

WILLIAM D. NORDHAUS

Yale University

Policy Games: Coordination and Independence in Monetary and Fiscal Policies

NO ONE WOULD dream of designing the human anatomy by disconnecting the controls of the left and right sides of the body. Yet, for the most important economic controls in a modern economy, monetary and fiscal policies, economists today generally endorse the separation of powers as a way of optimizing noninflationary growth. What are the costs and benefits of coordination and independence in macroeconomic policy? What are the consequences of the independence in policymaking that has become firmly rooted in the American polity? Does policy independence lead to a bias in the mix of monetary and fiscal policies? These are the questions addressed in this study.

One of the major implications of separated powers is seen in the mix of monetary and fiscal policies that is found in major countries today. Policymakers and economists in virtually all countries with separated monetary and fiscal policies believe that their countries suffer from fiscal deficits and real interest rates that are too high to promote a healthy level of private investment and adequate long-term growth of potential output. This syndrome of an unfavorable and undesirable monetary-fiscal mix has been a feature of the macroeconomic landscape for more than a decade.

Although there are many explanations of this endemic skewness of the fiscal-monetary mix, this paper considers the possibility that decisionmakers are caught in an interaction that locks them into high deficits and tight money. Fiscal authorities are elected and are reluctant to set in

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motion a policy that will lead to deteriorating economic conditions near elections with but modest long-run payoffs. Monetary authorities typically have a longer time horizon, but they also tend to be cautious and at times even sluggish. Hence when the economy is locked into a high-deficit equilibrium, a deficit-reduction strategy in the face of slow monetary reactions may risk a short-run but (for the elected) politically lethal economic slowdown. Self-interested politicians may therefore consider the high-deficit status quo to be the lesser evil. I call this syndrome the *monetary-fiscal game* to reflect the fact that monetary and fiscal policies in many large countries are substantially independent and have conflicting objectives.

Steps to reduce fiscal deficits must weigh how they will play out in the light of the monetary-fiscal game. Where the game is essentially noncooperative, the fiscal authorities must guess at the extent to which the short-run contractionary impulse of deficit reduction will be offset by financial markets, exchange rates, domestic and foreign monetary policies, or a rising tide of private spending. An important example came in the United States, where in 1993 the Clinton administration proposed and the U.S. Congress enacted major legislation to reduce the U.S. structural budget deficit by \$143 billion when phased in at the end of five years. This fiscal package was a high-stakes gamble that productive investment would indeed rise and that the contractionary effect would be offset either by monetary policy or by strong private investment and consumption. How big a risk was the administration running? To what extent could it count on monetary policy to offset the contractionary impulse of the plan if the economy turned sour?

An Analytical Approach to Monetary and Fiscal Coordination

This essay examines the issues of policy coordination in greater depth in two dimensions. In this section, I develop a game-theoretic model of the coordination of domestic fiscal and monetary policy. This approach provides a rich set of possible outcomes depending on the degree of coordination or independence, on the objectives of the two players, and on the dynamics. In the second part, I put some empirical flesh on the analytical bones by examining the likely economic impact of deficit reduction with different degrees of coordination.

Background

The standard treatment of macroeconomic policy takes monetary and fiscal policy as exogenous to the economic system. Much current analysis characterizes monetary policy as a game between the government and the private sector, a game that emphasizes credibility and dynamic consistency.¹ In addition, there is an extensive literature on the coordination of policy among nations.² One school of thought has endogenized policy in the analysis of the “political business cycle,” an approach that examines the impact of electoral forces on the setting of macroeconomic policy.³ Although many analyses consider the partisan struggle to win votes and influence macroeconomic outcomes,⁴ little attention has been paid to the nature of the political business cycle when fiscal and monetary authorities are independent.

Those who study fiscal history find that the monetary-fiscal game is very much a part of the policy process. The theory of policy as developed by Jan Tinbergen visualized a unitary policymaker optimizing policy in the face of economic constraints and uncertainties.⁵ Much writing about American fiscal and monetary policy is of a normative bent, as for example the work of Arthur Okun on “the fiscal-monetary partnership.”⁶ The possibility of conflicts amongst policymakers was formally analyzed in an early study by Robert Pindyck, which examined the general problem of conflicting objectives among policymakers.⁷ The most thorough analysis was that of Frederick Ribe, which dealt with the impact of coordination or lack of coordination on the efficiency of macroeconomic policy.⁸ Alan Blinder analyzed issues of coordination in the case where policymakers have two or three discrete options and suggested that the game takes the form of a prisoners’ dilemma.⁹ Alberto

1. See, for example, Kydland and Prescott (1977), Barro and Gordon (1983), Fischer (1989), Stokey (1991), and Annunziata (1993).

2. A recent overview is provided in Cooper (1985). Also see Cooper (1968), Oudiz and Sachs (1984), Hamada (1974, 1976), and the extensive survey and analysis of empirical macroeconomic models in Bryant, Holtham, and Hooper (1988).

3. See Nordhaus (1975, 1989).

4. See particularly Alesina (1987) and Hibbs (1994).

5. Tinbergen (1952).

6. See Okun (1970, especially pp. 53–57).

7. Pindyck (1976).

8. Ribe (1980).

9. Blinder (1982).

Alesina and Guido Tabellini reviewed the issues of rules and discretion in a noncooperative framework.¹⁰ A brief discussion of the issue is also found in Avinash Dixit and Barry Nalebuff.¹¹

It will be useful to remark on why lack of coordination may be important in practice. From a macroeconomic point of view, macroeconomic policy can rely on two separate instruments, monetary and fiscal policy. (There are in addition microeconomic instruments, such as trade policy, the structure of taxation, or price controls, but the macroeconomic implications of these are ignored for the moment.) As nations have come to emphasize the importance of stable prices, they have increasingly highlighted the usefulness of separating the monetary function from the governing fiscal institutions. The degree of separation differs from country to country, with Germany's Bundesbank retaining a fierce independence from the government, the U.S. Federal Reserve maintaining independence from the executive branch, the Japanese central bank being accountable to the Ministry of Finance, and the Russian central bank in the *interputsch* period (1991–93) being a toady to the parliament and the military-industrial complex. Fiscal institutions also differ greatly across countries, but, in almost all democracies, fiscal authority is ultimately in the hands of the legislature; where the executive is separate from the legislature (as in the United States), there may also be a separation of fiscal powers in the government.

In most developed countries, the central bank takes a stance that emphasizes austerity and low inflation. This central banker's credo was aptly explained by Arthur Burns shortly after he retired as Chairman of the Federal Reserve: "By training, if not also by temperament, [central bankers] are inclined to lay great stress on price stability, and their abhorrence of inflation is continually reinforced by contacts with one another and with like-minded members of the private financial community."¹² He contrasted the central bankers' perspective with that of the elected, fiscal branches: "In fact, much of the expanding range of government spending was prompted by the commitment to full employment. . . . 'Maximum' or 'full' employment, after all, had become the nation's major economic goal—not stability of the price level."¹³

10. Alesina and Tabellini (1987).

11. Dixit and Nalebuff (1991).

12. Burns (1979, p. 5).

13. Burns (1979, p. 12).

A Model of the Fiscal-Monetary Game

This section presents a simple model of the monetary-fiscal game. For the most part, it is a short-run, one-shot game emphasizing the differential impact of fiscal and monetary policies on inflation, unemployment, and the growth rate of potential output. It will be explored in the context of the American economy and of the domestic policy implications of fiscal and monetary policies, but it can be extended to include the international dimensions, and these will turn out to be an important part of the story in the empirical application. In this study, I examine the implications of differences in *objectives* between the monetary and fiscal authorities for the conduct and outcome of macroeconomic policy; the implications of differences in *macroeconomic theories* are not addressed here.¹⁴

The macroeconomic theory underlying this analysis is most easily applied to a closed economy, to a large open economy with a relatively small foreign-trade sector, or to a country with fixed exchange rates and relatively closed financial markets. It will be noted later that the analysis can be applied to virtually all schools of macroeconomics, although the interpretations will vary according to the specific model. For concreteness, I will show the equations for an economy in which the monetary authority is responsible for monetary policy as represented by the interest rate, r . (This is treated as the real interest rate in this section, but the analysis would apply with modifications to the nominal interest rate.) The fiscal authority is responsible for the structural fiscal surplus ratio, S , which measures the government surplus at high employment divided by potential GNP.¹⁵

14. Frankel (1988a, 1988b) analyzed the implications of cooperative and noncooperative approaches when policymakers share the same objectives but have different models of the economy. Frankel randomly marries policymakers with one of the eleven models under consideration and assumes that the policymaker unblinkingly follows the prescriptions of the associated model. He finds that cooperative solutions improve the outcome in about two-thirds of the cases and show no change or a worse outcome in the balance of the cases.

15. Yes, I use GNP, or even better net national product or real national income. In this analysis, I am interested in the real income and consumption of U.S. residents. Although GDP is a useful gauge of U.S. production, it does not correctly measure the real income of Americans. Where possible, therefore, I stick to the correct measure, national rather than domestic income.

For the purposes of this section, I consider a single-period model. The period can be thought of as the time horizon of the fiscal authority, which might be an electoral period. In addition, I assume that the two policy authorities have preferences over the macroeconomic outcomes, inflation (p), unemployment (u), and the growth of potential output (g).

To make the analysis tractable, I simplify as follows. First, it is assumed that both authorities desire levels of unemployment and inflation that are lower than are simultaneously feasible given the inflation-unemployment constraints. In addition, the fiscal authority has a penchant for high deficits because government spending and reduced taxes are the meat, potatoes, and gravy of politics. The monetary authority has no intrinsic interest in the government surplus, and neither group has any intrinsic interest in interest rates. Using these assumptions, I can write the preferences of the two authorities as

$$(1) \quad U^F = V^F(u, p, g, S),$$

$$(2) \quad U^M = V^M(u, p, g),$$

where U^k is the preference or utility level of policy authority k (k equaling F for the fiscal authority and M for the monetary authority), and V^k is the preference function.

The unemployment rate is the measure of the utilization of resources and could equally well be replaced by the ratio of actual to potential output. Unemployment is a function of the two policies, along with other predetermined and exogenous variables, such as the capital stock, technology, and foreign output.

$$(3) \quad u = u(r, S; \dots).$$

The dots to the right of the semicolon in equation 3 are a reminder that the model describes the short run and that many variables are fixed for this period. This relationship is a key one in what follows. The set of policies that lead to a given aggregate demand is called the *output-equivalent policies*. Hence, the combinations of r and S that lead, say, to an unemployment rate of 6 percent will be designated in output-equivalent units.

In this analysis, assume that both money and fiscal policy matter for aggregate demand. It simplifies the exposition to assume that monetary and fiscal policy are perfect substitutes in their effects on aggregate demand and therefore on unemployment in the short run. This characteris-

tic is sometimes called “the common funnel theorem.” To clarify the inessential nature of the common-funnel assumption, I describe later how the results would be modified for different assumptions.

The model follows modern inflation theory in assuming that the rate of inflation is a function of both the level of resource utilization (the unemployment rate) and the expected rate of inflation:

$$(4) \quad p = p(u) + p^e.$$

Equation 4 is the medium-run Phillips curve, where p^e is the expected rate of inflation. It is further assumed that the expected rate of inflation is a mixture of the underlying rate of inflation inherited from the past (a backward-looking component, p^B) and a forward-looking component, which is represented by the actual rate of inflation:

$$(5) \quad p^e = \omega p + (1 - \omega)p^B,$$

where ω is a parameter. Putting equations 4 and 5 together yields

$$(6) \quad p = p(u)/(1 - \omega) + p^B, \quad \text{for } 1 > \omega \geq 0,$$

and

$$(6') \quad u = u^n, \quad \text{for } \omega = 1.$$

When $\omega = 1$, this system reduces to equation 6' of the new-classical macroeconomics in which output and unemployment are unaffected by anticipated monetary or fiscal policies and, absent shocks, in which the unemployment rate is always equal to the natural rate of unemployment, u^n .

The final endogenous variable is the growth rate of potential output. In the short run, potential output growth is determined primarily by the investment ratio, equal to the ratio of investment to output. The investment ratio, in turn, is equal to the private saving ratio plus the government saving ratio, S . To simplify the analysis, I assume that the private saving ratio is unaffected by monetary or fiscal policy, so that the investment ratio is equal to the exogenous private saving ratio plus S . Hence, I can reduce the third target of policy to a function of the government saving rate, $g = g(S)$. Given time preference and investment opportunities, there will be some optimal rate of growth and optimal surplus ratio. (Presumably, in line with optimal growth theory, the surplus should not be so high that the real rate of return on capital is forever less than the rate of growth of population.)

Combining equations 3–6 with equations 1 and 2 yields the preference of each agency with respect to the policy variables:

$$(7) \quad U^F = V^F\{u(r, S; \dots), p[u(r, S; \dots)]/(1 - \omega) + p^B, g(S), S\} \\ = U^F(r, S),$$

$$(8) \quad U^M = V^M\{u(r, S; \dots), p[u(r, S; \dots)]/(1 - \omega) + p^B, g(S)\} \\ = U^M(r, S),$$

where U^F and U^M are the implicit preferences as functions of the policy variables. This specification takes the mainstream assumption that ω is greater than zero.

For new-classical assumptions, u equals u^n and macroeconomic policies determine the inflation rate, resulting in

$$(7') \quad U^F = V^F[u^n, p(r, S; \dots), g(S), S] = U^F(r, S),$$

$$(8') \quad U^M = V^M[u^n, p(r, S; \dots), g(S)] = U^M(r, S).$$

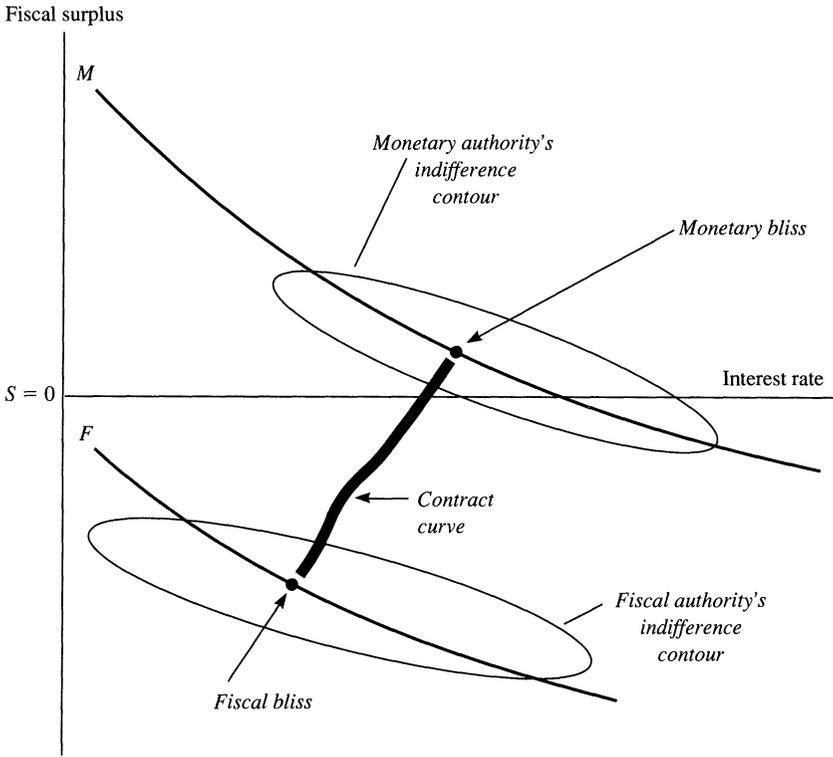
Aggregate Demand Curves and Bliss Points

Figure 1 shows the basic setup. The axes are the policy instruments represented by the fiscal surplus ratio (S) and the real interest rate (r). The solid circles marked “monetary bliss” and “fiscal bliss” represent the most preferred constrained outcomes (the constrained “bliss points”) of the two policymakers. In each case, the point represents the maximum of the preference function in either equation 7 or 8 subject to the constraints in equations 3–6. Points to the northeast represent lower aggregate demand. The ovals around the bliss points are each one of a family of indifference contours of the designated authority, with points inside the contours being preferred to points outside.

To make the theory operational, I have added a few further assumptions. The most important is that the preferences are taken to be quadratic and separable in the different variables (see the appendix). A lot of algebra or a little reflection shows that the bliss points are really determined by two factors, the optimal level of demand (which affects both unemployment and inflation) and the optimal government surplus (which determines the rate of growth and, in the case of the fiscal authority, the surplus itself).

In addition, one can represent sets of policies with the same pressure of strength of aggregate demand by a downward-sloping line. As exam-

Figure 1. Structure of the Monetary-Fiscal Game



Note: Monetary bliss and fiscal bliss represent the most preferred constrained outcomes of the two policymakers. Each oval around the bliss points is one of a family of indifference contours of the designated authority, with the points inside the contour being preferred to points outside it. *M* and *F* lines show the combination of policies that attains the most preferred aggregate demand for each. The heavy line between bliss points is the cooperative or contract curve.

ples, the lines labeled *F* or *M* through each bliss point represent the output-equivalent policies that give the aggregate demand preferred by the fiscal or monetary authority. Put differently, the aggregate demand lines through *F* and *M* represent those policies that produce the authority's optimal level of aggregate demand; the *M* line shows the combination of *r* and *S* that yields the optimal aggregate demand for the monetary authority while the *F* line does that for the fiscal authority. Because there are in effect only two independent targets (the level of aggregate demand and the level of the surplus), the bliss points lie at the intersection of the aggregate demand lines and the desired level of fiscal surplus.

In figure 1, the monetary authority has a more contractionary target for aggregate demand (reflecting its mission to contain inflation) along with a higher targeted government surplus (reflecting its desire for high output growth and distaste for deficit gravy). The fiscal authority has a relatively expansionary attitude toward aggregate demand (reflecting voter aversion to high unemployment and the lag of inflation behind low unemployment) and an inclination to run fiscal deficits (to finance everything from supply-side tax cuts to generous new entitlements). The analysis below concentrates on the pattern of preferences that is shown in figure 1, although from time to time (as in Russia) one finds preference reversals and anomalies.

Cooperative Equilibrium

Given the preferences of the two authorities, the macroeconomic outcome will be determined by the extent of cooperation or independence. The first and presumably happiest case would be that of *cooperation*. The heavy line between the bliss points in figure 1 is the contract curve showing the locus of interest rates and fiscal positions that result from joint implementation of monetary and fiscal policies. Not surprisingly, the cooperative policies are a compromise between the views of the two parties. It is likely that the government, which is the fiscal authority, would be the heavyweight in the discussions and that the monetary authority would pretty much follow the lead of the government. In this case, the outcome would be close to the fiscal bliss point, with relatively high inflation and deficits along with a tendency to counter recessions aggressively in the short run.

Noncooperative Equilibrium

In most industrial countries, monetary and fiscal policy are separated, however, and the monetary authority is directed to meet specific objectives, particularly price stability. Independent central banks have distinct governing boards and make decisions largely independently from the fiscal authorities. This process can be viewed as a two-person, non-zero sum game. Each player, *M* and *F*, decides on its policy taking into account the other's policy. For the most part, I will analyze the situation as a one-shot rather than repeated game, although a simple dynamic game will be presented shortly.

