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Reaganomics and Credibility

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by
Thomas J. Sargent

Howard: Dandy, the Vikings had the momentum throughout the first half. Let's see if the momentum stays with the Vikes into the second half. Otherwise, it's going to be a long night for the Bears.

Dandy Don: Yes Howard. It'll also be interesting to see if the Bears continue to be confused by the new formation that Bud Grant has installed for this game. We haven't seen the Vikings throw play action passes as much as they have this evening, and this has surprised the Bears. If the Bears can figure out the Vikes' new strategy and adjust to it, it will be a new ball game.

Monday Night Football

1. Introduction

An offensive football team is a collection of individuals with a common objective (to score a touchdown). This objective is attained by the cooperation of eleven players, each of whom is ultimately in control of his own actions. The effectiveness of any one player's actions depend intricately on the actions of his teammates. If the quarterback decides to throw the ball thirty yards downfield to the right side of the field on a count of three, it is necessary for success that a receiver run a pass pattern that will place him in a position to catch the ball. If the quarterback calls a "keeper" and runs around the end, it is important that the end not run a pass pattern, but that he

block. Thus the quarterback and the end, and also all of the other players, face a problem of coordination. It will not do simply to announce vague objectives in the huddle, such as "let's score a touchdown". Instead, somehow, a precise understanding must be reached on the part of each player of what each of his colleagues is planning to do on the next play, and of the "contingency plans" that each player will use as the play develops or breaks down. All football teams (except apparently one that I root for) accomplish this coordination task by giving one player, either the quarterback or a player just sent in by the coach, the authority to direct the actions of all the others by calling the play. A football team is an example of a system for which complete decentralization or "laissez-faire" is not a good idea.

The example of football contains important lessons about making macroeconomic policy. Within a single country, the authorities who are charged with responsibility for making monetary and fiscal policy are very much in the position of the end and quarterback, for their activities must be coordinated, one way or the other, and their objectives are presumably identical. Taking the world as a whole, the monetary and fiscal authorities of different countries have to somehow coordinate their policies, since one country's choices of monetary and fiscal strategies influence the options open to the others, so long as there is some freedom to exchange goods and make loans across borders. However, despite the interrelated consequences of their actions upon a common system, fiscal and monetary authorities from different countries sometimes have differing and even opposing goals. (Sometimes the

goals may even seem so opposed that the proper analogy is not to a quarterback and an end, but to two opposing football teams--say the Cowboys and the Redskins.) Presumably, the example of the quarterback and the end rings truest for the coordination of monetary and fiscal policy within one country, for here the assumption that the authorities share common objectives is better than for the international case.

This paper views the monetary and fiscal authorities of a single country as a "team", and judges their patterns of behavior against standards absorbed from the sports pages. This view provides a broad framework for summarizing classic doctrines and controversies in government finance, and also serves as a basis for criticizing the way in which monetary and fiscal policies have been coordinated de facto in the United States over the last several years.

I shall begin with a few formal definitions of concepts. These concepts will help to clarify the analogy between the quarterback-end problem and the monetary-fiscal problem.

2. Dynamic Games

A game consists of a collection of players and a set of rules spelling out rewards and penalties. A dynamic game is one which requires time to complete, and whose current score depends on past actions of the various players. In life, most games are dynamic.

Each player in a game is supposed to have a goal or objective that depends on the rewards and penalties spelled out in the rules of the game. This goal may be ideosyncratic (such as

personal glory or personal profit) or altruistic (such as the success of one's team or country). A team game is one in which a collection of two or more players share a common objective. Football and soccer are team games. So perhaps is the game of managing a country's monetary and fiscal affairs, at least if those in charge have in mind a common objective.

Each player in a dynamic game tries to achieve his objective by choosing a strategy. A strategy is defined as a rule that describes how a player's actions during the game depend on the information that he receives during the course of the game. Another term for a player's strategy is his "contingency plan." This term evokes the notion that each action taken by a player ought to depend on the situation as it is understood when that action is executed. A strategy relates a player's actions over time into a sensible pattern. Since time elapses during a dynamic game, whether a single action (or "move") is a good one cannot be judged in isolation from past and subsequently planned moves.

In general, each player chooses his strategy given his perception of the strategies of other players, and given his perception of the influence that his own choice of strategy has on the strategies chosen by other players. If player A correctly believes that he influences the choice of player B's strategy, then player A is said to be dominant relative to player B. To complete a description of a dynamic game, it is necessary to specify a structure of dominance across the players in the game. An equilibrium or solution of a dynamic game is a structure of dominance and a collection of strategies of all of the agents in

the game that maximize their respective objective functions, subject to each player's perception of the strategies of all of the remaining agents. Evidently, a solution of a dynamic game requires that all agents' perceptions of the structure of dominance be consistent and that their chosen strategies be mutually feasible, in the sense of being consistent with the physical technologies in place, and with the strategies being employed by the other agents.

