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**Fiscal Forecasts at the FOMC:  
Evidence from the Greenbooks**

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Série Scientifique/Scientific Series

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# Fiscal Forecasts at the FOMC: Evidence from the Greenbooks\*

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## Résumé/abstract

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 bias in the Fed Staff's fiscal forecasts and that these 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 structural surplus are much more highly correlated with those for the unemployment rate. 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).

**Mots clés/keywords** : fiscal policy, deficits, forecasting, FOMC, Greenbook

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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 suitable data sets. As we explain below, work on U.S. data has used forecasts that are perceived to have important defects. 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 doing so, it allows us to understand the extent to which monetary policymakers have been able to understand and anticipate fiscal changes, as well as how they learn over time about the trajectory of the federal government's fiscal balance.

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 (2014) 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 also examine estimates and forecasts of the cyclically-adjusted deficit to understand better how fiscal policy relates to perceptions of economic conditions.

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. One study, 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 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>

<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.



### *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. Each country creates its own forecast, however, 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> 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.

<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.

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 Board sometime 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 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.

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.
- 2) Fiscal policy is thought to affect the economy primarily through its contribution to overall aggregate demand.<sup>7</sup>

<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.

<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

- 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 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>

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.

<sup>12</sup>Nomination of G. William Miller: Hearing Before the Committee on Banking, Housing, and Urban

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 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.)

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 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.

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 mentioned fiscal policy, both as a source of long-run concern and as a source of 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

<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.

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 2006.<sup>19</sup> The Greenbook reports the Federal Reserve Board staff’s forecasts before every FOMC meeting (which 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, nominal output, and real output.<sup>20</sup> 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

<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 Appendix to Croushore and van Norden (2014) for details. As with other FOMC briefing materials, Greenbooks are not released for at least five years. We end our sample before the start of the Global Financial Crisis.

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

be if the unemployment rate were at a constant reference level over the forecast horizon. 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>21</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 Appendix to Croushore and van Norden (2014) provides more 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 (horizons -1, -2, etc.), the current quarter (horizon 0), and future quarters (horizons 1, 2, etc.).

<sup>21</sup>See the Federal Reserve Board website for FOMC Historical Materials and the Philadelphia Fed's Real-Time Data Research Center web site.



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>22</sup> Table 1 shows definitions of the variables, their forecast horizons, and the number of observations by period.<sup>23</sup>

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. This pattern looks different from the behavior we see in the first half of the sample, something we investigate below.

<sup>22</sup>Expenditures, receipts, HEB, and HEB6 typically have the shortest forecast horizons.

<sup>23</sup>See the Appendix to this paper for additional details.

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

TABLE 1—SUMMARY TABLE OF GREENBOOK FISCAL FORECASTS

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**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 the early 1980s;

HEB = HEB6 beginning in the fourth quarter of 1983.

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**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 2006: 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

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#### 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>25</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>26</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>27</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>25</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>26</sup>This means omitting forecasts made just before a benchmark change for which official estimates were published only after the change.

<sup>27</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 or receipts at any horizon. Expenditure forecasts are significantly biased (forecasts exceeded realizations, on average) at a zero-quarter horizon, but not for longer horizons. HEB forecasts are biased for almost all horizons (again with forecasts exceeding realizations, on average) while there is never significant evidence of bias for HEB6, suggesting that the “drift” in the benchmark rate of unemployment prior to the early 1980s is responsible for the bias.

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

TABLE 2—SUMMARY RESULTS OF BIAS TESTS

Horizon	Surplus		Expenditures		Receipts	
	First	Last	First	Last	First	Last
0	0.20	0.56	< 0.01	0.01	0.28	0.07
1	0.48	0.52	0.21	0.18	0.86	0.74
2	0.84	0.93	0.65	0.55	0.37	0.44
3	0.49	0.60	0.93	0.76	0.17	0.20
4	0.42	0.42	0.89	0.82	0.09	0.10
1-4	0.67	0.60	0.90	0.90	0.28	0.33

Horizon	HEB		HEB6	
	First	Last	First	Last
0	< 0.01	< 0.01	0.49	0.48
1	0.02	0.03	0.56	0.74
2	< 0.01	0.02	0.30	0.50
3	< 0.01	< 0.01	0.13	0.19
4	< 0.01	< 0.01	0.12	0.12
1-4	0.04	0.02	0.38	0.36

*Note:* The figures shown are  $p$ -values for tests of the null hypothesis that the mean forecast error is zero. 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 2006Q4, 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.

