

# Fiscal Forecasts at the FOMC: Evidence from the Greenbooks

By DEAN CROUSHORE AND SIMON VAN NORDEN\*

*This paper uses a new data set of fiscal policy forecasts and estimates prepared for the FOMC to understand how they have influenced U.S. monetary policy. We find limited evidence of forecast bias and that the forecasts contain useful information beyond that in the CBO's forecasts. Forecast errors for the fiscal variables have been only weakly correlated with forecast errors for inflation and output growth, but those for the budget surplus are much more highly correlated with those for the unemployment rate and the output gap. Some fiscal variables can also account for a significant fraction of the "exogenous" changes in the federal funds rate target studied by Romer and Romer (2004), which is consistent with the Board's statements on the importance of fiscal policy.*

*JEL: E62, H68*

*Keywords: fiscal policy, deficits, forecasting, FOMC, Greenbook*

\* Croushore: Robins School of Business, 1 Gateway Road, University of Richmond, VA 23173, dcrousho@richmond.edu. van Norden: HEC Montréal, 3000 Chemin de la Côte Sainte Catherine, Montréal, QC, Canada H3T 2A7, simon.van-norden@hec.ca. The authors would like to thank Sdok Sambo, Kuy Sokha, and their Digital Divide Data team in Cambodia for their work in entering the data, as well as Nicholas Knowlton-Winch of CIRANO and Wendy Chan of the Bank of Canada for their research assistance. The authors would also like to thank the editor and referees, as well as seminar participants at the Joint Statistical Meetings in Miami Beach and Montreal, at the Central Bank of Cyprus, the Bank of Canada, the CIRANO Real-Time Workshop, the American Economic Association, the University of Richmond, Warwick Business School, the Society for Economic Measurement, and the European Economic Association, as well as Gitanjali Kumar and Valerie Ramey for their helpful comments.

The zero lower bound on interest rates and subsequent experimentation with quantitative easing have powerfully occupied the attention of macroeconomists and central banks in recent years (and for good reason). At the same time, however, the global financial crisis and the subsequent European debt crisis have highlighted another, more persistent feature of the monetary policy environment: the volatility of fiscal variables. For example, the swings of U.S. fiscal policy from large deficits in the 1980s, to large projected surpluses at the end of the 1990s, to still-larger deficits thereafter, contrast with the relative fiscal discipline of the previous decades.

While there has been considerable work on the accuracy of central bank forecasts (such as those by the Federal Reserve Board's staff in the Greenbook) we are not aware of any that have examined fiscal variables. Instead, some of the best work on fiscal forecasts in recent years has been done on Eurozone data, due in part to the availability of data sets created in response to the Eurozone's explicit restrictions on fiscal policy. While U.S. fiscal policy has lacked comparable constraints, we document the Federal Reserve's long-standing recognition of the role that fiscal policy plays in monetary policy deliberations. As we explain below, previous work on U.S. data has used fiscal forecasts that are perceived to have important defects. This motivates the need for better data on fiscal projections to characterize the monetary policy environment.

This paper begins to remedy that situation by documenting and analyzing a new coherent database of Federal Reserve Board forecasts of U.S. federal fiscal policy variables. In addition to headline fiscal variables (receipts, expenditures and budgetary surplus), we also provide long and consistent historical estimates and forecasts of the cyclically-adjusted budget balance. These new series allow us to see the extent to which monetary policymakers have been able to identify and anticipate fiscal changes, as well as how these are related to changes in other macroeconomic variables and monetary policy decisions.

The evaluation of fiscal forecasts and fiscal policy also raises a number of

measurement-related issues. Evaluations are commonly based on currently available macroeconomic data. However, those data may differ in several ways from the information that was available to policymakers at the time. As Cimadomo (2016) notes, fiscal data are frequently revised. Others, such as Croushore (2011), note that GDP data are also frequently revised and business cycle turning points are identified only with a lag, making real-time considerations important. We therefore carefully match fiscal forecasts with contemporaneous data vintages of other key variables to allow us to properly understand the information available to policymakers. We believe this is the first paper to do so for U.S. fiscal forecasts.

We begin in section I with a discussion of the literature on forecasts of fiscal policy, followed by a review of the narrative evidence from the Board of Governors on the relationship between fiscal and monetary policy in section II. The following section describes the new Greenbook data set and the data transformations we use, and we evaluate the quality of the Greenbook forecasts in section IV, testing them for bias and comparing the properties of the forecast errors of the Greenbook forecasts to those of the CBO. The remainder of the paper explores the relationship between the Board staff's forecasts of fiscal variables and the FOMC's policy decisions in a variety of ways. Section V describes the relationship between fiscal forecast errors on the one hand and forecast errors in inflation and economic growth on the other. Section VI reviews the measure of monetary policy shocks proposed by Romer and Romer (2004) and the extent to which such shocks may be related to anticipated fiscal policy. The final section summarizes the results and our conclusions.

## I. Forecasting Fiscal Policy Variables

The literature on forecasting fiscal policy variables is sparse compared with that on forecasting monetary policy variables. Perhaps due to the relative importance of fiscal policy discipline in the Eurozone, much of the recent literature has examined fiscal policy forecasts in the European Union (EU), where the institutional

framework has been quite different from that in the United States. We will therefore review fiscal forecasting separately for the U.S. and the EU to set the stage for our later analysis.

#### *A. The U.S. Experience*

Two official government agencies forecast U.S. federal government spending, revenues, and deficits—the Congressional Budget Office (CBO) and the Office of Management and Budget (OMB). The CBO is a nonpartisan arm of the U.S. Congress and is responsible for providing apolitical analysis of government budget issues. The OMB is part of the U.S. Treasury Department and works for the President to analyze his budget proposals. Researchers have compiled data sets to analyze both forecasts on an ad hoc basis, but there is no continuing program to update such data sets or to make them available to other researchers.

In their recent analysis of the CBO forecasts, Kliesen and Thornton (2012) show that the CBO's one-year-ahead forecasts are not significantly better than a random walk model (which assumes that next year's deficit will equal last year's deficit). The CBO's five-year projections are worse (though not statistically significantly worse) than the random walk model. Perhaps unsurprisingly, they also find that the CBO forecasts are worse in recessions than in expansions, as we might expect for most forecasts.

Other studies that examine both the CBO and OMB forecasts include Auerbach (1994), Auerbach (1999), and Plesko (1988). Auerbach (1994) shows that both CBO and OMB forecasts have generally been overly optimistic. Auerbach (1999) examines the revisions to the fiscal forecasts, finding that forecast revisions are serially correlated, suggesting inefficiency, especially for OMB forecasts. Plesko finds that long-horizon revenue forecasts are biased upwards, but most other forecasts are unbiased.

A few other studies have looked at particular aspects of fiscal forecasts. Belongia (1988) compares the CBO's forecasts of deficits with those of the Council of

Economic Advisers (CEA) and private-sector forecasts and finds no evidence of bias in the forecasts, though private-sector forecasts were more efficient than the CBO or CEA forecasts. Reischauer (1990), showed that the Gramm-Rudman-Hollings Act changed the nature of the OMB's summer forecasts, which were used to determine sequestration under the law, making them more optimistic (forecasting smaller deficits) than the OMB's winter forecasts, which did not affect sequestration. In contrast to Plesko's results, Blackley and DeBoer (1993) find that forecasts of outlays were biased during Republican administrations, perhaps because those administrations used the forecasts as a bargaining tool. Campbell and Ghysels (1995) confirm Blackley and DeBoer's findings that the OMB's outlay forecasts are inefficient.

Compelling rationales for the bias and inefficiency of the CBO and OMB forecasts exist. The OMB is part of the government administration, and its forecasts are often used as a tactical weapon in political budget battles. The CBO is non-partisan but is constrained to forecast revenues and expenditures according to the *current law*, so it cannot condition on expected legislative changes. These inherent limitations create a void for researchers attempting to model or measure expected U.S. fiscal policy.

The Greenbook forecasts that we examine below are not unconditional forecasts: they are conditional on monetary policy assumptions. Improbable monetary policy assumptions will make fiscal policy forecasts unrealistic to the extent that those monetary assumptions affect forecast economic activity and the financing costs of the government debt. Given that previous studies have found Greenbook forecasts for economic activity to be quite good as *unconditional* forecasts, we expect such effects to be small. Thus, we expect the Greenbook forecasts to be of great interest. To our knowledge, the only previous study to have used Greenbook forecasts of fiscal variables is Auerbach and Gorodnichenko (2012), who used them only to construct measures of fiscal innovations and provide no

direct analysis of their properties.<sup>1</sup>

### *B. Lessons from the European Union*

Because of the Maastricht Treaty, researchers have devoted considerable effort to European fiscal forecasts, beginning in the late 1990s. The fiscal forecasting literature, summarized by Leal et al. (2008), shows that some of the same issues of bias and inefficiency exist in Europe as in the United States. Although each country creates its own forecast, the European Commission's (EC) oversight of the forecasting process helps to control forecast errors. As Leal et al. note, "Most studies on forecast track records tend to signal that projections by the EC for European countries are the most accurate within international organisations publishing fiscal forecasts, due to its being an independent authority."<sup>2</sup> In contrast, Beetsma, Giuliodori and Wiertz (2009) find that fiscal adjustments systematically fall short of forecast adjustments and that this shortfall increases with the forecast horizon. They also present evidence suggesting that as adjustment shortfalls accumulate, governments increasingly resort to creative accounting to mask the problem. Frankel (2011) finds that official forecasts of budget surpluses and overall growth are more (optimistically) biased in the case of Eurozone governments than for other nations he examines.

However, as is the case with the U.S. CBO, the EC is constrained to forecast based on "present policies," so its forecasts are not truly unconditional. Still, Artis and Marcellino (2001) find no statistically significant differences between the IMF, the OECD, and the EC in deficit/GDP forecasts for European countries, where the former two institutions presumably produce unconditional forecasts.<sup>3</sup>

<sup>1</sup>There are several important differences between their work and ours. Most notably, they use only one-quarter ahead forecasts for the growth rates of overall government spending and some of its components. We examine forecasts at multiple horizons for the level of federal government expenditures, receipts and other variables.

<sup>2</sup>See Leal et al. (2008), p. 350.

<sup>3</sup>To some extent, of course, the findings of bias and inefficiency of forecasts may depend on assumptions about the symmetry of the loss function. For example, Elliott, Komunjer and Timmermann (2005) find that IMF and OECD forecasts of G7 budget deficits are not rational under the assumption of symmetric loss but may be rationalized under asymmetric loss.

Merola and Perez (2013) find that some of the same biases that are apparent in government forecasts are also apparent for supposedly independent agencies, such as the EC.

The Greenbook forecasts of fiscal variables may be of interest for at least two reasons. First, to the extent that they are indicative of expected fiscal policy, they may provide insight into the uncertainty surrounding future changes in such policy as well as a measure of anticipated and unanticipated fiscal shocks.<sup>4</sup> Second, to the extent that they capture the FOMC's expectations of fiscal policy, they may provide insight into the factors that have shaped monetary policy. However, the latter depends on the extent to which the FOMC has considered fiscal policy to be an important factor. We examine this question quantitatively in the latter sections of the paper. Before considering the forecasts themselves, however, we begin in the next section by reviewing some of the Federal Reserve Board's public statements on the relationship between their monetary policy and U.S. fiscal policy.

