POSSIBLE MACROECONOMIC CONSEQUENCES OF LARGE FUTURE FEDERAL GOVERNMENT DEFICITS

By

Ray C. Fair

September 2009
Updated October 2009

COWLES FOUNDATION DISCUSSION PAPER NO. 1727

COWLES FOUNDATION FOR RESEARCH IN ECONOMICS
YALE UNIVERSITY
Box 208281
New Haven, Connecticut 06520-8281

http://cowles.econ.yale.edu/

Possible Macroeconomic Consequences of Large Future Federal Government Deficits

Ray C. Fair*

October 2009

Abstract

This paper uses a macroeconometric model of the U.S. economy to analyze possible macroeconomic consequences of large future federal government deficits. The analysis has the advantage of accounting for the endogeneity of the deficit. In the baseline run, which assumes no large tax increases or spending cuts and no bad dollar and stock market shocks, the debt/GDP ratio rises substantially through 2020. The estimates from this run are in line with other estimates. Various experiments off the baseline run are then done. If the dollar depreciates, inflation increases but the effect on the debt/GDP ratio is modest. It does not appear that the United States can inflate its way out of its deficit problem. If in addition U.S. stock prices fall, this makes matters worse by lowering output because of a negative wealth effect. Large personal tax increases or transfer payment decreases solve the deficit problem, but at a cost of considerable lost output over a decade. The Fed's ability to offset these losses is modest according to the model. Introducing a national sales tax is more contractionary than is increasing personal income taxes or decreasing transfer payments.

*Cowles Foundation and International Center for Finance, Yale University, New Haven, CT 06520-8281. Phone: 203-432-3715; e-mail: ray.fair@yale.edu; website: *fairmodel.econ.yale.edu*. The results in this paper can be duplicated on the author's website, and alternative baseline runs and experiments can be done. I am indebted to William Brainard for helpful comments.

1 Introduction

It is well known that large future federal government deficits are looming. The Congressional Budget Office (CBO) released estimates on August 25, 2009—CBO (2009b)—that showed a cumulative deficit between 2009 and 2019 of $8.7 trillion. The federal government debt as a percent of GDP was estimated to rise from 40.8 percent in 2008 to 67.8 percent in 2019. Auerbach and Gale (2009, Table 4) have for their "adjusted baseline" case the debt as a percent of GDP of 89.4 percent in 2019. There is considerable discussion in the media about this issue. Most people are alarmed, for example Samuelson (2009), and it has been used to argue against health care reform because of the possible added cost to the government. A few, for example Krugman (2009), are not worried: "…the extra debt should be manageable."

Many commentators argue that if something is not done to lower the deficits, bad things may happen to the economy. Often cited are a depreciation of the dollar, a decrease in U.S. stock prices, and an increase in interest rates on U.S. government securities (because of added risk). There are, however, no quantitative estimates of these possible effects. One needs a model of the economy to obtain such estimates, and this has not been done. This paper presents estimates using a model of the U.S. economy. A baseline run is obtained where nothing bad happens, and then alternative runs are made under various negative assumptions—in particular, dollar depreciation, oil price increases in dollars, and falling U.S. stock prices. As discussed in the next section, exchange rates, oil prices, and stock prices are essentially unpredictable, being determined in asset markets. This paper

thus provides *conditional* estimates. Conditional on a particular response in asset markets to the deficits, estimated effects on the macro economy are provided.

Results are also presented of 1) increasing personal income tax rates, 2) lowering federal government spending on transfer payments, and 3) introducing a federal government sales tax. The economic effects of these changes are estimated, including the effects on the government deficit and debt.

The advantage of the procedure in this paper is that, given the model, consistent stories can be told. Asset-market changes and government policy changes affect both the macro economy and the government deficit, and the model takes into account these effects. In the solution of the model the predicted values of the deficit are consistent with the predicted values of the other endogenous variables.

The stress in this paper is on demand effects. The traditional concerns of the public finance literature on dead weight losses and inefficiencies from taxes are not considered in this paper. The implicit assumption here is that these effects are second order relative to macro demand and price effects regarding the current federal budget problem. There is a tax effect on labor force participation, as seen below, but the main focus is on the demand side.

2 The Model

A structural macroeconometric model of the United States, denoted the "US model," is used in this paper. The US model is presented in Fair (2004), and it has been updated for purposes of this paper. The updated version is on the author's website. The methodology behind the model is compared to the methodology

of dynamic stochastic general equilibrium (DSGE) models in Fair (2009a). The ability of the model to forecast recessions and booms is analyzed in Fair (2009b). The model is completely estimated (by 2SLS for the 1954:1–2009:2 period); there is no calibration. There are three estimated consumption equations, three investment equations, an import equation, four labor supply equations, two labor demand equations, a price equation, a nominal wage equation, two term structure of interest rate equations, and an estimated interest rate rule of the Federal Reserve, among others. In the interest rate rule the Fed responds to inflation and unemployment. There are a total of 26 estimated equations and about 100 identities. The unemployment rate is determined by an identity; it equals unemployment divided by the labor force. In the identities all flows of funds among the sectors (household, firm, financial, state and local government, federal government, and foreign) are accounted for. The federal government deficit is determined by an identity, as is the federal government debt. There is an estimated equation determining the interest payments of the federal government as a function of interest rates and the government debt.

The model will not be discussed in detail here. It will be useful, however, to review a few of its properties. The multiplier for a change in government purchases of goods and services is about 2.0 after four quarters. (For all the multipliers discussed here the estimated interest rate rule of the Fed is included in the model—monetary policy is endogenous.) The multiplier for a change in the personal income tax rate is about 1.0 after four quarters. The same is true for a change in government spending on transfer payments to households. If the interest rate rule is dropped and the short term interest rate is increased by 1 percentage

point, real output falls by about .3 percent after four quarters and about .5 percent after eight quarters. Monetary policy thus has important effects on the economy, but not enough to come close to eliminating cycles. This is discussed in Fair (2005). Multipliers in the model from a sustained change in a policy variable generally peak between four and eight quarters and then decline after that.

