Review paper

Understanding policy in the great recession: Some unpleasant fiscal arithmetic

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ABSTRACT

I use the valuation equation of government debt to understand fiscal and monetary policy in and following the great recession of 2008–2009. I also examine policy alternatives to avoid deflation, and how fiscal pressures might lead to inflation. I conclude that the central bank may be almost powerless to avoid deflation or inflation; that an eventual fiscal inflation can come well before large deficits or monetization are realized, and that it is likely to come with stagnation rather than a boom.

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1. Introduction

I offer an interpretation of the macroeconomic events in the great recession of 2008–2009, and the subsequent outlook, focused on the fiscal stance of the U.S. government and its link to potential inflation. What happened? How did policies work? Are we headed for inflation or deflation? Will the Fed be able to fight deflation, and follow an "exit strategy" when it is time to fight inflation? Will large government deficits lead to inflation? If so, what will that event look like?

I base the analysis on two equilibrium conditions, some form of which hold in almost every model of money and inflation: the valuation equation for nominal government debt and a money-demand equation,

$$\frac{M_t + B_t}{P_t} = E_t \int_{\tau = 0}^{\infty} \frac{\Lambda_{t+\tau}}{\Lambda_t} (T_{t+\tau} - G_{t+\tau}) \, d\tau, \tag{1}$$

$$M_t V(i_t, \cdot) = P_t Y_t, \tag{2}$$

where M is money, B is debt, Λ is a stochastic discount factor, T is tax revenue including seigniorage, and G is government spending. Sargent and Wallace (1981) (also Sargent, 1992) used these two equations to analyze disinflation in the 1980s. I follow a similar path.

Monetary economists studying the postwar U.S. typically do not pay much attention to fiscal issues, feeling with some justification that fiscal issues are not a serious constraint to monetary policy. But these are new times, with massive fiscal deficits, credit guarantees, and Federal Reserve purchases of risky private assets. At some point (rises in B_t, declines in $T_\tau - G_\tau$) fiscal constraints must take hold. There is a limit to how much taxes a government can raise, a top of a Laffer curve, a fiscal

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limit to monetary policy. At that point, inflation must result, no matter how valiantly the central bank attempts to split government liabilities between money and bonds. Long before that point, the government may choose to inflate rather than further raise distorting taxes or reduce politically important spending. Argentina has found these fiscal limits. So far, the U.S. has not, at least recently. But unfamiliarity does not mean impossibility, the future may be different from the recent past, and fiscal constraints may change how monetary policy and inflation work. More generally, a lot of macroeconomics may need to be rewritten paying more attention to fiscal constraints. Conversely, a government that wants to stimulate or fight deflation has to convince markets that the right hand side of (1) is just a little looser, and conventional tools can all fail in this endeavor.

After a quick review of the theory underlying the fiscal equation, I analyze the current situation, common forecasts, and policy debates. I make the following points:

(1) Why did a financial crisis lead to such a big recession? We understand how a surge in money demand, if not accommodated by the Fed, can lead to a decline in output. I argue that we saw something similar—a "flight to quality", a surge in the demand for *all* government debt and away from goods, services and private debt. In the fiscal context of (1), this event corresponds to a decrease in the discount rate for government debt. Many of the Government's policies can be understood as ways to accommodate this demand, which a conventional swap of money for government debt does not address.

(2) Winter 2009 saw dramatic fiscal stimulus programs in the U.S., U.K., and many other countries, along with academic and public controversy over their effectiveness.
  (a) Will "fiscal stimulus" stimulate? In this analysis, deficits "stimulate" if and only if people do not expect future taxes to pay off the increased debt. Unlike conventional "Ricardian equivalence", we do not need irrationality or market failure for this expectation, since our government debt is nominal.
  (b) Much stimulus debate revolves around the fact that fiscal expenditures cannot happen quickly. In this analysis, *prospective* deficits are just as "stimulative" as current deficits.

(3) With interest rates near zero, monetary policy turned to quantitative easing: large additional purchases of short-term government debt, then long-term government debt, then private debt. I argue that the first does nothing; the second can change the timing but not overall magnitude of inflation; the third can overcome some of the "flight to quality".

(4) I examine the mechanisms and scenarios that could bring us inflation.
  (a) Can the Fed undo the massive money expansion with open-market purchases, or will it be hard to sell trillions of additional Treasury bills? The fiscal analysis does not suggest substantial impediments. If quantitative easing makes little difference on the way up, it is easy to reverse on the way down.
  (b) What will a fiscal inflation look like? I extend the simple fiscal equation (1) to long-term debt, and I analyze a stylized shock to expected surpluses. In a plausible scenario, long-term interest rates rise with the shock, but inflation only comes slowly after a few years.
  (c) Credit guarantees and nominal commitments to government employees make matters worse than actual deficits suggest, and raise the temptation for the government to inflate. On the other hand, they imply that a smaller inflation has a larger effect on government finances.
  (d) If taxes have any effect on growth, the "Laffer limit" of taxation may come much sooner than static analysis suggests. The present value of taxes is strongly influenced by growth. The big inflation danger is a long period of slow growth.

(5) Last, but perhaps most important: Will a fiscal inflation come with a boom or stagflation? I argue that the fiscal valuation equation acts as the "anchor" for monetary policy, or the "expectation" that shifts the Phillips curve. A fiscal inflation is therefore likely to lead to the same stagflationary effects as any loss of "anchoring".

I focus on Eqs. (1) and (2) because they are common to a wide array of fully fleshed-out models. It is also nice to see that we can begin to understand many events in their relatively frictionless context. However, Eqs. (1) and (2) are the beginning, not the end of analysis, and I do not mean to imply otherwise. In particular, monetary models also include a description of dynamics, and price-stickiness or other mechanism that sometimes translates inflation into real output, which I only touch on at the end of this essay. Additional frictions, to consider stimulative effects of tax or real debt-financed government spending, and additional financial frictions can easily be added to this style of analysis.

2. Fiscal review

2.1. The government-debt valuation equation

The government-debt valuation equation[1] states that the real value of nominal government debt must equal the present value of future primary surpluses. In the simplest case that the government issues floating-rate or overnight debt, it reads

$$\frac{M_t + B_t}{P_t} = E_t \int_{\tau=0}^{\infty} \frac{\Lambda_{t+\tau}}{\Lambda_t} \left(s_{t+\tau} + i_{t+\tau} \frac{M_{t+\tau}}{P_{t+\tau}} \right) d\tau \tag{3}$$

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[1] Many of the points in this section are treated at more length in Cochrane (1988, 2001, 2005). Cochrane (2005) presents a simple complete frictionless model based on (1) and (2). These papers also contain bibliographic reviews, which more properly attribute credit for the ideas.

where M_t is money, B_t is government debt, $\Lambda_{t+\tau}/\Lambda_t$ is the real stochastic discount factor between periods t and $t+\tau$, i_t is the nominal interest rate and $s_t = T_t - G_t$ denotes real primary surpluses. The web appendix (Cochrane, 2010a) derives this and related equations. In particular, it explains that we can also discount at the ex post real rate of return on government debt, i.e. we may substitute $1/R_{t,t+\tau}$ for $\Lambda_{t+\tau}/\Lambda_t$, which is useful for thinking about discount-rate effects more concretely. Seigniorage $i_t M_t/P_t$ is small for the U.S. economy, and I will ignore it in most application and discussion.

The description of price-level determination in (3) is not unusual or counterintuitive. If, at the current price level, the real value of government debt is greater than expected future surpluses, people try to get rid of that debt and purchase private assets and goods and services instead. This is "aggregate demand" or a "wealth effect of government debt".

How might debt and deficits translate into inflation? Eq. (3) gives an unusual answer and a warning: Expected *future* deficits s_{t+j} cause inflation *today*. Inflation need not wait for large deficits to materialize, for large debt to GDP ratios to occur, for monetization of debt or for explicit seigniorage. As soon as people figure out that there will be inflation in the future, they try to get rid of money and government debt now.