Campbell and Dufour (1991) and Campbell and Ghysels (1995), also called sign tests.<sup>28</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	0.411*	0.442	0.643***	0.612***	0.543	0.620***
1	0.398**	0.391**	0.570*	0.555	0.508	0.508
2	0.349**	0.333**	0.556	0.540	0.429	0.397
3	0.310*	0.357	0.429	0.452	0.429	0.333
4	0.323	0.290	0.194***	0.161***	0.290	0.323

Horizon	HEB		HEB6	
	First	Last	First	Last
0	0.581*	0.628***	0.529	0.538
1	0.586**	0.563	0.544	0.485
2	0.619*	0.651**	0.569	0.608
3	0.643	0.595	0.606	0.576
4	0.548	0.581	0.520	0.560

*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 2006Q4, except for HEB6, for which the sample is 1981Q1 to 2006Q4. *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 except HEB6. While they reinforce the previous findings from the zero-mean tests that showed bias in current-quarter forecasts for expenditures and HEB forecasts at all horizons, the median tests also show bias in short-horizon forecasts for the surplus, plus some evidence of bias at the current-quarter horizon for receipts, as well as for expenditures at the four-quarter horizon.

If we examine the forecast errors for expenditures at a zero horizon, as shown in Figure 4, we see that government expenditures were generally forecasted too high in the 1970s, 1980s, and 1990s, and then too low in the 2000s. It is surprising

<sup>28</sup>These tests control for serial correlation in forecast errors caused by overlapping forecasts and allow for exact inference in small samples.

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 forecasts at a zero horizon, 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>29</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>29</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>30</sup> Both sets of forecasts are compared in Table 4. Forecasts for the current and next calendar year were available from 1982 to 2006, 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 CBO forecasts are slightly more accurate in two of the six cases. The third line tests the null hypothesis that the two forecasts have equal mean-squared forecast errors and reports the associated  $p$ -values.<sup>31</sup> We find that the Greenbook forecasts are significantly more accurate only for current-year forecasts of receipts and year-ahead forecasts of receipts and expenditures. There is no statistically significant difference in the accuracy of their forecasts of the surplus. Perhaps surprisingly given the apparently small difference in mean-squared forecast error, we also find that the CBO forecasts for year-ahead receipts are more accurate than the Greenbook's. The fourth line in the table shows how our conclusions change when we test the null hypothesis of equal expected absolute forecast error. Results are similar, although we now find that Greenbook performs significantly better for the year-ahead surplus but not expenditures.

The final two lines of the table provide the results of forecast encompassing

<sup>30</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 the Greenbook's output forecasts. The CBO forecasts were made in late January or early February of each year, except for 1996 when the forecast was made in May. 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>31</sup>We use the modified Diebold-Mariano statistics proposed by Harvey, Leybourne and Newbold (1998).



TABLE 4—GREENBOOK VERSUS CBO

Variable	Surplus		Receipts		Expenditures	
	0	1	0	1	0	1
<b>Horizon (Years)</b>						
RMSFE - Greenbook	0.00901	0.01396	0.00504	0.01026	0.00527	0.00918
RMSFE - CBO	0.00873	0.01658	0.00658	0.01008	0.00564	0.00962
$H_0$ : Equal Quadratic Loss	0.804	0.108	0.008	0.000	0.431	0.033
$H_0$ : Equal Absolute Loss	0.917	0.032	0.004	0.004	0.760	0.374
$H_0$ : GB encompasses CBO	0.075	0.225	0.923	0.001	0.200	0.528
$H_0$ : CBO encompasses GB	0.306	0.062	0.000	0.000	0.002	0.001

*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 Diebold and Mariano (2002) 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.

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 expenditures (and we can reject the same hypothesis for the year-ahead surplus forecasts at the 10% level.) This implies that the Greenbook forecasts 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. However, we also find one instance (for year-ahead forecasts of receipts) in which the Greenbook forecasts clearly do not encompass those of the CBO, indicating that CBO forecasters had valuable insights that the Board staff lacked.

## V. Forecast Errors

Given that the Fed has no responsibility for the conduct of fiscal policy, one might wonder whether its ability to forecast fiscal variables matters for monetary policy outcomes. Are their forecast errors for fiscal variables even related to forecast errors of headline variables such as GDP 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 CPI less food and energy) and three real activity measures (real GDP growth, the unemployment rate and the output gap.)<sup>32</sup> Consistent with the Greenbook forecasts, both inflation measures and output growth are 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>33</sup> To conserve space, we present only selected results in depth after a brief summary.

With few exceptions, correlations between the inflation measures and our measures of fiscal balance (Surplus, HEB and HEB6) were very low and insignificantly different from zero.<sup>34</sup> Correlations between real growth measures and the fiscal balance measures were only slightly higher and also typically insignificant.<sup>35</sup> The

<sup>32</sup>Unemployment rates were collected directly from Greenbooks and checked against those available from the Federal Reserve Bank of St. Louis' ALFRED. The CPI Greenbook forecasts were taken from ALFRED (series CPIAUCSLGBFP and CPILFESLGBFP) and compared to the current vintage CPI series from FRED (series CPIAUCSL and CPILFESL, October 15, 2015 vintage.) What we refer to as real GDP growth is in fact real GNP growth (ALFRED series GNPCGBFL) prior to 1992 and real GDP growth (ALFRED series GDPC1GBFL) thereafter. Outcomes were measured using current vintages of output from the Real-Time Data Set for Macroeconomists at the Federal Reserve Bank of Philadelphia web site, though we found that the results are robust to the use of prebenchmark data instead. The Board Staff's estimates of the output gap are those made available by the Federal Reserve Bank of Philadelphia.