There are important wealth effects in the model. An increase in household wealth, say from an increase in stock prices, leads to an increase in consumption. Spending out of wealth is about 4 percent per year of the wealth change. The household wealth variable in the model includes housing wealth. Tests that I have done show that the consumption response to a change in financial wealth is close to the response to a change in housing wealth, and the two are added together in the model.

The demand pressure variable in the price equation is the unemployment rate, and the cost shock variable is the price of imports. The nominal wage rate appears in the price equation, and the price level appears in the nominal wage equation. The price equation is discussed and tested against other specifications in Fair (2008). The price of imports is an important explanatory variable in the price equation, and this is why increasing the price of imports in the experiments in Section 4 leads to an increase in the domestic price level.

DSGE models like the Galí and Gertler (2007) model have that property that a positive price shock is explosive unless the Fed raises the nominal interest rate more than the increase in the inflation rate. In other words, positive price shocks with the nominal interest rate held constant are expansionary (because the real interest rate falls). In the US model, however, they are contractionary. If there

is a positive price shock like an increase in the price of imports, the real wage initially falls because nominal wages lag prices. This has a negative effect on consumption demand. In addition, household real wealth falls because nominal asset prices don't initially rise as much as the price level. This has a negative effect on consumption through a wealth effect. There is little if any offset from lower real interest rates because households appear to respond more to nominal rates than to real rates. Positive price shocks are thus contractionary even if the Fed keeps the nominal interest rate unchanged. An increase in the price of imports of 10 percent in the model with the nominal interest rate unchanged leads to a decrease in real GDP of about .4 percent after four quarters. A tighter monetary policy would add to the contraction.

The US model is imbedded in a multicountry (MC) model, where U.S. exports and the price of imports are endogenous. The US model alone has been used in this paper, but the MC model has been used to estimate the response of U.S. exports to a depreciation of the dollar. For this experiment the exchange rate equations in the MC model were dropped and the dollar was depreciated by the same percent against all currencies. U.S. exports increased about .25 percent for a 1.0 percent depreciation of the dollar, and this result is used in Section 4.

U.S. imports are endogenous in the US model. The key explanatory variables in the estimated import equation are an overall activity variable and the price of imports relative to the price of domestically produced goods.

In the labor force participation equations the personal income tax rate has a negative effect on labor supply (substitution effect dominating) and wealth has a negative effect (positive income effect on leisure). This means, for example, that

an increase in the personal income tax rate has a different effect on the unemployment rate than does an equivalent size decrease in transfer payments because of different effects on labor supply. Also, an increase in household wealth, other things being equal, has a negative effect on the unemployment rate (decrease in the unemployment rate) because of a decrease in labor supply. There is thus no stable relationship between aggregate output and the unemployment rate because of varying effects on labor supply—no stable Okun's law. Potential labor productivity is exogenous in the model. Actual labor productivity is endogenous: it is equal to output divided by worker hours, both of which are endogenous.

In the estimated interest rate rule of the Fed, the response to an increase in inflation of one percent is for the short term interest rate to increase by slightly less than one percentage point in the long run (0.86 percentage points). (The interest rate in the rule is the three-month Treasury bill rate.) To examine the sensitivity of the results to this property, for some of the experiments in Section 4 the equation was changed to have a response greater than one.

There are two long term interest rates in the model, a bond rate and a mortgage rate, and these are determined by estimated term structure equations. These equations have the property (supported by the data) that a sustained increase in the short term interest rate of a certain amount leads to the same change in the long term rates in the long run.

The federal government interest payments equation mentioned above is an important equation for purposes of this paper. It relates interest payments to interest rates and the federal government debt. The data on interest payments are national income and product accounts (NIPA) data, and the data on the debt are flow of

funds accounts data. The link between interest payments and the debt is complicated because it depends on the time a security was issued, its maturity, and the interest rate at the time. The estimated interest payments equation is only a rough approximation. The interest rate used is a weighted average of the three-month rate and the current and seven lagged values of the bond rate. The interest payments equation is consistent with the historical data in the sense that it is estimated (no calibration), but it is still only a rough approximation. Regarding the term structure of interest rate equations, there is no adjustment for risk in the equations. Long terms rates depend on current and past short term rates. Any effects of the large federal deficits possibly increasing the interest rates that the federal government has to pay because of added risk are not captured in the model.

There is an equation in the US model explaining capital gains or losses on the stocks held by the household sector, and it has been dropped for purposes of this paper. The two right hand side variables in this equation are the change in the bond rate and the change in after tax profits. The equation explains very little of the variation in capital gains, and the two explanatory variables have very small effects on capital gains. The equation has been dropped so that capital gains can be used in the experiments in Section 4.

3 The Baseline Run

The results in this paper are based on actual data through 2009:2. The prediction period is 2009:3–2020:4, about 11 years. Because of this length and because some of the experiments have large inflation rates, all the nominal exogenous variables

in the model were tied to the GDP deflator.[1] Some of the nominal exogenous variables are spending variables of the state and local (S&L) governments and the federal government. This treatment thus means that government spending is tied to the rate of inflation—nominal spending increases as inflation increases. This seems more realistic than to assume that nominal spending does not change as inflation changes.

