Using Model Multipliers to Ensure Federal Deficit Neutrality in LIFT

R. M. Monaco
Tim A. Dowd[1]

Federal purchases of goods and services, federal tax rates, and several per-recipient outlays for federal transfer payment programs are exogenous to the LIFT model. In general, we change these variables and observe the effect of the change on the economy, including the federal deficit. Analyses like this are routine, and have been published in several places, including Monaco and Phelps (1995). Developments outside the federal sector can also influence the federal deficit. For example, Monaco, Janoska, Dowd, and Scandlen (1996) showed how an increase in fertility could lead to a smaller federal deficit and an increase in life expectancy at birth lead to a larger federal deficit. It is often useful to ask how simulation results might differ if we did not allow the federal deficit to change from simulation to simulation. In this paper, we outline a method for ensuring near deficit neutrality with respect to almost any baseline projection of the deficit.

Defining Deficit Neutrality

To simplify matters from the outset, we take as our measure of the deficit the national income and product account (NIPA) federal deficit (prior to 1995 benchmark revisions). Even restricting ourselves to the NIPA deficit, there are two competing ways to measure the deficit: as an absolute number or relative to some other aggregate. Each method poses interpretation problems. For example, forcing the value of the deficit to be unchanged from simulation to simulation presents problems because the price level usually varies from simulation to simulation. Thus, the same number for the federal deficit across two simulations can represent a very different real thrust to fiscal policy. Defining our deficit measure relative to GNP alleviates that problem somewhat, but then allows the actual value of the deficit to grow as the economy does. Although this may seem more economically neutral -- the "share" of the government is held constant, it does allow the federal sector to move in an absolute sense. That is, the deficit is allowed to rise as the economy grows. If there are absolute deficit limits, a relative neutrality scheme is inappropriate.

In this work, we chose to focus on relative deficit neutrality. Our scheme will generate near neutrality in the federal deficit relative to nominal GNP. One way to view this kind of neutrality is that policymakers are interested in how important the government is to the economy, rather than in specific deficit figures. Recent history has actually suggested that policymakers are more interested in absolute level of the deficit; witness the deficit targets of the Gramm-Rudman-Hollings legislation and the recent debate to balance the budget by 2002. Happily enough, the one case where both relative and absolute deficit neutrality are the same is when the absolute deficit target is zero.

---

[1]This work was funded by the Health Care Financing Administration, HCFA Contract 500-93-0007. We gratefully acknowledge HCFA's financial support, and the comments of John Phelps of the Office of the Actuary, who kept hammering on us until we figured out a method for handling deficit neutrality in alternate LIFT simulations.

Instruments for Achieving a Target Deficit Share

In LIFT, there are nearly as many instruments for achieving a deficit target as there are in reality. For example, we could change purchases of goods and services, or transfer payment benefit schemes, or payroll taxes, or excise taxes, or income taxes. To keep matters simple, in this work we restrict ourselves to changing the share of personal income that goes to the federal government (LIFT variable RTPFI). More complicated schemes for achieving a deficit target amount to the creation of a whole new scenario, and are best worked out individually.

Why Ensuring Deficit Neutrality is Difficult

Ensuring deficit neutrality is not trivial. The major problem is that LIFT responds with a lag to tax changes. Thus, raising or lowering taxes in a given year to reach the deficit target in that year will likely overshoot the target in subsequent years. Carr and Monaco (1994) report the results of simulations with a naive tax change scheme, in the context of attempting to hit a social insurance fund solvency target. Their scheme resulted in unstable oscillations of LIFT, with tax increases following on the heels of tax cuts until the simulation broke down. The major problem for achieving the targeted value is designing a tax policy that accounts for the model's responses to the tax changes themselves.

There are two classes of feasible solutions to this problem. First, we could try to develop a sophisticated forward-looking function within LIFT as it solves, which accounts for the expected reactions of the model to current tax changes. This would be an attempt to have the model, in essence, forecast its own future reactions to tax changes. If it could be programmed correctly, this would hit the target without error.