More specifically, the flow version of (3) says that the government prints money to redeem maturing debt, and then soaks up that money with current surpluses and by issuing new debt. If expected future surpluses decline, then people forecast future inflation when those deficits really are directly monetized. Nominal interest rates rise, and hence the government raises less revenue from today's debt sales. Now, the new money used to redeem maturing debt today is no longer all soaked up by current surpluses or new debt sales. (Selling more debt today would not help, because that requires raising promised future surpluses.) Instead, that money must chase goods and services. In this way, difficulties in rolling over short-term debt in the face of higher interest rates are one of the first signs of a fiscal inflation driven by expected future deficits, and a central mechanism by which future deficits induce current inflation.

One might well ask, "What surpluses?" as the U.S. has reported continual deficits for a long time. However, Eq. (3) refers to *primary* surpluses, i.e. net of interest expense. Like a household, if the government pays one dollar more than the interest costs, debt will not explode. Fig. 1 presents a simple estimate of the primary surplus, taken from the NIPA accounts, and expressed as a percentage of GDP. In fact, positive primary surpluses are not rare. From the end of the second world war until the early 1970s, the U.S. typically ran primary surpluses, and paid off much of the WWII debt in that way. The years 1973 and especially 1975 were years of really bad primary deficits, on the tail of a downward trend, and suggestively coinciding with the outbreak of inflation. The "Reagan deficits" of the early 1980s do not show up much, especially controlling for the natural business cycle correlation, because much of those deficits consisted of very high interest payments on a stock of outstanding debt. The return to surpluses in the late 1980s and the strong surpluses of the 1990s are familiar, and suggestively correlated with the end of inflation. Our current situation resembles a cliff, motivating some concern about future inflation.

However, though suggestive, the association of primary surpluses with the emergence and end of inflation in Fig. 1 requires a much more subtle analysis. First, Eq. (3) holds in every macroeconomic model, both ex ante and ex post. Success in such matching is in some sense guaranteed, especially once one takes into account the rate of return on government debt. Such success is not by itself persuasive that people anticipated the surpluses, or that the direction of causality in Eq. (3) goes one way or another.

Second, in any worked-out model, current surpluses are a bad indicator of the present value of future surpluses. All governments raise debt (run deficits) by credibly promising higher future surpluses. Thus we typically will see low current surpluses (deficits) accompanying expectations of *higher* future surpluses.
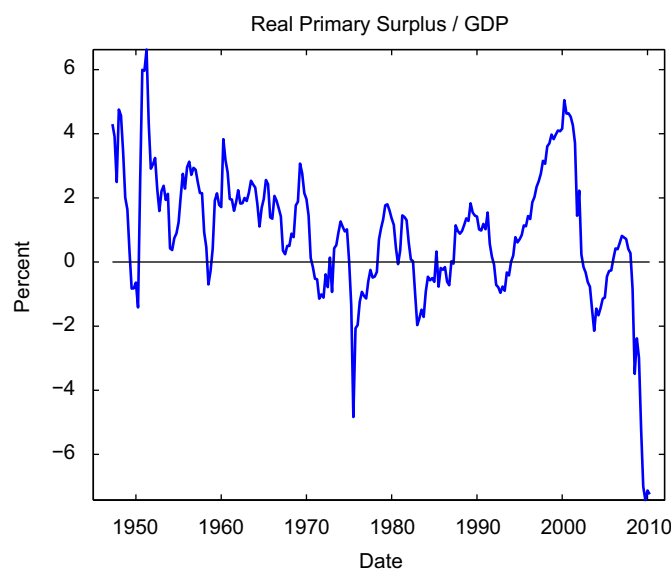

Fig. 1. Real primary surplus/GDP. Primary surplus is current receipts less current expenditures plus interests expense, deflated with the GDP deflator. Source: NIPA.

Third, changes in the discount rate or risk premium for government debt can have the same inflationary impact as bad news about future surpluses. If the discount rate or expected return declines, this makes government debt more valuable, and has the same deflationary effect as higher future surpluses. And vice versa—if the risk, liquidity, inflation premium for government debt, or real interest rates overall should rise, then government debt is less valuable. These events have an inflationary effect with no change in surpluses. Asset prices are dominated by discount-rate changes, and we should not be surprised to find them here as well.

2.2. Monetary and fiscal policy

To capture the idea that monetary policy can affect the price level by the split of government liabilities between money and debt, we also need a money demand function, that captures the "special" nature of money,

$$\left(M_t + M_t^i\right)V(i_t, \cdot) = P_t Y_t. \tag{4}$$

The notation $(i_t, \cdot)$ reminds us that many variables can affect velocity as well as interest rates; "precautionary" or "flight to quality" shifts in money demand. I include M^i because money-demand theories typically predict that inside money M^i (checking deposits) matter as well as the monetary base, direct government liabilities M_t.

Eqs. (3) and (4) each involve the price level. Thus, government must arrive at a "coordinated policy" by which monetary and fiscal policy agree on that price level, a choice of $\{M_t, B_t, s_t\}$ (and controls on M^i) such that both (3) and (4) hold.

Conventional treatments of monetary policy specify that the taxing authorities simply adjust surpluses s_{t+j} ex post to validate any price level chosen by monetary authorities through (4), thus assuming away any force for (3). Monetary policy needs an appropriate fiscal backing. We are here to think about what happens when (3) exerts more force on the price level. This change may happen by force, when debt, deficits and distorting taxes become large so the Treasury is unable or refuses to follow. Then (3) determines the price level; monetary policy must follow the fiscal lead and "passively" adjust M to satisfy (4). This change may also happen by choice; monetary policies may be deliberately passive, in which case there is nothing for the treasury to follow and (3) determines the price level.

The government-debt valuation Eq. (3) influences the price level in some unusual ways, that contrast with many classic monetary doctrines. First, except for the small seigniorage term $(i_t M_t / P_t)$, there is no difference between money and bonds in (3), so open market operations have no effects on the price level. Second, only *government* money and debt matter for the price level. People can generate arbitrary inside claims M^i with no inflationary pressure, and the government need not control such claims – ban banknotes, require reserves, etc. – in order to control the price level. In fact, the price level can remain determined even at the frictionless limit, say with all transactions mediated by debit cards on interest-paying funds, $M_t = 0$, or with money that pays market interest. Third, the government can follow a real-bills doctrine: If the government issues money M or debt B in exchange for assets of equal value, which can retire that debt in time, no inflation results. The price level also remains determinate with an interest-rate peg, or other "passive money" policies. All of these policies are normally considered sins, since they leave the split between M and B indeterminate. Instead, here they are ways of implementing the "passive" monetary policy that *should* accompany fiscal price-level determination. The fact that central banks so often pursue such policies, and inflation does not result, is one of the best empirical observations in favor of fiscal price-level determination.

The government can still target nominal rates in a fiscal regime, even with no monetary frictions at all. In (3), M_t and B_t are predetermined. They are dated at time $t-1$ in discrete time formulations. Thus, by setting the amount of M_t and B_t, the government can fix expected inflation and hence nominal rates, even if future s are completely beyond its control, and even if money demand (4) is absent. Changing the amount of government debt with no change in surpluses is the same thing as a currency reform or a corporation's share split. Thus, the observation of an interest-rate peg, or its variation with inflation and output as described by a Taylor rule, are perfectly consistent with fiscal price-level determination.

However, we do not have to specify how monetary-fiscal coordination is achieved. Though Leeper's (1991) limiting cases of "money dominant" and "fiscal dominant" regimes are nice theoretical extremes to consider, we do not have to make a choice or diagnosis of "regime". We need not argue what is "exogenous" or "endogenous". In particular, analyzing Eq. (3) does *not* require us to assume that surpluses are "exogenous" in any sense. Surpluses are always a choice, though one that involves distorting taxes and politically difficult spending decisions. Studying events conditional on such decisions does not assume that those decisions do not exist. We are never "choosing which equation holds". Both (3) and (4) hold in every equilibrium or regime. The regimes are observationally equivalent from macroeconomic time series. The regimes are not really distinguished conceptually either. Even if a pure fiscal or monetary dominant regime were in place, no series is predicted to Granger-cause another (Cochrane, 1988).