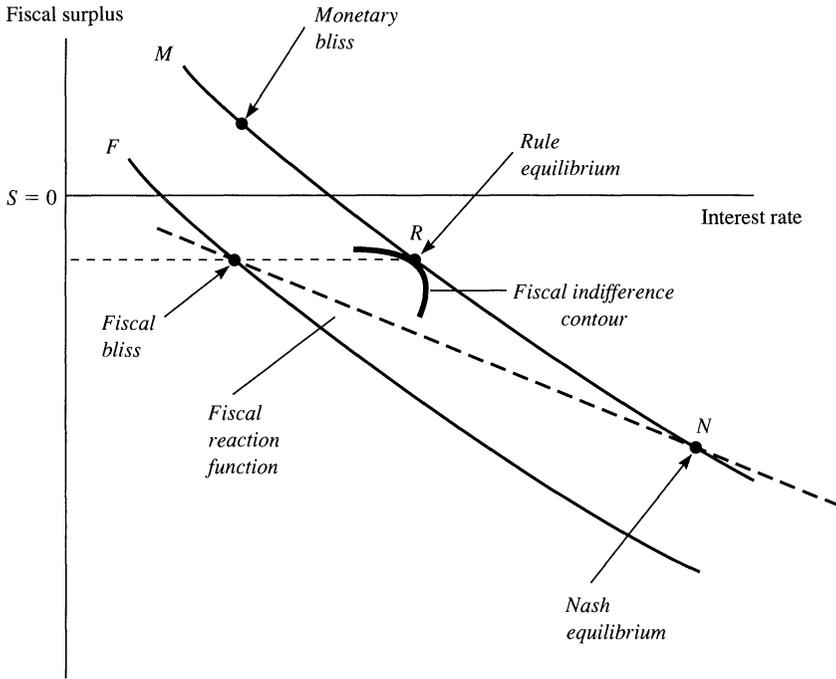
Assume that each authority behaves in a *noncooperative* manner, setting its policies assuming that the other's policies will not change, which leads to the Nash equilibrium solution.¹⁶ The appendix derives the major propositions for the reaction functions for the case of quadratic utility functions using the preferences in equations 7 and 8. Among the results are the following: each of the reaction functions has a negative slope; the slope of the monetary reaction function is steeper than that of the fiscal reaction function; and the optimal policies (or bliss points) are ones in which the monetary authority has a higher optimal fiscal surplus (but not necessarily a higher level of real interest rates) than the fiscal authority.

Figure 2 depicts the reaction functions showing how the monetary authority responds to the fiscal authority and vice versa. Note that this is only an *implicit* reaction function, however. Both policymakers are actually responding to the state of the economy (to inflation, unemployment, growth in potential output) and taking the policies of the other policymaker as given. The partner's policies are shown in the reaction function simply for expositional reasons so that one can solve for the outcome in terms of the actual policies. In other words, I do not assume that the central bank increases interest rates in response to the change in the fiscal stance; rather, the central bank is responding to the state of the economy.

For the preferences assumed in this study, I reach the surprising conclusion (shown in the appendix) that the monetary reaction function is independent of the central bank's preferences about fiscal policy if both parties follow a Nash strategy. This has important implications for an evaluation of the central bank's reaction to deficit-reduction packages, which will be explored later.

As mentioned above, figure 2 shows the reaction functions of the two players. The monetary reaction function coincides with the aggregate demand line of the monetary authority, shown as *M* in figure 2. For the assumed tastes, the fiscal reaction function is less steep than the fiscal aggregate demand target line (*F*), and the fiscal reaction function passes through the fiscal bliss point.

16. The term "noncooperative" is not used in the commonplace sense that people behave discourteously. Rather it is used in the technical, game-theoretic sense that the players in the monetary-fiscal game do not generally discuss their policies with one another, do not agree upon a joint strategy, and cannot make credible and firm commitments to a course of action.

Figure 2. Reaction Functions and Noncooperative Equilibrium

Note: The monetary authority's reaction function coincides with its aggregate demand line. The fiscal reaction function is flatter than either aggregate demand line. Nash equilibrium at *N* shows the results of a policy tug-of-war. If the monetary authority announces a sincere policy rule along *M*, then the fiscal authority maximizes at *R*, increasing utility for both players.

Figure 2 also shows the Nash equilibrium, point *N*, for the monetary-fiscal game. The characteristics of the noncooperative outcome are distinctly familiar and unhappy:

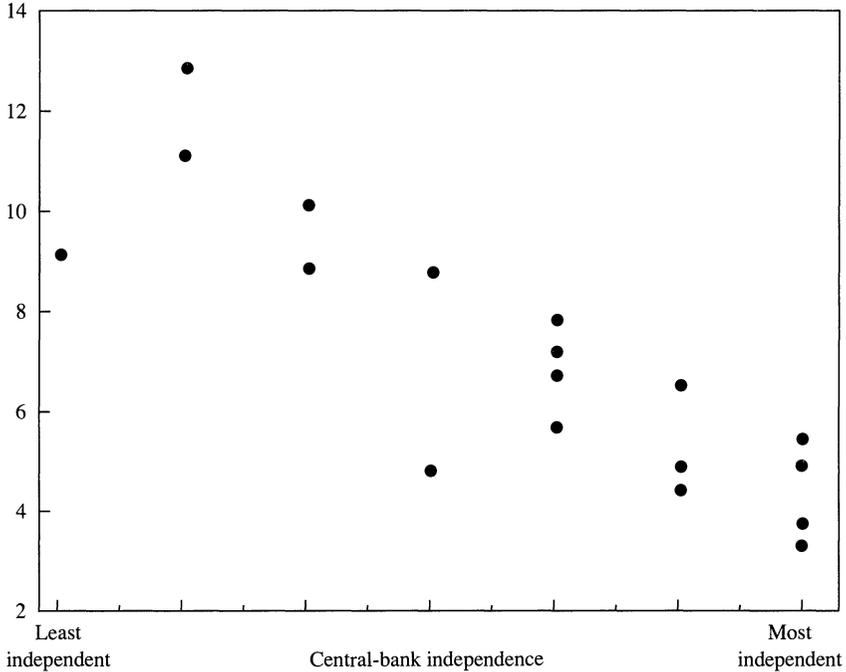
—The equilibrium is one in which the deficit is *higher* than the desired deficits of *either* party. This results from a conflict between the different objectives. The fiscal authority attempts to lower unemployment by raising the deficit; this is countered as the monetary authority raises interest rates to fight inflation; and so forth. At the end of this struggle, because the two parties pursue their different objectives, the surplus is the big loser.

—In the noncooperative equilibrium, the interest rate is also *higher* than either party would like for analogous reasons.¹⁷

17. The first two points are shown by Ribe (1980) in a different model.

Figure 3. Inflation and Central Bank Independence

Average inflation rate, 1960–89 (percent per year)



Sources: Grilli, Masciandaro, and Tabellini (1991) and OECD.

Note: In the fiscal-monetary game, greater central-bank independence leads to lower inflation. This tendency is found across major industrial countries.

—One of the major implications of the model is that inflation and, temporarily, unemployment are significantly affected by moving from a cooperative to a noncooperative solution. Figure 1 shows that the cooperative solution lies on the contract curve with an aggregate demand outcome somewhere between the fiscal and monetary authority’s bliss levels. However, once the game turns to noncooperative Nash, the level of aggregate demand is determined by the monetary authority, which is more restrictive and anti-inflationary than the fiscal authority.

—This result leads immediately to the proposition that countries with independent central banks should have lower inflation than countries with dependent central banks. Figure 3 shows the relationship between inflation and a measure of central-bank independence, and this

relationship indicates that there is a strong negative association between independence and inflation, as the fiscal-monetary game suggests.¹⁸

—In addition, the model suggests that there should be either no relationship or at best a weak *negative* relationship between central-bank independence and long-run productivity growth. In the long run, there will very little or no impact of independence on the unemployment rate because the unemployment rate will be close to the natural unemployment rate. There might be some slight negative relationship between central-bank independence and productivity, however, because independence will, other things equal, lead to a higher fiscal deficit, higher real interest rates, and lower national saving. In the standard neoclassical growth model, the lower saving rate will not affect very long-run productivity growth; but if there are either economies of scale or induced technological change, then independence might lead to some slight deterioration in productivity growth. Figure 4 shows the relationship between central-bank independence and productivity growth; there is indeed only a weak relationship, but the relationship is as predicted slightly negative.

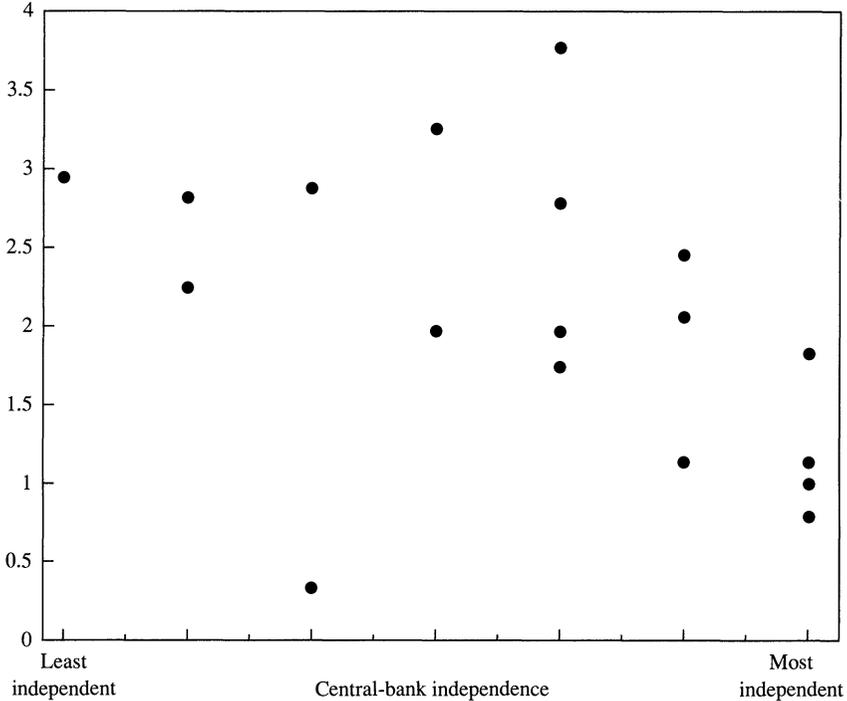
The model is useful in understanding how the United States got into the box of an unfavorable monetary-fiscal mix. According to some analysts, the fiscal-monetary mix was relatively favorable at the end of the 1950s, with a small fiscal surplus and relatively low real interest rates.¹⁹ The tax cuts of 1962–65, by which the Kennedy-Johnson administration expanded the economy with the main instrument under its control, led to a decrease in the high-employment surplus of around 1 percent of GNP. As the Federal Reserve slowly battled the rising inflation, the new equilibrium real interest rates ended up higher than they would otherwise have been. Similar episodes occurred with the Nixon “New Economic Policy” of 1971 and the Carter stimulus plan of 1977. The clearest example of fiscal shock–monetary response came with the Reagan supply-side policies, which raised the high-employment deficit to around 3 percent of GNP in 1984–86; as the Federal Reserve pursued its desired monetary policy, real interest rates were 2 to 4 percentage points higher

18. See Grilli, Masciandaro, and Tabellini (1991), de Haan and Sturm (1992), and Alesina and Summers (1993).

19. According to Schultze (1992, p. 208), the high-employment budget (with an inflation adjustment) was about 1 percent in surplus in 1956–60.

Figure 4. Productivity and Central Bank Structure

Average productivity growth, 1960–88 (percent per year)



Sources: Grilli, Masciandaro, and Tabellini (1991) and OECD.

Note: Although greater central-bank independence may reduce inflation, the fiscal-monetary game suggests that it will not benefit productivity and may actually reduce productivity growth if long-run growth is sensitive to the cost of capital as in new growth theories.

than they had been in earlier periods. In mid-1994, with the high-employment deficit running around 2 percent of GNP and the economy near potential output, real long-run interest rates are 3 to 4 percentage points higher than the historical average over the 1926–80 period.²⁰

In this game, the fiscal policy was often set with an eye to getting the economy moving again, while the monetary policy was motivated by the need to stop prices from racing any faster. Neither the Federal Reserve nor the administrations desired the outcomes of high real interest rates and high budget deficits; they were the result of tugs-of-war in which each policy authority pursued its objective without being able to control the other’s decisions.

20. For the historical data on real interest rates, see Ibbotson and Brinson (1987).

An analogous situation has occurred recently in Germany where, after German unification, the fiscal authorities did not take steps to offset the large demand stimulus. The result was soaring interest rates, with a contractionary impact spilling over to the rest of Europe. Again, neither the Bundesbank nor the German government desired the high deficit and high real interest rates; rather, the unwillingness of the government to increase taxes to pay for unification led to an expansion of demand, which in turn led the Bundesbank to raise real interest rates to ensure that inflation was under control.

A Monetary Rule

In a repeated game like that concerning the fiscal-monetary mix, the participants will surely recognize that the other has an approach, perhaps even a strategy, toward economic management. Of the two, monetary policymakers have developed a more coherent approach, while fiscal policy tends to be dictated by elections, partisanship, personalities, the power of opposing or blocking coalitions, and changing fads in economic theory.

To recognize the likelihood that the parties will recognize the repeated nature of the game, assume that the monetary authority has selected a clear and publicly stated approach. Within this framework, it might be to target nominal GNP, which would be equivalent to announcing that the central bank would keep the economy on the *M* line in figure 2. Also assume that the rule is “sincere,”²¹ articulated by the central bank, understood by the fiscal authority, and completely credible.

Figure 2 can then be used to find the “rule equilibrium.” The fiscal authority optimizes with respect to the monetary rule, choosing the level of the fiscal surplus that leads to the highest attainable level of utility for the fiscal authority given the monetary rule. This leads to an equilibrium at point *R*, which can be compared with the Nash equilibrium at point *N*. Note that the rule approach leads to the following:

21. A “sincere” policy is nonstrategic Stackelberg in which the reaction function coincides with the player’s preferences. In principle, a “strategic” or “insincere” Stackelberg approach could announce a reaction function that would lead the fiscal authority to choose the monetary authority’s bliss point. Rogoff (1985) analyzes an insincere approach in a new-classical economy. He shows that the outcome is improved by appointing nonrepresentative central bankers whose tastes are more anti-inflationary than is the true social welfare function.

—The outcome is an improvement for *both* fiscal and monetary participants in that the outcome improves the utility level of both.

—The outcome has a lower government deficit, lower interest rates, and therefore higher investment than the Nash solution.

—Note that, in the present setup, a monetary rule improves utility but does not affect inflation or unemployment because the monetary authority's reaction function corresponds to its aggregate demand curve.

One of the most popular themes in analyzing monetary policy concerns whether the monetary authority should follow firm rules rather than discretionary policies. In traditional monetarist approaches, monetary rules are a discipline upon the central bank, preventing it from capitulating to the governing party near elections or destabilizing the economy through ill-designed monetary steps. In the newer approaches stressing credibility, the monetary authority is viewed as involved in a game with private-sector wage and price setters; by announcing a firm and credible rule, the monetary authority can establish a low-inflation equilibrium.

The role of a monetary strategy is quite different in the monetary-fiscal game than in the credibility game with the private sector. Here, the other player is the fiscal authority. By following a firm and credible strategy, the central bank leads the fiscal authority to an improved fiscal policy. The fiscal authority will know that it cannot improve on the central bank's output and inflation target, although the fiscal authority can may still dish up more deficit gravy than the central bank would desire. Hence, without improving on the inflation and unemployment record, the central bank, by taking leadership in the game, improves the fiscal-monetary mix and improves the outcome from the point of view of *both* the fiscal and monetary authorities. At the same time, while more attractive than the earlier Nash equilibrium, the rule equilibrium is off the contract curve and is still not efficient. It has the defect that, while it corresponds to the monetary authority's preferred level of aggregate demand, the deficit is still higher than the monetary authority would desire.

Dynamics and the Effects of Deficit-Reduction Strategies

Up to now the emphasis has been on the difference in ultimate objectives between the monetary and fiscal authorities. Quite a different trap

arises in a noncooperative situation when one player reacts cautiously or slowly to changes in the economy. This possibility is examined empirically in the next section, and it is useful to lay out the game at this point.

The difficulty in a dynamic situation is the following. Say that the economy starts out in an initial situation with an unfavorable fiscal-monetary mix and the fiscal authority desires to move to a high-investment policy by reducing the deficit with the understanding that, according to the monetary rule, monetary expansion would offset the fiscal contraction.²² The rub is that monetary policy may not react instantaneously. Instead, the monetary authority may want to make sure that the fiscal steps are not reversed, or may be unsure about the economic reaction because of macroeconomic controversies, or may simply want to wait until it is sure that the promised slowdown occurs. In short, monetary policy may not offset the fiscal contraction immediately but might do so only with a substantial lag.

Faced with this delayed reaction, the fiscal authority may decide that the economic cost is too high. Because it is necessary to incur some recession to get the central bank to offset the fiscal tightening, and because of the short electoral time horizon facing the elected fiscal authority, they may decide to live with the unfavorable monetary-fiscal mix rather than incur recession as the price to pay for improving the monetary-fiscal mix. To understand the role of dynamics, extend the analytical model laid out in equations 1–8 with two further assumptions:

1. Assume that policies affect the economy with a one-period lag.
2. Assume that the fiscal and monetary authorities act as a function of the current state of the economy rather than of forecasts of the future state of the economy; this is called a *results-oriented* policy.²³

The timing assumption (1) is inessential. The “period” here can be taken to be the average lag of the target variables behind the policy variables; in most macroeconomic models, it would be 1½ to 2 years, slightly

22. According to Bob Woodward, this was the way President Clinton’s economic advisers in 1993 rationalized undertaking the unemployment risks in deficit-reduction program (see particularly Woodward, 1994, pp. 82–86, for a pastiche of Alan Blinder’s analysis of deficit reduction).

23. There is no good term for this syndrome, and “results oriented” might equally well be described as “myopic,” “a whites-of-the-eyes mentality,” “forecasting averse,” or “acting in the fog of uncertainty.” The point is that for its own reasons the monetary authority bases its actions primarily on actual results rather than forecasted or anticipated results.

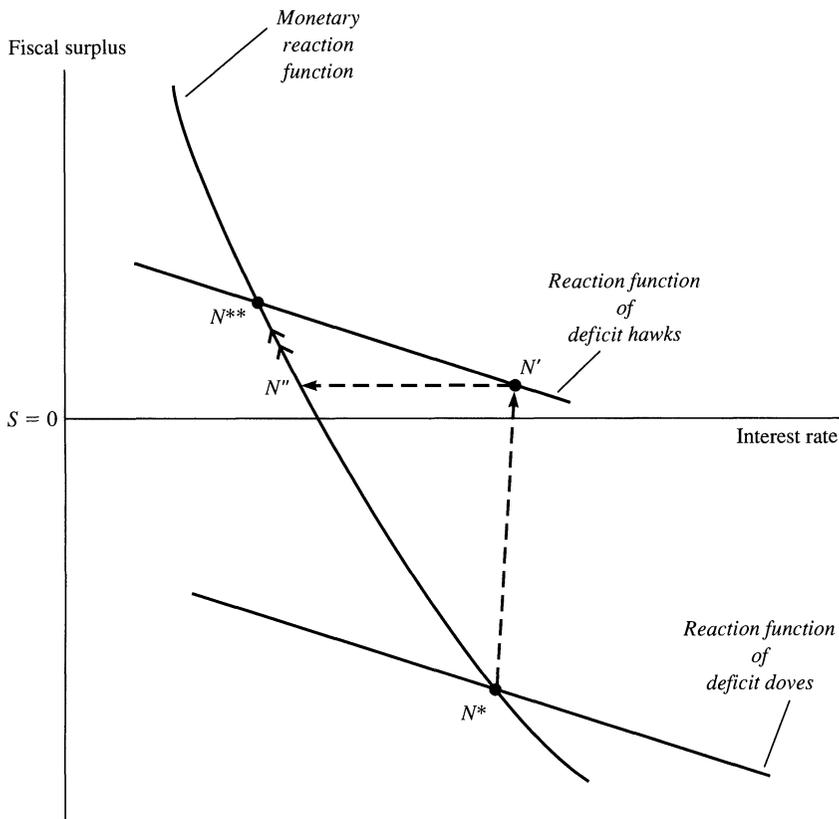
shorter for output and slightly longer for inflation. Assumption 2 implies that there will be a lag in the response of policymaker B to the actions of policymaker A as policymaker B waits to see the results of policymaker A's policy. It has the effect of turning a complex repeated game into a series of one-shot games. I return to the rationale and evidence for the results-oriented nature of policymaking in the next section.