For the baseline run assumptions have to be made about future government policy. This is obviously difficult because tax and spending legislation changes over time. There are five key federal government spending variables in the model: purchases of goods, civilian jobs, military jobs, transfers to households, and transfers to S&L governments. There are five key exogenous federal government tax rates: personal income, corporate profits, indirect business, employee social security, and employer social security. The stimulus bill, passed at the beginning of 2009, affects some of these variables for 2009 through 2011. My latest forecast of the U.S. economy at the time of this writing (dated August 24, 2009) uses CBO (2009a) estimates of the effects of the stimulus bill on government spending and taxes to guide the choice of the government tax and spending variables in the model. The forecast was through 2012:4, and the results are presented on the website listed in the introductory footnote. For purposes of this paper the values used for this forecast have largely been retained.[2]

[1] To be precise, for a nominal exogenous variable y a real variable x was created as y/p, where p is the GDP deflator. Then x was treated as exogenous, and the equation $y = p \cdot x$ was added to the model. In making future projections of the exogenous variable, x was projected.

[2] There is a variable in the US model that reflects the bailout spending, namely capital transfers from the federal government to financial business. Values of this variable are the government's estimate of the eventual cost to the federal government of the bailout activity. The value for 2008:4 is $268.1 billion, the value for 2009:1 is $223.3 billion, and the value for 2009:2 is $144.4 billion

For 2013:1–2020:4 the five tax rates were taken to remain unchanged from their 2012:4 values in the forecast, which were themselves taken to remain roughly unchanged from their actual 2009:2 values. The five spending variables were taken to grow in real terms at constant rates. The following discussion gives an idea of how the chosen growth rates for the spending variables relate to actual past growth rates. Three periods are considered: Clinton—1993:1–2000:4, Bush—2001:1–2007:4, and since 1990—1990:1–2007:4. The last two periods stop in 2007:4 because the stimulus bill and earlier legislation affected 2008 and 2009. The actual past growth rates and the projected growth rates are presented in Table 1. Whether these projections are likely to underestimate or overestimate spending is hard to say. Based on behavior since 1990, slightly higher values were used for purchases of goods and jobs and slightly lower values were used for transfer payments.

Given the choice for federal transfer payments to S&L governments, the values of the exogenous tax and spending variables for S&L governments were chosen so that the governments had roughly balanced budgets, something that most state constitutions require.

Three important variables in the model are essentially unforecastable. The first is capital gains or loss on stocks held by the household sector. This variable depends on changes in stock prices, which are not forecastable. For the baseline run the ratio of the capital gains variable to GDP was assumed to equal its historical

(all at annual rates). For the forecast the value of this variable was taken to be $120 billion in 2009:3, $80 billion in 2009:4, and zero after that. This variable adds to the federal government debt. Its only role in the present analysis is to start the debt off at a higher level than it would otherwise be.

Table 1
Actual and Projected Federal Government Spending Variables
Percentage Changes at Annual Rates

Variable	Clinton 1993:1–2000:4	Bush 2001:1–2007:4	Since 1990 1990:1–2007:4	Projected 2013:1–2020:4
goods purchases	−1.1	7.5	2.5	3.0
transfers to households	2.3	4.5	3.9	3.0
transfers to S&L	4.5	3.2	5.1	3.0
civilian jobs	−1.5	0.0	−0.7	1.0
military jobs	−3.1	1.1	−1.9	0.0

average (1952:1–2009:2 period) each quarter. The second variable is the change in housing wealth of the household sector, which is also essentially unforecastable. For the baseline run the housing price variable relative to an aggregate price variable was taken to grow at its historical average (which is 1.0 percent). The third is the import price deflator, which depends in large part on exchange rates and oil prices, which are not forecastable. For the baseline run the import price deflator was taken to grow at an annual rate of 1 percent.

U.S. exports are exogenous when the US model is not imbedded in the MC model. They are unforecastable in the MC model to the extent that they depend on stock prices, housing prices, and import prices of other countries. For the baseline run exports were taken to grow at an annual rate of 8 percent until 2014:4 and then at 10 percent after that. These are fairly large growth rates. Smaller rates would lead to a lower output path and higher unemployment path for the baseline run.

The remaining exogenous variables in the model are either fairly easy to forecast, like population, or are small and not important. Values of each of these variables were chosen to be consistent with recent behavior.

Results for the baseline run are presented in Table 2. Values of eleven variables are presented for the fourth quarter of each year. A key point to remember throughout this paper is that there is much more uncertainty regarding the baseline run than there is regarding the difference between another run and the baseline run. Standard errors of differences are smaller than standard errors of levels because common errors in the two runs cancel out. Another way of looking at this is to note that the conclusions at the end of the paper are not likely to be sensitive to the use of different baseline runs.

The debt/GDP ratio (debt) in 2019 is .748. This compares to .678 for CBO and .894 for Auerbach and Gale (2009), mentioned in Section 1. The baseline run is thus within range of other projections. Inflation (π) is about 3 percent for most of the period, which is higher than CBO projections. Nominal GDP for CBO in 2019 is $21.114 trillion, which compares to $24.867 trillion for the baseline run (not shown). CBO's inflation rate (GDP deflator) is 1.5 percent or less throughout this period, which leads to the much lower nominal GDP value.