Alternative structures of dominance give rise to different ways of playing a game, or really different games. For example, in a Nash equilibrium each agent in the game takes the strategies of the other agents as given and beyond his influence. Nash players interact in this way despite the fact that each player's choice of strategy does influence the strategies chosen by all of the other players. In a Stackleberg or dominant player equilibrium, one player takes into account the influence that his choice of strategy has on the strategies of the remaining players, while the remaining players act as followers and ignore the influence of their strategies on the dominant player's strategy. Usually, the dominant player is imagined to be large and powerful while the followers are imagined to be individually weak, numerous, and dispersed. If there is a small number, say two, of powerful players, then possibilities exist for a struggle between them for dominance. It can happen that each of two players wants to be dominant himself, and wants the other player to act as a follower. If both sides try to implement their desired strategies, an impasse or state of "Stackleberg warfare" exists.

"Stackleberg warfare" is not an equilibrium or solution of the game because the wishes and perceptions on which the two players are acting are not mutually consistent. Situations of Stackleberg warfare are pathologies, and represent attempts to implement disorderly and infeasible coordination schemes. Below, we shall assert that recent monetary and fiscal policy in the U.S. have been in a state of Stackleberg warfare.

A fundamental and general principle that emerges from the study of dynamic games is that agents' strategies are interdependent. Interdependence of strategies generally holds regardless of the structure of dominance though the exact forms of dependence will depend on it. The principle of strategic interdependence is reflected in the need for a quarterback and end to coordinate their strategies. It is also reflected in the coordination problem facing monetary and fiscal authorities.

The reader who is familiar with the game of football will be able to recognize how the categories defined above apply to football. From the point of view of a single football team, football is a dynamic team game, in which each player's optimal strategy depends on the optimal strategies of the other players as well as on the strategy being used by the opposing team and also the rules set by the league. The optimal strategy for a given team depends on the rules of the game and also on the strategies chosen by the opposing team. Since my main purpose in this paper is to analyze the macroeconomy, and not the National Football League, I will not pursue the analysis of football as a dynamic game any further here. Instead, I shall now describe aspects of the economy of a single country as a dynamic game.

3. An Economy as a Dynamic Game

The economy or game is imagined to consist of three players: the "public", the "monetary authority", and the "fiscal authority". The public consists of people, organized into households, agencies of the government, and corporations, and who are the ultimate beneficiaries of all economic activity. The public makes decisions about consumption, investment, and private employment, and pays the taxes imposed on it by the fiscal authority. The public also sets the terms on which it will accumulate government debts of various forms. The fiscal authority makes decisions about public expenditures and rates at which taxes are to be collected from the public. By making these decisions, the fiscal authority determines the rate of government deficit, the amount by which government expenditures exceed tax collections.^{1/} The deficit is financed by issuing government debt, either in the interest bearing form of government bonds, or in the noninterest bearing form of currency and bank reserves, often called "high-powered money". The decision about the composition of the debt as between bonds of various maturities and currency or high-powered money is at each point in time under the control of the monetary authority. The monetary authority exercises this control through its authority to engage in open market exchanges of one kind of public debt for another. Thus, while the fiscal authority influences the rate of addition to the public debt, the monetary authority determines its composition. Debt management is a term that is aptly used to describe what the monetary authority does.^{2/}

Macroeconomic analysis (of the rational expectations variety) aims to study the interactions of these three classes of agents as a team dynamic game. Abstracting from distributional effects across members of the public, which is following a long tradition in macroeconomics, the monetary and fiscal authorities are imagined to share common objectives with the public and with each other. These common objectives make it a team situation. The aspect that all three players are making decisions that affect the future state of the system makes it a dynamic game. Thus, the public chooses investment rates in physical and human capital and the terms on which it is willing to accumulate various amounts and types of government debt, while the fiscal authority determines the current and prospective state of total government indebtedness, and the monetary authority determines its composition.

I now put this structure of ideas to work by using it to analyze a classic issue about government finance that is important today: the consequences for inflation of government deficits and of alternative ways of financing them.

Government expenditures can be financed by alternative combinations of levying taxes, borrowing in interest bearing form, and printing high-powered money. The consequences for the price level path of alternative methods of financing a given stream of government expenditures conceivably differ, and differ in ways that depend on how the strategies of the public and the fiscal and monetary authorities are imagined to interact. To discuss these consequences, we need models of the decision strategies of each of our three groups of agents, and of their interactions. We can

describe some of the major issues with the aid of simple strategic models for each of our "players".

