The Policy Tango: Toward a Holistic View of Monetary and Fiscal Effects

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*T*he macroeconomic policy debates now taking place in many industrial nations focus on what mix of monetary and fiscal policies they should adopt. To pull Japan out of its worst recession since the mid-1970s, Japanese policymakers have coupled a fiscal policy that includes higher spending on public works projects with a monetary policy that has substantially lowered short-term interest rates. The European Community has been concerned for many years about wide fluctuations in its exchange rates and about high inflation rates brought on by persistently large government budget deficits. To address these problems, European countries are considering thoroughgoing macroeconomic policy reform that is scheduled to culminate in a European Monetary Union with a single currency whose supply will be controlled by a European central bank. Along with monetary union come limitations on the size of government deficits and the level of government debt the countries can have. Here in the United States, the Clinton administration has initiated what is certain to be an ongoing debate about how to reduce the federal deficit to pay off the threefold increase in federal government debt accumulated over the past decade. To avoid having the deficit reduction endanger the economy's slow recovery from the 1991 recession, the administration has called on the Federal Reserve to expand the money supply to keep short-term interest rates low.[1]

The circumstances surrounding each of these situations differ, of course. Japan's countercyclical policies, although aggressive, are responding to a temporary decline in its economy and do not imply basic changes in how policy is conducted. Europe's plans are more ambitious, involving adopting an entirely new policy environment in which individual countries sacrifice independent control over monetary policy while they retain control over spending and tax policies. The United States, like Japan, is not developing new policy institutions. American changes are larger than Japan's, however, and are not primarily a response to cyclical economic conditions.

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mate connection between monetary and fiscal policy and that each policy must be analyzed and chosen with the other in mind to produce coherent macropolicy. As this article explains, the relationship between policies stems from private behavior. People will purchase government bonds—thereby lending the government money—only if they are assured that the debt will be paid off eventually. Monetary and fiscal policy are therefore forced to act cooperatively to ensure the government's solvency; changes in one policy cannot help but elicit the changes in the other. It is crucial that this interplay be taken into account in economic policy decisions.

But there is a rub: Policy institutions in many countries are not designed to cooperate formally in selecting the two policies. Instead, distinct policy authorities, having only vague or nonexistent formal connections to each other, separately pick the two policies, and often no institutional mechanism exists to ensure that they will be chosen with any consistency. History is replete with examples in which

economic forces have been out of tune with institutional arrangements.

The lack of harmony between economic forces and policy institutions is not a political accident but arises consciously from a desire to achieve economic checks and balances. Political leaders recognize that when private and government debt are high, public sentiment creates strong incentives to generate inflation that will devalue the debt and transfer wealth from creditors to borrowers. Monetary policy can thus be a powerful, indirect tool for altering the distribution of wealth in the economy. Fiscal policy redistributes wealth directly by changing taxes, subsidies, and government purchases.

Countries have instituted various institutional schemes to balance the redistributive powers of macropolicy. The U.S. Congress deemed it wise to check using inflation to devalue debt by lodging monetary power with an independent Federal Reserve while retaining fiscal authority. New Zealand carries monetary independence further: its central bank governor is handed a mandate to achieve a precise inflation target and is free to pursue any policy necessary to achieve it, but a governor who fails to hit the target can be removed from office. Under the agreements for European Monetary Union, governments that wish to join the union must give their central banks and the planned European central bank independence from elected officials. Britain, France, and Japan are currently examples of less clear divisions of monetary and fiscal powers, with monetary policy residing with a finance ministry controlled by the ruling political party. From each institutional arrangement emerges a mix of policies, which is a balance of the opposing economic and political forces at play. This article focuses on the resulting mix of policies, regardless of how a country's macroeconomic balance of power is achieved. Whatever the institutional details of its balance, a country has distinct monetary and fiscal instruments at its disposal, and private behavior restricts the ways these instruments can be set.

The dichotomous nature of the processes for determining policy in various countries is reflected in the way economic research proceeds. Even though in boardrooms and briefing rooms monetary and fiscal policies may be regularly discussed in tandem, in classrooms and seminar rooms they are frequently presented in isolation. Economic researchers trained in that environment tend to analyze the behavior of one policy authority at a time, leaving that of the other unspecified. The larger significance of this tradition is that it has led to a set of widely held beliefs about the effects

of monetary and fiscal changes—beliefs that underlie many actual policy decisions.

Abandoning the usual approach of studying one policy in isolation, this article considers monetary and fiscal policy jointly. The systematic approach used reveals that the traditional beliefs about policy effects, based as they are on analyses that change one policy at a time, embody implicit assumptions about how the two policy authorities interact. When the implicit assumptions hold, the traditional beliefs are true. However, under different, equally plausible assumptions, the traditional beliefs can be false. Systematic analyses lay bare the implicit assumptions and make it possible for policymakers to evaluate which assumptions are likely to be valid when actual policy decisions are being made.

A holistic view, accounting for all the policy interactions and analyzing their effects, leaves behind simple textbook descriptions of monetary and fiscal policy. Some surprising economic insights surface, and these new understandings can entail relinquishing long-cherished beliefs that, for example, "If the Fed expands the money supply, inflation will pick up" or "When Congress increases taxes, the economy will grow more slowly." Such sweeping generalizations have evolved from analyses that contemplate changing one policy instrument and not the other. But it is not that simple. In reality, policies cannot avoid interacting, and when they do, the effects of monetary expansions depend on tax policy and the impacts of tax increases hinge on monetary policy. Analyzing one policy at a time is like dancing a tango solo: it is a lot easier, but it is incomplete and ultimately unfulfilling.

Current Debates about Monetary and Fiscal Policy

Current policy debates can be couched in terms of the tango that monetary and fiscal policy must dance to ensure that the government remains solvent in the long run. Actual policy choices typically interact in the short run as well, of course, but over short horizons monetary and fiscal instruments can be adjusted independently. For example, when Japanese monetary and fiscal policymakers recently lowered interest rates and raised government spending to spur aggregate demand, they altered the short-run but not the long-run interactions between policies. European and American policy debates are less straightforward, as they involve

both short- and long-run considerations. To understand these debates, it is necessary to explore how private sector behavior constrains policy choices in the long run.

Although it is possible to choose short-term policies separately, in the long run it may be infeasible to do so. Monetary and fiscal policies are inextricably linked in the long term because the current net worth of the government, as for private individuals and businesses, equals its expected future income minus expenditures. This long-run accounting identity connects the real (inflation-adjusted) value of debt owed by the government and held by the public to future tax revenues and government spending.[2] Because it relates debt today to fiscal choices in the future, the identity is called the "intertemporal budget constraint."

Unlike individuals and businesses, however, the government has two sources of revenues. It can raise funds directly through, for example, personal or corporate taxes or indirectly by printing new money and using it to buy government bonds. The new money can also generate unanticipated inflation, which decreases the government's liabilities by making dollar-denominated debt worth less in real terms. In other words, monetary policy, fiscal policy, or a mix of both can raise the revenues needed to make the long-run identity hold. And when one policy is changed and that change causes the budget identity to be violated, the other policy must change to make the identity hold. For this reason, monetary and fiscal policy necessarily interact.

How the two interact determines how the revenues are raised. Specifically, the policies must interact in ways ensuring that whenever real debt increases, sufficiently higher revenues or lower expenditures will occur some time in the future. Such long-run interactions guarantee debtholders that the government bonds they buy will pay interest in the future.[3] If the policies in place do not assure debtholders that they will receive their interest payments, the private sector will refuse to buy government debt. This guarantee can be met by lots of different schemes for raising revenues, each of which affects private behavior and, therefore, the economy differently. It is the way in which policies interact in the long run to raise the revenues to pay off debt that determines how easier monetary policy or higher taxes affect the economy.

If John Maynard Keynes's epigram that "this *long run* is a misleading guide to current affairs. *In the long run* we are all dead" (1924, 88, emphasis in original) is correct, how can the government's intertemporal budget be relevant for actual policy analysis? To be sure, the condition that revenues or expenditures must

change "some time in the future" imposes very weak restrictions on policy behavior.[4] Recent research has found, however, that combining the concept of an intertemporal budget identity with common assumptions about how one policy authority behaves can impose restrictions on how the other policy authority must behave.[5] Moreover, this research suggests that analyses failing to account for the inherent interactions of monetary and fiscal policies can yield misleading beliefs about policy effects.

European Monetary Union. Recognizing how monetary and fiscal policies are related to each other provides a new perspective on Europe's drive toward a monetary union. Once countries have unified their

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monetary systems, they are compelled to give up individual control of their monetary policy in favor of European-wide monetary policy. The stated objective is to force "acceptance of monetary discipline and therefore renunciation of debt monetization" (Commission of the European Communities 1990, 100). Because countries can no longer individually adjust monetary policy, EMU effectively commits the fiscal authorities to respond to shocks that increase the real value of government debt by raising direct taxes or lowering expenditures. And, as discussed above, private individuals will agree to purchase the incremental increases in debt only if the fiscal authorities have persuaded them that the requisite changes in fiscal policy will be forthcoming. Adopting appropriate fiscal policies, therefore, is crucial to the success of monetary union. This scenario exemplifies how, even though a country's accounting identity holds over an infinite horizon, the identity will impose practical restrictions on the kinds of fiscal policies a government can adopt.[6]

The European Community seeks to establish a policy environment that, from the perspective of individual countries, is similar to that in America before 1933. Until President Franklin D. Roosevelt "liberated fiscal policy"—to use Herbert Stein's (1969) phrase—American monetary policy was inflexibly dominated by external forces, compelling fiscal policy to balance the government's budget on its own. Roosevelt's suspension of convertibility of dollars into gold and the passage of the Emergency Banking Act of 1933 freed up monetary policy to help with budget balancing so that fiscal policy could stimulate the economy with deficit spending. Of course, Europe's primary objective differs from Roosevelt's: Europeans want to reign in inflation, and Roosevelt wanted to fight deflation. Nonetheless, Roosevelt's actions played a large role in shaping the American macropolicy environment today.

The Clinton Plan. The current American situation blends the European objectives for the long run with the Japanese concerns about the short run. In *A Vision of Change for America*, President Clinton's overarching long-run concern is to curtail the growth of federal debt by cutting spending and increasing taxes. The President explicitly calls for monetary policy to support the administration's fiscal changes: "deficit reduction must be . . . coordinated with other Government policies (and with the Federal Reserve's monetary policy) to limit the economic cost." To be specific, he continues, "deficit reduction of under one percent of GDP is manageable, as long as the Federal Reserve cooperates by easing the money supply" (1993, 65, parentheses in original). The president is concerned that lower deficits will tend to depress economic activity unless they are coupled with easier monetary policy. The Fed, therefore, is being asked to expand the money supply to contribute to the administration's long-run goal of raising revenues and to offset the contractionary short-run effects of lower deficits.

American policies over the past decade highlight another, subtler way that the long-run government budget identity can affect the economy in the short run. Throughout the period fiscal policy has been running steady deficits, and the Fed has been reasserting its commitment to stabilize prices, implying little budget relief from monetary policy. This combination of policies, if it were to persist indefinitely, would violate the government's long-run identity: the government would become insolvent. If individuals believe that the government will not default outright on its debt obligations and continue to buy and hold government bonds, they must believe that at some time in the future policy will change to be consistent with the intertemporal identity, and currently they are speculating on how the change will occur. It seems plausible that

this uncertainty about future policy may be making private decisionmakers more cautious and less willing to make long-term investment and saving commitments, contributing to the sluggish economic growth of recent years.

Analyzing macropolicy as a whole, as opposed to studying monetary or fiscal policy separately, helps to understand current policy debates in the United States and abroad. Explicitly looking at fiscal conditions when analyzing monetary policy helps explain both the pressures that have been building on the Fed over the past decade and the rationale underlying Europe's desire to move toward a unified monetary system. The joint analysis of policies also reveals that many traditional beliefs about how one policy tool works hinge critically on implicit assumptions about how the other policy tool will behave—assumptions that may not always hold.

Myths about Policy

As noted earlier, academic research typically studies monetary policy independently of fiscal policy, and vice versa. Such analysis in isolation has led to certain beliefs about monetary and fiscal effects. These beliefs may more accurately be called myths because they are so deeply held and can help to interpret the mysteries of economic data, although they are not literally true. In the discussion that follows, several myths are spelled out and demonstrated to hold true for certain assumptions about policy behavior. Under other assumptions, however, the myths prove to be either false or misleading.