For the baseline run real GDP growth (g) stabilizes at a little over 3 percent from 2016 on. The unemployment rate (u) falls to 5.4 percent by the end. The short term interest rate (r) is about 3.5 percent in the last half of the period. The ratio of the federal deficit to GDP (def), which was .018 in 2007 and reached a peak of .106 in 2009, stabilizes at around .05. The ratio of federal interest payments to GDP (int) rises to .041 by 2020. The U.S. current account deficit as a percent of GDP (ca) reaches a peak of .052 in 2014 and then falls to .028 by 2020. This fall reflects the large growth rate for U.S. exports assumed for the last half of the period. Although not shown, there are no large changes in the debt/GDP ratio of

Table 2
Baseline Run and Two Bad Shocks

qtr	g	u	π	r	R	ca	int	rec	exp	def	debt
Run 1. Baseline											
Actual values											
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.412
Forecast values											
2009.4	-1.6	10.2	0.2	0.0	5.0	0.037	0.021	0.158	0.264	0.106	0.525
2010.4	3.4	9.3	0.2	0.1	4.2	0.045	0.026	0.173	0.249	0.076	0.612
2011.4	3.2	8.3	1.6	0.6	3.8	0.045	0.028	0.176	0.244	0.068	0.656
2012.4	4.0	7.3	2.5	1.4	3.8	0.046	0.029	0.179	0.243	0.063	0.680
2013.4	3.9	6.6	3.1	2.2	4.1	0.049	0.030	0.182	0.240	0.058	0.692
2014.4	3.6	6.0	3.4	2.8	4.4	0.052	0.031	0.184	0.239	0.055	0.701
2015.4	3.5	5.8	3.3	3.2	4.8	0.052	0.033	0.186	0.239	0.053	0.709
2016.4	3.2	5.6	3.2	3.4	5.1	0.051	0.035	0.188	0.240	0.053	0.717
2017.4	3.0	5.6	3.0	3.5	5.3	0.047	0.036	0.189	0.242	0.052	0.728
2018.4	3.0	5.7	2.8	3.5	5.5	0.042	0.038	0.191	0.243	0.052	0.739
2019.4	3.1	5.6	2.7	3.5	5.6	0.036	0.040	0.193	0.244	0.051	0.748
2020.4	3.3	5.4	2.7	3.7	5.7	0.028	0.041	0.195	0.244	0.049	0.754
Run 2. Dollar Depreciation											
Actual values											
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.412
Forecast values											
2009.4	-1.6	10.2	0.2	0.0	5.0	0.037	0.021	0.158	0.264	0.106	0.525
2010.4	3.4	9.3	0.2	0.1	4.2	0.045	0.026	0.173	0.249	0.076	0.612
2011.4	3.1	8.4	2.2	0.9	3.9	0.049	0.028	0.176	0.245	0.069	0.654
2012.4	3.8	7.5	3.8	2.0	4.1	0.051	0.029	0.178	0.244	0.066	0.673
2013.4	3.7	6.8	4.8	3.0	4.5	0.054	0.031	0.180	0.242	0.062	0.680
2014.4	3.6	6.4	5.4	3.9	5.1	0.057	0.032	0.181	0.242	0.060	0.682
2015.4	3.5	6.1	5.6	4.6	5.7	0.056	0.034	0.183	0.242	0.059	0.681
2016.4	3.3	5.9	5.7	5.2	6.3	0.054	0.036	0.184	0.243	0.060	0.681
2017.4	3.1	5.8	5.7	5.5	6.8	0.050	0.038	0.185	0.245	0.060	0.683
2018.4	3.1	5.8	5.6	5.7	7.2	0.044	0.041	0.186	0.247	0.061	0.686
2019.4	3.3	5.7	5.6	5.9	7.6	0.036	0.043	0.187	0.248	0.061	0.688
2020.4	3.5	5.5	5.6	6.2	7.9	0.026	0.045	0.188	0.249	0.060	0.688

Ten year real output loss versus run 1: $364 billion.

Table 2 (continued)

qtr	g	u	π	r	R	ca	int	rec	exp	def	debt
Run 3. Dollar Depreciation and Sluggish Stock Market											
Actual values											
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.412
Common forecast values											
2009.4	-1.6	10.2	0.2	0.0	5.0	0.037	0.021	0.158	0.264	0.106	0.525
2010.4	3.4	9.3	0.2	0.1	4.2	0.045	0.026	0.173	0.249	0.076	0.612
Different forecast values											
2011.4	3.0	8.4	2.2	0.9	3.9	0.049	0.028	0.176	0.245	0.069	0.654
2012.4	3.6	7.6	3.7	1.8	4.0	0.051	0.030	0.178	0.244	0.066	0.675
2013.4	3.6	7.1	4.7	2.8	4.4	0.053	0.031	0.180	0.242	0.063	0.684
2014.4	3.5	6.7	5.2	3.6	4.9	0.055	0.032	0.181	0.242	0.061	0.688
2015.4	3.5	6.5	5.5	4.2	5.5	0.054	0.034	0.182	0.243	0.060	0.689
2016.4	3.3	6.4	5.6	4.7	6.0	0.051	0.036	0.183	0.244	0.060	0.690
2017.4	3.2	6.4	5.5	4.9	6.4	0.047	0.038	0.184	0.245	0.061	0.692
2018.4	3.2	6.4	5.5	5.1	6.7	0.040	0.040	0.185	0.247	0.061	0.695
2019.4	3.3	6.3	5.4	5.3	7.0	0.032	0.042	0.187	0.248	0.061	0.697
2020.4	3.5	6.2	5.5	5.5	7.3	0.023	0.044	0.188	0.248	0.060	0.697
Ten year real output loss versus run 1: \$845 billion.											

- g = real GDP, four quarter percent change, percentage points.
- u = unemployment rate, percentage points.
- π = GDP deflator, four quarter percent change, percentage points.
- r = three-month Treasury bill rate, percentage points.
- R = AAA bond rate, percentage points.
- ca = U.S. current account deficit as a percent of GDP.
- int = federal government interest payments as a percent of GDP.
- rec = federal government total revenue (NIPA) as a percent of GDP.
- exp = federal government total expenditure (NIPA) as a percent of GDP.
- def = federal government deficit (NIPA) as a percent of GDP.
- debt = federal government debt as a percent of GDP.

S&L governments, which, as noted above, was imposed in the choice of the tax and spending variables of the S&L governments.