<sup>33</sup>The pre-1991 sample was sometimes constrained by limited availability of the Greenbook data. Although GNP forecasts are available from the start of 1978 and CPI inflation forecasts from October 1979, CPI ex food and energy forecasts are only available from early 1986 onwards. Other price measures, such as output or consumption deflators, had still shorter time spans available. More on the results from splitting the sample is available in Croushore and van Norden (2014).

<sup>34</sup>The  $R^2$  from these regressions was almost always less than 5% and typically less than 1%. We rejected the null hypothesis of no correlation at the 5% significance level in 24 of the 180 cases we examined. Many of these were in the pre-1991 sample, where sample sizes were very small. There appeared to be a small but significant positive correlation between forecast errors for CPI inflation (but not CPI-ex-food-and-energy) and HEB or HEB6 in the full-sample at horizons of up to 2Q.

<sup>35</sup>Aside from the exceptions that we note, the  $R^2$ 's were almost always less than 10% and typically less than 5%. We rejected the null hypothesis of no correlation at the 5% significance level in 9 of the 80 cases we examined.

main exception to this was in the case of the Surplus in the post-1990 sample, at horizons of 2F or more, where we found marginally significant positive correlations that explained 10-15% of the variance in real GDP growth. Given the lack of similar evidence when using HEB instead of the Surplus, we interpret this as evidence that forecast errors for real growth are associated with forecast errors in the cyclical component of the fiscal surplus.

Unemployment rate forecast errors, however, were much more strongly related to our fiscal balance variables, as shown in Table 5. The upper panel of the table shows results for forecast errors for the Surplus while the lower panel shows them for HEB. The former shows strongly significant evidence of a negative correlation between forecast errors in the overall federal budget surplus and those for the unemployment rate, particularly at horizons of two to four quarters. This correlation can account for between a quarter and a half of the overall forecast error variance of the unemployment rate, with similar results over each of our two sub-samples. Given the much weaker results that we found above using real output growth, the strength of this result is surprising. As one might expect, we also found strong correlations of the unemployment rate forecast errors with those for Receipts and those for Expenditures at the two-to-four-quarter horizons. The estimated coefficients imply that, for example, using the four-quarter-ahead forecast from the first meeting in a quarter, a forecast error of 1% of GDP in the Surplus is on average associated with an unexpected drop in the unemployment rate of one quarter of one percent.

More surprisingly, we also find considerable correlations between unemployment rate forecast errors and those for HEB in the post-1990 period, but nowhere else. While the forecast errors for the latter (shown in the lower panel of Table 5) explain less than 3% of the variance of unemployment rate forecast errors for any forecast horizon over the full sample or the pre-1991 sample, the  $R^2$  rises from near zero at the shortest horizons to just over 13% at a 3Q and near 25% at a 4Q horizon. The latter effect is statistically significant and has an impact coefficient

TABLE 5—UNEMPLOYMENT RATE FORECAST ERRORS

Forecast Horizon	Full Sample		Pre-1991		Post-1990				
	$R^2$	$\beta$	$t$ -ratio	$R^2$	$\beta$	$t$ -ratio	$R^2$	$\beta$	$t$ -ratio
Surplus									
0L	0.001	0.70	0.40	0.001	1.06	0.39	0.003	1.01	0.44
0F	0.067	-9.46	-1.68	0.127	-14.31	-1.92	0.001	0.79	0.27
1L	0.080	-10.56	-2.26	0.116	-14.27	-2.27	0.012	-2.74	-1.17
1F	0.223	-20.76	-3.06	0.310	-26.17	-3.35	0.037	-6.71	-2.23
2L	0.260	-22.10	-3.48	0.330	-28.89	-4.12	0.147	-10.54	-3.32
2F	0.302	-26.06	-4.13	0.381	-33.87	-4.69	0.186	-13.32	-3.32
3L	0.348	-27.99	-3.85	0.420	-37.40	-4.40	0.296	-16.03	-3.23
3F	0.393	-32.25	-3.98	0.478	-43.51	-4.58	0.333	-19.80	-3.89
4L	0.380	-31.12	-4.18	0.410	-41.64	-4.22	0.429	-22.27	-3.54
4F	0.410	-32.49	-4.46	0.420	-43.02	-3.84	0.478	-25.19	-4.44
HEB									
0L	0.005	1.22	1.43	0.001	0.73	0.92	0.006	1.01	0.56
0F	0.002	1.53	0.60	0.020	5.07	2.79	0.033	-4.11	-1.12
1L	0.000	-0.40	-0.16	0.001	0.95	0.27	0.013	-2.53	-1.01
1F	0.006	-3.77	-0.83	0.000	-1.04	-0.17	0.063	-8.33	-1.52
2L	0.019	-6.91	-1.15	0.012	-6.77	-0.71	0.063	-7.48	-1.46
2F	0.008	-4.99	-1.00	0.001	-2.00	-0.26	0.062	-8.90	-1.51
3L	0.019	-7.98	-1.47	0.004	-4.32	-0.55	0.132	-13.42	-1.61
3F	0.014	-7.71	-1.10	0.000	-0.60	-0.05	0.136	-16.70	-1.71
4L	0.023	-9.82	-0.94	0.000	1.51	0.09	0.244	-22.79	-1.91
4F	0.027	-10.53	-0.92	0.004	4.99	0.33	0.280	-27.18	-2.36

