II. Fiscal Theory in a One-Period Economy

The FTPL is defined by its non-Ricardian assumption on fiscal policy. The best way to understand this assumption and to quickly get to the heart of the FTPL is to examine a one-period model.[21] That's what we do here.

We begin with the conventional wisdom, the classic Sargent and Wallace (1981) analysis. We go on to explain how the FTPL differs from this conventional wisdom: Sargent and Wallace adopt the Ricardian view, while the FTPL adopts the non-Ricardian view of policy. We explore several interpretations of these assumptions and conclude that the non-Ricardian assumption requires that the government is able to commit to its policy actions in advance. We then ask, how can we assess the empirical plausibility of the non-Ricardian assumption? Finally, we explain how the FTPL can be used to study the price level in an economy with no government-provided fiat money.

Sargent and Wallace's Unpleasant Monetarist Arithmetic

Suppose that in the morning of the only day in this model, private agents hold a given amount of government debt, b. Here and throughout this review, we assume government debt is non-negative: Agents cannot borrow from the government. In the Sargent and Wallace model, debt is fixed in real terms; it represents a commitment to pay a fixed real amount of goods—for instance, corn.

The government's budget constraint is given by

$$b' + s^f + s^m = b.$$

The left and right sides of this equation summarize the sources and uses, respectively, of corn to the government. The first source of funds, b', is corn the government receives from households that purchase new debt in the evening. The second term, s^f, denotes taxes net of spending, and the third term, s^m, is seignorage from government-supplied fiat currency. The right side of the budget constraint, b, is the principal and interest on past government debt.

Optimizing households will obviously never choose $b' > 0$, and they are constrained from setting $b' < 0$ by assumption. Therefore, household optimization implies that b' must be zero. By imposing this result, we get the intertemporal government budget equation,

$$(2.1) \qquad b = s^f + s^m.$$

Sargent and Wallace's main conclusions can be understood from this equation. Suppose a "loose" fiscal policy is adopted—that is, s^f is reduced. Simple arithmetic dictates the monetary authority must increase s^m. Under normal circumstances, this translates into an increase in inflation.[22] In a multiperiod model, there is some discretion over timing. The rise in inflation can occur sooner or later, or it could be spread out over time. Whatever the timing, though, if the fiscal authority reduces s^f, the arithmetic necessitates inflation must go up at some point. Hence the title of Sargent and Wallace's famous paper, "Some Unpleasant Monetarist Arithmetic."

The same arithmetic suggests a solution to the inflation problem: Design central banks so they can credibly commit to not "caving in" to an irresponsible fiscal authority that sets s^f too low. Governments around the world have sought to implement this solution by making central banks independent and directing them to assign a high priority to inflation. With the monetary authority completely committed to a fixed value for s^m, the arithmetic forces the fiscal authority to adopt a fiscal policy consistent with that s^m. This is the basis for the current conventional view that to achieve a stable price level, it is sufficient to have a tough, independent central bank that is focused on prices.

The Fiscal Theory

According to FTPL advocates, the Sargent and Wallace framework may not be relevant for economies like the United States. In practice, government debt is a commitment to deliver a

■ **21** We are grateful to Marco Bassetto for suggesting this to us.

■ **22** By "normal," we mean that the economy is on the "right" side of the Laffer curve. Seignorage is the nominal increase in the money stock divided by the price level. A convenient formula becomes available if we temporarily reinterpret our model as a multiperiod model in a steady state. Let the demand for real balances be $m = \exp(-\alpha\pi)$, where $\alpha > 0$, π is the gross inflation rate from this period to the next, and m is the money stock divided by the price level. Seignorage, then, is just $m(1-1/\pi) = \exp(-\alpha\pi)(1-1/\pi)$. For inflation rates below $\pi^* = \left(\alpha + \sqrt{\alpha^2 + 4\alpha}\right)/(2\alpha)$, seignorage is increasing in inflation, and for inflation rates above this point, seignorage is decreasing. The "right" side of the Laffer curve refers to inflation rates below π^*.

certain amount of domestic currency, not goods. This creates new possibilities.

Let's revise the previous analysis, replacing b with B, nominal debt. The government's budget constraint becomes

(2.2) $B' + P(s^f + s^m) = B.$

As before, optimizing households will not buy government debt in the evening. With demand at zero, equilibrium can be reached only at $B' = 0$. Equation (2.2), with $B' = 0$, is the government's intertemporal budget equation,

(2.3) $B = P(s^f + s^m).$

Now, P is an endogenous variable. If the fiscal authority makes s^f small, there is no arithmetic to compel the monetary authority to raise s^m. If the monetary authority holds fast to s^m while the fiscal authority reduces s^f, the equation can be satisfied as long as P jumps. This is what FTPL advocates expect would happen.

