

Fiscal Policy and the Inflation Target

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Draft of September 14, 2011

Abstract

Low interest rates in the United States have recently been accompanied by large fiscal stimulus. However, previous discussions of monetary policy did not anticipate this fiscal activism, leading to over-estimates of the costs of the zero lower bound and, hence, of the appropriate inflation target. To rectify this, I include counter-cyclical fiscal policy within a large-scale model of the US economy and find that it stabilizes activity at low interest rates. If fiscal policy behaves as it has recently, then the inflation target can remain near its pre-crisis level, despite increased volatility of macroeconomic shocks.

JEL Codes: E52, E62

* Research Department, Reserve Bank of Australia. Email: tulipp@rba.gov.au. This paper was written while the author was employed at the Federal Reserve Board of Governors. I am grateful to many of my colleagues at the Fed for helpful comments and technical assistance. I would particularly like to thank Flint Brayton, Eric Engen, Glenn Follette, Mariano Kulish, Mark Lasky, David Orsmond, and Dan Sichel. Candace Adelberg and Peter Chen provided research assistance. I am especially grateful to John Roberts for many thoughtful, detailed suggestions that greatly improved the paper. The views presented in this paper are solely those of the author and do not necessarily represent those of the Federal Reserve Board, the Reserve Bank of Australia or their staffs. This paper is available at www.petertulip.com.

Most US central bankers say that monetary policy should deliver an average inflation rate of about 2 percent in the long run (FOMC, 2011).¹ Many considerations influence this choice, but it partly reflects a tradeoff: Lower inflation has direct welfare benefits but it also means interest rates have a greater probability of falling to their lower bound of zero. The zero lower bound is a problem because it prevents the central bank from fighting recessions with large reductions in interest rates. So the economy would be less stable with a low inflation target.

Several researchers have quantified this argument. Most prominently, David Reifschneider and John C. Williams (2000) conduct stochastic simulations of the Federal Reserve's FRB/US model and conclude that the zero lower bound noticeably increases the variability of economic activity for inflation targets below 2 percent or so. Similar studies include Gunter Coenen, Athanasios Orphanides, and Volker Wieland (2004), Benjamin Hunt and Douglas Laxton (2004), and Williams (2009). Roberto M. Billi and George A. Kahn (2008) provide an overview. Estimates like these have played a central role in the FOMC's discussion of appropriate inflation targets. See, for example, the transcript and staff materials for the FOMC meeting of February 1, 2005 (FOMC, 2005; Douglas Elmendorf et al, 2005). These studies have been emphasized by policymakers such as Ben Bernanke (2003) and Janet Yellen (2009) in discussing their choice of inflation targets.

A limitation of much of the policy discussions and the underlying research is that they have assumed that fiscal policy is passive, doing little to stimulate the economy (beyond automatic stabilizers) when interest rates approach zero. That assumption was consistent with both actual fiscal policy and expert policy recommendations until recently. However, as argued by Alan J. Auerbach, William G. Gale, and Benjamin H Harris (2010), there has been a renewed inclination for active counter-cyclical fiscal policy on the part of both policy makers and advisers. The key finding of this paper is that this new fiscal activism allays concerns about the zero bound.

I explore these issues using stochastic simulations of FRB/US model, which is a large-scale model of the US economy maintained by the staff of the Federal Reserve Board. My simulations suggest that counter-cyclical fiscal policy permits lower inflation targets without increasing the variability of activity. For example, I estimate that a 2 percent inflation target is consistent with a standard deviation of unemployment of 1.4 percentage points when fiscal policy is passive – but the same variability of unemployment could be achieved with a target of zero inflation if fiscal policy-makers behave as they have recently.

Several previous researchers, such as Reifschneider and Williams, have discussed these issues in general terms. Williams (2009) estimates the effect of counter-cyclical fiscal policy on the inflation target; however, his example is illustrative rather than realistic. More important, he considers fiscal stimulus in worst-case scenarios but not in likely scenarios. Accordingly, his 2009 paper and subsequent work with co-authors (Hess Chung, Jean-Philippe Laforte, Reifschneider, and Williams (2011 p32) call for more research on the issue. This paper takes a step toward addressing that need by examining the role of fiscal policy in more detail.

¹ To be precise, the central tendency of long-run inflation projections of FOMC participants at their April 2011 meeting was 1.7 to 2 percent. These projections indicate “the inflation rate that Committee participants judge to be most consistent with the Federal Reserve’s mandate to foster maximum employment and stable prices” (Bernanke, 2011)

A related branch of the literature, surveyed by Stephanie Schmitt-Grohé and Martín Uribe (2010), considers the optimal rate of inflation assuming that the zero bound is irrelevant. Schmitt-Grohé and Uribe justify this assumption by arguing that under *optimal* monetary policy the probability of hitting the zero bound is very low. However, the recent history of interest rates in the United States, Japan, and other countries suggests that under *actual* monetary policy, the chances of hitting the zero bound are considerable.

To be clear, this paper is not intended to evaluate alternative policies for dealing with the zero bound. That issue has been addressed elsewhere by many authors, including Michael Woodford and Gauti B. Eggertsson, (2004) and N. Gregory Mankiw and Matthew Weinzierl (2011). Rather, I take actual monetary policy, as described by a conventional policy reaction function, as given. And I use a fiscal policy reaction function that describes recent behavior. This paper examines the implications of these reaction functions for economic stability and the inflation target. A positive analysis of actual policy seems a useful stepping-stone to a consideration of proposed improvements.

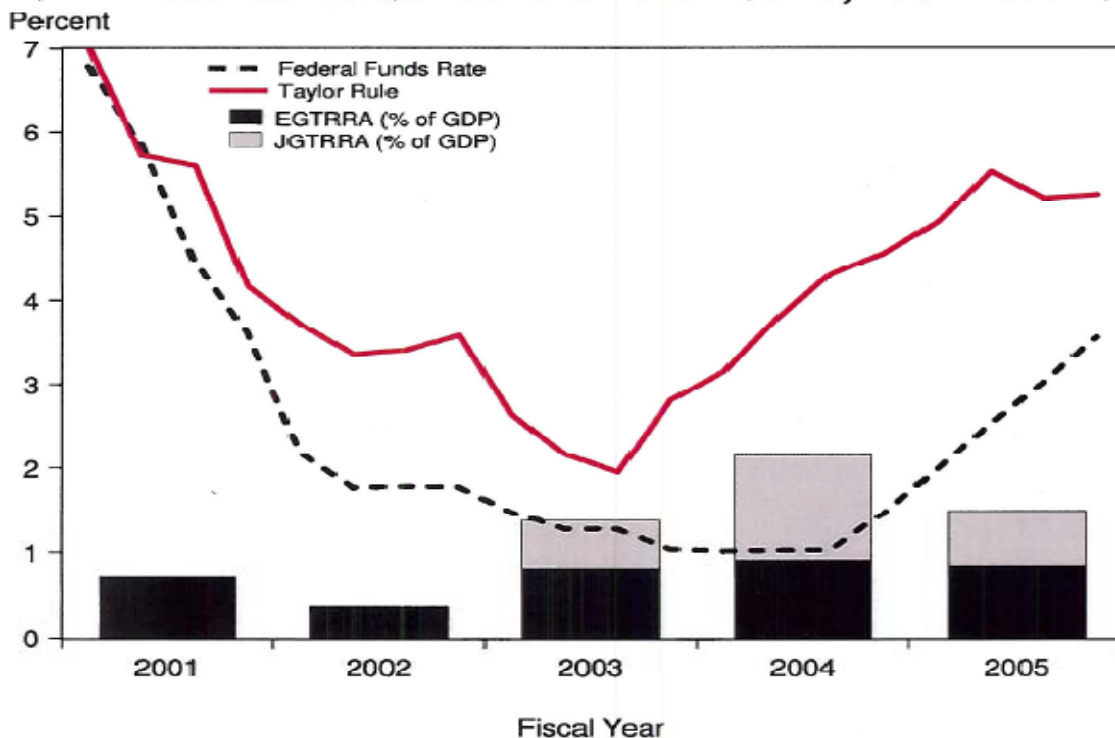
Similarly, this paper does not examine implications of recent innovations in monetary policy, such as asset purchases. The rationale for considering new developments in monetary policy is similar to that for considering new developments in fiscal policy, and the implications for the inflation target are qualitatively similar. I expect including asset purchases as an extra instrument of monetary policy would further allay concern about the zero bound, reinforcing one of my key results. But, at this stage, that conjecture remains to be verified.