Policy Myth #1: *"Inflation is always and everywhere a monetary phenomenon."* Milton Friedman (1970, 24) penned this famous aphorism when, as the intellectual leader of the monetarist school of thought, he argued that to determine the level of prices and inflation, one need only to look at money and monetary policy. Other macroeconomists, such as John G. Gurley and Edward S. Shaw (1960) and James Tobin (1980), have all along emphasized that total government liabilities—high-powered money plus government debt—influence inflation and the overall economy. The rise of the rational expectations school over the past twenty years, however, has focused attention once again on monetary policy alone: government debt affects the economy only through its effects on high-powered money.[7]

Policy Myth #2: *If the private sector does not perceive expansions in government debt to increase total wealth in the economy, then the choice between debt- or tax-financing of government spending is irrelevant for real and nominal outcomes.* This thesis, attributed to the early nineteenth-century economist David Ricardo (1973), was well in the mainstream of post–World War Two economic thought before Robert J. Barro (1974) formalized it.[8] The idea is that if the private sector discounts its future tax liabilities in the same way that it discounts its future interest receipts, then debtholders recognize that their future interest income will be taken away in taxes. With no change in after-tax future income, an increase in government debt will not generate the increase in private wealth that stimulates consumption. The argument lies at the heart of the debate about "whether deficits matter" and was applied to rationalize the Reagan administration's claim that "theoretical conclusions about [the link between deficits and interest rates] have no universal validity" (U.S. Treasury 1984, 2).

Policy Myth #3: *A monetary policy that pegs the nominal interest rate leaves the price level indeterminate.* This view of Knut Wicksell's (1898) was modernized by Thomas J. Sargent and Neil Wallace (1975) and further explored by Bennett T. McCallum (1981, 1986). A central bank pegs the nominal rate by conducting open market operations to buy or sell whatever quantity of bonds is necessary for supply and demand in the bond market to be equal at the pegged rate. In the money market, the pegged rate implies that the nominal demand for high-powered money completely determines its supply.

Intuitively, a peg permanently fixes the nominal interest rate, which pegs the expected inflation rate through the relation equating the nominal rate to the sum of the expected real rate and expected inflation.[9] Associated with this pegged expected inflation rate is an implied expected future growth rate of high-powered money. Although the fixed nominal rate pins down future money growth and inflation rates, it does not determine the current money stock or price levels: if the demand for real money balances depends on the nominal rate, then the pegged rate determines the ratio of the nominal money stock to the price level, M/P, but M and P are not separately determined. There are infinitely many money stock/price level combinations that equal the quantity of real balances demanded and clear the money market. This result relies on the belief that the price level is determined entirely by the interaction of the supply and demand for money—Policy Myth #1.

This point may seem obscure, but there are some practical implications of the assumption that a monetary policy that pegs the nominal interest rate leaves

the price level indeterminate. First, because the real value of nominal assets depends on the price level, when the price level is not pinned down the distribution of real wealth is not determined either. Second, a literal interpretation of this myth suggests that Fed policy during World War Two, which pegged the nominal rate on government bonds, was a bad idea.[10] Of course, the price level was not indeterminate during this episode, so somehow when the policy was implemented the initial money supply was also determined. Thus there is a concrete policy implication of the myth: to specify policy completely, a pegged rate must be coupled with some mechanism that chooses the current level of high-powered money.[11]

Policy Myth #4: *If government deficits are systematically financed by money creation, deficits should predict growth in high-powered money.* This belief forms the basis for nearly all the empirical work that has sought to determine whether monetary authorities have paid off government debt by printing money. The belief rests on a particular chain of events. Initially, tax cuts are financed by selling debt to the public, and then the monetary authority buys the debt from the public by increasing the growth of high-powered money. In the data this chain shows up as a tendency for increases in deficits to be followed by more rapid money growth.[12]

Each of these four myths may be true or false, depending on how monetary and fiscal policy behave. But before the implications of policy interactions can be explored, it is crucial to understand the rudiments of the government's budget.

The Economic Force of the Government's Budget Identity

Economists have long recognized that government policy choices must satisfy a budget identity (for example, Bent Hansen 1958 and Don Patinkin 1965). David J. Ott and Attiat Ott (1965) and Carl F. Christ (1968) found that traditional beliefs about policy effects in Keynesian models changed dramatically once the models incorporated an explicit government budget. This early work assumed that private behavior depended only on current and past economic conditions so that expected future policy actions and, therefore, the government's intertemporal identity did not affect private decisions.

Recent research treats the private sector as making optimal choices in a dynamic and uncertain economic setting. In this environment, rational individuals make economic decisions by weighing the benefits of consuming today against those of consuming in the future. When the future is uncertain, they must forecast economic variables like inflation and taxes to evaluate whether they are better off consuming or saving today. In addition, rational consumers will save by purchasing government debt only if they believe the policy authorities will honor the debt obligations. Rational private behavior therefore forces monetary and fiscal authorities to adopt policies that are consistent with the intertemporal identity. Several authors have used the intertemporal constraint to derive theoretical results (Sargent and Wallace 1981; S. Rao Aiyagari and Mark Gertler 1985), and others have applied these insights to explain historical episodes of high inflation (Sargent 1982, 1986; Preston J. Miller 1983; Rudiger Dornbusch, Federico Sturzenegger, and Holger Wolf 1990).

The simplest form of the government's budget identity arises in an economy with no high-powered money. Suppose the government has a fixed level of expenditures, $\bar{g}$, each period and pays for them with direct taxes, τ, and one-period nominal debt, B. The choices of taxes and debt must satisfy the condition that current income (tax revenues plus borrowing) equals current outgo (spending plus debt servicing):

$$\tau + \frac{B}{P} = \bar{g} + \frac{R_{-1}B_{-1}}{P}. \qquad (1)$$

B_{-1} is the nominal value of one-period debt sold to the public last period, and R_{-1} is the gross nominal interest rate on that debt. P is the general price level, defined as the rate of exchange between goods and units of debt.

This is a dynamic equation that describes how real debt, B/P, evolves over time. Suppose that the ex post (realized) net real rate of return on government debt is constant at $\bar{\rho}$. Then $1 + \bar{\rho} = RP/P_{+1}$, where P_{+1} is next period's price level, and the budget identity can be rewritten as

$$\frac{B}{P} - \frac{B_{-1}}{P_{-1}} = \bar{g} - \tau + \bar{\rho}\frac{B_{-1}}{P_{-1}}. \qquad (2)$$

This equation says that the change in real debt from one period to the next equals the deficit net of interest payments, $\bar{g} - \tau$, plus the interest payments on debt sold earlier, $\bar{\rho}B_{-1}/P_{-1}$. If $\bar{\rho}$ is .02 and the net of interest deficit is zero, then the level of debt grows by 2 percent each period. Starting from an initial level of real debt of, say, 5, debt explodes as depicted by the thinner line in Chart 1. For comparison, the thicker line in the chart shows the level of real American federal debt held by the private sector from 1970

to 1992 as a percentage of real gross domestic product (GDP).[13] Of course, if policy makes real debt explode, individuals know that the government will not be able to repay its debt, they will refuse to lend to the government, and debt will have no value.

To persuade people to buy debt, the government must sell debt backed by resources that can be used to pay off the debt. For example, the government could promise that for every dollar of debt sold, future taxes will rise to cover the interest payments on the debt. This backing of debt leads to the government's intertemporal budget identity, which equates the real value of debt to the sum of all future surpluses net of interest payments, discounted by the appropriate real interest rate factor:

$$\frac{B}{P} = \frac{\tau_{+1} - \bar{g}}{1 + \bar{\rho}} + \frac{\tau_{+2} - \bar{g}}{(1 + \bar{\rho})^2} + \frac{\tau_{+3} - \bar{g}}{(1 + \bar{\rho})^3} + \ldots \quad (3)$$

or $\frac{B}{P}$ = discounted value of all future direct taxes minus spending.

The products of the $\bar{\rho}$'s that appear in the denominators serve as the rates at which future surpluses are discounted. In this relationship only three things can change over time: today's nominal debt, today's price level, and future direct taxes. When taxes are cut and financed by selling debt today, either future taxes or current prices must change for the identity to hold.

With a couple of auxiliary assumptions about the economy, the relationship in (3) can be used to comment on the first two policy myths. Assume that (a) capital markets are perfect in the sense that individuals and the government discount the future at the same rate and (b) fluctuations in tax policy do not systematically affect the ex post real rate of return on debt. Although unrealistic, these assumptions are common to theoretical discussions and serve as a useful benchmark. These assumptions also ensure that increases in government debt do not increase private wealth once future tax liabilities are netted out.

Now consider two tax policies that have precedents in American history. For most of its history, America has financed large increases in government debt by subsequently raising taxes. For example, when B increased to pay for the Revolutionary War, Secretary of the Treasury Alexander Hamilton insisted that τ rise in the late 1700s and early 1800s to pay off the debt. If future τ's rise by enough to equal the increase in nominal debt, the two sides of equation (3) can remain equal without any change in prices. Consequently, inflation is not a fiscal phenomenon, and the exchange of debt- for tax-financing of spending has no real or nominal effects; Policy Myths #1 and #2 hold, respectively.

However, the truth of these myths relies on the assumption that debt expansions are followed by sufficiently higher direct taxes. Suppose instead that a fiscal situation closer to that of the 1980s was believed to prevail indefinitely, where there was strong political sentiment against raising taxes, making future taxes independent of the current level of government debt. Then the right side of expression (3) is fixed, which fixes the real value of debt today. Now an expansion of nominal debt created by a current deficit must increase the price level to keep the level of real debt constant. Under this assumption on tax policy, the two myths are false. Deficits are inflationary, so it matters how spending is financed.

The simple budget constraint merely illustrates the potential connections between fiscal policy and the price level. Without specifying private and policy behavior more completely, it is impossible to explain how fiscal policy is transmitted through the economy and to conclude whether fiscal policy is causing prices to change, or vice versa. Without high-powered money and monetary policy specified, it is awkward to describe how monetary and fiscal policy interact and what assumptions are implicitly being made about both policies in the above examples. These tasks require that more economic structure be built into the analysis.

Chart 1
Real Debt: Actual American and Artificial Explosive

Debt as a
Percentage of GDP
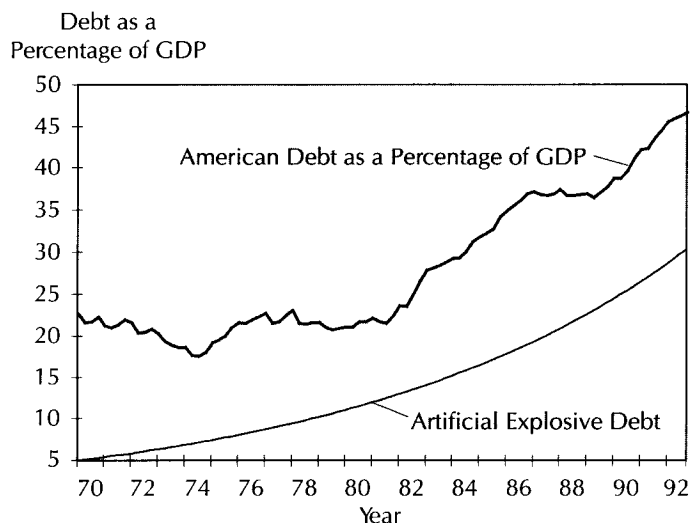
Source: U.S. Department of the Treasury, U.S. Department of Commerce, author's calculations.

Building More Economic Structure

This section describes an economic model that provides a holistic framework for studying monetary and fiscal policy. Within this framework the four policy myths can be systematically evaluated to reveal the implicit assumptions about policy behavior underlying traditional beliefs about policy effects. When different but equally reasonable assumptions are made, the myths are no longer true. Although it may seem complex, this model is the simplest possible explicit description of private and policy behavior that uncovers the hidden assumptions and produces predictions of the effects of policy changes on output, prices, and interest rates.

