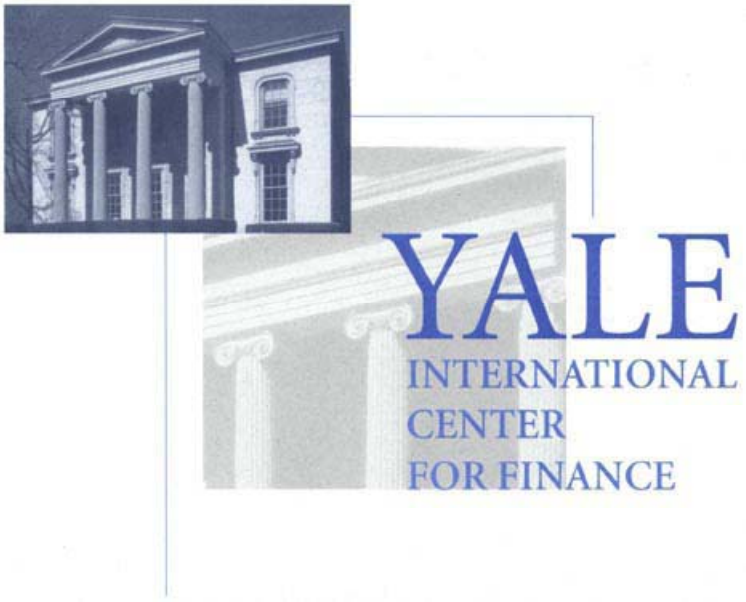

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Possible Macroeconomic Consequences of Large Future Federal Government Deficits

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Abstract

This paper uses a macroeconometric model of the U.S. economy to analyze possible macroeconomic consequences of the large future federal government deficits. The analysis has the advantage of accounting for the endogeneity of the deficit. The results are bleak. Assuming no large tax increases or spending cuts and no bad dollar and stock market shocks, the debt/GDP ratio rises substantially through 2020. These estimates are in line with other estimates.

If the dollar depreciates in response to the deficits, 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. 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.

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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), using earlier CBO estimates and making adjustments, have for their "adjusted baseline" case the debt as a percent of GDP of 87.8 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.

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 website listed in the introductory footnote. 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. There are a total of 26 estimated equations and about 100 identities. The unemployment rate is determined by an identity. 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 same is true for a change in exports. 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).

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. 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 leads to a decrease in real GDP of about .8 percent after four quarters.

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.

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 exogenous nominal variables in the model were tied to the GDP deflator. To be precise, for an exogenous nominal 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 variables, x was projected. Some of the exogenous nominal 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.[1]

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 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. For federal government purchases of goods (in real terms) the three growth rates are (all growth rates are

[1]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 (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.

at annual rates in percentage points) -1.1, 7.5, and 2.5. The value used was 3.0. For federal transfers to households (in real terms) the three rates are 2.3, 4.5, and 3.9, and the value used was 3.0. For federal transfers to S&L governments (in real terms) the three rates are 4.5, 3.2, and 5.1, and the value used was 3.0. For federal civilian jobs the three rates are -1.5, 0.0, and -0.7, and the value used was 1.0. Finally, for federal military jobs the three rates are -3.1, 1.1, and -1.9, and the value used was 0.0. Whether these values 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 of the 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 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 2 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. This is a fairly large growth rate, but, as will be seen, even this rate results in large U.S. current account deficits as a percent of GDP. The use of a lower growth rate would obviously make this worse.