Another approach would be to try to use results from previous LIFT simulations to approximate the forward-looking function outside the model, and then to introduce the adjusted stream of tax rates to LIFT via exogenous "fixes." This approach has been the one most frequently used to try to achieve federal deficit neutrality in LIFT. Typically, tax changes from a naive rule -- like one described above -- are modified by model-runner intuition and introduced as a fix from outside the model. One algorithm might be: (1) calculate the tax rate necessary to hit the deficit target in each year, ignoring lagged impacts. (2) Cut the required tax changes by some fraction to account for lags. (3) Introduce to LIFT. (4) Go back to (1).

Algorithms like this have been widely used with LIFT, with varying degrees of success. The major drawback in naive rules is that they can take several iterations to achieve the deficit target. If a LIFT simulation running to 2050 takes more than an hour to run, the costs of running LIFT four or five times to achieve a deficit target are quite large. Naive rules can be improved by more fully incorporating the LIFT reactions to tax rate changes over time. To do this, we calculate how LIFT's federal deficit as a share of GNP changes with a one-time change to the tax rate (RTPFI). Using these multipliers and the technique outlined below, we can calculate the inverse function; that is, how RTPFI must change in order to move the deficit share of GNP by so many percentage points. If LIFT is largely linear in this space, the inversion is a very good approximation and we will come quite close to achieving deficit neutrality on the first try. If LIFT's responses are not linear, the approximation will not be a good one, and it may take a few more iterations to hit the deficit target.

Reduced-Form Multiplier Matrices[2]

Imagine a small, linear macroeconomic model with an exogenous personal income tax rate. Suppose, as a simulation, we raise the personal tax rate by 1 percentage point in the first year of the simulation and let it fall back to its base values in all subsequent years. The simulation horizon is three years. A table of hypothetical results is shown below.

Hypothetical Results of a One-time Increase in the Tax Rate
Differences from baseline values

	Deficit as a percent of GNP	Tax Rate Change in percentage points
Year 0	-0.2	1.0
Year 1	-0.3	0.0
Year 2	-0.1	0.0

The table shows that a one-time change in the tax rate leads to a 0.2 percentage point decline in the deficit as a share of GNP initially. The model's feedbacks and the lagged effects of the tax change keep the deficit share of GNP 0.3 percentage points below the base in Year 1, and 0.1 percentage points below the base in Year 2. The table illustrates how the effects of the tax change are distributed through time. We can use this relationship to set up the following matrix equation, where we define Y_t to be the change in the deficit as a share of GNP, X_t to be the change in the tax rate, and the R matrix to be a matrix of reaction coefficients:

The technique discussed here is developed in Bryant, et. al. See that reference for more discussion of the pitfalls of this approach and an application of the model multipliers approach for investigating monetary and fiscal policy options across several different macro models.

Y	=	R			X
Yt		-0.2	0.0	0.0	1
Y_{t+1}	=	-0.3	-0.2	0.0	0
Y_{t+2}		-0.1	-0.3	-0.2	0

This matrix equation duplicates the results defined in the table of simulation results. The first row of the R matrix shows the contemporaneous effect of a tax rate change on the deficit-to-GNP ratio. Incidentally, it also shows that, in the model at least, future tax rate changes do not affect the current deficit-to-GNP ratio (columns 2 and 3 of row 1 of the matrix are zero). The second row indicates that the contemporaneous effect of X on Y is still -0.2 (element 2,2 in the R matrix), and the 1 year lagged effect is -0.3. The final row of the R matrix shows the effects of tax rate changes in the two previous years and the contemporaneous effect of the third-year tax change. The key realization embedded in the table is that a one-percentage-point change in the tax rate in any year leads to a 0.2 percentage point reduction in the same year, a 0.3 percentage point reduction a year later, and a 0.1 percentage point reduction two years later.

We can use the matrix equation to tell us the effects on the deficit share of GNP of any combination of tax changes over a three-year horizon. For example, we could investigate the effects of raising tax rates by 0.5 percentage point in Year 0, dropping rates by 3 percentage points in Year 1 and then raising them by 6 percentage points in Year 2. We would simply substitute these values in for the X vector above and multiply by the R matrix to find the values for the Y vector.