The new regime of fiscal activism

The United States has had two recent encounters with the zero bound on interest rates, in the early 2000s and now. Both have been accompanied by large fiscal stimulus. This relationship is illustrated in Charts A and B, which show interest rates and Congressional Budget Office (CBO) estimates of the budgetary costs of major legislation intended to boost aggregate demand. Chart A shows CBO estimates of the budgetary cost of the Economic Growth and Tax Relief Reconciliation Act, or EGTRRA of 2001, and the Jobs and Growth Tax Relief Reconciliation Act, or JGTRRA of 2003. Chart B shows CBO estimates of the budgetary cost of the stimulus Acts of 2008, 2009 and 2010 (formally, the Economic Stimulus Act of 2008; the American Recovery and Reinvestment Act, or ARRA, of 2009, and the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act, or TRUIRJCA, of 2010). As discussed in Appendix 2, I subtract the contribution of the Alternative Minimum Tax from the CBO estimates.

Chart A

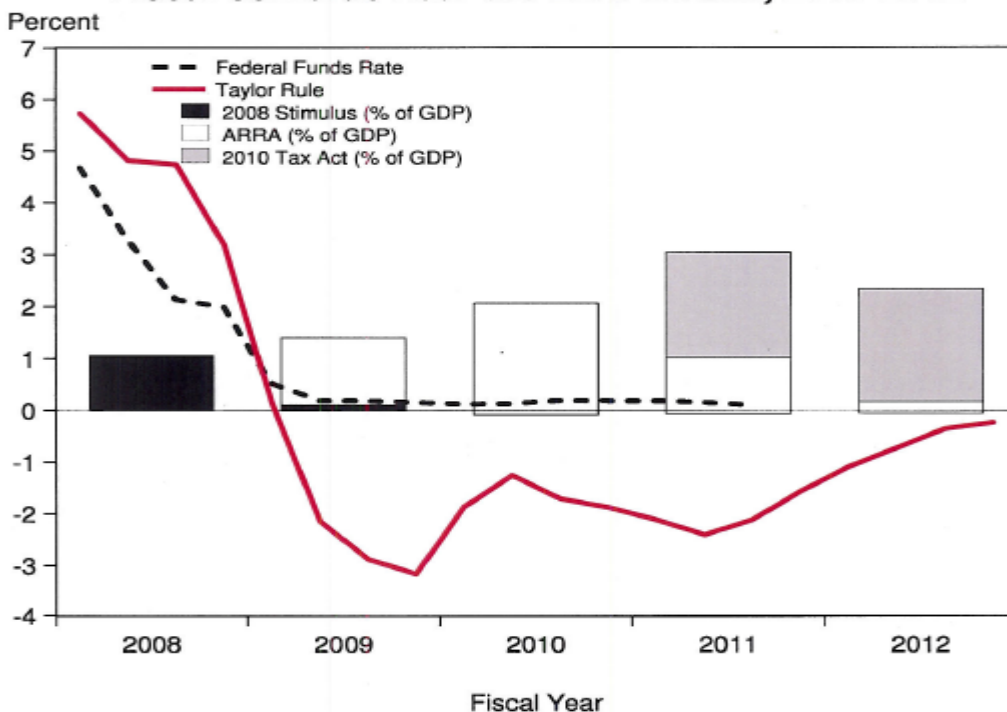
Fiscal Stimulus near the Zero-Bound; 2001-2005



Sources: “Federal Funds rate”: Federal Reserve; “Taylor Rule”: CBO (2011) and author’s calculations; “EGTRRA”: CBO (2001 p8); “JGTRRA”: CBO (2003 p18)

Chart B

Fiscal Stimulus near the Zero-Bound; 2008-2012



Sources: Federal Funds rate and Taylor Rule, see Chart A; “2008 Stimulus”: CBO (2008 p2); “ARRA”: CBO (2009, 2011 p13) and JCT (2009); “2010 Tax Act”: CBO (2011 p9)

Charts A and B also show that, in each episode, fiscal stimulus was delivered in a succession of distinct packages. So, although the number of observations is small, there has been a pattern of counter-cyclical activism. Furthermore, stimulus has been enacted during both republican and democratic administrations.

Discretionary fiscal policy has also been strongly counter-cyclical in other countries. The recent global recession was accompanied by discretionary fiscal measures in OECD economies averaging 3.4 percent of annual GDP between 2008 and 2010 (OECD, 2009, Table 3.1)

The turn to fiscal activism in the United States is new. In contrast to the most recent two business cycles, fiscal policy was neutral to contractionary in previous US recessions. Auerbach, Gale, and Harris (2010) provide a narrative description of this shift, noting the explicit decisions of Congress to tighten fiscal policy in 1982 and 1990. A quantitative measure of the shift can be seen, for example, in Glenn Follette and Byron Lutz's (2010, Table 6) estimates of fiscal impetus, an impact-weighted measure of the stance of fiscal policy. In the three years following the business cycle peaks of 1969, 1973, 1980, and 1990, federal fiscal impetus averaged 0.1 percent of GDP, near its "neutral" benchmark of about 0.2 percent. In contrast, it averaged almost one percent of GDP after the peaks of 2000 and 2007, using data through 2009.

One reason for considering the new fiscal activism to be structural is that it has been accompanied by a parallel change in policy advice. Many economists have explained that whereas they used to be skeptical of fiscal intervention, they now view it as desirable at the zero bound. Examples include Brad DeLong (2011) and Paul Krugman (2011). Surveys of the state of academic thought, such as David Romer (2011) or Olivier Blanchard, Giovanni Dell'Ariccia, and Paolo Mauro (2010) suggest this change is widespread. In the words of Gary Becker (2009), "There appears to have been a huge conversion of economists toward Keynesian deficit spenders." The evolution in advice partly represents new circumstances rather than a change in opinion. According to Lawrence Summers (2010), "most economists across a broad spectrum" simultaneously believe that fiscal stimulus is effective at the lower bound but that it is not effective in normal circumstances.

Given these developments, it would now seem sensible to consider the possibility that large fiscal stimulus will be employed when the economy next approaches the zero bound. That requires modifications to the models used to estimate the effect of the zero bound, none of which include active counter-cyclical fiscal policy.

Modeling counter-cyclical fiscal policy

To model fiscal policy near the zero bound, I construct a simple rule which approximately describes recent behavior. However, a range of possible reaction functions are consistent with the limited data. So, to more precisely tie down my specification, it is also guided by the perceived objectives of policy makers and advisers. That is, the rule is intended to be sensible policy as well as realistic. In addition to being more interesting, such a rule is more likely to be stable, as policy makers are less likely to adhere to flawed rules. The multiple objectives do, however, sometimes involve tradeoffs. Furthermore, while I believe my

judgments as to what constitutes sensible counter-cyclical policy are in line with mainstream economics, others would make different assumptions.²

Counter-cyclical fiscal policy is desirable when monetary policy is likely to be constrained by the lower bound. A simple indicator of that likelihood would be a low value of the actual federal funds rate. However, because the funds rate does not fall below zero, it provides no indication of the severity with which the constraint binds. Accordingly, I tie stimulus to low values of a monetary policy rule. (Though I acknowledge that the actual funds rate has been a better indicator of fiscal stimulus sometimes—see, for example, the 2004 observation in Chart A).

My main determinant of fiscal stimulus is a variation of the Taylor rule that is popular within the literature. (It is used, for example, in several of the references cited in my introduction.) Let RFFTAY equal the sum of the equilibrium real interest rate, assumed to be 2.5 percent, the 4-quarter percent change in core PCE prices (PICX4), half the gap between PICX4 and the rule's inflation target (PITARG), and the output gap (GDPGAP) with a coefficient of 1.

$$1) \text{ RFFTAY} = 2.5 + \text{PICX4} + 0.5 * (\text{PICX4} - \text{PITARG}) + 1 * \text{GDPGAP}$$

The rule's inflation target, PITARG, is exogenous. It is assumed to be 2 percent for constructing Charts A, B, and C.

Using a Taylor-type rule in my fiscal reaction function makes fiscal policy place the same weights on inflation and resource utilization as monetary policy, so the two arms of policy work in concert. In contrast, Feldstein (2007) suggests that counter-cyclical fiscal policy should react to 3-month changes in payroll employment, whereas Orszag (2011) would tie it to the unemployment rate. Feldstein's measure would help to explain recent stimulus and has been a successful predictor of future variations in the Taylor rule. However, a problem with both suggestions is that they do not take account of inflation. For example, weakness in the labor market during the early 1980s, in 1989, or 2000 reflected a need to reduce inflationary pressure.