Interpreting Ricardian and Non-Ricardian Fiscal Policy

At this point, we must clarify two key concepts. Fiscal and monetary policy are said to be *non-Ricardian* if $s \equiv s^f + s^m$ is chosen in a way that does not guarantee the intertemporal budget equation (2.3) is satisfied for all possible prices. In contrast, s is a Ricardian fiscal policy if it is chosen so that the intertemporal budget equation is satisfied no matter what P is realized. In our single-period model, this can happen only if s is a particular function of the price level, $s(P) = B/P$. The assumption that fiscal and monetary policy are non-Ricardian defines the FTPL.

How are we to interpret non-Ricardian policy? In principle, two interpretations are possible. The first may seem natural, initially; however, on further reflection it makes no sense. In this interpretation, the government is unconcerned with the intertemporal budget equation when it chooses s: Either it is unaware of its existence, or it simply does not care. If the government were completely unconcerned with intertemporal budget balance, it would be impossible to understand why we have taxes. Absent concerns that stem from the existence of the intertemporal budget equation, borrowing is always more appealing than raising taxes because the latter produces deadweight losses. If governments didn't raise taxes, however, s would be negative and there would be no positive value of P to satisfy the intertemporal budget equation. If we adopt this interpretation of non-Ricardian policy, the apparent existence of equilibrium is a puzzle. This interpretation deserves no further consideration.

Can the government's concern for intertemporal budget balance be reconciled with the notion that s is set exogenously, not as a function of P? Yes, if we imagine the government commits to s in advance, before P is determined. We can illustrate this in two ways. The first is based on the parable of the Walrasian auctioneer, who helps the economy find the equilibrium price level. Under the non-Ricardian assumption, the government announces s before the Walrasian auctioneer finds the market-clearing price level. When the government selects s, it fully understands that households will buy zero B' in equilibrium. However, because of its first-move advantage, the government knows it can force the auctioneer to choose P so that $P = B/s$.

Our second illustration is drawn from everyday life. A pedestrian who wants traffic to stop at a crosswalk will sometimes step into the street, making a show of being unconcerned about oncoming cars. Is such a person really unconcerned with the prospect of being struck and killed? Of course not. He expects the oncoming cars, seeing his commitment to cross regardless of the consequences, to stop rather than suffer the horror of an accident. Under a non-Ricardian fiscal policy, the government's approach is analogous to that of the pedestrian. The government's "policy" is simply an action, s. In principle, a value of P could occur that would put the government in the fiscally explosive situation of offering debt that the market refuses to absorb—that is, $B' > 0$. However, if the market is completely convinced of the government's commitment to s, then, like the car that stops for the pedestrian, the market will generate a value of P to guarantee debt is not excessive (in this case, "excessive" simply means greater than zero). The non-Ricardian government banks on the idea that the market

abhors non-equilibrium P as much as drivers abhor hitting pedestrians.[23]

Although the word "commitment" in this context is consistent with the technical economics literature, it may nevertheless confuse the reader because it has so many meanings in everyday language. By saying the government has commitment, we mean only that it moves first, before prices are set. We do not mean to imply the government's motives are laudable, or its ability to move first reflects strength of character on the part of policymakers. For example, a government that is perpetually in gridlock because legislators cannot reach agreement acts with commitment, in our usage of the term.[24]

Now consider Ricardian policies. For the purpose of our analysis, we take no position on the relationship between these policies and the government's ability to commit. Still, we suspect that Ricardian policies are consistent with any degree of commitment.

Although Sargent and Wallace don't use this language, it seems fair to say they adopt a Ricardian specification of policy. If we think of their analysis as applying to a realistic modern economy, then we must think of real government debt in their model (that is, b in equation [2.1]) as B/P. For different values of P, the value of b changes, leading to adjustments in $s^m + s^f$ under the Sargent and Wallace analysis. Therefore, we interpret Sargent and Wallace as adopting the Ricardian assumption.

Is the FTPL *Sensible?* An Analogy to Microsoft

Under the FTPL, the price level is determined by equation (1.1) or equation (2.3). A reasonable question at this point is, is there any sensible interpretation of the FTPL? At first glance, determining P in this way may seem like accounting gimmickry without substantive interest. But this is not the case. As Cochrane (2000) emphasizes, the price of Microsoft shares is determined the same way! Under the FTPL, the government's relationship to its bondholders is somewhat like Microsoft's relationship to its equity holders.

