, 2018

How to avoid the next financial crisis

Latest IMF data highlights the lasting damage done by the 2008

The financial crisis of 2008-09 and the resulting recession were a historical watershed. The pre-crisis world was one of globalisation, belief in markets and confident democracies. Today's is a mirror image.

The economic impacts are certainly not the end of the story. But they are the beginning. The latest World Economic Outlook of the IMF provides a valuable empirical analysis of the effects. It brings out two big points: the impacts have been long lasting and have spread far beyond the countries that suffered banking crises.
The obvious way to measure the economic impact of crises is by comparing post-crisis performance with what would have happened if pre-crisis trends had continued. Yet pre-crisis trends were, to some extent, unsustainable. So, the IMF's analysis adjusts pre-crisis trend growth for credit booms.

The IMF notes that "91 economies, representing two-thirds" of global gross domestic product in purchasing-power-parity terms, experienced a decline in output in 2009. This was the biggest negative shock in the postwar era. Moreover, the bigger the losses in the short run, the bigger they were in the long run, too. Countries with large immediate falls in output also showed larger increases in income inequality, relative to pre-crisis averages.

Which sorts of countries lost most and how much did they lose? To answer this question, the WEO divides its 180-country sample into ones that suffered banking crises and those that did not.

The former group contained 24 countries, 18 of which are high-income economies. It found that 85 per cent of them still show shortfalls of output relative to trend. For countries that suffered banking crises, the modal (most frequent) average shortfall of output between 2015 and 2017, relative to pre-crisis trends, was close to 10 per cent. But a number suffered losses of between 20 and 40 per cent. (See charts.)

Yet output also remains below pre-crisis trends in 60 per cent of countries that did not suffer banking crises. Modal losses here have been much the same as in crisis-hit countries, though the distribution is less skewed to the downside.

The pervasiveness of losses may not be that surprising: this crisis emanated from the core of the global economy and caused big declines in global demand. The results were deep recessions, which cast very long shadows into the future.

Again, while advanced economies were particularly hard hit, emerging economies did not do much better. This was a western *financial* crisis, but it was a global *economic* crisis. China's stimulus programme of about 10 per cent of GDP greatly cushioned the impact.
The proximate explanations for the huge shortfalls in output were collapses in investment: by 2017, on average, investment was a quarter below pre-crisis trends. This weak investment must also help explain low rates of innovation, which is particularly visible in directly-hit countries. New technology is often embodied in new equipment: take robots, for example.

On average, countries that experienced banking crises suffered a four percentage point bigger loss in output by 2011-13 than ones that did not. Those with large pre-crisis macroeconomic imbalances, notably unsustainable current account deficits, also suffered relatively large losses. So did those with relatively inflexible labour markets. Again, those whose exports were more exposed to crisis-hit markets were hit harder. Countries that were more exposed to the global financial system also suffered larger losses. Lack of fiscal policy space proved costly, as well, as did a lack of exchange rate flexibility. The last is certainly an explanation, albeit not the only one, for the terribly poor performance of the eurozone.

The monetary actions taken by the high-income countries in the aftermath of the crisis have been controversial in many emerging markets. Many in high-income countries have also argued that the dramatic monetary easing was a mistake. Yet the evidence that output shortfalls are fiscal policy responses would have reduced the need for so long a period of unconventional monetary policies.

Equally controversial were the capital injections and guarantees provided to the financial sector in the crisis. Maybe, ways could have been found to rescue banks without rescuing bankers. But the greater the support for the damaged financial sector, argues the WEO, the stronger the rebound. This evidence gives no support to "liquidationism" — the view that banking collapses and depressions are benign purgatives.

Here are three tasks and a lesson.

The first task is that of monetary policy normalisation in a world that has so much debt. Higher US policy rates have already revealed the vulnerability of a number of emerging economies. More turbulence seems highly likely.

A second task is how to respond to another big recession, when the policy space is so diminished.

The final task is coping with the political aftermath of the crisis. The decline in western credibility and relative power and the rise of demagogic forces are real, powerful and dangerous.

The lesson is that big financial crises are — no surprise — very damaging. Once they have happened, it is too late. The analysis of regulation in the October Global Financial Stability Report suggests that we must ignore bankers' bleating against regulation: above all we must keep capital requirements up.

Recoveries could have been stronger with sustained fiscal and financial action, notably in the eurozone. But the costs of crisis would still have been high. "Never again" must be the watchword.