I assume fiscal stimulus occurs when, but only when, RFFTAY falls to low levels. So counter-cyclical fiscal policy is not called for when interest rates are unconstrained. This imparts a nonlinearity that does not exist in some other fiscal rules, such as Auerbach and Gale (2009). The reason is that, as Feldstein (2002), Blinder (2004), and Taylor (2000) discuss, there has been a general presumption against discretionary counter-cyclical fiscal policy when interest rates are free to adjust. In those conditions, fiscal measures are offset by the monetary policy rule and so have little medium-term effect on demand. Discretionary counter-cyclical fiscal policy can be costly, as well as ineffective – it distracts scarce attention, it blurs accountability, and execution is imperfect – and these costs are often judged to be not worth incurring when the multiplier is low. Furthermore, as Lawrence Christiano, Martin Eichenbaum, and Sergio Rebelo (2011) and Woodford (2011) have argued, extending a stimulus past the point at which interest rates are bound at zero reduces the effectiveness of the stimulus at the zero bound, when it is most needed.

² For example, some readers have suggested the stimulus should comprise more spending and transfers, which have a higher “bang-for-the-buck”. However, as discussed in Mankiw and Weinzierl (2011), that view is controversial.

However, that is not to say that fiscal stimulus should wait until the zero bound actually binds (in contrast to the rule in Williams, 2009). As interest rates decline toward zero, there is an increasing probability of hitting the constraint. Moving after this became certain would be unnecessarily late, given the asymmetry of policy mistakes. As Paul Krugman (2008) has argued, too much fiscal stimulus can be undone by tighter monetary policy, so does little damage. Too little fiscal stimulus is not immediately correctable if interest rates are low so means lower income and employment. Accordingly, I assume stimulus is proportionate to the amount the Taylor-type rule falls below a positive threshold, specifically 2 percent. Denote this amount by INTGAP.

$$2) \text{ INTGAP} = \max(2 - \text{RFFTAY}, 0)$$

I assume a threshold of 2 percent, a choice that involves some tradeoffs. A higher threshold would help explain the tax cuts of 2001 and 2008. In July 2001, households started receiving tax cuts worth 0.3 percent of GDP, when the outcome of the Taylor-type rule stood at 4 percent. In April 2008, households started receiving tax rebates worth 0.8 percent of annual GDP, though the outcome of the Taylor-type rule again was 4 percent. However, the rationale for these measures was somewhat different from the rationale for fiscal stimulus considered in this paper. In particular, the 2001 tax cut was not originally conceived as an instrument of counter-cyclical policy, though the recession that preceded its passage seemed to convince pivotal members of Congress to support it. A more complicated rule would probably be needed to describe these developments. However, because fiscal policy needs to be understood and supported by the political/legislative process, the stimulus rule should be simple.

I explain STIMULUS, the increase in the deficit as a proportion of GDP, as a function of the lagged four-quarter average of INTGAP. The lags reflect delays in policy implementation, and help fit the data:

$$3) \text{ STIMULUS}_t = \beta \sum_{k=1}^4 \text{ INTGAP}_{t-k}/400$$

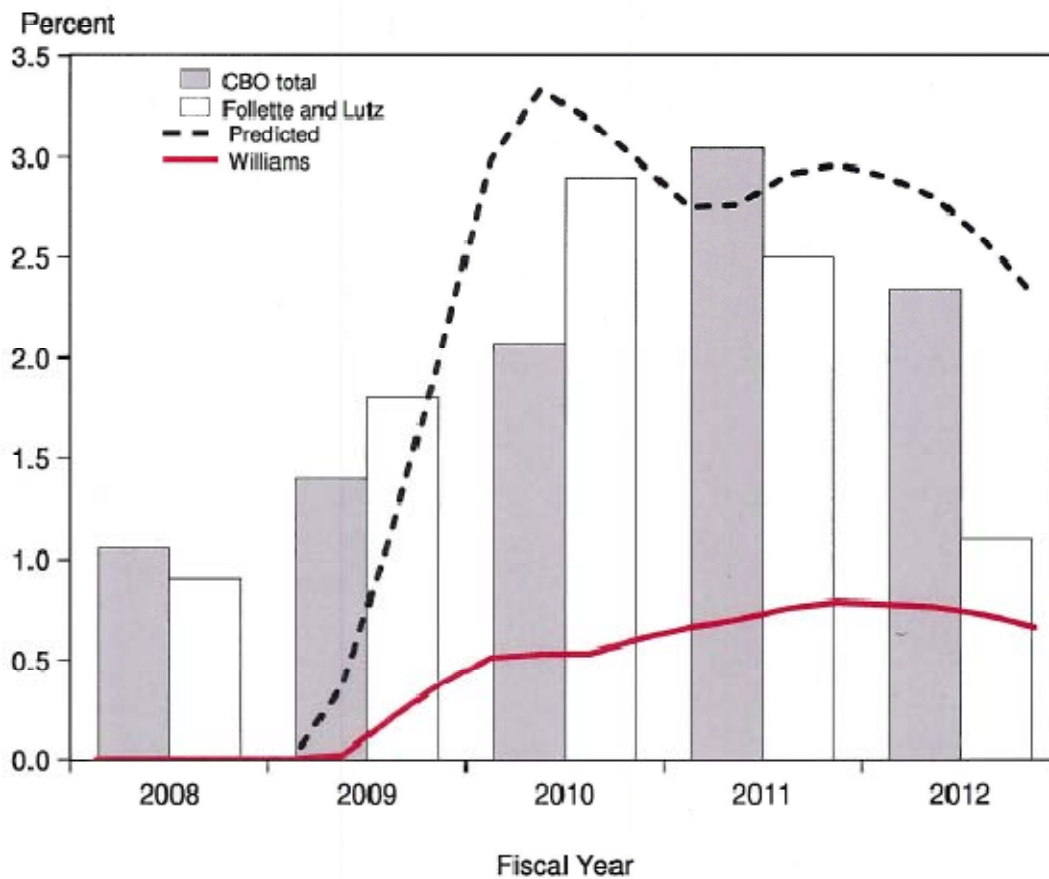
I show results for different values of β below. An estimate of 0.7 would deliver a cumulative stimulus from 2009 to 2012 of 9½ percent of annual GDP, which is close to estimates of the total amount of stimulus delivered over this period, discussed below.

Chart C shows various estimates of recent stimulus, measured in terms of budget cost as a percentage of GDP. Predictions from equation (3), with $\beta = 0.7$, are shown as the dashed black line. These are constructed using projections of the output gap and inflation from CBO (2011). CBO-based estimates – that is, the sum of the three major acts shown in Chart B – are depicted by the dark bars. As can be seen, with this calibration, equation (3) approximately describes the CBO-based estimates. Whereas my equation delivers a cumulative stimulus of 9.5 percent of annual GDP, the CBO-based estimates imply a cumulative stimulus of 8.9 percent (summing the 2009 and 2010 acts) or 9.9 percent (if the Economic Stimulus Act of 2008 is included as well).

Equation (3), with a value of $\beta = 0.7$, was fit to the data in early 2011. Since then, the economic outlook has deteriorated, implying that the zero bound constraint is more severe and will last longer. As of September 2011, Congress is considering the American Jobs Act, a stimulus bill estimated to cost 3 percent of annual GDP. Were Congress to fully enact this bill, it would imply slightly more aggressive fiscal stimulus than implied by equation (3).

The light bars in Chart C show an alternative measure of fiscal stimulus by Glenn Follette and Byron Lutz (2010), kindly updated for me by Glenn Follette, which I discuss in Appendix 2. My rule also roughly approximates the Follette-Lutz estimates, which imply a total stimulus of 9.2 percent of annual GDP from 2008 through 2012. A third alternative, by Alan S. Blinder and Mark Zandi (2010), which is not shown, estimates fiscal stimulus enacted through mid-2010 (that is, before the 2010 Tax Act) at about 7 percent of annual GDP, marginally more than my estimates for the comparable period. Last, the red solid line in Chart C represents the fiscal rule modeled by John Williams, which implies a stimulus that is substantially smaller and later than the other estimates.³

Chart C
**Alternative Measures of Fiscal Stimulus
 Percent of GDP**



Sources: “CBO Total”: Chart B
 “Follette and Lutz”: Follette and Lutz (2010), updated for fiscal years and the 2010 Tax Act
 “Predicted”: Authors’ calculations, CBO (2011)
 “Williams”: Authors’ calculations, Williams (2009), CBO (2011)

³ I interpret Williams’ equation (6) as describing the deviation of government consumption purchases (excluding employee compensation) from its trend, where the trend is 4 percent of real GDP in 2010q4, then grows at 2.5%. I use CBO estimates of the output gap and inflation, and the same Taylor-type rule I use elsewhere.