**Notes:**

The 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  $t$ -ratios. The number of lags used was equal to  $2(h + 1)$  where  $h$  is the forecast horizon in quarters.

nearly identical to that of the Surplus.

It is tempting to attribute this negative correlation to the impact of economic growth surprises which lower the unemployment rate and improves the fiscal balance. However, as we noted above, this correlation all but disappears when using real output growth in place of the unemployment rate. This also fails to explain the correlation between HEB and UNEMP forecast errors, since HEB is explicitly conditioned on a fixed unemployment rate from 1983 onwards.

We also examined the relationship between output gap forecast errors and those of our fiscal variables, as shown in Table 6.<sup>36</sup> To be sure, the output gap is not literally a “headline” variable (the Board generally avoids publishing its estimates); however, it is generally thought that the Federal Reserve’s dual mandate effectively implies a medium-term output gap target near zero. Unfortunately, these internal output gap estimates and forecasts are only available from 1987Q3 onwards. For that reason, Table 6 presents only full-sample estimates.<sup>37</sup>

We find that the strength of the correlations between the forecast errors of any of our four fiscal variables and those of the output gap increase almost monotonically with the forecast horizon and can account for between 20 percent and 40 percent of the unexpected variation in the output gap at the longest horizon (4F). The positive coefficients that we see on the Surplus implies that a larger than expected deficit (i.e. a positive forecast error for the Surplus) is associated with smaller than expected output gap (i.e. a weaker economy.) The negative coefficients that we see on Expenditures imply that expenditures tend to be higher than expected when the economy is weaker than expected (i.e. when output gap forecast errors are positive.) Correlations are always statistically significantly different from zero at the longer forecast horizons, with a negative surprise in the fiscal Surplus of 1% of GDP associated with a output gap lower (i.e. weaker) than expected by roughly 0.5% of GDP on average.

<sup>36</sup>Output gap forecast errors were constructed using the last available Greenbook estimate as the best measure of the outcome.

<sup>37</sup>Separate estimates for the post-1990 period were always quantitatively very similar to the full-sample

TABLE 6—OUTPUT GAP FORECAST ERRORS

Horizon	$R^2$	$\beta$	$t$ -ratio	$R^2$	$\beta$	$t$ -ratio	
		HEB6			Surplus		
0L	0.017	-13.70	-1.10	0.042	27.29	1.81	
0F	0.001	-3.13	-0.25	0.067	33.16	2.29	
1L	0.000	-1.30	-0.11	0.064	32.08	2.48	
1F	0.000	1.93	0.19	0.077	34.49	2.10	
2L	0.019	15.20	1.18	0.143	37.54	2.76	
2F	0.030	21.23	2.37	0.183	43.75	2.99	
3L	0.086	32.85	1.80	0.255	44.55	3.03	
3F	0.114	43.25	2.48	0.306	52.70	3.77	
4L	0.177	47.36	1.89	0.345	49.20	3.31	
4F	0.231	58.65	2.32	0.393	54.84	3.79	
		Receipts			Expenditures		
0L	0.063	38.94	3.08	0.000	0.58	0.02	
0F	0.053	37.46	2.12	0.011	-16.54	-0.67	
1L	0.047	38.58	2.49	0.026	-27.86	-1.17	
1F	0.028	27.86	1.99	0.049	-39.27	-1.71	
2L	0.083	40.74	2.45	0.081	-46.87	-2.10	
2F	0.083	43.81	5.24	0.141	-62.52	-2.32	
3L	0.133	49.24	3.89	0.211	-71.04	-2.38	
3F	0.144	56.91	4.83	0.287	-88.26	-2.81	
4L	0.213	61.47	3.44	0.291	-78.02	-2.66	
4F	0.229	68.97	4.17	0.365	-87.98	-3.15	

**Notes:**

The table reports regressions of Greenbook Output Gap forecast errors on forecast errors for the variables shown in the table. The horizon is reported in the number of quarters, and whether the forecast was made during the first meeting of the quarter (F) or the last meeting of the quarter (L). For example, a horizon of 3F means a three-quarter horizon using the forecast from the first meeting of the quarter.

