2018

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Dean D. Croushore
University of Richmond, dcrousho@richmond.edu

Simon van Norden

Recommended Citation

Croushore, Dean and Simon van Norden. "Fiscal Forecasts at the FOMC: Evidence from the Greenbooks." *The Review of Economics and Statistics* 100, no. 5 (December 2018): 933-945. https:doi.org/ 10.1162/rest_a_00664.

FISCAL FORECASTS AT THE FOMC: EVIDENCE FROM THE GREENBOOKS

Dean Croushore and Simon van Norden*

Abstract—This paper examines fiscal policy forecasts prepared for the Federal Open Market Committee and its influence on U.S. monetary policy. The forecasts contain useful information beyond that in the CBO's forecasts. Fiscal forecast errors are only weakly correlated with forecast errors for inflation and output growth, but those for the budget surplus are 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 that Romer and Romer (2004) studied, consistent with the board's statements on the importance of fiscal policy.

I. Introduction

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 a 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. 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 and their forecast performance. Given the Federal Reserve's long-standing recognition of the role that fiscal policy plays in monetary policy deliberations, which we document in this paper, this is also needed to properly 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.

Section II discusses the literature on forecasts of fiscal policy, followed by a review in section III of the narrative evidence from the Board of Governors on the relationship between fiscal and monetary policy. Section IV describes the new Greenbook data set and the data transformations we use, and we evaluate the quality of the Greenbook forecasts in section V, testing them for bias and comparing the properties of the forecast errors of the Greenbook forecasts to those of the Congressional Budget Office (CBO). The remainder of the paper explores the relationship between the board staff's forecasts of fiscal variables and the policy decisions of the Federal Open Market Committe (FOMC) in a variety of ways. Section VI describes the relationship between fiscal forecast errors on the one hand and forecast errors in inflation and economic growth on the other. Section VII 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.

II. 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 therefore review fiscal forecasting separately for the United States and the EU to set the stage for our later analysis.

Received for publication November 7, 2014. Revision accepted for publication October 28, 2016. Editor: Yuriy Gorodnichenko.

* Croushore: University of Richmond; van Norden: HEC Montréal.

We 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. We also thank the editor and referees, as well as seminar participants at the Joint Statistical Meetings in Miami Beach and Montreal, 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.

A supplemental appendix is available online at http://www.mitpressjournals.org/doi/suppl/10.1162/rest_a_00664.

The Review of Economics and Statistics, December 2018, 100(5): 933–945

doi:10.1162/rest_a_00664

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, a nonpartisan arm of the U.S. Congress, 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, while their five-year projections are worse (though not statistically significantly worse). 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, 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 upward, 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 nonpartisan 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 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 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.[1]

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 Commissions'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."[2] In contrast, Beetsma, Giuliodori, and Wierts (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. 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

[1] 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.

[2] See Leal et al. (2008, p. 350).

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.[3] 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 depend on the extent to which the FOMC has considered fiscal policy to be an important factor. We examine this question quantitatively later in the paper. Before considering the forecasts themselves, however, we review some of the Federal Reserve Board's public statements on the relationship between U.S. monetary and fiscal policy.

III. 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.[4] A few weeks later, responding to 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).[5] However, our period of interest is that covered by the Greenbooks (from 1965 on), one that saw considerable variation in both monetary and fiscal policy and in economic conditions. In the remainder of this section, we 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 fiscal and monetary policy jointly determine economic conditions.
2. Fiscal policy is thought to affect the economy primarily through its contribution to overall aggregate demand.[6]
3. The board takes fiscal policy as exogenous; its members ignore possible reactions of fiscal policy to their policy choices.[7]

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."[8] 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."[9]

During his nomination hearings, Arthur F. Burns testified, "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."[10]

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

[4] "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 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." Ben S. Bernanke, Semiannual Monetary Policy Report to the Congress before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, Washington, DC, February 26, 2013.

[5] 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.

[6] 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.

[7] 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 terms.

[8] William McChesney Martin Jr., "Statement before the Joint Economic Committee," February 26, 1969, https://fraser.stlouisfed.org/title/?id=448#!7936.

[9] 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.