The dynamic monetary-fiscal game has the same equilibria as the static game analyzed up to now, but the dynamics are quite different. Starting at an initial equilibrium, if either fiscal or monetary policy changes, there will be a short-run deviation from the long-run equilibria shown in figures 1 and 2. For example, assume that the fiscal authority decides that it wants a policy of lower fiscal deficits and reduces the deficit in period 0. This would lead to a contraction of the economy in period 1. There would be no monetary reaction in period 0 because the economy would be unaffected, but the monetary authority would react by lowering real interest rates in period 1. This would take the economy back to the monetary authority's desired output level in period 2. The fiscal authority might then react with further contraction, leading to high unemployment and monetary expansion in period 3, and so on.

Figure 5 shows the results schematically for the case where deficit hawks (such as the Clinton administration in 1993) replace the deficit doves. The lower fiscal line shows the reaction function associated with the deficit doves while the higher line is that of the deficit hawks. Given the dynamics, the economy would start at the original Nash equilibrium at N^* . If the game is played out with a results-oriented monetary policy, the economy would follow the arrows shown in figure 5. After the initial deficit reduction, aggregate demand would fall and the economy would be at point N' . The monetary authority would react by lowering interest rates, moving the economy to N'' . Eventually, the economy would end up at a higher-saving Nash equilibrium, N^{**} , but along the way unemployment would definitely be higher than if no fiscal policy change had been undertaken.

There are a number of alternative approaches that the fiscal authorities could follow when confronted with a noncooperative game, results-oriented monetary policy, and time lags in the effects of policy. Under a far-sighted policy, the government might enact a phased fiscal policy that moved very slowly to reduce the deficit. This would not reduce the total unemployment but might make the pain more bearable. Or the gov-

Figure 5. Dynamics of Deficit Reduction



Note: Say that deficit hawks with the upper reaction function replace deficit doves with the lower one. Because of lags in the economy and “whites-of-the-eyes” monetary reaction, the fiscal tightening will be followed by higher than desired unemployment along the deficit-reduction path from N^* to N^{**} .

ernment might optimize as shown in figure 2, picking a fiscal stance that optimized the government’s utility subject to the central bank’s reaction function; this stance would lead to an even larger deficit reduction and to even higher unemployment than the Nash equilibria shown in figure 5. Another interesting possibility would arise if the government tried to reduce the budget deficit in a way that maximized its chances of reelection; the monetary policy–constrained political business cycle would have contractionary measures in the early part of the electoral cycle and expansionary policies timed to boost the economy before the central bank had the opportunity to offset them.

The robust conclusion for all these situations is that in the presence of time lags and results-oriented monetary policy, any noncooperative deficit-reduction strategy would tend to raise unemployment in the short run as a way of inducing the central bank to play its part in the game.

Is the (Independence) Game Worth the Candle?

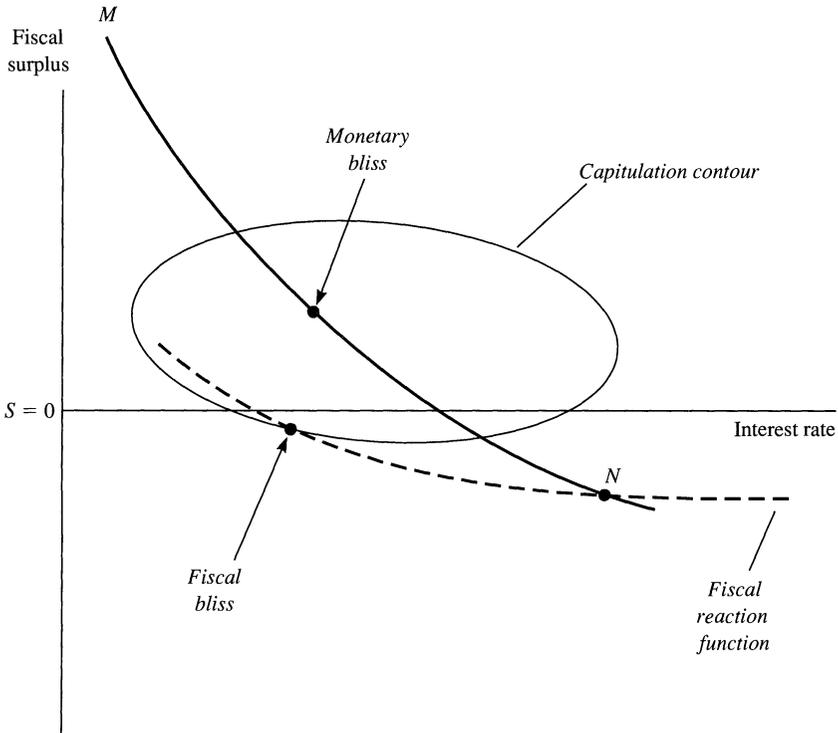
As combatting inflation has come to dominate macroeconomic concerns, the pendulum has swung toward strong support for an independent central bank. Yet, as I have shown, there may be large losses from noncooperative policies. When fiscal-monetary games turn into fiscal-monetary wars, the economy may diverge sharply from anyone's preferred outcome. This was shown in figure 2 where the Nash equilibrium N is far removed from the contract curve. Is there any case where dependence or capitulation is better than independence?

What might dependence mean? In countries like Japan or Britain, which have subordinate central banks, monetary policy is conducted out of the finance ministry on behalf of the government. It is assumed therefore that monetary dependence means that monetary policy is set by the fiscal authority, which puts the economy at the fiscal bliss point. The opposite case, where a coordinated policy would be run by the national central bank, is simply unrealistic for most countries, although fiscal policy is sometimes dictated by the world's central bankers at the International Monetary Fund.

The key question is how the fiscal bliss point compares with the Nash equilibrium from the point of view of the monetary authority. Figure 6 illustrates this by depicting the indifference contour of the monetary authority that goes through the fiscal bliss point; call this the *capitulation contour*. Equilibria inside the capitulation contour are ones for which the monetary authority would prefer a noncooperative situation, while the points outside the contour represent situations where the monetary authority would prefer to let the fiscal authority call the tune.

The main point is that if the Nash equilibrium lies outside the capitulation contour (as in figure 6), then monetary capitulation is superior to independence for *both* parties. When faced with the situation in figure 6, the monetary authority is advised to declare victory and withdraw. Of course, in this case, inflation will be higher than with an independent central bank; but the gains in other objectives, such as economic

Figure 6. Is Monetary Independence Worth the Cost?



Note: Noncooperative equilibrium with monetary independence puts the economy at Nash equilibrium, *N*. The "capitulation contour" shows the combinations of policies that are equivalent to adopting the fiscal authority's policies. If Nash equilibrium is outside the capitulation contour, which is the case here, independence is worse than capitulation.

growth, will outweigh the inflationary losses from the points of view of both policymakers.

When is a capitulation strategy attractive? The divergence between the cooperative and noncooperative strategies is greatest when the slopes of the reaction functions are nearly equal but the bliss points are far apart. This occurs when the fiscal authority has little taste for deficit spending and when the major difference between the two parties concerns the optimal inflation or unemployment rate (see the appendix on this point).

Autres Temps, Autres Paradigmes

Finally, I show that this basic story can be applied to a number of different situations—when asymmetries are introduced, when open econo-

mies are considered, and when other macroeconomic models are examined. Most of the results hold up under these alternative approaches, but some new wrinkles also appear. Here are a few examples.

CASE 1. An interesting new twist arises if there are asymmetries in the behavior of the different policymakers.²⁴ Consider an asymmetrical response by the fiscal authority: it is delighted to provide handouts but very reluctant to reduce programs or raise taxes. In the polar case—where deficits always ratchet upward—the fiscal authority’s reaction function has a horizontal line that shoots out to the left at the existing fiscal surplus or deficit. As figure 7 shows, the equilibrium tends to move down the monetary authority’s reaction curve as deficits increase because of entitlements or supply-side policies. In this case, the fiscal authority sets the deficit while the monetary authority reacts with ever higher real interest rates to attain its aggregate demand target.

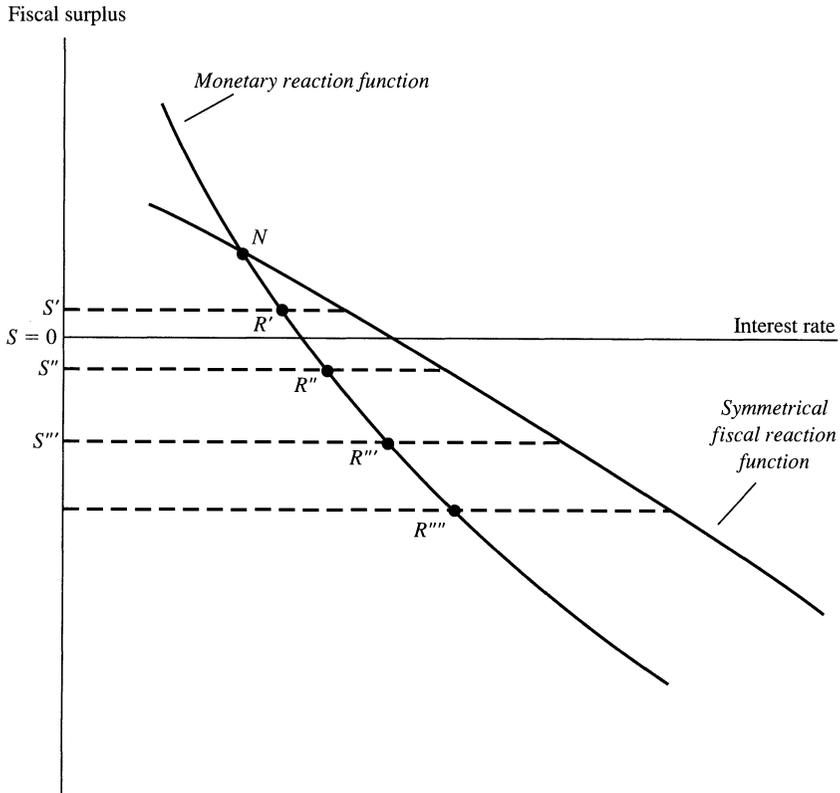
CASE 2. Consider the monetarist case in which “only money matters” for aggregate demand while fiscal policy matters only for the composition of output. In this case, the aggregate demand lines will have the same shape as in the mainstream variant. If the optimal inflation rate of the fiscal authority is higher than that of the monetary authority, then the reaction functions shown in figures 1 and 2 are unchanged from the mainstream case and all the results hold. As long as the central bank’s instrument continues to be the money supply or interest rates, the results are identical to the mainstream model derived above.

CASE 3. The approach taken above assumes that wages and prices follow an accelerationist Phillips curve in which policymakers can for a short time move unemployment away from the natural rate. Even in this world there are two major issues about which the monetary and fiscal authority can argue. First, if the elected fiscal authority faces reelection, then the fiscal authority may attempt to time policies to ensure a healthy, growing, and noninflationary economy in the period shortly before the electoral bell tolls. Therefore, as long as there is some room to improve the state of the economy in the eyes of the electorate, the fiscal authority may push for popular policies, which, rational expectations notwithstanding,²⁵ are still low unemployment and rapid growth in disposable income in the period right before elections.

24. This point was suggested by Charles Schultze.

25. Much current economic ideology holds that voters cannot be fooled by nonsustainable policies like tax cuts, transfer programs, or unsustainably low unemployment. The evidence does not sustain this view; see Nordhaus (1989) and Hibbs (1994).

Figure 7. Equilibrium with Tax-Averse Fiscal Policy



Note: With the growth of entitlements and antitax sentiments, fiscal authorities are increasingly reluctant to reduce structural deficits, even though new programs are always in strong demand. If there is powerful deficit-reduction aversion, then the fiscal reaction function bends to the left at the existing fiscal posture, as shown by the dashed lines. In this case, if deficits arise to fight poverty or recessions, the structural deficits rise from the original equilibrium at N to S' , S'' , S''' , and so forth. This leads to a worsening fiscal policy and higher real interest rates as the equilibrium creeps down the monetary reaction function from N to R' , R'' , R''' , and so forth.

A second area for disagreement arises from the difference in the inflation targets of the two authorities. Say that the central bank and the fiscal authority agree on the fiscal surplus target. Further assume that unemployment is at the natural rate and inflation is at the fiscal authority's target. Still, the monetary authority would probably want to squeeze a little more inflation out of the economy, so there is likely to be continued disagreement on the desirable strength of aggregate demand. This proposition is clearly supported by the revealed preference of fiscal

and monetary policymakers in the United States. Over the past three decades, it is hard to recall a single instance in which the president leaned on the Federal Reserve to increase interest rates, while virtually every administration at some point expressed at least mild concern that high interest rates were choking off recovery or causing recession.²⁶

CASE 4. Consider the new-classical variant of the model. When anticipated policies affect inflation but not unemployment, the aggregate demand line determines only the rate of inflation. However, as in case 1, the aggregate demand line will have the same shape as in the mainstream variant and the results are the same as in the mainstream case. The difference is that the outcomes are identical for inflation, economic growth, and the composition of output, while there is no effect of policies on unemployment. If the two authorities have the same inflation target, then the aggregate demand lines in figure 2 would coincide, and the Nash equilibrium would come at the fiscal bliss point and would therefore be efficient.

CASE 5. Consider next a true classical model in which money is the only nominally denominated exogenous variable and all prices and wages are perfectly flexible. In this example, one has a genuine “dual funnel” economy in which prices are affected only by monetary policy and real variables are affected only by fiscal policies. There is no policy conflict here, the reaction functions are perpendicular, and the Nash equilibrium is efficient.²⁷

CASE 6. Consider the case of an open economy. Life becomes genuinely more complicated here because the interaction between monetary policy and exchange rates needs to be incorporated. One important consideration is the effect of fiscal policy on exchange rates and real incomes. In the closed-economy situation, it was presumed that an increase in domestic saving ended up in domestic capital. In a large open economy with flexible exchange rates, an increase in saving is likely to lead to a depreciation of the currency, which in turn will increase saving (or decrease dissaving) abroad. But the higher growth of net national product arising from greater foreign wealth will not translate dollar-for-dollar into higher potential consumption because of terms of trade losses inherent in the depreciation of the currency. In extreme cases, higher

26. Accounts of presidential consternation over tight money during the Johnson, Nixon, and Carter administrations are given in Stein (1984).

27. This point was stimulated by a comment of Robert Mundell.

domestic saving may actually lead to lower consumption forever, a case I call *immiserizing saving*.

CASE 7. What would happen if there were a conversion on the road to *deficitus* wherein the fiscal authority (genuinely) became as concerned about inflation as the monetary authority? By the end of the Carter administration, the executive half of the fiscal authority appeared to share the strong anti-inflation propensities of the monetary authority (although the legislative half, as usual, was strongly averse to anti-inflationary fiscal medicine). In this case, the aggregate demand lines of the two policymakers would coincide. The outcome would then be at the common desired aggregate demand and at the fiscal policy of the fiscal authority. In terms of the diagram, the two policymakers share the same aggregate demand line but have differing bliss points. Here, because the fiscal authority has control over fiscal policy, the economy ends up at the fiscal bliss point. Note that there is no policy conflict here, and the need for coordination disappears. A similar but incredible situation would occur if the fiscal authority cared only about the fiscal posture; in this case, the fiscal authority would determine the state of the budget and the monetary authority would determine output, unemployment, and inflation.

Coordination in Practice

With this outline of the monetary-fiscal game, the next goal of this paper is to investigate the actual dynamics of policy and response. The emphasis in this section is on the monetary reaction to fiscal policies. It begins with a vector autoregression (VAR) that maps out the way that policies and outcomes have behaved over the postwar period. I then examine the difference between cooperative and noncooperative fiscal policies using the example of the 1993 U.S. deficit-reduction package. The results of this section indicate that standard models may overestimate economic gains if the monetary-fiscal game is ignored and if the potential losses through the foreign sector are not included.

A VAR of Policies and Outcomes

It is useful to map out statistically the relationship between the major variables to see how targets responded to policies and how policies re-

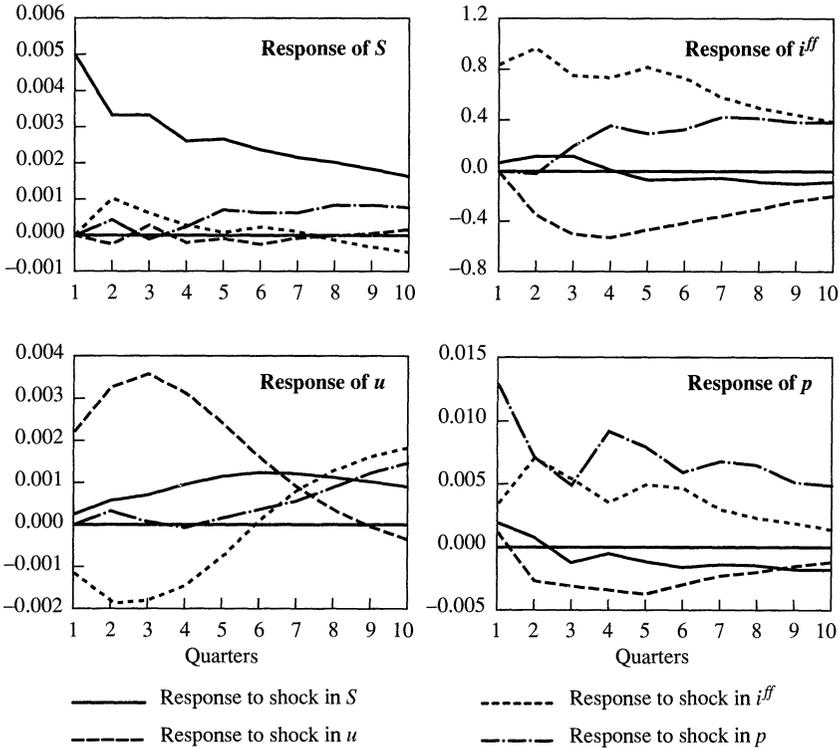
sponded to targets. For this purpose, I perform a simple VAR for four variables: the difference between the actual and the natural unemployment rate ($udiff$), the rate of consumer price inflation (p), the high-employment surplus rate (S), and the nominal federal-funds rate (iff). Further, the ϵ^{ff} are the coefficients on the variables in the VAR, t is time, and the ϵ_{it} are the shocks or innovations. In the VAR, the basic structure is

$$\begin{aligned}
 udiff_t &= \sum_{v=1}^4 \{ \alpha_{11v} udiff_{t-v} + \alpha_{12v} p_{t-v} + \alpha_{13v} S_{t-v} + \alpha_{14v} iff_{t-v} \} + \epsilon_{1t}, \\
 p_t &= \sum_{v=1}^4 \{ \alpha_{21v} udiff_{t-v} + \alpha_{22v} p_{t-v} + \alpha_{23v} S_{t-v} + \alpha_{24v} iff_{t-v} \} + \epsilon_{2t}, \\
 S_t &= \sum_{v=1}^4 \{ \alpha_{31v} udiff_{t-v} + \alpha_{32v} p_{t-v} + \alpha_{33v} S_{t-v} + \alpha_{34v} iff_{t-v} \} + \epsilon_{3t}, \\
 iff_t &= \sum_{v=1}^4 \{ \alpha_{41v} udiff_{t-v} + \alpha_{42v} p_{t-v} + \alpha_{43v} S_{t-v} + \alpha_{44v} iff_{t-v} \} + \epsilon_{4t}.
 \end{aligned}$$

These experiments are concerned with determining the extent to which policies respond to the state of the economy and to other policies as well as the extent to which policies are successful in extinguishing unexpected shocks to output and inflation. The advantage of the VAR is that it is (relatively) agnostic on the controversial issues of the structure of the economy.