Following in the tradition of Keynes, the public is assumed to be willing to hold interest bearing government debt on the same terms on which it holds private evidences of indebtedness. This means two things. First, public borrowing is assumed to pay the same interest rate as private borrowings. Second, the total amount of government and private borrowing must be consistent with the public's willingness to accumulate wealth, which is limited. We assume that all interest bearing government debt is one period in maturity, and denote the one-period real pre tax net rate of return on private securities between t and $t + 1$ as $r(t)$. We assume that $r(t)$ is an exogenous sequence, and that $r(t) > 0$. For simplicity, we assume an economy that is not growing over time. We also abstract from uncertainty.

The public's willingness to accumulate real interest bearing government debt, $B(t)$, is assumed to be limited. In particular, we assume that $B(t)$ is constrained by

$$(0) \quad B(t) \leq \bar{B}$$

Equation (0) asserts that, like all private borrowers, the government is faced with an upper bound on the amount of debt that it can place. One upper bound on $B(t)$ is total wealth in a country. When all savings of a country have been absorbed in government debt, no more government debt can be placed. In practice, the actual upper bound \bar{B} is far lower than the total wealth. In August 1982, $B(t)$ in Mexico appeared to have hit \bar{B} . In France,

between 1924 and 1926, $B(t)$ appeared to have been close to \bar{B} , precipitating a continuing financial crisis and "the waltz of the portfolios" of the Finance Ministers of France.

The public's willingness to accumulate base money is assumed to be described by a demand function of the specific form

$$(1) \quad M(t)/p(t) = a(1) - a(2)E_t(p(t+1)/p(t)), \quad a(1) > a(2) > 0$$

where $M(t)$ is the stock of base money at time t , $p(t)$ is the price level at time t , and $E_t(\cdot)$ is the value of (\cdot) expected to prevail by the public as of time t .^{3/}

Equation (1) is a version of the demand function for money that Phillip Cagan used to study hyperinflations. It depicts the demand for real base money as a decreasing function of the expected gross rate of inflation $E_t(p(t+1)/p(t))$. A variety of theories imply a demand function for base money of this form. There is also ample empirical evidence that is consistent with the inverse dependence between real balances $M(t)/p(t)$ and expected inflation $E_t(p(t+1)/p(t))$ that is posited by (1). For example, in the year before August 1946, the price level in Hungary increased by a factor of about $4 \cdot 10^{24}$. It is reasonable to expect that people had caught on to the extraordinarily rapid ongoing inflation, so that $E_t(p(t+1)/p(t))$ was large by the middle of 1946. In August 1946, the real value of high-powered money $M(t)/p(t)$ in Hungary, measured in 1946 U.S. dollars, was less than \$25,000.

The system that emerges from writing down the version of (1) appropriate for dates $t, t + 1, t + 2, \dots$ can be solved to express $p(t)$ solely in terms of expected future values of $M(t)$:

$$(2) \quad p(t) = (1/a(1)) \sum_{j=0}^{\infty} (a(2)/a(1))^j E_t M(t+j)$$

Equation (2) expresses the price level at t as a function of the supply of base money expected to prevail from now into the indefinite future. The logic underlying this equation is simple. Equation (1) implies that the price level at t varies directly with the money supply at t and with the price level expected to prevail at $t + 1$. Equation (1) also implies that the price level at $t + 1$ varies directly with the money supply at $t + 1$ and with the price level expected to prevail at $t + 2$, and so on. Upon eliminating future expected price levels from this infinite sequence of relationships, equation (2) emerges. Notice that in the special case of $a(2) = 0$, equation (2) becomes a version of the simple quantity theory of money, stating that the price level at t is proportional to the supply of high-powered money at t .

Equation (2) shows how the price level at t is determined by the interaction of the the public's preference for holding high-powered money, which is reflected in the parameters $a(1)$ and $a(2)$, with the expected path of high-powered money now and into the indefinite future. According to equation (2), if government deficits are to influence the price level, it can only be through their effects on the expected path of high-powered money. In this sense, equation (2) embodies the monetarist presumption that "inflation is always a monetary phenomenon."