## II. Narrative Evidence

One of the clearest examples of the importance that the Federal Reserve sometimes attaches to fiscal policy occurred recently, when sequestration was to impose cuts in federal spending at the start of March 2013. In his semiannual Monetary Policy Report to Congress just a few days before the cuts were to take effect, Federal Reserve Chair Ben Bernanke devoted almost a third of his prepared remarks to fiscal policy, urging Congress to adopt a less contractionary fiscal policy in the short term to help support economic growth.<sup>5</sup> A few weeks later, responding to

<sup>4</sup>The relationship between private expectations and the Greenbook forecasts of fiscal variables is hard to assess, not least because the latter are only published after a delay of at least five years. We leave this question for future research.

<sup>5</sup>"Although monetary policy is working to promote a more robust recovery, it cannot carry the entire burden of ensuring a speedier return to economic health. The economy's performance both over the near term and in the longer run will depend importantly on the course of fiscal policy. ... recent progress in lowering the deficit has been concentrated in near-term budget changes, which, taken together, could create a significant headwind for the economic recovery. ... this additional near-term burden on the

a reporter after the March 2013 FOMC meeting, the Chairman replied “... federal fiscal restraint in 2013 is cutting something like  $1\frac{1}{2}$  percentage points off of growth, which, of course, is very significant. So, that is an issue for us. We—you know, we take as given what the fiscal authorities are doing. The economy is weaker. Job creation is slower than it would be otherwise. And so, that is one of the reasons that our policy has been as aggressive as it is. That being said, as I’ve said many times, monetary policy cannot offset a fiscal restraint of that magnitude, and so the final outcome will be worse—or, in terms of jobs—than would have been the case with less fiscal restraint.” For the remainder of that year and much of the following year, the press release following every FOMC meeting noted that “...fiscal policy is restraining economic growth...”

This makes clear that the Board thought fiscal policy was an important determinant of overall economic conditions (and at the time, one that could not be fully offset by monetary policy).<sup>6</sup> However, our period of interest is that covered by the Greenbooks (1965 onwards), one which saw considerable variation in both monetary and fiscal policy, and in economic conditions. In the remainder of this section, we will review public statements from the Board and its members in chronological order. With few exceptions, we will see that there has been considerable consistency over time in at least three aspects of the stated relationship between fiscal and monetary policy.

- 1) They acknowledge that both fiscal and monetary policy are important co-determinants of economic conditions.

recovery is significant. ... the Congress and the Administration should consider replacing the sharp, frontloaded spending cuts required by the sequestration with policies that reduce the federal deficit more gradually in the near term but more substantially in the longer run. Such an approach could lessen the near-term fiscal headwinds facing the recovery while more effectively addressing the longer-term imbalances in the federal budget.” Chairman Ben S. Bernanke Semiannual Monetary Policy Report to the Congress Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, Washington, D.C. February 26, 2013.

<sup>6</sup>Another striking example of the Board’s attention to fiscal policy came in the late 1990s with the arrival of substantial federal government surpluses. At the time, projections suggested a possible future shortage of government bonds in financial markets, leading Board economists to consider how to conduct monetary policy in the absence of federal government debt. The recession of 2001 and subsequent tax cuts eliminated this “problem,” but it is clear that the Fed was quite concerned about the potential supply of an asset central to its conduct of monetary policy.



- 2) Fiscal policy is thought to affect the economy primarily through its contribution to overall aggregate demand.<sup>7</sup>
- 3) The Board takes fiscal policy as exogenous; they ignore possible reactions of fiscal policy to their policy choices.<sup>8</sup>

That said, we can find statements explicitly linking fiscal and monetary policy throughout much of the Greenbook period. Chairman Martin’s Congressional testimony contained such remarks as “Much of the burden of accomplishing the containment of domestic demand pressures this year will rest on monetary policy, for . . . fiscal policy is scheduled to become less restrictive after midyear.”<sup>9</sup> He also noted that “One curious concern voiced in the press is that our action might hamper the Administration in its efforts to introduce a “tough” budget next year. Nonsense. . . . It is monetary policy that must adapt itself to the hard facts of the budget—and not the other way ’round.”<sup>10</sup>

During his nomination hearings, Arthur F. Burns testified that “Once doubts, which are very extensive, about our fiscal policy are resolved, . . . then I think we can have an easing of monetary policy such as you desire and such as I desire.”<sup>11</sup> His successor, G. William Miller, testified at his own nomination hearings that “I think the question of what interest rates will be in the future, whether they could be lowered or raised, will depend a great deal on how the economy behaves for the balance of this year and what fiscal measures are taken in this Congress—on what happens with the tax proposals. . . . I think it’s an interrelation between

<sup>7</sup>Another place we see this is in the narrative structure of the discussion in most Greenbooks. Reviewing Domestic Nonfinancial Developments, the discussion starts with components of consumption, followed by investment and then by fiscal measures, mirroring the standard  $C + I + G$  of national expenditure accounting.

<sup>8</sup>To be sure, there are also numerous examples of Board members publicly trying to influence fiscal policy, typically by urging legislators to do more to reduce projected deficits over the medium and longer term.

<sup>9</sup>William McChesney Martin, Jr., “Statement before the Joint Economic Committee.” February 26, 1969, <https://fraser.stlouisfed.org/title/?id=448#!7936>, accessed on June 25, 2015

<sup>10</sup>William McChesney Martin, Jr., “The Federal Reserve’s Role in the Economy: Remarks before the 59th Annual Meeting of the Life Insurance Association of America, New York City, December 8, 1965.

<sup>11</sup>Nomination of Arthur F. Burns: Hearing Before the Committee on Banking and Currency, United States Senate, Ninety-First Congress, First Session on the Nomination of Arthur F. Burns to Be a Member of the Board of Governors of the Federal Reserve System, December 18, 1969, <https://fraser.stlouisfed.org/title/?id=783>, accessed on October 5, 2015.

action on the fiscal side and action on the monetary side that sets the direction of the economy. . . . I don't think monetary policy can operate in isolation from what is going on in other parts of the system."<sup>12</sup>

After this early period, we can also look at the Board's Monetary Policy Reports to Congress to understand the role that fiscal policy has played in monetary policy formulation. The first such report in 1979 included responses to specific questions about the interplay of fiscal and monetary policy, such as "How should monetary and fiscal policy be coordinated? . . . It is essential that the overall thrust of monetary and fiscal policy be in the direction of restraint of aggregate demand if domestic inflationary pressures are to be reduced. . . . Can monetary policy offset expansive fiscal policy? It is possible for tight monetary policies to offset an expansive fiscal policy. It would not appear that there is currently any reason for substantial concern about monetary and fiscal policies working a [sic] cross-purposes; there is good communication among the policymakers involved and a broad recognition of the problems confronting the nation."<sup>13</sup>

Perhaps the most important departure from this paradigm begins in the late 1970s with the shift to monetary aggregate targeting under Chairman Volcker. As before, the Fed appears to take fiscal policy as both exogenous and an important co-determinant of overall economic outcomes. However, the conduct of monetary policy is perceived to be much more independent of the future course of fiscal policy under this policy regime. In Congressional testimony, this often took the form of the Fed chair discussing how changes in future fiscal variables would affect economic outcomes (particularly interest rates) without any suggestion that monetary policy would adjust as a result.<sup>14</sup> This in turn may simply have reflected

<sup>12</sup>Nomination of G. William Miller: Hearing Before the Committee on Banking, Housing, and Urban Affairs, United States Senate, Ninety-Fifth Congress, Second Session, on the Nomination of G. William Miller to Be Chairman of the Board of Governors of the Federal Reserve Board, January 24, 1978, <https://fraser.stlouisfed.org/title/?id=268>, accessed on October 5, 2015.

<sup>13</sup>"Federal Reserve's First Monetary Policy Report for 1979: Hearings before the Committee on Banking, Housing, and Urban Affairs, United States Senate, Ninety-sixth Congress, First Session," Monetary Policy Oversight—Senate Hearings (February 20 and 23, 1979), p. 111. <https://fraser.stlouisfed.org/title/?id=671#!22306>, accessed on October 5, 2015.

<sup>14</sup>As one of many examples, see Chairman Volcker's discussion of the budgetary situation starting on p. 11 of Federal Reserve's Second Monetary Policy Report for 1983: Hearings before the Committee on

the limited influence that fiscal variables have on monetary aggregates (such as the growth rate of M2 or the ratio of non-borrowed to borrowed reserves.)

By the 1990s, however, the Fed had put a greater emphasis on transparency and we have more explicit statements about policy formulation at the Board of Governors. For example, the 1998 Gillis Lecture by Laurence H. Meyer (Governor from 1996–2002) in particular gives a detailed view of the FOMC decision process.<sup>15</sup> At this time, Congress had adopted pay-as-you-go (PAYGO) rules that had greatly restricted the scope for discretionary fiscal policy. During this period, while we again see that the Fed appears to take fiscal policy as both exogenous and an important co-determinant of overall economic outcomes, the assumptions are that the burden of stabilization policy will fall on monetary policy, while other goals will dictate the course of fiscal policy. For example, Governor Meyer summed up the relationship as follows “My reading is that both monetary and fiscal policies, via their influence on aggregate demand, affect output and employment in the short run. . . . In practice, recently and for the indefinite future, fiscal policy is dominated with the task of reducing the deficit, leaving the stabilization objective almost exclusively in the hands of the Federal Reserve.”<sup>16</sup> Similarly, Governor Ned Gramlich discussed the roles of the monetary and fiscal authorities in stabilization policy and concluded that “On the monetary side, authorities should try to stabilize the economy without anticipating help from fiscal policy.”<sup>17</sup>

The expiry of the PAYGO rules and the return of large fiscal deficits early in the new century caused Fed Governors to repeatedly mention fiscal policy, both as a source of long-run concern and as a source of near-term economic shocks.

Banking, Housing, and Urban Affairs, United States Senate, and the Subcommittee on Economic Policy, Ninety-eighth Congress, First Session, <https://fraser.stlouisfed.org/title/?id=671#!22315>, accessed on October 5, 2015.

<sup>15</sup>Meyer, Laurence H. “Come with Me to the FOMC.” Remarks at the Gillis Lecture, Willamette University, Salem, Oregon, April 2, 1998, <https://fraser.stlouisfed.org/title/?id=936#!36332>, accessed on October 5, 2015.

<sup>16</sup>Meyer, Laurence H. “Monetary Policy Objectives and Strategy.” Remarks before the National Association of Business Economists 38th Annual Meeting, Boston, Massachusetts, September 8, 1996, <https://fraser.stlouisfed.org/title/?id=936#!36375>, accessed on October 5, 2015.

<sup>17</sup>Gramlich, Edward M. “A Stabilization Policy Strategy.” Remarks before the Wharton Public Policy Forum Series, Philadelphia, Pennsylvania, April 22, 1999, <https://fraser.stlouisfed.org/title/?id=914#!35463>, accessed on October 5, 2015.

For example, Chairman Greenspan noted in Congressional testimony “The fiscal issues that we face pose long-term challenges, but federal budget deficits could cause difficulties even in the relatively near term. . . . should investors become significantly more doubtful that the Congress will take the necessary fiscal measures, an appreciable backup in long-term interest rates is possible . . . Such a development could constrain investment and other interest-sensitive spending ...”<sup>18</sup>

This interaction of monetary and fiscal policy gives the Fed staff strong motivation to forecast fiscal variables well; significant time and effort is invested, and there is discussion of fiscal policy in every FOMC Greenbook. In the next two sections, we describe our new dataset of Greenbook fiscal variables and then consider their forecast behavior.