Figures 8 and 9 show the impulse-response curves for two different sample periods, 1955:1–1994:2 and a subperiod of more active monetary policy 1979:3–1994:2. The first question is how quickly unforeseen shocks to unemployment and inflation are eliminated. The figures show that unemployment is eliminated quite slowly, with a shock disappearing in nine quarters for the longer period and about eight quarters for the later period of activist monetary policy. Inflation is eliminated even more slowly—shocks to inflation are reduced to zero only after about six years (not shown). Within the VAR framework, policy stabilizes unemployment, for a VAR with exogenous policy has a period for extinguishing unemployment shocks of four years; the counterpart of better performance on unemployment is worse performance on inflation, as the period for eliminating inflation is shorter with exogenous than with endogenous policy.

Figure 8. Vector Autoregression of Policies and Objectives, 1955:1–1994:2



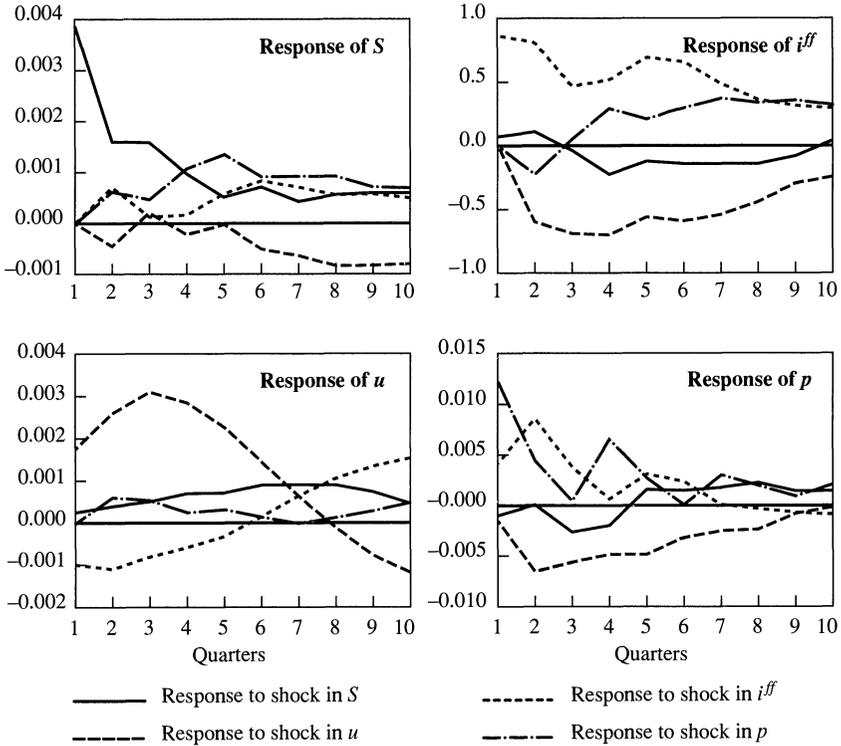
Source: Author's calculations.

Note: Graphs show the impulse responses to innovations of one standard deviation for the different variables for the sample period 1955:1 to 1994:2. Variables are civilian unemployment rate (u), annualized rate of inflation of the CPI (p), the federal funds rate (i^{ff}), and the cyclically adjusted federal budget surplus (S).

A second question usefully addressed by the VAR is the nature of the reaction of policy to either the state of the economy or to other policies. Figures 8 and 9 show the response of the federal-funds rate and the high-employment fiscal surplus to the other variables for the periods 1955:1 to 1994:2 and 1979:3 to 1994:2, respectively. To focus first on the response of i^{ff} in both periods, the reactions clearly show the appropriate sign (a positive response to inflation and negative to unemployment). The later period in figure 9 shows a quicker and more forceful response to unemployment but a slower and less forceful response to inflation after 1979.

Monetary policy shows virtually no reaction to fiscal policy in the figures, confirming the hypothesis that monetary policy has been “re-

Figure 9. Vector Autoregression of Policies and Objectives, 1979:3–1992:4



Source: Author's calculations.

Note: This figure shows the same variables and ordering as figure 8 for the period of more active monetary policy, 1979:3 to 1992:4.

sults oriented” rather than reacting to forecasts of the impact of fiscal or other changes on future economic activity. Finally, note that the federal-funds rate responds relatively slowly to both inflation and unemployment, a result consistent with the slow extinguishing of shocks to those variables and a potential cause of the noncooperative equilibrium analyzed above.

Fiscal policy is clearly determined by other factors. The positive relation to interest rates may be the effect of interest rates on debt service (which is not removed from the structural surplus). Reversing the causal ordering had little effect on the estimated impulse-response curves.²⁸

28. Figures 8 and 9 assume that the ordering of variables (from most to least prior) is the fiscal surplus, the federal-funds rate, unemployment, and inflation.

With one exception, these results are insensitive to the ordering and sub-period. The only period when the dynamics look utterly different is the monetarist period (1979:3–1983:4). During this time, the response to inflation and unemployment was much quicker, with the average lag being about two-and-one-half quarters as compared with an average lag of about five quarters during the rest of the period.

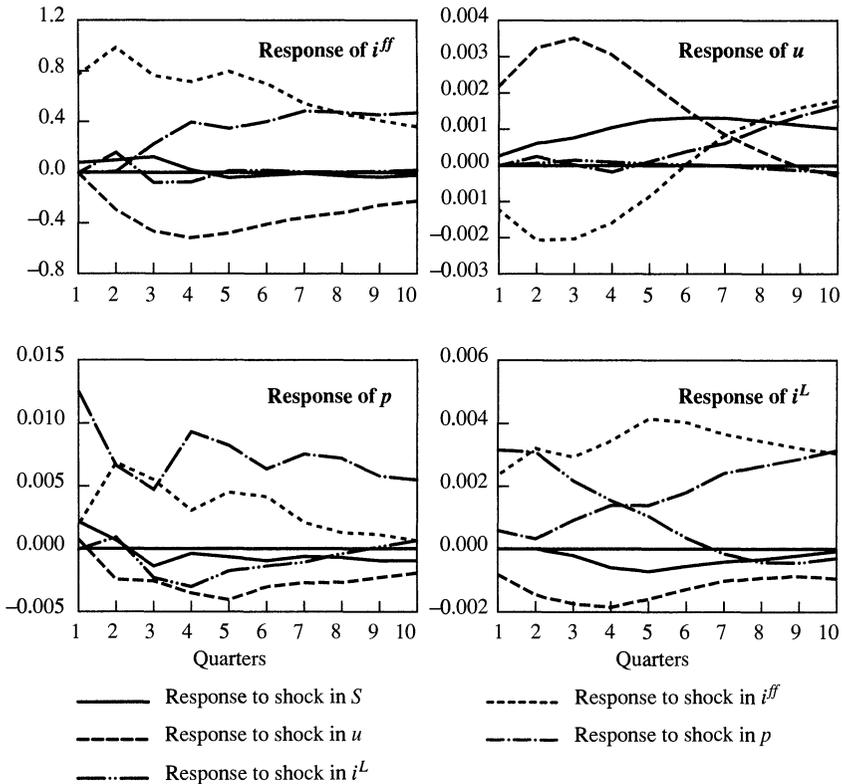
A final issue concerns the possibility that the analysis is biased because it omits the forward-looking character of financial markets, particularly the reaction of equity, bond, and foreign exchange markets to expected future economic conditions. This possibility can be incorporated into the analysis by including in the VAR a forward-looking financial variable, which is here taken to be the 10-year Treasury bond rate (i^L). The modified VAR has exactly the same lag structure as shown above. In the estimation, I assume that the long rate is a purely forward-looking rate and a function of current and expected future short-term interest rates as well as expected future economic conditions. Because of this assumption, I perform the VAR impulse-response estimation by having i^L as the last variable in the causal structure, caused by all the other variables.

Figure 10 shows the results of this new VAR. Its structure is identical to the first two VARs in all respects except that it adds the forward-looking long-term interest rate. The differences in the results that come from including the forward-looking component of financial markets are imperceptible. The impact of monetary policy on unemployment is slightly larger than that in figure 8, but the lag structures are essentially identical. Upon examining the determinants of movements in long-term interest rates, it is interesting to note that the major *short-term* influences come from shocks to short- and long-term interest rates, and that, contrary to journalistic wisdom, shocks to inflation have little immediate impact upon long-term interest rates. Overall, this expanded VAR indicates that the inclusion of forward-looking elements does not change the basic results.

Structural Empirical Modeling of Coordination and Independence

The VAR helps sort out the basic structure but cannot help estimate the impact of different strategies on economic performance. For this, one needs to return to the Neolithic Age of Structural Models. For con-

Figure 10. Vector Autoregression of Policies and Objectives, with Long-Term Interest Rate, 1955:1–1994:2



Source: Author's calculations.

Note: An alternative approach adds the long-term interest rate (i^L) as a forward-looking, "caused" variable to the earlier structure for the period 1955:1–1994:2. The impact of policy on the major economic variables and the lag of monetary policy behind economic shocks are indistinguishable from the simpler structure in figure 8.

creteness, I use the U.S. 1993 deficit-reduction package as a point of reference.²⁹ The basic outline of the 1993 deficit-reduction package is straightforward: the 1993 budget act contains tax and expenditure provisions that are projected to reduce the structural budget deficit by \$143 billion between 1993 and fiscal year 1998. The reductions are made up in roughly equal parts of expenditure reductions and tax increases.

29. The essential fiscal elements of the Clinton economic plan were enacted as the Omnibus Budget and Reconciliation Act of 1993. A brief discussion, along with the estimated budget impacts that are used here, is presented in Congressional Budget Office (1993). The administration's analysis is contained in *Economic Report of the President* (1994).

The purpose of the deficit-reduction package was expressed clearly and simply by President Clinton's Council of Economic Advisers: "The key macroeconomic rationale for reducing the Federal deficit is to increase investment and therefore productivity and real incomes in the future."³⁰

This section examines the effect of the Clinton package under two sets of assumptions about monetary policy. In the *noncooperative monetary policy*, the Federal Reserve is assumed to respond primarily to the state of the economy in a way consistent with its reactions over the past two decades. I discuss below the exact specifications of this policy. In the *cooperative monetary policy*, it is assumed that the Federal Reserve takes steps to keep the economy on the same trajectory as would have occurred without the deficit-reduction package. This policy is implemented by targeting a given unemployment path, although targeting the price level or nominal GNP would lead to virtually the same monetary

I then examine the impact of the deficit-reduction package using three different models: a small *minimodel* developed for this study, the *Fair model* developed by Ray Fair, and the well-known *DRI macroeconomic model* of the economy.³¹ To get at the nub of the issue, the estimates must incorporate two features. First, the models must either contain a sensible monetary reaction function or be manipulable so as to allow one to be included. Second, the model should have endogenous potential output (including earnings on foreign investment) since the whole point of the deficit-reduction game is to increase investment and thereby increase the rate of growth of potential and actual output. Unfortunately, no model contains both of the desired features. The Fair model has a Federal Reserve reaction function but also has exogenous potential output. By contrast, the DRI model has an elaborate supply side with endogenous potential output, but the monetary sector is modeled as a fixed path of nonborrowed reserves and does not allow for a conventional reaction function. Given these difficulties, I have developed a minimodel that has both endogenous potential output and a monetary reaction function. To use the DRI model, I combined the monetary reaction function described below (which treats the federal-funds rate as endogenous) with the standard DRI model structure (which has exogenous) nonbor-

30. *Economic Report of the President* (1994, p. 85).

31. See Fair (1993) and DRI (1990).

rowed reserves). The runs for the Fair model, in which potential output is exogenous, focus primarily on short-run movement of output around its potential.

Model Structure

The underlying specifications of the three models are similar. I will outline the structure of the minimodel and then discuss the differences between the minimodel and the other two models. Potential domestic output, $Q(t)$, is determined by exogenous labor force, $L(t)$, exogenous technology, $A(t)$, and endogenous capital, $K(t)$:

$$(9) \quad Q(t) = A(t)K(t)^aL(t)^{1-a}.$$

In what follows, all lower-case Greek letters are parameters. Actual real GNP, $X(t)$, is determined by three factors: exogenous forces, $\beta_0(t)$, fiscal policy measured by the ratio of the high-employment surplus to potential GNP, $S(t)$, and endogenous monetary policy represented by the short-run real interest rate, $r(t)$, at different lags, j :

$$(10) \quad \log [X(t)] = \beta_0(t) + \sum \beta_{1,j}S(t-j) + \sum \beta_{2,j}r(t-j).$$

The unemployment rate, $u(t)$, is determined by Okun's law:

$$(11) \quad u(t) = u^n(t) - \sum \gamma_{1,j} [X(t-j)/Q(t-j) - 1],$$

where $u^n(t)$ is the exogenous natural rate of unemployment.

The inflation rate follows the natural-rate hypothesis:

$$(12) \quad p(t) = \sum \theta_{1,j}p(t-1-j) + \sum \theta_{2,j}[u(t-j) - u^n(t)],$$

where $\theta_{k,j}$ are coefficients, $\sum \theta_{1,j}$ equals 1, and $p(t)$ is the inflation rate.

For the minimodel, I drastically simplify the crowding-out process by assuming that the government deficit completely crowds out domestic investment. This corresponds to Modigliani's stock version of the crowding-out hypothesis, which holds that government debt displaces private capital in the nation's portfolio.³² More precisely, assume that an increase in the net outstanding debt leads to a decrease in the net private wealth that is a fraction, λ , of the change in net debt. This assumption leads to the following equation for the capital stock:

32. Modigliani (1989).

$$(13) \quad K(t) = K^*(t) - \lambda D(t),$$

where $K^*(t)$ is the domestic capital stock without the deficit-reduction program, λ is the crowding-out or capital-displacement fraction, and $D(t)$ is the *change* in the net government debt from the deficit-reduction policy.³³

The final issue concerns the strategic assumptions about fiscal and monetary policy. For this experiment, it is assumed that fiscal policy is determined by the complicated and unpredictable interaction of the executive and legislative branches. The important assumption is that changes in fiscal policy are *exogenous* in that they are independent of the strategy of the monetary authority. The results of the VAR suggest that structural deficits are indeed exogenous.

Monetary policy, however, is taken to be endogenous. Again, assume that the central bank has a preference function, $V^M(u, p, g)$. The central bank then determines real interest rates by maximizing this preference function, which leads to a reaction function of the following generic form:

$$(14) \quad \partial V^M(u, p, g) / \partial r = 0.$$

The most important assumption is that monetary policy is results oriented and determined by outcomes rather than by forecasts, fiscal policies, monetary variables, or exchange rates. In this respect, the model falls short of the optimizing central bank, which would use forecasts and conjectural variations on both exogenous and fiscal actions in determining monetary policy. Yet, it is tuned to the state of the economy rather than some arbitrary intermediate objective, such as reserves, debt, the money supply, or some monetarist operating rule.

A full discussion of the nature of the monetary reaction function is not given here.³⁴ Monetary policy in the United States has responded to varying influences—election returns, fads, ideologies, and economic theories—during the twentieth century, and the coefficients of the reaction function have varied with these influences. However, the signifi-

33. This formulation simplifies by assuming that the deficit-reduction package has no effect on investment other than through the impact on the government debt and omits the foreign sector. These simplifications will be corrected in the DRI simulations.

34. A useful discussion is contained in McNees (1986).

cance of inflation and unemployment (or output) comes through loud and clear in past empirical studies.³⁵

The Minimodel

The minimodel has been fitted to historical data where that is sensible and calibrated to existing models and findings where that seemed more appropriate. The estimation period is 1955:3 to 1994:2 unless otherwise noted. The specific equations are derived as follows. In equation 9, potential output is estimated using the Okun's law equation 11, assuming that the capital elasticity α equals 0.25. Future potential output growth is taken from projections by the Congressional Budget Office (CBO).³⁶ The parameters of equation 10 are derived from macroeconomic modeling exercises, particularly the estimates of the impact of monetary and fiscal policy in work by Ralph Bryant, Gerald Holtham, and Peter Hooper.³⁷ It is assumed that the semilogarithmic multiplier of fiscal policy (holding interest rates constant) on real GNP is -2.0 —that is, a one percentage point increase in the ratio of the high-employment surplus to output lowers output by 2 percent. The semilogarithmic multiplier of the real short-term interest rate on real GNP is -1.0 . Both policies are assumed to have a geometrical declining impact with an average lag of five quarters. The Okun's law coefficient in equation 11 is estimated to be 2.1. The inflation equation is fitted to quarterly data with a single lag. The crowding-out coefficient in equation 13 is assumed to be $\lambda = 1$ in light of experience in the 1980s, while the depreciation rate of the capital stock is taken to be 10 percent a year at a declining balance rate.

Different approaches to the crucial monetary policy equation are summarized in table 1. The basic structure is that the Federal Reserve sets the federal-funds rate adaptively in response to the difference between its targeted performance and actual economic performance. The

35. There is a vast literature on the actual and optimal behavior of the monetary authorities. It is quite rare that empirical macroeconomic models assume an endogenous central bank. For examples in macroeconomic models, see Fair (1993). For empirical studies of Federal Reserve behavior, see Kettl (1986), Goldfeld (1973), McNees (1986), and Perry and Schultze (1993).

36. Congressional Budget Office (1993).

37. Bryant, Holtham, and Hooper (1988).

Table 1. Alternative Estimates of Federal Reserve Reaction Function, 1955:2–1994:2^a

Independent variable	OLS	OLS, 1979:3–1994:2	Polynomial distributed lag ^b	Instrumental variable ^c	Forecast ^d	OLS, with surplus
Constant	0.002	0.004	0.001	0.002	–0.000	0.002
Federal-funds rate, one lag	0.880 (0.034)	0.825 (0.063)	0.882 (0.032)	0.908 (0.100)	0.916 (0.035)	0.880 (0.034)
Unemployment rate	–0.130 (0.062)	–0.032 (0.141)	–0.091 (0.060)	–0.098 (0.090)	–0.198 (0.076)	–0.130 (0.062)
Inflation rate	0.129 (0.035)	0.222 (0.066)	0.178 (0.038)	0.099 (0.094)	0.147 (0.039)	0.129 (0.035)
Surplus	...	...	...	...	...	–0.001 (0.058)
R ²	0.923	0.897	0.939	0.922	0.923	0.923
Standard error of estimate	0.00983	0.00853	0.00877	0.00985	0.00989	0.00983

Source: Author's calculations.

a. The dependent variable is federal-funds rate (i^f). Other variables are the difference between civilian unemployment rate and Robert Gordon's estimate of the natural rate of unemployment ($udiff$); annualized quarterly change in the consumer price index (p); and high-employment surplus as percent of potential output (S); standard errors of coefficients are in parentheses.

b. Lag of two quarters on unemployment and four quarters on inflation with a quadratic lag function.

c. Instruments are $udiff(-1)$, $udiff(-2)$, $udiff(-3)$, $udiff(-4)$, $p(-1)$, $p(-2)$, $p(-3)$, and $p(-4)$.

d. Values of unemployment and inflation are replaced by two-quarter leading values. Instruments for future values are $udiff$, $udiff(-1)$, $udiff(-2)$, $udiff(-3)$, $udiff(-4)$, $p(-1)$, $p(-2)$, $p(-3)$, and $p(-4)$, and $i^f(-1)$.

urable targets are the unemployment rate and the inflation rate of consumer prices. I assume that because of uncertainties, political constraints, and caution, the Federal Reserve moves only partially toward its inflation and unemployment objectives. The sample period is 1955:3 to 1994:2, and the variables are the nominal federal-funds rate (i^f), the difference between the civilian unemployment rate and Robert Gordon's estimate of the natural rate ($udiff$), and the annualized quarter-to-quarter consumer price index (p), all in natural numbers.³⁸ The coefficients for the equation in the first column are reasonable and moderately well determined. The equation shows a small increase in the target real interest rate as inflation rises and shows lower real interest rates as unemployment rises. This reaction function threatens to show instability because the real interest rate initially declines after inflation shocks, but in practice the lag in the aggregate demand equation is long enough so that instabilities do not emerge.