[10] Nomination of Arthur F. Burns: Hearing before the Committee on Banking and Currency, U.S. Senate, Ninety-First Congress, First Session on the Nomination of Arthur F. Burns to Be a Member of the

His successor, G. William Miller, testified at his own nomination hearings, "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 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."[11]

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."[12]

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 codeterminant 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 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.[13] This in turn may simply have reflected the limited influence that fiscal variables have on monetary aggregates (such as the growth rate of M2 or the ratio of nonborrowed 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 to 2002) in particular gives a detailed view of the FOMC decision process.[14] 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 codeterminant 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, 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."[15] Similarly, Governor Ned Gramlich discussed the roles of the monetary and fiscal authorities in stablization policy and concluded, "On the monetary side, authorities should try to stabilize the economy without anticipating help from fiscal policy."[16]

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 as a source of both long-run concern and near-term economic shocks. 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."[17]

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

Board of Governors of the Federal Reserve System, December 18, 1969, https://fraser.stlouisfed.org/title/?id=783.

[11] Nomination of G. William Miller: Hearing before the Committee on Banking, Housing, and Urban Affairs, U.S. 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.

[12] "Federal Reserve's First Monetary Policy Report for 1979: Hearings before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, Ninety-Sixth Congress, First Session," Monetary Policy Oversight—Senate Hearings (February 20, 23, 1979), p. 111. https://fraser.stlouisfed.org/title/?id=671#!22306.

[13] As one of many examples, see 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 Banking, Housing, and Urban Affairs, U.S. Senate, and the Subcommittee on Economic Policy, Ninety-Eighth Congress, First Session, https://fraser.stlouisfed.org/title/?id=671#!22315.

[14] Laurence H. Meyer, "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.

[15] Laurence H. Meyer, "Monetary Policy Objectives and Strategy," remarks before the National Association of Business Economists 38th Annual Meeting, Boston, September 8, 1996, https://fraser.stlouisfed.org/title/?id=936#!36375.

[16] Edward M. Gramlich, "A Stabilization Policy Strategy," remarks before the Wharton Public Policy Forum Series, Philadelphia, April 22, 1999, https://fraser.stlouisfed.org/title/?id=914#!35463.

[17] Alan Greenspan, "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.

IV. 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.[18] 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% or 6.0% natural rate of unemployment (which we call HEB6), the unemployment rate, and nominal output.[19] The HEB variables are designed to 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.[20] 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 downward. This caused both the surplus as well as GDP to be revised upward. 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% natural rate of unemployment, but before that, the assumed natural rate of unemployment varied as it drifted up from an initial 4% 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.[21] 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 shows a sample Greenbook page. Each variable in it can be represented as a string of estimates for past quarters (e.g., horizons -1, -2), the current quarter (horizon 0), and future quarters (e.g., horizons 1, 2).

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 twelve 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 onward.[22] 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).[23] 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.[24]

V. Evaluating the Forecasts

Forecast evaluation requires a comparison of forecasts with a measure of outcomes. As the literature shows (see Croushore, 2011), the revision of published 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

[18] 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.

[19] All the fiscal variables are reported on a National Income and Product Accounts (NIPA) basis rather than a fiscal-year basis.

[20] From September 1988 onward, HEB estimates were also accompanied by estimates of the fiscal impetus.

[21] See the Federal Reserve Board website for FOMC Historical Materials (www.federalreserve.gov/monetarypolicy/fomc_historical.htm) and the Philadelphia Fed's Real-Time Data Research Center website (www.philadelphiafed.org/research-and-data/real-time-center/).

[22] Expenditures, receipts, HEB, and HEB6 typically have the shortest forecast horizons.

[23] Note that our output series were recorded in levels, not growth rates.

[24] 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).