### III. Greenbook Fiscal Forecasts—A New Data Set

To assess the Fed’s ability to forecast fiscal variables and their influence on monetary policy, we first compiled fiscal forecasts from all Greenbooks from August 1967 to December 2010.<sup>19</sup> The Greenbook reports the Federal Reserve Board staff’s forecasts before every FOMC meeting (which typically take place at least twice per quarter). We examine the first and last Greenbook of each quarter to obtain a consistent data set with eight forecasts of quarterly data per year.

In each Greenbook, we gathered all the quarterly federal fiscal forecasts and reports of past data that are available for receipts, expenditures, the surplus, the high-employment budget surplus (HEB), a version of HEB based on a 6.1 percent or 6.0 percent natural rate of unemployment (which we call HEB6), the unemployment rate, and nominal output.<sup>20</sup> The HEB variables are designed to

<sup>18</sup>Greenspan, Alan, “Federal Reserve Board’s Semiannual Monetary Policy Report to the Congress.” Testimony before the Committee on Financial Services, U.S. House of Representatives, February 11, 2004, p. 10, <https://fraser.stlouisfed.org/title/?id=452#!8806>, accessed on October 5, 2015.

<sup>19</sup>The underlying data are available at the websites of the Federal Reserve Bank of Philadelphia and the Federal Reserve Board of Governors. See the online Appendix for details. As with other FOMC briefing materials, Greenbooks are not released for at least five years. Our sample ends with the Greenbooks for 2010; in earlier work, we also examined samples excluding the Global Financial Crisis.

<sup>20</sup>All the fiscal variables are reported on a National Income and Product Accounts (NIPA) basis,

measure the cyclically-adjusted or “structural” budget surplus. This is the Board staff’s counterfactual estimate of what the surplus (or deficit) would be if the unemployment rate were at a constant reference level over the forecast horizon.<sup>21</sup> The budget deficit concept used in HEB always corresponds to that used in the Surplus/Deficit measure.

The occasional redefinition of some of our data series caused complications. For example, beginning in 1996, overall government spending was replaced by government consumption expenditures and investment. Government spending on investment was removed from expenditures, but depreciation of capital was added. So, in periods when government investment exceeded depreciation, government expenditures were revised downwards. This caused both the surplus as well as GDP to be revised upwards. Another important change came in October 1999, when the BEA began treating government expenditures on software as investment. Again, this caused downward revisions to government expenditures and upward revisions to the surplus. Also, beginning in the early 1980s, HEB was based on a 6 percent natural rate of unemployment, but before that, the assumed natural rate of unemployment varied as it drifted upwards from an initial 4 percent rate.

Our primary data sources were page scans of the Greenbook independently published by the Federal Reserve Board and the Real-Time Data Research Center at the Federal Reserve Bank of Philadelphia.<sup>22</sup> After initial data entry and error-checking by a commercial firm, we compared some series (e.g., unemployment) against known values from other sources and checked the rest against the original PDF files. We believe our data to be at least as accurate as other published sources and our error rate to be less than 0.05%. The online Appendix to this paper provides extensive details on the construction of our data set. Figure 1

rather than a fiscal-year basis.

<sup>21</sup>From September 1988 onwards, HEB estimates were also accompanied by estimates of the Fiscal Impetus.

<sup>22</sup>See the Federal Reserve Board website for FOMC Historical Materials and the Philadelphia Fed’s Real-Time Data Research Center web site.

shows a sample Greenbook page. Each variable in it can be represented as a string of estimates for past quarters (horizons -1, -2, etc.), the current quarter (horizon 0), and future quarters (horizons 1, 2, etc.).

The forecast horizons reported in the Greenbook varied considerably over time as shown in Figure 2. Greenbook forecasts generally go to the end of a calendar year; as the year progresses, we see somewhat fewer quarters of forecasts and somewhat more quarters of historical data. Both then change abruptly once a year when forecasts for the next calendar year are added. The earliest Greenbooks we recorded might contain only two quarters of forecasts and four quarters of current and historical estimates; none contained estimates more than 12 quarters ahead or into the past. As we examine longer forecast horizons (particularly those more than four quarters ahead), our sample is progressively drawn from more recent Greenbooks. For that reason, when comparing results across different forecast horizons, we sometimes restrict the sample period. For forecast horizons up to four quarters, all of our series have at least one forecast per year from the first meeting in 1974Q4 onwards.<sup>23</sup> Table 1 shows definitions of the variables, their forecast horizons, and the number of observations by period.

After compiling the raw data, we normalized all fiscal variables, dividing them by the corresponding Greenbook values for nominal output (GNP before 1992, GDP from 1992 on).<sup>24</sup> The string diagram in Figure 3, which shows the budget surplus as a share of GDP (or GNP), provides a concise overview of the relevant fiscal trends and the Greenbook's forecasts. For example, the early 1990s was a period when projections of steadily improving fiscal balances were met with a steadily deteriorating deficit. By the late 1990s, however, projections of roughly constant deficits and surpluses missed a sustained fiscal improvement. After 2001, however, we see a return to a pattern of persistently overoptimistic projected surpluses.<sup>25</sup>

<sup>23</sup>Expenditures, receipts, HEB, and HEB6 typically have the shortest forecast horizons.

<sup>24</sup>Note that our output series were recorded in levels, not growth rates.

<sup>25</sup>This pattern looks different from the behavior we see in the first half of the sample, something we investigated in Croushore and van Norden (2014).

TABLE 1—SUMMARY TABLE OF GREENBOOK FISCAL FORECASTS

---

**Variable Definitions**

All of the fiscal variables are nominal. To normalize, we divide all of them by nominal output.

Forecasts of fiscal variables are divided by forecasts of nominal output, while realizations of fiscal variables are divided by realized nominal output.

Surplus: The conventionally measured federal government budget surplus (negative for deficit); equals receipts minus expenditures.

Expenditures: Federal government current expenditures; major redefinitions occurred in 1996 when investment was removed from expenditures and capital depreciation was added, and in 1999 when spending on software was reclassified as investment.

Receipts: Federal government receipts from all sources.

HEB: The high-employment budget surplus, which is based on a varying assumed natural rate of unemployment over time, rising gradually from 4.0 percent in the 1960s to 6.1 percent in the early 1980s.

HEB6: The high-employment budget surplus based on a 6.0 or 6.1 percent natural rate of unemployment over time, beginning in 1980Q4;

HEB = HEB6 beginning in 1983Q4.

---

**Timing of forecasts**

1967: Forecasts for surplus, expenditures, and receipts are available

1967 to 1968: Irregular and generally very short horizons

1969 to 1972: Typical pattern is a 4-quarter horizon in the first and third quarters; 3-quarter horizon in the second and fourth quarters

1970: Forecasts and data on HEB begin in July 1970

1972 to 1980: Irregular pattern of forecast horizons, generally 2 to 6 quarter horizons

1981: Forecasts and data on HEB6 begin in January 1981

1981 to 1988: Typical pattern is forecast horizons of 7 quarters in first quarter of the year, 6 in the second, 5 in the third, 4 in the fourth

1989 to 1992: Irregular pattern of forecast horizons, generally 5 to 10 quarter horizons

1993 to 2010: Typical pattern is forecast horizons of 8 quarters in first quarter of the year, 7 in the second, 6 in the third, 9 in the fourth

---

#### IV. Evaluating the Forecasts

Forecast evaluation requires a comparison of forecasts with a measure of outcomes. As the real-time literature shows (see Croushore (2011)), the revision of published macroeconomic data means that the choice of outcome measures (also called realized or actual values) may affect our results.

To evaluate the Greenbook forecasts, we use the last reported value before a benchmark revision of the National Income and Product Accounts (NIPA), called “prebenchmark data,” for expenditure, receipts, and surplus measures that are part of the NIPA.<sup>26</sup> Redefinitions of the variables during benchmark revisions, especially the major redefinitions made in 1999, make the evaluation of forecasts using fully revised data problematic. Benchmark revisions in particular may cause a researcher to find widespread evidence of forecast bias simply because the precise definition of the series has changed since the forecasts were made, so that the currently published series give a distorted view of the forecast’s performance. The prebenchmark data are the most fully revised data available at each date under a consistent methodology.<sup>27</sup> For conceptual variables that are not part of the NIPA data, we use the last value published in the Greenbook, which we call “last reported.” The conceptual variables are the structural surplus measures, HEB and HEB6.<sup>28</sup>

The Greenbook forecasts have a reputation for excellence in forecasting macroeconomic variables, as Romer and Romer (2000) show. Are they as good at forecasting fiscal policy variables? To find out, we tested them for bias in several ways.

<sup>26</sup>Prebenchmark series were constructed by the authors using original vintage data from the ALFRED database at the Federal Reserve Bank of St. Louis.

<sup>27</sup>This means omitting forecasts made just before a benchmark change for which official estimates were published only after the change.

<sup>28</sup>In an earlier version of this paper, Croushore and van Norden (2014), we examined other measures, including the first officially-published estimate, the officially-reported value as of one year after the initial release, and the “current” official estimate, which was current as of December 2012. This had only limited effects on the results.



*A. Bias*

A basic test of forecast performance is the Mincer-Zarnowitz test, regressing the realized values of a variable on a constant and the forecasts. If the forecasts are unbiased, the constant term should be zero and the coefficient on the forecasts should equal 1. However, Mankiw and Shapiro (1986) show that in small samples (which is the case here), such tests may reject too often because the right-hand side variable is often autocorrelated and thus correlated with lags in the error term. Instead, a zero-mean forecast error test covers the same concept (and is a necessary condition for unbiasedness) without being subject to the small-sample bias.

The results of tests for forecast bias are summarized in Table 2. The table shows  $p$ -values for the null hypothesis of no bias for six different forecast horizons (zero, one, two, three, and four quarters ahead, as well as the average value of the variable over the next four quarters, labelled 1-4), two different meeting times during the quarter (first and last) and five different variables (surplus, expenditures, receipts, HEB, and HEB6). The forecast error is defined as the forecast minus the realized value of the variable. Its estimated standard error adjusts for the usual overlapping observations problem using Newey-West robust standard errors with lag length equal to the forecast horizon minus one.

There is no significant evidence of bias for forecasts of the budget surplus and little evidence of bias for expenditure forecasts at any horizon. Receipts forecasts are significantly biased (forecasts exceeded realizations, on average) at several horizons, especially longer ones. HEB forecasts are biased for all horizons (again with forecasts exceeding realizations, on average) while there is somewhat less, but still considerable, evidence of bias for HEB6, suggesting that the “drift” in the benchmark rate of unemployment prior to the early 1980s is responsible for much of the bias.<sup>29</sup>

<sup>29</sup>In an earlier version of this paper, we used a sample ending in 2006 and found no significant evidence of bias in the Receipts or HEB6. We conclude that much of the evidence of bias that we see in Table 2

TABLE 2—SUMMARY RESULTS OF BIAS TESTS

Horizon	Surplus		Expenditures		Receipts	
	First	Last	First	Last	First	Last
0	0.48	0.87	0.06*	0.13	0.31	0.07*
1	0.96	0.86	0.53	0.51	0.59	0.74
2	0.39	0.43	0.78	0.92	0.21	0.22
3	0.17	0.24	0.53	0.73	0.07*	0.08*
4	0.14	0.15	0.48	0.58	0.04**	0.04**
1-4	0.32	0.29	0.61	0.63	0.14	0.16

Horizon	HEB		HEB6	
	First	Last	First	Last
0	< 0.01***	< 0.01***	0.04**	0.03**
1	< 0.01***	< 0.01***	0.05*	0.13
2	< 0.01***	< 0.01***	0.04**	0.07*
3	< 0.01***	< 0.01***	0.02**	0.03**
4	< 0.01***	< 0.01***	0.02**	0.02**
1-4	< 0.01***	< 0.01***	0.09*	0.08*

*Note:* The figures shown are  $p$ -values for tests of the null hypothesis that the mean forecast error is zero. Asterisks indicate the  $p$ -values associated with tests of the null hypothesis that the median forecast error is zero (\*/\*\*/\*\*\* indicate  $p$ -values less than 10/5/1 %).