The baseline run reveals that there is nothing predictable in the US model that says that the U.S. economy cannot have a historically large debt/GDP ratio with reasonably good growth, inflation, and unemployment. If there are no bad shocks during this period, the model says that there will be no economic crisis even though

the debt/GDP ratio will be rising fairly rapidly. There may, of course, be asset-market reactions (bad shocks) to this situation, and the rest of this paper examines the consequences of some of the possible reactions.

4 Alternative Runs

Bad Shocks

As noted in Section 1, a concern of many people is that the large deficits will lead to a large depreciation of the dollar. Since exchange rates are essentially unforecastable, it is not possible to predict something like this ahead of time. What is done here is simply to assume that a depreciation will take place and examine its macro consequences. The assumption here is beginning in 2011 people begin to lose confidence in the U.S. dollar, which leads to a depreciation of the dollar and possibly a rise in the dollar price of oil. The depreciation and the possible rise in the dollar price of oil is assumed to take the form of an increase in the price of imports in the model. The price of imports is assumed to grow at an annual rate of 6 percent rather than 1 percent in the baseline run. Over the ten year period between 2011 and 2020 this is an increase of 63 percent from the baseline case. For example, if the euro were 1.50 dollars in 2011, it would rise to 2.45 dollars in 2020. For this run an equation for U.S. exports was added to the model, where the elasticity of real exports to the relative price change was taken to be .25, as discussed in Section 2. (Real imports are endogenous in the model, and they fall, other things being equal, as the price of imports rises relative to the domestic price

level.) This experiment is thus a slowly eroding value of the dollar—5 percent a year. It is not, for example, a one-time crash.

The results for this run (run 2) are presented second in Table 2. The U.S. inflation rate is now 5.6 percent at the end of the period rather than 2.7 percent in the baseline run. The short term interest rate does not rise quite as much as the increase in the rate of inflation. At the end of the period it is 6.2 percent compared to 3.7 percent in the baseline run. The unemployment rate is on average slightly higher compared to the baseline run. The sum of real GDP over the 10 years, 2011–2020, is $364 billion lower than in the baseline run. (All real output values are in 2005 dollars in this paper.) Remember that, other things being equal, a cost shock is contractionary in the model, and it turns out that this effect outweighs the stimulative effects from lower imports and higher exports. The real output differences are, however, fairly small, averaging only about $36 billion per year.

The current account deficit as a percent of GDP does not change much from the baseline run. The increase in real exports and the fall in real imports from the depreciation lowers the deficit, but the rise in the price of imports raises it. The net effect is only a modest change.

The debt/GDP ratio is lower than in the baseline run, although the differences are not large. The ratio is .688 in 2020 compared to .754 in the baseline run. There are a number of reasons for this closeness. First, interest payments as a fraction of GDP are higher because of the higher interest rates set by the Fed in its fight against inflation. Second, the real economy is not quite as strong, and this cuts into tax revenue. Third, the spending of the federal government is tied to the rate of inflation in the model, as discussed in Section 2. On net, these results say that

it is not easy to inflate away the government debt.

Run 3 adds stock market woes to the mix. In run 2 stock prices are taken to rise at their historical average relative to GDP. In run 3 it is assumed that beginning in 2011 the rise is only half as fast. In run 2 the sum of capital gains over the 10 years is $21.8 trillion (nominal), and in run 3 it is $10.8 trillion. Otherwise, no other changes were made between runs 2 and 3. The results for run 3 are presented third in Table 2.

Comparing run 3 to run 2, the negative wealth effect leads to lower output growth and higher unemployment. Interest rates are slightly lower because the Fed responds to both inflation and unemployment according to the estimated interest rate rule. The sum of the real output loss over the ten years, run 3 versus run 1, is $845 billion, which compares to $364 billion for run 2 versus run 1. As noted in Section 2, there is a wealth effect on labor supply in the model: a decrease in wealth has a positive effect on labor supply (income effect). The lower wealth in run 3 versus run 2 thus leads to a larger labor force, other things being equal, which is one of the reasons for the higher unemployment rate in run 3. The debt/GDP ratio falls slightly compared to run 1, .697 versus .754 in 2020, but it is slightly higher than in run 2 (.688). Run 3 thus has an increase in inflation and unemployment compared to run 1 and only a slight fall in the debt/GDP ratio. This is probably the run that many people fear.

Table 3 is the same as Table 2 except the interest rate rule of the Fed has been changed to have the Fed respond more to inflation. The coefficient on inflation in the interest rate rule was doubled, and the equation was reestimated (1954:1–2009:2 period) with this constraint imposed. This equation was then used for