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 1. Values of ten 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 to GDP ratio in 2019 is .777. This compares to .678 for CBO and .878 for Auerbach and Gale (2009), mentioned in Section 1. The baseline run is thus within range of other projections. Inflation is over 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 $25.256 trillion for the baseline run (not

Table 1
Baseline Run and Two Bad Shocks

qtr	g	u	π	r	ca	int	rec	exp	def	debt
					1. Baseline					
					Actual values					
2007.4	2.5	4.8	2.7	3.4	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	0.044	0.016	0.167	0.214	0.047	0.412
					Common forecast values					
2009.4	-1.7	10.2	0.2	0.0	0.038	0.021	0.158	0.264	0.106	0.525
2010.4	3.3	9.3	0.4	0.2	0.046	0.026	0.173	0.250	0.077	0.611
					Different forecast values					
2011.4	3.1	8.4	1.9	0.7	0.047	0.028	0.176	0.245	0.069	0.656
2012.4	4.0	7.5	2.8	1.5	0.048	0.029	0.179	0.243	0.065	0.678
2013.4	3.9	6.7	3.5	2.4	0.050	0.030	0.181	0.240	0.060	0.690
2014.4	3.6	6.2	3.8	3.0	0.054	0.032	0.183	0.240	0.057	0.698
2015.4	3.1	6.0	3.8	3.4	0.056	0.033	0.184	0.241	0.057	0.708
2016.4	2.7	6.1	3.6	3.4	0.057	0.035	0.185	0.243	0.058	0.722
2017.4	2.5	6.3	3.3	3.3	0.056	0.037	0.187	0.246	0.059	0.739
2018.4	2.5	6.5	3.1	3.2	0.054	0.039	0.188	0.249	0.061	0.758
2019.4	2.7	6.6	3.0	3.1	0.050	0.041	0.189	0.251	0.061	0.777
2020.4	2.9	6.6	3.0	3.1	0.045	0.043	0.191	0.252	0.061	0.793
					2. Dollar Depreciation					
					Actual values					
2007.4	2.5	4.8	2.7	3.4	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	0.044	0.016	0.167	0.214	0.047	0.412
					Common forecast values					
2009.4	-1.7	10.2	0.2	0.0	0.038	0.021	0.158	0.264	0.106	0.525
2010.4	3.3	9.3	0.4	0.2	0.046	0.026	0.173	0.250	0.077	0.611
					Different forecast values					
2011.4	3.0	8.4	2.5	1.0	0.051	0.028	0.175	0.245	0.070	0.653
2012.4	3.7	7.6	4.1	2.1	0.053	0.030	0.177	0.245	0.067	0.672
2013.4	3.7	7.0	5.2	3.2	0.056	0.031	0.179	0.242	0.063	0.678
2014.4	3.5	6.5	5.9	4.1	0.059	0.032	0.180	0.242	0.062	0.680
2015.4	3.1	6.4	6.1	4.8	0.061	0.034	0.181	0.244	0.063	0.682
2016.4	2.8	6.4	6.1	5.1	0.061	0.037	0.182	0.247	0.065	0.687
2017.4	2.6	6.6	6.0	5.2	0.059	0.040	0.182	0.250	0.067	0.696
2018.4	2.6	6.8	5.8	5.3	0.055	0.042	0.183	0.253	0.070	0.708
2019.4	2.8	6.9	5.8	5.3	0.050	0.045	0.184	0.256	0.072	0.720
2020.4	3.0	6.8	5.8	5.4	0.045	0.047	0.185	0.257	0.073	0.731

Ten year real output loss versus run 1: $563 billion.

Table 1 (continued)