The model combines assumptions (a) and (b) and their implication that government debt is not net wealth to the private sector with descriptions of how the private sector and the policy authorities make decisions. (A more formal description of the model appears in the appendix.) Although much of private behavior can be derived from a model which assumes that individuals live forever and behave rationally to maximize their well-being, government behavior is characterized by simple ad hoc rules. Because the policy rules encompass a wide range of monetary and fiscal behavior, they can be used to evaluate many of the hypothesized behaviors that arise in policy discussions.

The model economy is buffeted by exogenous (external) shocks that randomly change the economy's productivity, consumers' preferences, and policy choices. Individuals make decisions today, aware of how the decisions will affect their well-being in the future. To make good decisions in an environment where the future is uncertain, they need to forecast future economic variables such as inflation, government spending, and taxes. In the model these forecasts are made "rationally," meaning that individuals use all available information on how the economy works and how policy authorities behave, so the model contains explicit assumptions about private and policy behavior. Consumers are assumed to understand this behavior and, when they make decisions today, they know the values of all current and past variables.

How the Private Sector Behaves. The model abstracts from many real-world complications. For example, to explore how monetary and fiscal policy must interact to satisfy the intertemporal budget identity and determine the price level, it is possible to abstract from international considerations, investment decisions that affect the capital stock, and the existence of many kinds of financial assets. The model also assumes that the economy does not grow in the long run. Long-run growth could easily be incorporated into the model without changing any of the model's implications, as long as it is assumed that government policy decisions do not affect the long-run growth rate. (The next section returns to this point.)

In the model, the production of goods depends in a simple way on other economic conditions. People work to earn wages that can be used to buy goods for consumption today or to buy nominal assets, which are redeemed to buy goods that will be consumed in the future. Production in the model is driven by the fact that workers know the dollar amount of their wage earnings but do not know how much their wages will buy. The purchasing power of their dollar earnings depends on the overall level of prices. Workers do not know the overall price level when they are paid, however, so they try to predict it using whatever information is available. When overall prices rise faster than workers predict and nominal wages keep pace, workers think the purchasing power of their wages is rising. A higher perceived real wage induces workers to work longer hours, increasing production. This behavior generates a positive relationship between the aggregate supply of goods and surprise increases in inflation. Production deviates from its natural level whenever inflation is higher or lower than workers anticipate.

The relationship between production and surprise changes in inflation forms an aggregate supply function.[14] Denoting the gross inflation rate by $\pi = P/P_{-1}$ and the expectation of that inflation rate based on information available last period by π^e, the supply curve is

$$y = \lambda_1(\pi - \pi^e) + \epsilon. \qquad (4)$$

When actual inflation equals expected inflation, output is at its natural rate and is unrelated to policy. Because output increases when inflation is unexpectedly high, $\lambda_1 > 0$. Exogenous changes in productivity that shift the supply curve are represented by the temporary random shock ϵ. Negative values of this shock imply that less output can be produced with the same labor input. For example, this summer's floods in the Midwest were a negative productivity shock that reduced crop production, regardless of the quantity of labor employed.

In actual economies, people use some of their wages to buy goods and pay taxes, and they save the rest. In the model, individuals may hold their savings as money, which earns no interest, or as a government bond, which earns the one-period gross nominal interest rate R. People demand money balances, M^d, to buy

consumption goods, c, so this transaction demand rises with consumption. When the nominal interest rate rises it becomes more costly to hold noninterest-bearing money, so people hold more of their savings in the form of bonds and the demand for real balances falls. With money in the model, the price level is now defined as the rate of exchange between goods and units of money. The demand for real balances is written as

$$\frac{M^d}{P} = \delta_1 R + \delta_2 c + \xi, \qquad (5)$$

where the interest elasticity of money demand is negative ($\delta_1 < 0$) and the consumption elasticity is positive ($\delta_2 > 0$). The variable ξ is an exogenous money demand shock, reflecting the possibility that money demand may shift for reasons other than changes in the interest rate or consumption. For example, the introduction of automatic teller machines shifted ξ down because people began to withdraw cash from interest-bearing accounts more frequently, which reduced the aggregate amount of cash demanded at any particular time.

When they make their savings decisions, consumers in this model choose whether to spend an additional dollar on consumption today or to buy a bond that pays R dollars tomorrow. One dollar can buy $1/P$ units of goods today, and R dollars tomorrow can buy R/P_{+1} units of consumption goods. Because consumers are also impatient, they must be compensated for postponing consumption. To reach an equilibrium, consumers will save up to the point at which they are indifferent between consuming today and postponing their consumption until tomorrow. These considerations lead to the well-known Fisher relation:

$$R = r^e_{+1} + \pi^e_{+1}, \qquad (6)$$

which equates the nominal return on a one-period bond to the expected real interest rate, r^e_{+1}, plus the expected inflation rate, π^e_{+1}, over the term of the bond. Because they do not know what shocks will hit the economy between the time they buy bonds and the time they redeem them, consumers must forecast the real interest rate and the inflation rate; the expected terms denote these forecasts. The real interest rate fluctuates with shocks that affect the growth rate of consumption, shocks such as productivity, consumer preferences, and government spending.

The model abstracts from the international sector and investment in physical capital so that all output produced in the country is consumed either by individuals or the government, leading to the national income identity:

$$c + g = y. \qquad (7)$$

One crucial aspect of private behavior remains to be taken into account. When individuals behave rationally to maximize their well-being, real government debt cannot grow "too fast." Essentially, real debt grows too fast when its rate of accumulation exceeds the rate at which individuals discount the future. Because individuals are impatient and would rather consume today than wait to consume tomorrow, a one dollar tax today hurts more than a one dollar tax tomorrow. Suppose that there is no inflation in the economy and that people's impatience implies that they must be paid $1.03 tomorrow to postpone buying and consuming $1.00's worth of goods today but that debt is growing at a 5 percent rate. To balance the budget, future taxes must also rise at a 5 percent rate. This faces individuals with the choice of buying $1.00's worth of goods today or buying $1.00's worth of government bonds today, which pay $1.03 tomorrow but carry with them a tax liability of $1.05 tomorrow. No one will buy the debt when faced with this choice. Consequently, private behavior imposes the restriction that monetary and fiscal policy must prevent debt from growing too fast.

How the Government Behaves. The government buys goods, levies direct taxes, controls high-powered money, and sells and pays off its debt. Debt is sold on the open market and can be bought by individuals or by the monetary authority. To buy debt, the monetary authority conducts an open market purchase, which decreases the amount of debt held by the private sector and increases the quantity of high-powered money in the economy.

Policy actions can affect private behavior directly through a number of channels. Changes in high-powered money that affect the nominal interest rate will alter private holdings of money and bonds, which could affect the price level. When the changes in money are unanticipated, prices will also change unexpectedly, so production and consumption will adjust. Anticipated increases in money growth are factored into savers' expectations of inflation and drive up the nominal interest rate. Fluctuations in government spending will alter consumption and, through the elements in equation (6), real and nominal interest rates. When these changes produce surprise inflation, production also changes.

In the model the analysis makes the common simplifying assumptions that government spending is determined by noneconomic considerations and that it does not contribute to the overall productivity of the economy. Under the first assumption, policy decisions

can change tax revenues but not spending. The assumption that spending is exogenous could be changed without altering any of the important results. The second assumption says that government spending is a net drain on the economy, which is clearly unrealistic. Actual spending contributes to the economy's physical and human capital infrastructure through such programs as highway construction and public education. These programs enhance the productivity of private capital, increasing the economy's long-run growth rate. Although interesting, a full accounting of these considerations is well beyond the scope of this article. Moreover, a realistic model of government spending would not alter the article's theme that monetary and fiscal policy must be consistent with each other in the long run.

Analogous simplifying assumptions are made about the tax structure in the model. Direct taxes do not appear explicitly in the description of private behavior because they are assumed to be "lump sum," which are taxes that do not depend on any characteristic of the individual, such as income or wealth. Of course, actual taxes do depend on an individual's characteristics, and they affect behavior by directly altering incentives to work and save. Lump-sum taxes are an approximation to the actual tax structure, and the assumption allows all of the effects of tax changes to arise from budget-balancing considerations.[15] Depending on how monetary and fiscal policy interact, taxes may nonetheless alter behavior by influencing interest rates, prices, and output. The effects of monetary and tax policy on real variables are temporary; in the long run, these policies do not affect consumption, output, or the real interest rate, although they may permanently change nominal variables.

The introduction of money leads to a modified budget identity that unites monetary and fiscal behavior. Given the exogenous stream of government spending, g, the choices of money and taxes must imply a path of real debt that satisfies the constraint

$$\tau + \frac{B}{P} + \frac{M - M_{-1}}{P} = g + \frac{R_{-1}B_{-1}}{P}. \qquad (8)$$

On the right side of this equation are the sources of government spending: the government buys goods and services (g), and it retires one-period debt and pays interest to service debt ($R_{-1}B_{-1}/P$). The left side of the identity shows that the expenditures are financed by direct taxes (τ), by selling new debt (B/P), and by printing new high-powered money to add to the existing money stock ($[M - M_{-1}]/P$). Revenues generated by printing new money are called "seigniorage" or, more popularly, "inflation taxes." Including money in the budget modifies the intertemporal identity in equation (3) to include future seigniorage terms. Now the real value of debt depends on the discounted stream of future direct taxes plus seigniorage minus expenditures.

There are two ways that policy can stabilize real debt to prevent it from exploding, and both ways involve adjusting revenues. The stabilizing policies become transparent when the budget is written as an explicit relation between real debt in two periods:

$$\frac{B}{P} - \frac{B_{-1}}{P_{-1}} = g - \tau - \frac{M - M_{-1}}{P} + \rho \frac{B_{-1}}{P_{-1}}. \qquad (9)$$

With spending fixed, if either direct taxes or seigniorage depends on the level of real debt or debt servicing in the right way, adjustments in these revenue sources can offset the interest payments that make debt grow too fast. When policy authorities adjust revenues in this way, every increase in real debt coincides with an increase in current or future revenues. Otherwise debt grows too fast. Policy stabilizes debt when revenues— from either direct taxes ("fiscal policy") or inflation taxes ("monetary policy")—rise by at least the increase in interest payments. From the perspective of stabilizing debt, therefore, monetary and fiscal policy are perfectly symmetric. Although the two instruments have different effects on other variables, they have identical effects on the budget.

To complete the description of the economic model, the way in which monetary and tax policies are set needs to be specified. Convenient rules for policy behavior are posited, although many possible rules could achieve the objective of stabilizing real debt. The fiscal authority adjusts direct lump-sum taxes in response to last period's level of real government debt and to output:

$$\tau = \gamma_1 \frac{B_{-1}}{P_{-1}} + \gamma_2 y + \psi. \qquad (10)$$

When γ_1 is large enough, future taxes are increased sufficiently to prevent debt from exploding. Tax policy also contains a countercyclical part that lowers taxes when output falls. The variable ψ is a random shock.

Many discussions of monetary policy pose the monetary authority as following an interest rate policy, implying that the authority adjusts high-powered money so that the nominal interest rate responds to economic conditions. Suppose that policy responds to inflation and output:

$$R = \alpha_1 \pi + \alpha_2 y + \theta. \qquad (11)$$

To offset inflationary pressures, the monetary authority contracts high-powered money to raise the nominal

interest rate when inflation rises. Monetary policy also contains a countercyclical part that expands high-powered money and lowers the interest rate when output is declining. θ is a random shock.

Policy behavior consists of explicit responses to economic conditions and random shocks—the θ and ψ terms. Of course, actual policy behavior is much more complicated than equations (10) and (11) and does not include random components that are unrelated to the economy. These simple rules focus on particular aspects of actual behavior and are not intended to be a complete description of actual policy making. The random terms represent aspects of policy behavior that stem from the complexities of the procedures by which policy choices are made. To avoid modeling the details of exactly what various economic decisionmakers know and how the policy process works, policy is treated as having a random and exogenous part. Private decisionmakers are assumed to know the probability laws governing the randomness, and they use this knowledge to form their forecasts of future interest rates and taxes.

Why Are These Policy Rules Interesting? For a set of ad hoc policy rules to be worth analyzing, they must capture some aspects of actual policy choices. Rules (10) and (11) allow three general features of policy to be analyzed. First, since the private sector is willing to purchase government bonds, policy behavior must assure debtholders that the government will not default on its obligations. Second, most economists do not believe that every level of consumer prices is consistent with underlying economic conditions. Actual policy behavior must be completely specified so that the price level is determined. Third, monetary and fiscal policy regularly respond to short-run declines in output. Whatever objectives policy authorities may have, policy behavior must be consistent with the first two features. Although there are many ways that these features could be embodied in policy rules, equations (10) and (11) do so very simply.