Table 3
Baseline Run and Two Bad Shocks
Fed Responds More to Inflation

qtr	g	u	π	r	R	ca	int	rec	exp	def	debt
					Run 1a. Baseline						
					Actual values						
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.412
					Common forecast values						
2009.4	-1.6	10.2	0.2	0.0	5.0	0.037	0.021	0.158	0.264	0.106	0.525
2010.4	3.4	9.3	0.2	0.1	4.2	0.045	0.026	0.173	0.249	0.076	0.612
					Different forecast values						
2011.4	3.2	8.3	1.6	0.7	3.8	0.045	0.028	0.176	0.244	0.068	0.656
2012.4	4.0	7.4	2.5	1.6	3.9	0.046	0.030	0.179	0.243	0.064	0.680
2013.4	3.9	6.6	3.1	2.5	4.2	0.048	0.031	0.182	0.240	0.058	0.694
2014.4	3.6	6.1	3.4	3.1	4.6	0.051	0.032	0.184	0.240	0.056	0.703
2015.4	3.5	5.8	3.3	3.4	5.0	0.051	0.034	0.186	0.240	0.054	0.711
2016.4	3.2	5.6	3.2	3.6	5.3	0.050	0.035	0.188	0.241	0.053	0.720
2017.4	3.0	5.6	3.0	3.6	5.5	0.047	0.037	0.189	0.242	0.053	0.730
2018.4	3.0	5.6	2.8	3.5	5.6	0.042	0.039	0.191	0.244	0.053	0.741
2019.4	3.1	5.5	2.7	3.5	5.6	0.036	0.041	0.193	0.245	0.051	0.750
2020.4	3.3	5.3	2.7	3.5	5.7	0.029	0.042	0.196	0.245	0.049	0.756
					Run 2a. Dollar Depreciation						
					Actual values						
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.412
					Common forecast values						
2009.4	-1.6	10.2	0.2	0.0	5.0	0.037	0.021	0.158	0.264	0.106	0.525
2010.4	3.4	9.3	0.2	0.1	4.2	0.045	0.026	0.173	0.249	0.076	0.612
					Different forecast values						
2011.4	3.0	8.4	2.2	1.3	4.1	0.049	0.028	0.176	0.245	0.069	0.654
2012.4	3.6	7.6	3.7	2.7	4.4	0.051	0.030	0.178	0.245	0.067	0.675
2013.4	3.6	7.0	4.8	3.9	5.1	0.053	0.032	0.180	0.243	0.063	0.685
2014.4	3.5	6.5	5.3	5.0	5.8	0.055	0.034	0.182	0.244	0.063	0.690
2015.4	3.6	6.2	5.6	5.8	6.6	0.054	0.037	0.183	0.245	0.062	0.691
2016.4	3.4	6.0	5.7	6.4	7.3	0.052	0.040	0.184	0.247	0.063	0.693
2017.4	3.3	5.8	5.7	6.8	7.9	0.048	0.043	0.186	0.250	0.064	0.697
2018.4	3.2	5.7	5.7	7.0	8.3	0.042	0.046	0.187	0.252	0.065	0.701
2019.4	3.3	5.6	5.6	7.2	8.7	0.035	0.049	0.188	0.254	0.066	0.706
2020.4	3.6	5.4	5.7	7.4	9.1	0.026	0.052	0.190	0.255	0.065	0.708

Ten year real output loss versus run 1a: $571 billion.

Table 3 (continued)

qtr	g	u	π	r	R	ca	int	rec	exp	def	debt
Run 3a. Dollar Depreciation and Sluggish Stock Market											
Actual values											
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.412
Common forecast values											
2009.4	-1.6	10.2	0.2	0.0	5.0	0.037	0.021	0.158	0.264	0.106	0.525
2010.4	3.4	9.3	0.2	0.1	4.2	0.045	0.026	0.173	0.249	0.076	0.612
Different forecast values											
2011.4	3.0	8.4	2.2	1.3	4.1	0.049	0.028	0.176	0.245	0.070	0.655
2012.4	3.5	7.7	3.7	2.5	4.4	0.051	0.030	0.178	0.245	0.067	0.678
2013.4	3.5	7.3	4.6	3.7	4.9	0.052	0.032	0.180	0.244	0.064	0.689
2014.4	3.5	6.9	5.2	4.6	5.6	0.054	0.034	0.181	0.245	0.064	0.696
2015.4	3.6	6.6	5.4	5.4	6.3	0.052	0.037	0.183	0.246	0.063	0.699
2016.4	3.4	6.4	5.6	5.9	7.0	0.049	0.039	0.184	0.248	0.064	0.702
2017.4	3.3	6.4	5.6	6.3	7.5	0.045	0.042	0.185	0.250	0.065	0.706
2018.4	3.3	6.3	5.5	6.5	7.9	0.039	0.045	0.187	0.252	0.065	0.711
2019.4	3.4	6.2	5.5	6.7	8.3	0.031	0.048	0.188	0.254	0.066	0.716
2020.4	3.6	6.1	5.5	6.9	8.6	0.022	0.051	0.190	0.255	0.065	0.718
Ten year real output loss versus run 1a: $1.067 trillion.											

• See notes to Table 2.

the runs. The results in Table 3 are as expected. Interest rates increase more in run 2a in response to the inflation than they do in run 2, and this in turn results in a smaller fall in the debt/GDP ratio. The sum of the real output loss, run 2a versus run 1a, is $571 billion, which is larger than the $364 billion run 2 versus run 1. This is, of course, as expected because of the higher interest rates. The sum of the real output loss, run 3a versus run 1a, is $1.067 trillion, which is larger than the $845 billion run 3 versus run 1.

Policy Changes

Run 4 imposes a personal income tax increase; run 5 imposes a cut in federal transfer payments to households, and run 6 imposes a national sales tax.[3] Each change is assumed to be imposed in 2011:1 and be sustained. The amount of the revenue increase or the spending decrease is taken to be roughly 4 percent of nominal GDP. For example, nominal GDP in 2011 in the baseline run is about $15 trillion, and 4 percent of this is $600 billion. This is a substantial tax increase or spending cut. These runs are the same as run 1 except for the tax or spending changes. These changes are not phased in. The changes all go into effect in 2011:1. In practice they would probably be phased in, but for present purposes this does not matter much. What is of interest are the long run responses, and these are not sensitive to whether the changes are phased in or not. The results are presented in Table 4.

Consider runs 4 and 5 first. The effects in the model of changing personal income tax rates and transfer payments are similar; they both affect the disposable income of the household sector. One difference is that a tax rate increase has a negative effect on labor force participation, and so the labor force is smaller, other things being equal, in the tax rate case than in the transfer case. This results in a smaller unemployment rate, other things being equal, in the tax rate case. In run 4 the unemployment rate is 5.6 percent at the end of the period, which compares to 6.3 percent in run 5. On the other hand, the sum of the real output losses are

[3]There is an aggregate federal personal income tax rate (D1G) and an aggregate federal indirect business tax rate (D3G) in the US model. These rates are based on NIPA data. For run 4 D1G was increased, and for run 6 D3G was increased, each by enough to raise revenue of roughly 4 percent of nominal GDP.