FIGURE 1.—A SAMPLE GREENBOOK PAGE

Strictly Confidential (FR)
Class II FOMC

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

January 29, 1997

Item	Fiscal year[5] 1995[a]	1996[a]	1997	1998	1996 Q1[a]	Q2[a]	Q3[a]	Q4	1997 Q1	Q2	Q3	Q4	1998 Q1	Q2	Q3	Q4
UNIFIED BUDGET					Not seasonally adjusted											
Receipts[1]	1355	1453	1525	1575	322	446	362	346	341	459	380	363	351	469	392	382
Outlays[1]	1519	1560	1634	1692	393	392	395	405	412	408	410	426	419	424	422	471
Surplus/deficit[1]	-164	-107	-109	-117	-72	54	-33	-59	-71	51	-31	-63	-68	45	-30	-89
On-budget	-226	-174	-184	-187	-84	14	-36	-76	-83	11	-36	-72	-81	2	-36	-101
Off-budget	62	67	75	69	12	39	2	18	12	40	5	8	12	43	6	11
Surplus excluding deposit insurance[2]	-182	-116	-118	-120	-75	52	-34	-65	-72	51	-32	-64	-69	44	-31	-90
Means of financing																
Borrowing	171	130	118	146	80	-23	39	49	58	-31	43	54	69	-25	48	73
Cash decrease	-2	-6	4	0	-1	-16	-6	11	13	-16	-4	10	10	-15	-5	10
Other[3]	-5	-16	-13	-29	-7	-14	0	-1	1	-5	-8	0	-11	-5	-13	6
Cash operating balance, end of period	38	44	40	40	22	38	44	33	20	36	40	30	20	35	40	30
NIPA FEDERAL SECTOR					Seasonally adjusted, annual rate											
Receipts	1459	1544	1625	1684	1523	1576	1582	1625	1606	1626	1645	1663	1672	1691	1711	1731
Expenditures	1629	1683	1749	1798	1678	1702	1703	1730	1741	1755	1772	1782	1792	1802	1815	1829
Consumption expend	455	457	462	463	454	464	461	463	460	461	464	463	464	462	464	460
Defense	304	303	303	305	299	307	305	306	301	302	304	305	306	303	305	303
Nondefense	151	155	159	158	155	156	157	157	159	160	160	157	158	159	159	157
Other expenditures	1175	1226	1287	1335	1225	1239	1241	1267	1281	1294	1308	1319	1328	1340	1351	1369
Current account surplus	-171	-139	-124	-114	-155	-127	-121	-105	-135	-129	-127	-119	-120	-112	-104	-98
Gross investment	65	63	62	62	65	66	64	64	61	62	62	63	62	61	61	60
Current and capital account surplus	-236	-202	-186	-176	-220	-193	-185	-169	-196	-190	-189	-182	-182	-172	-166	-159
FISCAL INDICATORS[4]																
High-employment (HEB) surplus/deficit	-263	-237	-245	-249	-247	-233	-231	-222	-251	-251	-254	-253	-253	-247	-244	-241
Change in HEB, percent of potential GDP	0	- 4	1	1	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	1 3	1 8	- 2	- 8	-2 2	- 5	1	-2 7	-1 8	-1 3	- 3	-2

1-24

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 the enactment of the President's proposals), excluding deposit insurance spending, are $134 billion in FY97 and $96 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

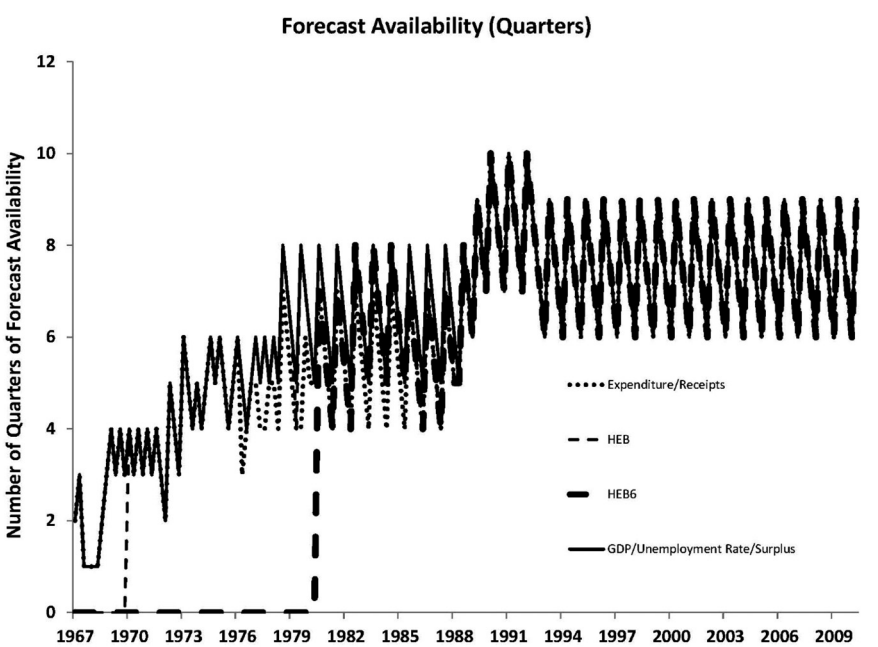
4 HEB is the NIPA current and capital account surplus in current dollars, with cyclically sensitive receipts and outlays adjusted to the level of potential output generated by 1 8 percent real growth and an associated unemployment rate of 6 percent Quarterly figures for change in HEB and FI are not at annual rates Change in HEB, as a percent of nominal potential GDP, is reversed in sign FI is the weighted difference of discretionary changes in federal spending and taxes (in chained (1992) dollars), scaled by real federal consumption plus investment For change in HEB and FI, negative values indicate restraint