Estimation is by OLS with data from 1987Q3 to 2006Q4. HAC standard errors used to calculate the  $t$ -ratios.

Overall, fiscal forecast errors appeared to be largely unrelated to the forecast errors for several key macroeconomic variables. Although we found stronger correlations between unemployment rate forecast errors and those for the surplus or HEB, the direction of causation is unclear. Thus, improved fiscal forecasts may or may not help improve forecasts for the unemployment rate or output gap.

## 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>38</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>39</sup> 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, 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.

Table 7 compares estimates from the Romer and Romer (2004) original specification with those incorporating Greenbook estimates of the Federal Government Surplus. The table reports which sets of variables in the regression have estimated coefficients that are statistically significantly different from zero. The first regression, labeled A, repeats the Romer’s original work, regressing the changes

results shown in Table 6.

<sup>38</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>39</sup>Romer and Romer (2004), p. 1064.

in the Federal Funds Rate Target on their selected control variables.<sup>40</sup> In other columns in the table, we add Greenbook forecasts for current and future values of various fiscal measures.<sup>41</sup>

Column B adds the Surplus/Deficit forecasts. In addition to an economically important rise in the  $R^2$ , the added variables are jointly statistically significant while some of the variables in the Romers' original specification no longer appear to be. However, we cannot reject the null hypothesis that the sum of the coefficients on the Surplus forecasts equals zero. This leads us to column C, which replaces the Surplus with its first difference and drops sets of insignificant variables. The result is our preferred specification, with fewer explanatory variables and a slightly higher  $R^2$  than the original regression, as well as a stronger negative coefficient on the old target rate, which is now statistically significant. As the latter controls the rate at which policy shocks decay, this implies that monetary policy shocks have somewhat less persistent effects on the target rate. Both specifications B and C show that expected fiscal policy three to four quarters into the future has a statistically significant effect on the Federal Funds Rate, with larger Surpluses associated with lower interest rates. This is consistent with a monetary policy that aims to stabilize aggregate demand, as described in the narrative evidence in Section II.<sup>42</sup>

The following pair of columns (D & E) uses HEB6 in place of the Surplus. While the structural surplus may be a more conceptually appealing as an indicator of the fiscal policy stance, it constrains our sample period to begin only in November 1980, thereby reducing our sample size by roughly half. However, we again find that this fiscal variable appears to play (D) a statistically significant

<sup>40</sup>We use the Romers' original data set, which the authors have graciously made publicly available. Throughout our analysis, our regressions are estimated by Ordinary Least Squares. Although our data set includes the all the FOMC meetings used in the Romers' study, many of the earliest meetings contain forecasts for only the very shortest horizons. Including a four-quarter forecast horizon for our Surplus variable reduces the sample from the Romers' original 261 observations to 220; including a four-quarter forecast horizon for HEB6 further reduces this to 122.

<sup>41</sup>Revisions of the fiscal forecast were also examined, but were never statistically significant.

<sup>42</sup>However, we also note the counterintuitive result that fiscal policy at other forecast horizons is also statistically significant but with the opposite sign.



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

Regression Variables Included	A	B	C	D	E
Constant	x	x	x	x	x
OLDTARG	x	x	***	***	***
GRAY (M to 2)	x	x		x	x
IGRY (M to 2)	***	***	***	***	***
GRAD (M to 2)	x	***	***	x	***
IGRD (M to 2)	x	x		x	
GRAU0	***	x		x	
SRPL (0 to 4)		***			
DSRPL (1 to 3)			***		
HEB (0 to 4)				***	***
<i>N</i>	261	220	237	122	122
<i>R</i> <sup>2</sup>	0.280	0.351	0.289	0.503	0.481
[ <i>FISCAL</i> ] = 0 under <i>H</i> <sub>0</sub>		3.780 F(5,196)	5.327 F(3,224)	4.442 F(5,98)	5.646 F(5,103)
<i>p</i> -Value		0.003	0.001	0.001	0.000

**Notes:**

OLS regression results for dependent variable *DTARG*—the change in the Federal Funds Rate Target. An “x” indicates that all of the variables were included in the regression and had t-ratios less than 2. A “\*\*\*” indicates that the variables were included in the regression and that not all had t-ratios less than 2.

*OLDTARG* - Federal Funds Rate Target before start of FOMC meeting.