The "regimes" are really not conceptually different as well. Though important in the history of thought, perhaps the whole "regime" concept should be abandoned in favor of simply looking at both (3) and (4). Suppose one theorist sees a pure Ricardian regime: the Fed perfectly controls the price level through $MV=PY$, and the Treasury meekly follows providing the required surpluses. Another theorist could interpret the same economy in exactly the opposite way: The only point of $MV=PY$ and the Ricardian commitment is to signal, communicate, and commit to a *fiscal* path which produces the desired price level. A billboard with a Ricardian commitment to the price level P, if believed, would work as well.

Since both (3) and (4) hold in every regime, the operative question is how? Even one thinks the Fed is in charge of the price level through (4), and Congress and the Treasury pledge to respond with the appropriate surpluses in (3), it is useful to examine that implicit fiscal backing to see if it is vaguely plausible that it will or can be provided.

2.3. Sargent, Wallace, seigniorage and nominal debt

My analysis of (3) and (4) differs from Sargent and Wallace (1981) and many other joint fiscal-monetary analyses, in that I explicitly consider *nominal* government debt—debt is only a promise to pay U.S. dollars.

To see the importance of nominal vs. real debt, we can rewrite (3) (see the Appendix) as

$$\frac{B_t}{P_t} = E_t \int_{\tau=0}^{\infty} \frac{\Lambda_{t+\tau}}{\Lambda_t} \left(T_{t+\tau} - G_{t+\tau} + \frac{dM_{t+\tau}}{P_{t+\tau}} \right) d\tau, \tag{5}$$

counting seigniorage by money creation rather than interest savings. With real debt, this equation reads

$$b_t = E_t \int_{\tau=0}^{\infty} \frac{\Lambda_{t+\tau}}{\Lambda_t} \left(T_{t+\tau} - G_{t+\tau} + \frac{dM_{t+\tau}}{P_{t+\tau}} \right) d\tau, \tag{6}$$

where b_t denotes the *real* amount of debt, which does not change if the price level changes.

Sargent and Wallace, examining (6), argued that looming $T_{t+\tau} - G_{t+\tau}$ problems would have to be met by seigniorage, $dM_{t+\tau}/P_{t+\tau}$. That money creation, through $M_{t+\tau}V(\cdot) = P_{t+\tau}Y_{t+\tau}$ would create inflation at time $t+\tau$. Finally, that future inflation could be brought back to the present time t by hyperinflation dynamics $M_t V[E_t(dP_t/P_t)] = P_t Y_t$, with a "discount rate" driven by the interest-elasticity of money demand.

With nominal debt, as in (5), inadequate future $T_{t+\tau} - G_{t+\tau}$ can raise the current price level P_t directly. This rise lowers the outstanding value of nominal government debt, reestablishing equation (5). This channel is absent with real debt. (State-contingent debt or an explicit default can also accomplish such a revaluation, but Sargent and Wallace sensibly assumed that the U.S. government would inflate rather than explicitly default.) The discount rate is related to the real rate of interest, and exists with no money demand.

Most commentators assume that inflation can only come after money creation, whether induced by seigniorage needs or by policy mistakes. In fact, with nominal debt, not only can inflation come before the seigniorage, as pointed out by Sargent and Wallace, it can come without any current or past money creation[2] at all, $dM = 0$ in (5). A fiscal or "flight from the dollar" inflation can occur based directly on expectations of future fiscal trouble.

Nominal debt works like equity: its price can absorb shocks to expected future cashflows, and its price reflects expectations of future events. Real debt works like debt, which must be repaid or explicitly default. There is sense in the view that exchange rates and inflation reflect "confidence" in the government, output, productivity and fiscal prospects, all having nothing to do with central banks' arrangement of the maturity and liquidity structure of government debt.

2.4. Long-term debt and inflation dynamics

Eq. (3) describes the simple case of floating-rate or overnight debt. The dynamic relationship between debt, surpluses and inflation can be quite different with long-term debt. These differences are important in order to apply these ideas to U.S. policy and to the U.S. economy. Most of all, (3) seems to predict that surplus shocks imply price-level jumps, while inflation is serially correlated. Long-term debt allows smooth responses to shocks and serially correlated inflation, even before invoking any price stickiness.

Long-term debt alters the picture in two ways. First, long-term debt acts as a cushion. B_t in (3) represents the nominal *market value* of debt. A shock to the present value of surpluses can then be met by a decline in the market value of long-term debt rather than with a price-level jump. The decline in market value represents future rather than current inflation, and thus predictable movements in the price level. Second, with long-term debt, the central bank can rearrange the timing of inflation, even with no control over surpluses s or their discount rate. Purchases of long-term debt, in exchange for short-term debt, result in more inflation now, less inflation later, and lower nominal rates on long-term debt. This action makes sense of 2010 "quantitative easing" plans for long-term debt purchases. Conversely, sales of long-term debt, soaking up short-term debt, postpone inflation, and allow the central bank to further smooth inflation over time in response to negative surplus or discount-rate shocks.

As an extreme but simple example, suppose that debt consists of a single perpetuity: A constant coupon c is redeemed each period, with no other debt purchases or sales and no money. In this case, the price level is the ratio of the nominal coupon coming due each period to the real surpluses that can redeem it,

$$\frac{c}{P_t} = s_t. \tag{7}$$

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[2] A clarification: *M* here refers to money, held despite an interest cost. In a frictionless model, inflation still comes from "monetization", in the sense that the government prints money to pay off debt, larger than is soaked up by taxes and debt sales if the price level is too low. This extra money then puts upward pressure on prices. In the frictionless limit, this happens instantaneously. Nobody holds any dominated-rate-of-return debt overnight, so there is no seignorage.

In this case, inflation only happens when the actual poor surpluses s_{t+j} are realized, and not in anticipation of those surpluses as in (3) or (5).

With long-term debt, the present-value equation (3) still holds, in the form

$$\frac{B_t}{P_t} = \frac{\int_{j=0}^{\infty} Q_t^{(j)} B_t^{(j)}\, dj}{P_t} = E_t \int_{\tau=0}^{\infty} \frac{\Lambda_{t+\tau}}{\Lambda_t} s_{t+\tau}\, d\tau, \tag{8}$$

(again, simplifying to no money), where $B_t = \int_{j=0}^{\infty} Q_t^{(j)} B_t^{(j)}\, dj$ denotes the nominal market value of government debt, $B_t^{(j)}$ denotes maturity j debt and

$$Q_t^{(j)} = E_t \left(\frac{\Lambda_{t+j} P_t}{\Lambda_t P_{t+j}} \right)$$

denotes the nominal price at t of j-year debt. Here we see that with long-term debt, the market value of debt as well as the price level can absorb expected-surplus shocks. In the extreme perpetuity example (7), bad news about a future surplus s_{t+j} raises only the future price level P_{t+j}. Future inflation lowers bond prices $Q_t^{(j)}$, so bond prices in the numerator of (8) do *all* the adjusting at t rather than time-t prices P_t in the dominator. In general, surplus shocks affect both current and future inflation.