5 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

a--Actual

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



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.

TABLE 1.—SUMMARY TABLE OF GREENBOOK FISCAL FORECASTS

Variable definitions

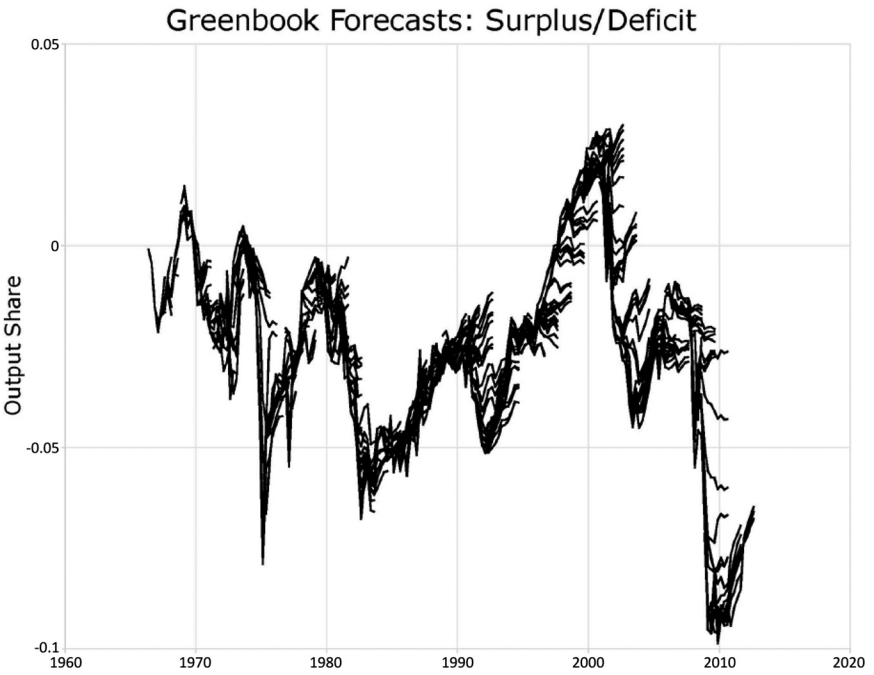
Surplus: The conventionally measured federal government budget surplus (negative for deficit); equals receipts minus expenditures.
Expenditures: Federal government current expenditures; major redefinitions occurred in 1996 when investment was removed from expenditures and capital depreciation was added, and in 1999 when spending on software was reclassified as investment.
Receipts: Federal government receipts from all sources.
HEB: The high-employment budget surplus, based on assumed natural rates of unemployment, which rose from 4.0% initially to 6.1% in 1983Q4
HEB6: The high-employment budget surplus based on a 6.0% or 6.1% natural rate of unemployment over time, beginning in 1980Q4; HEB = HEB6 beginning in 1983Q4.

Forecast availability

Pre-1981: Irregular pattern of forecast horizons, generally two to six quarter horizons.
1981–1988: Typically seven quarters in Q1, six in Q2, five in Q3, four in Q4.
1989–1992: Irregular pattern of forecast horizons, generally five to ten quarter horizons.
1993–2010: Typically eight quarters in Q1, seven in Q2, six in Q3, nine Q4.