For the 2001-2005 period, predictions of equation (3) are zero, because the Taylor rule did not fall below 2 percent. Nonetheless, that episode is relevant for establishing a pattern of fiscal activism at low interest rates. As noted above, I was unable to develop a stimulus rule that also explained the fiscal expansion of the early 2000's. If the calibration were adjusted to place more weight on this episode, then my rule would imply bigger, earlier, stimulus going forward.

Turning to details of implementation, I assume that STIMULUS is composed of 50% reductions in personal taxes, 25% increases in federal government consumption purchases, and 25% increases in transfers to persons. This is a parsimonious approximation to recent behavior, which avoids channels of influence where FRB/US modeling is not firmly guided by the available literature, such as changes in corporate taxes or in grants to states.⁴

These effects are added to FRB/US's standard fiscal policy equations, presented in Appendix 3. These equations, estimated from 1965 through 2007, capture the normal response of fiscal instruments to the output gap, inflation and other macroeconomic variables. Previous researchers, for example Reifschneider and Williams, have described this response as "passive" or "neutral": reflecting automatic stabilizers but not discretionary fiscal policy. That is a reasonable description, although it is not exact because the equations also capture variations that are systematic but require legislation. Indexation of the alternative minimum tax to inflation and extension of unemployment benefits in recessions are examples. However, even with these effects, overall cyclical variations in fiscal instruments tend to be small and offsetting.

An important feature of the FRB/US fiscal equations is that personal tax rates adjust so as to gradually stabilize the ratio of government debt to GDP. This effect means that fiscal policy becomes contractionary after a prolonged stimulus, toward the end of lower bound episodes. Furthermore, the long-run average ratio of debt to GDP is not materially affected by repeated stimulus. And it means that the relevant "counter-factual" – that is, policy in the absence of fiscal stimulus – is what might be called "sustainable policy" rather than existing policy. The relevant estimates of recent fiscal stimulus are larger than would be constructed using a baseline of existing policy.

A key identifying assumption underpinning my calibration of the stimulus rule is that the standard FRB/US fiscal equations approximately reflect CBO's baseline of existing legislation. If that assumption is approximately valid, then a stimulus calibrated to the CBO estimates can be added to the FRB/US equations. I make allowances for indexation of the alternative minimum tax and unemployment benefits to improve this approximation. These issues are discussed in Appendix 2.

The above approach is not the only way that counter-cyclical fiscal policy could be modeled. One alternative would be to re-estimate the fiscal equations of a macro-economic model, such as FRB/US. That has advantages; for example, the counter-factual is precisely defined and complications of double-counting are avoided. But it also has substantial difficulties. One problem is distinguishing counter-cyclical fiscal policy from other variations in the budget (military operations, noise in tax receipts, changes in pharmaceutical benefits). The

⁴ Updated estimates from Follette and Lutz suggest that federal fiscal stimulus from 2008 through 2012 comprised 31% individual tax cuts, 24% transfers, 18% grants to state and local governments, 18% corporate tax cuts, and 8% "other", largely federal government purchases. Largely reflecting their different baseline, Follette and Lutz's estimates include more transfers but less personal tax cuts than my CBO-based estimates.

scope for bias is large given that we have very few observations near the zero bound. Second, the estimates depend on equations that are specific to one particular model, which reduces their transparency, credibility, and comparability with other estimates. Third, much of the fiscal response to the current crisis is legislated to occur in 2011 and 2012, which, as of early 2011, was yet to show up in the data. As data accumulates, within-model estimation will become increasingly attractive.

The effect of fiscal stimulus

Estimates of the effect of fiscal stimulus require a macroeconomic model. I use the FRB/US model of the US economy, the same model as used in some key contributions on this topic (Reifschneider and Williams, 2000; FOMC, 2005; Williams, 2009). Many detailed descriptions of FRB/US are available; two that are relevant to this paper are Reifschneider and Williams, or Douglas W. Elmendorf and Reifschneider (2002). In brief, FRB/US is one of the main macroeconometric models used at the Federal Reserve Board of Governors. It is relatively large and detailed, with approximately 500 variables and 170 estimated equations, of which 65 are shocked in stochastic simulations. It is designed and regularly revised with the intent of closely fitting the data. The main behavioral relationships are derived from explicit optimization problems, under the assumption of costly adjustment. Most equations are estimated individually, with explicit expectational terms. For estimation, most operational work, and this paper, expectations are determined by small-scale vector autoregressions (VARs). However, the model can also be solved under model-consistent expectations, an issue discussed in Appendix 1.

Although many features of the model affect my results, the fiscal multipliers are particularly relevant. Table 1 shows the estimated response of GDP to sustained variations in key fiscal variables with nominal interest rates held fixed.

Table 1: FRB/US fiscal multipliers at fixed nominal funds rate

Effect on level of real GDP (percent deviation from baseline) of a sustained change in fiscal variables by 1 percent of GDP

	After 4 quarters	After 12 quarters
Government purchases	0.99	1.22
Personal tax receipts	-0.31	-0.56
Transfers	0.42	0.50

Source: Author's calculations

Estimation of fiscal multipliers is controversial, and subject to substantial uncertainty. I do not wish to enter this debate here, beyond some brief comments as to why the estimates in Table 1 provide an interesting and relevant benchmark. The FRB/US multipliers are similar to many other estimates that assume constant nominal interest rates. For example, a survey by the OECD (2009, Ch 3) concluded “a review of the evidence ... typically suggests a first-year government spending multiplier of slightly greater than unity, with a tax cut multipliers of around half that”. A narrower but more detailed comparison by the IMF found FRB/US fiscal

multipliers at fixed nominal interest rates to be similar to those of other structural models used by central banks and international organizations (Gunter Coenen et al, 2010). David Romer (2011) surveys research following the recent crisis and concludes that most papers, especially those with constant interest rates, “suggest substantial effects of fiscal policy”. FRB/US multipliers have been one of the main sets of estimates relied upon by policy-makers (Christina Romer and Jared Bernstein, 2009; CBO, 2010). The CBO (2010, Appendix) compares fiscal multipliers from models like FRB/US with other estimates in the literature and concludes that the FRB/US multipliers are useful in current conditions.⁵

John F. Cogan, Tobias Cwik, John B. Taylor, and Volker Wieland (2010) have argued that FRB/US multipliers are too high. Part of their argument is that the FRB/US model is “Old Keynesian” and out of step with modern modeling techniques. However, Coenen *et al* find that FRB/US multipliers are similar to those of six recent DSGE models. Cogan *et al* present multipliers that are much smaller than those in Table 1. However, as Woodford (2011) argues, Cogan *et al*'s preferred estimates assume that government spending will greatly outlast the zero bound and hence be crowded out. Cogan *et al*'s experiment is important, but it is not the policy I am considering here.

To consider the effect of fiscal stimulus, I do repeated stochastic simulations of FRB/US about its long-run steady state. I follow the approach discussed by Reifschneider and Williams with a few variations. Whereas Reifschneider and Williams use a linearized version of the model with model-based expectations, I use the non-linear form with VAR expectations. Assuming VAR expectations is controversial for fiscal policy analysis. However, as I discuss in Appendix 1, there are both practical and conceptual reasons for preferring VAR expectations to model-based expectations for this particular exercise, though it is not clear that this choice has much effect on the results.

I use the 2010 vintage of the model, estimated through 2009. I randomly draw residuals of the model equations from the period 1968 through 2009, then simulate the model over 120 years, store, and repeat 500 times.⁶ I use a block-bootstrap with block size of four quarters.⁷ That means that serially correlated surprises, such as the financial crisis of 2008-09, are reflected in the simulations. To avoid double-counting the recent stimulus, the fiscal equations of the model are only estimated through 2007 and bootstrapped residuals for fiscal variables are set at zero after 2008q1. (Double-counting turns out to be relatively unimportant). I discard the first 20 years of each simulation to prevent dependence on initial conditions. The aim of this approach is to generate 50,000 years of artificial data with the same conditional correlations (across variables and across time), covariances, skewness, and kurtosis as the last 40-odd years of US history. Unusual events, such as the financial crisis of 2008, or the oil price increase of

⁵ The estimates in Table 1 differ from FRB/US multipliers published elsewhere, given that my purposes and context are slightly different. For example, my multipliers are higher than FRB/US multipliers that assume monetary policy follows a Taylor-type rule or those that (equivalently) assume that the zero bound is explicitly expected to not bind for a significant length of time. They are lower than estimates that assume the zero bound is expected to last many years.

⁶ About 3 percent of simulations of 120 years fail – that is, once every 4,000 years. Typically, this is because the model wanders off to an inadmissible region; for example, with a negative income or expenditure share. When this happens, I disregard the simulation.