Table 4
Three Policy Changes

qtr	g	u	π	r	R	ca	int	rec	exp	def	debt
Run 4. Increase in Federal Personal Income Tax Rate											
Actual values											
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.412
Common forecast values											
2009.4	-1.6	10.2	0.2	0.0	5.0	0.037	0.021	0.158	0.264	0.106	0.525
2010.4	3.4	9.3	0.2	0.1	4.2	0.045	0.026	0.173	0.249	0.076	0.612
Different forecast values											
2011.4	-0.7	9.6	1.3	0.0	3.6	0.039	0.028	0.215	0.252	0.037	0.648
2012.4	3.8	9.3	1.4	0.1	3.2	0.032	0.027	0.217	0.250	0.033	0.652
2013.4	5.1	7.8	2.5	1.2	3.3	0.031	0.026	0.219	0.242	0.023	0.631
2014.4	4.6	6.5	3.5	2.4	3.8	0.033	0.025	0.222	0.237	0.016	0.601
2015.4	4.0	5.7	3.8	3.3	4.4	0.034	0.025	0.223	0.234	0.011	0.569
2016.4	3.4	5.4	3.8	3.7	5.0	0.034	0.025	0.225	0.233	0.008	0.539
2017.4	3.0	5.4	3.4	3.9	5.4	0.032	0.025	0.226	0.232	0.006	0.513
2018.4	2.8	5.5	3.1	3.8	5.6	0.027	0.025	0.227	0.232	0.005	0.489
2019.4	2.9	5.6	2.8	3.7	5.7	0.020	0.025	0.228	0.232	0.004	0.467
2020.4	3.1	5.6	2.6	3.7	5.8	0.011	0.024	0.230	0.231	0.001	0.443
Ten year real output loss versus run 1: $3.232 trillion.											
Run 5. Decrease in Federal Transfer Payments to Households											
Actual values											
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	-0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	-0.047	0.412
Common forecast values											
2009.4	-1.6	10.2	0.2	0.0	5.0	0.037	0.021	0.158	0.264	0.106	0.525
2010.4	3.4	9.3	0.2	0.1	4.2	0.045	0.026	0.173	0.249	0.076	0.612
Different forecast values											
2011.4	-0.8	9.9	1.2	0.0	3.6	0.039	0.028	0.174	0.211	0.037	0.650
2012.4	3.7	9.7	1.2	0.0	3.2	0.032	0.027	0.176	0.208	0.032	0.654
2013.4	5.3	8.3	2.2	0.9	3.2	0.030	0.026	0.179	0.201	0.022	0.632
2014.4	4.7	7.0	3.3	2.0	3.6	0.033	0.025	0.182	0.196	0.014	0.601
2015.4	4.1	6.2	3.7	2.9	4.2	0.035	0.024	0.184	0.193	0.009	0.567
2016.4	3.5	5.9	3.7	3.3	4.6	0.035	0.024	0.185	0.191	0.006	0.536
2017.4	3.0	6.0	3.3	3.3	5.0	0.034	0.024	0.186	0.191	0.004	0.508
2018.4	2.8	6.2	3.0	3.2	5.1	0.029	0.023	0.187	0.190	0.003	0.483
2019.4	2.8	6.3	2.7	3.0	5.2	0.022	0.023	0.188	0.190	0.001	0.459
2020.4	3.1	6.3	2.5	2.9	5.2	0.013	0.022	0.190	0.188	-0.002	0.434
Ten year real output loss versus run 1: $3.062 trillion.											

Table 4 (continued)

qtr	g	u	π	r	R	ca	int	rec	exp	def	debt
Run 6. National Sales Tax											
Actual values											
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.412
Common forecast values											
2009.4	-1.6	10.2	0.2	0.0	5.0	0.037	0.021	0.158	0.264	0.106	0.525
2010.4	3.4	9.3	0.2	0.1	4.2	0.045	0.026	0.173	0.249	0.076	0.612
Different forecast values											
2011.4	-3.8	11.0	5.4	0.0	3.6	0.033	0.028	0.204	0.256	0.052	0.656
2012.4	2.9	11.7	0.1	0.0	3.2	0.019	0.029	0.205	0.257	0.052	0.691
2013.4	6.4	9.9	1.3	0.5	3.0	0.015	0.028	0.207	0.247	0.040	0.686
2014.4	6.0	7.7	3.1	2.0	3.5	0.018	0.027	0.210	0.240	0.030	0.660
2015.4	5.0	6.2	4.2	3.3	4.3	0.021	0.026	0.212	0.235	0.023	0.629
2016.4	3.9	5.5	4.3	4.0	4.9	0.024	0.027	0.213	0.233	0.019	0.600
2017.4	3.2	5.5	4.0	4.1	5.4	0.024	0.027	0.214	0.232	0.018	0.578
2018.4	2.8	5.6	3.4	4.0	5.7	0.022	0.028	0.215	0.233	0.018	0.560
2019.4	2.7	5.9	3.0	3.7	5.8	0.016	0.029	0.216	0.234	0.018	0.547
2020.4	2.9	6.0	2.7	3.5	5.8	0.007	0.029	0.217	0.234	0.017	0.535
Ten year real output loss versus run 1: \$5.034 trillion.											