This model can be used to generate values for all the economic variables over time. These economic time series are the equilibria that emerge when private and policy decisionmakers respond in the ways the model posits to the random shocks that hit the model. To understand these behavioral responses, it is necessary to explore how economic decisions are made and the ways in which exogenous shocks produce fluctuations in the model economy. This exploration also helps explain why the source of fiscal financing is important for determining how policy actions affect the model economy.

*E*conomic Fluctuations and Sources of Fiscal Financing

The economic model just presented can be used to conduct long-run and short-run analyses of policy. These two sorts of analyses differ both in the kinds of questions they address and in the ways they imply that the theoretical model should be connected to actual data. Long-run analyses compute the model's "steady state," which occurs when all the variables have settled down to their average, long-run values, assuming that no further shocks hit the model. (The appendix reports the model's steady state.) Occasionally, policy questions concentrate on the long run as in, What will be the steady state growth rates of output and prices if monetary policy permanently increases the growth rate of the money supply from 3 percent to 6 percent? To answer this question, first the model's long-run growth rates are computed under the two assumptions about money growth. Then the model is connected to actual data by finding two economies with money growth rates of 3 percent and 6 percent and checking whether their growth rates of output and prices coincide with the model's predictions.

More often, actual policy questions have a shorter horizon flavor as in the question, How will output and inflation change over the next four years if the monetary authority temporarily lowers the short-term interest rate by 1 percentage point? Now the connection between the model and the actual data focuses on how economic variables fluctuate following a reduction in the interest rate. Long-run averages of the data play no role in this analysis. Of course, because current economic behavior depends on expectations of the future, even a model used to address short-run questions must be consistent with sensible long-term economic behavior. Otherwise, the model is liable to make an untenable prediction such as saying that individuals will buy a bond even if there is no prospect that the bond will ever be paid off.

In the actual economy a wide variety of unanticipated shocks causes economic variables to fluctuate around their long-run average values. Changes in oil prices, extremes in weather, cutbacks in military spending, shifts in consumers' preferences, technological innovations, and changes in tax rates or the money supply are among the shocks that can change incentives influencing the private sector and policy authorities. Economic decisionmakers react to such shifts by altering their behavior, which in turn changes the outcomes for variables like output, interest rates, and prices.

The model is designed to capture how the exogenous shocks induce changes in behavior and generate fluctuations in economic variables.[16]

In this model, the long-run steady state can be cleanly separated from the short-run fluctuations. It is possible for two versions of the model to produce identical long-run average values of the variables even though the versions imply quite different responses of variables to shocks in the short run. Few economists believe that the actual economy can be dichotomized in this way into long and short runs, but this abstrac-

Policy stabilizes debt by raising future revenues—through either direct taxes or inflation taxes—whenever real debt increases.

tion helps to focus the analysis.[17] (If the model's short and long runs were to interact more realistically, the points of this discussion would still hold but would be obscured and harder to understand.)

Because in the context of monetary and fiscal policy the focus is on the ways economic decisionmakers respond to shocks, the model emphasizes how government revenues change following exogenous shocks rather than how deficits are financed on average. The model's two sources of revenues—direct taxes and inflation taxes—affect individual behavior differently, and the economic effects of a shock that incrementally increases the real value of government debt will hinge on how the marginal increase in debt is financed.

Suppose that two models have the same steady state but differ in the source of revenues that adjusts to shocks that raise real debt. When future lump-sum taxes rise—but money creation remains fixed—savers recognize that their future tax liability is independent of their behavior and they cannot avoid paying the taxes. They respond by purchasing and holding the increase in government bonds and using the proceeds from the bonds to pay the increase in lump-sum taxes. Because in this scenario individuals' incentives do not change, their willingness to hold more bonds does not

alter other economic variables. This fact is reflected in the model in that lump-sum taxes do not enter any of the equations describing private sector behavior.[18]

When instead future money creation increases while lump-sum taxes remain fixed, the unanticipated shock does change the incentives facing savers. Individuals know that the higher money growth will increase inflation, making their nominal assets less valuable. They try to avoid paying this (expected) inflation tax by reducing their demand for nominal bonds. To induce them to hold the marginal increase in debt, the nominal interest rate on bonds must rise, in accordance with the Fisher relation in equation (6). The increase in nominal interest rates reduces the demand for real money balances in equation (5), which increases the current price level because the current nominal supply of money is fixed by assumption. Because the shock was unanticipated, all of these changes were unpredictable at the time the shock hit. Consequently, the increase in current prices is a surprise, and output rises in the manner described by the aggregate supply function in (4). As the effects of the shock die out over time, the economy returns to its original position at its long-run steady state.

The fact that the steady states for the two revenue schemes were identical makes it clear that the different economic outcomes arise from different assumptions about how monetary and fiscal policy respond to shocks. The two financing schemes present individuals with different economic margins on which to base their decisions. This argument implies that the average level of inflation tax revenues is irrelevant for determining how the economy responds to shocks. Rather, it is the financing of marginal increases in debt that matters for determining the economy's behavior in the face of exogenous shocks. More concretely, it is possible for the long-run average level of inflation taxation to be zero even when shocks that increase real debt are financed entirely by money creation. Alternatively, an economy with high average inflation rates could be fully financing marginal increases in debt with direct taxes.

One practical implication of this line of reasoning is that a simple summary statistic like the average level of seigniorage in an economy has nothing to do with the role that seigniorage plays in determining economic fluctuations. Nor is such a statistic informative about whether monetary policy has relied importantly on seigniorage when it responds to shocks. A potentially important application of this point is in the debate surrounding European Monetary Union, where the argument has been made that once European countries have sacrificed monetary independence, they will be forced

to rely more heavily on fiscal policy to achieve economic stabilization objectives such as combating recessions. Because recessions are precipitated by exogenous shocks that lower output, the argument involves fiscal policy's response to these shocks, which necessarily centers on marginal sources of fiscal financing. In addressing this issue, however, many researchers have presented statistical evidence about average sources of financing (Vittorio Grilli 1989; Daniel Cohen and Charles Wyplosz 1989; Centre for Economic Policy Research 1991).[19]

In policy rules (10) and (11), the parameters γ_1 and α_1 determine whether policy authorities adjust direct taxes or money creation in response to shocks that change the real value of government bonds. All feasible (γ_1, α_1) combinations imply monetary and tax policies that satisfy the government's intertemporal budget identity. Analysis of these combinations identifies the ways monetary and fiscal policy must behave in order to be consistent with each other in the long run. Different ways of ensuring policy consistency imply different schemes for raising revenues and have different effects on the economy.

*H*ow Policies Must Interact in the Long Run

To balance the intertemporal budget and completely specify policy so that the price level is determined, monetary and fiscal policy together must behave in particular ways. Neither policy authority can accomplish these tasks alone. The policy rules in this model were chosen so that only the sensitivity of the nominal interest rate to inflation (determined by α_1) and the responsiveness of taxes to real debt (set by γ_1) matter for the two tasks. Because in this model monetary and tax policies affect output only through their effects on unanticipated inflation, the countercyclical responses of policy to output (through α_2 and γ_2) play no role in the long-run stability of the economy.

With rules for monetary and tax policy behavior in hand, it is possible to describe the nature of the policy interactions explicitly. For example, if an unanticipated monetary expansion, which is a shock to the random term θ in equation (11), raises inflation and output, its effects will spill over to tax policy. In the short run, a countercyclical tax policy sets the parameter γ_2 in the tax rule (10) so that direct taxes rise when output is high. The monetary expansion lowers real debt in three ways. First, the monetary authority increases high-powered money initially by buying debt

on the open market, which decreases the amount of nominal debt held by the public. Second, the real value of the lower nominal debt gets reduced further by the increase in prices. Finally, the countercyclical tax hike is used to retire debt, further lowering the level of real debt. The effects of the monetary policy shock flow into the long run if fiscal policy responds to the lower real debt by reducing future direct taxes to maintain the budget identity. Analogous interactions can be triggered by a shock to the random part of tax policy—the ψ term in (10).

Table 1 restates the Policy Myths and policy rules and summarizes the implications of different assumptions about policy behavior for the myths. Each choice of the policy parameters—α_1, α_2, γ_1, and γ_2 in the policy rules—corresponds to a different assumption about policy behavior and implies different policy interactions. For the issue of long-term budget balancing, there are four general combinations of γ_1 and α_1 parameters to consider. Two sets of pairs balance the long-run budget and ensure that the price level is determined. One set of combinations specifies policy incompletely, leaving the price level undetermined, and one violates the intertemporal budget restraint.[20]

Policy Combination I: When α_1 is large and positive, the monetary authority contracts high-powered money to make the nominal interest rate rise strongly in response to inflationary pressures. As α_1 increases, monetary policy leans more heavily against inflation and the price level fluctuates less. A strong response of the interest rate to inflation implies that monetary policy ignores the state of government debt, so fiscal policy must ensure that real debt does not grow too fast. The fiscal authority stabilizes debt by choosing a large enough positive value of γ_1. In this case, an increase in real debt portends high enough future direct taxes to satisfy the intertemporal identity.

Believers in Policy Myths #1 and #2 have this combination of monetary and fiscal policies in mind, as Table 1 points out. Because this model incorporates lump-sum taxes, tax changes have no direct effects on behavior. A cut in taxes today increases real debt held by consumers. They use the increased disposable income to buy the newly issued government bonds and the corresponding interest payments to pay off the tax increases in the future. Because the real interest payments exactly equal the amount that taxes rise, everything balances out in the long run and consumers get no net increase in wealth from the tax cut. Output, prices, and interest rates are unchanged. Inflation, therefore, can be entirely a monetary phenomenon only if fiscal policy cooperates by paying for debt increases

Table 1
Policy Myths, Policy Behavior, and Economic Implications

Policy Myth #1: "Inflation is always and everywhere a monetary phenomenon."
Policy Myth #2: If the private sector does not perceive expansions in government debt to increase total wealth in the economy, then the choice between debt- or tax-financing of government spending is irrelevant for real and nominal outcomes.
Policy Myth #3: A monetary policy that pegs the nominal interest rate leaves the price level indeterminate.
Policy Myth #4: If government deficits are systematically financed by money creation, then deficits should predict growth in high-powered money.

Assumptions about Monetary and Fiscal Policy Behavior

Tax Policy

$$\tau = \gamma_1 \frac{B_{-1}}{P_{-1}} + \gamma_2 y + \psi. \tag{10}$$

Monetary Policy

$$R = \alpha_1 \pi + \alpha_2 y + \theta. \tag{11}$$

When γ_1 is large, fiscal policy adjusts the level of direct taxes strongly in response to the level of real government debt, and when α_1 is large, monetary policy adjusts the nominal interest rate sharply in response to inflation.

Economic Implications of Policy Combinations

Policy Combination	Economic Implications
I Nominal rate responds *strongly* to inflation, and direct taxes respond *strongly* to real debt.	**I** Real debt does not grow too fast, and the price level is uniquely determined. Policy Myths #1 and #2 are true.
II Nominal rate responds *weakly* to inflation, and direct taxes respond *weakly* to real debt.	**II** Real debt does not grow too fast, and the price level is uniquely determined. Policy Myths #1, #2, and #3 are false. Myth #4 may be true or false.
III Nominal rate responds *weakly* to inflation, and direct taxes respond *strongly* to real debt.	**III** Real debt does not grow too fast, and the price level is not uniquely determined. Policy Myth #3 is true.
IV Nominal rate responds *strongly* to inflation, and direct taxes respond *weakly* to real debt.	**IV** Real debt explodes so that the government is insolvent, and no equilibrium exists in which government debt has value.
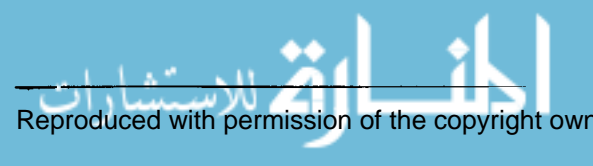
entirely with direct taxes. Far from "irrelevant," fiscal policy is essential.