⁷ Whereas a basic bootstrap draws one quarter of observations at a time, the block bootstrap draws blocks of consecutive quarters, so as to capture unmodelled leads and lags.

1973, are effectively assumed to be once-in-40-years events. Alternatively, they can be considered to be representative of a larger class of less frequent events.

This approach generates distributions of many key macroeconomic variables that are similar to those seen in recent US history. For example, the standard deviation of the unemployment rate is 1.3 percentage points in simulations with high inflation targets. This compares with an actual standard deviation of the gap between the unemployment rate and the model's effective NAIRU of 1.4 percentage points from 1968 through 2009.⁸ With respect to the distribution of variables conditional on a given starting point, Reifschneider and Tulip (2007, Table 9) show that FRB/US stochastic simulations are similar to real-time errors from major US macroeconomic forecasters.

The top panel of Table 2 shows key summary statistics for simulations with no unusual fiscal stimulus; that is, β in equation (3) equals zero. As the inflation target approaches the lower bound, monetary policy is constrained more often. For example, as shown in the top row, interest rates are zero 8 percent of the time with an inflation target of 2 percent, rising to 14 percent of the time if the target is 1 percent. And, as shown in the second and third rows, the severity of these episodes, as measured by their duration or the standard deviation of unemployment, also increases at low inflation rates.

Table 2: Simulated outcomes at different inflation targets

	Inflation target			
	0 percent	1 percent	2 percent	4 percent
A. Without stimulus				
1. Proportion of time at zero bound	.25	.14	.08	.03
2. Median length of zero bound episode (quarters)	8	6	5	4
3. Standard deviation of unemployment rate	1.71	1.51	1.38	1.28
B. With recent stimulus				
4. Proportion of time at zero bound	.20	.11	.06	.02
5. Median length of zero bound episode (quarters)	6	5	4	3
6. Standard deviation of unemployment rate	1.39	1.29	1.26	1.23

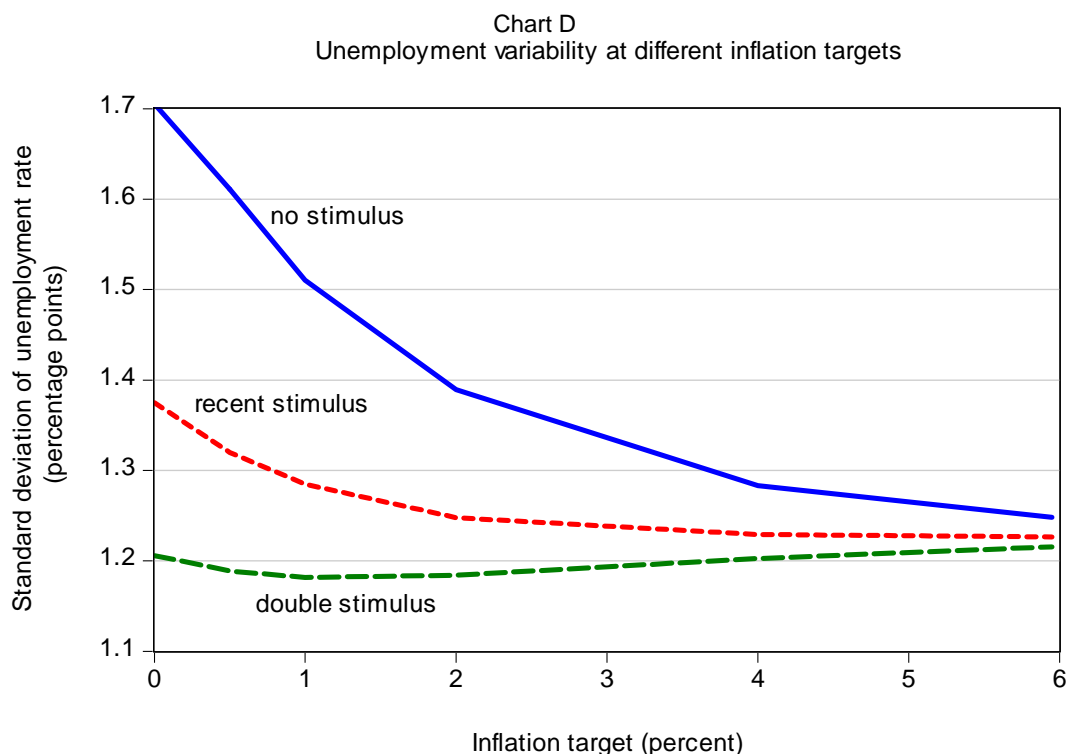
Source: Author's calculations

The baseline simulations are in line with previous research using FRB/US. The standard deviation of unemployment is higher than that reported by Reifschneider and Williams, but that is accounted for by the difference in sample period, which here includes the recent financial

⁸ The standard deviation of interest rates and the inflation rate is substantially larger in the data than in the simulations. One possible explanation is that the model's inflation target is an exogenous constant in the simulations but may have varied over time in reality.

crisis. If this episode is excluded, the results are essentially the same, as discussed in the following section.

As with the earlier research, this baseline assumes that fiscal policy behaves passively, in line with historical patterns. In contrast, the lower panel shows the effect of counter-cyclical fiscal policy, that is with $\beta = 0.7$. I interpret this calibration as describing recent policy, and label it as such. However, it should be emphasized that equation (3) is only an approximation. As can be seen by comparing the upper and lower panels, counter-cyclical fiscal policy reduces the frequency and severity of zero bound episodes. Chart D plots the standard deviation of the unemployment rate for different inflation targets. The lines labeled “no-stimulus” and “recent stimulus” represent simulations with β equal to zero and 0.7 respectively. With active fiscal policy, the economy is more stable, especially at low inflation rates.



Source: Author’s calculations

The difference between the lines labeled “no-stimulus” and “recent stimulus” provides a measure of the benefits from counter-cyclical fiscal policy. If fiscal policy is passive, then an inflation target of 2 percent is associated with a standard deviation of the unemployment rate of 1.39 percentage points. However, if fiscal policy is similar to recent experience, then the same variability of unemployment could be achieved with an inflation target of zero. Put another way, counter-cyclical fiscal policy is estimated to lower the standard deviation of the unemployment rate by 9 percent at a 2 percent inflation target or by 19 percent at a zero inflation target.

A third alternative, labeled “double stimulus” in Chart D, sets $\beta = 1.4$, twice the previous value. According to these estimates, this more aggressive fiscal policy almost eliminates economic variability arising from the zero bound. Such a policy may seem attractive; however, a discussion of optimal fiscal policy would also consider costs, and is beyond the scope of this

paper.⁹ In any case, from the perspective of monetary policy, it seems appropriate to take current fiscal policy as given.

The results in Chart D span a wide range of possible outcomes, which reduces the need for detailed sensitivity analysis. In qualitative terms, it is relatively straightforward to see how alternative modeling choices would affect the results. For example, if fiscal policy multipliers were smaller than FRB/US estimates, or if the stimulus were smaller than my “recent stimulus” simulations, those simulations would more closely resemble the “no stimulus” experiment. Such an outcome would be likely if, for example, fiscal stimulus placed more weight on low-multiplier instruments, such as tax cuts, or if stimulus were expected to considerably outlast the zero bound, giving rise to offsetting increases in bond yields. Alternatively, if fiscal policy were more potent, timely, or aggressive than assumed in the “recent stimulus” simulations, those results would move toward those depicted by the “double stimulus” simulations. Such an outcome would be likely if the fiscal rule placed more weight on the 2001 and 2008 fiscal measures.

Perhaps a more important sensitivity is to the assumed volatility economic shocks, addressed in the following section.