*GRAY* - Greenbook forecast rate of output growth

*IGRY* - Change in Greenbook forecast rate of output growth from previous FOMC meeting

*GRAD* - Greenbook Inflation forecast

*IGRD* - Change in Greenbook inflation forecast from previous FOMC meeting

*GRAU0* - Greenbook Unemployment Rate estimate for current quarter

*SRPL* - Greenbook forecast Surplus(Deficit) to GDP ratio

*DSRPL* - Greenbook forecast change in Surplus(Deficit) to GDP ratio

*HEB* - Greenbook forecast High-Employment Budget Surplus (Deficit) to GDP ratio

*x to y* - forecast horizons (quarters.) *M* indicates estimate for the preceding quarter.

*N* - number of observations.

[*FISCAL*]=0 - *F*-test of the null hypothesis that all coefficients on the fiscal variables are zero.

role in our shortened sample while one of the Romer and Romer variables (the change in forecast inflation) does not. Dropping the latter (E) leaves us with our preferred specification for the structural deficit. We note that, in addition to coefficient signs similar to those we discussed previously, the overall fit of the equation over this sample is much better than that over the full sample, suggesting that exogenous monetary policy shocks were relatively less important. This may in part reflect the omission of large changes in the rate in 1979 and 1980, including 387.5 basis point movement on April 22, 1980, which is by far the largest movement in the sample. We also see a much larger (more negative) coefficient on the lagged level of the target, suggesting that monetary policy shocks were much less persistent.

To better understand the importance of the role that fiscal variables played, we used these estimation results to simulate the impact of the estimated monetary policy shocks on the Federal Funds Rate.<sup>43</sup> The results are for our two preferred models (C and E in Table 7) are compared in Figure 6 to that of the Romer and Romer (2004). The results show that taking account of fiscal policy forecasts results in monetary policy shocks that were consistently less expansionary in the pre-1980 sample and more expansionary from the early 1980s onwards. The differences are also relatively large; Romer and Romer (2004)'s estimates imply that policy shocks moved the Federal Funds Rate by up to +/- 300 basis points, while the differences between their estimates and those incorporating our fiscal variables are the same order of magnitude. We conclude that the response of monetary policymakers to expected fiscal policy is statistically significant and economically important for the identification of exogenous shifts in monetary policy.

<sup>43</sup>To do so, we simply set all the control variables to zero and shocked DTARG with the estimated OLS residuals.

## 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 the structural surplus (HEB6) appear to be unbiased, and in several cases performed slightly better than those of the CBO, both in terms of mean-squared errors and in terms of forecast-encompassing. However, forecasts for expenditures, receipts, and HEB showed 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 correlated with those for the unemployment rate and output gap, but not with those for real output or inflation. Therefore, it is not clear whether improved fiscal forecasts would be helpful in forecasting macroeconomics aggregates, or vice versa. 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 are consistent with the public claims of Board chairman and Governors. Therefore, understanding fiscal-policy shocks is important for the study and measurement of monetary-policy shocks.

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January 29, 1997

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

Item	Fiscal year <sup>5</sup>		1996				1997				1998			
	1995*	1996*	Q1*	Q2*	Q3*	Q4	Not seasonally adjusted				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	421
Surplus/deficit <sup>1</sup>	-164	-207	-71	-46	-33	-59	-71	-49	-30	-75	-68	-59	-30	-39
Off-budget	-24	-174	-84	14	-36	-76	-83	11	-36	-72	-81	-42	-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	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
<b>NIPA FEDERAL SECTOR</b>														
Receipts	38	44	22	38	44	33	20	36	40	30	20	35	40	30
Expenditures	1459	1544	1523	1576	1582	1625	1606	1626	1645	1663	1672	1691	1711	1731
Consumption	1629	1683	1678	1702	1703	1730	1741	1755	1772	1782	1792	1802	1815	1829
Nondefense	45	307	289	307	305	306	301	302	304	305	306	303	305	303
Other expenditures	1175	1226	1225	1239	1241	1267	1281	1294	1308	1319	1328	1340	1351	1369
Current account surplus	-171	-139	-155	-127	-121	-105	-135	-129	-127	-119	-120	-112	-104	-98
Gross investment	65	63	65	66	64	64	61	62	62	63	62	61	61	60
Current 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	3	1	8	-2	-2	-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 from the weighted average of quarterly changes in HEB and real growth in HEB, as a percent of nominal potential output, reported in the Monthly Treasury Statement. Quarterly changes in HEB and real growth in HEB, as a percent of nominal potential output, are reported in the Monthly Treasury Statement.

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.