The relevance of tax policy also shows up in more subtle ways. One way monetary policy controls inflation is to accommodate exogenous shifts in money demand that would otherwise cause prices to fluctuate. These shifts are modeled as changes in ξ in the money demand function, equation (5). The monetary authority accommodates exogenous shifts by contracting the money supply when, for given levels of the interest rate and consumption, people want to hold less money. This policy response prevents the nominal interest rate and prices from changing. Of course, if people suddenly decide to hold less of their savings in money, they must be holding more in bonds, and real debt rises. If tax policy does not raise future direct taxes in turn, debt explodes. These considerations imply that a policy of accommodating money demand shifts is feasible only if fiscal policy cooperates by adjusting direct taxes strongly when real debt changes.

Policy Combination II: There is another way to balance the budget while prices are determined, which is summarized in the table. As shown in the analysis of the simple budget constraint without money in equation (3), if fiscal policy is sufficiently insensitive to the level of real debt, the price level can be determined by expected future net-of-interest surpluses plus seigniorage. Taxes are insensitive to debt when γ_l is small. Now, with fiscal policy ignoring the state of debt, monetary policy must kick in to satisfy the budget identity. If monetary policy balances the budget, then it must make the nominal interest rate respond weakly to inflation (α_1 is small or zero) and give up trying to control inflation. When it gives up targeting inflation, the monetary authority supplies whatever quantities of current and future high-powered money are needed to ensure that the budget is balanced.

This policy combination is the theoretical justification for statistical work that tests whether deficits have been monetized by seeing if deficits predict growth in high-powered money. If the monetary authority raises the nominal rate weakly in response to inflation, the tax cuts are financed by more rapid current and future money growth. Because the money growth is spread over time, deficits will predict money growth and Policy Myth #4 will be true.

The fact that the nominal rate can be insensitive to inflation without leaving the price level indeterminate leads to Policy Myth #3. It turns out that the nominal rate can be pegged independently of economic conditions (α_1 and α_2 set equal to zero), yet the price level will be determined uniquely by fiscal policy, just as it

was in the discussion attending equation (3). Myth #3 is untrue because, even though monetary policy does not determine the current level of money, the current price level depends on future net-of-interest surpluses plus seigniorage when direct taxes are insensitive to debt. The pegged nominal rate, combined with this price level and the demand for real money balances, determines the current money stock.[21] This, of course, is also a situation in which inflation is not entirely a monetary phenomenon and the choice between debt and direct tax financing of spending matters, so Policy Myths #1 and #2 do not hold either. As with policy combination I, it is the interaction of monetary and fiscal policies that makes these results possible. If the fiscal authority refuses to finance debt with future direct taxes, then the monetary authority must prevent debt from exploding by allowing high-powered money to adjust as needed to balance the budget over time.

The possibility of a pegged nominal rate raises difficulties for statistical work. In this case the monetary authority prevents tax shocks from having any effect on the nominal interest rate. If the nominal rate is fixed, the Fisher relation in equation (6) implies that the expected inflation rate is fixed, so future money growth must not be changing. If future direct taxes and future inflation taxes are fixed, the increase in nominal debt must be matched dollar-for-dollar by a contemporaneous increase in high-powered money: deficit shocks are instantaneously monetized. Because the resulting money growth is not spread over time, past deficits will not predict it, and Policy Myth #4 will fail to hold. As mentioned earlier, during World War Two the Fed adopted a policy of pegging the interest rate on Treasury bonds to help finance the war effort. In effect, much of the debt accumulated during the war was monetized instantaneously. Because wage and price controls kept inflation down, the inflationary effect of the monetization was not felt until after the war.

Problems for statistical work are compounded by the recognition that news about tax changes typically arrives long before the legislated changes actually affect people's take-home pay. Anticipated future tax changes alter people's current savings decisions and, therefore, financial prices today. If monetary policy prevents the nominal rate from moving in response to tax news, it can turn out that deficits are monetized before they even show up in data on tax revenues. Then deficits will not predict money growth. Instead, the statistical timing inherent in Policy Myth #4 is reversed: money growth can predict deficits even though deficit shocks are fully monetized.[22]

Policy Combination III: There remain other assumptions that can be made about policy behavior. For example, suppose that both policy authorities attend to budget balancing. Then monetary policy makes the nominal rate insensitive to inflation while fiscal policy makes taxes respond strongly to debt. Now Policy Myth #3 is true: this combination of policies does not pin down the initial money stock and, therefore, the price level.

To see this point, assume that monetary policy pegs the nominal rate by making it unresponsive to inflation and output. Real balances are determined by the pegged nominal rate, but the nominal money stock and the price level are not separately determined by monetary policy. Because future taxes depend strongly on current real debt, any level of real debt implies a stream of future direct taxes that satisfies the budget identity. But if the price level is undetermined, real debt and future taxes are also. This result suggests that researchers who have concluded that the price level will not be determined if the monetary authority pegs the nominal rate were implicitly assuming that direct taxes would nonetheless respond strongly to real debt. Under a different assumption about fiscal behavior, prices are uniquely determined.

Another way to think about the price level indeterminacy result is that when monetary policy pegs all current and future nominal rates and fiscal policy adjusts taxes strongly to changes in real debt, policy is incompletely specified. Neither of these policies sets the current money supply, so this mix of policies leaves a policy variable unspecified and, therefore, the price level undetermined. Viewed in this way, Policy Myth #3 appears to have little to do with actual policy behavior and more to do with poorly specified theoretical models. A pegged nominal rate, coupled with some assumptions about fiscal behavior, can complete the specification of policy (policy combination II) while a pegged rate, combined with other fiscal assumptions, does not complete the specification (policy combination III).

Policy Combination IV: Finally, policy could be such that neither authority prevents real debt from growing too fast. A situation in which monetary policy tries to stabilize inflation while fiscal policy refuses to finance debt expansions with higher future taxes is infeasible and implies that real debt explodes over time. Private individuals, who buy debt with an eye toward redeeming it in the future, will recognize that policies imply the government's insolvency and will refuse to buy the debt. When government debt has no value, the government is forced to pay for expenditures entirely out of current revenues.

Monetary and fiscal policy combinations that are inconsistent, implying that the government is insolvent, are not mere theoretical curiosities. It is easy to find examples of people having refused to buy new issuances of government debt. In the 1840s five American states defaulted on their interest payments, and British financiers refused to extend additional loans to them. During the Great Depression every Latin American country except Argentina defaulted on its debt to foreigners. Latin American countries ran into problems again in the early 1980s and found it necessary to reschedule their debt payments.

Because it is only under policy combinations I and II that people will buy debt and prices will be determined, the rest of this article focuses on these policies. The economy looks very different in the two cases.

## How Policy Interactions Can Change Policy Effects

To illustrate the wide range of effects that monetary and tax policy changes can have on the economy, this section uses the theoretical model introduced in the article to conduct some hypothetical policy experiments. The experiments consist of temporarily changing one of the exogenous random variables in the model and using the model to trace out the resulting changes in the economy under various assumptions about policy behavior. The results are shown in Charts 2 through 4. (The exact settings of the model's parameters are reported in the appendix.)

The Effects of an Exogenous Monetary Contraction. Chart 2 contrasts the effects on output, inflation, real debt, and direct taxes of an exogenous monetary contraction under policy combinations I and II, which is modeled by a temporary increase in the random term θ in the monetary policy rule. To make comparisons easier, the assumption that policies do not respond countercyclically to output is maintained and only the parameters α_1 and γ_1 are different under the two policy combinations. The thicker lines in the chart correspond to policy combination I and the thinner lines to combination II.

An increase in θ means that the monetary authority exogenously raises the nominal interest rate and reduces high-powered money by selling government bonds in the open market, which increases the dollar amount of bonds held by the private sector. When monetary policy targets inflation and fiscal policy balances the budget (policy combination I), the monetary

Chart 2
### Effects of a One-Time Temporary Monetary Contraction

———— Changes in variables under policy combination I ———— Changes in variables under policy combination II

Output

Inflation

Real Debt

Direct Taxes

Period after Shock
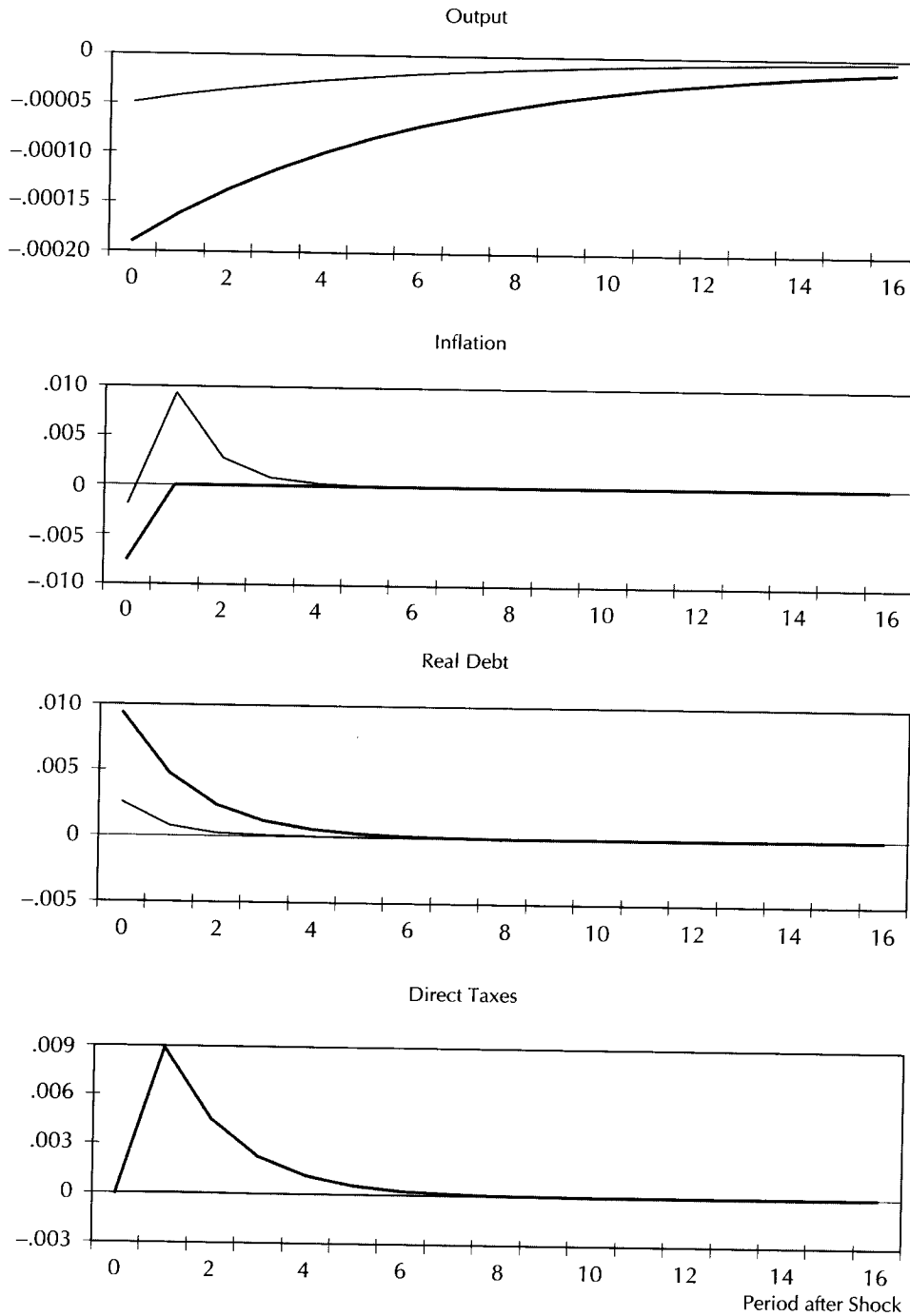
Note: The panels depict changes after an increase in θ in the monetary policy rule. Under policy combination I, Policy Myth #1 is true. Under policy combination II, Policy Myth #3 is false. Details about the simulations appear in the appendix.