The matrix encapsulates the model's dynamic properties. However, the key insight for our present purpose is that we can use this matrix equation in a way that goes beyond showing model properties. For example, we can use the equation to solve backwards, that is, solve for the tax changes that must accompany a given vector of changes in the deficit as a share of GNP. To do this, we simply premultiply both sides of the equation by the R^{-1} matrix, and multiply it by a given vector of changes in the deficit as a share of GNP.

Implementing the Procedure with LIFT

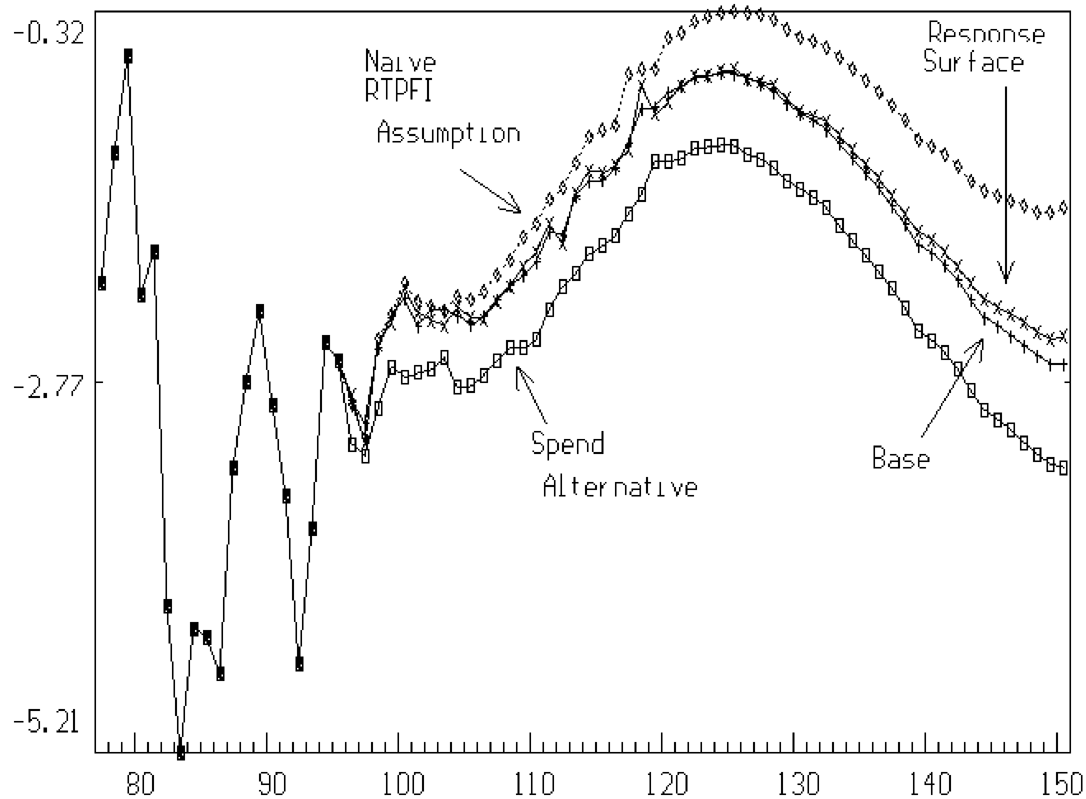
To use the technique proposed above, we need to map the responses of the LIFT deficit share to increased tax rates. First, we ran LIFT and saved a base simulation. Then we raised the share of personal income taxes in personal income (RTPFI) by one percentage point in one year, and determined the time-path of responses of the federal deficit relative to GNP. Using these coefficients, we then constructed the R matrix above. Finally, we inverted the R matrix to allow us to solve for the implied changes in the tax rate necessary to arrive at the given changes in the federal deficit.