qtr	g	u	π	r	ca	int	rec	exp	def	debt
3. Dollar Depreciation and Sluggish Stock Market										
Actual values										
2007.4	2.5	4.8	2.7	3.4	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	0.044	0.016	0.167	0.214	0.047	0.412
Common forecast values										
2009.4	-1.7	10.2	0.2	0.0	0.038	0.021	0.158	0.264	0.106	0.525
2010.4	3.3	9.3	0.4	0.2	0.046	0.026	0.173	0.250	0.077	0.611
Different forecast values										
2011.4	2.9	8.5	2.5	0.9	0.051	0.028	0.175	0.246	0.070	0.654
2012.4	3.4	7.9	4.0	1.8	0.052	0.030	0.177	0.246	0.068	0.677
2013.4	3.5	7.5	4.9	2.7	0.054	0.031	0.179	0.244	0.065	0.687
2014.4	3.4	7.3	5.5	3.4	0.055	0.032	0.180	0.244	0.064	0.693
2015.4	3.1	7.3	5.8	3.8	0.056	0.034	0.181	0.245	0.065	0.698
2016.4	2.8	7.5	5.8	4.0	0.055	0.036	0.181	0.247	0.066	0.706
2017.4	2.7	7.7	5.6	4.1	0.053	0.038	0.182	0.250	0.068	0.716
2018.4	2.7	8.0	5.5	4.0	0.049	0.040	0.182	0.252	0.070	0.728
2019.4	2.8	8.3	5.5	3.9	0.044	0.042	0.183	0.254	0.072	0.740
2020.4	3.0	8.4	5.5	3.8	0.038	0.043	0.184	0.255	0.072	0.750
Ten year real output loss versus run 1: $1.581 trillion.										

- 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.
- 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.

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 stabilizes at a little less than 3 percent, the unemployment rate at about 6.5 percent, and the short term interest rate at about 3 percent. The ratio of the federal deficit to GDP, which was .018 in 2007 and reached a peak of .106 in 2009, stabilizes at around .06. The ratio of federal

interest payments to GDP rises to .043 by 2020. The U.S. current account deficit as a percent of GDP is large throughout the period. It rises from 3.8 percent in 2009 to 5.7 percent in 2016 and then falls back to 4.5 percent in 2020. Although not shown, there are no large changes in the debt/GDP ratio of S&L governments, which, as noted above, was imposed in the choice of the tax and spending variables of the S&L governments.

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 oil prices no longer being tied to the dollar. The depreciation and the possible rise in the price of oil in dollars is assumed to take the form of an increase the price of imports in the model. Instead of growing at the baseline rate of 2 percent, it is assumed that the price of imports grows at 7 percent, 5 percent more. 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 1.45 dollars in 2011, it would rise to 2.36 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 are presented second in Table 1. The U.S. inflation rate is now about 6 percent in the long run rather than 3 percent. The short term interest rate does not rise quite as much as the increase in the rate of inflation. The unemployment rate is on average slightly higher. The sum of real GDP over the 10 years, 2011–2020, is $563 billion lower in the second run than in the first. (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 $56 billion per year.

The current account deficit as a percent of GDP does not change much from run 1. 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 to GDP ratio is lower in run 2, although the differences are not large. The ratio is .731 in 2020 compared to .793 in run 1. 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.

The third run 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 ratio of capital gains on stocks held by the household sector to GPD is zero (rather than its historical average). In run 2 the sum of capital gains over the 10 years is $20.2 trillion (nominal), and in run 3 this is turned off. Otherwise, no other changes were made between runs 2 and 3. The results for run 3 are presented third in Table 1.

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 $1.581 trillion, which compares to $563 billion for run 2 versus run 1. As noted in Section 2, there is a wealth effect on labor supply: 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 to GDP ratio falls slightly compared to run 1, .750 versus .793 in 2020, but it is slightly higher than in run 2 (.731). In general run 3 is not a happy picture: high inflation and unemployment and only a slight fall in the debt to GDP ratio from the already large values in run 1. This is the run many people fear. The extra bad news here is that if this does happen, it will not solve the debt problem.

Table 2 is the same as Table 1 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 the runs. The results in Table 2 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 to GDP ratio. The sum of the real output loss, run 2a versus run 1a, is $777 billion, which is larger than the $563 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 $1.824 trillion, which is larger than the $1.581 trillion 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.[2] Each change is assumed to be imposed in 2011:1 and be sustained. The amount of the revenue increased or the spending decreased is taken to be roughly 4 percent of nominal GDP. For example, nominal GDP in 2011 in the baseline run is about $13.5 trillion, and 4 percent of this is $540 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.

[2]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 increase, each by enough to raise revenue of roughly 4 percent of nominal GDP.