All of the fiscal variables are reported in nominal terms. We divide forecasts of fiscal variables by forecasts of nominal output and realizations of fiscal variables by realized nominal output.

FIGURE 3.—GREENBOOK GOVERNMENT SURPLUS FORECASTS



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).

Income and Product Accounts (NIPA), called prebenchmark data, for expenditure, receipts, and surplus measures that are part of the NIPA.[25] 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.[26] 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.[27]

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.

[25] We constructed prebenchmark series using original vintage data from the ALFRED database at the Federal Reserve Bank of St. Louis.

[26] This means omitting forecasts made just before a benchmark change for which official estimates were published only after the change.

[27] 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.

TABLE 2.—SUMMARY RESULTS OF BIAS TESTS

	Surplus		Expenditures		Receipts		HEB		HEB6	
Horizon	First	Last	First	Last	First	Last	First	Last	First	Last
0	0.48	0.87	0.06*	0.13	0.31	0.07*	< 0.01***	< 0.01***	0.04**	0.03**
1	0.96	0.86	0.53	0.51	0.59	0.74	< 0.01***	< 0.01***	0.05*	0.13
2	0.39	0.43	0.78	0.92	0.21	0.22	< 0.01***	< 0.01***	0.04**	0.07*
3	0.17	0.24	0.53	0.73	0.07*	0.08*	< 0.01***	< 0.01***	0.02**	0.03**
4	0.14	0.15	0.48	0.58	0.04**	0.04**	< 0.01***	< 0.01***	0.02**	0.02**
1–4	0.32	0.29	0.61	0.63	0.14	0.16	< 0.01***	< 0.01***	0.09*	0.08*

The figures shown are *p*-values for tests of the null hypothesis that the mean forecast error is 0. Asterisks indicate the *p*-values associated with tests of the null hypothesis that the median forecast error is 0 (*/**/*** indicate *p*-values less than 10/5/1%). Calculations use Newey-West heteroskedasticity and autocorrelation robust standard errors with the number of lags equal to the forecast horizon because the data are known with a lag of one period and because we face the overlapping-observations problem. 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.

TABLE 3.—ZERO-MEDIAN TESTS OF FORECAST ERRORS

	Surplus		Expenditures		Receipts		HEB		HEB6	
Horizon	First	Last	First	Last	First	Last	First	Last	First	Last
0	0.43	0.46	0.60**	0.58**	0.53	0.61***	0.60**	0.66***	0.56	0.58*
1	0.42*	0.42*	0.53	0.51	0.51	0.50	0.60***	0.59**	0.57*	0.53
2	0.37*	0.38	0.41	0.45	0.42	0.41	0.62*	0.65**	0.58	0.61
3	0.36	0.38	0.38	0.40	0.45	0.36	0.64	0.62	0.59	0.56
4	0.34	0.31	0.23***	0.20***	0.31	0.34	0.54	0.57	0.45	0.55

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 0 (*/**/*** 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.

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 0, and the coefficient on the forecasts should equal 1. However, Mankiw and Shapiro (1986) show that in small samples (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 forecast horizons (zero, one, two, three, and four quarters ahead, as well as the average value of the variable over the next four quarters, labeled 1 to 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 1.

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.[28]

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 0, following Campbell and Dufour (1991), and Campbell and Ghysels (1995), also called sign tests.[29] Table 3 shows the *p*-values of the test statistic of the null hypothesis that forecast errors have a median of 0.

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.

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."

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

[29] These tests control for serial correlation in forecast errors caused by overlapping forecasts and allow for exact inference in small samples.

TABLE 4.—GREENBOOK VERSUS CBO

Variable	Surplus		Receipts		Expenditures	
Horizon (years)	0	1	0	1	0	1
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	**0.031**	**0.034**	0.342	0.142
H_0 : Equal absolute loss	0.578	0.221	**0.022**	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	**0.003**	**0.015**	**0.017**	0.071

RMSFE: 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. *p*-values $< 5\%$ are in bold.

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 be recalled that the CBO forecast conditions on distinctly different assumptions. 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.[30] 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 available from only 1990 on.