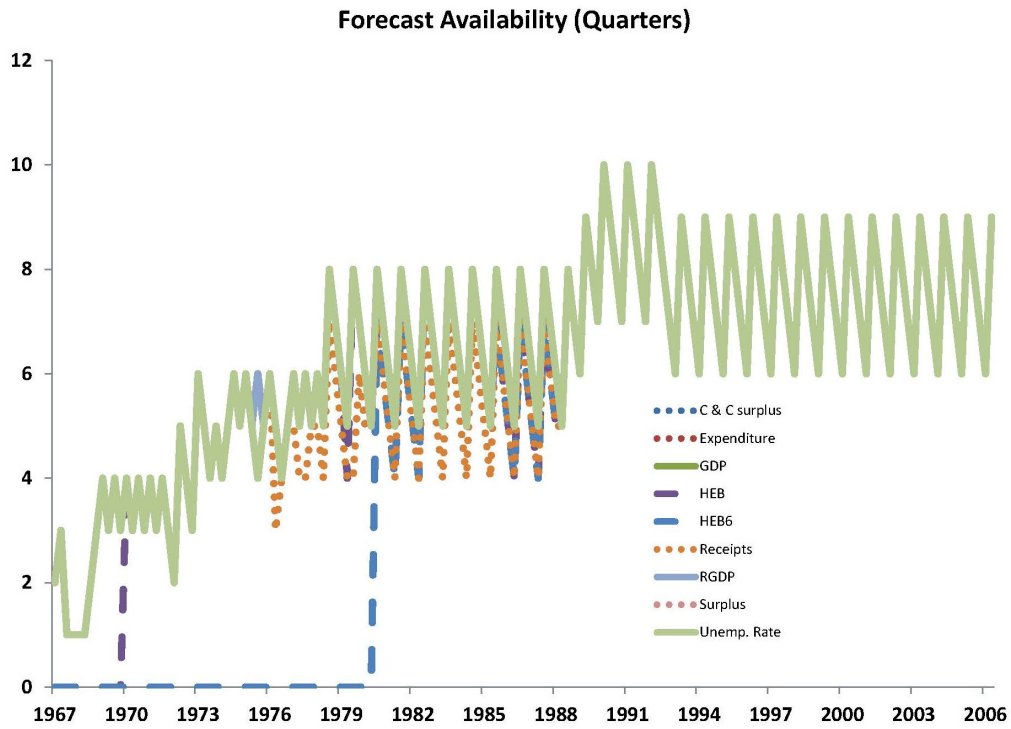


FIGURE 2. GREENBOOK FORECAST HORIZONS BY DATE AND SERIES

*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.



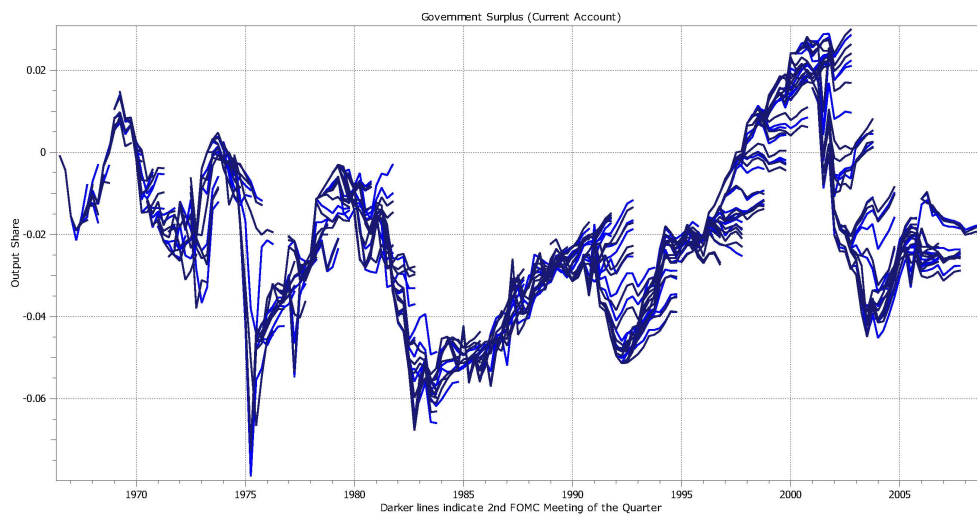


FIGURE 3. GREENBOOK GOVERNMENT SURPLUS FORECASTS

*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).