Table 2
Baseline Run and Two Bad Shocks
Fed Responds More to Inflation

qtr	g	u	π	r	ca	int	rec	exp	def	debt
					1a. Baseline					
					Actual values					
2007.4	2.5	4.8	2.7	3.4	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	0.044	0.016	0.167	0.214	0.047	0.412
					Common forecast values					
2009.4	-1.7	10.2	0.2	0.0	0.038	0.021	0.158	0.264	0.106	0.525
2010.4	3.3	9.3	0.4	0.2	0.046	0.026	0.173	0.250	0.077	0.611
					Different forecast values					
2011.4	3.1	8.4	1.9	0.9	0.047	0.028	0.176	0.245	0.069	0.656
2012.4	3.9	7.5	2.8	1.9	0.048	0.030	0.179	0.244	0.065	0.680
2013.4	3.9	6.8	3.5	2.8	0.050	0.031	0.181	0.241	0.060	0.693
2014.4	3.6	6.3	3.8	3.5	0.053	0.033	0.183	0.241	0.059	0.702
2015.4	3.1	6.1	3.8	3.8	0.055	0.035	0.184	0.243	0.058	0.713
2016.4	2.8	6.1	3.6	3.9	0.056	0.037	0.186	0.245	0.059	0.727
2017.4	2.6	6.3	3.3	3.7	0.056	0.039	0.187	0.248	0.061	0.745
2018.4	2.6	6.5	3.1	3.5	0.053	0.042	0.188	0.251	0.062	0.764
2019.4	2.7	6.6	3.0	3.4	0.050	0.044	0.190	0.253	0.063	0.784
2020.4	2.9	6.5	3.0	3.4	0.046	0.045	0.192	0.254	0.063	0.801
					2a. Dollar Depreciation					
					Actual values					
2007.4	2.5	4.8	2.7	3.4	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	0.044	0.016	0.167	0.214	0.047	0.412
					Common forecast values					
2009.4	-1.7	10.2	0.2	0.0	0.038	0.021	0.158	0.264	0.106	0.525
2010.4	3.3	9.3	0.4	0.2	0.046	0.026	0.173	0.250	0.077	0.611
					Different forecast values					
2011.4	2.9	8.5	2.5	1.5	0.051	0.028	0.175	0.246	0.070	0.654
2012.4	3.5	7.7	4.1	2.9	0.053	0.030	0.177	0.246	0.068	0.675
2013.4	3.6	7.2	5.1	4.3	0.055	0.032	0.179	0.245	0.066	0.685
2014.4	3.5	6.7	5.8	5.4	0.057	0.035	0.180	0.246	0.065	0.689
2015.4	3.2	6.5	6.1	6.1	0.058	0.038	0.182	0.248	0.067	0.694
2016.4	2.9	6.5	6.1	6.6	0.058	0.041	0.182	0.252	0.069	0.702
2017.4	2.8	6.6	6.0	6.8	0.057	0.045	0.183	0.255	0.072	0.713
2018.4	2.7	6.7	5.9	6.9	0.054	0.049	0.184	0.259	0.075	0.727
2019.4	2.8	6.8	5.9	6.9	0.049	0.052	0.185	0.263	0.078	0.742
2020.4	3.1	6.7	5.9	7.1	0.044	0.056	0.187	0.266	0.079	0.756

Ten year real output loss versus run 1a: $777 billion.