The most notable feature of this equation is that the reaction to shocks is quite slow, a point foreshadowed by the earlier VAR experi-

38. Gordon (1988).

Table 2. Regression or Forecast Error for Federal-Funds Rate
Percentage points per year

<i>Period</i>	<i>Regression error^a</i>	<i>Forecast error^b</i>	
		<i>Static</i>	<i>Dynamic</i>
1993:3	0.06	0.06	-1.16
1993:4	-0.34	-0.19	-1.21
1994:1	0.58	-0.01	-1.08
1994:2	-0.18	0.44	-0.51
RMSE or SEE ^c	0.965	0.978	2.22

Source: Author's calculations.

a. See VAR from figure 8.

b. See the first equation in table 1.

c. Root mean squared error (RMSE) for forecasts or standard error of equation (SEE) for estimated equations (in percentage points).

ments. The preferred equation in table 1 (that in the first column) shows a more rapid reaction of monetary policy to shocks than do the VARs shown in figures 8–10. For example, the median lag for reacting to inflation is five quarters for the equation in table 1 versus seven quarters for inflation in the VARs.

It might be asked whether either the VAR or the equation tracks what appears to be unusually responsive behavior of the Federal Reserve in the first half of 1994. Table 2 presents the residuals from the two systems. These results indicate that the behavior in the first half of 1994 was not far out of line with earlier periods. Indeed, it appears that monetary policy was, if anything, somewhat loose relative to historical behavior during the second half of 1993 and that the Federal Reserve made up about half of the relative looseness during the first half of 1994. The notion that the Federal Reserve in early 1994 moved in a way that was unprecedented is simply unsupported by the reaction functions.

The second column in table 1 shows the basic equation in the subperiod of activist monetary policy (1979:3 to 1994:2). For this period, the lag of policy is shorter and policy tends to react more strongly to inflation and much less strongly to unemployment. The third column estimates a polynomial distributed lag on the two target variables, and the resulting lag here is somewhat longer than in the first two columns. The fourth column shows an instrumental variable estimate using lagged target variables as instruments for the lagged dependent variable and current target variables. This estimate is useful because of possible bias in the estimate of the lagged dependent variable. The instrumental variable es-

timate shows less well-determined coefficients than the ordinary least squares (OLS) estimates, but no major change in the coefficients appears. Not included in table 1 are estimates corrected for first- and second-order autocorrelation of residuals, with and without instrumental variables, which give estimated coefficients on the lagged dependent variable ranging from 0.834 to 0.894, depending upon the exact specification.

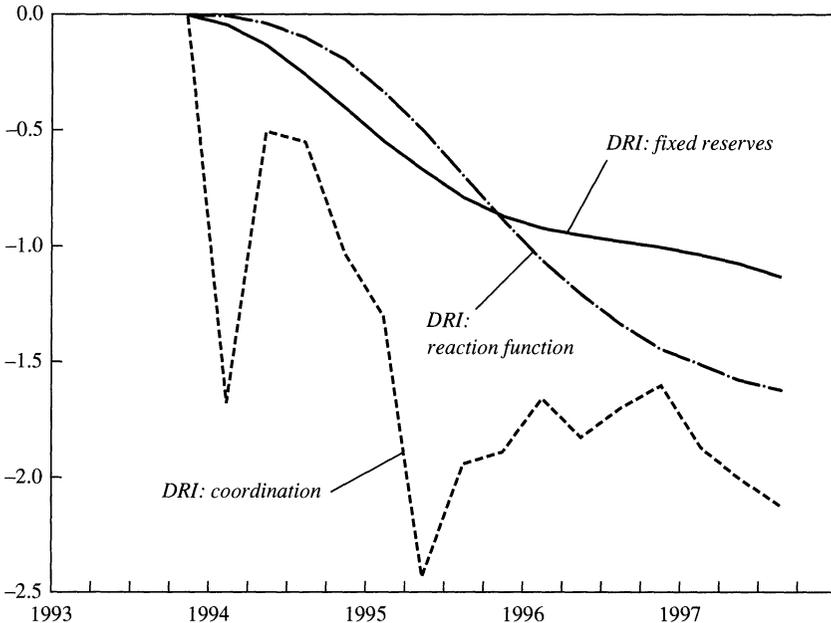
The fifth column asks whether a forward-looking monetary policy improves the equation. In this approach, it is assumed that the Federal Reserve sets policy on the basis of future inflation and unemployment as forecast by current and past trends in those variables. This approach does tend to increase the importance of unemployment in the monetary authority's reaction function, perhaps because unemployment is an inertial and cyclically lagging indicator. However, as was foreshadowed by the VAR shown in figure 10, including forward-looking elements does not overturn the basic structure.

Finally, recall that I have emphasized the importance of the presumption that the Federal Reserve tends to be "results oriented" rather than forecast or model oriented.³⁹ The evidence speaks firmly in favor of this presumption. One piece of evidence was in the VARs shown in figures 8–10, which indicated that the federal-funds rate moves gradually in response to shocks to inflation and unemployment. Another way of seeing this is to note that to offset fiscal policy would require a very large movement of interest rates more or less simultaneous with fiscal shifts. Using the consensus monetary and fiscal multipliers discussed above, a decline in the fiscal deficit of 1 percent of GNP would require a decline in interest rates of around 200 basis points, which is not seen in reality. (The sharp and immediate response of interest rates needed to offset a fiscal shift is also shown in figure 11.) The lack of responsiveness is clearly seen in the VAR experiments shown in figures 8–10. Finally, the sixth column in table 1 directly estimates the Federal Reserve's reaction to fiscal changes and finds that the coefficient on the federal-funds rate has the wrong sign, although it is thoroughly insignificant. Given the standard error of the coefficient, one can pretty definitely rule out the

39. Chairman Alan Greenspan laid out this philosophy in testimony on August 10, 1994. As reported in "Economy: Markets May Provide Better Warnings Than CPI on Inflation, Greenspan Says," *Wall Street Journal*, August 11, 1994, p. A2.

Figure 11. Reaction of Federal-Funds Rate to Deficit Reduction, 1993:4–1997:4

Difference of federal-funds rate from baseline (percent per year)



Source: Author's projections using models described in the text.

Note: The trajectories of interest rate reactions are quite different depending upon the monetary reaction. The simulation estimates the reaction of the federal-funds rate under cooperative and noncooperative approaches to the 1993 deficit-reduction program beginning in 1993:4. Relative to the baseline, an assumption of fixed reserves shows a relatively rapid reaction to change in output compared with the historical monetary reaction function. The coordinated strategy shows a sharp drop in the federal-funds rate, which is necessary to offset the forecasted output impact.

possibility that monetary policy responds immediately to fiscal policy rather than to the state of the economy.

The “baseline” fiscal forecast was taken from the CBO’s baseline projection of September 1993.⁴⁰ The alternative deficit-reduction forecast was taken to be the deficit reduction as estimated by the CBO. In estimating the impact, I have assumed that the entire deficit reduction takes the form of a reduction in national-defense purchases. Although this was not the estimated form of the deficit reduction, it was in fact the major change in the federal budget over the 1990s. In addition, taking the budget changes as expenditure reductions removes a number of theoretical controversies, such as Robert Barro’s critique and concerns that the in-

40. See Congressional Budget Office (1993).

creases in tax rates may lead to erosion of the tax base rather than to increase in tax revenues.⁴¹ The fiscal package was, therefore, a deficit-reduction program to lower the primary high-employment deficit by 1.8 percent of GNP between 1993 and 1998, after which there are assumed to be no further changes from the baseline. The effect on the actual deficit will be somewhat different because of the feedback of the cyclical deficit on the debt.⁴²

The Fair Model

A second approach is to estimate the impact of the deficit-reduction package in the Fair model. This model is particularly useful because it contains endogenous monetary policy.⁴³ Fair made a version of his model available for these simulations. To estimate the impact, I simply entered the baseline and deficit-reduction fiscal proposals into the Fair model with endogenous monetary policy and calculated the impact on the economy.⁴⁴ The Fair model holds potential output exogenous, however, so that the impact could be measured only on actual output and cannot be used to examine the impact on potential output and long-run economic growth.

The DRI Model

A third model used here is the macroeconomic model developed by the forecasting firm DRI. This model is available for personal computers along with historical data and projections for 12 years. The estimates below use the November 1993 simulations; these projections are used to place the estimates of the impact of policy in the context of views about the economy at the time of the deficit reduction. The advantage of the DRI model is that it contains virtually everything of interest. The disad-

41. Barro (1974).

42. If the strict Ricardian hypothesis holds, then the impact upon aggregate demand would be maintained if the deficit reduction took the form of expenditure cuts but would be completely erased if the deficit reduction were tax increases.

43. See Fair (1993) for the latest results.

44. The monetary reaction function in the Fair model is a more elaborate version of the one shown in the first column of table 1. The dependent variable is the nominal three-month treasury bill rate, and the lag is virtually identical to that used here.

vantage is that it models monetary policy by assuming that nonborrowed reserves are constant.⁴⁵

To implement the DRI model, I employ the nominal interest-rate reaction function shown in the first column of table 1. This integration was accomplished by iterating back and forth between the estimated equation and the DRI model (with the federal-funds rate held exogenous) until the model outcomes converged with the estimated interest rate reaction function.

For the cooperative simulations, models were run so that the unemployment rate was unchanged by the introduction of the fiscal policy. This was easily accomplished in the minimodel, but the algorithm for solving the DRI model proved dynamically unstable when the unemployment rate was targeted, so it was necessary to approximate the desired path.

Results of the Simulation

Table 3 summarizes the impact of a 1993-style deficit reduction in the DRI model. Saving and investment increase relative to the baseline fiscal policy for all monetary strategies, and all categories of investment benefit. It is interesting to note that in the DRI model the increase in real net exports outweighs the increase in domestic investment. As will be seen below, this finding has major implications for the value of deficit reduction because it raises the possibility that the prosaving policies may lead to a decline in consumption for a decade or even longer.

Figure 11 shows the effect of deficit reduction on the level of the federal-funds rate in the DRI model. Each path is calculated relative to the baseline or pre-1993 fiscal policy. This figure shows the cooperative path, with sharply declining rates after deficit reduction, along with two noncooperative reaction functions (the "DRI: fixed reserves" and the preferred equation in table 1, shown as "DRI: reaction function"). Note that the interest rate under the cooperative policy shows a dramatic and immediate drop to offset the fiscal impact; this policy is clearly differen-

45. See DRI (1990) for a discussion of the model's properties. Most macroeconomic models share with the DRI model the convention of modeling monetary policy by assuming that either nonborrowed reserves or the money supply is an exogenous variable. As is seen below, this convention tends to produce too much of a reaction of interest rates to shocks.

tiated both from the other simulations and from monetary policy reality. In other runs (not shown), I investigated the effects of the alternative reaction functions shown in table 1. It turns out that there is very little difference in the simulated outcome among the different reaction functions or between the Fair model and the minimodel.

Figure 12 shows the impact of different policies on the unemployment

Table 3. Impact of Alternative Policy Strategies^a

<i>Policy effect</i>	<i>Average for 1993–2004</i>	<i>Difference from baseline</i>
	<i>(billions of 1987 dollars)</i>	<i>(billions of 1987 dollars)</i>
<i>Total GDP</i>		
Actual		
Baseline	5,943	0.0
Coordinated	5,977	33.7
Reaction function	5,933	–10.5
Fixed reserves	5,918	–24.8
Potential		
Baseline	5,963	0.0
Coordinated	5,995	31.8
Reaction function	5,974	11.0
Fixed reserves	5,968	4.2
<i>Real national income</i>		
Baseline	5,235	0.0
Coordinated	5,258	23.6
Reaction function	5,221	–13.5
Fixed reserves	5,210	–25.1
<i>Price level (end of period)</i>		
<i>GDP deflator</i>	<i>(1987 = 1.00)</i>	<i>(percent)</i>
Baseline	1.75	0.0
Coordinated	1.74	–1.0
Reaction function	1.70	–3.0
Fixed reserves	1.69	–3.8
<i>Consumption deflator</i>		
Baseline	1.82	0.0
Coordinated	1.81	–0.7
Reaction function	1.87	2.9
Fixed reserves	1.83	0.2
	<i>(percent of labor force)</i>	<i>(percentage points)</i>
<i>Civilian unemployment rate</i>		
Baseline	5.67	0.0
Coordinated	5.66	–0.0
Reaction function	5.86	0.2
Fixed reserves	5.93	0.3

(continued)

Table 3 (continued)

<i>Policy effect</i>	<i>Average for 1993–2004</i>	<i>Difference from baseline</i>
	<i>(billions of 1987 dollars)</i>	<i>(billions of 1987 dollars)</i>
<i>Composition of output</i>		
<i>Consumption</i>		
Baseline	3,904	0.0
Coordinated	3,912	7.5
Reaction function	3,898	–6.0
Fixed reserves	3,894	–10.1
<i>Total private investment</i>		
Baseline	1,084	0.0
Coordinated	1,130	46.7
Reaction function	1,108	24.7
Fixed reserves	1,103	19.3
<i>Equipment</i>		
Baseline	626	0.0
Coordinated	641	15.5
Reaction function	632	6.1
Fixed reserves	629	3.5
<i>Residential investment</i>		
Baseline	244	0.0
Coordinated	264	19.6
Reaction function	259	15.0
Fixed reserves	258	14.0
<i>Net exports</i>		
Baseline	–109	0.0
Coordinated	–55	54.0
Reaction function	–62	46.6
Fixed reserves	–67	42.2
<i>Defense</i>		
Baseline	275	0.0
Coordinated	200	–75.4
Reaction function	200	–75.4
Fixed reserves	200	–75.4

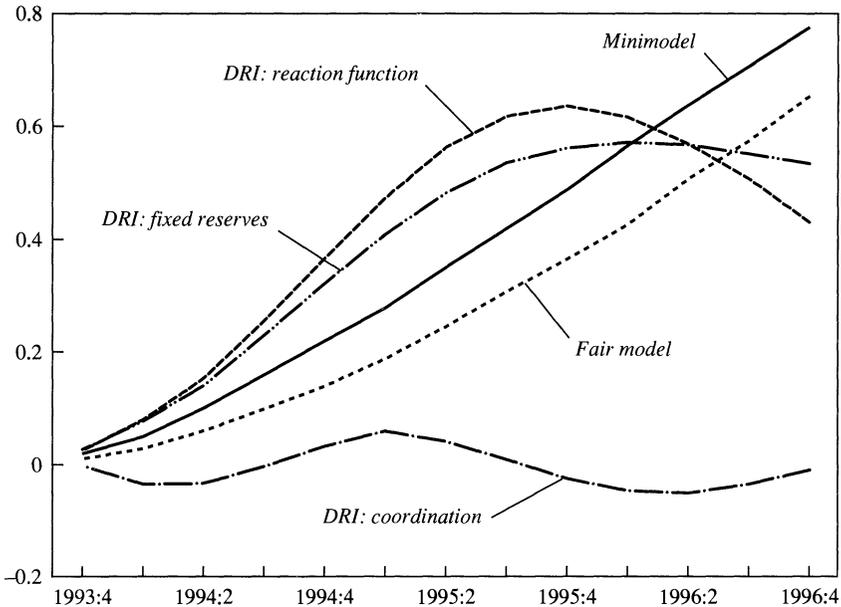
Source: Author's calculations using the DRI model, November 1993 version.

a. "Baseline" uses the fiscal policy before the 1993 budget act. "Coordinated" uses a Federal Reserve reaction that keeps unemployment on the same path as the baseline. The "reaction function" uses the nominal reaction function shown in the first column of table 1. The "fixed reserves" holds the same nonborrowed reserves as in the baseline.

rate using the same monetary reactions discussed in the paragraph above. In addition, it shows the changes in the unemployment rate in the other two models. The three models and different reaction functions show a similar pattern of response for the first two years, after which the differences in the reaction functions lead to divergent paths. For all strategies and all three models, a 1993-style deficit reduction, along with

Figure 12. Unemployment Reaction under Different Strategies, 1993:4–1996:4

Difference of unemployment rate from baseline (percent of labor force)



Source: Author's projections using models described in the text.

Note: The unemployment rate shows substantial increases in response to the 1993 deficit-reduction program for all noncooperative approaches compared with the baseline. The coordinated strategy sets monetary policy to maintain the baseline unemployment and inflation profile.

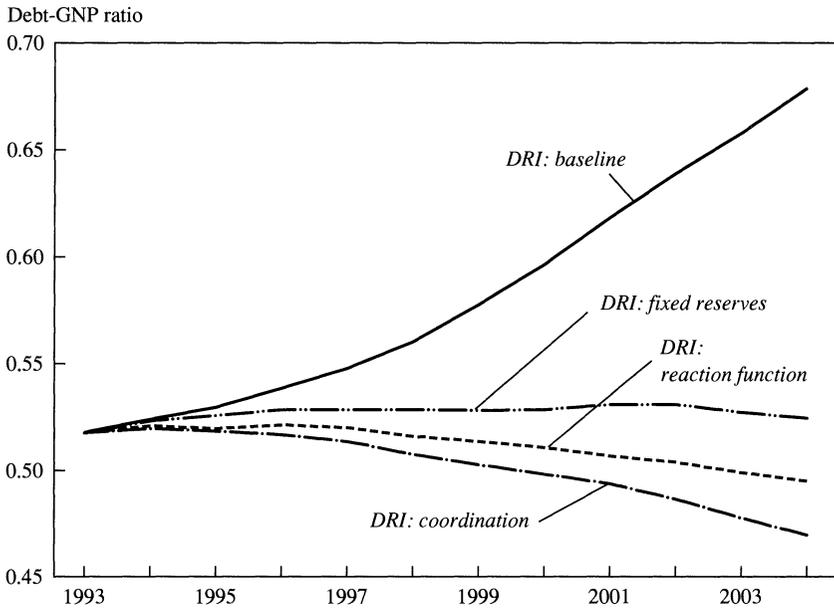
a noncooperative monetary policy, leads to an increase in the unemployment rate of about 0.5 percentage point after two years.

Figure 13 shows the impact of the policy on the outstanding federal debt. The analysis suggests that, even in the presence of noncooperative monetary policy, deficit reduction does succeed in stabilizing the debt-output ratio. It is interesting to note that the reaction functions themselves have a marked effect on the debt-output ratio; this effect arises because of the impact of the cumulative *cyclical* deficits on the debt.

Effects on Output, Consumption, and Real National Income

The proof of the deficit-reduction recipe is in the pudding of higher potential consumption or real national income. Often, analyses of deficit reduction examine the defective measure of GDP. Table 4 shows the cumulative losses or gains for different time periods and different models. The different models show general agreement about the effects of a non-

Figure 13. Debt-GDP Ratio Stabilizes with Deficit Reduction, 1993–2004



Source: Author's projections using models described in the text.

cooperative monetary policy over the short run. The cumulative GNP loss from a noncooperative policy is between 4 and 6 percent of one year's GNP over a seven-year period.

Unfortunately, neither the Fair model nor the minimodel can fully assess the effect on long-run consumption and real national income, so for these outcomes I turn to the DRI model. An examination of long-run output trends (not shown) indicates that the cooperative strategy leads to a higher cumulative GNP over the period 1993–2004; by contrast, the noncooperative strategies lead to an initially lower GNP followed by a higher GNP after the investments have begun to pay off in higher potential output. It is sobering to see that the noncooperative strategies do not make up the early losses until more than a decade after the policy has been implemented. By the twelfth year after the program, GNP with the deficit-reduction fiscal program is between 1½ and 2¼ percent higher than the baseline fiscal policy.