Chart 3
## Effects of a One-Time Temporary Tax Increase

——— Changes in variables under policy combination I   ——— Changes in variables under policy combination II

Output

Inflation

Real Debt

Direct Taxes

Period after Shock
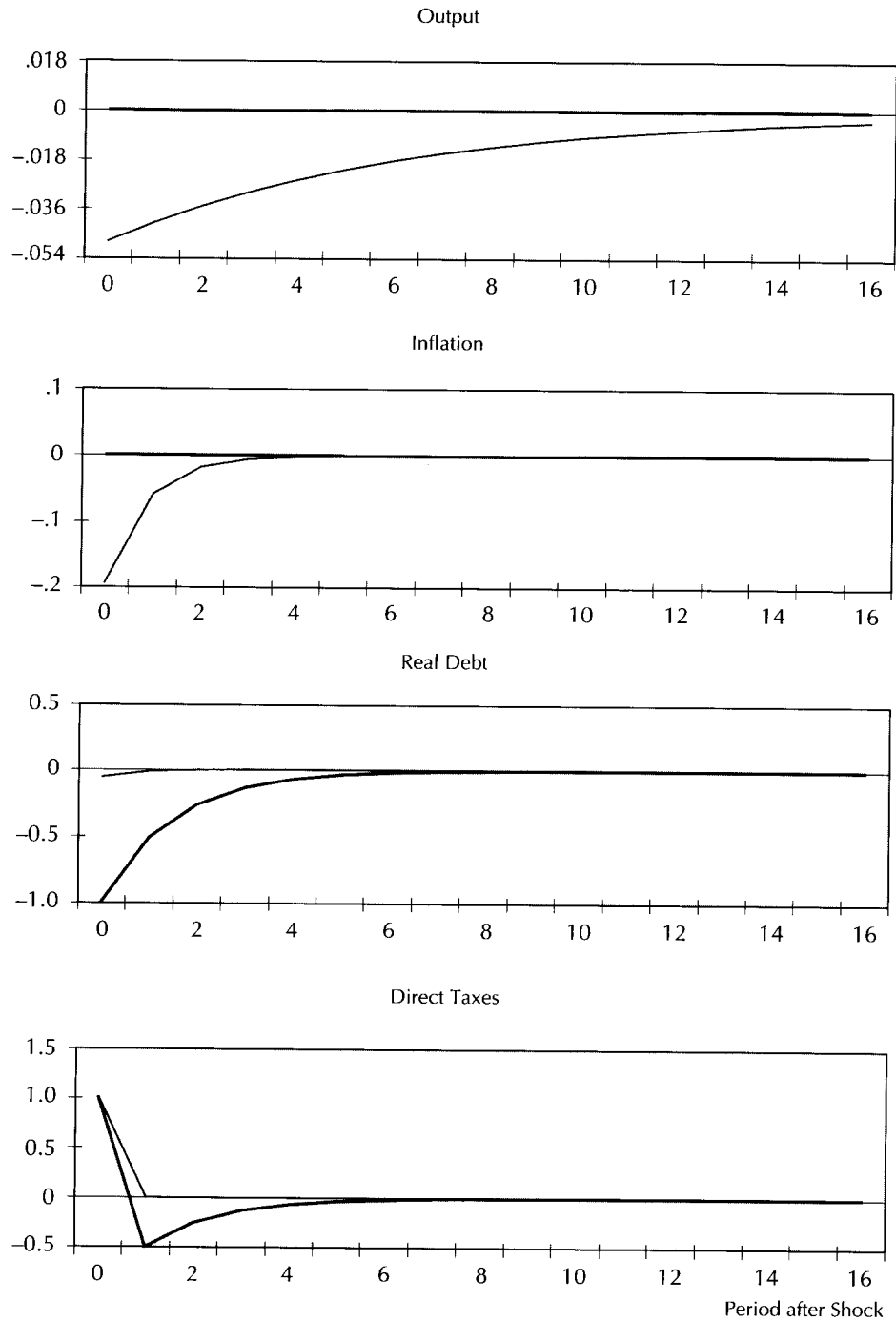
Note: The panels depict changes following an increase in ψ in the tax policy rule. Under policy combination I, Policy Myth #2 is true. Under policy combination II, Policy Myths #2 and #3 are false, but Myth #4 is true. Details about the simulations appear in the appendix.

Chart 4
Effects of a Temporary Increase in Productivity without and with Countercyclical Policies

——— Changes in variables without countercyclical policies   ——— Changes in variables with countercyclical policies

Output

Inflation

Real Debt

Direct Taxes

Period after Shock
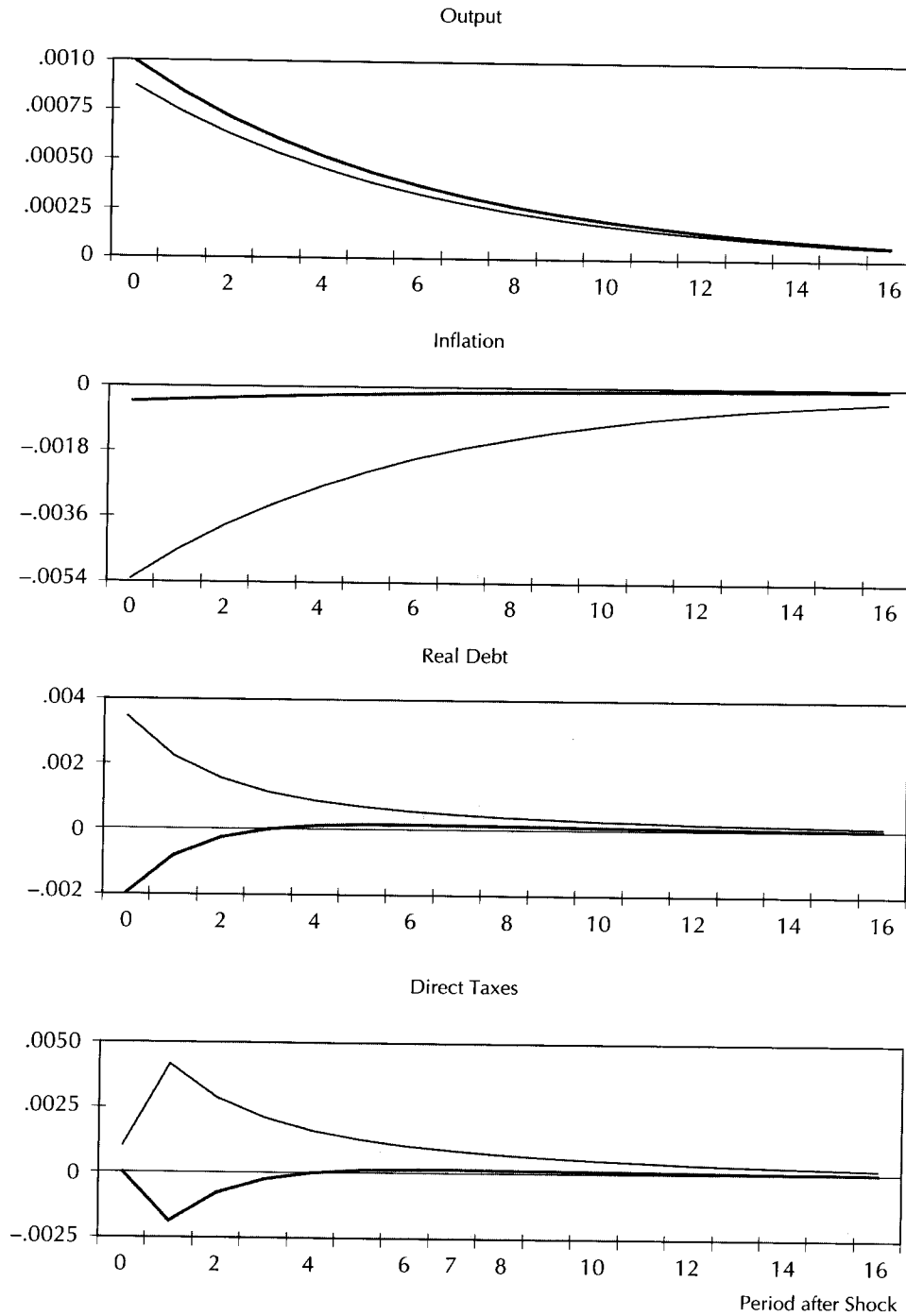
Note: The panels depict changes after a one-time, persistent positive productivity shock (an increase in ϵ in the aggregate supply function). Responses with no countercyclical policies and responses with countercyclical policy both assume policy combination I. Details about the simulations appear in the appendix.

contraction reduces output and inflation sharply, as shown in the thicker lines in the first two panels of the chart. Coupling the open market sale of bonds with the drop in prices increases real debt substantially (third panel). People are willing to absorb the increase in debt because fiscal policy is committed to raising direct taxes in the future to pay off the debt (bottom panel).[23] Because the monetary contraction was temporary, its effects on the economy die out after a few periods. This sequence of responses under policy combination I is consistent with the traditional analyses of monetary policy effects like those represented by Policy Myth #1.

The dynamic impacts of the policy and nonpolicy shocks that hit the economy depend on how monetary and fiscal policy interact in the short and the long runs.

Of course, if fiscal policy refuses to respond strongly to debt, then monetary policy cannot tightly target inflation (policy combination II). The same-sized monetary contraction now has a much weaker effect on output, inflation, and real debt, as the thinner lines in Chart 2 show. Moreover, if direct taxes do not rise (bottom panel), then inflation taxes must pay off the increase in real debt. As a result, the decline in inflation lasts only one period. Very quickly inflation begins to increase, "inflating away" the increase in debt produced by the initial open market sale (second panel). On the whole, tighter monetary policy raises inflation under these assumptions on policy behavior.[24] This pattern of responses contrasts sharply with those from the first policy combination, demonstrating that the predictions of monetary policy effects from traditional analyses implicitly embed the assumption that fiscal policy will adjust revenues as needed to satisfy the intertemporal budget identity. When the fiscal authority does not behave in this assumed way, the traditional beliefs need not hold.

Policy combination II is also an example in which monetary policy can peg the nominal interest rate by

setting $\alpha_2 = 0$, yet the price level is determined. In this case, which is not shown in the chart, the monetary contraction would have no effect on current inflation, but it would raise inflation in the future. This case also refutes Policy Myth #3.

Under both policy combinations, real debt eventually returns to its original level. The chart depicts just two of the many ways that monetary and fiscal policy together can ensure that real debt does not grow too fast after the supply of high-powered money contracts exogenously. Associated with each different assumption about how the policies interact will be different effects on the economy of a monetary contraction.

The Effects of an Exogenous Tax Hike. Even starker differences between the two policy combinations appear when taxes increase to retire nominal debt, as Chart 3 shows. For this experiment, the random term ψ in the tax rule, equation (10), is increased temporarily and its effects are traced through the model. As before, the experiment assumes that policies do not respond countercyclically to output.

Combination I, shown as the thicker lines in the chart, confirms Policy Myths #1 and #2. Tax changes do not affect output or prices because they constitute a pure substitution between direct taxes today and direct taxes in the future (top two panels). The bottom two panels of the chart show that the tax hike reduces real debt immediately, lowering direct taxes in the future by exactly enough to return debt to its original level. Consequently, inflation is not a fiscal phenomenon, and tax changes do not affect real or nominal variables, as Myths #1 and #2 assert.

These myths get turned on their heads when taxes do not respond to debt and monetary policy balances the budget. These results from policy combination II appear as thinner lines in Chart 3. Now the same-sized temporary tax increase has real and nominal consequences. The temporary tax increase appears in the bottom panel as an initial increase in direct tax revenues, which then return to their original preshock level. Real debt cannot change because future direct taxes are fixed (third panel), forcing prices to fall in proportion to the decline in nominal debt. With inflation lower than workers expect, work effort and output fall (top two panels). This chain of events arises because monetary policy in effect takes on responsibility for budget balancing. The monetary authority balances the budget by entering the open market and selling bonds from its portfolio. The bond sales offset the reduction in privately held nominal debt generated by the initial tax hike and reduce high-powered money.

Charts 2 and 3 underscore the dangers in making sweeping generalizations about the effects of changes in the money supply or taxes. These dangers come entirely from considering how policies must interact in the long run. The situation grows more complex once policies also pursue short-run objectives.

The Effects of Countercyclical Policies. The final policy experiment focuses on short-run responses of policy by positing that policies may respond countercyclically to declining output by lowering the nominal interest rate (and expanding the money supply) and reducing direct taxes. Chart 4 shows how variables change following a temporary increase in productivity, both without a countercyclical response of policy (so that γ_2 and α_2 are zero) and with such a response, where the two policy parameters are positive.[25] The thicker lines in the chart are results without countercyclical policies, and the thinner lines are outcomes with countercyclical policies. (The experiment assumes policy combination I so that monetary policy targets inflation and fiscal policy balances the budget.)