Calculations use Newey-West heteroscedasticity and autocorrelation robust standard errors with the number of lags equal to the forecast horizon minus one.

The sample period is based on forecasts made from 1974Q4 to 2010Q4, except for HEB6, for which the sample begins in 1981Q1.

*First* and *Last* refer to the first and last FOMC meetings of each quarter.

The measure of outcomes used to evaluate the forecast is the prebenchmark value (the last official estimate published prior to a benchmark revision of the series) for surplus, expenditures, and receipts, and the last reported value in the Greenbook for HEB and HEB6.

Some researchers criticize tests of the mean forecast error for their sensitivity to large outliers and lack of power in some situations. We therefore also performed tests of the null hypothesis that the median forecast error was zero, following Campbell and Dufour (1991) and Campbell and Ghysels (1995), also called sign tests.<sup>30</sup> Table 3 shows the  $p$ -values of the test statistic of the null hypothesis that forecast errors have a median of zero.

TABLE 3—ZERO-MEDIAN TESTS OF FORECAST ERRORS

Horizon	Surplus		Expenditures		Receipts	
	First	Last	First	Last	First	Last
0	0.434	0.462	0.600**	0.579**	0.531	0.607***
1	0.417*	0.424*	0.535	0.514	0.507	0.500
2	0.366*	0.380	0.408	0.451	0.437	0.408
3	0.362	0.383	0.383	0.404	0.447	0.362
4	0.343	0.314	0.229***	0.200***	0.314	0.343

Horizon	HEB		HEB6	
	First	Last	First	Last
0	0.600**	0.655***	0.558	0.583*
1	0.604***	0.590**	0.571*	0.529
2	0.620*	0.648**	0.576	0.610
3	0.638	0.617	0.590	0.564
4	0.625	0.571	0.448	0.552

*Note:* The figures shown are the proportion of forecast errors  $> 0$ .

Asterisks indicate the  $p$ -values associated with tests of the null hypothesis that the median forecast error is zero (\*/\*\*/\*\*\* indicate  $p$ -values less than 10/5/1 %).

Test size is corrected for overlapping forecast horizons: see Campbell and Ghysels (1995) for details.

The sample period is based on forecasts made from 1974Q4 to 2010Q4, except for HEB6, for which the sample is 1981Q1 to 2010Q4. *First* and *Last* refer to the first and last FOMC meetings of each quarter. The measure of outcomes used to evaluate the forecast is the prebenchmark value (the last official estimate published prior to a benchmark revision of the series) for surplus, expenditures, and receipts, and the last reported value in the Greenbook for HEB and HEB6.

The results provide evidence of median forecast bias at some forecast horizons for all series. Consistent with the zero-mean tests showing bias in HEB, the zero-median tests also confirm the presence of some bias in all other variables, with the weakest evidence of bias in the surplus.

If we examine the forecast errors for expenditure nowcasts, as shown in Figure 4, we see that government expenditures were generally forecasted too high in the

for these variables is concentrated around the time of the 2008 financial crisis.

<sup>30</sup>These tests control for serial correlation in forecast errors caused by overlapping forecasts and allow for exact inference in small samples.

1970s, 1980s, and 1990s, and then too low in the 2000s. It is surprising to observe this pattern, when longer-horizon forecasts show much less evidence of bias, except for the results of the zero-median test at the four-quarter horizon. Looking at the HEB nowcasts, as shown in Figure 5, we see that the HEB forecasts were mostly poor (with forecasts above realizations) in the early part of the sample period from the mid-1970s to the early 1980s. After that, however, the forecasts look more rational and have a mean forecast error near zero.<sup>31</sup>

The results suggest that most Greenbook forecasts of the fiscal variables show significant *median* forecast biases, especially at short horizons. On the one hand, this might simply be due to skewness in the forecast errors. On the other hand, it is likely that the Fed’s staff spends much more time and attention on macroeconomic forecasts at longer horizons that may be more relevant to monetary-policy decision-making than on the fiscal “nowcasts.”

#### B. Forecast Comparisons

Another way to understand the performance of the Greenbook forecasts is to compare their accuracy with that of other forecasters. This kind of comparison is complicated by several factors, however. Many forecasters (including the IMF and the OECD) forecast the general government sector rather than the federal government. Some forecast variables on a budget-accounting basis rather than a National Income and Product Accounts basis. Many forecast only annual rather than quarterly totals, and their forecasts are updated less frequently than the Greenbook. Finally, nearly all cover a much shorter historical period.

In light of these limitations, perhaps the best available comparison for the Greenbook forecasts are those produced by the CBO for the annual federal government surplus, expenditures and receipts. In interpreting these results, it should

<sup>31</sup>We also examined forecast errors in receipts, which were particularly large in the late 1990s and early 2000s, when the Greenbook persistently forecasted a rise in receipts that did not materialize. In this period, the Greenbook (and other forecasters) did not foresee the tax cuts that would be put in place, as well as the slowdown in the tech sector and the economy in 2000 and 2001.

be recalled that the CBO forecast conditions on distinctly different assumptions, as discussed above. In particular, the CBO’s constraint to forecast the variables based on “current policy” might well lead their forecasts astray at times when Congress is expected to change policy in a significant way.

We take the first CBO forecast of each year and compare it to the corresponding Greenbook forecast by combining the four quarterly Greenbook forecasts to compute the implied annual forecast.<sup>32</sup> Both sets of forecasts are compared in Table 4. Forecasts for the current and next calendar year were available from 1982 to 2010, except for expenditures and receipts where forecasts for the next calendar year were only available from 1990 onwards.

Table 4 compares the performance of the Greenbook and the CBO in a number of ways. The first two lines simply report the root-mean-squared forecast errors. We see that Greenbook forecasts are somewhat more accurate in every case. The third and fourth lines test the null hypothesis that the two forecasts have equal quadratic loss and absolute loss, respectively, and report the associated  $p$ -values.<sup>33</sup> We find that the Greenbook forecasts are significantly more accurate for government receipts but not expenditures or the surplus.<sup>34</sup>

The final two lines of the table provide the results of forecast encompassing tests. Forecast  $A$  is said to encompass Forecast  $B$  if the *forecast errors* of  $A$  are uncorrelated with the *forecasts* of  $B$ . This implies that  $A$  is efficient in the sense that the information in  $B$  cannot be used to improve  $A$ . Our results show that we are able to strongly reject the null hypothesis that the CBO forecasts encompass the Greenbook forecasts of receipts and current-year expenditures (and we can reject the same hypothesis for the year-ahead expenditures at the 10%

<sup>32</sup>CBO forecasts for fiscal variables were divided by their forecast values for nominal GNP or GDP to calculate the implied forecasts for output shares. Similarly, we combined the Greenbook fiscal variables across four consecutive quarterly horizons before converting to output shares using the Greenbook’s output forecasts. The CBO forecasts were made in late January or early February of each year, except for 1996, 2009 and 2010 when the forecast was made in May, June and May respectively. Due to benchmark changes in the National Income and Product Accounts, we omitted those forecasts whose outcomes were affected by definitional changes. The latter had only a minor impact on our results.

<sup>33</sup>We use the modified Diebold-Mariano statistics proposed by Harvey, Leybourne and Newbold (1997).

<sup>34</sup>The evidence is weaker when we focus on Absolute rather than Quadratic loss; we then find a significant difference only in the case of forecasts for current-year receipts.

TABLE 4—GREENBOOK VERSUS CBO

Variable	Surplus		Receipts		Expenditures	
	0	1	0	1	0	1
<b>Horizon (Years)</b>						
RMSFE - Greenbook	0.0086	0.0141	0.0049	0.0103	0.0052	0.0088
RMSFE - CBO	0.0092	0.0171	0.0067	0.0121	0.0058	0.0107
$H_0$ : Equal Quadratic Loss	0.726	0.251	<b>0.031</b>	<b>0.034</b>	0.342	0.142
$H_0$ : Equal Absolute Loss	0.578	0.221	<b>0.020</b>	0.156	0.671	0.333
$H_0$ : GB encompasses CBO	0.465	0.378	0.800	0.099	0.564	0.375
$H_0$ : CBO encompasses GB	0.252	0.185	<b>0.003</b>	<b>0.015</b>	<b>0.017</b>	0.071

*Note:* *RMSFE* indicates the Root-Mean-Squared Forecast Error.

Figures shown for the null hypothesis of equal Quadratic or Absolute loss are  $p$ -values associated with the Harvey, Leybourne and Newbold (1997) modified Diebold-Mariano test statistic of the corresponding null hypothesis.

Figures in the final two rows are  $p$ -values for tests of the null hypothesis of forecast encompassing using the statistic proposed by Harvey, Leybourne and Newbold (1998) and incorporate their proposed small-sample adjustment.

**Boldface** denotes  $p$ -values  $< 5\%$ .

level.)<sup>35</sup> We find no comparable evidence to reject the hypothesis that Greenbook forecasts encompass those of the CBO. This implies that the former capture useful information which the CBO forecasts miss. One possible explanation for this is the CBO’s requirement to forecast conditional on “current law,” which forces them to omit information about expected legislative changes.

## V. Forecast Errors

Despite the narrative evidence given above, one might question whether the Fed’s expectations of fiscal variables should matter much for monetary policy outcomes. Are their forecast errors for fiscal variables even related to forecast errors of headline variables such as real growth and inflation? If so, this raises the possibility that improving projections of fiscal variables might improve forecasts for the headline variables. We therefore examined the relationships among these sets of forecast errors.

As headline variables, we used two inflation measures (CPI and the GDP deflator) and three real activity measures (real GDP growth, the unemployment rate

<sup>35</sup>In all of these cases, our estimates implied that moving the CBO forecast more towards that of Greenbook would improve the former’s forecast accuracy.

and the output gap.)<sup>36</sup> Consistent with the Greenbook forecasts, measures of inflation and output growth were based on quarter-to-quarter changes expressed at annual rates. We examined all forecast horizons from 0L (nowcasts from the last meeting of the quarter) to 4F (4-quarter-ahead forecasts from the first meeting of the quarter.)

To understand the relationship between fiscal forecast errors and those for headline variables, we simply regressed the latter on the former, considering results for the full sample, the pre-1991 sample and the post-1990 sample.<sup>37</sup> Below we summarize the main results; complete results are presented in the online Appendix to this paper.