We now can also see how, with long-term debt, the government can trade current for future inflation, holding fixed the surplus stream, by buying or selling additional long-term debt. New debt dilutes the claims of existing long-term debt, giving the government some resources to avoid current inflation, i.e. lower the current price level P_t over what it otherwise would be. However, by increasing the stock of long-term debt it makes the eventual inflation worse, i.e. it raises P_{t+j} over what it otherwise would be.[3]

The maturity structure of outstanding long-term debt gives the "budget constraint" to the government's options for trading inflation today for inflation at future dates by such surplus-neutral debt sales and purchases. This statement is easiest to digest in the case of a constant real rate so $\Lambda_t = e^{-rt} \Lambda_t$. Then (8) reads

$$\int_{j=0}^{\infty} E_t \left(\frac{1}{P_{t+j}} \right) e^{-rj} B_t^{(j)}\, dj = E_t \int_{\tau=0}^{\infty} e^{-r\tau} s_{t+\tau}\, d\tau. \tag{9}$$

By buying and selling debt at date t and later, after $E_t s_{t+\tau}$ is revealed, the government can achieve *any* sequence $E_t(1/P_{t+j})$, consistent with this equation, without making any changes in surpluses. The more long-term debt outstanding – the greater $B_t^{(j)}$ relative to $B_t^{(0)}$ – the better the tradeoff. (For a proof, see Cochrane, 2001, p. 88). A maturity structure with only floating-rate or overnight debt is a special case in which all $B_t^{(j)} = 0, j > 0$. In this case, the government can still freely choose the expected *future* price level $\{P_{t+j}\}$, with no change in surpluses, since they no longer enter this "budget constraint" for $\{P_{t+j}\}$ sequences. However, since $\{P_{t+j}\}$ are absent, this action does not affect the current price level P_t.

In sum, long-term debt changes the dynamic relationship between surplus, discount rates, and inflation substantially. However, the simple floating-rate case remains a useful guide, if we remember to apply it on a scale of several years, on the order of the typical maturity of US debt.

3. The great recession, and "more of both" policy

With this conceptual framework in mind, we can examine the events of the great recession, try to understand policy actions, and speculate about the future.

The first issue is, why was there such a large fall in output? For once in macroeconomics we actually have a good idea what the shock was—there was a "run" in the shadow banking system. (See for example Gorton and Metrick, 2009b, or Duffie, 2010.) But how did this shock propagate to such a large recession?

We have long understood that a sharp precautionary increase in money demand, if not met by money supply, would lead to a decline in aggregate demand. With price stickiness or dispersed information, a decline in aggregate demand can express itself as a decline in real output rather than a decline in the price level. This is in essence Friedman and Schwartz's explanation for the great depression. However, this story cannot credibly apply to the 2008–2009 recession. The Federal Reserve flooded the country with money (reserves). There is no evidence for a flight to money at the expense of government bonds. There was no run on commercial banks as in the great depression; in fact bank deposits increased.

There is instead evidence for a broader "flight to quality", a flight to *all* government debt at the expense of private debt and goods and services. In the fiscal analysis of (3), this is a decline in the discount rate for government debt, which lowers

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[3] Here is an example. Start with constant coupons c and surpluses s, as in (7). Suppose the government sells at time t additional debt $B_t(t+j)$ coming due at time $t+j$. At $t+j$, (7) becomes

$$\frac{c + B_t(t+j)}{P_{t+j}} = s.$$

Thus, the debt sale increases P_{t+j}. At date t, we have

$$\frac{c}{P_t} = s + \frac{1}{P_t} Q_t^{(j)} B_t(t+j) = s + \beta^j \frac{1}{P_{t+j}} B_t(t+j) = \left[1 + \beta^j \frac{B_t(t+j)}{c + B_t(t+j)} \right] s.$$

Thus, the debt sale decreases P_t.

aggregate demand. We also can interpret many actions by the U.S. and other governments as efforts to exchange government debt for private debt to satisfy that demand, as Friedman and Schwartz would have had them exchange government debt for money.

This analysis may seem conservative; it rehabilitates a view of the recession close to a standard monetary one, based on a notion of "aggregate demand" with real effects. However, it is also a somewhat novel analysis, since demand and supply *of all government debt* take center stage, not demand and supply for money. The alterative common view of the recession focuses on a "lending channel" or other credit frictions. These are really "aggregate supply", the economy cannot produce as much for given capital and labor. These channels, as well as traditional "supply", or "reallocation" shocks may be part of the story, of course. In particular, the latter may well be a big part of the story for the anemic 2010 recovery. But they are not necessarily the whole story.

3.1. Money supply and demand

To evaluate money supply and demand, Fig. 2 shows the behavior of the Federal Funds and 3 month Treasury bill rates. Fig. 3 presents M1, currency and deposits, and Fig. 4 describes Federal Reserve assets and liabilities.

As the financial crisis took off in the third week of September 2008, the Federal reserve swiftly cut the Federal Funds target to a range between 0 and 25 bp, and signaled it would leave interest rates there for a long time (Fig. 2). The standard measures of money, M1, currency and deposits, all increased substantially, shown in Fig. 3. M1 rose \$250b, currency rose \$100b and deposits spiked to \$200b and leveled off about \$120b. In percentage terms, currency rose 15% and M1 rose 20%, all despite a fall in GDP. The expansion of the Fed's balance sheet in Fig. 4 is the most dramatic. Excess reserves rose from \$6b to \$800b.

While it is hard to disprove anything in economics, it certainly seems an uphill battle to argue that the recession resulted from a failure by the Fed to accommodate shifts in money demand.

3.2. More of both; aggregate demand

Conventional monetary policy only trades money for government debt. It considers demand for more money and *less* government debt, and policy that controls this split. The events of the great recession suggest a large increase in demand for *both* money and government debt. All government bond interest rates declined sharply. By contrast, private rates rose, and dramatic credit spreads opened. A large liquidity spread opened up between on-the-run and off-the-run government issues. The dollar rose, putting a dramatic end to the "carry trade".

Fig. 5 presents some of this evidence. You can see the rise in credit and term spreads. Baa and Aaa rates rise, while the 3 month Treasury Bill rate declines; it was below the Federal funds rate and even briefly negative as shown in Fig. 2; 3 month nonfinancial commercial paper does not change much but financial paper rises sharply. The Fed's major currencies index rose from 74.1 on September 22, to 82.0 on November 3, a 10.6% rise, while the stock market was crashing. Quantities are harder to document than prices but there were dramatic reports of markets that "froze up"—issuers were unwilling to suffer these rates. These events suggest a "flight to quality" or "flight to liquidity" from private assets to U.S. debt of all maturities.

As one micro-motivation for the flight to quality in the financial crisis, government bonds became practically the only security one could easily repo. (Gorton and Metrick, 2009a). In normal times, if you own a corporate bond or a
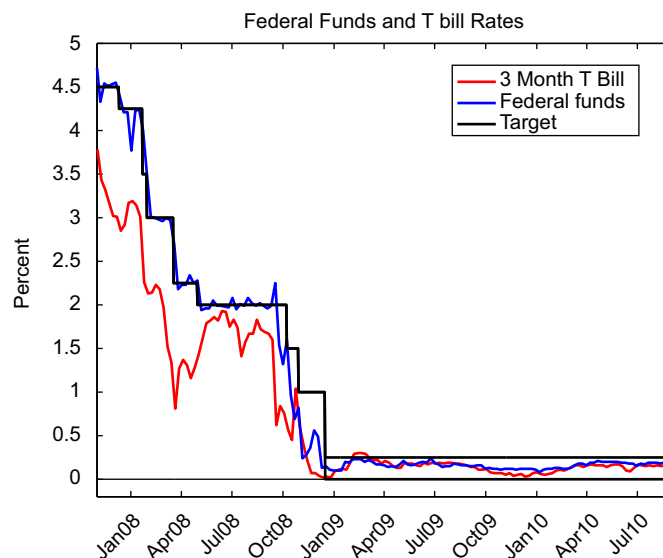