A temporary increase in productivity is modeled by an increase in ϵ in the aggregate supply function, equation (4). Without countercyclical responses from policy, higher productivity increases output and money demand and lowers inflation (top two panels). To target inflation, monetary policy offsets some of the downward price pressures by partially accommodating the higher money demand with an open market purchase of bonds that increases high-powered money. Inflation ultimately falls slightly, as do nominal and real debt (third panel). Fiscal policy lowers future direct taxes accordingly (bottom panel).

Including a countercyclical policy response to output dramatically alters the outcomes, as shown by the thicker lines in Chart 4. Instead of expanding the money supply, monetary policy now contracts it, attenuating the increase in output and exaggerating the drop in inflation (top two panels). To contract money, the monetary authority sells bonds, increasing real debt (third panel). Countercyclical fiscal policy raises taxes when output is high and long-run fiscal policy increases future direct taxes to pay off the debt (bottom panel).[26]

While these experiments are hypothetical, they highlight the vast array of policy effects that are possible. The dynamic impacts of the policy and nonpolicy shocks that hit the economy depend on how monetary and fiscal policy interact in the short and the long runs. Careful analysis must account for these interactions, and failing to do so can produce misunderstandings of how policy affects the economy.

This Is Just the Beginning

This article has argued that monetary and fiscal policy should not be analyzed in isolation from each other. Indeed, economic theory says that they cannot accurately be studied separately. And the article offers a crude but holistic framework for understanding how policy affects the economy. Even this crude framework can help to explain some of the actual policy changes taking place. In the model in this article, Japanese efforts to stimulate their economy with easier monetary and fiscal policies appear as choices of the countercyclical policy parameters γ_2 and α_2 in the policy rules, which make the interest rate and taxes fall when output declines. The Japanese efforts focus on the short run and do not seem to be about choosing parameters γ_1 and α_1, which represent different schemes for balancing the budget in the long run.

European Monetary Union can be modeled as policy combination I, although this model glosses over the institutional details of a single European monetary authority. For long-run considerations, the essential fact is that in a monetary union individual countries cannot use monetary policy to generate revenues to balance the budget. Sacrificing control of monetary policy also engenders short-run tensions such as those cropping up in the exchange rate system in Europe, which until recently implicitly pegged currencies to the German mark. Pegged currencies, like a monetary union, mean that individual European countries cannot manipulate monetary policy to accomplish countercyclical goals. Instead, they must rely entirely on fiscal policy to achieve both short-run and long-run objectives, which may be too much to ask of fiscal policy. Some evidence of the tensions emerged this year when in August Europe decided to widen the target exchange rate bands substantially, effectively abandoning efforts to maintain fixed exchange values of their currencies.

By analyzing monetary and fiscal policy simultaneously, the framework in this article provides policymakers with a basis for judging what the effects of their actions will be. For example, an exogenous monetary policy contraction will lower inflation only if fiscal policy pays for the resulting increase in real debt by raising direct taxes in the future. When political sentiment makes it more likely that future direct taxes will not be adjusted, the monetary contraction may actually raise inflation. These sorts of considerations are essential to making sound policy choices, but they get papered over by analyses that focus only

on monetary policy, implicitly assuming that fiscal policy will adjust as needed to balance the budget. The article has highlighted other myths about policy effects and pointed out some situations in which the myths hold true and others in which they are false.

Although adequate for explaining some actual policy behavior, this framework is unfortunately still too crude to address some pressing policy issues. For example, during the 1980s, American monetary and fiscal policy appeared to be on a collision course headed toward insolvency, yet people continued to buy American government debt. In terms of the theory in this article, the American experience appears to fall under policy combination IV, where neither authority is balancing the budget. But the theory says that with such policies, people would refuse to purchase government bonds. Cynical explanations of the inconsistency between the theory and the reality come cheaply: people are not rational, so analyses that rely on such esoterica as expectations about the future and intertemporal budget identities have little value.

More appealing explanations are dearer and harder to work out. Actual policy behavior is far more complex than the assumptions outlined here. It is probably impossible to write down a realistic characterization of policy that assumes that the policy authority responds to a small set of variables in some fixed way for all time. Actual policy choices depend on current economic conditions in a complicated manner. Policy behavior also evolves over time; even if the policies in

place today seem inconsistent with each other, they are likely to change in the future to become consistent. Economic decisionmakers speculate about what combinations of policies are likely to prevail in the future, and they hedge their decisions accordingly.

The more complex conceptualization of policy may explain recent American economic performance. Coming out of the 1991 recession, the economy grew much more slowly than is typical during the expansion phase of the business cycle, in spite of substantially lower short-term interest rates. Consumers and businesses, aware of the large accumulation of debt during the past decade, are speculating on how the policy authorities will finance that debt. President Clinton's recently passed deficit reduction package makes only a small dent in the debt, so it is but a partial answer. In addition, businesses are wary of the extra costs that will be imposed on them by whatever health care plan ultimately is adopted. In the face of this extreme uncertainty, it is rational for consumers to avoid making large expenditures and for businesses to put off hiring new workers. Thus, uncertainty about how the policy inconsistency will be resolved can retard economic growth.

It is tempting to throw up the American example as evidence that monetary and fiscal policy do not tango. But the steps described here are just the beginning. The actual policy dance is more intricate. Understanding the more complicated movements is more than aesthetically fulfilling or intellectually challenging. It is crucial to making good monetary and fiscal policy.

Appendix: The Economic Model and Its Solution

This appendix presents the full model summarized in the text. It describes how to solve the model to find its equilibria and how to use the model to produce simulations.

Aggregate Supply:

$$y_t = \lambda_0(1 - \lambda_2) + \lambda_1(\pi_t - E_{t-1}\pi_t) + \lambda_2 y_{t-1} + \epsilon_t, \qquad \text{(A1)}$$

where $\lambda_1 > 0$ implies the supply function slopes upward and $0 < \lambda_2 < 1$ implies output is stationary. E_t denotes the mathematical expectations operator conditional on information available at time t, which includes all variables dated t and earlier.

Demand for High-Powered Money:

$$\frac{M_t^d}{P_t} = \delta_0 + \delta_1 R_t + \delta_2 c_t + \xi_t, \qquad \text{(A2)}$$

where $\delta_1 < 0$ and $\delta_2 > 0$.

Demand for Government Debt:

$$\frac{u'(c_t)}{P_t} = \beta R_t E_t \left[\frac{u'(c_{t+1})}{P_{t+1}} \right], \qquad \text{(A3)}$$

where utility is $u(c_t) = \omega_t \cdot \log(c_t)$, $0 < \beta < 1$ is the discount factor, so that $1/\beta$ is the steady state real interest rate in this model with no growth.

National Income Identity:

$$c_t + g_t = y_t. \qquad \text{(A4)}$$

Monetary Policy Rule:

$$R_t = \alpha_0 + \alpha_1 \pi_t + \alpha_2 y_t + \theta_t, \qquad \text{(A5)}$$

where the sign of α_1 is not constrained a priori and $\alpha_2 > 0$ implies countercyclical monetary policy.

Tax Policy Rule:

$$\tau_t = \gamma_0 + \gamma_1 \frac{B_{t-1}}{P_{t-1}} + \gamma_2 y_t + \psi_t, \qquad (A6)$$

where the sign of γ_1 is not constrained a priori and $\gamma_2 > 0$ implies countercyclical fiscal policy.

Government Budget Constraint:

$$\frac{B_t}{P_t} + \frac{M_t}{P_t} + \tau_t = g_t + \frac{R_{t-1} B_{t-1}}{P_t} + \frac{M_{t-1}}{P_t}. \qquad (A7)$$

The model is linear except for (A3) and (A7). A version of the model that has been linearized around the deterministic steady state is solved and analyzed. The exogenous shocks $\{\epsilon_t, g_t, \theta_t, \xi_t, \psi_t, \omega_t\}$ follow stationary first-order autoregressive processes that are mutually uncorrelated. The mean of g_t is g_0, the mean of ω_t is unity, and the remaining four processes have means of zero.

The deterministic steady state, which is derived by setting all the shocks to their mean values and solving the model, is

$$y = \lambda_0, \quad c = \lambda_0 - g_0, \quad R = \frac{\alpha_0 + \alpha_2 \lambda_0}{1 - \alpha_1 \beta}, \quad \pi = \beta R,$$

$$\frac{M}{P} = \delta_0 + \delta_1 R + \delta_2 c,$$

$$\frac{B}{P} = \frac{1}{1 + \gamma_1 - \beta^{-1}} \left[g_0 - \gamma_0 - \gamma_2 y + \left(\frac{1}{\pi} - 1 \right) \frac{M}{P} \right],$$

$$\tau = \gamma_0 + \gamma_1 \frac{B}{P} + \gamma_2 y.$$

The linearized model can be reduced to a dynamic system in three endogenous variables. Define $\pi_t \equiv P_t/P_{t-1}$ and $b_t \equiv B_t/P_t$. Let $x_t \equiv (y_t, \pi_t, b_t, \epsilon_t, g_t, \theta_t, \xi_t, \psi_t, \omega_t)'$ denote the vector of deviations of these variables and the exogenous variables from their steady state values. Define the one-step-ahead forecast errors $\eta_{yt} \equiv y_t - E_{t-1} y_t$ and $\eta_{\pi t} \equiv \pi_t - E_{t-1} \pi_t$ and let $v_t \equiv (\eta_{yt}, \eta_{\pi t}, 0, \eta_{\epsilon t}, \eta_{gt}, \eta_{\theta t}, \eta_{\xi t}, \eta_{\psi t}, \eta_{\omega t})'$ be a vector of serially uncorrelated disturbances, where $\eta_{\epsilon t}$ through $\eta_{\omega t}$ are the innovations associated with the exogenous shocks.

The system can be written as

$$x_t = A x_{t-1} + B v_t. \qquad (A8)$$

The first three rows of the A and B matrices are

$$A = \begin{bmatrix} \lambda_2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & \alpha_1 \beta & 0 & 0 & -\beta R/c & \beta & 0 & 0 & -\beta R \\ a_{31} & a_{32} & \beta^{-1} - \gamma_1 & 0 & a_{35} & a_{36} & 1/\pi & 0 & \beta \varphi_2 R \end{bmatrix}$$

and

$$B = \begin{bmatrix} 0 & \lambda_1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta R/c & b_{22} & 0 & -\beta R/c & 0 & 0 & 0 & 0 & 0 \\ -\beta \varphi_2 R/c & b_{32} & 0 & b_{34} & 1+\delta_2 & -\delta_1 & -1 & -1 & 0 \end{bmatrix},$$

where

$$a_{21} \equiv \beta[\alpha_2 c + R(1 - \lambda_2)]/c,$$
$$a_{31} \equiv \varphi_3 - \beta \varphi_2 (\alpha_2 + R/c) + \lambda_2 (\beta \varphi_2 R - c \varphi_1)/c,$$
$$a_{32} \equiv -\alpha_1 \beta \varphi_2 + \varphi_4,$$
$$a_{35} \equiv -\delta_2/\pi + \beta \varphi_2 R/c,$$
$$a_{36} \equiv (b + \delta_1 - \beta \varphi_2 \pi)/\pi,$$
$$b_{22} \equiv 1 - \beta \lambda_1 R/c,$$
$$b_{32} \equiv -\lambda_1 \varphi_1 - \varphi_2 + \beta \lambda_1 \varphi_2 R/c,$$
$$b_{34} \equiv -\varphi_1 + \beta \varphi_2 R/c,$$
$$\varphi_1 \equiv \delta_1 \alpha_2 + \delta_2 + \gamma_2,$$
$$\varphi_2 \equiv \delta_1 \alpha_1 + (m + bR)/\pi^2,$$
$$\varphi_3 \equiv [\alpha_2(b + \delta_1) + \delta_2]/\pi,$$
$$\varphi_4 \equiv \alpha_1(b + \delta_1)/\pi.$$

The remaining six rows of A and B describe the exogenous processes.