Lessons of the crisis

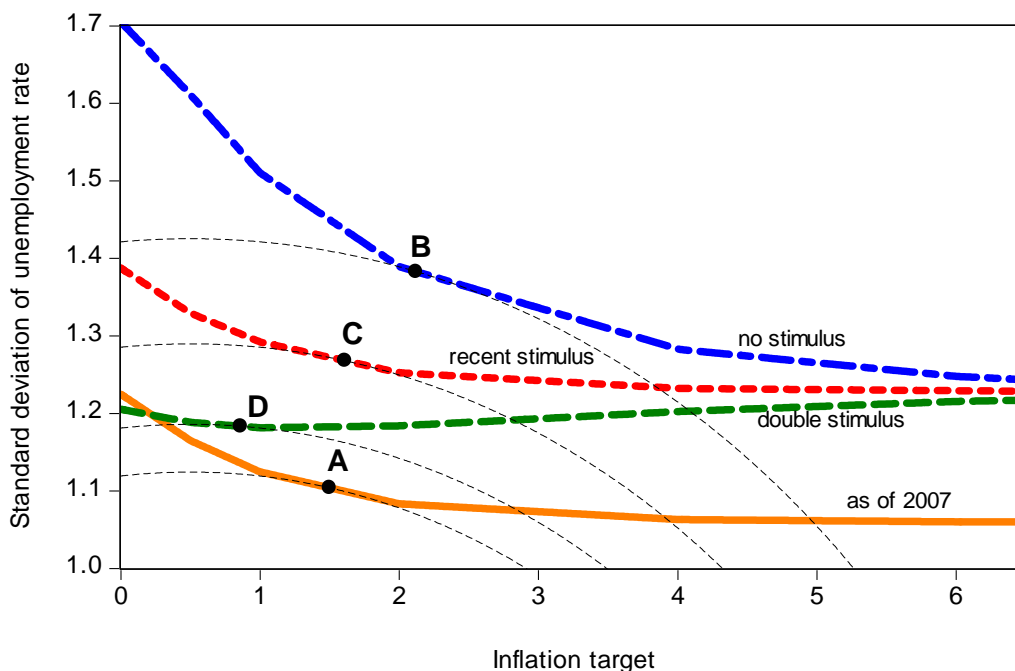
The previous section suggested that researchers and policy-makers may have overestimated the optimal inflation target by neglecting counter-cyclical fiscal policy. However, that is not the only lesson from the recent crisis. We have also learned, for example, that macroeconomic shocks are more volatile. Yellen (2009), Williams (2009), and Blanchard *et al* (2010) have discussed having a higher inflation target because of this increase in perceived volatility. This raises the question of how changes in fiscal activism and volatility should be balanced. Put another way, suppose a policy maker regarded an inflation target of say 1.5 percent as appropriate before the recent recession (as suggested by Elmendorf *et al*, 2005, among others). Given what has been learned since then, what might be his or her new target?

Chart E provides a possible comparison. The dashed blue, red, and green lines represent the trade-off between inflation and instability reproduced from Chart D, labeled as before. To illustrate how a central banker in early 2007 might have perceived the trade-off, the solid line labeled “as of 2007” is constructed assuming passive fiscal policy and drawing residuals from the period 1968 to 2006. That curve is essentially the same as the estimates of Reifschneider and Williams, adjusting for measurement differences.¹⁰

⁹ An interesting feature of the “double stimulus” simulation is that unemployment is slightly more stable at low inflation (1 or 2 percent) than at higher rates. Presumably this is because this particular fiscal rule – which only kicks in at low interest rates – is more stabilizing than the baseline monetary policy rule.

¹⁰ See their presentation to the FOMC on January 29, 2002, page 161 of transcript. My estimates are essentially the same as those in row 2 of the middle panel if the inflation rate is shifted half a percentage point, the average difference between CPI inflation and PCE inflation.

Chart E
Different trade-offs between inflation and unemployment instability



Source: Author's calculations

The thin dotted curve drawn through the point A reflects a hypothetical indifference curve. The preferences that might give rise to a choice like A can be represented by the loss function:

$$4) L = (\pi - 0.5)^2 + 22\sigma^2,$$

where π is the inflation target, the parameter 0.5 is Elmendorf *et al*'s estimate of the measurement bias in the PCE price series, σ is the standard deviation of the unemployment rate, and the coefficient 22 is chosen so as to minimize the loss at A. For simplicity, I assume that other factors that affect preferences over inflation objectives, such as tax distortions or downward nominal wage rigidity, are roughly offsetting. At point A, the central banker has an inflation target of 1.5 percent, which implies a standard deviation of the unemployment rate of 1.10 percentage points. Such a choice implies that an extra percentage point of inflation is worth 0.04 percentage points extra standard deviation of unemployment. Indifference curves through points B, C, and D represent the same preferences.

Under these assumptions, a central banker who perceives that volatility has increased, but that fiscal policy will remain passive, might choose a point such as B, with an inflation target of 2 percent. The difference between points A and B illustrates the sensitivity of this approach to changes in estimates of volatility.

Were the central banker also to believe that recent fiscal stimulus is likely to be repeated, he may choose a point like C, also with a target of 1½ percent. According to the model's estimates, the inflation target is about the same as the pre-recession choice, because the change in fiscal policy offsets the increase in perceived volatility. Thus, although changes in volatility

are important for the choice of inflation target, whether fiscal policy is active or passive is of similar importance.

If fiscal policy were even more aggressive, the inflation target could be lower still. For example, a fiscal policy that is twice as aggressive as recently would imply point D, with an inflation target of 0.9 percent. For such an aggressive fiscal policy, the trade-off between steady-state inflation and instability is very flat. In these conditions, the inflation target is essentially decided by considerations other than the zero bound, such as estimates of measurement bias.

The examples above are illustrative and omit some other important lessons from the recent crisis. For example, we have also learned that central banks are likely to purchase long-term securities so as to reduce bond premiums. Furthermore, point A may not be the best starting point, as suggested by Billi (2011). But notwithstanding these caveats, the simulations shown in Chart E suggest that the inflation target should not increase simply because perceived volatility has increased.

Directions for future research

The simulations shown in Chart D imply that counter-cyclical fiscal policy, such as we have just seen, can be expected to stabilize the economy, at a given inflation target.

This result could be developed and refined in several directions. An obvious priority is to incorporate non-conventional monetary policy, as discussed by Chung, Laforde, Reifschneider, and Williams (2011). This should be included for essentially the same reasons as those I gave for including fiscal activism. A more important, but harder, challenge is to determine how large will be the shocks hitting the economy. As discussed in reference to Chart E, the inflation target is sensitive to this assumption unless fiscal policy is more aggressive than recently.

My simulations quantify substantial benefits from systematic counter-cyclical fiscal policy. However, for this finding to contribute to the development of fiscal policy, it would need to be shown that these benefits exceed the costs. The current version of FRB/US is not specified so as to address this question, because the costs of counter-cyclical fiscal policy in FRB/US are simply assumed to be unimportant. For example, perceptions of default probabilities do not depend on debt levels, labor supply does not respond to fluctuations in tax rates, and my stimulus rule did not include measurement or other errors. A model that relaxed these assumptions would be able to more persuasively address the issue of optimal fiscal policy.

Appendix 1: Expectations

In the simulations, agents are assumed to base their expectations on small-scale vector autoregressions (VARs) rather than full model-consistent expectations. This choice represents a compromise reflecting conceptual and practical considerations.

Conceptually, it is implausible to assume that most economic agents know the structure of the model, given that most professional economists do not. In particular, people are unlikely to perceive a change in policy regime simply because it is announced. For example, changes in monetary policy rules in the early 1980s in the US and UK seem to have led to recessions rather than changes in inflation expectations. Similarly, households respond to tax cuts when the policy change is implemented, not when it is enacted or credibly announced (see the references listed in footnote 3 of Auerbach, Gale, and Harris, 2010). Accordingly, use of VAR-based expectations seems appropriate when considering one-off shocks or variations within the range of recent experience. Consistent with this, FRB/US coefficients are estimated assuming VAR expectations.

However, repeated shocks that differ from recent experience will result in expectational errors from which people will learn. As people learn from experience, model-consistent expectations become a more realistic description. Hence, for analysis of a change in policy rules, model-consistent expectations are ordinarily more appropriate.

A difficulty in applying this general principle to fiscal stimulus at the zero bound is that it is a policy that is applied infrequently. Interest rates only occasionally hit the zero bound and the constraint seriously binds only once every decade or so. To be precise, in simulations with $\beta = 0.7$ and a 2 percent inflation target, a stimulus exceeding 2 percent of GDP occurs once every 12 years, on average. So learning about the relevant change in structure seems likely to take a long time, perhaps decades. In the meantime, historically-based expectations may be more realistic.

In practical terms, stochastic simulations of nonlinear models under model-consistent expectations are computationally difficult. Accordingly, previous researchers have used linearized versions of their models, which is a problem for this study given that the fiscal rule is non-linear. Reifschneider and Williams show that a non-linear constraint can be introduced into an otherwise linear model by adding non-zero residuals, with a large cost in computational complexity. These costs would be much greater for multiple non-linear constraints.

A further difficulty with previous work is that the expectations are not actually “model-consistent,” but “model-based.” They represent the model’s deterministic solution, rather than the mean of the stochastic solution. Because the zero bound is asymmetric, these will differ. For example, decision-makers are assumed to know how long zero-bound episodes will last, even though this expectation (the deterministic solution) will typically be biased. In contrast, VAR expectations implicitly assume that decision makers expect shocks to persist about as long as similar shocks have persisted in the past.