With few exceptions, correlations between errors in Greenbook inflation (PCPI and PGDP) forecasts and those in fiscal balance (SURPLUS, HEB and HEB6) were low and typically insignificant.<sup>38</sup> Correlations between errors in Greenbook real output growth forecasts and fiscal balance variables, were also quite modest, although occasionally significant and positive.<sup>39</sup> However, forecast errors in the

<sup>36</sup>Unemployment rates were collected directly from Greenbooks and checked against those available from the Federal Reserve Bank of St. Louis' ALFRED database. Greenbook forecasts for the other variables were taken from the Federal Reserve Bank of Philadelphia's Greenbook database. Published series for CPI inflation and the unemployment rate undergo little revision; we used July 2016 vintage data from FRED (series UNRATE and CPIAUCSL) to measure outcomes for these variables. What we refer to as real GDP growth and the GDP deflator in fact use GNP data prior to 1992 (series GNPC96 and GNPDEF) and GDP thereafter (series GDPC1 and GDPDEF.) Outcomes were measured using pre-benchmark vintages of output from the Federal Reserve Bank of St. Louis ALFRED database. The Board Staff's estimates of the output gap are those made available by the Federal Reserve Bank of Philadelphia. Outcomes for the output gap were measured by the last-reported Greenbook value.

<sup>37</sup>Greenbook forecasts for the output gap and CPI inflation were only available from August 1987 and October 1979 respectively. The resulting lack of degrees of freedom made inference problematic in some cases, particularly in the pre-1991 sample for longer-horizon forecasts of the output gap. In addition, HEB and HEB6 are identical during the period for which we have output gap data; we therefore only consider the gap's relationship to HEB. An earlier version of this paper used shorter series of Greenbook forecasts (available from the Federal Reserve Bank of St. Louis ALFRED database) and core inflation (CPI ex food and energy) data in place of the GDP deflator; results were qualitatively similar.

<sup>38</sup>The  $R^2$  from these regressions was never more than 1% in the post-1990 sample and rarely more than 5% in the full sample. In the pre-1991 sample, however, there was often statistically and economically significant evidence of a positive relationship between inflation surprises and fiscal surprises. This was strongest between HEB and inflation, where fiscal surprises typically accounted for 15-20% of the variance in inflation surprises and a positive fiscal surprise (i.e. a larger than expected structural surplus) of 1% of output was associated with a positive inflation surprise (i.e. higher than expected inflation) of almost 1%. However, the economic importance of this effect was greatly reduced when using HEB6 or SURPLUS, suggesting that revisions in the benchmark rate of unemployment used to calculate HEB accounted for much of this relationship.

<sup>39</sup>The  $R^2$  from these regressions were rarely more than 5% in the full sample, although somewhat higher in the subsamples. While surprises in HEB were significantly negatively correlated with real growth surprises (higher than expected structural fiscal surpluses were associated with lower than expected

fiscal balance variables were most strongly and robustly correlated with surprises in the unemployment rate and the output gap. The relationship was strongest at longer forecast horizons, where surprises in the surplus could account for over one-third of their variance of forecast errors in the output gap or the unemployment rate. As shown in Tables 5 and 6, this reflected both a significantly negative correlation between surprises in the unemployment rate and those in federal government receipts as well as an even stronger positive correlation between surprises in the unemployment rate and those in federal government expenditures.

Overall, we therefore find that while there is no apparent relationship between inflation and fiscal forecast errors, there is much more evidence linking the latter to forecast errors for real variables, particularly for unemployment rates and the output gap. This is consistent with the hypothesis that improved fiscal forecasts would be linked to improved forecasts for key real economic variables.

## VI. Monetary Policy “Shocks”

Another way of understanding the potential importance of the Fed’s fiscal forecasts is to examine their relationship to estimates of exogenous monetary policy shocks. Romer and Romer (2004) constructed what has become an often-used measure of such shocks by regressing changes in the fed funds rate target on a variety of control factors.<sup>40</sup> The residuals are deemed to represent exogenous changes in policy. In the Romers’ words, “...because we control for the Federal Reserve’s forecasts of the paths of output and inflation, most of those residual influences are appropriate for estimating the impact of monetary policy on the economy.”<sup>41</sup> However, Rossi and Zubairy (2011) show that neglecting the role of

growth) in the pre-1991 sample, this relationship vanished in the post-1990 sample as well as for the other two measures of fiscal balance. This seemed to reflect upward shifts in benchmark rate of unemployment during the early part of the sample. Forecast errors for all three fiscal balance variables had significantly positive correlations with real growth surprises over longer forecast horizons in the post-1990 sample, although this only explained about 10% of the variance in real output growth.

<sup>40</sup>The control variables that they use consist of (1) the level of the Fed Funds Rate Target prior to the FOMC meeting, (2) the estimated rate of unemployment, and Greenbook estimates of past, current and future values of (3) inflation and (4) real output, as well as (5 & 6) revisions in these forecasts from those of previous FOMC meeting.

<sup>41</sup>Romer and Romer (2004), p. 1064.



TABLE 5—GREENBOOK FORECAST ERRORS FOR UNEMPLOYMENT RATE

<b>UNEMP = <math>\alpha + \beta \cdot \text{HEB6}</math></b>									
<b>Horizon</b>	<b>Full Sample</b>			<b>Pre-1991</b>			<b>Post-1990</b>		
	$R^2$	$\beta$	t-Stat	$R^2$	$\beta$	t-Stat	$R^2$	$\beta$	t-Stat
0Q Last	0.009	1.5	0.932	0.000	0.4	0.149	0.015	1.7	0.961
0Q First	0.009	-2.7	-0.819	0.000	0.2	0.050	0.027	-3.8	-0.967
1Q Last	0.011	-3.5	-1.210	0.028	-9.8	-0.983	0.007	-2.0	-0.753
1Q First	0.045	-10.2	-2.150	0.055	-19.7	-1.718	0.054	-8.1	-1.378
2Q Last	0.015	-6.8	-1.607	0.000	-2.7	-0.204	0.057	-7.4	-1.394
2Q First	0.010	-6.3	-0.854	0.006	12.1	0.354	0.055	-8.8	-1.434
3Q Last	0.027	-11.1	-1.315	0.001	6.2	0.206	0.127	-13.7	-1.566
3Q First	0.025	-11.7	-1.099	0.023	27.0	1.277	0.131	-17.1	-1.666
4Q Last	0.064	-16.6	-1.172	0.297	112.1	2.143	0.244	-23.7	-1.859
4Q First	0.080	-20.1	-1.444	0.186	78.7	0.000	0.277	-27.8	-2.270
<b>UNEMP = <math>\alpha + \beta \cdot \text{HEB}</math></b>									
<b>Horizon</b>	<b>Full Sample</b>			<b>Pre-1991</b>			<b>Post-1990</b>		
	$R^2$	$\beta$	t-Stat	$R^2$	$\beta$	t-Stat	$R^2$	$\beta$	t-Stat
0Q Last	0.007	1.4	1.785	0.001	0.7	0.916	0.015	1.7	0.961
0Q First	0.003	1.8	0.689	0.020	5.1	2.794	0.027	-3.8	-0.967
1Q Last	0.000	-0.1	-0.056	0.001	1.0	0.266	0.007	-2.0	-0.753
1Q First	0.005	-3.5	-0.762	0.000	-1.0	-0.173	0.054	-8.1	-1.378
2Q Last	0.019	-6.9	-1.112	0.012	-6.8	-0.713	0.057	-7.4	-1.394
2Q First	0.007	-4.8	-0.940	0.001	-2.0	-0.257	0.055	-8.8	-1.434
3Q Last	0.018	-8.0	-1.430	0.004	-4.3	-0.548	0.127	-13.7	-1.566
3Q First	0.013	-7.6	-1.049	0.000	-0.6	-0.055	0.131	-17.1	-1.666
4Q Last	0.023	-9.9	-0.918	0.000	1.5	0.092	0.244	-23.7	-1.859
4Q First	0.025	-10.4	-0.889	0.004	5.0	0.331	0.277	-27.8	-2.270
<b>UNEMP = <math>\alpha + \beta \cdot \text{SURPLUS}</math></b>									
<b>Horizon</b>	<b>Full Sample</b>			<b>Pre-1991</b>			<b>Post-1990</b>		
	$R^2$	$\beta$	t-Stat	$R^2$	$\beta$	t-Stat	$R^2$	$\beta$	t-Stat
0Q Last	0.001	0.7	0.402	0.001	1.1	0.393	0.003	1.0	0.441
0Q First	0.067	-9.5	-1.683	0.127	-14.3	-1.920	0.001	0.8	0.268
1Q Last	0.080	-10.6	-2.258	0.116	-14.3	-2.274	0.012	-2.7	-1.169
1Q First	0.223	-20.8	-3.059	0.310	-26.2	-3.351	0.037	-6.7	-2.229
2Q Last	0.260	-22.1	-3.476	0.330	-28.9	-4.123	0.147	-10.5	-3.321
2Q First	0.302	-26.1	-4.127	0.381	-33.9	-4.690	0.186	-13.3	-3.322
3Q Last	0.348	-28.0	-3.845	0.420	-37.4	-4.403	0.296	-16.0	-3.232
3Q First	0.393	-32.3	-3.983	0.478	-43.5	-4.583	0.333	-19.8	-3.886
4Q Last	0.380	-31.1	-4.177	0.410	-41.6	-4.223	0.429	-22.3	-3.539
4Q First	0.410	-32.5	-4.464	0.420	-43.0	-3.839	0.478	-25.2	-4.438

*Note:* This table reports the results of regressions of Greenbook Unemployment Rate forecast errors on forecast errors for the variables shown in the table. Estimation is by OLS, with HAC standard errors used to calculate the  $t$ -statistics. The number of lags used was equal to  $2(h+1)$  where  $h$  is the forecast horizon rounded to the nearest quarter. Under the **Horizon** heading, “First” and “Last” indicate whether the forecast was made during the first or last meeting of the quarter.

TABLE 6—GREENBOOK FORECAST ERRORS FOR UNEMPLOYMENT RATE (CONT.)

<b>UNEMP = <math>\alpha + \beta \cdot</math> RECEIPTS</b>									
<b>Horizon</b>	<b>Full Sample</b>			<b>Pre-1991</b>			<b>Post-1990</b>		
	$R^2$	$\beta$	t-Stat	$R^2$	$\beta$	t-Stat	$R^2$	$\beta$	t-Stat
0Q Last	0.001	0.8	0.526	0.006	3.0	1.212	0.016	-2.6	-1.659
0Q First	0.054	-12.1	-1.961	0.070	-16.3	-1.646	0.034	-6.5	-1.334
1Q Last	0.028	-9.9	-2.262	0.022	-10.6	-1.515	0.062	-9.0	-2.257
1Q First	0.074	-18.7	-2.307	0.084	-23.0	-1.910	0.061	-11.4	-1.767
2Q Last	0.085	-19.3	-2.417	0.084	-23.6	-1.921	0.127	-13.8	-3.042
2Q First	0.074	-20.2	-2.936	0.062	-22.4	-2.185	0.152	-17.5	-2.643
3Q Last	0.089	-23.1	-2.629	0.061	-25.1	-1.604	0.233	-21.4	-2.796
3Q First	0.112	-28.9	-3.131	0.076	-31.8	-1.888	0.255	-26.9	-3.334
4Q Last	0.100	-24.4	-2.826	0.032	-18.2	-0.906	0.277	-28.7	-3.068
4Q First	0.133	-30.6	-3.091	0.037	-23.0	-0.843	0.313	-34.0	-3.385
<b>UNEMP = <math>\alpha + \beta \cdot</math> EXPEND</b>									
<b>Horizon</b>	<b>Full Sample</b>			<b>Pre-1991</b>			<b>Post-1990</b>		
	$R^2$	$\beta$	t-Stat	$R^2$	$\beta$	t-Stat	$R^2$	$\beta$	t-Stat
0Q Last	0.000	-0.2	-0.109	0.001	0.8	0.220	0.039	-4.2	-1.793
0Q First	0.017	6.2	1.156	0.064	14.0	1.949	0.045	-7.5	-1.950
1Q Last	0.070	14.1	2.035	0.132	21.7	2.574	0.003	-2.0	-0.589
1Q First	0.198	29.1	3.140	0.327	39.8	4.504	0.000	1.1	0.406
2Q Last	0.270	36.7	3.401	0.382	48.6	4.457	0.046	10.5	2.404
2Q First	0.345	44.0	4.139	0.482	57.0	6.114	0.071	14.5	2.274
3Q Last	0.419	49.1	3.984	0.551	62.7	5.097	0.161	21.8	3.114
3Q First	0.439	52.8	4.352	0.572	66.6	5.713	0.202	27.6	4.228
4Q Last	0.490	53.3	4.676	0.612	67.8	5.530	0.345	36.1	3.706
4Q First	0.528	55.3	4.835	0.674	71.8	5.674	0.390	39.8	4.631

*Note:* This table reports the results of regressions of Greenbook Unemployment Rate forecast errors on forecast errors for the variables shown in the table. Estimation is by OLS, with HAC standard errors used to calculate the  $t$ -statistics. The number of lags used was equal to  $2(h+1)$  where  $h$  is the forecast horizon rounded to the nearest quarter. Under the **Horizon** heading, “First” and “Last” indicate whether the forecast was made during the first or last meeting of the quarter.

fiscal policy can distort our perceptions of monetary policy and its effects. In the remainder of this section, therefore, we use our Greenbook forecasts to investigate how taking account of fiscal variables alters Romer and Romer (2004)'s estimates of monetary policy shocks.