To test the usefulness of the response surface approach, we compared the response surface results to those of a simple algorithm for making changes to the tax rate to ensure deficit neutrality. The simple algorithm that we used was to change RTPFI by the difference in the deficits divided by personal income, which measures, in a static sense, how much tax rates must rise to keep deficits at their base level. Figure 1 compares four separate deficit share time paths. The object of the exercise is to try to approximate the Base deficit share time path as closely as possible.

Figure 1 illustrates the four relevant time-paths. The Base line shows the path of the federal deficit share of GNP from 1977 through 2050. The Spend Alternative line shows the effect of raising federal nondefense spending by $12 billion (1977 dollars) starting in 1996. That amount represents an increase in federal purchase equal to about 0.4 percent of GNP in 1996. The Naive RTPFI line shows the deficit share time-path when we increase RTPFI each year by the amount necessary to eliminate the difference between the Base and the Spend Alternative line. The Naive RTPFI path makes no allowance for LIFT responses. Finally, Response Surface line shows the results of using a path of RTPFI values derived using the techniques above.

Figure 1 has several interesting features. First, the Naive RTPFI and the Response Surface simulations do about equally well in tracing out the Base path for the first ten years of the simulation. After about 2005 however, the Naive RTPFI line diverges from both the Base path and the Response Surface path. By 2050, the Naive Alternative is about as far away from the Base as the Spend Alternative (albeit on the other side). The likely reason for the overshooting of the Naive Alternative is the deficit-debt dynamic and the role that interest payments play in producing the federal deficit. Because the Naive RTPFI alternative does not allow for the effect of lower interest payments from a smaller federal debt (as a result of a string of smaller deficits), it tends to collect more revenue than it needs in the distant future. While repeated applications of the Naive Alternative approach -- with scaling to reduce out-year tax collections -- would certainly allow us to more closely approximate the Base, using the Response Surface approach has moved us very close to the Base in one step. Thus, using the response matrix to tune the tax changes allows us to develop our alternative scenarios much more quickly and easily. As an aside, it is worth noting that there is a slightly widening gap between the Base and response matrix deficit-share paths toward the end of the 65-year simulation horizon. This may suggest some longer-term nonlinear response in LIFT that our static response matrix is unable to capture.

FIGURE 1: Federal Surplus as a Percentage of GNP



Another Illustration: Balancing the Budget

We have developed the response surface approach in the context of a situation where we are trying to match the deficit-to-GNP share of a base simulation with an alternative based on a shock to another variable. For example, we used the technique to match deficit-to-GNP shares in a base with an alternative with higher federal spending. It is not necessary, however, that the alternative be a fully developed LIFT simulation. Instead, we can use the response surface to help us develop an alternative scenario that approaches any arbitrary deficit-to GNP path.

As an example, we began with a baseline forecast developed in February 1996. We then asked the response surface equation to calculate the tax rate changes necessary to reduce the baseline deficit-to-GNP ratio to -0.1 percent by 2005 and keep it at -0.1 percent through 2050. Thus, we actually use the response surface approach to help develop the alternative scenario. Table 1 shows the macroeconomic differences between the two projections.

The table shows that, although reducing the deficit gradually through 2005 reduces real GNP and employment, and raises the unemployment rate, by 2050, potential real GNP and GNP are both higher by about a full percentage point. Page 9 shows that the deficit to GNP ratio fell to -0.1 percent in 2005 and remained at that level through 2050. Tax increases necessary to create this simulation resulted from the application of the response surface equation. The ratio of taxes to personal income shown on page 9 shows that tax increases are initially large -- around 2 percentage points between 2000 and 2005. By 2025, however, the ratio of taxes to personal income is back to base levels, where it remains until about 2035. Modest tax increases -- relative to the base -- are necessary after 2035.

Conclusion

Our work illustrates the effectiveness of using a simple response surface approach in maintaining budget neutrality. A key issue is the applicability of the R matrix coefficients to all changes and all versions of LIFT. For example, our R matrix coefficients depend, to at least some extent, on the assumptions about exchange rates and about monetary policy. Thus, a set of simulations with exogenous assumptions very different from those used to derive the original response matrix could result. Since it is reasonably easy to construct the R matrix (see the Appendix), we would recommend that, if budget neutrality is likely to be an issue in a set of simulations, an R matrix consistent with the version of LIFT being used in the simulations be constructed. Our limited experience suggests that the R matrix embedded in our spreadsheets captures most of the relevant effects across a couple of different versions of LIFT.