Moreover, the nonlinear version of the model with VAR-based expectations has been documented, scrutinized, and successfully used in a wide variety of applications.¹¹ This scrutiny increases confidence in and understanding of the results. Properties of the linearized model are less clear.

Some simple comparisons suggest that the results may be similar if expectations are assumed to be model-consistent. As discussed above, the inflation/unemployment variability frontiers are very similar to those in previous work using model-based expectations, when put on a consistent basis. Furthermore, fiscal multipliers may be similar, on average. Table A.1 compares FRB/US fiscal multipliers after 4 quarters under different assumptions about expectations. Under VAR expectations, agents implicitly assume that shocks persist as long as similar shocks in the past. For model-consistent expectations, the future persistence of the shock matters and needs to be specified: I assume that both shocks and zero bound episodes are expected to last 8 quarters. This is a bit longer than most zero bound episodes (Table 2), but may be representative, given that most stimulus occurs in longer-lasting recessions, and the positive threshold for stimulus. For the experiments shown in Table A.1, multipliers with model-consistent expectations are slightly smaller than those with VAR expectations, but the difference is small. These comparisons suggest that the overall impact of fiscal policy may not be significantly different once expectations become model-consistent.

Table A.1: FRB/US fiscal multipliers, with different assumptions about expectations

Effect on level of real GDP (percent deviation from baseline) after 4 quarters of a change in fiscal variables by 1 percent of GDP expected to last 8 quarters

	VAR expectations	Model-consistent expectations
Government purchases	0.99	0.94
Personal tax receipts	-0.31	-0.27
Transfers	0.42	0.28

Source: Author's calculations

Note: Multipliers with model-consistent expectations use the non-linear version of FRB/US ("PFVER").

¹¹ For regular applications, see the alternative scenarios and confidence intervals typically published around page I-17 in each Greenbook, available at <http://www.federalreserve.gov/monetarypolicy/fomchistorical2004.htm>

Appendix 2: Measurement of recent stimulus

The stimulus rule, equation (3) is calibrated to fit the most recent round of stimulus. Recent experience is an interesting benchmark both because it provides a guide to what is likely to occur in the future and because it is a familiar reference point for discussions of whether fiscal policy should do more or less. Estimates of recent stimulus by Follette and Lutz and by Blinder and Zandi (through mid 2010) are similar to CBO estimates of the major legislation. Notwithstanding this agreement, several issues in measuring recent stimulus may be worth noting.

To avoid double-counting, I want to exclude measures that the standard FRB/US equations predict would have occurred anyway. The main component of the CBO estimates to which this applies is indexation of the alternative minimum tax (AMT), which I subtract from the published CBO totals to give the series plotted in Charts B and C. Follette-Lutz and Blinder-Zandi already exclude AMT indexation.

Although the FRB/US equations for transfers have a substantial cyclical effect, they do not explain all the recent increase, the shortfall being about 1½ percent of GDP. Fortunately, that roughly corresponds to increases in transfers that have been legislated in the three large bills. So restricting estimates of stimulus to the three large bills is a crude but simple approximation to the increase in transfers that is additional to the FRB/US equations.

The biggest difference between the CBO estimates and Follette-Lutz is the extension of middle-class tax cuts that were scheduled to expire at the end of 2010. They are included within the CBO estimates, which are relative to a counter-factual of “existing legislation,” but excluded from Follette-Lutz, which is relative to a counter-factual of “existing policy.” In contrast, my implicit counter-factual is “predictions of FRB/US equations” or what might be called “sustainable policy,” which call for a large increase in taxes around this time in order to stabilize the debt. So the CBO estimates happen to provide a measure of stimulus in 2011 and 2012 that is closer to my purposes.

Less important, but high profile, are asset purchases such as the Troubled Asset Relief Program or TARP. I do not include this as systematic counter-cyclical policy largely because the net present value of asset purchases is highly uncertain and their multiplier is widely assumed to be quite low. So repetition of future TARP-like programs would have little effect on the cyclical behavior of the economy.

There are other recent programs that might be considered to be counter-cyclical fiscal policy, including Cash for Clunkers, the home-buyers tax credit, and so on. But the total budgetary cost of these measures was small (see Blinder and Zandi, Table 10).

A further limitation of my estimates is that they will soon be out of date. As noted above, the American Jobs Act, which calls for a stimulus of 3 percent of GDP, is currently before Congress. Given the deterioration of the economy since the previous stimulus, this Act seems qualitatively consistent with equation 3). However, analysis of its quantitative implications is left for future research.

Appendix 3: FRB/US fiscal equations

This Appendix presents key equations in the fiscal block of FRB/US, modified to include the effects of counter-cyclical stimulus, as defined in equation (3). The model's full equation listing is available on request.

Real transfers (GFT) equal the trend share (GFTRT) of transfers in potential output (XGDPT) plus deviations from that trend (GFTRD) plus a quarter of the stimulus, in real dollars.

$$5) \text{ GFT} = (\text{GFTRD} + \text{GFTRT}) * \text{XGDPT} + .25 * \text{STIMULUS} * \text{XGDP}(-1)$$

Real government consumption purchases, excluding employee compensation before the stimulus (EGFOBASE) is a function of own lags, a stochastic time trend, EGFOT, and the output gap, GDPGAP.

$$6) \text{ D}(\text{LOG}(\text{EGFOBASE})) = -.0026 - .17 * \text{LOG}(\text{EGFOBASE}(-1) / \text{EGFOT}(-1)) - .24 * \text{D}(\text{LOG}(\text{EGFOBASE}(-1))) - .11 * \text{D}(\text{LOG}(\text{EGFOBASE}(-2))) + 1.78 * \text{D}(\text{LOG}(\text{EGFOT})) - .00039 * \text{GDPGAP}(-1) + .0012 * \text{GDPGAP}(-2)$$

EGFO is EGFOBASE plus a quarter of the total stimulus, in real dollars. The separation of EGFO and EGFOBASE ensures that the endogenous persistence in EGFOBASE does not amplify the stimulus.

$$7) \text{ EGFO} = \text{EGFOBASE} + .25 * \text{STIMULUS} * \text{XGDP}(-1)$$

Nominal personal tax receipts (TFPN) equal the tax rate (TRFP) times taxable income (YPNADJ) minus half the stimulus in nominal dollars.

$$8) \text{ TFPN} = \text{TRFP} * \text{YPNADJ} - .5 * \text{STIMULUS} * \text{XGDPN}(-1)$$

The tax rate (TRFP) is a function of the trend tax rate (TRFPT), own lags and the output gap (GDPGAP). I shock TFPN rather than TRFP so that the endogenous persistence in TRFP does not amplify the stimulus.

$$9) \text{ TRFP} = \text{TRFPT} + .57 * (\text{TRFP}(-1) - \text{TRFPT}(-1)) + .35 * (\text{TRFP}(-2) - \text{TRFPT}(-2)) + .00034 * \text{GDPGAP}(-1)$$

The trend tax rate (TRFPT) adjusts to stabilize debt (GFDBTN) at 55% of nominal GDP (XGDPN)

$$10) \text{ TRFPT} = \text{TRFPT}_{t-1} + 0.05 * (\text{GFDBTN}_{t-1} / \text{XGDPN}_{t-1} - .55) + 0.5 * \text{D}(\text{GFDBTN}_{t-1} / \text{XGDPN}_{t-1} - .55)$$