Table 2 (continued)

qtr	g	u	π	r	ca	int	rec	exp	def	debt
3a. Dollar Depreciation and Sluggish Stock Market										
Actual values										
2007.4	2.5	4.8	2.7	3.4	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	0.044	0.016	0.167	0.214	0.047	0.412
Common forecast values										
2009.4	-1.7	10.2	0.2	0.0	0.038	0.021	0.158	0.264	0.106	0.525
2010.4	3.3	9.3	0.4	0.2	0.046	0.026	0.173	0.250	0.077	0.611
Different forecast values										
2011.4	2.8	8.5	2.5	1.4	0.050	0.028	0.175	0.246	0.071	0.655
2012.4	3.2	8.0	3.9	2.6	0.052	0.030	0.177	0.247	0.070	0.680
2013.4	3.3	7.7	4.9	3.7	0.053	0.032	0.179	0.246	0.067	0.694
2014.4	3.4	7.5	5.4	4.7	0.053	0.035	0.180	0.247	0.067	0.702
2015.4	3.1	7.4	5.7	5.3	0.054	0.037	0.181	0.250	0.069	0.711
2016.4	2.9	7.5	5.8	5.6	0.053	0.040	0.182	0.253	0.071	0.721
2017.4	2.8	7.7	5.7	5.8	0.051	0.044	0.183	0.256	0.073	0.734
2018.4	2.8	8.0	5.6	5.8	0.047	0.047	0.184	0.260	0.076	0.749
2019.4	2.9	8.2	5.6	5.7	0.042	0.050	0.185	0.263	0.078	0.764
2020.4	3.1	8.2	5.6	5.8	0.037	0.053	0.186	0.265	0.079	0.778
Ten year real output loss versus run 1a: $1.824 trillion.										

• See notes to Table 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 3.

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 6.8 percent at the end of the period, which compares to

Table 3
Three Policy Changes

qtr	g	u	π	r	ca	int	rec	exp	def	debt
4. Increase in Federal Personal Income Tax Rate										
Actual values										
2007.4	2.5	4.8	2.7	3.4	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	0.044	0.016	0.167	0.214	0.047	0.412
Common forecast values										
2009.4	-1.7	10.2	0.2	0.0	0.038	0.021	0.158	0.264	0.106	0.525
2010.4	3.3	9.3	0.4	0.2	0.046	0.026	0.173	0.250	0.077	0.611
Different forecast values										
2011.4	-0.8	9.7	1.5	0.0	0.041	0.028	0.214	0.253	0.038	0.648
2012.4	3.6	9.4	1.8	0.1	0.034	0.027	0.216	0.250	0.034	0.651
2013.4	5.0	8.0	2.9	1.2	0.033	0.026	0.218	0.243	0.025	0.630
2014.4	4.6	6.7	3.9	2.5	0.035	0.025	0.220	0.238	0.018	0.600
2015.4	3.7	6.0	4.3	3.3	0.039	0.025	0.222	0.236	0.014	0.570
2016.4	3.0	5.9	4.2	3.7	0.041	0.025	0.223	0.236	0.013	0.545
2017.4	2.6	6.1	3.8	3.7	0.041	0.025	0.223	0.236	0.013	0.524
2018.4	2.4	6.4	3.4	3.4	0.039	0.026	0.224	0.238	0.014	0.509
2019.4	2.4	6.7	3.1	3.2	0.034	0.026	0.224	0.239	0.014	0.495
2020.4	2.7	6.8	2.9	3.0	0.028	0.026	0.225	0.239	0.013	0.482
Ten year real output loss versus run 1: $3.302 trillion.										
5. Decrease in Federal Transfer Payments to Households										
Actual values										
2007.4	2.5	4.8	2.7	3.4	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	0.044	0.016	0.167	0.214	0.047	0.412
Common forecast values										
2009.4	-1.7	10.2	0.2	0.0	0.038	0.021	0.158	0.264	0.106	0.525
2010.4	3.3	9.3	0.4	0.2	0.046	0.026	0.173	0.250	0.077	0.611
Different forecast values										
2011.4	-0.9	10.0	1.4	0.0	0.041	0.028	0.174	0.211	0.038	0.649
2012.4	3.6	9.9	1.5	0.0	0.034	0.027	0.176	0.209	0.034	0.653
2013.4	5.2	8.6	2.6	0.9	0.033	0.026	0.178	0.202	0.024	0.632
2014.4	4.7	7.2	3.7	2.1	0.036	0.025	0.181	0.197	0.017	0.600
2015.4	3.8	6.6	4.2	2.9	0.040	0.024	0.182	0.195	0.013	0.569
2016.4	3.0	6.5	4.1	3.2	0.042	0.024	0.183	0.194	0.011	0.542
2017.4	2.6	6.7	3.7	3.1	0.043	0.024	0.184	0.195	0.011	0.520
2018.4	2.4	7.1	3.3	2.8	0.041	0.024	0.184	0.195	0.011	0.503
2019.4	2.4	7.4	2.9	2.5	0.037	0.024	0.185	0.196	0.011	0.488
2020.4	2.6	7.6	2.8	2.2	0.031	0.024	0.186	0.196	0.010	0.473
Ten year real output loss versus run 1: $3.198 trillion.										