The technique of using model multipliers to help craft deficit-neutral LIFT simulations can be generalized to other variables. For example, tax change multipliers could be derived for real GDP, the unemployment rate or even output of motor vehicles and parts. In situations where there will be many test simulations focusing on a few key variables, the model-multipliers technique can significantly reduce the time-cost of scenario development.

TABLE 1

Titles of Alternate Runs
Line 1: A Base in February 1996 18:00 02/13/96
Line 2: Forcing deficit to 0 Feb 96 14:46 02/14/96

Alternatives are shown in deviations from base values.

	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	95-05	05-15	15-30	30-50
Gross Domestic Product, bil 77$	3059.0	3358.5	3675.6	4049.2	4437.8	4800.3	5184.4	5621.1	6084.1	6588.9	7134.3	7744.9	1.8	1.9	1.6	1.6
	0.0	-32.6	-22.3	10.9	24.8	31.7	39.1	44.0	49.8	57.9	72.3	91.5	-0.1	0.1	0.0	0.0
Potential GNP, bil 77$	3002.4	3362.9	3690.7	4049.9	4433.2	4813.5	5209.5	5631.4	6084.9	6574.6	7116.6	7722.5	2.1	1.8	1.6	1.6
	0.0	-2.0	12.8	32.1	36.8	36.0	35.0	35.7	37.7	46.9	59.3	70.6	0.0	0.0	-0.0	0.0
Components, bil 77$																
Personal consumption	2070.4	2210.1	2383.9	2575.3	2806.1	3038.0	3268.0	3523.6	3790.9	4090.0	4404.8	4753.7	1.4	1.6	1.5	1.5
	0.0	-50.1	-82.4	-62.0	-48.4	-38.0	-27.5	-26.9	-32.9	-44.8	-48.5	-31.0	-0.4	0.2	0.1	0.0
Fixed investment	513.7	565.0	642.5	730.9	817.3	903.2	996.6	1099.6	1212.4	1341.8	1488.3	1656.2	2.2	2.4	2.0	2.0
	0.0	-6.7	7.5	9.9	5.9	5.3	3.1	2.3	2.5	5.3	6.3	11.3	0.1	-0.0	-0.0	0.0
Exports	486.9	632.6	766.3	931.1	1071.2	1169.1	1266.4	1381.0	1499.2	1621.6	1744.4	1884.1	4.5	3.3	1.7	1.6
	0.0	4.8	18.7	30.6	38.6	39.6	40.8	44.3	51.8	62.9	74.9	76.4	0.2	0.1	-0.0	0.0
Imports	548.2	610.2	704.5	801.8	888.5	962.6	1023.7	1089.0	1155.9	1224.2	1307.3	1389.7	2.5	2.3	1.4	1.2