Of course, the point of deficit reduction is not to produce gross output but to reduce consumption now so as to increase consumption in the future. Figure 14 shows the effect of deficit reduction on cumulative pri-

Table 4. Differences in Cumulative GDP from Baseline for Various Models

Billions of 1987 dollars

<i>Model</i>	<i>1993–96</i>	<i>1993–99</i>	<i>1993–2004</i>
<i>Cooperative</i>	7	62	405
<i>Noncooperative</i>			
DRI: Fixed reserves	– 157	– 327	– 298
DRI: Reaction function	– 162	– 226	– 126
Minimodel	– 161	...	...
Fair model	– 126	...	...

Source: Author's calculations using models described in the text.

vate consumption. (Note that it excludes defense, or public consumption, and therefore overstates the impact on total consumption.) The cooperative strategy does succeed in raising cumulative consumption in the future. Surprisingly, the noncooperative approaches do not make enough improvements in potential output to offset their harm to actual output and consumption over the first 12 years; consequently, they actually lose consumption over the entire period and are still heading downhill by the end of the simulation.

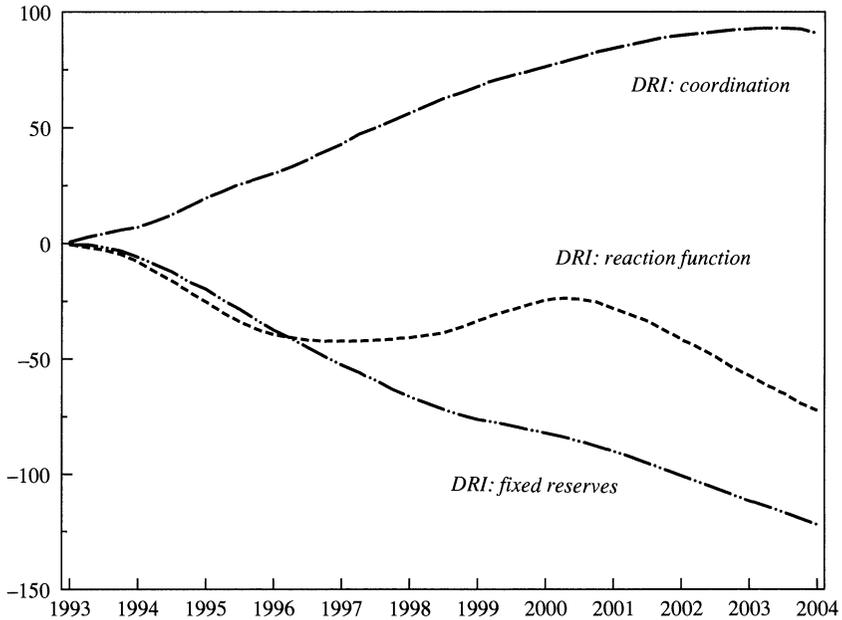
While private consumption is close to the appropriate measure, it is still not the correct measure of domestic economic welfare because it excludes public consumption (which declines by \$75 billion in the defense sector) and does not properly account for net capital accumulation. The most appropriate measure is net national income measured at domestic purchasing power; I call this *real national income* (or *RNI*).

To calculate real national income, I take real GNP, subtract depreciation, and then correct for changes in the terms of trade. In the DRI model, depreciation is calculated as corrected nominal capital consumption deflated by the GDP deflator. The terms of trade correction adds to net national product the difference between nominal exports of goods and services deflated by the import deflator and nominal exports of goods and services deflated by the export deflator.⁴⁶ Real national in-

46. In symbols, say that D is real net output produced and purchased at home, M is nominal imports, X is nominal exports, p_M is the deflator for imports, and p_X is the deflator for exports. Then conventional net national output is $NNP = D + X/p_X - M/p_M$. Real national income is measured as $RNI = D + X/p_M - M/p_M$. The terms of trade losses are the difference between X/p_X and X/p_M . The U.S. Department of Commerce designates real national output measured in this fashion as "command basis" rather than as production basis.

Figure 14. Cumulative Private Consumption, 1993–2004

Difference in cumulative consumption expenditures from baseline
(billions of 1987 dollars)



Source: Author's projections using models described in the text.

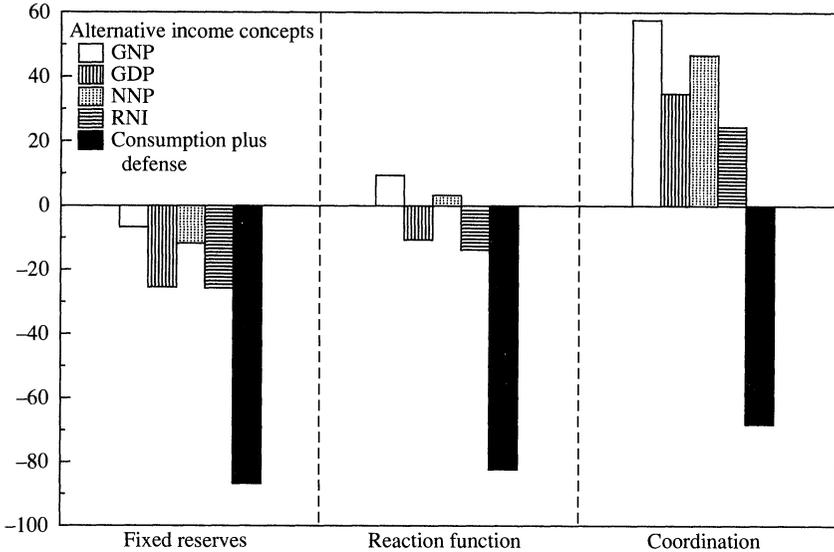
Note: Simulation of the DRI model indicates that cumulative private consumption heads south for all the noncooperative strategies and never recoups earlier losses. Coordinated policies have higher private consumption although public consumption is lower.

come is an appropriate national welfare measure because it measures sustainable consumption rather than sustainable production. It is particularly important to examine RNI in cases where a substantial part of the effect comes through increased foreign saving induced by changes in the terms of trade.

Figure 15 shows the impact of the monetary strategies on different concepts of national income and output using the DRI model. The three strategies shown are, first, one in which the Federal Reserve keeps non-borrowed reserves unchanged; second, the Federal Reserve's nominal reaction function shown in the first column of table 1; and, third, the cooperative strategy in which unemployment or nominal GNP is unchanged. In each case, the value is the difference in the average value of income or output relative to the baseline strategy (that is, no deficit

Figure 15. Gains and Losses from Deficit Reduction, 1993–2004

Average difference in income or output from baseline
(billions of 1987 dollars per year)



Source: Author's projections using models described in the text.

Note: Conventional measures such as GNP or GDP show that noncooperative scenarios almost break even over the first 12 years after deficit reduction and that cooperative policies have major gains. When depreciation and the leakage from the foreign savings bucket are taken into account, real national income and consumption look much less favorable. (The figure shows the average values in 1987 prices for the first 12 years of the simulations relative to the no-deficit reduction baseline.)

reduction) for the period 1993–2004. The first bar for each simulation shows the average effect on real GNP. The second bar shows the impact on real GDP—this figure matching up with the estimates given in table 3. The difference between the first two bars is net earnings on foreign assets. Note that although GDP is the customary measure, GNP is the appropriate measure of income of U.S. residents. The next bar corrects GNP for depreciation, taking into account that GNP contains some double counting and showing the correction necessary to get *net* national product.

The most appropriate measure is the fourth bar. This measure subtracts the terms of trade losses from net national product. The major finding here is that real national income over the period 1993–2004 *declines* for the noncooperative strategies and makes only a modest gain for the cooperative strategy. One should not be surprised that there are terms of trade losses from deficit reduction because increased foreign

investment requires a depreciation in the real value of the dollar. What is surprising is the magnitude of the terms of trade losses, which are about the same size as the net output gains. The final set of bars in figure 15 shows total consumption (private consumption expenditures plus national defense). These bars show that all strategies actually reduce total consumption over the first 12 years of the program.

The potentially detrimental effects of increased saving on real national income and consumption are called *immiserizing saving* to parallel the notion of “immiserizing growth.”⁴⁷ The idea can be explained with a simple growth model and a simple example.⁴⁸ The simple model is as follows.⁴⁹ Consider a small open economy with full employment, perfect capital mobility, perfect competition, and no risk or taxes. Any increase in saving in this case goes into net foreign saving at the world interest rate, r^f . The equations of the economy can be written as follows (suppressing time where inessential):

$$(15) \quad Q = C + X - M + pW^f r^f,$$

where Q is net national product, C is consumption, X and M are the volume of exports and imports (both exclusive of earnings on investments), p is the domestic price of foreign currency and foreign goods, and $pW^f r^f$ is earnings on foreign investments. (Note that X and p are used differently here than in the rest of the paper.) For simplicity, assume that domestic capital is fixed so that, by assumption, all increased saving goes into foreign investment. The current account in domestic output terms is $CA = X - M + pW^f r^f$. Further suppose that the absolute value of price elasticities of imports and exports are ϵ and γ respectively, that trade is initially balanced, and that initial net foreign assets are zero. Normalize initial $X = M = p = 1$, so that initial CA equals zero.

To increase saving, the country depreciates its currency, raising p from 1 to $(1 + \Psi)$, where Ψ is small. This will lead to an improved current account by $CA = (\epsilon + \gamma - 1)\Psi$, and the attempt to increase saving increases actual saving as long as $(\epsilon + \gamma)$ exceeds one (the static Mar-

47. See Bhagwati (1969).

48. A related discussion is contained in Oudiz and Sachs (1984). An analysis of the long-run properties of fiscal policy is contained in McKibbin and Sachs (1991) and McKibbin and Bagnoli (1993). These studies do not explicitly investigate the impact of saving decisions on long-run consumption trajectories.

49. A closely related analysis of the effect of fiscal policy on saving is presented in Obstfeld (1989), who investigates this issue in a small open economy.

shall-Lerner conditions). For simplicity, assume that the increased saving is unchanged over time, so that all earnings on increased foreign investment are consumed. These conditions all imply that the change in consumption (call it δC) from the change in prices will be

$$(16) \quad \delta C(t) = -(\epsilon + \gamma)\Psi + W^f(t)r^f = -(\epsilon + \gamma)\Psi + tr^f CA \\ = \{- (\epsilon + \gamma) + tr^f(\epsilon + \gamma - 1)\}\Psi.$$

Clearly, consumption initially declines because of the depreciation and the deterioration in the terms of trade, but it makes up the difference over time from the earnings on foreign assets.

The present value of the consumption arising from the saving effort, δPV , is simply the present value of equation 16, valued at the consumption discount rate, ρ . This is equal to

$$(17) \quad \delta PV = \int_0^{\infty} \{tr^f(\epsilon + \gamma - 1) - (\epsilon + \gamma)\}\Psi e_{-\rho t} dt.$$

For constant interest and discount rates, this is equal to

$$(18) \quad \delta PV = \Psi/\rho [r^f(\epsilon + \gamma - 1)/\rho - (\epsilon + \gamma)].$$

Equation 18 has a number of interesting implications. To begin with, it is obvious that the sum of the export and import elasticities ($\epsilon + \gamma$) must exceed unity for a saving program to succeed. If the Marshall-Lerner conditions do not hold, then an attempt to increase foreign saving will never get off the ground (the well-known transfer problem). But the conditions under which increased foreign saving improves economic welfare are even stricter than the Marshall-Lerner conditions. Assume, for example, that the rate of return on foreign saving is equal to the consumption discount rate ($r^f = \rho$). In this case, the term in brackets reduces to -1 , which shows that the present value of consumption is negative. In other words, unless the foreign rate of return is above the consumption discount rate, the present value of a foreign saving program will be negative if the country is not a price taker.

One might also ask how much the return on foreign saving must be above the discount rate for the program to break even. By equating the term in brackets to zero, the breakeven condition is found to be $r^f/\rho = (\epsilon + \gamma)/(\epsilon + \gamma - 1)$. The term on the right reflects the terms of trade effect and exceeds unity if the elasticities are finite. For example, if the sum of export and import elasticities is three, then the return on foreign

saving must exceed the consumption discount rate by one-half for a saving program to have a positive present value of consumption.

A simple numerical example can illustrate this result. Suppose that a country increases national saving using a policy that depreciates the exchange rate, increases competitiveness, reduces the volume of imports, increases exports, and increases the current account and net foreign investment. Assume that the increase in net exports comes entirely out of consumption. For concreteness, assume that the exchange rate is passed completely into prices, that the price elasticity of imports is -1 , that the price elasticity of exports is -1.5 , and that effects occur with a one-year lag.⁵⁰ Further assume that the foreign savings are put into investments with a real annual rate of return of 5 percent, and the consumption discount rate is also 5 percent. For the specific example, assume that imports and exports are equal to 1,000 units each and that the depreciation is 1 percent.

Under this assumption, figure 16 shows the effect. The change in relative prices induces an increase in real net exports of 25 units, which displaces 25 units of domestic consumption. Because of the terms of trade change, the improvement in the current account is only 15 units. The improved current account leads to an accumulation of foreign assets producing the “earnings on foreign investment” shown as an upward-sloping line in figure 16. The net effect on consumption is shown as the “net change in consumption.” This change is negative for a long time, with consumption reaching prepolicy levels only in year 33.

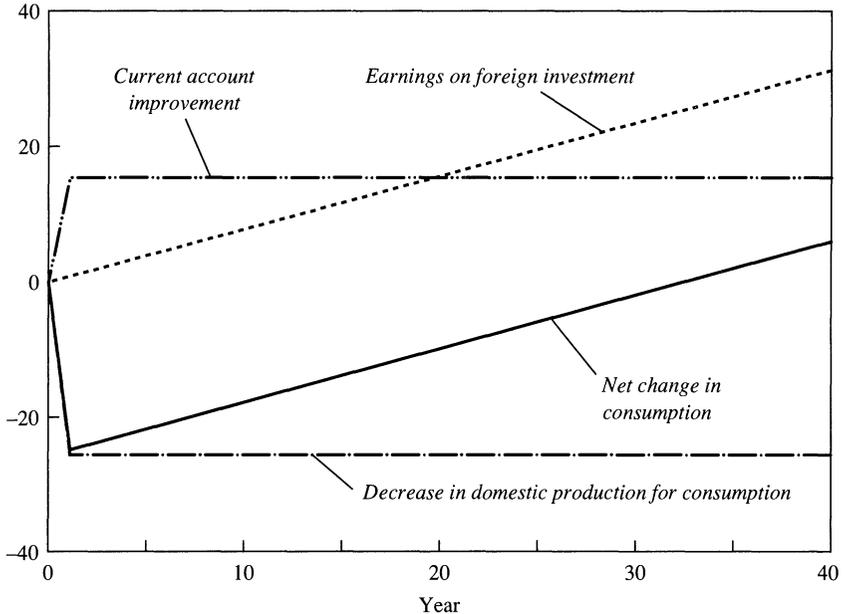
How sensitive are these results to the model? They hold in the DRI model and in the simple example described above. In addition, with the help of Ralph Bryant, I investigated the potential for immiserizing saving using the Brook-I version of the MULTIMOD model developed by the staff of the International Monetary Fund. This is a large, rational-expectations, classical model of 11 regions, which has been modified by Bryant and Charles Soludo.⁵¹ The experiments compare a baseline simulation with a gradual cut in government expenditure in the United States. The results look very much like the DRI simulation. Private consumption rises less than the cut in government consumption, so that national consumption (consisting of private consumption and government

50. These figures are drawn from the survey in Goldstein and Khan (1985).

51. The Bryant simulation and a sketch of the Brook-I variant contained in Bryant (1994), which also contains a brief description of MULTIMOD.

Figure 16. Immiserizing Saving

Impact of saving (units per year)



Source: Author's projections using models described in the text.

Note: When an increase in saving goes into foreign investment, some of the consumption reduction gets dissipated in terms of trade losses, so the current account improvement (here shown as 15 units) is less than domestic expenditure switching (here shown as 25 units). It will take many years before consumption gets back to its starting point, and the present value of the consumption changes can easily be negative. The assumptions underlying this figure are described in the text.

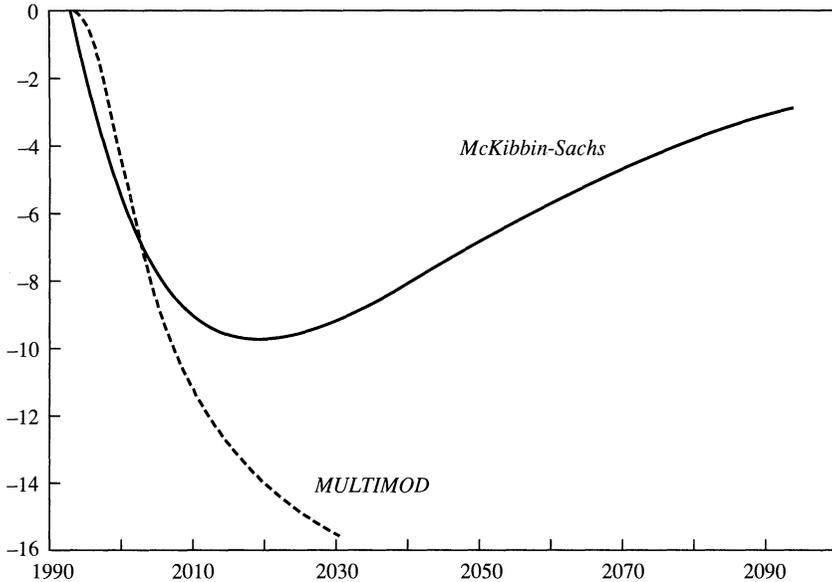
purchases) declines over the entire simulation period of 1992–2030. The immiserizing-saving paradox seems to strike here as well.

Second, using a simulation provided by Warwick McKibbin for the period 1993–2094, I estimated the impact of U.S. deficit reduction on U.S. consumption in the McKibbin-Sachs model.⁵² Like the MULTIMOD model, this model is a large, multiregion, flexible-price approach in which the intertemporal budget constraints and preferences are included. In the McKibbin-Sachs simulation, again, the impact of a phased decrease in U.S. government consumption of 2 percent of GDP is calculated. This model has short-run effects similar to those in the MULTIMOD model, but total annual U.S. consumption does begin to rise, although only about 30 years after the deficit reduction. In addition,

52. See McKibbin and Sachs (1991).

Figure 17. Cumulative Discounted Consumption in Alternative Models, 1993–2090

Cumulative change in discounted consumption as a percent of the 1993 level



Source: Author's projections using models described in the text.

Note: The impact on total U.S. consumption from a deficit reduction is tested in two long-term classical models—the MULTIMOD/Brook-I approach and the McKibbin-Sachs models. For both, government consumption is reduced by 2 percent of U.S. GDP. The figure shows cumulated discounted consumption at each date for a consumption discount rate of 5 percent per year. Using a present-value criterion, the initial losses in consumption are never recouped in either model.

in McKibbin and Sachs, total *undiscounted* U.S. cumulative consumption surpasses baseline total consumption by 2057.

Finally, I calculate the discounted present value of the change in U.S. consumption for the deficit-reduction package of 2 percent of GDP for both the MULTIMOD and McKibbin-Sachs models. For these calculations, I use a discount rate on consumption of 5 percent a year, which is the solution to the Ramsey equation for the parameters of the McKibbin-Sachs model and is also equal to the long-run real interest rate in the solution path for that model. The results are shown in figure 17. This figure shows *cumulated discounted consumption* for the United States at each date. The two models have quite similar trajectories for the first two decades. Although cumulated discounted U.S. consumption declines in the MULTIMOD throughout the period (simply indicating that total consumption flow is always lower than that in the baseline path), cumulative

discounted public and private consumption in McKibbin-Sachs turns upward in 2021, although it does not reach zero within the first hundred years.

These results indicate that the present value of a prosaving policy that reduces government consumption is negative for at least a century. In other words, the immiserizing-saving paradox holds for all three models for the period considered.