We follow Coibion et al. (2012) in estimating the relationship over an expanded data sample ending in December 2008 (after which the federal funds rate was at its effective lower bound.)<sup>42</sup> We added forecasts of the surplus and of HEB in various combinations together with the revisions in those forecasts.<sup>43</sup> Because the potential sample period varies slightly depending on the set of variables included, we take care to re-estimate the original Romer and Romer (2004) specification over precisely the sample period used for each of our fiscal variable specifications.<sup>44</sup>

Coefficient estimates are presented in the online Appendix. Table 7 quantifies the statistical importance of fiscal variables in these regressions. To better understand their economic importance, we simulated the impact of the estimated monetary policy shocks on the federal funds rate.<sup>45</sup> Changes in the latter may be different from the former, as the latter takes into account the impact of fiscal variables on the estimated policy reaction function.

Table 7 shows that the addition of fiscal forecasts is strongly statistically significant in almost every case, implying that the federal funds rate target has historically adjusted in response to anticipated fiscal developments. The inclusion of the surplus boosts the regression  $R^2$  from 23% to 26%, while the inclusion of HEB boosts it from 29% to 36%. Changes in the estimated monetary pol-

<sup>42</sup>We used the extended data set assembled by Coibion et al. (2012), available at [http://eml.berkeley.edu/ygorodni/RR\\_MPshocks\\_Updated.xls](http://eml.berkeley.edu/ygorodni/RR_MPshocks_Updated.xls).

<sup>43</sup>We preferred the use of HEB rather than HEB6 in this analysis largely because HEB better captured the headline variable presented to the FOMC. As Romer and Romer (2004) argue, changes in the tastes or operating procedures of the Federal Reserve constitute a potentially important source of policy shocks; we take this to include their changing views about the benchmark rate of unemployment.

<sup>44</sup>In choosing the lags to include in the regression, we again follow Romer and Romer (2004) and include lags -1 to 2Q for all variables other than HEB; for the latter we used -1 to 4Q (although our results are robust to this distinction.) We preferred to use slightly longer lags for HEB because we think that *structural* deficits are essentially exogenous with respect to monetary policy shocks over a longer horizon.

<sup>45</sup>To do so, we simply set all the control variables to zero and shocked the federal funds rate with the estimated OLS residuals.

TABLE 7—REVISED ESTIMATES OF ROMER AND ROMER (2004): SUMMARY STATISTICS

	<b>SURPLUS &amp; Innov.</b>	<b>SURPLUS</b>	<b>HEB &amp; Innov.</b>	<b>HEB</b>	<b>SURPLUS &amp; HEB</b>
<b><math>R^2</math> with</b>	0.2677	0.2635	0.3891	0.3588	0.3942
<b><math>R^2</math> without</b>	0.2334	0.2342	0.3087	0.2889	0.2889
<b>p-value (F)</b>	0.0538	0.0106	0.0016	0.0001	0.0000
<b>Shock corr.</b>	0.9774	0.9807	0.9401	0.9496	0.9230
<b>Impact corr.</b>	0.9836	0.9853	0.9204	0.9332	0.6413

**Notes:**

Results for revised estimates of exogenous monetary policy shocks based on Romer and Romer (2004)'s OLS regression for changes in the federal funds rate target. Estimation ends in December 2008, after which the target rate was constrained by the zero lower bound. Detailed estimation results may be found in the appendix.

**& Innov.** - indicates that the regression includes the values of the indicated variable as well as the change in its values from the previous FOMC meeting.

**p-value (F)** - p-value of the F-statistic testing the null hypothesis that estimated coefficients on all included fiscal variables are jointly equal to zero.

**Shock corr.** - Correlation between policy shocks estimated when including and excluding fiscal variables.

**Impact corr.** - Correlation between impact of shocks on federal funds rate estimated when including and excluding fiscal variables.

icy shocks are modest; correlations between the old and new shocks series hover around the 94-98% range, while those between the old and new impact series are slightly lower in the case of HEB. However, the inclusion of either set of fiscal variables attenuates the impact of the policy shocks on the federal funds rate target. In particular, Figure 6 shows that including HEB reduces the expansionary effects of monetary policy shocks throughout most of the 1970s while reducing their contractionary effects from the mid-1980s through 2000. Changes in either direction occasionally exceeded 150 basis points, which represents a substantive fraction of the estimated overall impact of policy shocks.

Table 7 also shows that the addition of both HEB and the surplus together has a substantially larger impact. The  $R^2$  rises from 29% to 39%, the correlation between the shock series falls to 92% and that between the impact series falls to under 65%. These changes are reflected in Figure 7, which shows that the attenuation mentioned above becomes substantially larger, with differences in the impact of policy shocks exceeding 250 basis points in the mid-1970s and briefly

exceeding 300 basis points in mid 1998.<sup>46</sup>

While the above evidence suggests that fiscal policy has influenced monetary policy targets, it is however inconsistent with conventional theories of fiscal dominance of monetary policy. The latter emphasize concerns over government financing requirements, particularly in terms of overall debt levels. However, this stock of debt is unlikely to be highly correlated with the flow variables (deficits, revenues and expenditures) examined above. Proof of the latter is lacking, however, simply because the federal sector tables in the Greenbooks (as well as the main tables of economic indicators) make no reference to federal government debt levels or financing costs. This is consistent with the Greenbook's overarching narrative focus on components of aggregate demand, but not with concerns over the impact of monetary policy decisions on government finance. We also note that even in the case where fiscal variables appear most important, the results in Table 7 show that they only explain about 10% of the variance of changes in the federal funds rate target, with exogenous monetary policy shocks accounting for the lion's share.

## VII. Summary and Conclusions

The goal of this paper was to better understand the Federal Reserve Board's ability to understand and anticipate changes in fiscal variables. To do so, we assembled a new data set containing a complete set of Greenbook fiscal forecasts spanning many decades and several complete business cycles.

Our analysis highlighted both positive and negative aspects of the forecasts' performance. On the positive side, Greenbook forecasts of both the surplus and expenditures show relatively small signs of bias, and performed slightly better than those of the CBO, both in terms of mean-squared errors and (in several cases) in terms of forecast-encompassing. However, forecasts for other fiscal vari-

<sup>46</sup>Part of the reason for the substantial change in the estimated impact of shocks lies in the change in the estimated size of the error-correction coefficient, which almost doubles from -0.018 to -0.033, implying less shock persistence.

ables showed more severe evidence of bias. The evidence of Greenbook superiority to the CBO forecasts was less clear for expenditures and receipts. At longer horizons, forecast errors for the fiscal variables were strongly correlated with those for the unemployment rate and output gap, but not with those for real output or inflation. Improvements in fiscal forecasts are therefore likely to be related to improvements in forecasting those macroeconomics aggregates. Our analysis of monetary-policy shocks, as in Romer and Romer (2004), shows that monetary policymakers seem to respond to fiscal shocks in ways that have been quantitatively important, consistent with the public statements of Federal Reserve Chairmen and Governors. Therefore, understanding fiscal-policy shocks is important for the study and measurement of monetary-policy shocks.

## REFERENCES

- Artis, Michael, and Massimiliano Marcellino.** 2001. "Fiscal Forecasting: The Track Record of the IMF, OECD, and EC." *Econometrics Journal*, 4: S20–S36.
- Auerbach, Alan J.** 1994. "The U.S. Fiscal Problem: Where We Are, How We Got Here, and Where We're Going." *NBER Macroeconomics Annual*, 9: 141–175.
- Auerbach, Alan J.** 1999. "On the Performance and Use of Government Revenue Forecasts." *National Tax Journal*, 52: 767–782.
- Auerbach, Alan J., and Yuriy Gorodnichenko.** 2012. "Measuring the Output Responses to Fiscal Policy." *American Economic Journal: Economic Policy*, 4(2): 1–27.
- Beetsma, Roel, Massimo Giuliodori, and Peter Wierds.** 2009. "Planning to Cheat: EU Fiscal Policy in Real Time." *Economic Policy*, 24(60): 753–804.
- Belongia, Michael T.** 1988. "Are Economic Forecasts by Government Agencies Biased? Accurate?" *Federal Reserve Bank of St. Louis Review*, 15–23.
- Blackley, Paul R., and Larry DeBoer.** 1993. "Bias in OMB's Economic Forecasts and Budget Proposals." *Public Choice*, 76(3): 215–232.
- Campbell, Bryan, and Eric Ghysels.** 1995. "Federal Budget Projections: A Nonparametric Assessment of Bias and Efficiency." *Review of Economics and Statistics*, 77(1): 17–31.
- Campbell, Bryan, and Jean-Marie Dufour.** 1991. "Over-rejections in Rational Expectations Models: A Nonparametric Approach to the Mankiw-Shapiro Problem." *Economics Letters*, 35: 285–290.
- Cimadomo, Jacopo.** 2016. "Real-Time Data and Fiscal Policy Analysis: A Survey of the Literature." *Journal of Economic Surveys*, 30: 302–326.