Table 3 (continued)

qtr	g	u	π	r	ca	int	rec	exp	def	debt
3a. National Sales Tax										
Actual values										
2007.4	2.5	4.8	2.7	3.4	0.046	0.020	0.183	0.202	0.018	0.380
2008.4	-1.9	6.9	2.0	0.3	0.044	0.016	0.167	0.214	0.047	0.412
Common forecast values										
2009.4	-1.7	10.2	0.2	0.0	0.038	0.021	0.158	0.264	0.106	0.525
2010.4	3.3	9.3	0.4	0.2	0.046	0.026	0.173	0.250	0.077	0.611
Different forecast values										
2011.4	-3.9	11.1	5.7	0.0	0.035	0.028	0.204	0.257	0.053	0.656
2012.4	2.7	11.9	0.4	0.0	0.022	0.029	0.204	0.258	0.054	0.691
2013.4	6.2	10.2	1.7	0.5	0.018	0.028	0.206	0.248	0.042	0.686
2014.4	6.0	8.0	3.5	2.0	0.020	0.027	0.209	0.241	0.032	0.661
2015.4	4.6	6.6	4.6	3.3	0.026	0.027	0.210	0.237	0.026	0.632
2016.4	3.6	6.1	4.7	3.9	0.031	0.027	0.211	0.235	0.024	0.607
2017.4	2.9	6.2	4.3	3.9	0.034	0.028	0.212	0.236	0.024	0.589
2018.4	2.4	6.5	3.8	3.7	0.033	0.029	0.212	0.238	0.026	0.579
2019.4	2.2	6.9	3.3	3.2	0.030	0.030	0.213	0.240	0.027	0.574
2020.4	2.4	7.3	3.0	2.8	0.025	0.030	0.213	0.241	0.028	0.572
Ten year real output loss versus run 1: $5.190 trillion.										

• See notes to Table 1.

7.6 percent in run 5. On the other hand, the sum of the real output losses are similar: $3.302 trillion in run 4 and $3.198 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 less than 1.5, and by 2020 the debt to GDP ratio is only .482 in run 4 and .473 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 9 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 is contractionary. The results in Table 3 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 $5.190 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 to GDP ratio does not fall as much. It falls to .572, compared to .482 and .473 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 deficit and debt picture looks bleak. The picture 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 not optimistic about the future course of the U.S. economy. Without large tax increases or spending cuts, the federal debt to 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.

It is also possible, however, that the present conclusions are too pessimistic. There is considerable uncertainty attached to the baseline run, a forecast for 11 years, and it could be that real output grows faster and the unemployment rate is lower than the baseline run predicts. A somewhat faster growing economy would not, however, be enough to solve the government debt problem, and the economy would still be threatened by a flight from the dollar and from U.S. stocks. Also, remember that there is much less uncertainty regarding the estimated changes between, say, run 2 versus run 1 and run 3 versus run 1 than there is in run 1 itself. The estimated changes in the tables are not likely to be sensitive to alternative baseline runs.

Regarding runs 4 and 5, if in response to the federal government getting its act together stock prices and housing prices rose more than their historical averages, the wealth effect from this 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, there might be an asset boom, which 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

and have 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," June.

[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.