How sensitive are these conclusions to the degree of openness of the economy? Surprisingly, large open economies like the United States are most likely to face the dilemma of immiserizing saving. Small open economies are price takers in international trade. They need very little change in the terms of trade to increase their current account surplus and therefore do not incur a large terms of trade penalty from increases in foreign saving. At the other pole are large closed economies, perhaps like the United States a generation ago. For these economies, all or almost all domestic saving goes into domestic investment, so again no terms of trade penalty is necessary to increase ex post saving. In between these two polar cases are large countries that suffer a deterioration in the terms of trade to achieve a large share of increased saving going into foreign investment. Perhaps, from the point of view of the national return to saving, the United States is in that unfortunate middle ground between very open and very closed.

It is instructive to compare all these results with those presented in the 1994 *Economic Report of the President*. Although the Council of Economic Advisers (CEA) defends deficit reduction as a way of increasing investment, productivity, and real incomes, the bottom line is presumably potential consumption or real income à la John Hicks.⁵³ The CEA estimates the impact of deficit reduction using a standard Solow-style growth model for its calculation. It assumes that the lower deficit is divided 60:40 between increased investment and a reduced current account deficit. The CEA further assumes that there is no loss of output, which implicitly corresponds to the cooperative strategy analyzed here. The CEA concludes

53. Hicks (1939, pp. 173, 178). Recall that Hicks defines income as follows: "Income No. 1 is thus the maximum amount which can be spent during a period if there is to be an expectation of maintaining intact the capital value of prospective receipts" and "it equals Consumption plus Capital accumulation."

This discussion ignores the subtlety of Hicks's discussion of price changes, interest rate effects, the difference between ex ante and ex post capital, and a number of other factors.

[The deficit-reduction plan] takes about 5 years for the change in fiscal policy to have a net positive effect on consumption. Thereafter, the effect of the economic plan is to raise consumption permanently, eventually by more than 2½ percent per year.⁵⁴

These calculations are much more optimistic than mine. The CEA estimate of the impact on *GDP* is not far from the DRI cooperative approach. The CEA's estimated impact on consumption and real national income is a rosy scenario even relative to the cooperative DRI solution. The major potential flaws in the CEA analysis are not taking into account the terms of trade loss that presumably will precede the reduction in the current account deficit and assuming a cooperative policy. Figure 17 suggests that the consumption crossover point for the foreign sector is likely to be much longer than the CEA's hopeful estimate of five years.

Conclusions

This analysis of the monetary-fiscal game suggests that there are many slips between the cup of deficit reduction and the lip of real national income. It does not seem accurate to assume that the monetary authority will offset the effects of fiscal policy in the short run, which implies that poorly timed deficit reduction may come at a steep price in terms of output and consumption loss. Starting from a desired output path, a deficit-reduction package is estimated to produce a significant increase in unemployment in the short run and is likely to reduce output and consumption for at least a decade and possibly much longer.

All this evidence suggests at the very least that, as long as monetary policy is results oriented rather than cooperative, using cyclical policy to reduce the budget deficit in periods of economic slack is not sensible. Of course, deficit reduction is not designed to increase unemployment in a recession but rather aspires to raise long-term economic growth by increasing investment. The results here suggest that a deficit-reduction package is likely to increase domestic and foreign investment. However, if the policy is noncooperative, the contractionary effect of the package may be to lower consumption, and the consumption losses in the early period may never be recouped.

These results are highly sensitive to models and assumptions. I may

54. *Economic Report of the President* (1994, p. 86).

well have underestimated the gains from deficit reduction if there are externalities of investment, particularly investment in equipment. If the estimated social return from conventional production functions underestimates the social return, the impact on potential output would be higher than otherwise calculated. This modification is unlikely to add up to much, however, because conventional estimates indicate that only a small fraction of the lower deficit turns up in higher spending on business investment (see table 3). Assuming that the additional equipment has an external rate of return (over the private return) of 30 percent a year, the additional boost to potential output would be only $\frac{1}{4}$ to $\frac{1}{2}$ percent of output at the end of the simulation (as compared to the $1\frac{1}{2}$ to $2\frac{1}{4}$ percent increase in GNP from the investment itself).

These calculations are subject to all the reservations that have been noted above and should be viewed as having large potential error because of problems of misspecification, uncertainties about the appropriate Federal Reserve reaction function, uncertainties about fundamental parameters such as the crowding-out fraction and the reaction of the exchange rate, ambiguities that arise from immiserizing saving, and controversies such as those surrounding the Ricardo-Barro hypothesis or the extent of externalities in equipment investment.

Subject to these reservations, four major conclusions emerge from these results. The first is to lend support to those who question the wisdom of deficit-reduction programs in the face of high unemployment, particularly when the monetary authority is independent, cautious, results oriented, and highly averse to inflation. Unwelcome declines in aggregate demand and increases in unemployment are unlikely to be offset by a monetary stimulus in the short run or by a sufficient increase in potential output in the long run.

The second point is the mirror image of the first—that the potential gains from coordination are extremely high. A coordinated macroeconomic policy would be one in which the interest rate reaction comes simultaneously with, and in sufficient strength to offset the contractionary impact of, the fiscal contraction. Whereas an uncoordinated deficit-reduction policy might well lead to lower output and consumption than doing nothing, a cooperative approach would allow the nation to reap the gains of higher investment without suffering the losses of transient unemployment. I estimate that the total gain from coordination for a policy like the 1993 deficit-reduction package is on the order of \$100 billion to \$300 billion of cumulative output over a decade.

The third and most surprising point is that the nation may fall into the immiserizing-saving trap, which occurs when deficit reduction in a large open economy has unfavorable effects on consumption because a large share of the increased saving occurs abroad. Under this scenario, when increased domestic saving leads to a depreciation of the currency, the reduction in real national income will be greater than the increase in foreign saving. This would not matter for small open economies (for which the terms of trade losses are trivial) or for large relatively closed economies (for which most of the savings reaction is domestic). But somewhere in between these poles, and perhaps just where the United States lies today, is an unfortunate region where increased domestic saving could actually reduce the value of consumption forever.

Finally, as these different strands come together, it becomes easier to see why it is that nations can get caught in a low-savings trap when they play the fiscal-monetary game. The fiscal-monetary game combines fiscal authorities who are soft-hearted, work in unstable jobs, and are extremely averse to short-run economic downturns with monetary authorities who are hard-headed, have considerable job security, and are highly averse to inflation. Deficit reduction must be initiated by the group with the shortest time horizons, yet it is likely to produce immediate if temporary unemployment if it is badly timed, and it will definitely incur the wrath of the antitax lobby and other affected interest groups. The resulting contraction may last for an electoral cycle if the monetary authority is sluggish and results oriented.

The social return to deficit reduction is modest in the best and most cooperative of worlds; in a noncooperative world plagued by immiserizing saving, deficit reduction may actually make consumers worse off forever. Given the tastes of the players and the meager and uncertain returns to deficit reduction, it is hardly surprising that major deficit reductions like that of 1993 are a rare and endangered species in today's political economy.

APPENDIX

Derivation of Reaction Functions

THE PURPOSE of this appendix is to derive the reaction functions for the case of quadratic preferences in the nonclassical case (the classical case

is discussed in the first footnote to this appendix).⁵⁵ The preference functions of the two policymakers are given by

$$(A1) \quad U^F = V^F(u, p, g, S),$$

$$(A2) \quad U^M = V^M(u, p, g).$$

The paper has shown that because $g = g(S)$, this can be transformed into functions of u , p , and S . The functions will be taken to be quadratic and separable and can be written as

$$(A3) \quad U^F = -(u - u^*)^2 - \beta^*(p - p^*)^2 - \gamma^*(S - S^*)^2,$$

$$(A4) \quad U^M = -(u - u^{**})^2 - \beta^{**}(p - p^{**})^2 - \gamma^{**}(S - S^{**})^2,$$

where β and γ are parameters. The variables with a single asterisk refer to the unconstrained optima for the fiscal authority and those with double asterisks refer to the unconstrained optima of the monetary authority. By linearizing for the nonclassical case, the economy can be written succinctly as

$$(A5) \quad u = \mu_S S + \mu_r r,$$

$$(A6) \quad p = -\alpha u + k = -\alpha \mu_S S - \alpha \mu_r r + k.$$

Here, α and k are parameters, μ_S and μ_r are multipliers of u with respect to S and r , and r is the real interest rate. Further, from equation A6, $\alpha = -p'(u)/(1 - \pi) > 0$, and $k = p^B + \text{inessential constants}$. Maximizing utility leads to the following first-order conditions:

$$(A7) \quad \partial U^F / \partial S = -2(u - u^*)\mu_S + 2\beta^*(p - p^*)\alpha\mu_S - 2\gamma^*(S - S^*) = 0,$$

$$(A8) \quad \partial U^M / \partial r = -2(u - u^{**})\mu_r + 2\beta^{**}(p - p^{**})\alpha\mu_r = 0.$$

Substituting equations A5 and A6 and reducing yield

$$(A9) \quad (u - u^*) + \beta^*(u - u^+)\alpha^2 + \gamma^*(S - S^*)/\mu_S = 0,$$

$$(A10) \quad (u - u^{**}) + \beta^{**}(u - u^{++})\alpha^2 = 0,$$

55. One can derive the new classical case as follows: Replace equations A5 and A6 with $p = -\mu_S S - \mu_r r$ (where μ_S and μ_r are the multipliers of inflation with respect to S and r and simply use the same notation for expositional simplicity). Because unemployment is predetermined, one can set its coefficient equal to zero in the utility function. Solving equations A7 and A8 with these new conditions shows that the maximum condition for the monetary authority is for $p = p^{**}$, which shows that the monetary authority determines the inflation rate (rather than aggregate demand in the general case). If the optimal inflation rates coincide, then S equals S^* , which implies that the fiscal authority determines the deficit and that the outcome is efficient.

where u^+ and u^{++} are the unemployment rates that correspond to the desired inflation rates, p^* and p^{**} , respectively.

Solving for the optimal policies for each policymaker, one obtains

$$(A11) \quad \mu_S S + \mu_r r = [u^* + \beta^* \alpha^2 u^+ - \gamma^*(S - S^*)/\mu_S]/(1 + \beta^* \alpha^2),$$

$$(A12) \quad \mu_S S + \mu_r r = (u^{**} + \beta^{**} \alpha^2 u^{++})/(1 + \beta^{**} \alpha^2).$$

To simplify, one can, without loss of generality, change units of S so that $\mu_S = 1$; further define $\phi^* = 1/[1 + \beta^* \alpha^2]$ and $\phi^{**} = 1/[1 + \beta^{**} \alpha^2]$. This yields

$$(A13) \quad S = -\mu_r r + \phi^*[u^* + \beta^* \alpha^2 u^+ - \gamma^*(S - S^*)],$$

$$(A14) \quad S = -\mu_r r + \phi^{**}(u^{**} + \beta^{**} \alpha^2 u^{++}),$$

which gives the reaction functions of the fiscal authority:

$$(A15) \quad S^F(r) = -[\mu_r/(1 + \phi^* \gamma^*)]r + \phi^*(u^* + \beta^* \alpha^2 u^+ + \gamma^* S^*)/(1 + \phi^* \gamma^*).$$

Write the reaction function of the monetary authority as an implicit function for transparency:

$$(A16) \quad S = -\mu_r r^M(S) + \phi^{**}(u^{**} + \beta^{**} \alpha^2 u^{++}).$$

Equation A15 is the reaction function of the fiscal authority, while equation A16 is the reaction function of the monetary authority. The interpretation is that $S^F(r)$ is the surplus set by the fiscal authority as a function of the monetary policy and other variables, and $r^M(S)$ is the interest rate set by the monetary authority as a function of fiscal policy and other variables. The slope of the reaction functions (in terms of the change in S per unit change in r) can be determined as follows:

$$(A17) \quad \partial S^F/\partial r = -\mu_r/[1 + \gamma^* \phi^*], \text{ and}$$

$$(A18) \quad \partial S/\partial r^M = -\mu_r.$$

Because γ^* and ϕ^* are both positive constants, the slope of the fiscal reaction function in equation A17 is less in absolute value than that of the monetary authority in equation A18. This relationship is shown in figures 1–6.

The location of the reaction functions depends on all the parameters. The bliss points for each policymaker can be located by finding the intersection of the optimal aggregate demand line with the optimal fiscal posi-

tion. For example, for the fiscal authority, the maximum of equation A3 with respect to both r and S yields the optimal level of aggregate demand and the optimal fiscal posture. By the common-funnel theorem, there are only two independent targets (aggregate demand and the fiscal surplus), so these can be perfectly reached by the combination of r and S . It is obvious that if the monetary authority has a lower target for aggregate demand (say because it has a higher target for unemployment and a lower target for inflation) along with a higher target for the fiscal surplus, then its bliss point lies above (although not necessarily to the left of) the bliss point of the fiscal authority. Since each policymaker's reaction function goes through its bliss point, this shows that the shape of the reaction function is as shown in figures 1–6.

For completeness, I show this proposition for the simplest case in which it is assumed that all parameters of the preference functions are the same except that the optimal unemployment rate of the monetary authority is higher than that of the fiscal authority, so that $u^{**} > u^*$. Evaluating the reaction functions in equations A13 and A14 at $S = S^*$, and equating all parameters other than u^* and u^{**} to the fiscal parameters, one finds

$$(A19) \quad S^F = -\mu_r r + \phi^*(u^* + \beta^* \alpha^2 u^+),$$

$$(A20) \quad S = -\mu_r r^M + \phi^*(u^{**} + \beta^* \alpha^2 u^+).$$

Because ϕ^* is a positive constant, the level of the surplus along the monetary reaction function in equation A20 evaluated at the same level of r is higher by the amount $\phi^*[u^{**} - u^*]$. This implies that the monetary bliss point is above the fiscal bliss point as long as the optimal fiscal surplus desired by the monetary authority is higher than the optimal fiscal surplus desired by the fiscal authority. It is conceivable that if the central bank's most preferred fiscal surplus is extremely high the monetary bliss point is above and to the left of the fiscal bliss point. This would indicate that the monetary authority has a lower desired real interest rate than does the fiscal authority. The same argument can be made to show that the reaction functions are as pictured if the two authorities have equal unemployment targets and the fiscal authority has a higher target inflation rate than the monetary authority.

Finally, note that as long as the monetary authority follows a Nash strategy, the monetary reaction function coincides with its aggregate de-

mand line—that is, with that combination of interest rates and fiscal surpluses that would optimize aggregate demand. Put differently, the central bank's fiscal preferences do not affect the central bank's reaction function. This result is easily seen in the monetary reaction function, which contains no parameters that reflect the central bank's preference concerning the fiscal surplus.

Comments and Discussion

Charles L. Schultze: There are three separate, although related, themes in William Nordhaus's challenging and thought-provoking paper. First, Nordhaus demonstrates that under certain behavioral assumptions the fiscal and monetary authorities, acting independently and noncooperatively, will produce an outcome in which both budget deficits and real interest rates are higher than either of the two authorities want. Second, even when U.S. fiscal authorities decide to lower the deficit, the operating rules of the Federal Reserve are so cautious that a substantial amount of transitional unemployment is likely to be created. Nordhaus sees the first noncoordination problem as an important cause of the postwar drift to higher budget deficits and higher interest rates and the second noncoordination problem as a further reason why the political system is so reluctant to correct the resulting skewness in the fiscal-monetary mix. In the final part of the paper, Nordhaus stresses the negative impact on income and consumption that comes from the adverse changes in the terms of trade that accompany the higher saving and lower interest rates. He raises the possibility that under some circumstances the terms of trade effect may be so large that the present value of the consumption stream would be reduced by an increase in national saving. In many ways, this is the most interesting but also the most controversial part of the paper. I will have time for only a few comments on the final part of the Nordhaus paper.

The First Theme

Starting with the first theme, Nordhaus convincingly demonstrates the *possibility* of a noncooperative Nash equilibrium producing a fiscal-monetary mix with higher deficits and interest rates than anybody

wants. But is this what explains the drift toward the skewed fiscal-monetary mix that we have observed in the United States and Europe? I don't think so. As the paper points out, two requirements are necessary to produce the Nordhaus result. First, the fiscal authorities must consistently prefer levels of aggregate demand higher than those preferred by the monetary authority. And second, the fiscal authorities must not believe that the monetary authorities mean business; so they persist in raising the budget deficit above the level they themselves think is optimal in futile efforts to impose their own aggregate demand preferences. If the two authorities have more or less the same preferences about aggregate demand or, even with different preferences, if the fiscal authority maximizes its preferences subject to the realization that the monetary authority will not allow aggregate demand to exceed its own preferences, then the fiscal authority simply picks the deficit it wants on structural grounds and the monetary authority sets the level of short-term interest rates to achieve its own demand preferences. End of story. There is no counterproductive Nash equilibrium.

In recent years, the major shifts toward a policy mix of high budget deficits and high interest rates occurred in the Reagan-Bush years in the United States and the Kohl deficit-financing years of German reunification. From the current and subsequent statements of the main players, the initial 1981 tax and spending policies that first gave rise to the Reagan-era deficits were clearly chosen for *structural* reasons, not as an effort to offset the then prevalent high interest rate policies of Paul Volcker's Federal Reserve. The fiscal authorities got more deficit than their rosy scenarios predicted, but that's not relevant to the point at hand. Later on, during the long recovery from the 1982 recession, as real interest rates were pushed up to historic highs by the Federal Reserve, there were numerous efforts, some that met with small success and some with no success, to *reduce* the budget deficit, but I don't see any evidence of additional fiscal expansion undertaken to counter unwanted demand restriction by the Federal Reserve.

Although Nordhaus does not refer to it, the recent German experience tells much the same story. For political and structural reasons, the Kohl government decided to finance the costs of reunification with East Germany without a tax increase. The Bundesbank reacted to prevent overheating by raising interest rates. But there is nothing in the record to suggest that the deficit was further widened by efforts of the Kohl gov-

ernment to counteract the Bundesbank's demand restraints. In neither of these two recent cases did a significant component of the sharply increased deficits and real interest rates appear to arise from efforts by the fiscal authorities, along the lines of Nordhaus's figure 2, to offset the restrictive policies of the central bank with further doses of fiscal expansion.

There is another scenario, quite similar to that posed by Nordhaus but with slightly different dynamics, that might be invoked to explain the development of the fiscal-monetary mix in the United States during the postwar years *prior* to the Reagan era. In most recessions or early recoveries, the executive branch and Congress either distrusted the Federal Reserve's willingness or did not believe in its ability to stimulate the economy through monetary policy. Expansionary fiscal measures were consequently adopted, allegedly of a temporary nature. Because of political inertia, at least some of the deficit-raising measures became permanent, forcing the Federal Reserve, as recovery proceeded, to raise interest rates to a level higher than at the peak of the prior business cycle. Because of this lack of coordination, or better yet because of this distrust, we ended up with an increasingly undesirable fiscal-monetary policy mix by a ratchet-like procedure. The only problem with this story is that it doesn't quite fit the facts. In the first place, there was no upward drift in real interest rates prior to the 1980s. Second, if one uses as a measure of fiscal looseness the inflation-adjusted high-employment deficit, the small average surplus in the 1950s was indeed converted to a small average deficit in the 1960s and 1970s. But that deficit exhibited only a tiny upward trend until the Reagan era began. In short, there may have been a small, but certainly not a substantial, long-term drift for the worse in the monetary-fiscal policy mix in the years before 1980.

The Second Theme

Nordhaus poses a second type of coordination problem arising not because of any conflict over ultimate aggregate objectives but from the very sluggish and outcomes-oriented operating rules of the Federal Reserve. His view of these rules can be summarized: "Don't fire until you see the whites of their eyes and even then use only rifle bullets and no heavy artillery." As a consequence, when the fiscal authorities do sum up the courage to cut the deficit they are faced with substantial transition losses of output and employment.