The government deficit and the level and rate of change of the stock of base money are not related in any necessary way at a particular point in time. The reason is that the government can, at least up to a point, borrow by issuing interest bearing

debt, and so need not necessarily issue base money to cover its deficit. More precisely, we can think of representing the government's budget constraint in the form^{4/}

$$(3) \quad G(t) - T(t) = (M(t) - M(t-1))/p(t) \\ + B(t) - (1+r(t-1))*B(t-1)$$

where $G(t)$ is real government expenditures at t , $T(t)$ is real tax collections net of transfers (except for interest payments on the government debt), $B(t)$ is the real value at t of one-period bonds issued at t , to be paid off at $t + 1$ and to bear interest at the net real rate $r(t)$. Equation (3) asserts that the real government deficit at t , $G(t) - T(t)$ can be financed by a combination of printing new high-powered money, in the amount $M(t) - M(t-1)$, which raises $(M(t) - M(t-1))/p(t)$ in real resources, and by borrowing in interest bearing form $B(t)$ in excess of the principle and interest on the debt that is maturing, $(1+r(t-1))B(t-1)$. Equation (3) must hold for all t . For simplicity, equation (3) assumes that all government interest bearing debt is one period in maturity. It is important to point out that the formulation (3) in effect assumes that government debt is indexed, and constitutes a sure claim on given amounts of future goods. Either the debt is regarded as explicitly indexed, or else the bonds are nominal ones, with the nominal rate of interest being imagined to adjust by the subsequently realized rate of inflation so that they turn out to bear real rate $r(t)$ in equilibrium. In a rational expectations model in which there is no objective uncertainty, which is the kind of model we have in mind here, these two interpretations

are equivalent. It is important to emphasize that on either one of these interpretations, the government is imagined to honor its commitments to repay interest bearing debt at the real interest rate that was anticipated at the time at which the debt was contracted. In reality, when part of the outstanding government debt is nominal, the government has the option of "defaulting" on part of it by acting so as to inflate at a higher rate than had been expected when the debt was contracted. In the subsequent presentation, we shall begin by assuming that the government always abstains from defaulting on any of its interest bearing debt.

We imagine that there is a fiscal authority that selects a time stream of $G(t)$ and $T(t)$. A consequence of the fiscal authority's choice is a stream of government deficits net of interest payments, $G(t) - T(t)$. There is also a monetary authority, which determines the composition of the government debt in the hands of the public through open market operations. The monetary authority's open market operations at time t are subject to a constraint, which is derived by simply rearranging (3):

$$M(t) + p(t)*B(t) = M(t-1) + (1+r(t-1))*p(t)*B(t-1) \\ + p(t)*(G(t)-T(t)).$$

The monetary authority is free to choose $M(t)$ and $p(t)*B(t)$ subject to the constraint that they add up to the total on the right side of the preceding equation. In other words, at a point in time, the monetary authority can exchange base money for bonds of equal value.

4. Are Government Deficits Inflationary?

Under the system formed by (2) and (3), the inflationary consequences of a government deficit at time t depend sensitively on the government's strategy for servicing the debt that it issues. This dependence can be illustrated by considering two polar regimes for servicing the debt, and for coordinating monetary and fiscal policy.

We consider first a strict "Ricardian regime" in which government deficits have no effects on the rate of inflation. In this regime, the government always finances its entire deficit or surplus by issuing or retiring interest bearing debt. Additional base money is never issued to finance a deficit. This regime can be characterized by either of the following two equations, which are equivalent in view of equations (3) and (0):

$$(4) \quad M(t) - M(t-1) = 0 \text{ for all } t$$

$$(5) \quad B(t) = E_t \sum_{j=0}^{\infty} R_{tj}^{-1} (T(t+j+1) - G(t+j+1)) \text{ for all } t$$

where $R_{tj} = \prod_{i=0}^j (1+r(t+i))$. Equation (4) states that the supply of base money is always a constant, while equation (4) states that the real value of interest bearing government debt at t equals the present value of prospective government surpluses. In this regime, a positive value of interest bearing government debt signals a stream of future government budgets that is in surplus in the present value sense of equation (5). Increases in government debt are necessarily temporary, in a sense made precise by (5).^{5/}

In the Ricardian regime, government deficits have no effects on the price path because they are permitted to have no effects on the path of base money. For the path of base money to be unaffected by government deficits, it is necessary that the government deficits be temporary and be expected to be accompanied by offsetting future government surpluses. In the Ricardian regime, the government behaves like a firm with respect to financing its deficit. To finance a given deficit, the government competes for funds from lenders on an equal footing with private borrowers. To attract funds, the government must offer lenders a prospective stream of net revenues sufficient to support the value that it presently proposes to borrow. The government's stream of net revenues is $T(t) - G(t)$. The present value of this stream forms the "backing" for the government's borrowing, just as the present value of a stream of prospective net revenues from a new machine might form the backing for a private loan. Furthermore, like any private borrower, the government can borrow only a limited amount in interest bearing form, an amount determined by the maximum present value of prospective government surpluses that the economy can support. This is the limit \bar{B} embodied in equation (0).