The system in (A8) generally has many possible solutions, but not all will be stable. To solve for the stable solutions, first find the Jordan canonical form of A,

$$A = W \Lambda W^{-1}, \qquad (A9)$$

where Λ is a diagonal matrix containing the eigenvalues of A, W is the matrix of right eigenvectors, and W^{-1} is the matrix of left eigenvectors.

Because A is lower triangular, the eigenvalues can be read off immediately as $(\lambda_2, \alpha_1 \beta, \beta^{-1} - \gamma_1)$, plus the autoregressive coefficients of the stationary exogenous processes. Since $\eta_{yt} = \lambda_1 \eta_{\pi t} + \eta_{\epsilon t}$ and $0 < \lambda_2 < 1$, the results in Blanchard and Kahn (1980) imply that a unique stationary saddle path equilibrium requires that between the remaining two eigenvalues, one must lie inside and one must lie on or outside the unit circle.[1] This immediately implies that policy choices of values for α_1 and γ_1 completely determine the dynamics of the equilibrium.

There are four regions of the policy parameter space to consider. These regions and the resulting implications for the model are

Region I: $|\alpha_1 \beta| > 1$ and $|\beta^{-1} - \gamma_1| < 1 \Rightarrow$ unique equilibrium

Region II: $|\alpha_1 \beta| < 1$ and $|\beta^{-1} - \gamma_1| > 1 \Rightarrow$ unique equilibrium

Region III: $|\alpha_1\beta| < 1$ and $|\beta^{-1}-\gamma_1| < 1 \Rightarrow$ indeterminate equilibrium

Region IV: $|\alpha_1\beta| > 1$ and $|\beta^{-1}-\gamma_1| > 1 \Rightarrow$ no equilibrium exists

Loosely speaking, the stable eigenvalue guarantees that real debt does not explode while the unstable eigenvalue ensures the price level is uniquely determined. A stationary solution to the model requires that the time paths of variables lie on the stable manifold of the solution space. To impose this, the solution method forces to zero linear combinations of the variables that are in the direction of the eigenvector associated with the unstable eigenvalue. If μ is the row of W^{-1} that is associated with the unstable eigenvalue, then a unique stationary solution must satisfy

$$\mu x_t = 0, t = 0, 1, 2, \ldots, \qquad (A10)$$

or, equivalently,

$$\mu x_0 = 0 \text{ and } \mu B v_t = 0, t = 1, 2, \ldots \qquad (A11)$$

Expression (A10) is the model's equilibrium decision rule. The second expression in (A11) is the equilibrium mapping from innovations in the exogenous processes to one-step-ahead (reduced-form) errors in endogenous variables.

Stationary equilibria come from solving (A10) simultaneously with (A8). Of course, the combined system has one redundant equation that must be eliminated. Suppose that the *i*th eigenvalue is unstable. Define an identity matrix, S, which has μ as its *i*th row, and A^* and B^* matrices, which equal their counterparts in equation (A8) except that their *i*th rows have been replaced by zeros. To obtain stationary solutions, solve the system

$$Sx_t = A^*x_{t-1} + B^*v_t. \qquad (A12)$$

The mapping in (A11) from the exogenous disturbances to the one-step-ahead forecast errors can be used to obtain sequences of $\{\eta_{yt}, \eta_{\pi t}\}$ from the realizations of the exogenous shocks.

The simulations reported in the text used the following parameter settings:

$$y = 10, \quad c = 8, \quad g = 2, \quad R = 1.04,$$
$$\pi = 1, \quad \frac{M}{P} = .77, \quad \frac{B}{P} = 4, \quad \tau = 2.1,$$
$$\beta = .9879, \quad \delta_1 = -.05, \quad \delta_2 = 1, \quad \lambda_1 = .25, \quad \lambda_2 = .85.$$

The standard error of the innovation in each exogenous process was set to .01. The policy processes, θ and ψ, are serially uncorrelated and the remaining processes have a first-order autoregressive coefficient of .80. For each set of policy parameters, 5,000 periods of the model were computed using the same draw of the random processes. The graphs depict distributed lag coefficients from regressions of the endogenous variable of interest on current and sixteen lags of the innovations in the six exogenous processes. These regressions have R^2's of 1.0, and the estimated coefficients converge to the population moments as the number of simulated periods increases. Charts 2 through 4 report the coefficients, scaled by one standard deviation of the innovation in the exogenous process and by the variable's deterministic steady state value.

The policy parameters used in the simulations are

Policy Combination I:

No countercyclical policy: $\alpha_1 = 1.3, \alpha_2 = 0,$
$\gamma_1 = .5, \gamma_2 = 0$ (Charts 2, 3, and 4).

With countercyclical policy: $\alpha_1 = 1.3, \alpha_2 = .25,$
$\gamma_1 = .5, \gamma_2 = .25$ (Chart 4).

Policy Combination II:

No countercyclical policy: $\alpha_1 = .3, \alpha_2 = 0,$
$\gamma_1 = .01, \gamma_2 = 0$ (Charts 2, 3, and 4).

With countercyclical policy: $\alpha_1 = .3, \alpha_2 = .25,$
$\gamma_1 = .01, \gamma_2 = .25$ (Chart 4).

Note

1. Actually, if a linear-quadratic model is imagined to underlie the model in the text, the transversality condition implies that the dividing line is $1/\beta^{1/2}$ rather than unity. One, however, produces stationary simulations of the model.

Notes

1. The former Soviet Union is undergoing even more fundamental reforms of its macroeconomic policies in its transition from a centrally planned to a market-based economy. The reforms include developing a central banking system and creating a market for government debt. Although an analysis of such reforms is beyond the scope of this article, once the reforms are in place the analysis in this article will apply to that nation also.

2. This statement carries the implicit assumption that the government does not renege on its outstanding debt. Hamilton (1947) points out that until the eighteenth century, countries sold debt primarily to finance wars. They repaid the debt when they won the war and defaulted when they lost. The idea that a nation should always honor its debt obligations is relatively modern.

3. Increases in real debt always must be followed by higher revenues or lower spending. When the increase in debt spurs economic growth, however, the higher revenues may be achievable without increasing tax rates. Some people refer to this situation as a case in which the economy can "grow out of its deficits." More generally, if the economy's growth rate exceeds the real interest rate on government bonds, then government debt can be paid off even though tax rates remain fixed. Darby (1984) and Miller and Sargent (1984) debate this assumption.

4. Hansen, Roberds, and Sargent (1991) show that the dynamic government budget constraint alone imposes no observable restrictions on the data because policy behavior has only to satisfy the constraint over an infinite horizon.

5. Some examples of this line of research include Sims (1988, forthcoming), Leeper (1989, 1991), and Leeper and Sims (1993).

6. The influence of the accounting identity has been felt daily in European exchange rate markets. As a precursor to full monetary union, until recently some European countries were implicitly pegging their currencies to the German mark by maintaining the value of their currencies against the mark within very narrow target bands. (Technically, the countries try to maintain the value of their currencies against a weighted basket of European currencies, called the European Currency Unit. A country's target bands are defined as deviations from a central parity rate of exchange between that country's currency and the ECU. When the German mark strengthens, other currencies depreciate against the ECU and, therefore, implicitly against the mark.) After East-West German unification raised real interest rates in Germany substantially, the pegging countries were forced to adopt tight monetary policies. By keeping interest rates high in Britain, France, and Italy, the monetary authorities prevented pounds, francs, and lira from being converted into marks and flowing into high interest-earning German assets. Such flows would cause the mark to appreciate and threaten to push exchange rates outside their target bands. Unfortunately, the European countries' tight monetary policies coincided with weak domestic economic growth, which was calling for monetary expansion. European countries have been struggling with the tension between the desire to peg their currencies and the need to stimulate their economies.

It would be natural for the European countries to turn to fiscal policy to stimulate their economies by cutting taxes or raising spending. Monetary policy could then continue to focus on maintaining the value of their currencies. They did not call on fiscal policy for two reasons. First, as a condition for joining the monetary union, a country's fiscal deficit must be small relative to the size of the economy. Easier fiscal policy and larger deficits could jeopardize satisfying this criterion. Second, fiscal policy is often a less versatile tool than monetary policy for stabilizing the economy. Any substantive changes in taxes or spending typically require extensive debate and entail long lags before they affect the economy. A change in monetary policy, on the other hand, can be implemented immediately. Moreover, if a country's monetary policy is committed to maintaining the value of its currency, the policymakers realize that higher deficits today must be paid for by higher taxes or lower spending in the future—changes that are politically difficult to implement. This sort of "discipline" is precisely what underlies the move toward monetary union.

As it happened, the pressures on European countries to lower interest rates intensified last fall. In September 1992 Britain and Italy succumbed to the pressure and abandoned implicitly pegging their currencies to the mark. Their monetary authorities were then free to ease monetary conditions and lower interest rates to stimulate private domestic demand.

7. The rational expectations school assumes that people use all available information to form expectations when they make economic decisions. See Tobin (1980) for a discussion of the relationship between rational expectations and monetarism.

8. See, for example, the article by Christ (1968) and the series of articles in Ferguson (1964). Braudel points out that the eighteenth-century English recognized that increases in government debt required increases in tax revenues: "As for the claim that the state was borrowing money out of concern not to tax its subjects too heavily, that was absolute nonsense! Every new loan made it necessary to create a new tax, a fresh source of income, so that the interest could be paid" (1979, 376). Braudel goes on to note that as early as the accession of William of Orange in the 1680s, the government sold long-term loans whose interest payments were guaranteed by an earmarked tax.

9. This statement is true assuming that the real rate is determined by the marginal product of capital and is independent of monetary policy in the long run.

10. Friedman (1959, 1968) and Friedman and Schwartz (1963) detail what they believe are additional deleterious effects of interest-rate pegs.

11. The belief that a pegged nominal rate leaves prices undetermined has gained wide acceptance among monetary

economists. It has also worked its way into the argument that monetary policy must target some "nominal anchor," such as a monetary aggregate, when it uses an interest rate instrument to execute monetary policy. Patinkin, a leading monetary theorist, wrote, "a necessary condition for the determinacy of the absolute price level . . . is that the central bank concern itself with some money value" (1965, 309). Setting the nominal rate without trying to hit a nominal target, the argument goes, allows the level of prices to be anything.

12. King and Plosser (1985), for example, apply this reasoning to test whether American deficits have been financed by money creation.

13. The chart may make it seem that American government debt is on an explosive path. But this is a superficial interpretation of the data. Because individuals continue to buy and hold government bonds, they must believe that the government is not insolvent and will pay its debt eventually. The final section of the article returns to an interpretation of American data over the past decade.

14. Friedman (1968) developed this relationship, and Lucas (1972, 1973) formalized it in a series of influential papers. There are other ways to motivate an aggregate supply function that implies that unanticipated inflation increases output.

15. Like all approximations, this is not a bad one when the tax changes are "small." If the changes in taxes are large and sustained, lump-sum taxes may give misleading results.

16. Over time, the exogenous shocks average out to zero, so the model's variables fluctuate above and below their steady state values by equal amounts.

17. For example, many economists believe that if policy could temper the severity of recessions in the short run, the economy would grow faster in the long run.

18. Of course, lump-sum taxes enter the private sector's budget constraints, but they do not appear in the marginal conditions reported in the model.

19. The analysis may be clarified by a baseball analogy. Baseball analysts bring a wide variety of statistics to bear on the question of whether a player is an "important" (or "clutch") hitter. Because an overall batting average does not tell the whole story, analysts compute averages when runners are in scoring position, when the game is close in late innings, or when the games are played after the regular season. These statistics report whether the player is important *on the margin* by conditioning the average on other crucial circumstances. Frequently, a player with a modest overall batting average is known for delivering game-winning hits.

20. The details of how to derive these results appear in the appendix.

21. This statement means that a pegged nominal rate implies the supply of money is determined entirely by its demand.

22. This argument is presented and studied empirically in Leeper (1989).

23. In the real world, taxes affect incentives to work and invest, so the higher future taxes would increase work effort and depress investment today. The change in behavior could translate into a smaller decline in output initially but a larger drop in subsequent periods.

24. Essentially, the initial monetary contraction constitutes an inflation tax cut, which is made up by a future inflation tax hike when fiscal policy is unresponsive to debt. Sargent and Wallace (1981) find a similar result in a very different kind of model.

25. The exact values are reported in the appendix.

26. If direct tax changes alter incentives, the effects on output and inflation can be quite different.

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