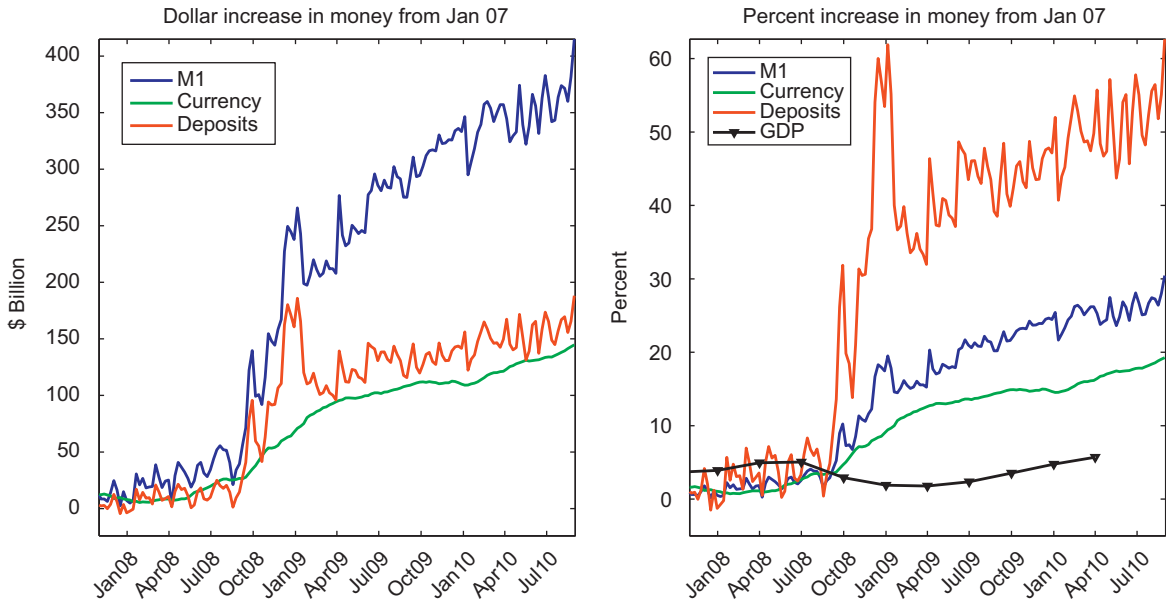**Fig. 2.** Federal Funds and 3 month Treasury bill rates.
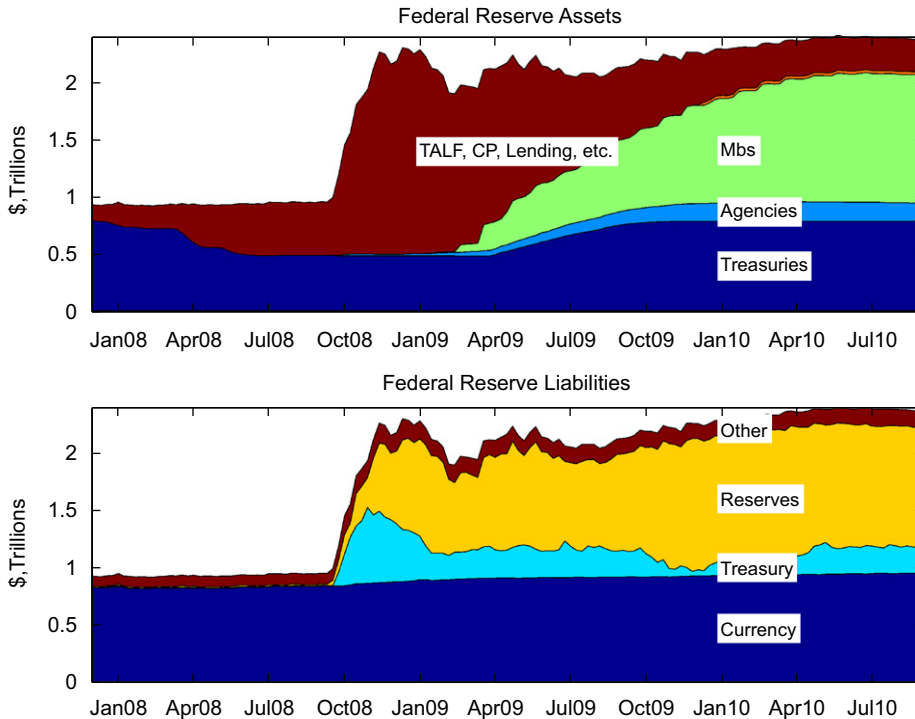
Fig. 3. Money stock.

Fig. 4. Federal reserve assets and liablilities.
Source: Federal Reserve H.4.1 release, June 25, 2009.

mortgage-backed security, you can sell it in a repurchase agreement or use it as collateral for a loan, thus financing the bond purchase. In the Fall of 2008, suddenly the collateral requirements increased dramatically. A government bond was as good as a dollar to a large, cash-strapped financial institution, because if you had a government bond, you could borrow a dollar.

The combination of near-zero government rates and reserves paying interest means that the distinction between government bonds and money (reserves) was a third-order issue for financial institutions, especially compared to the very high interest rates, lack of collateralizability, and illiquidity of any instrument that carried a whiff of credit risk. If they wanted more of either reserves or government debt, they wanted more of both. Something like the "special" or "liquidity" services we usually associate with money applied to all government debt for these central actors. Those services were related to liquidity,
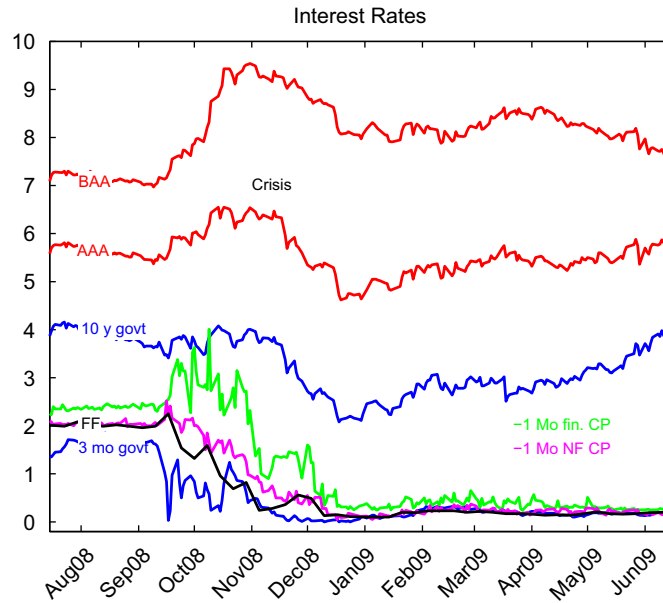
Fig. 5. Interest rates. Moody's BAA and AAA; 10 year Treasury constant maturity and 3 month Treasury bill; 3 month nonfinancial and financial commercial paper.

transparency on balance sheets, acceptability as collateral, and absolute security of nominal repayment, rather than the acceptability as means of payment in transactions that we usually emphasize in money-demand theories.

$MV(\cdot) = PY$ does not allow us to address a "flight to quality" of this sort. We can understand it in the fiscal framework, however, since that framework treats M and B symmetrically. A sudden demand for government debt, with no (good) news about surpluses, means that people are willing to hold that debt despite dramatic spreads between government-debt interest rates and private-debt rates. In our fiscal framework,

$$\frac{M_t + B_t}{P_t} = E_t \int_{\tau=0}^{\infty} \frac{1}{R_{t,t+\tau}} s_{t+\tau} \, d\tau, \tag{10}$$

a lower discount rate $R_{t,t+\tau}$ raises the right hand side, and lowers aggregate demand on the left. People want to hold more M and B, while holding less private debt and less goods and services.

(For the moment, I will not be specific about the mechanism by which a decline in "aggregate demand" corresponds to a decline in output vs. prices. I will look at the simple monetary and fiscal equations, think about inflationary and deflationary scenarios, and allow some of that pressure to be reflected in output rather than prices. I return to this question below.)

This analysis, linking variation in demand for government debt and hence aggregate demand, to variation in the discount rate for government debt, might apply more generally.

First, this mechanism may apply more generally over time. Fluctuations in "aggregate demand" are somewhat mysterious, and do not easily line up with other ways we might measure expectations of future surpluses. But accounting for the history of U.S. stock prices by news about expected dividends has been an even more catastrophic failure. The asset pricing literature has concluded that time-varying discount rates account for essentially all stock market price fluctuations. Perhaps we can similarly account for "aggregate demand" fluctuations by changes in the *discount rate* for government debt rather than (or as well as) changes in expectations of future surpluses. Real interest rates are low in recessions as people want to save more than they want to invest, and people fly to quality quite generally in recessions, in a generic rise in risk aversion. We can think of the consequent low real government rates as *causing* the decline in aggregate demand, by causing a rise in the real value of government debt on the right side of (10). (Of course "cause" is a dangerous term in general equilibrium, and I use it mostly to counter the usual verbal analysis in which declines in "aggregate demand" are conversely the "cause" of lower interest rates.)