The Ricardian regime may seem remote as a description of recent behavior of the U.S. government and some of its major trading partners. It is worthwhile to recall that states and cities in the United States are constitutionally required to operate under a Ricardian rule, since they have no right to issue base money. In the nineteenth century, the Ricardian rule was

followed, with temporary lapses, by Great Britain, the United States, and the more advanced countries on the European continent. (It is no coincidence that the economically advanced countries all adopted such a rule, and that they all abandoned it at about the same time, during and after World War I. There are irresistible forces impelling countries that trade with each other to coordinate their monetary and fiscal policies. Those forces often cause countries to run fiscal policies that resemble one another. A country had to follow a Ricardian rule, or something close to it, in order to adhere to the international gold standard.)

There are alternatives to the Ricardian debt servicing regime under which government deficits are inflationary. To take an example at the opposite pole from the Ricardian regime, we consider a rule that was followed for a while during the great Revolutions in France and Russia, was used during each of the great European hyperinflations of the twentieth century, and a version of which was actually advocated by Milton Friedman in 1948. This rule can be characterized by either of the two equations,

$$(6) \quad B(t) = 0 \text{ for all } t,$$

$$(7) \quad G(t) - T(t) = (M(t) - M(t-1))/p(t) \text{ for all } t.$$

In view of the government budget constraint (3), these two equations are equivalent characterizations of a rule in which the entire deficit is always immediately financed by printing additional base money. Interest bearing debt is never issued. In

this regime, the time path of government deficits affects the time path of both base money and the price level in a rigid and immediate way that is described by equation (7) and by our theory of the price level, equation (2). Under this debt servicing regime, it is possible for the government budget to be persistently in deficit, within limits imposed by equation (7) and the demand function for base money (1) (or its implied theory of the price level (2)). In this regime, deficits need not be temporary.

In this regime, the government finances a current deficit not by a promise to run surpluses in the future, as in the Ricardian regime, but instead by levying an immediate "inflation tax" on the present holders of base money. Whereas the Ricardian regime involves a commitment ultimately to abstain from any resort to an inflation tax, the polar alternative 1948 Friedman regime involves a promise that any government deficit will be immediately and fully monetized. We shall return later to the question of why someone like Milton Friedman, who has never been an advocate of monetary regimes leading to rampant inflation, would at one time have advocated a regime of full monetization of government deficits, the regime that has accompanied the worst inflations in history.

It is possible to imagine deficit financing regimes that are intermediate between Ricardo's and Friedman's. Bryant and Wallace (1980) and Sargent and Wallace (1981) have described such regimes. In all versions of these regimes, interest bearing government debt is issued, but is eventually repaid at least partly by issuing additional base money. In the regime studied by

Sargent and Wallace, the deficit path involves such a persistent stream of large deficits, that eventually the inflation tax must be resorted to, with increases in base money having to be used to finance the budget.

In all of these intermediate deficit financing regimes of the Bryant-Wallace variety, increases in interest bearing government debt are typically inflationary, at least eventually, because they signal eventual increases in base money. Sooner or later, these prospective increases in base money will increase the price level, how soon depending on the coefficients $a(1)$ and $a(2)$ in equation (1). According to (2), the closer is $a(2)/a(1)$ to unity, the bigger is the effect of a given future increase in base money on the price level today. This is true, because according to (1), the larger is $a(2)$ relative to $a(1)$, the more sensitive is the current price level to the expected future price level, and therefore also to expected future values of base money.

The preceding discussion indicates that the observed correlation between government deficits and the price level depends on the debt-repayment regime that was in place when the observations were generated. On the one hand, under a Ricardian regime, deficits and the price level would be uncorrelated, because government deficits would not cause movements in the stock of base money. On the other hand, under Friedman's regime, deficits would be highly correlated with the price level. It would therefore be a mistake to estimate the correlation between the deficit and the price path from time series observations drawn from a period under which a Ricardian regime was in place, and to

assert that this same correlation will hold between the deficit and inflation under a regime like that described by Friedman or Bryant and Wallace. It would be a mistake because it would ignore the principle of strategic interdependence: private agents' interpretations of observed deficits, and consequently the impact of observed deficits on the price level, depend on the debt servicing regime that they imagine to be in place.

The Ricardian regime, Friedman's 1948 regime, and the intermediate Bryant-Wallace regimes each involve solutions of one kind or another to the problem of coordinating the actions of the monetary and fiscal authorities. The government budget constraint (3) implies that coordination is necessary, for by virtue of its control over the division of government debt in the hands of the public between interest bearing debt and base money, the monetary authority controls the flow of revenues from the inflation tax which can be used to cover current and future deficits. In principle, the monetary authority has the power to force the system into the Ricardian regime, simply by refusing to monetize any interest bearing government debt. The fiscal authority would thereby be compelled to place its debt with private lenders, presumably by competing on an equal footing with other borrowers.