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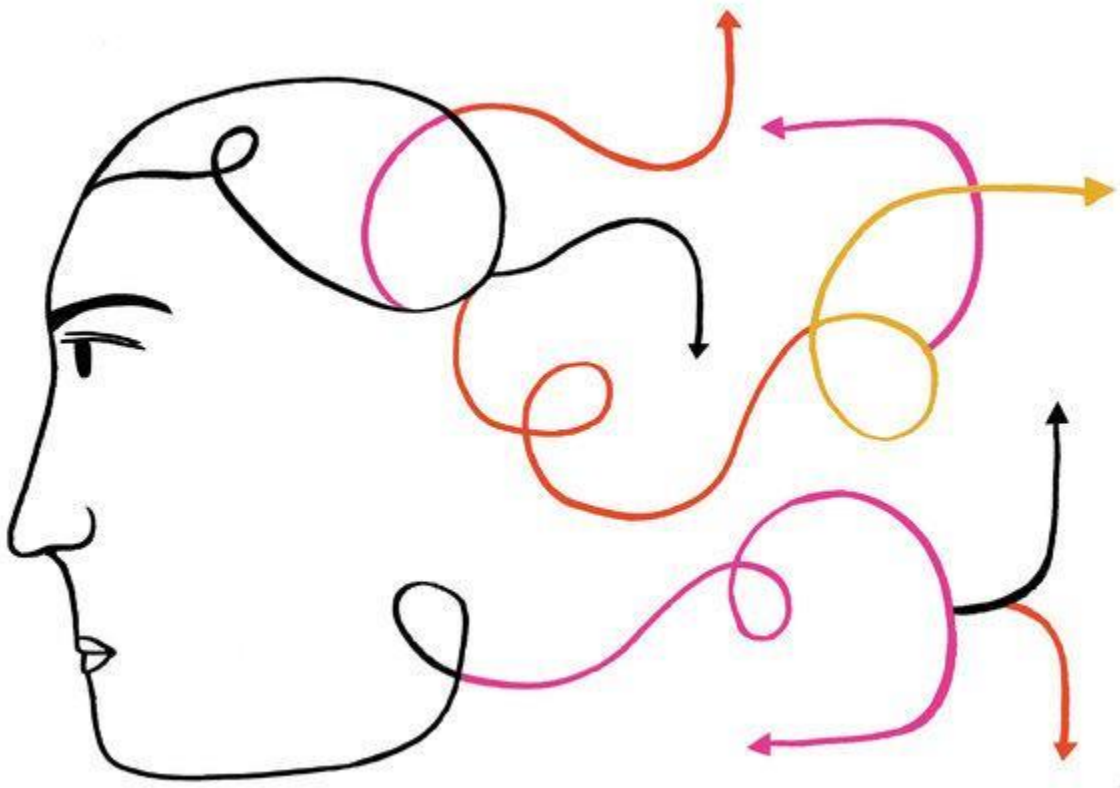
ECONOMIC VIEW

Why Our Beliefs Don't Predict Much About the Economy

Image



CreditCreditHanna Barczyk

By Robert J. Shiller

- Oct. 12, 2018

The more we learn about how people really think, the more we must rethink economic theory.

Changes in fundamental beliefs play a major role in the fluctuations of the economy. That's the implication of two fascinating new studies that show how people systematically change their beliefs in thinking about the financial future. At the moment, the knowledge that economists have accumulated about this subject suggests that we should have a high degree of humility — not only in forecasting where we are going, but in describing where we have been.

In a 2018 paper, Julian Kozlowski of the Federal Reserve Bank of St. Louis, Laura Veldkamp of Columbia University and Venky Venkateswaran of New York University attribute some of the economic pain that occurred after the 2008 financial crisis to a change in beliefs that may still be playing a role 10 years later.

Before financial tremors began to be felt in 2006, practically no one viewed a crisis of the magnitude of the Great Depression as being remotely possible, these authors say. The financial crisis changed that perspective, and people have continued to worry about this newly discovered threat, with the result that risk-taking has been inhibited and government-controlled interest rates — so-called riskless rates — have remained relatively low.

The scholars show that after an outlier event like the 2008 financial crisis occurs, standard statistical techniques show a sudden and persistent increase in the probability that such an event will occur again.

Now that such a financial crisis is forever in our data set, it is rational, they say, to continue to worry about another such crisis, even decades later. Those worries can hold back the economy.

Consider what this means for housing.