Table 4 compares the performance of the Greenbook and the CBO in a number of ways. The first two rows simply report the root-mean-squared forecast errors. We see that Greenbook forecasts are somewhat more accurate in every case. The third and fourth rows test the null hypothesis that the two forecasts have equal quadratic loss and absolute loss, respectively, and report the associated *p*-values.[31] We find that the Greenbook forecasts are significantly more accurate for government receipts but not for expenditures or the surplus.[32]

The final two rows 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% level.)[33] 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 that 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.

VI. Forecast Errors

Despite the narrative evidence we have given, one might question whether the Fed's expectations of fiscal variables should matter much for monetary policy outcomes. In this section, we first consider a weaker condition by examining whether forecast errors for fiscal variables are correlated with forecast errors of headline variables such as real growth and inflation. We do so by simply regressing the latter on the former, considering results for the full sample, the pre-1991 sample, and the post-1990 sample. As headline variables, we used two inflation measures (CPI and the GDP deflator) and three real activity measures (real GDP growth, the unemployment rate, and the output gap).[34] Consistent with the

[30] 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 forecasts whose outcomes were affected by definitional changes. The latter had only a minor impact on our results.

[31] We use the modified Diebold-Mariano statistics proposed by Harvey, Leybourne and Newbold (1997).

[32] 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.

[33] In all of these cases, our estimates implied that moving the CBO forecast more toward that of Greenbook would improve the former's forecast accuracy.

[34] Unemployment rates were collected directly from Greenbooks. 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

TABLE 5.—GREENBOOK FORECAST ERRORS FOR UNEMPLOYMENT RATE

Horizon	Full Sample			Pre-1991			Post-1990		
UNEMP = $\alpha + \beta \cdot$ HEB	R^2	β	t-Stat	R^2	β	t-Stat	R^2	β	t-Stat
0Q First	0.003	1.8	0.69	0.020	5.1	2.79	0.027	−3.8	−0.97
2Q First	0.007	−4.8	−0.94	0.001	−2.0	−0.26	0.055	−8.8	−1.43
4Q First	0.025	−10.4	−0.89	0.004	5.0	0.33	0.277	−27.8	−2.27
UNEMP = $\alpha + \beta \cdot$ SURPLUS	R^2	β	t-Stat	R^2	β	t-Stat	R^2	β	t-Stat
0Q First	0.067	−9.5	−1.68	0.127	−14.3	−1.92	0.001	0.8	0.27
2Q First	0.302	−26.1	−4.13	0.381	−33.9	−4.69	0.186	−13.3	−3.32
4Q First	0.410	−32.5	−4.46	0.420	−43.0	−3.84	0.478	−25.2	−4.44
UNEMP = $\alpha + \beta \cdot$ RECEIPTS	R^2	β	t-Stat	R^2	β	t-Stat	R^2	β	t-Stat
0Q First	0.054	−12.1	−1.96	0.070	−16.3	−1.65	0.034	−6.5	−1.33
2Q First	0.074	−20.2	−2.94	0.062	−22.4	−2.18	0.152	−17.5	−2.64
4Q First	0.133	−30.6	−3.09	0.037	−23.0	−0.84	0.313	−34.0	−3.39
UNEMP = $\alpha + \beta \cdot$ EXPEND	R^2	β	t-Stat	R^2	β	t-Stat	R^2	β	t-Stat
0Q First	0.017	6.2	1.16	0.064	14.0	1.95	0.045	−7.5	−1.95
2Q First	0.345	44.0	4.14	0.482	57.0	6.11	0.071	14.5	2.27
4Q First	0.528	55.3	4.83	0.674	71.8	5.67	0.390	39.8	4.63

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.

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).[35] We now summarize the main results; complete results are presented in the online appendix.

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.[36] Correlations between errors in Greenbook real output growth forecasts and fiscal balance variables were also quite modest, although occasionally significant and positive.[37] However, forecast errors in the 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 table 5 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 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.

for these varibles. 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 prebenchmark 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.

[35] Greenbook forecasts for the output gap and CPI inflation were available from only 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 consider only 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, excluding food and energy) data in place of the GDP deflator; results were qualitatively similar.

[36] 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% to 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 (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.

[37] 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 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 the 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 explained only about 10% of the variance in real output growth.