• See notes to Table 2.

similar: \$3.232 trillion in run 4 and \$3.062 trillion in run 5. The tax increases and spending decreases are thus contractionary, as expected. They do, however, solve the debt problem. The deficit as a percent of GDP falls to essentially zero, and by 2020 the debt/GDP ratio is only .443 in run 4 and .434 in run 5. The Fed keeps the interest rate lower in run 4 than in run 1 to fight the increase in unemployment—and even lower in run 5—although, as noted in Section 2, it has limited ability to offset the contractionary fiscal policies. Runs 4 and 5 thus suggest that the debt problem can be solved via personal income tax increases or transfer payment decreases, but at a cost of lost real output over ten years of about \$300 billion per year.

In run 6 a federal sales tax increase was imposed on total nominal consumption (services, nondurables, and durables). This is a radical experiment and not realistic

in that it is probably not feasible to tax all types of consumption. Also, the tax increase is large, enough to raise 4 percent of GDP, which is larger than is likely to be feasible. This experiment should, however, give one a general idea of the effects of a sales tax increase. In the model sales taxes are passed on to consumers, and so there is a large one-time price increase when the sales tax is imposed. This results in a fall in real wealth and in the real wage, which are contractionary. The results in Table 4 show that the contraction is larger for run 6 than for runs 4 and 5. The sum of the real output loss over the ten years is $5.034 trillion, about $2 trillion more than for runs 4 and 5. There is also more inflation using the GDP deflator because sales taxes are in the GDP deflator. Due primarily to the more sluggish economy, the debt/GDP ratio does not fall as much. It falls to .535, compared to .443 and .434 for runs 4 and 5, respectively. Although this experiment is pushing the model outside normal behavior and thus has more uncertainty attached to it, the results suggest that a national sales tax has more output costs than do personal tax increases and spending cuts.

5 Conclusion

This paper provides estimates of possible macroeconomic consequences of large future federal government deficits. The results are conditional on essentially unforecastable events: flight from the dollar, stock market stagnation, personal tax increases, transfer payment decreases, and a national sales tax. In other words, the results are conditional on asset market behavior and government policy behavior, both of which are not forecastable. The main conclusions are:

1. Assuming no major changes in federal government tax and spending policies, the federal debt as a percent of GDP rises to about 75 percent by 2020. This rise is similar to that of the CBO (2009b) and Auerbach and Gale (2009), although in the present case all the macroeconomic endogeneity has been accounted for.

2. A depreciation of the dollar leads to inflation, as expected, but this is of only modest help regarding the debt problem. It does not appear that the United States can inflate away its debt problem. The picture is worse regarding output if there is a flight from U.S. stocks as well as the dollar.

3. Personal income tax increases and transfer payment decreases have similar effects on the economy. A tax increase or spending decrease of 4 percent of nominal GDP is enough to solve the debt problem. The real output cost is about $300 billion per year.

4. A national sales tax is more contractionary in the model than are personal tax increases and transfer decreases, due in large part to decreases in real wealth and real wages. A national sales tax thus does not look like a good idea, although there is more uncertainty here regarding the ability of the model to deal with this case.

5. In the estimated interest rate rule of the Fed both inflation and unemployment matter, and so the Fed's response to shocks depends on how these two variables are affected. The effects of interest rate changes on the economy are not large enough in the model to have the Fed come close to offsetting the effects of shocks. For example, much of the output costs to tax increases or spending decreases seem unavoidable.

The results in this paper are thus pessimistic about the future course of the U.S. economy. Without large tax increases or spending cuts, the federal debt/GDP ratio will rise substantially. If there is a shock to the dollar because of the large deficits, there will be increased inflation, but this will not help the debt problem much. If there is a negative shock to U.S. equity prices, this will make matters worse. Large personal tax increases or spending cuts will solve the debt problem, but at

a cost of considerable lost output for over a decade. As noted in Section 2, the experiments in this paper do not take account of possibly higher interest rates on federal government securities because of added risk. Because of this, the results in this paper may not be pessimistic enough.

An optimistic case regarding real output and the debt/GDP ratio would be run 4 or 5 (tax increases or spending cuts) combined with an asset boom in housing or equity prices. The wealth effect from the asset boom would offset at least some of the negative effects from the tax increases or spending cuts. (Remember that for runs 4 and 5 stock prices and housing prices are taken to grow at their historical averages.) In other words, a historically above average increase in asset prices would make runs 4 and 5 relative to run 1 look better. This cannot be predicted since asset-market changes are not predictable, but it obviously could happen. Probably the most optimistic situation regarding the economy would be for the government to raise taxes or cut spending substantially with this followed by an asset boom. But would the boom last?

References

[1] Auerbach, Alan J., and William G. Gale, 2009, "The Economic Crisis and the Fiscal Crisis: 2009 and Beyond: An Update," September.

[2] Congressional Budget Office, 2009a, Letter to Charles E. Grassley, March 2.

[3] Congressional Budget Office, 2009b, "The Budget and Economic Outlook: An Update," August.

[4] Fair, Ray C., 2004, *Estimating How the Macroeconomy Works*. Cambridge, MA: Harvard University Press.

[5] Fair, Ray C., 2005, "Estimates of the Effectiveness of Monetary Policy," *Journal of Money, Credit and Banking*, 645–660.

[6] Fair, Ray C., 2008, "Testing Price Equations," *European Economic Review*, 1424–1437.

[7] Fair, Ray C., 2009a, "Has Macro Progressed?" September.

[8] Fair, Ray C., 2009b, "Analyzing Macroeconomic Forecastability," September.

[9] Galí, Jordi, and Mark Gertler, 2007, "Macroeconomic Modeling for Monetary Policy Evaluation," *Journal of Economic Perspectives*, 21, 25–45.

[10] Krugman, Paul, 2009, "Till Debt Does Its Part," *New York Times*, August 28.

[11] Samuelson, Robert, 2009, "Politicians Duck Hard Choices on Deficit," August 31.