	0.0	-19.9	-33.2	-31.9	-28.9	-24.9	-22.6	-24.1	-28.0	-33.8	-38.8	-34.1	-0.5	0.2	0.1	-0.0
Federal government	184.8	184.8	184.8	184.8	185.5	186.3	187.1	188.0	188.8	189.6	190.5	191.4	0.0	0.0	0.1	0.1
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
State & local gov.	327.0	356.3	383.0	408.1	427.3	446.6	469.1	495.4	525.0	556.3	589.0	620.7	1.6	1.1	1.0	1.1
	0.0	-0.2	-0.4	-0.4	-0.3	-0.2	-0.1	-0.1	-0.1	-0.2	-0.2	-0.1	-0.0	0.0	0.0	0.0
Price Level and Inflation Indicators																
GNP deflator (77=100)	230.3	267.8	311.5	359.9	414.6	477.3	546.8	622.0	707.8	806.6	919.7	1043.8	3.0	2.9	2.7	2.6
	0.0	-0.6	-5.2	-12.5	-17.7	-21.6	-24.8	-27.4	-29.5	-32.2	-35.6	-38.2	-0.2	-0.3	-0.0	0.0
PCE deflator (77=100)	326.5	387.1	458.0	536.8	625.8	723.8	834.9	958.3	1103.5	1271.1	1463.8	1671.8	3.4	3.1	2.8	2.8
	0.0	0.5	-4.2	-14.1	-21.7	-27.3	-32.1	-35.5	-37.2	-39.1	-41.9	-46.4	-0.1	-0.3	-0.0	0.0
Avg Hourly compensation	267.3	313.8	369.9	439.5	523.6	625.2	743.4	877.7	1033.1	1217.5	1440.0	1708.5	3.2	3.5	3.4	3.3
	0.0	-0.7	-5.9	-15.5	-23.3	-29.6	-34.9	-39.3	-42.7	-46.8	-52.5	-59.1	-0.2	-0.3	-0.0	0.1
Private Labor Productivity	139.7	145.1	150.6	157.6	164.6	172.6	181.2	189.9	198.8	208.1	218.2	229.7	0.8	0.9	1.0	1.0
	0.0	0.4	1.1	1.2	1.1	0.9	0.9	1.0	1.1	1.4	1.5	1.4	0.1	-0.0	-0.0	0.0
GNP Gap, % of potential	101.9	99.9	99.6	100.0	100.1	99.7	99.5	99.8	100.0	100.2	100.2	100.3	-0.2	0.1	-0.0	0.0
	0.0	-0.9	-0.9	-0.5	-0.3	-0.1	0.1	0.1	0.2	0.2	0.2	0.3	-0.1	0.1	0.0	0.0
Employment Indicators																
Total jobs, mil	130.6	140.0	149.4	158.3	166.7	172.8	178.2	184.5	191.8	199.4	206.5	213.0	1.3	1.1	0.7	0.7
	0.0	-1.3	-1.7	-0.7	-0.2	0.0	0.2	0.4	0.3	0.2	0.3	0.7	-0.1	0.1	0.0	0.0
Unemployment rate, %	5.8	5.9	6.0	5.5	5.1	5.3	5.3	5.0	4.9	4.6	4.4	4.0	0.4	-1.6	-0.1	-1.1
	0.0	0.9	1.1	0.4	0.1	-0.0	-0.1	-0.2	-0.2	-0.1	-0.1	-0.3	1.6	-1.4	-0.4	-0.2