VII. 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.[38] 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."[39] However, Rossi and Zubairy (2011) show that neglecting the role of fiscal policy can distort our perceptions of monetary policy and its effects. In the remainder of this section, we use our Greenbook forecasts to investigate how taking account of fiscal variables alters Romer and Romer's (2004) 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).[40] We added forecasts of the surplus and of HEB in various combinations together with the revisions in those forecasts.[41] Because the potential sample period varies slightly depending on the set of variables included, we take care to reestimate the original Romer and Romer (2004) specification over precisely the sample period used for each of our fiscal variable specifications.[42]

Coefficient estimates are presented in the online appendix. Table 6 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.[43] 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.

[38] The control variables that they use consist of (a) the level of the fed funds rate target prior to the FOMC meeting, (b) the estimated rate of unemployment, and Greenbook estimates of past, current, and future values of (c) inflation and (d) real output, as well as (e and f) revisions in these forecasts from those of previous FOMC meeting.

[39] Romer and Romer (2004, p. 1064).

[40] We used the extended data set assembled by Coibion et al. (2012), available at http://eml.berkeley.edu/~ygorodni/RR_MPshocks_Updated.xls.

[41] 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.

[42] 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 prefered 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.

[43] To do so, we simply set all the control variables to 0 and shocked the federal funds rate with the estimated OLS residuals.

TABLE 6.—REVISED ESTIMATES OF ROMER AND ROMER (2004): SUMMARY STATISTICS

	Surplus and Innovation	Surplus	HEB and Innovation	HEB	Surplus and HEB
R^2 with	0.2677	0.2635	0.3891	0.3588	0.3942
R^2 without	0.2334	0.2342	0.3087	0.2889	0.2889
p-value (F)	0.0538	0.0106	0.0016	0.0001	0.0000
Shock correlation	0.9774	0.9807	0.9401	0.9496	0.9230
Impact correlation	0.9836	0.9853	0.9204	0.9332	0.6413

Results for revised estimates of exogenous monetary policy shocks based on Romer and Romer's (2004) 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 are in the appendix. **and Innovation:** 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 0. **Shock correlation:** Correlation between policy shocks estimated when including and excluding fiscal variables. **Impact correlation:** Correlation between impact of shocks on federal funds rate estimated when including and excluding fiscal variables.

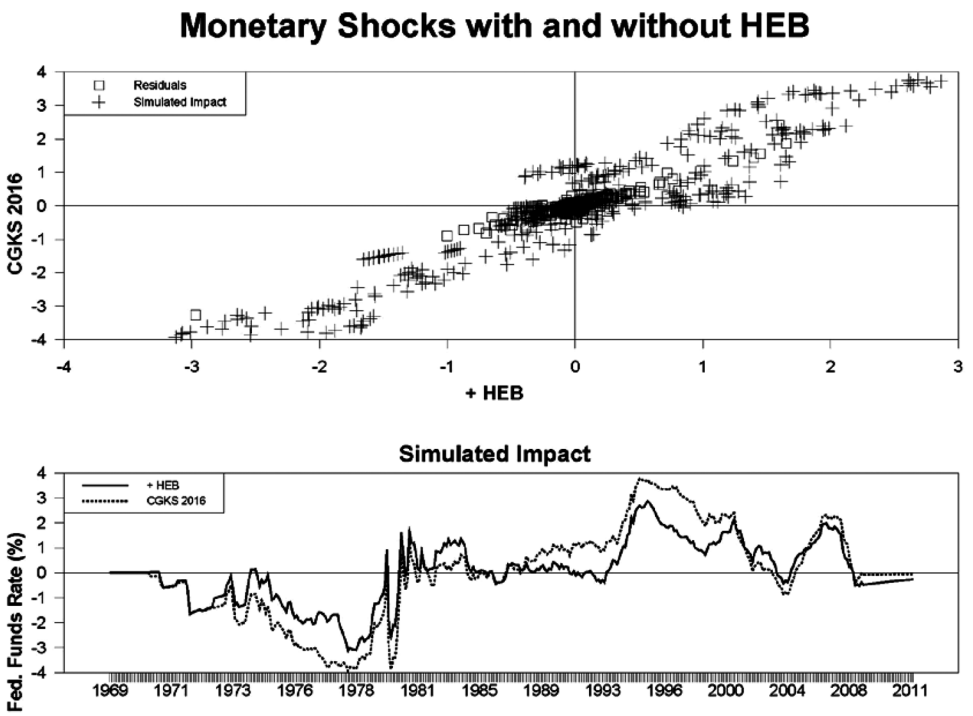
Table 6 shows that the addition of fiscal forecasts is strongly statistically significant in almost every case, implying that the federal funds rate target has historically adjusted in response to anticipated fiscal developments. The inclusion of the surplus boosts the regression R^2 from 23% to 26%, while the inclusion of HEB boosts it from 29% to 36%. Changes in the estimated monetary policy shocks are modest; correlations between the old and new shocks series hover around the 94% to 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 4 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 6 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 5, 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.[44]