This view predicts that a variance decomposition of (10) will find that volatility in the value of government debt on the left will largely correspond to volatility in expected returns on the right rather than volatility in expected cashflows, just as Campbell and Shiller (1988), Cochrane (1992, 2008) and many others find for stocks, and even more analogously, as Gourinchas and Rey (2007) find for sovereign debt.[4]

Second, it gives a new sense of the "reserve currency" nature of the dollar. The dollar is the "reserve *debt*" not the "reserve *currency*". Foreign central banks and other institutions hold a lot of U.S. debt, and use this as backing for their own currencies. But they are holding *debt*, not *currency*. In "flight to quality" episodes, people seem to flock to U.S. debt, sending down

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[4] See also Berndt et al. (2010) who examine the fiscal adjustment following military expenditures.

long-term interest rates. Arguably, the U.S. has financed a part of its trade surplus by this one-time rise in U.S. debt holdings by foreigners. Eq. (10), with a low risk premium applied to all U.S. government debt makes sense of these observations. A special demand for U.S. *currency* or dollar-denominated private deposits and a focus on the split between M and B does not.

3.3. Accommodation

We can understand many actions of the Treasury and Fed as attempts to accommodate the demand for government debt vs. private debt as well as by accommodating the demand for money relative to bonds.

3.3.1. Open-market debt operations
The Fed ran "open-market debt operations", exchanging private debt for government debt without changing the monetary base. As shown in Fig. 4, between 2007 and September 2008, Treasury and agency debt decline as a fraction of Fed assets (top graph), while the overall size of the Fed's balance sheet does not change much. From January 3, 2007 to September 3, 2008, for example, Fed holdings of Treasury securities declined from \$779b to \$480b while overall assets only increased from \$911b to \$946b. The Fed provided the private sector about \$300b of Treasury debt in exchange for corresponding private debt.

The "Treasury" item in Federal Reserve liabilities, the bottom graph in Fig. 4 represents a similar operation. The rapid rise here represents the Treasury Supplementary Financing Account. The Treasury sold additional debt and parked the proceeds with the Fed. Starting with \$4b on September 9, 2008, the total Treasury account hit a peak of \$621b on November 11 and was \$502b on December 12. The Fed turned around and lent this money or bought assets. (Lending and asset purchases are in many cases the same. Lending money creates private debt as an asset on the Fed's balance sheet.) On net, the government issued Treasury debt in exchange for private debt.

How might such an "open-market debt operation"; a switch of private for government debt without changing M, "stimulate" the economy? Let D_t denote private debt owned by the government. Our fiscal equation becomes

$$\frac{M_t + B_t - D_t}{P_t} = E_t \int_{\tau=0}^{\infty} \frac{1}{R_{t,t+\tau}(M+B,\cdot)} s_{t+\tau} \, d\tau. \tag{11}$$

I write $R(M+B,\cdot)$ to capture the above idea that people are sometimes willing to hold government debt despite a low rate of return; the same "quality" premium discussed above. (Krishnamurthy and Vissing-Jorgenson, 2008 give evidence for a Treasury-debt liquidity demand of this sort.)

Thus, by increasing the supply of Government debt, the discount rate R rises (or the increased quantity offsets the deflationary effects of the flight to quality, captured in the · terms). Aggregate demand increases, even if government holdings of private debt D_t offset greater government debt, so $B - D$ is unchanged; even if money M is unchanged; and even if there is no surplus news so s is unchanged.

However, this mechanism has its limits. It does not do any good in a situation such as Fall 2010, when all dollar interest rates are low. In such a case, any liquidity premium for government debt over private debt has plausibly been satiated, and open-market debt operations will have no further effect. If the flight from foreign to dollar assets represents some similar premium for all dollar-denominated debt, buying foreign assets in return for U.S. assets might satisfy that demand and raise U.S. interest rates. But once "liquidity" or "quality" demands are satisfied, even these purchases will have no effect.

There has been a lot of comment on the size of Fed operations, on the order of a trillion dollars. However, with roughly \$13 trillion of US government debt and another \$13 trillion of liquid private debt outstanding, quantitatively significant rearrangements of private portfolios will take huge operations, for which a trillion dollars may seem trivial. Experience of open-market operations in the paltry \$6 billion (2006) market for bank reserves is not a good guide.

3.3.2. Guarantees
The government also guaranteed large amounts of private debt, including Fannie and Freddie, guarantees of TARP bank credit, and guarantees of new securitized debt. The implicit guarantees of much larger amounts of debt – the widespread perception that no large financial institution will be allowed to fail – add to this list. To the extent that the private sector has a liquidity demand for debt with the government's credit rating, at the expense of debt which does not carry that guarantee, issuing such guarantees is the same thing as explicitly issuing Treasury debt in exchange for private debt.

3.3.3. Interest on reserves
The Fed has also started paying interest on reserves. Reserves that pay interest *are* government debt. By creating such reserves the Fed can rapidly expand the supply of short-term, floating-rate debt, without needing any cooperation from the Treasury or a rise in the Congressional debt limit. It also can execute massive open-market operations at the stroke of a pen. With a trillion dollars of excess reserves, changing the interest on reserves from 0 to the overnight rate is exactly the same thing as a trillion-dollar open-market operation.

3.3.4. Balance sheet expansion
In the second phase of accommodation, starting in September 2008, the Fed rapidly expanded its balance sheet. For the Fed, this means printing money (creating reserves) to buy assets rather than just exchanging private for Treasury assets. In conventional open-market purchases, we would have seen Treasury debt in Fed assets rise in tandem with the rise in

reserves. Strikingly, the Fed took pains not to increase its holdings of Treasury debt, and to leave such debt in private hands. Fed holdings of Treasury debt stay low through the winter of 2009. The Fed funded the entire near-doubling of its liabilities by buying private assets instead. We can think of this as a nearly $1trillion conventional monetary expansion coupled with a $1trillion "open-market debt operation".

The government also increased the supply of its debt overall. Not only is $B+M-D$ rearranged, it is larger by the $1.5 trillion fiscal deficit. This might represent fiscal stimulus, described next as increases in B and M without increasing future s, but even if s_{t+j} rises enough that there is no such fiscal stimulus (for example, if the spending represents investment with a good rate of return to the taxpayer), this action can be seen as helping to accommodate a large liquidity demand for government debt.

In sum, in this analysis, we can read the government's actions as a much-modified version of Friedman and Schwartz's advice for the great depression. In that event, the Fed failed to accommodate a demand for money at the expense of government debt. In this one, the government recognized and partially accommodated a massive demand for *both* money and government debt, at the expense of private debt.

3.3.5. The Fed view

This is not at all how the Fed thinks about its policy actions, at least as I interpret Fed statements. The first stage, trading private for government debt without increasing money in early 2008, was, to the Fed, a way to support private credit markets without the inflationary effect that increasing M might have had. Starting in October 2008, the Fed started buying commercial paper, reaching $300b within a month. In early 2009, it started buying mortgage-backed securities, both directly and via agencies (the thin blue wedge marked "mbs"), and it started on an aggressive program of buying long-term Treasuries, which you can see in the rise of the "Treasury" component of Fig. 4. This time the Fed was not concerned about meeting the purchases with a large increase in reserves.

As I read Fed statements, the Fed was trying to attack interest rate spreads in these individual markets, not just to supply more government debt. The Fed sees credit markets hobbled by numerous frictions, constraints, or segmentation. These markets develop premia higher than the Fed thinks are appropriate, and it thinks that it can reduce the premiums in individual markets by buying securities in those markets. It hoped to do so by small purchases, or through the act of trading—by becoming the uninformed "noise trader" that liquefies finance models. In the event, it often ended up being almost the whole market for new issues, a position that makes affecting prices somewhat easier.