Microsoft works to set aside real output for equity holders, though its motives for doing so are different from the government's. Microsoft does not calibrate its dividend stream to guarantee the present-value formula for its stock price will hold for all possible stock prices. Instead, the mechanism operates in precisely the opposite direction: Market traders forecast what Microsoft will generate for them, then calculate the ratio of that amount to the number of shares outstanding, and that's the stock price! FTPL advocates argue the price level in an actual economy is determined in exactly the same way. The government does not calibrate s to ensure its present-value budget equation (2.3) for all values of P. Instead, bondholders figure out how many goods (s) the government is setting aside for them and then calculate the price level as the ratio of B to s.

Is the Non-Ricardian Assumption Empirically Plausible?

In assessing the FTPL as a positive theory for a particular time period, the plausibility of the non-Ricardian assumption must be considered. A simple examination of time-series data will not help. Under both the non-Ricardian and the Ricardian assumptions, we expect to see $s = B/P$. The only direct way to distinguish the two assumptions is to see how s responds when the economy is out of equilibrium. According to the Ricardian assumption, s adjusts with P to

■ **23** As the analogy suggests, there can be trouble if commitment is not credible. If the oncoming traffic is not completely convinced of the pedestrian's commitment (drivers believe the pedestrian is sneaking glances at the oncoming traffic, ready to make adjustments in case something goes wrong), then miscalculations can lead to a tragic collision. We argue (see especially "Summary" on page 24) that this is possible if private agents are not completely convinced of the government's commitment to non-Ricardian fiscal policy. In this case, markets might produce the "wrong" prices, leading to excessive government debt in that the private sector refuses to purchase it. Buiter (1999) seems to be concerned with this kind of outcome: He refers to the "painful" fiscal adjustments that must be made when the "Ricardian reality dawns" and the private sector refuses to buy government debt. We do not mean to suggest that catastrophe will always occur if there is uncertainty about government policy. As "The FTPL with Stochastic Fiscal Policy" (page 15) shows, the non-Ricardian assumption is perfectly consistent with stochastic fiscal policy.

■ **24** In private communication, Christopher Sims pointed out that our notion of commitment encompasses "the commitment of two pedestrians who enter a crosswalk while engaged in a fist fight. Few doubt that they are not watching traffic."

preserve $s = B/P$. According to the non-Ricardian assumption, s is like a utility-function parameter: Its value remains unchanged, so that $s \neq B/P$ out of equilibrium. This sounds like an easy thing to check—just compare s and B/P out of equilibrium. The problem is that, according to the theories considered here, only equilibrium values of s are recorded in the data.[25]

This does not mean there is no way to choose between the non-Ricardian and the Ricardian assumptions. In fact, we think there are two ways to go. One is to extrapolate what is reasonable out-of-equilibrium behavior, based on what we see in equilibrium.[26] Another way is to view the FTPL as a starting point for a natural set of auxiliary assumptions that restrict time-series data and then test those assumptions.[27] If the non-Ricardian assumption leads to a useful set of theories, this would tip the balance in favor of that assumption. We now discuss these two approaches.

Extrapolating Out-of-Equilibrium Behavior from Equilibrium

According to the non-Ricardian assumption, the government's policy is a commitment to a particular action, s. Under the Ricardian assumption, policy is a strategy for setting s as a function of real debt. If governments directly recorded their policies in writing, we could better discriminate between the two assumptions. There are two situations where this seems to have occurred, and, with one important caveat, the results appear to favor the Ricardian over the non-Ricardian assumption. The Maastricht Treaty requires members of the European Union to adjust their fiscal variables when their real debt gets too large. The IMF works in the same way, pressuring its members to adjust fiscal variables if their real debt gets out of hand. We think it is fair to say that if a non-equilibrium P were somehow called out, these arrangements would generate an adjustment in s. Casual examination of the (admittedly, equilibrium) time-series data suggests the same. In practice, when the debt gets large, political pressures come into play to adjust the surplus to bring the debt back in line. This happened in the United States in the late 1980s and 1990s, when the federal debt began to grow significantly, producing political support for raising taxes and/or reducing spending.

Now, for the caveat: These examples suggest the non-Ricardian assumption may be an implausible characterization of current policy in Europe, the United States, and some emerging-market economies. However, as our introduction emphasized, these examples do not establish the non-Ricardian assumption as implausible for *all* times and places.

Is the Non-Ricardian Assumption a Good Starting Point?

Another way of assessing the empirical value of the non-Ricardian assumption asks how good a platform it is for developing useful, testable restrictions. Space does not permit us to pursue this idea here, beyond mentioning that interesting work is under way. In particular, Canzoneri, Cumby, and Diba (1998), Cochrane (1998a, b), Loyo (1999), and Woodford (1998b) have pursued the assumption of statistical exogeneity of the government surplus. This is not an implication of the non-Ricardian assumption per se, though that assumption does naturally lead one to it.