Under each of the debt servicing regimes that we have described so far, interest bearing government debt has been assumed in effect to be indexed. As mentioned earlier, either the debt is regarded as explicitly indexed, or else the rationality of the public's price level expectations and the fact that the government is imagined to adhere to policies or entire time paths of

$(G(t) - T(t))$, $M(t)$, and $B(t)$ mean that a system with nominal government debt behaves just like a system with indexed government bonds.^{6/} Since we want to apply the results of our reasoning to recent U.S. experience, in which government borrowing is in nominal terms, it is important to stress the aspect of the preceding regimes that government plans are adhered to. Though in some of the above regimes the government may resort to an inflation tax, it is known in advance that the government plans to do so. There is no element of fraud or deception in the inflation generated under such regimes.

However, when all or part of the government interest bearing debt is in nominal form, at each point in time the government appears to have the option of defaulting on part of the debt by inflating at a rate greater than had initially been expected. In the context of the rational expectations assumption that we are working with here, inflation at a greater rate than had initially been expected by the public is brought about when the government departs from an initial plan for $G(t) - T(t)$, $M(t)$, and $B(t)$ that was thought by the public to be in place and embarks on a plan implying a higher price level for the present period than had originally been anticipated. Resorting to this option is a form of default, because it gives holders of interest bearing government debt and base money different real rates of return than they initially had bargained for on the basis of the originally planned time paths of $G(t) - T(t)$, $M(t)$, and $B(t)$.

This default option can be represented by reformulating the government budget constraint (3) in terms of the nominal

interest rate on government interest bearing debt. Let $rn(t)$ be the nominal interest rate on one period debt from period t to $t + 1$. Then the real rate of interest $r(t-1)$ is related to $rn(t-1)$ as

$$(1+r(t-1)) = (1+rn(t-1))*p(t)/p(t-1)$$

which states that with a previously fixed nominal rate of interest, the realized real rate of interest between $t - 1$ and t is lower the higher is the price level at t . We can use the above equation to write the government budget constraint as

$$(8) \quad G(t) - T(t) = (M(t)-M(t-1))/p(t) + B(t) \\ - B(t-1)*(1+rn(t-1))*p(t-1)/p(t).$$

This equation shows how generating a higher price level than had previously been expected helps to finance a current deficit, and to diminish the need to sell new government debt.

There are serious questions about whether, and if so, under what circumstances a government should resort to the option of defaulting that is present when part of the debt is in nominal terms. There is also a serious question of the scope that a government actually has for repeatedly resorting to the default option.^{7/} Presumably, a government that once reneges on its plans for $G(t) - T(t)$, $M(t)$, and $B(t)$ is less likely to be trusted the next time. The public can be expected to evaluate subsequent government plans and announcements against the background of the government's reputation for executing previous plans. Prospective lenders to a government and holders of its base money thus have some latitude to punish a government with a history of defaulting on its plans.

5. Reaganomics and Credibility

We have argued that the government budget constraint requires that monetary and fiscal policies be coordinated, and that a variety of coherent and default-free schemes for coordinating them can be imagined, the Ricardian regime and Friedman's 1948 regime being polar examples. We have also indicated that when some of the government debt is in nominal form (and remember that base money itself is in such a nominal form), there lurks the possibility of defaulting on part of the debt by renegeing on the original plan for time paths of monetary and fiscal variables. I shall now use these ideas as a basis for criticizing the program for coordinating monetary and fiscal policy that was implicit in Reaganomics, as it was manifested during the first year and a half or so of the Reagan Administration.

The Reagan Administration began office encouraging a policy for the monetary authority that would be appropriate for the Ricardian regime, but plans for taxes and expenditures that could be feasible only, if at all, under some version of a Bryant-Wallace regime. The administration initially supported a commitment to a monetarist policy of $(M(t)-M(t-1)) = 0$ forever. Simultaneously, however, in conjunction with the Congress, the Administration adopted tax and expenditure plans that implied large positive values of $(G(t)-T(t))$ into the indefinite future. As we have seen above, such monetary and fiscal policies are incompatible, it simply not being feasible to carry out both of them.