Whether the Fed was successful in affecting individual premiums in this way is an interesting question. The opposite possibility is that the spreads on these assets represent credit risk and credit risk premiums; that the markets are not as segmented or liquidity-constrained as the Fed thinks, so that the Fed's purchases can do little to lower spreads for very long. Taylor (2009b) argues not, Ashcraft et al. (forthcoming) argue yes.

In turn, as I read Fed statements, the Fed believes that these actions will "stimulate" by reducing interest rates faced by borrowers, also constrained to specific markets. Lower interest rates raise "demand", which in the first instance raises output and later leads to inflation by Phillips curve logic. This channel also requires frictions absent in my analysis.

4. Fiscal stimulus

Starting in February 2009, The U.S. government engaged in a large "fiscal stimulus" designed to raise aggregate demand, with multi-trillion dollar deficits projected to last many years. The question here is, will these deficits actually "stimulate" as promised, within the fiscal-monetary framework I am exploring?

The fiscal valuation equation

$$\frac{M_t + B_t}{P_t} = E_t \int_{\tau=0}^{\infty} \frac{1}{R_{t,t+\tau}} s_{t+\tau} \, d\tau \tag{12}$$

offers a twist on the standard view of this issue: If additional debt $M+B$ corresponds to expectations of higher future taxes or lower spending, it has no "stimulative" effect. (Again, I leave the nominal/real split for later.) If, however, additional debt corresponds to expectations that future surpluses will *not* be raised, then indeed the debt issue can raise aggregate demand.

This sounds like fairly standard "Ricardian equivalence" analysis. However, standard Ricardian equivalence presumes that the government issues *real* debt, always corresponding to higher expected future surpluses, so that some irrationality, market incompleteness or market failure is needed for any stimulative effect. Here, we realize that the government issues *nominal* debt. It can be perfectly rational for people to expect that the government does not plan to raise future surpluses.

I am abstracting here from distorting taxes, financial frictions, output composition effects, and the price-stickiness and multiple equilibria of New-Keynesian models, all of which potentially have important effects on the analysis of fiscal stimulus. For example, Uhlig (2010) emphasizes distorting taxes; Christiano et al. (2010) get large Ricardian (tax-financed are the same as deficit-financed) multipliers out of a New-Keynesian model with zero interest rates. My goal is only to analyze what $MV=PY$ and (12) have to say about the issue before one adds other considerations, not to deny other channels or try to have a last word on an 80 year old debate.

4.1. Will spending come too late?

Many critics objected that fiscal stimulus would not stimulate in time, because the spending will come too late, after the recession is over. This reflects the standard analysis, enshrined in undergraduate textbooks since the 1970s, that fiscal policy affects "demand" as it is spent. Eq. (12) suggests the opposite conclusion. In order to get stimulus (inflation) now, *future* deficits ($s_{t+\tau}$ for large τ) are just as effective as current deficits, and possibly more so. What matters is to communicate effectively that future deficits are unlikely ever to be paid off with surpluses.

4.2. Expectations

A fiscal stimulus/inflation is harder than it sounds. Government debt sales are deliberately set up to engender expectations that the debt *will* be paid off. Most of the time, governments do not sell debt to inflate; they sell debt to raise real resources that they can use for temporary expenditures like wars. If a debt sale comes instead with no change in expected future surpluses, it only raises interest rates and the price level. It raises no real revenue, and does not raise the real value of outstanding debt. Governments are usually very careful to communicate that this is *not* the case. Engendering the opposite expectations may be quite difficult. Everyone is used to meaningless long-term budget projections, especially in the U.S.

As an extreme contrast, consider a currency reform in which the government redeems the old currency and issues new currency with three zeros missing. This operation is *exactly* a debt rollover in which $B_t = B_{t-\Delta}/1000, M_t = M_{t-\Delta}/1000$ with no change in future surpluses, and no revenue. A currency reform is designed to communicate expectations that real surpluses will not change, precisely so that it *will* move the price level the next day and will not generate any revenue. The only difference between a currency reform and a debt sale is the expectations of future surpluses that each institution communicates.

Currency reforms also have no output effects. Whatever price-stickiness, information asymmetry, or coordination problem gives rise to some temporary output rise from inflation, that mechanism is completely absent when the government undertakes a currency reform. Thus, the job for fiscal stimulus, in this analysis, is to sell debt while communicating that future surpluses will not rise – so that there will be some stimulus – but to do so in such a way that exploits whatever price stickiness or information asymmetry generates an output effect, which a currency will not do. Since most Phillips curve models specify that expected inflation generates a slump, not a boom, this is a challenge. The challenge is raised substantially by our limited knowledge about the precise mechanism of the Phillips curve, and by our government's limited ability to communicate credible messages about surpluses in the far future.

4.3. Announcements

We can read government announcements, at least as an indication of what they wanted us to expect. The Government's dramatic deficit projections surrounding the stimulus bill in January and February 2009 read to me as loud announcements "you'd better spend the money now, because we're sure not raising taxes or cutting spending enough to soak it up". And long-term budget projections remain bleak. On March 20, 2009 OMB director Peter Orszag was quoted to say "Over the medium to long term, the nation is on an unsustainable fiscal course". "Unsustainable" literally means that the right hand side of the fiscal equation is lower than the left. The normally staid Congressional Budget Office (2009) *Long Term Budget Update* echoes the sentiment: "Over the long term … the budget remains on an unsustainable path", complete with graphs of exponentially exploding debt.

On the other hand, the main problems in long-term budget projections are Social Security and medical entitlements. We have known that these programs are on an unsustainable course for years. This was not news during the winter of 2009. Markets had long had a reasonable expectation that sooner or later the government would get around to doing something about them. Fixing these programs is an easy matter for economics, it is just tough politically. Furthermore, by spring 2009, the tone of government statements had changed completely from "stimulus" to concern over long-term budget deficits and a desire to lower them, not to enlarge and commit to "unsustainable" deficits. OMB director Orszag's March 20, 2009 "unsustainable" comment was followed quickly by "to be responsible, we must begin the process of fiscal reform now". It was delivered at a "Fiscal Responsibility Summit".

Most of the Administration's defense of fiscal stimulus (for example, Romer and Bernstein, 2009) cites simple Keynesian flow multipliers from the 1960s-vintage ISLM models, not the sort of fiscal-monetary inflation I have described as "stimulus". (And, curiously, not the models themselves.) And by May, even these statements gave way to worries about fiscal sustainability that can be read as belief in dramatically negative multipliers. For example, the Council of Economic Advisers (2009) health policy analysis states that "slowing the growth rate of health care costs will prevent disastrous increases in the Federal budget deficit" and will therefore raise the level of GDP by 8%, permanently. By the winter of 2009–2010 the word "stimulus" disappeared from the Administration's lexicon. Arguments for "jobs" and mortgage-relief legislation made no mention of increasing the deficit, but were defended as microeconomic interventions that would help even if tax-supported. Chairman Bernanke's June 3 (2009b) testimony worries about long-term deficits, and thus whether the fiscal backing to *contain* rather than to *produce* inflation will be present.

Furthermore, Chairman Bernanke and the other Federal Reserve Governors are loudly saying the Fed can and will control inflation. Whether the Fed will be able to do so is another question, but at least we hear determination to fight and win any

game of chicken with the Treasury. Secretary Geithner went out of his way to assure the Chinese that the dollar will not be inflated (Cha, 2009).

In sum, government statements do not paint a clear picture. This may reflect an understandable indecision on the part of the government facing a Catch-22: In this analysis, the only way to "stimulate" is to commit forcefully and credibly to an unsustainable fiscal path, so that people will try to get rid of their government debt including money, and in so doing drive up demand for goods, services, and real assets. But such an action trades stimulus today for great financial and economic difficulty when deficits and inflation arrive.