While the above evidence suggests that fiscal policy has influenced monetary policy targets, it is 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)

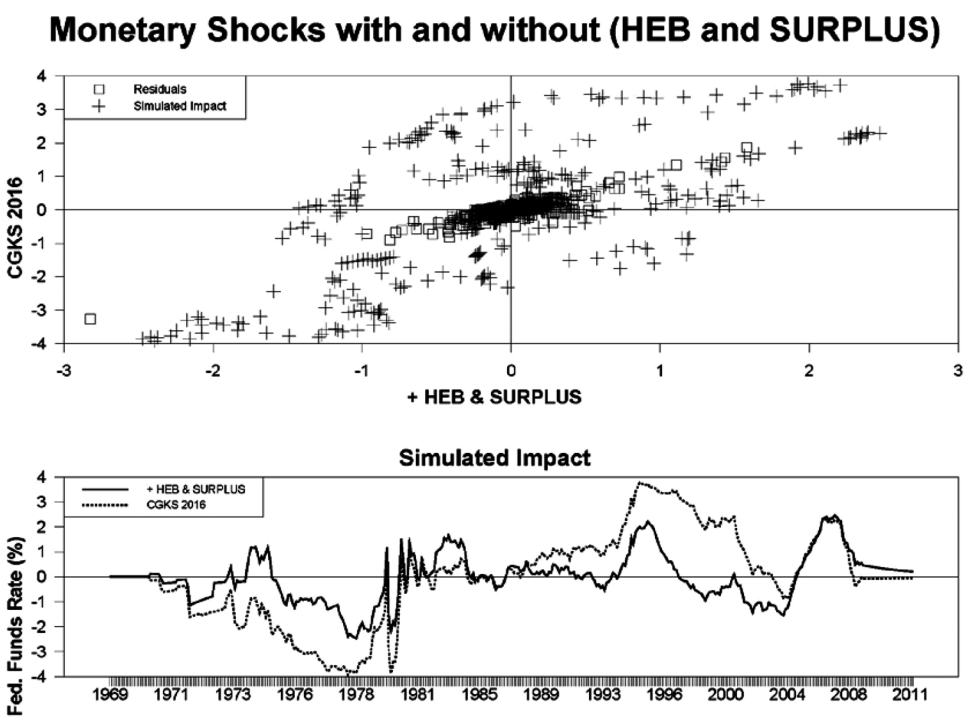
[44] Part of the reason for the substantial change in the estimated impact of shocks lies in the change in the estimated size of the error-correction coefficient, which almost doubles from −0.018 to −0.033, implying less shock persistence.

FIGURE 4.—MONETARY POLICY SHOCKS WITH AND WITHOUT HEB



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 that ignore the fiscal variables (*x*-axis) versus those that 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 labeled *CGKS 2016*.

FIGURE 5.—MONETARY POLICY SHOCKS WITH AND WITHOUT HEB AND SURPLUS



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 that ignore the fiscal variables (*x*-axis) versus those that 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 labeled *CGKS 2016*.

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 where fiscal variables appear most important, the results in table 6 show that they explain only about 10% of the variance of changes in the federal funds rate target, with exogenous monetary policy shocks accounting for the lion's share.

VIII. Summary and Conclusion

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 in terms of both mean-squared errors and (in several cases) forecast encompassing. However, forecasts for other fiscal variables 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.

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