My colleague Neil Wallace has described the scheme for coordinating monetary and fiscal policies that was being utilized

at the inception of the Reagan Administration as coordination via resort to a "game of chicken". The monetary authority had promised to stick to a tight money policy of $M(t) - M(t-1) = 0$ for all future t 's, come hell or high water. But meanwhile, the fiscal authority had set in place tax and expenditure plans that implied large values of $(G(t)-T(t))$ into the indefinite future. On the one hand, if the monetary authority could successfully stick to its guns and forever refuse to monetize any government debt, then eventually the arithmetic of the government's budget constraint would compel the fiscal authority to back down and to swing its budget into balance. On the other hand, if the fiscal authority were to stick to its guns and simply refuse to reduce the stream of $(G(t)-T(t))$, then eventually the arithmetic of the government budget constraint would compel the monetary authority to monetize large parts of the deficit. All that is clear is that in this situation, one of the two parties to the conflict eventually has to give in. (The party to capitulate is called a "chicken".)

This situation can be likened to the quarterback of a football team (the fiscal authority) announcing that he is going to run the ball and wants the tight end to block, while simultaneously the tight end (the monetary authority) announces that he wants to catch a pass and will run a pass route on the next play. The quarterback and the tight end point out to one another that the other had better capitulate, or else the next play will go badly. About the only thing that is certain about this situation is that it cannot long endure.

Coordination of monetary and fiscal policy by use of such a game of chicken necessarily confronts private agents with uncertainty about subsequent taxes, rates of inflation, and rates of interest on government securities. Unlike uncertainty about the weather or about the success of a new technology or machine, the uncertainty injected into the economy over the outcome of a struggle between monetary and fiscal policies such as we have described is entirely avoidable and unnecessary. Private agents are forced to form opinions about when and how the conflict between government agencies will be resolved. Some of the observed market reactions to that situation can be interpreted in terms of the preponderance of public opinion about how the conflict would eventually be resolved. For example, the high long-term nominal interest rates that prevailed in 1981 and 1982 can be interpreted as reflecting the market's guess that large deficits would persist and eventually be monetized in large part, leading to high inflation rates in the future. In addition, the very injection of substantial extraneous uncertainty is potentially capable of triggering contractions in output and expansions of unemployment due to the additional sheer confusion faced by agents.

On this interpretation of Reaganomics, Reaganomics was not credible because it was not feasible. It was simply not feasible simultaneously to carry out both the fiscal and monetary aspects of Reaganomics. Therefore, to rational observers, Reaganomics was incredible. This was paradoxical because more than any recent administration, spokesman for the Reagan Administration initially placed substantial stress on "announcement effects" and

the immediate benefits that would flow from adhering to a credible long-run strategy.

However, there is perhaps another and more favorable interpretation of Reaganomics that involves a more complicated game of chicken against the background of the government budget constraint. This game of chicken involves not two but three players. Imagine that a first player sets a path for $T(t)$, a second player sets a path for $G(t)$, and a third player via open market operations, sets a path for $M(t) - M(t-1)$. Suppose that the first and third parties wish to reduce the size of the government, as measured by the stream of $G(t)$. While these two parties do not directly control $G(t)$, by acting together they can bring pressure upon it. For if the entire path of $T(t)$ is somehow reduced, and if the monetary authority maintains a policy of setting $M(t) - M(t-1) = 0$ for all future t , then the arithmetic of the budget constraint (3) and the implied need to finance current deficits by promising to run future surpluses will cause the second party to capitulate and to reduce $G(t)$.

Though oversimplified, this three-party game captures the motivation of some advocates of the Reagan Administration's policies. The Administration can be viewed as having implemented a strategy of moving quickly to reduce taxes before announcing or planning concrete expenditure reductions, while simultaneously encouraging tight monetary policy, and then opposing rescinding tax increases in order to balance the large deficits that threatened to develop in the future. Viewed in this way this game of chicken, fought against the backdrop of the arithmetic of equation

(3), is a struggle over how large the government of the United States is to be. The particular strategy for reducing the size of the government that I have described is attractive, even for one who wants a smaller government, only if one is relatively confident that the uncertainties injected into monetary and fiscal arrangements by fighting the struggle in this way will not unduly adversely affect the performance of national output and employment.

6. Conclusion

There is a variety of methods of coordinating monetary and fiscal policies that are superior to resorting to Wallace's game of chicken. For example, a case can be made that either of the polar regimes described above, the Ricardian regime or Friedman's 1948 regime, dominates the game of chicken. The game of chicken that we have described amounts to a struggle for dominance between the fiscal and monetary theory, in which each party promises to stick to a strategy that is feasible only if the other player acts as a follower. (Such a situation in which each player seeks to behave like a leader is the case of "Stackleberg warfare" referred to above.) Under the Ricardian regime, the monetary authority in effect dominates the fiscal authority in so far as concerns decisions about the present value of government deficit. On the other hand, under Friedman's 1948 regime, it is the fiscal authority that dominates the monetary authority so far as concerns decisions about the rate of growth of base money. Each of these polar regimes has a well defined structure of dominance, and has relatively straightforward implications for the paths of