References

- Auerbach, Alan J., and William G. Gale, 2009. "Activist Fiscal Policy to Stabilize Economic Activity," in *Financial Stability and Macroeconomic Policy*, Federal Reserve Bank of Kansas City.
- Auerbach, Alan J., William G. Gale, and Benjamin H. Harris, 2010. "Activist Fiscal Policy," *Journal of Economic Perspectives* Vol. 24, No 4, Fall.
- Becker, Gary "On the Obama Stimulus Plan" January 11, 2009, <http://uchicagolaw.typepad.com/beckerposner/2009/01/on-the-obama-stimulus-plan-becker.html>
- Bernanke, Ben S., 2002. "Deflation: Making sure 'It' Doesn't Happen here," Speech at the National Economists Club, Washington, D.C., November 21, 2002
- Bernanke, Ben S., 2003. *Remarks at the 28th Annual Policy Conference: Inflation Targeting: Prospects and Problems*, St Louis Missouri, October 17, 2003.
- Bernanke, Ben S., 2011. Press Conference, April 27, 2011
- Billi, Roberto (2011) "Optimal Inflation for the US Economy" *American Economic Journal: Macroeconomics* Vol 3, No 3, July 2011, pp 29-52
- Billi, Roberto and George A Kahn (2008) "What is the Optimal Inflation Rate?" *Federal Reserve Bank of Kansas City, Economic Review*, 2008, Second Quarter
- Blanchard, Olivier, Giovanni Dell'Ariccia, and Paolo Mauro, 2010. "Rethinking Macroeconomic Policy," *IMF Staff Positional Note* SPN/10/03, International Monetary Fund.
- Blinder, Alan S. 2004. "The Case Against the Case Against Fiscal Policy" in R. Kopke, G. Tootell, and R. Triest, eds., *The Macroeconomics of Fiscal Policy*, MIT Press
- Blinder, Alan S. and Mark Zandi, 2010. *How the Great Recession Was Brought to an End*, July 27, 2010. <http://www.economy.com/mark-zandi/documents/End-of-Great-Recession.pdf>
- Christiano, Lawrence, Martin Eichenbaum, and Sergio Rebelo (2011) "When Is the Government Spending Multiplier Large?" *Journal of Political Economy*, Vol. 119, No. 1 (February 2011), pp. 78-121
- Chung, Hess, Jean-Philippe Laforte, David Reifschneider, John C. Williams, 2011. "Have we Underestimated the Likelihood and Severity of Zero Lower Bound Events?" *Working Paper Series 2011-01*, Federal Reserve Bank of San Francisco.
- Coenen, Günter, Athanasios Orphanides, Volker Wieland, 2004 "Price Stability and Monetary Policy Effectiveness when Nominal Interest Rates are Bounded at Zero," *Advances in Macroeconomics*, 4, no. 1, article 1.
- Coenen, Günter, Christopher J. Erceg, Charles Freedman, Davide Furceri, Michael Kumhof, René Lalonde, Douglas Laxton, Jesper Lindé, Annabelle Mourougane, Dirk Muir, Susanna Mursula, Carlos de Resende, John Roberts, Werner Roeger, Stephen Snudden, Matthias Trabandt, and Jan in 't Veld, 2010. "Effects of Fiscal Stimulus in Structural Models," *IMF Working Papers* 10/73, International Monetary Fund.

- Cogan, John F., Tobias Cwik, John B. Taylor, and Volker Wieland, (2010). "New Keynesian Versus Old Keynesian Government Spending Multipliers," *Journal of Economic Dynamics and Control* 34: 281-295
- Congressional Budget Office (CBO, 2001) *The Budget and Economic Outlook: An Update*, August 2001
- Congressional Budget Office (CBO, 2003) *The Budget and Economic Outlook: An Update*, August 2003
- Congressional Budget Office (CBO, 2008) *H.R. 5140 Economic Stimulus Act of 2008*, Congressional Budget Office Cost Estimate February 11, 2008
- Congressional Budget Office (CBO) (2009) *Estimated Cost of the Conference Agreement for H.R. 1, The American Recovery and Reinvestment Act of 2009*, Transmitted to Speaker Nancy Pelosi, February 13, 2009
- Congressional Budget Office (CBO) (2010) *Estimated Impact of the American Recovery Reinvestment Act on Employment and Economic Output from July 2010 through September 2010*, Nov 2010, Congressional Budget Office
- Congressional Budget Office (CBO) (2011) *The Budget and Economic Outlook: Fiscal Years 2011 to 2021* January 2011
- Delong, Brad (2011) "What Have We Unlearned from Our Great Recession?" presentation at American Economic Association, Jan 7, 2011.
- Elmendorf, Douglas, Deborah Lindner, David Reifschneider, John Roberts, Jeremy Rudd, Robert Tetlow, and David Wilcox (2005) "Considerations Pertaining to the Establishment of a Specific, Numerical, Price-Related Objective for Monetary Policy" memo to the Federal Open Market Committee, Board of Governors of the Federal Reserve System, Washington DC, January 21, 2005. Available at www.petertulip.com.
- Elmendorf, Douglas W. and Reifschneider, David (2002) "Short-Run Effects of Fiscal Policy with Forward-Looking Financial Markets," *National Tax Journal*, Vol. LV, No. 3 September 2002, 357-386.
- Federal Open Market Committee (FOMC, 2005) *Meeting of the Federal Open Market Committee*, February 1-2, 2005, Transcript and Presentation materials. www.federalreserve.gov/monetarypolicy/fomchistorical2005.htm.
- Federal Open Market Committee (FOMC, 2011) *Summary of Economic Projections*, April 27, 2011.
- Feldstein, Martin, (2002) "Commentary: Is There a Role for Discretionary Fiscal Policy?" in *Rethinking Stabilization Policy*, Kansas City: Federal Reserve Bank of Kansas City, 2002.
- Feldstein, Martin (2007) "How to Avert a Recession" *The Wall Street Journal*, December 5.
- Follette, Glenn and Byron Lutz, 2010. "Fiscal policy in the United States: automatic stabilizers, discretionary fiscal policy actions, and the economy," *Finance and Economics Discussion Series* 2010-43, Board of Governors of the Federal Reserve System, Washington DC.

- Hunt, Benjamin and Douglas Laxton (2004) "The Zero Interest Rate Floor (ZIF) and its Implications for Monetary Policy in Japan" *National Institute Economic Review* January 2004 vol. 187 no. 1 76-92
- Joint Committee on Taxation (JCT, 2009) *Estimated Budget Effects of the Revenue Provisions Contained in the Conference Agreement for Agreement for H.R. 1, The American Recovery and Reinvestment Act of 2009*, February 12, 2009
- Krugman, Paul, (2008) "Too much of a good thing" November 28, 2008.
<http://krugman.blogs.nytimes.com/2008/11/28/too-much-of-a-good-thing/>
- Krugman, Paul, (2011) "Academic Debate, Real Consequences" August 26, 2011.
<http://krugman.blogs.nytimes.com/2011/08/26/academic-debate-real-consequences-wonkish/#more-23765>
- Mankiw, N. Gregory and Matthew Weinzerl (2011) "An Exploration of Optimal Stabilization Policy" forthcoming in *Brookings Papers on Economic Activity*
- Organization of Economic Cooperation and Development (OECD, 2009) *Economic Outlook*, April 2009, Paris
- Orszag, Peter (2011) "Link U.S. Payroll Tax Holiday to Unemployment Rate," June 30, 2011,
<http://www.bloomberg.com/news/2011-06-30/payroll-tax-should-be-linked-to-unemployment-rate-peter-orszag.html>
- Posen, Adam S. (1998) *Restoring Japan's Economic Growth* Peterson Institute, Washington DC
- Reifschneider, David and Peter Tulip (2007) "Gauging the Uncertainty of the Economic Outlook from Historical Forecasting Errors", *Finance and Economics Discussion Series 2007-60*. Washington: Board of Governors of the Federal Reserve System.
- Reifschneider, David and John C. Williams, 2000. "Three lessons for monetary policy in a low inflation era," *Journal of Money Credit and Banking*, Vol 32, No. 4 (November 2000, Part 2)
- Romer, Christina and Jared Bernstein, 2009. *The Job Impact of the American Recovery and Reinvestment Plan*, Council of Economic Advisors, Washington DC.
- Romer, David, (2011) "What Have We Learned About Fiscal Policy from the Crisis?" *IMF Conference on Macro and Growth Policies in the Wake of the Crisis*, March 2011, IMF Washington DC
- Schmitt-Grohé, Stephanie and Martin Uribe (2010) "The Optimal Rate of Inflation" forthcoming in *Handbook of Monetary Economics Volume 3*, edited by Benjamin M Friedman and Michael Woodford, Elsevier/North Holland.
- Spilimbergo, Antonio, Steve Symansky, Olivier Blanchard, and Carlos Cottarelli, 2008. "Fiscal Policy for the Crisis," *IMF Staff Positional Note* SPN/08/01, International Monetary Fund.
- Summers, Lawrence, 2010, "America's sensible stance on recovery" *Financial Times*, July 18 2010
- Taylor, John B. 2000, "Reassessing Discretionary Fiscal Policy" *Journal of Economic Perspectives*, Vol 14, No. 3, Summer pp 21-36.
- Williams, John C., 2009. "Heeding Daedalus: Optimal inflation and the zero lower bound," *Brookings Papers on Economic Activity*, Fall 2009

- Woodford, Michael, 2011, "Simple Analytics of the Government Expenditure Multiplier"
American Economic Journal: Macroeconomics 3 (January 2011): 1-35
- Woodford, Michael, and Gaudi B. Eggertsson, 2004. "Optimal Monetary and Fiscal Policy in a
Liquidity Trap," *NBER International Seminar on Macroeconomics* July 2004
- Yellen, Janet L., (2009) Speech to conference on "Financial Markets and Monetary Policy",
Washington D.C. June 5, 2009