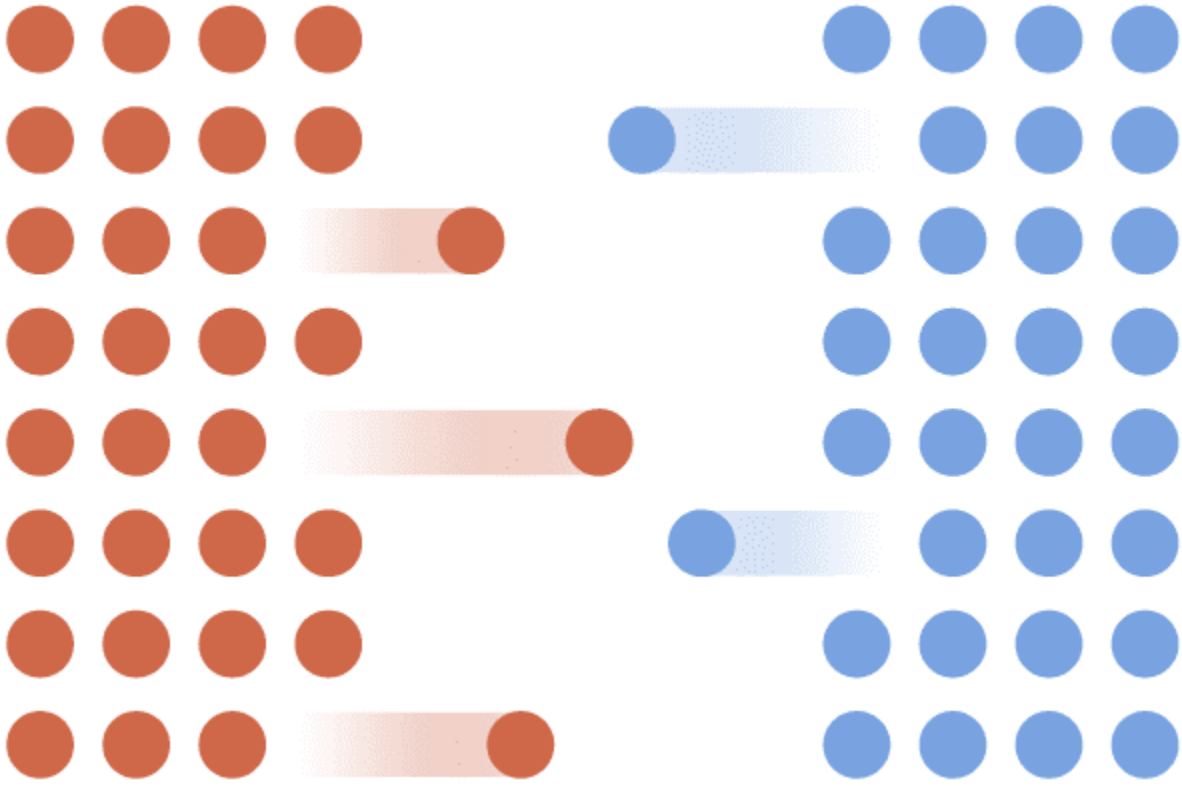
The real (inflation-corrected) S&P/CoreLogic/Case-Shiller National Home Price Index fell 36 percent from 2005 to 2012. Going all the way back to 1890, home prices had never fallen so sharply.

Before 2008, people might have rationally given the likelihood of such a fall a zero probability. Now that we have experienced it, the probability will never be zero again.

These scholars are correct, but the situation, in my view, is even worse than they imply. That's because there is evidence from behavioral economics that people are not entirely logical, and do not actually rely fully on logic or standard statistical techniques.

This behavioral economic perspective is embraced by Nicola Gennaioli of Bocconi University and Andrei Shleifer of Harvard University in their remarkable new book, "A Crisis of Beliefs" (Princeton University Press, 2018).

What Teachers Are Doing to Pay Their Bills



The Battle for Congress Is Close. Here’s the State of the Race.

52 Places to Go in 2018

Focusing on the stock market, Professor Gennaioli and Professor Shleifer demonstrate how changeable expectations for the future really are. People tend to believe that recent trends will continue, whatever they may be, and then, when things shift, they change their expectations again.

These authors, referring to previous research with Robin Greenwood at Harvard, examined six separate surveys of expected returns on the stock market, some looking at individuals, and some focusing on professionals. The surveys correlated substantially with one another, showing that they were actually measuring popular beliefs about the stock market.

But Professor Gennaioli and Professor Shleifer also showed that these expectations for future returns were systematically wrong, showing no ability to predict what actually happened.

These kinds of mistakes tend to follow certain psychological laws. Professor Gennaioli and Professor Shleifer stress that people have what they call “diagnostic beliefs,” a concept related to the “representativeness heuristic” described in 1974 by the psychologists Daniel Kahneman and Amos Tversky.

Diagnostic beliefs work like this: A physician, in trying to diagnose a patient's illness, orders a blood test that reliably gives a positive result for all patients who have a certain disease. Unfortunately, the test also gives many false positives. It is easy to assume the patient has the disease. But the test may just be a false positive.

The market boom leading to the 2008 financial crisis was the result of mistaken beliefs like the doctor's diagnostic errors, the researchers say. These diagnostic beliefs were based on what seemed to be a "kernel of truth," Professors Gennaioli and Shleifer say: Investors had a high return in the market. But they exaggerated the meaning of that kernel of truth, creating a market bubble.

More broadly, fundamental beliefs about the economy change through time. Thus, for example, the remarkable performance in the United States stock market since 2009 and in the housing market since 2012 are a result of a newly emergent belief system, reinforced not just by presidential statements or even by tax cuts but by a psychological dynamic that operates according to well-defined psychological principles, based, erroneously, on the belief that past growth in market prices is strong positive evidence for more growth in the near future.

The problem for economics research today is to try to clarify these changing belief systems, their impact on the economy, and their duration. Further study may well show that the economic effects of beliefs founded on false premises can be profound for decades after the initial changes take place.

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A version of this article appears in print on Oct. 14, 2018, on Page BU4 of the New York edition with the headline: Great and Not-So-Great Expectations. Order Reprints | Today's Paper | Subscribe