Nordhaus proceeds by fitting a very simple equation describing the reaction function of the Federal Reserve and combines it with the DRI model, and several others, including one of his own, to simulate the transition losses presumably following the Clinton deficit-reduction program. These turn out to be quite substantial.

Several caveats are in order about this conclusion. Within the DRI framework that Nordhaus uses, serious questions can be raised about the realism of Nordhaus's reaction function, or any simple linear relationship based on a few variables. The equation that Nordhaus ends up using for his main simulation contains only two independent variables, the NAIRU-adjusted unemployment rate and the inflation rate. The equation is fit from 1955:1 through 1994:2. But that allows for none of the major regime changes that monetary policy has passed through over the years, although his formulation would not capture those changes anyway. The second column of his table 1 shows the result if the equation is fitted to the Volcker-Greenspan era (from 1979 to date). Here the coefficient on the unemployment rate is virtually zero, implying the Federal Reserve no longer reacts to shifts in unemployment. If Nordhaus had used that version in his simulations, the transition losses would undoubtedly have been much larger than he reports.

In fact, what the results in the second column almost surely reflect is the period of the early and mid-1980s when Volcker first ratcheted up interest rates to wring out inflation despite high and rising unemployment. And then starting after a brief respite in late 1982, the Federal Reserve began to *anticipate* the potential consequences of the surging budget deficits and the falling national saving rate by pushing up real interest rates to historically unprecedented levels very early in the fledgling recovery when unemployment was still exceedingly high. It did not wait for higher inflation to appear before acting. Starting in May 1983, with unemployment still at 10 percent and inflation substantially reduced, the Federal Reserve pushed up the federal-funds rate over 250 basis points over the next 15 months. In the early 1980s, it *did* set monetary policy on a reasonable forecast of the economic consequences of enacted budgetary legislation.

In a related vein, most recessions prior to the latest one were importantly driven by the actions of a Federal Reserve determined not merely to halt a rise in inflation but to achieve a significant reduction in the level of inflation. As a consequence, the Federal Reserve was in no hurry to bring down the level of real interest rates early in the recession.

The Nordhaus reaction function reflects this history. Even if the Federal Reserve were unwilling to anticipate the transitional consequences of deficit tightening, it is not obvious they would react as slowly to the subsequent rise in unemployment as they did during the early stages of the past recession.

One final point on this subject. Since the Clinton deficit-reduction program was enacted, the short-run performance of the economy could scarcely be improved. Employment gains have accelerated, and most observers think the economy has now reached or closely approached its potential. I find it hard to fault the Federal Reserve up to this point. Yet, if one takes the Nordhaus simulations with their monetary reaction function at face value, one is forced to conclude that the growth of the economy in the absence of deficit reduction would have threatened overheating and a rise in inflation. Ironically, in this view, the only thing that could have rescued us from the excessively easy baseline policy being followed by the Fed was the perfect timing of the administration's contractionary fiscal policy. Ah, you say, but the game isn't over yet. The recent moves to monetary tightness may throw the economy into the kind of unemployment envisaged in the Nordhaus simulation. Possibly true, but if that happens the Federal Reserve clearly will not be blamed for *sluggishness* and an insistence on waiting for outcomes before acting but for an excessive willingness to act in advance on forecasts of inflation and overheating that hadn't yet arrived.

Finally, in Nordhaus's DRI simulations, the reader should be aware that the large size of the losses owing to the absence of policy coordination are partly due to his ambitious definition of coordination—namely, perfect stabilization of the unemployment rate, with the Federal Reserve beginning to act only as the fiscal action goes into effect. Because the lags in the effect of monetary policy are longer than the lags in the effect of changes in defense spending, the Federal Reserve has to proceed in a strong “yo-yo” movement, alternatively lowering and raising the federal-funds rate by large amounts. That is undoubtedly the reason why Nordhaus reports that the DRI model “proved dynamically unstable when the employment rate was targeted,” forcing the use of an approximation by hand. And even then, by early 1995, one of the swings of the yo-yo would have pushed the funds rate 240 basis points below the DRI baseline, which translates into a nominal funds rate of 1.3 percent.

Consequences of Deficit Reduction

As I said earlier, perhaps the most interesting and provocative part of the Nordhaus paper is his estimate of the surprisingly large losses from terms of trade effects and the long delay in reaping the apparently small benefits of an increase in national saving. Nordhaus is correct to emphasize the fact that for a large country like the United States, the payoff to an increase in national saving is likely to be significantly delayed (and possibly reduced, even in the long run) by interactions with the world economy. A substantial fraction of the rise in national saving will initially show up not as an increase in domestic investment but as a rise in net foreign investment. That will reduce the net return from the new saving in one certain way and one possible way. The rise in net foreign investment will certainly require, at least for a while, a reduction in the nation's terms of trade. And if the reduced inflow of foreign capital is modeled primarily as a decrease in the outflow of American fixed income obligations, the real return to the economy will be a good bit smaller than the return to an increase in the stock of domestic capital.

But to evaluate the seriousness of the problem, we need to see what's inside the black box. From Nordhaus's table 2, for example we see that the DRI model, in the coordination case, produces a rise in net exports equal to 54 percent of the gain in total investment (net exports plus total private domestic investment). And in the simulation with the reaction function, the share of net exports in the total is 65 percent. For a ten-year period, both of these seem somewhat high (but probably lie at the upper end of a reasonable range). Another question arises with respect to the assumptions used in the model about the rate of return to changes in net foreign investment. A widely used rule of thumb is that the real return to private business investment is 10 percent. What does the DRI model assume about the marginal return to net foreign investment? If it mainly consists of the return to fixed income obligations, shouldn't we make an adjustment for risk? In his later section on immiserating saving, Nordhaus assumes a 5 percent real return. With an assumed rate of time preference also equal to 5 percent, it doesn't take much of a terms of trade loss to make deficit reduction a losing proposition. But is 5 percent the right rate to use? We also know that the terms of trade losses will eventually be converted to gains, as the inflow of income from abroad rises; the time path of that process is also critical. What are the DRI as-

sumptions? Many of the same kind of questions arise in interpreting Nordhaus's longer-term simulations using MULTIMOD and McKibbin-Sachs models.

To the extent that Nordhaus's pessimistic evaluations are correct, it carries the implication that the country would have gained by staying on the old deficit path. Yet, figure 13 shows that under the old deficit path the ratio of federal debt to GDP would be increasing steadily (by about 0.16 decade coming). Thus, the gain from running higher deficits would ultimately have been unsustainable. The meaning of immiserating saving ought to be interpreted in that light.

Finally, if the Nordhaus-DRI conclusions are essentially correct, one is led to the proposition that it would make eminent good sense: (i) to use investment tax credits or other devices to channel most of the increased national saving resulting from deficit reduction into domestic business investment; and (ii) to increase public investments wherever hard analysis (rather than wishful thinking) shows the payoffs to be substantial. We would thereby not only increase the rate of return to society but avoid some of the terms of trade losses.

Stanley Fischer: Traditionally, William Nordhaus identifies the brand or vintage of any paper that he discusses. Anticipating this paper, one could have expected an early technical Nordhaus, the 1969 vintage, or a 1975 nuclear Nordhaus of backstop technologies, or a whimsical modern Nordhaus of the history of light, or even a cheerful 1994 Nordhaus of the joys of global warming.

However, what we have here is a well-written, extremely thorough, 1975 Nordhaus, "The Post-Game Theory Prerational Expectations Macro Vintage," on the surprising benefits of fiscal and monetary policy coordination. The basic argument is that many countries are now locked in their high budget deficit impasses because the fiscal authority is unable to count on sufficiently rapid help from the monetary authority—in the form of a timely easing of monetary policy to prevent a recession—if it decides to cut the deficit. This is a highly implausible argument.

The Argument

There is nothing wrong with the basic theorem. The proof that coordination is better is straightforward. There is a monetary authority and a

fiscal authority. Each has its own tastes. The monetary authority is more averse to inflation than is the fiscal authority. The fiscal authority is directly concerned about the budget surplus, but the budget surplus does not itself enter the loss function of the monetary authority (the Federal Reserve).

This is a useful assumption that together with other assumptions in the model implies that the Federal Reserve's reaction function determines the level of aggregate demand. Because tastes differ, the Nash equilibrium produces a bad outcome with a higher real interest rate and a bigger budget deficit than is needed. As Nordhaus explains, the fiscal authority attempts to lower unemployment by raising the deficit (in any case, the fiscal authority prefers higher deficits) while the monetary authority raises interest rates to fight the resultant inflation.

Nordhaus adduces the well-known negative relationship between inflation and central-bank independence in support of the basic model. But if the Nordhaus model described reality, central-bank independence would also be associated with higher unemployment, an implication that is not clearly evident in the data.¹ Nordhaus argues that we would expect very little impact of independence on unemployment even in his model because the unemployment rate, on average, will be close to the natural rate. But if that is the case, then surely the policy game should be multiperiod and not one-shot.

Going beyond the basic argument summarized in figures 1 and 2, Nordhaus allows for lags in the effects of policy and assumes that the Federal Reserve will change policy only after the fiscal authority has acted. Then a fiscal contraction may indeed lead to a large loss of output, because given the lags in the effects of monetary policy it takes time to return the economy to full employment.

The empirical importance of the output loss identified by the theory cannot be measured *ex ante*. To assess the validity of the model, Nordhaus runs vector autoregressions that enable him to argue that monetary policy has not in the past reacted to anticipated fiscal policy, that the federal-funds rate reacts slowly to inflation and unemployment, and that fiscal policy has been essentially exogenous.

In addition, he uses three structural models to examine the potential effects of policy coordination. It is good to see structural models coming

1. The evidence on this issue is not clearcut because the natural unemployment rate in many European countries has been rising over the past 30 years.

back. It is hard to know how to do policy analysis without them, but the paper also reveals some of the problems with these models, namely, that the economic mechanisms in them are not transparent and that in these cases the lags of policy seem to be extraordinarily long. I was also struck by the fact that the fiscal multiplier that Nordhaus assumes is very large—namely, two in his own (estimated-calibrated) model.

The results of the empirical work are summarized in figures 8–15. Figure 14 makes Nordhaus's point most clearly. With coordinated policies—in which monetary policy becomes expansionary in time to prevent the fiscal contraction from reducing output—there is a cumulative consumption increase (in the DRI model), compared with a cumulative consumption loss when policy is not coordinated.

Evaluation

How seriously should we take these results? At the theoretical level, there are three key questions: first, what would happen if expectations were rational; second, what happens in a multiperiod game; third, what would happen if more forward-looking elements were included in the analysis?²

On the first question, the issue is not really rational expectations but whether there is a short-run Phillips curve trade-off. There is, and the real issue then becomes whether that trade-off is sufficiently slow to give this analysis any validity. I believe the answer is yes, that in individual episodes whether monetary policy accommodates a fiscal contraction does have real effects. Second, in the multiperiod version of the game, there would be much more attention to the cumulative effects of fiscal expansion on inflation.

It is the absence of forward-looking elements in the model that must influence the results most heavily. One does not have to go all the way to Ricardian equivalence to recognize that consumers and investors are aware of the government budget constraint and that a policy decision that resolves uncertainty by putting fiscal policy back on a sustainable

2. The model also lacks an intertemporal budget constraint. If the interest rate exceeds the growth rate, then the transversality condition implies that a deficit has to be dealt with at some time, an element that is missing from the model. However, it would still be best dealt with if a monetary expansion offsets the fiscal contraction, no matter when the fiscal contraction takes place.

path may have very different implications for consumption and investment than the Keynesian models in this paper.

Francesco Giavazzi and Marco Pagano have studied two big fiscal contractions in Europe that led to demand expansions.³ These fiscal contractions took place in small countries, Ireland and Denmark. They led to demand expansions mainly because they increased consumption, presumably because individuals were relieved of the uncertainty of not knowing how they would be taxed to pay for the deficits in future.

However, the biggest problem I have in assessing the relevance of the Nordhaus results is in judging whether the monetary and fiscal authorities are on the contract curve. Here is Federal Reserve Chairman Alan Greenspan testifying to the Joint Economic Committee of the Congress in 1990, when the Bush tax increase was being debated:

The participants in the budget summit are endeavoring to craft a package of sizable deficit reductions. If they succeed and the Congress does enact a credible, long term, enforceable budget agreement, I would expect long term interest rates to decline.⁴

In that context, I would presume that the Federal Reserve would move toward ease to accommodate those changes in the capital markets. What adjustment might be necessary, and how it might be timed, cannot be spelled out before the fact. The actions required will depend on current economic conditions, the nature and magnitude of the fiscal package, and the likely timing of its effects.

What is going on here? According to the Nordhaus view, this is the monetary authority's reaction function, and the chairman is testifying in a way that will take the economy to the Nash equilibrium. More plausibly, I believe, this should be interpreted as a negotiation between two groups, Congress and the Federal Reserve, that are trying to reach a point on the contract curve. Of course, Nordhaus might say that Greenspan's statement that the Federal Reserve's actions cannot be spelled out in advance only proves the validity of the model's assumption that there are substantial lags in the response of monetary policy to fiscal contraction. The other view is that those statements are just part of the bargaining.

Surely in 1993, the Federal Reserve and the administration did it about right. Or so any reader of *The Agenda*⁵ would have to think. I thus

3. Giavazzi and Pagano (1990).

4. U.S. Joint Economic Committee (1991).

5. Woodward (1994).

do not understand why Nordhaus chooses the Clinton tax increase as an example in his favor. If the argument supports his view, it would be because that was a case of cooperation that illustrates how well policy can work when it is coordinated.

Of course, one could argue that there are such long lags in the monetary policy process that the Federal Reserve should have moved sooner. But it took a good long while for the tax package to work its way to Congress and longer yet to come into effect. So at least in this case the lags were not important.

Concluding Comments

Let me conclude with three comments. One relates to the significance of administration (and congressional) rhetoric in favor of low interest rates. As Nordhaus points out, administrations favor low interest rates. What should we make of that? That seems to be nothing more than a statement of *ceteris paribus* preferences, precisely along the lines of the administration preference function in the Nordhaus model. There is no good political reason for an administration to express a preference for higher rather than lower interest rates. That does not imply anything much about whether a clever politician in the White House might prefer higher rates now, which will prolong the recovery, to lower rates, which will result in a recession just before the next election.

Second, is it really the absence of the assurance of supporting monetary policy that is keeping deficits high around the world? Or is it rather the direct political pain that results from raising taxes and cutting spending? The outcome of the 1993 fiscal-monetary maneuver, which had entirely favorable economic effects and no discernible political benefits, suggests that fiscal adjustment per se is what keeps politicians from dealing with the deficit.

Third, would we really want fiscal and monetary policy coordinated by putting them in the same organization? In the United States that means that either Congress or the Treasury would take responsibility for monetary policy. Neither prospect is pleasing, even though Milton Friedman has on occasion argued that the Treasury should take over monetary policy so that the responsibility will be clearly placed with the administration. The evidence in favor of central-bank independence is powerful and is not addressed in this interesting paper.

But perhaps the paper is making a more limited point only, that fiscal consolidation is usually contractionary and that, if it is, adverse output effects can be reduced by monetary easing. That does not take formal coordination, and it has been observed in the United States in recent history. So perhaps with intelligent central bankers one can have the benefits of both central-bank independence and the degree of coordination this paper advises.

General Discussion

Several participants discussed the fiscal and monetary reaction functions in the Nordhaus model. Robert Gordon asked whether the different policy prescriptions of the executive and the Federal Reserve came because the natural rate of unemployment is estimated differently or because one of them rejects the natural rate hypothesis altogether. He inquired why the party in error would not learn from the observed evolution of inflation, so that the policy prescriptions of the two parties would converge over time. William Nordhaus believed that the differences are not about estimates of the natural rate. Rather, they are about performance over time horizons where policy can affect outcomes. He observed that these differences can easily be seen in historical accounts of public disagreements between the government and the Fed and noted that the executive especially cares how well the economy is doing at the time of elections. Charles Schultze reemphasized that even if the fiscal authority and the Fed differ over the desired level of aggregate demand, the bad equilibrium obtains only if the government believes that it can change aggregate demand by fighting the Fed. He observed that politicians may grumble, but they do not embark on fiscal expansions to offset high interest rates. Nordhaus agreed with Schultze's analytical point, but pointed out that Schultze's equilibrium is not on the contract curve and remains inefficient.

Several discussants took issue with the position that the Fed is forward looking rather than merely focused on results already in hand. Benjamin Friedman suggested that, following an OPEC oil price hike, the Fed would not wait to see its effects on the economy before taking action. He added that the issue of looking forward is distinct from the

coordination issue. For example, if the Fed is forward looking it will respond to fiscal policy changes, but this does not necessarily imply policy coordination. Daniel Sichel observed that the Fed devotes substantial resources to forecasting and would certainly characterize itself as forward looking. Moreover, recent Fed actions—such as its reaction to the 1987 stock market crash and the 1994 increase of interest rates—indicate that it is willing to act before it sees adverse movements in unemployment or inflation. Sichel also cautioned that Nordhaus's estimates of the Fed's responsiveness might be biased because the Fed's actual reaction function is not easily modeled. Instead of responding marginally to each change in the economy, the Fed typically acts when a key variable—like inflation—crosses a threshold, which itself changes over time.

Nordhaus offered two responses. First, the Fed might desire to be forward looking, but the question is whether it can actually act that way with all the bureaucratic and political constraints. For example, Chairman Greenspan implied that the Fed could not comment ahead of time on how it would react to the 1990 budget accord. More generally, Nordhaus argued that when it comes to offsetting changes in fiscal policy the Fed does “too little too late” to be considered forward looking. Second, estimates of the Fed's reaction function show long lags of unemployment and inflation, Schultze's comment notwithstanding. Nordhaus acknowledged that there might be biases in estimates of reaction functions, but table 1 shows that lags are long for all specifications and are even longer in VAR estimates.

The discussion turned to the role of exchange rate changes in producing immiserizing saving, which Gregory Mankiw related to optimal tariff analysis. Under certain circumstances, a tariff can be an optimal policy in a large open economy because it can improve the terms of trade by shifting the demand curve for foreign goods. Similarly, immiserizing saving arises as purchases of foreign assets increase the supply of dollars on the world market, worsening the terms of trade. This effect could be offset with taxes or capital controls that reduce the demand for foreign assets. Mankiw believed, however, that the negative terms of trade effect of foreign investment is likely to be small, and thus believed the possibility of immiserizing saving has little policy significance.

Friedman reasoned that the overall welfare effect of policies designed to increase potential GNP has to be evaluated over very long time horizons because productivity reacts slowly to investment. Nordhaus

agreed that immiserizing saving is analytically similar to the question of terms of trade tariffs but demurred on Mankiw's quantitative conclusion, arguing that the answer depended on the elasticities and rates of return.

Ralph Bryant highlighted the practical problem for coordination raised by the fact that fiscal policy affects the economy faster than monetary policy. He suggested that fiscal actions have their biggest effects in the initial quarters, while the mean lag of the effects of a monetary action is 12 to 15 months. Even if the Fed responds immediately, it will not be able to offset the short-run effects of a fiscal contraction. Gordon did not find this timing problem important for long-run analysis, since short-run contractions would be quickly reversed. However, Barry Bosworth noted that these short-run contractions are recessions to the public and politicians and that avoiding them was an important issue in the fiscal-monetary game that Nordhaus modeled.

Bosworth questioned the use of the 1993 budget episode as an example of a fiscal-monetary game. He reasoned that much of the monetary stimulus offsetting the fiscal contraction did not reflect explicit Fed action, but rather came from a drop in long-term interest rates as private actors adjusted their expectations of the deficit. Although monetary action through 1992 helped to offset the subsequent fiscal contraction, these earlier cuts in interest rates were a response to a recession rather than to future fiscal constraint.

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