This approach can best be understood by an analogy attributed to Benjamin Friedman (see Cochrane [1998a]). Consider the equation of exchange, $MV = PY$, where M is money, V is velocity, and Y is output. As it stands, this equation has no testable implications; without additional assumptions, it simply defines V. Still, if incorporating simple, plausible assumptions converts the equation into a theory that allows us to understand the data better, then the equation of exchange is empirically useful.[28] Similarly, the non-Ricardian assumption may be a good starting point for identifying simple auxiliary assumptions that convert the FTPL into a useful, testable theory. If so, this would help vindicate the non-Ricardian assumption as a useful empirical assumption.

■ **25** This result holds even if there are multiple periods and uncertainty.

■ **26** There are examples of models in which the equilibrium time-series data contain information about what happens out of equilibrium. For example, in Green and Porter (1984), limited information has the consequence that events occur in equilibrium that are observationally equivalent to agents' having deviated from the equilibrium. Although agents don't actually deviate in the equilibrium, they must, nevertheless, be punished as though they had as a credible signal of what would happen if a deviation really did occur. In this sense, the events in equilibrium provide evidence of what would happen out of equilibrium.

■ **27** For a thorough discussion of this strategy, see Woodford (1998b).

■ **28** An example of such an assumption is the specification that V has a simple functional relationship to the nominal rate of interest.

Although we are inclined to be skeptical of the non-Ricardian assumption, the FTPL is still very much in its infancy. It remains to be seen where the FTPL will take us and what observations it will help us to explain. The initial results are promising, though not uncontroversial. Cochrane (1998a,b) argues that an FTPL that assumes a statistically exogenous surplus process helps us understand the dynamics of U.S. inflation in the 1970s, and Loyo (1999) argues that it is useful for understanding Brazil's high inflation in the 1980s.

Another literature, begun by Calvo (1978), Kydland and Prescott (1977), and Barro and Gordon (1983), posits that the absence of commitment in government policy can account for the high-inflation episodes mentioned in the previous paragraph. One way to assess the FTPL is to compare its ability to account for such experiences with that of the time-consistency literature. The outcome of this comparison is not obvious. McCallum (1997), among others, argues that time inconsistency is *not* a useful explanation for high-inflation episodes. Ireland (1998) argues the other way, that absence of commitment is useful.[29]

The Price Level in a World with No Government-Provided Money

Some FTPL advocates claim that an important virtue of the theory is that it provides a way of thinking about the price level that works even in a world where supply and demand for government fiat money are nonexistent. Cochrane (1998a, 2000) argues this is of interest because, to a first approximation, we have already reached that point.[30]

The basic pieces of the argument are already in place: Under the non-Ricardian assumption that $s^f + s^m$ is exogenous, equation (2.3) determines the price level. This conclusion can be reached without reference to money or whether it is even present in the economy. That's the tip-off for the result to come: The price level can be pinned down, even if there is *no* government-provided money in the economy. To see this, imagine that trade in the economy is carried out by barter. Equivalently, one could think of a scenario in which trades are financed with the exchange of financial claims on privately held assets. These trades could even be denominated in "dollars," even though government-provided money ("dollars") does not exist.

What is nominal, dollar-denominated government debt in this world with no dollars? Clearly it is not a pledge to deliver government-provided money, because there is none! Instead, it is a pledge to deliver B dollars' worth of goods to the bearer of B. The formal obligation leaves open exactly how many goods B dollars corresponds to, because the price level is unspecified. In this sense, it is like real-world U.S. government debt.[31] The price level that is realized is determined by the government's fiscal decisions. Fiscal decisions result in real surplus, s, which is what the government actually has available for paying off bondholders. With the amount of goods available to pay bondholders equal to s and the nominal value of debt equal to B, the natural definition of the price level is $P=B/s$.

At this point, the price level in a world without government-provided money may seem a useless appendage. In part IV, we shall see that the price level in such an economy can play an important role, helping to implement an efficient fiscal policy.

■ **29** For further discussion, see Albanesi, Chari, and Christiano (1999) and Christiano and Gust (2000a,b).

■ **30** According to Woodford (1998a,b,c), the assumption that money demand and supply are *literally* nonexistent is too extreme. He prefers to analyze a "cashless limit." This is an economy in which the demand for money is so small that seignorage is negligible and can, to a first approximation, be safely ignored in the government's budget constraint (both the flow-budget constraint and the intertemporal budget equation). However, the demand for money is sufficiently large that the central bank can still control the rate of interest.

■ **31** The U.S. government also offers indexed debt, which corresponds to a commitment to deliver a specific amount of a basket of goods. Indexed debt is a small portion of the government's portfolio of liabilities.