government interest bearing debt and base money, to which the public can be imagined to adjust readily. Furthermore, each of the polar regimes entails a relatively clear assignment of responsibility for inflation, in so far as government policy influences the rate of inflation. As we have portrayed the structure of the economy and characterized the conduct of policy under the Ricardian regime, inflation can emerge only if there occur changes in the preferences of the public, the structure of legal regulations, or perhaps the conduct of foreign governments that supply substitutes for base money and government debt, each of which would be reflected in a change in our parameters $a(1)$ and $a(2)$. Under Friedman's 1948 scheme, government deficits have direct and immediate inflationary consequences, which are there for everyone to see.

How is the question of coordination of monetary and fiscal policies to be resolved? Current legislation in the United States leaves the method of resolution open, so that in practice it is resolved by the successive interactions of a succession of personalities and administrations within our fiscal and monetary institutions. It can be argued that superior outcomes would be achieved if the responsibilities of the monetary and fiscal authorities were legislatively or constitutionally restricted so as to determine in advance which institutions are to lead and which are to follow.

Footnotes

1/Technically, this is the government deficit net of interest payments.

2/Since its decisions about the composition of the debt influence the interest payments that the government must make, the monetary authority helps determine the government deficit gross of interest payments, and thereby the rate at which total government debt changes.

3/Notice that when $a(2) = 0$, equation (1) becomes a simple version of the quantity theory of money.

4/Another way to write (3) is

$$\begin{aligned} G(t) - T(t) + r(t-1)B(t-1) &= (M(t)-M(t-1))/p(t) \\ (3') & \\ &+ B(t) - B(t-1) \end{aligned}$$

The term $G(t) - T(t) + r(t-1)B(t-1)$ is often called the government deficit gross of interest payments, while $G(t) - T(t)$ is termed the government deficit net of interest payments. The monetary authority is assumed to control the ratio of $B(t)$ to $M(t)$ at each point in time. It thereby influences the subsequent rate of growth of total government indebtedness by influencing the interest expenses $r(t-1)B(t-1)$ that appear in (3').

5/One way to implement the regime given by (4) and (5) is simply to adjust current taxes $T(t)$ by an amount equal to any variations in interest payments $r(t-1)B(t-1)$ that are associated with variations in past government expenditures or taxes. This policy amounts always to levying current taxes sufficient to

service the interest payments that are currently due. This is the way that McCallum (1984) proceeds in one of his experiments.

6/This is one of the findings of the theoretical literature on indexed government bonds: that under general circumstances, they make no difference to a rational expectations equilibrium. See Liviatan (1983) or Peled (1980).

7/These questions are raised and discussed by Kydland and Prescott (1977) and Calvo (1978).

References

- Bryant, John and Neil Wallace. 1980. "A Suggestion for further Simplifying the Theory of Money." Research Department Staff Report 62. Federal Reserve Bank of Minneapolis.
- Cagan, Phillip. 1956. "The Monetary Dynamics of Hyperinflation." In Studies in the Quarterly Theory of Money, ed., Milton Friedman, pp. 25-117. Chicago: University of Chicago Press.
- Calvo, Guillermo. 1978. "On The Time Consistency of Optimal Policy in a Monetary Economy." Econometrica, vol. 46, No. 6.
- Friedman, Milton. 1948. "A Monetary and Fiscal Framework for Economic Stability." American Economic Review 38, (June): pp. 245-64.
- _____. 1960. A Program for Monetary Stability. New York: Fordham University Press.
- Kydland, Finn E. and Edward C. Prescott. 1977. "Rules Rather Than Discretion: The Inconsistency of Optimal Plans." Journal of Political Economy, vol. 85, No. 3.
- Liviatan, Nissan. 1983. "On Equilibrium Wage Indexation and Neutrality of Indexation Policy," in Pedro Aspe Armella, Rudiger Dornbusch, and Maurice Obstfeld, eds., Financial Policies and the World Capital Market: The Problem of Latin American Countries. University of Chicago Press.
- McCallum, Bennett T. "Are Bond-financed Deficits Inflationary? A Ricardian Analysis." Journal of Political Economy, vol. 92, No. 1, February 1984, pp. 123-135.

Peled, Dan. 1980. Government Index Bonds--Do They Improve Mat-
ters?" Ph.D. Thesis, University of Minnesota, (November).

Sargent, Thomas J. and Neil Wallace. 1981. "Some Unpleasant
Monetarist Arithmetic," Federal Reserve Bank of Minneapolis
Quarterly Review, Fall.