- Coibion, Olivier, Yuriy Gorodnichenko, Lorenz Kueng, and John Sylvia.** 2012. “Innocent Bystanders? Monetary Policy and Inequality in the U.S.” *NBER working paper 18170*.
- Croushore, Dean.** 2011. “Frontiers of Real-Time Data Analysis.” *Journal of Economic Literature*, 49(1): 72–100.
- Croushore, Dean, and Simon van Norden.** 2014. “Fiscal Policy: Ex Ante and Ex Post.” *Federal Reserve Bank of Philadelphia Working Paper 14-22*.
- Elliott, Graham, Ivana Komunjer, and Allan Timmermann.** 2005. “Estimation and Testing of Forecast Rationality Under Flexible Loss.” *Review of Economic Studies*, 72: 1107–1125.
- Frankel, Jeffrey A.** 2011. “Over-Optimism in Forecasts by Official Budget Agencies and Its Implications.” *Oxford Review of Economic Policy*, 27(4): 536–542.
- Harvey, David S, Stephen J Leybourne, and Paul Newbold.** 1998. “Tests for Forecast Encompassing.” *Journal of Business & Economic Statistics*, 16(2): 254–259.
- Harvey, David, Stephen Leybourne, and Paul Newbold.** 1997. “Testing the Equality of Prediction Mean Squared Errors.” *International Journal of Forecasting*, 13(2): 281–291.
- Kliesen, Kevin L., and Daniel L. Thornton.** 2012. “How Good Are the Government’s Deficit and Debt Projections and Should We Care?” *Federal Reserve Bank of St. Louis Review*, 94(1): 21–39.
- Leal, Teresa, Javier J. Perez, Mika Tujula, and Jean-Pierre Vidal.** 2008. “Fiscal Forecasting: Lessons from the Literature and Challenges.” *Fiscal Studies*, 29(3): 347–386.



- Mankiw, N. Gregory, and Matthew D. Shapiro.** 1986. “Do We Reject Too Often? Small Sample Properties of Tests of Rational Expectations Models.” *Economic Letters*, 20: 139–145.
- Merola, Rosanna, and Javier J. Perez.** 2013. “Fiscal Forecast Errors: Governments Versus Independent Agencies?” *European Journal of Political Economy*, 32: 285–299.
- Plesko, George A.** 1988. “The Accuracy of Government Forecasts and Budget Projections.” *National Tax Journal*, 41: 483–501.
- Reischauer, Robert D.** 1990. “Taxes and Spending Under Gramm-Rudman-Hollings.” *National Tax Journal*, 43: 223–232.
- Romer, Christina D., and David H. Romer.** 2000. “Federal Reserve Information and the Behavior of Interest Rates.” *American Economic Review*, 90(3): 429–457.
- Romer, Christina D., and David H. Romer.** 2004. “A New Measure of Monetary Shocks: Derivation and Implications.” *The American Economic Review*, 94(4): 1055–1084.
- Rossi, Barbara, and Sarah Zubairy.** 2011. “What is the Importance of Monetary and Fiscal Shocks in Explaining US Macroeconomic Fluctuations?” *Journal of Money, Credit and Banking*, 43(6): 1247–1270.

STAFF PROJECTIONS OF FEDERAL SECTOR ACCOUNTS AND RELATED ITEMS  
(Billions of dollars except as noted)

January 29, 1997

Item	Fiscal year <sup>5</sup>		1996			1997			1998					
	1995*	1996*	Q1*	Q2*	Q3*	Q4	Not seasonally adjusted							
<b>UNIFIED BUDGET</b>														
Receipts <sup>1</sup>	1355	1453	322	446	362	346	341	459	380	363	351	469	392	382
Outlays <sup>1</sup>	1519	1660	393	392	395	405	412	408	410	426	419	428	422	424
Surplus/deficit <sup>1</sup>	-164	-207	-71	-46	-33	-39	-71	-59	-30	-66	-68	-59	-30	-42
Off-budget	-24	-174	-84	14	-36	-76	-83	11	-36	-72	-81	-4	-36	-103
Surplus excluding deposit insurance <sup>2</sup>	62	67	13	39	2	18	12	40	5	8	12	43	6	11
Means of financing	-182	-116	-75	52	-34	-65	-72	51	-32	-64	-69	44	-31	-90
Cash decrease	171	130	80	-23	39	49	58	-31	43	54	69	-25	48	73
Other <sup>3</sup>	-2	-6	-1	-16	-6	11	13	-16	-4	10	10	-15	-5	10
Cash operating balance, end of period	-5	-16	-7	-14	0	-1	1	-5	-8	0	-11	-5	-13	6
Cash operating balance, end of period	38	44	22	38	44	33	20	36	40	30	20	35	40	30
<b>MIPA FEDERAL SECTOR</b>														
Receipts	1459	1544	1523	1576	1582	1625	1606	1626	1645	1663	1672	1691	1711	1731
Expenditures	1629	1693	1678	1702	1703	1730	1741	1755	1772	1782	1792	1802	1815	1829
Consumption	45	48	48	48	48	48	48	48	48	48	48	48	48	48
Nondefense	30	30	29	30	30	30	30	30	30	30	30	30	30	30
Other expenditures	151	155	155	156	157	157	159	160	160	157	158	159	159	157
Current account surplus	1175	1226	1287	1239	1241	1267	1281	1294	1308	1319	1328	1340	1351	1369
Gross investment	-171	-139	-155	-127	-121	-105	-135	-129	-127	-119	-120	-112	-104	-98
Current and capital account surplus	65	63	62	66	64	64	61	62	62	63	62	61	61	60
Account surplus	-236	-202	-220	-193	-185	-169	-196	-190	-189	-182	-182	-172	-166	-159
<b>FISCAL INDICATORS<sup>4</sup></b>														
High-employment (HEB) surplus/deficit	-263	-337	-247	-333	-231	-222	-251	-251	-254	-253	-253	-247	-244	-241
Change in HEB percent	0	-4	1	-2	0	-1	4	0	0	0	0	-1	0	0
Fiscal impetus (FI), percent, cal. year	-5	6	-1	6	-3	5	-5	5	-5	1	-2	7	-1	3

1 OMB's July 1996 deficit estimates (assuming the enactment of the President's proposals) are \$126 billion in FY97 and \$94 billion in FY98. CBO's January 1997 baseline deficit estimates are \$124 billion in FY97 and \$120 billion in FY98. Budget receipts, outlays, and surplus/deficit include corresponding Social Security (OASDI) categories. The OASDI surplus is excluded from the on-budget deficit and shown separately as off-budget, as classified under current law. The Postal Service deficit is included in off-budget outlays beginning in FY90.

2 OMB's July 1996 deficit estimates (assuming 1997 enactment of the President's proposals), excluding deposit insurance spending, are \$134 billion in FY97 and \$136 billion in FY98. CBO's January 1997 baseline deficit estimates, excluding deposit insurance, are \$136 billion in FY97 and \$124 billion in FY98.

3 Other means of financing are checks issued less checks paid, accrued items, and changes in other financial assets and liabilities of potential output generated by 1 percent real growth in current dollars, with cyclically sensitive receipts and outlays adjusted to the level of potential output generated by 1 percent real growth and an associated unemployment rate of 6 percent. Quarterly figures for change in HEB and change in annual real growth in HEB, as a percent of nominal potential output, are reversed in sign. For the weighted deficit, the quarterly change values indicate restraint.

4 Fiscal 1995 data for the unified budget come from OMB, fiscal 1996 and quarterly data come from the Monthly Treasury Statement and may not sum to OMB fiscal year totals.

5 Actual.

FIGURE 1. A SAMPLE GREENBOOK PAGE

Note: A typical Greenbook page showing a variety of fiscal forecasts; this one is from January 1997.

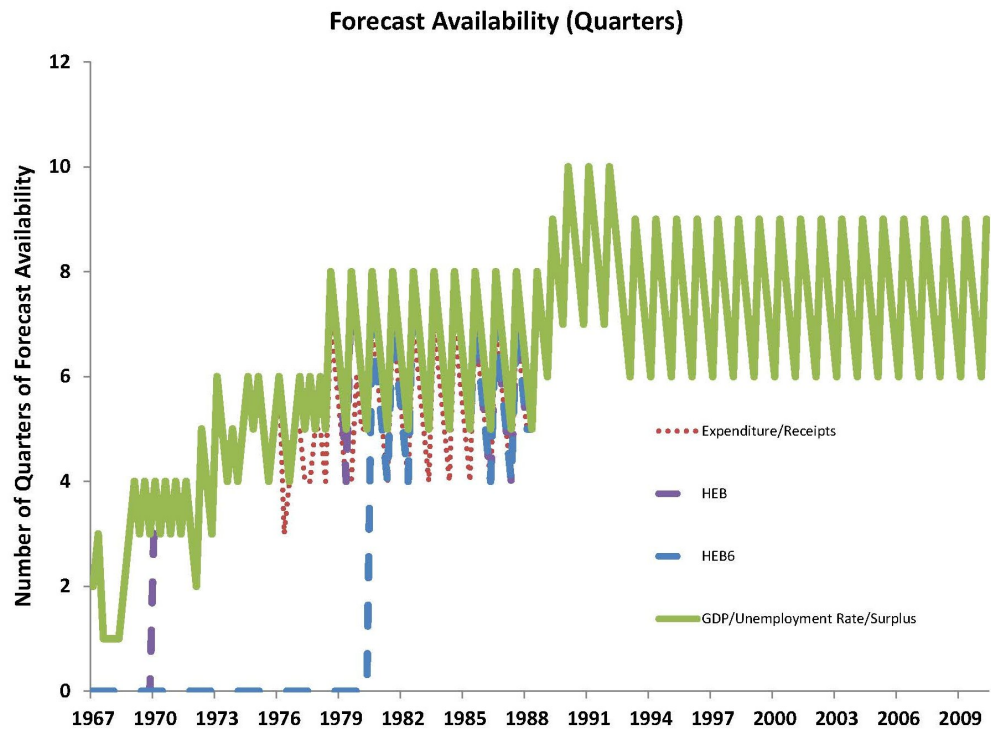


FIGURE 2. GREENBOOK FORECAST HORIZONS BY DATE AND SERIES

*Note:* The horizons of the Greenbook forecasts vary by variable and have generally risen over time. Data are from the first FOMC meeting of each quarter.

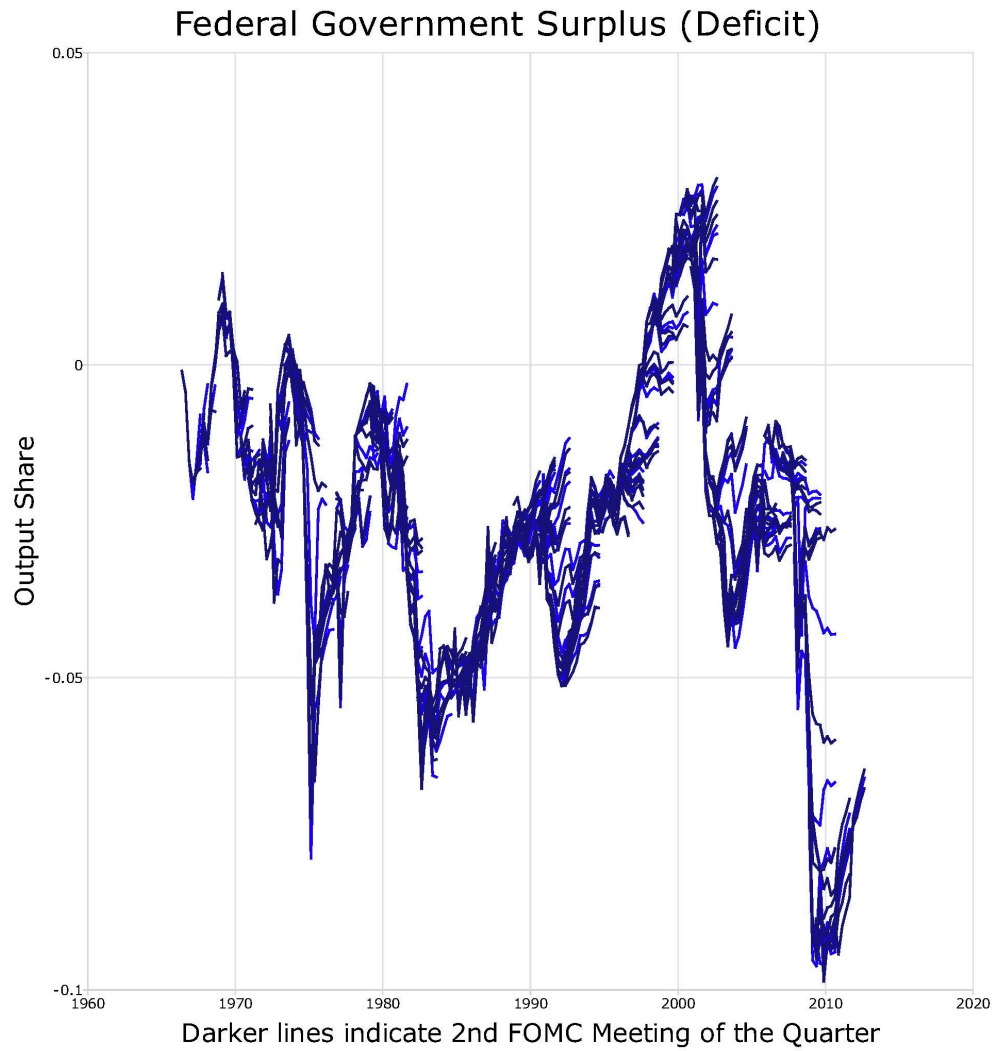


FIGURE 3. GREENBOOK GOVERNMENT SURPLUS FORECASTS

*Note:* This string diagram shows both the history and the forecasts for the surplus over time. You can see periods when the surplus forecasts were persistently too high (as in the early 1990s) or too low (as in the second half of the 1990s).