TABLE 1 (continued)
Titles of Alternate Runs
Line 1: A Base in February 1996 18:00 02/13/96
Line 2: Forcing deficit to 0 Feb 96 14:46 02/14/96

Alternatives are shown in deviations from base values.

	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	95-05	05-15	15-30	30-50
Financial Indicators																
Three month T-bills, %	5.8	5.5	5.5	5.3	5.3	5.1	4.9	4.8	4.9	4.9	5.0	5.0	-0.5	-0.4	-0.7	0.2
	0.0	-0.5	-1.0	-0.8	-0.4	-0.2	-0.1	-0.1	-0.1	-0.0	-0.0	0.0	-1.9	1.1	0.5	0.1
Foreign Indicators																
U.S./Foreign Price levels	1.7	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.4	1.4	1.4	-0.3	-0.2	-0.3	-0.4
	0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.3	-0.0	0.0
U.S. - foreign real int. rate	0.8	0.4	0.4	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	-8.1	-6.8	-13.7	7.8
	0.0	-0.3	-0.4	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	8.1	9.8	17.2	-16.5
Avg foreign demand for US exports	384.3	491.9	635.8	816.3	948.9	1023.6	1073.3	1129.7	1185.0	1240.3	1295.5	1350.4	5.0	4.0	1.2	0.9
	0.0	-0.4	-0.9	-0.5	-0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.4	-0.0	0.0	0.0	0.0
Average effective relative prices																
Exports, US/foreign (1977=100)	94.4	91.2	91.1	90.3	89.1	87.8	84.9	81.7	78.7	76.0	73.5	70.7	-0.4	-0.2	-0.6	-0.7
	0.0	-1.1	-2.5	-2.9	-3.0	-2.8	-2.5	-2.4	-2.5	-2.8	-3.0	-2.7	-0.3	-0.1	0.0	-0.0
Imports, foreign/US (1977=100)	93.4	93.9	92.4	91.6	91.8	92.6	95.3	98.4	101.5	104.7	107.5	111.2	-0.1	-0.1	0.5	0.6
	0.0	1.1	2.5	3.0	3.1	2.9	2.9	3.0	3.3	3.8	4.3	4.0	0.3	0.1	-0.0	0.0
Real disposable income	1577.6	1714.6	1851.7	2012.2	2191.3	2358.1	2529.9	2734.6	2944.2	3178.9	3423.2	3696.3	1.6	1.7	1.5	1.5
	0.0	-55.0	-88.8	-69.7	-52.3	-36.6	-22.7	-22.1	-25.7	-33.4	-33.9	-17.2	-0.5	0.2	0.1	0.0
Savings rate, pct	4.5	4.3	4.5	5.0	4.9	4.2	4.0	4.1	4.3	4.5	4.6	4.6	-0.1	0.8	-1.1	0.5
	0.0	-0.9	-1.2	-0.8	-0.5	-0.2	-0.0	0.1	0.1	0.1	0.1	0.2	-3.2	2.1	0.8	0.1
Federal deficit, bil $	-178.7	-207.8	-271.9	-294.5	-292.1	-266.8	-247.2	-309.5	-397.6	-564.4	-721.7	-802.0	4.2	0.7	0.4	4.8
	0.0	119.2	263.7	280.7	266.4	238.1	219.0	276.9	370.4	531.3	678.2	738.0	-35.1	10.7	1.2	-1.4
relative to GNP	-2.5	-2.3	-2.4	-2.0	-1.6	-1.2	-0.9	-0.9	-0.9	-1.1	-1.1	-1.0	-0.7	-4.0	-3.9	0.6
	0.0	1.3	2.3	1.9	1.4	1.0	0.8	0.8	0.9	1.0	1.0	0.9	-34.8	10.9	1.2	-1.5
Total taxes / Personal income	12.8	12.8	12.3	12.2	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.1	-0.4	-0.2	-0.0	0.0
	0.0	1.6	2.2	1.3	0.7	0.2	-0.0	0.0	0.1	0.3	0.2	0.0	1.6	-1.1	-0.4	0.0
Factor Payments																
Labor compensation	4168.9	5252.9	6623.6	8423.1	10679.6	13306.2	16462.5	20325.1	25118.5	31098.7	38542.4	47605.0	4.6	4.8	4.3	4.3
	0.0	-65.4	-174.0	-320.5	-470.5	-603.4	-723.1	-847.5	-965.4	-1116.7	-1282.0	-1408.4	-0.3	-0.2	0.0	0.1
Net interest	433.9	636.0	844.8	1107.5	1433.9	1831.2	2322.2	2920.5	3650.8	4558.1	5693.4	7061.0	6.7	5.3	4.7	4.4
	0.0	-6.2	-11.3	-18.1	-31.4	-43.7	-53.0	-62.2	-70.3	-78.1	-93.6	-82.9	-0.1	-0.1	0.0	0.0
Corporate profits	566.4	662.4	802.0	994.3	1216.2	1488.2	1824.5	2236.6	2729.6	3341.6	4084.1	4999.9	3.5	4.2	4.1	4.0
	0.0	-6.7	-12.5	-24.6	-39.6	-51.1	-60.7	-69.8	-77.1	-86.2	-97.1	-103.7	-0.2	-0.2	0.0	0.1
Proprietor income	449.6	553.2	693.5	875.5	1098.0	1347.6	1643.0	2003.8	2440.6	2992.2	3662.1	4477.4	4.3	4.6	4.0	4.0
	0.0	-9.9	-17.8	-27.7	-41.6	-52.4	-61.6	-71.2	-80.3	-91.1	-101.4	-103.8	-0.3	-0.1	0.0	0.1
Depreciation	462.9	594.8	785.9	1006.7	1263.9	1580.1	1962.4	2419.4	2969.4	3649.0	4482.5	5530.4	5.3	4.8	4.3	4.1
	0.0	-3.5	-5.3	-10.2	-17.5	-29.0	-46.8	-65.7	-79.6	-89.6	-96.1	-102.2	-0.1	-0.1	-0.1	0.0