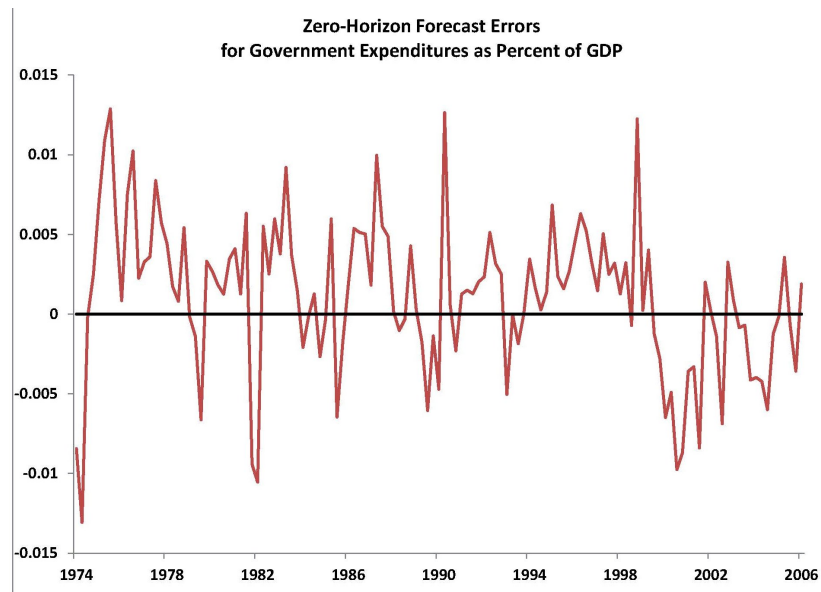


FIGURE 4. TIME-SERIES PLOT OF CURRENT-QUARTER EXPENDITURE FORECAST ERRORS

*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.

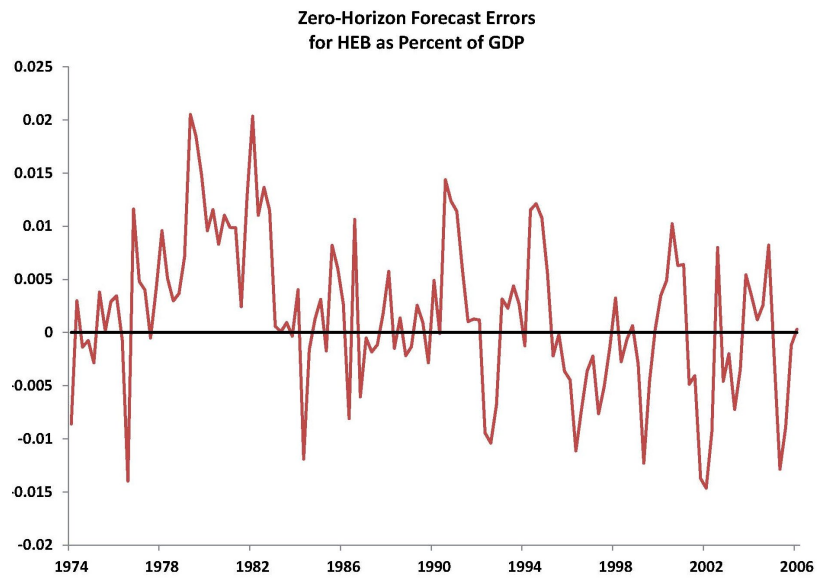


FIGURE 5. TIME-SERIES PLOT OF CURRENT-QUARTER HEB FORECAST ERRORS

*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.

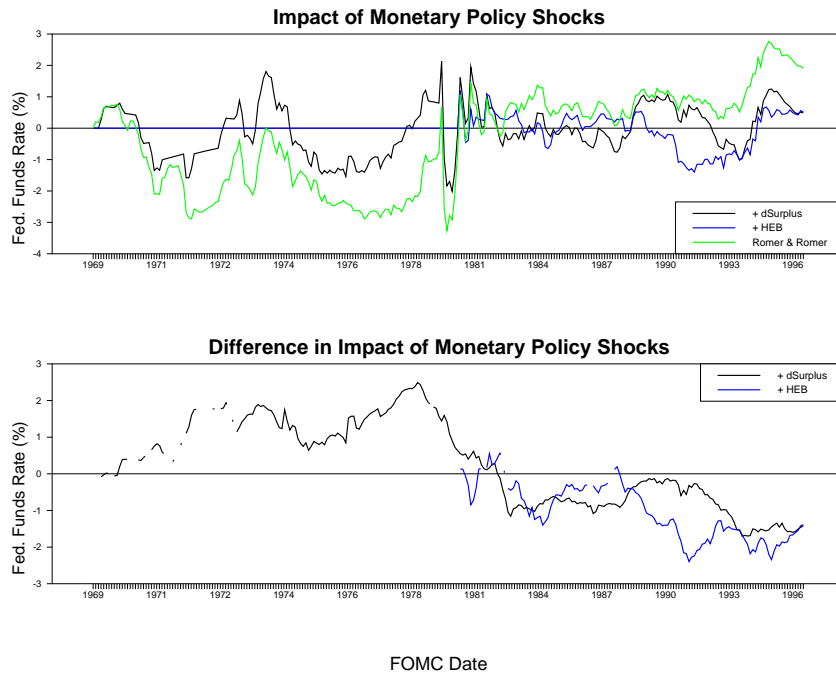


FIGURE 6. EFFECTS OF MONETARY POLICY SHOCKS WITH AND WITHOUT FISCAL VARIABLES

*Note:* This figure shows the impact of the fiscal variables on monetary-policy shocks.



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