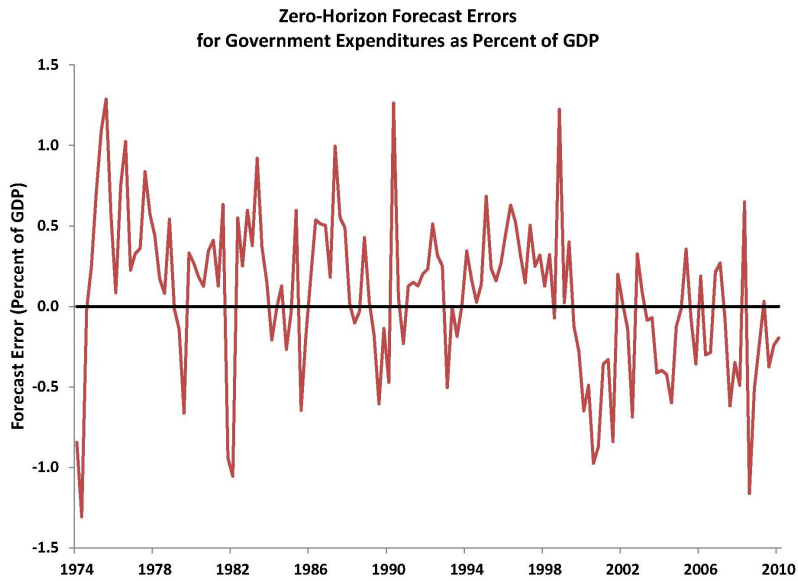


FIGURE 4. TIME-SERIES PLOT OF CURRENT-QUARTER EXPENDITURE FORECAST ERRORS

*Note:* This time-series plot of the forecast errors for government expenditures shows generally positive forecast errors (forecasts exceeding realizations) for much of the 1970s, 1980s, and 1990s, followed by mostly negative forecast errors in the 2000s.

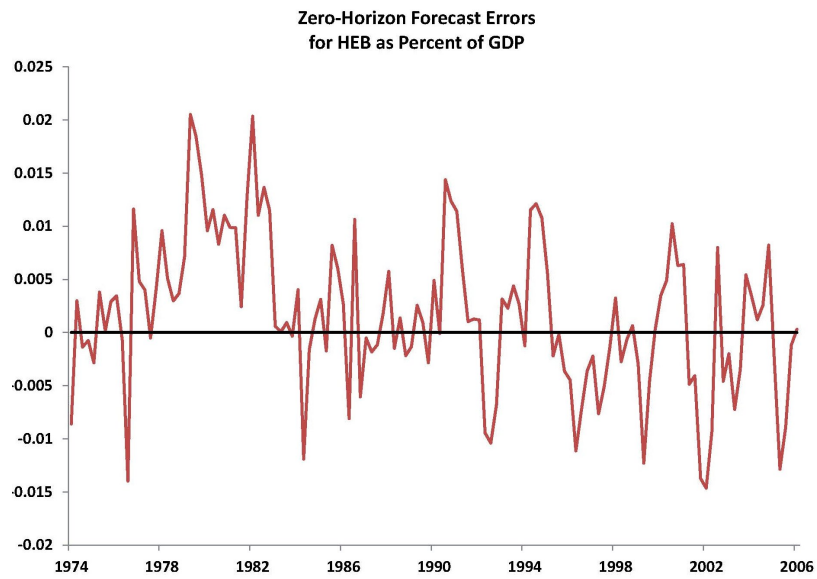


FIGURE 5. TIME-SERIES PLOT OF CURRENT-QUARTER HEB FORECAST ERRORS

*Note:* This time-series plot of the forecast errors for HEB, the structural budget surplus, shows generally positive and growing forecast errors (forecasts exceeding realizations) for the second half of the 1970s into the early 1980s, followed by forecast errors with a mean near zero after the early 1980s.

### Monetary Shocks with and without HEB

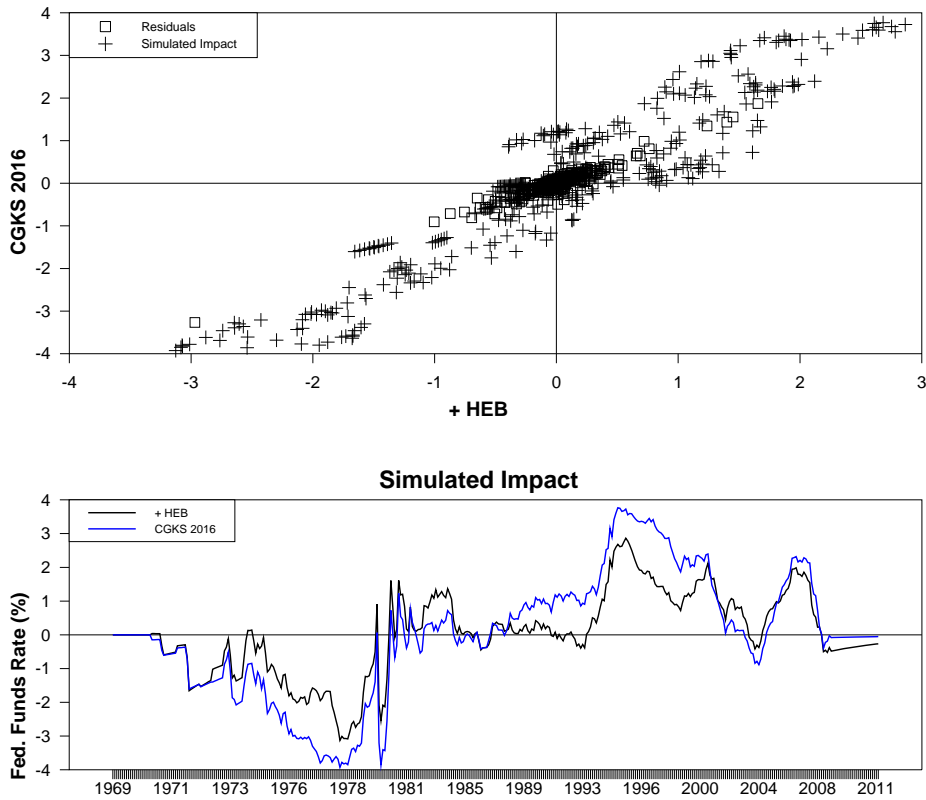


FIGURE 6. MONETARY POLICY SHOCKS WITH AND WITHOUT HEB

*Note:* This figure shows how the addition of HEB alters estimates of monetary policy shocks and their impact on the federal funds rate target. The upper panel shows a scatter plot of results which ignore the fiscal variables (x-axis) versus those which include fiscal variables (y-axis). Squares indicate OLS regression residuals (i.e. estimated policy shocks) while crosses indicate their estimated impact on the federal funds rate target. Time series for the latter are also compared in the lower panel, where estimates excluding fiscal variables are labelled *CGKS 2016*.

## Monetary Shocks with and without (HEB and SURPLUS)

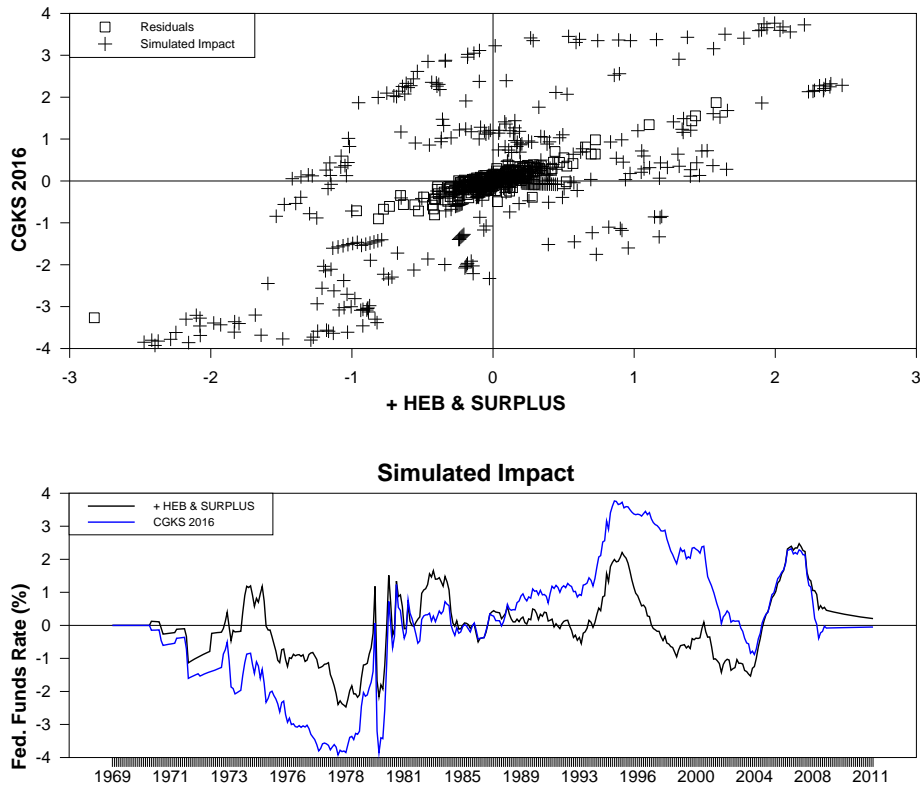


FIGURE 7. MONETARY POLICY SHOCKS WITH AND WITHOUT HEB AND SURPLUS

*Note:* This figure shows how the addition of HEB and SURPLUS alters estimates of monetary policy shocks and their impact on the federal funds rate target.

The upper panel shows a scatter plot of results which ignore the fiscal variables (x-axis) versus those which include fiscal variables (y-axis). Squares indicate OLS regression residuals (i.e. estimated policy shocks) while crosses indicate their estimated impact on the federal funds rate target. Time series for the latter are also compared in the lower panel, where estimates excluding fiscal variables are labelled *CGKS 2016*.