APPENDIX

Using the Response Surface Approach with LIFT

The R matrix and its inverse are created with the program RSTOFIX.EXE located on the accompanying disk. Once the inverse is created it is multiplied by the desired changes in GFDEF, the response variable. The result of the multiplication is a series of fixes for RTPFI, the policy variable. In order to generate the changes in the policy variable, you simply use the save command in PDG and type out the desired difference in the government federal deficit (gfdef) divided by GNP. You must also type out the reactions in the response variable to a 1 percent change in the policy variable. The file policy.add (also on the diskette) has all the necessary commands in order to generate the desired changes in the deficit to gnp series. The file response.add has all the necessary commands to generate the series of reactions in the response variable.

Steps to use the response surface

1. Make a base simulation of LIFT.
2. Increase the policy variable 1% in the fix file, and make an alternative LIFT simulation. 3 Get into G or PDG, and type "add response.add".

The file response.add contains the following commands:

```
hbk base
f b.gfdef = gfdef/gnpz
hbk taxalt
f i.gfdef = gfdef/gnpz
f d_gfdef = b.gfdef-i.gfdef
sav initial.dat 96 150
ty d_gfdef
q
```

4. Create alternative scenario, and run LIFT.
5. Get into G or PDG, and type "add policy.add".

The file policy.add contains the following commands:

```
hbk base
f b.gfdef = gfdef/gnpz
hbk alt
f i.gfdef = gfdef/gnpz
f d_gfdef = b.gfdef-i.gfdef
sav gfixes.sav 96 150
ty d_gfdef
q
```

The command hbk base banks the base bank. If you are using a different type of bank or the name of the bank is different, then you should change this command line in response.add or policy.add. The second line forms the base deficit to gnp ratio. The third and fourth lines perform the same tasks as just described for the alternative simulation. The fifth line forms the difference in the budget deficits. The sixth and seventh lines open the file, and type the variable d_gfdef from 1996 to 2050 in the file initial.dat or gfixes.sav.

6. Use the program RSTOFIX at the DOS prompt. The program command syntax is the following:

RSTOFIX <Infile> <Outfile> <Initialization File> <Policy Variable Name>

The defaults are: infile (desired RV) = gfixes.sav
outfile = gfixes.dat
initialization file = initial.dat
Policy Variable Name = DVAR

RSTOFIX </h> gives this description of the command Syntax.

7. Add the outfile fixes to the LIFT fix file.

8. Run LIFT.

REFERENCES

Bryant, R.C., Henderson, D.W., Symansky, S.A., "Estimates of the Consequences of Policy Actions Derived from Model Simulations," in Bryant, R.C., Henderson, D.W., Holtham, G., Hooper, P., Symansky, S.A., *Empirical Macroeconomics for Interdependent Economies*. The Brookings Institution, Washington D.C., 1988, pp. 63-91.

Carr, A. and Monaco R.M. "The Double Whammy of High Health Care Prices." in Janoska, J.J. and Monaco, L.S., eds., *Papers From the Second INFORUM World Conference*. IERF Inc, College Park, MD. 1995, pp. 209-245.

Monaco, R.M., Janoska, J.J., Dowd, T.A., Scandlen C.B., "LIFT 2050: A Framework For Making Very Long-term Economic Projections, with Illustrations." *INFORUM Working Paper 96-001*. (February 1996).

Monaco, R.M., Phelps, J.H., "Health Care Prices, The Federal Budget, and Economic Growth.", *Health Affairs*, Volume 14, Number 2 (Summer 1995). pp. 248-259.