Alas, the resulting muddle, of current fiscal stimulus but trying to convince people that the long-run deficit will be addressed and debt paid off without inflation, makes little sense from any theoretical point of view. It would not provide nominal stimulus. The main argument for real fiscal stimulus is that people disregard the future taxes. But is there a voter left in the country who is unaware that taxes are likely to rise? How many actually *over* estimate the coming rise in taxes? And if there are such people, loudly announcing plans for long-run budget control along with short-run stimulus completely undoes the stimulative effect. St. Augustine, asking the Lord for "chastity, but not yet", does not stimulate. If one wants stimulus, Casanova is needed.

4.4. Identification

This analysis implies that historical evaluation of fiscal multipliers suffers a (an additional) deep identification problem. What were expectations in previous events? If people expected eventual inflation, i.e. that the debt would *not* be paid off, we should see increased aggregate demand, and we would be able to measure the presence or absence of associated real stimulus. That experience would not inform us about the effects of a stimulus package that came with the expectation that future tax revenues would rise rather than higher future inflation.

Expectations whether debt will be paid or inflated can vary considerably with the circumstances of the event. Wars are quite different from recession-fighting stimulus packages, and those are different from large promised social and retirement programs. Furthermore, stimulus packages come with different fiscal backgrounds. For example, Chile, with a large positive net asset position, is likely to face different expectations about long-run fiscal solvency of a large stimulus plan than are Italy or Greece, with larger outstanding debt.

5. Inflation or deflation?

Now that the financial crisis has passed, will we face inflation or deflation?

The recent history of inflation and deflation worries can be summarized by the interest rate plot in Fig. 6. We have two episodes of deflation worries, in the financial crisis of 2008, and the summer of 2010, bracketed by a period of inflation worry in late 2009.

The year 2006 reminds us of "normal times". BAA and AAA spreads were quite steady, so those rates went up and down with the 10 year Treasury rate. We often read the spread between 10 year TIPS (Treasury Inflation Protected Securities) and Treasury yields as a measure of expected inflation. This spread was nearly constant, so people read the variation in rates as real, and the small variation in actual inflation as temporary fluctuations against "stable" expectations. Starting in Summer
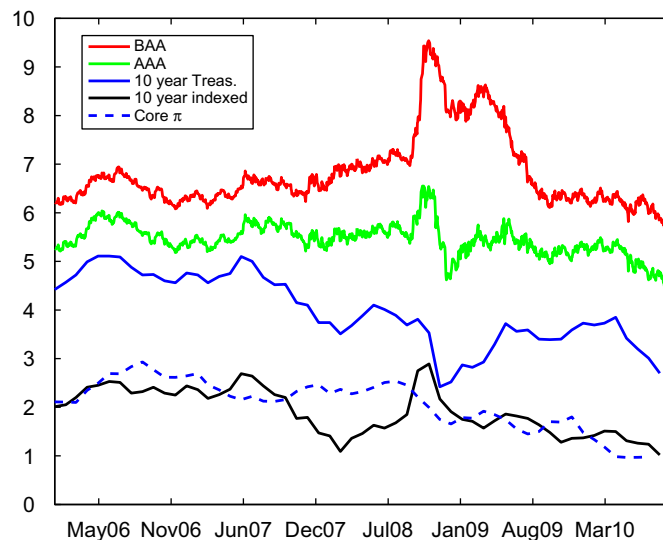

Fig. 6. Interest rates and inflation.

2007 we see the beginnings of recession and financial difficulty, with credit spreads widening—BAA and AAA rise, Treasury and TIPS decline. As yet though there is no news on inflation or expected inflation.

The Financial crisis of 2009 stands out, as BAA and AAA rates spike while treasuries decline sharply. In the financial crisis, inflation declined and the TIPS rate rose sharply, superficially suggesting a sharp decline in expected inflation. However, the TIPS market is small and illiquid. On-the-run/off-the-run and other government spreads also widened, so this event may say more about liquidity than about inflation expectations. Still, there were plenty of reasons to worry about deflation and economic collapse.

The financial crisis ended, with credit spreads tightening and the usual behavior that BAA and AAA track the long-term Treasury rate with a fairly constant spread. Throughout 2009, long term yields were rising while the TIPS yield fell. During this time many commentators, noting the huge increases in money and debt, together with "unsustainable" long-run deficit projections, started worrying about inflation, and it seemed like the markets were also doing so. For example, Ferguson (2009), Feldstein (2009) and Anna Schwartz (Satow, 2008) thought inflation is on its way. Laffer (2009) thought something like hyperinflation is on the way. I wrote the first draft of this paper. Not all agreed. Krugman (2009) argued that "Deflation, not inflation, is the clear and present danger". Fed officials gave many comforting speeches on their "exit strategy" (for example, Bernanke, 2010a). These debates continued, with reports of a heated discussion within the Federal Reserve (Hilsentrath, 2010).

Then the Greek debt crisis erupted, and long-term treasuries declined, with the TIPS spread declining as well, and measured inflation slowly declining. This leaves us with current worries about preventing deflation.

5.1. Fighting deflation; joint monetary/fiscal stimulus

In the great recession of 2008–2009, as well as in the doldrums of 2010, the Fed went beyond accommodation to various attempts at monetary stimulus. These situations are worth analyzing historically, and also looking forward. Can the Federal Reserve fight deflation? Or will all its tools eventually run out?

5.1.1. Interest rates
Short-term interest rates are already near zero. Once they are fully set to zero that channel – at least as achieved by trading M for B and exploiting whatever liquidity difference between these two remains – is finished.

5.1.2. Quantitative easing I
When interest rates hit zero, the Fed can still pursue "quantitative easing". It can continue to buy short-term Treasury or other debt, or lend directly. These actions increase the money supply, even if they no longer affect short-term rates. People who think in terms of monetary aggregates rather than interest rates have advocated such easing. The Bank of England explicitly engaged in a quantitative easing program, and many commentators view the U.S. reserve expansion in this light.

But in our framework, it is hard to see how quantitative easing can have any effect. The Fed *can* increase reserves M and decrease B, but nobody *cares* if it does so. Agents are happy to trade perfect substitutes at will. Velocity V will simply absorb any further changes. The argument for quantitative easing must rest on the idea that V is fixed, but why should the relative demand for perfect substitutes be fixed? Trading M for B, especially at zero rates, is like trading green M&M's for red M&Ms. The color on your plate might change, but it would not help your diet.

5.1.3. Quantitative easing II
In 2009, the Fed turned to buying long-term government debt. The rise in Treasuries in Fed assets shown in Fig. 4 reflects this action. In the Fall of 2010, it is announcing a plan to renew such purchases. In our fiscal framework, this action *can* have an effect. With long-term debt outstanding, buying long-term debt and selling short term debt transfers inflation (aggregate demand) from the future to now, and lowers long-term nominal rates.

However, the Fed would have to undertake a massive program to have much effect, altering substantially the overall maturity structure of U.S. debt. Also, this policy can only rearrange the timing, but not the level of deflation, raising current inflation at the expense of lowering future inflation.

At a deeper level, it reflects a view that the central problem with the US economy is an overly long maturity structure of government debt. "If only those fools at Treasury had issued more short-term debt in the first place, we wouldn't be in this mess. Well, we can undo that". Of all the diagnoses for looming deflation or economic doldrums, this sounds pretty far-fetched.

Last, and perhaps most important, the fiscal analysis suggests that this is an ideal time for the exact opposite policy, to substantially *lengthen* the maturity structure of U.S. debt. Long-term debt smooths surplus shocks. When a surplus (or discount rate) shock hits, the market value of long-term debt can fall to reestablish fiscal balance, rather than requiring the price level to rise. If the government is rolling over short-term debt, fiscal shocks have to be expressed immediately, as Greece recently discovered. Governments are usually reluctant to fund themselves with long-term debt, on the view (common to hedge funds) that rolling over short-term financing is cheaper. But 2% long-term rates represent an outstanding opportunity for the U.S. to adopt what is, in the fiscal analysis, a much more stabilizing maturity structure.

Needless to say, mine is an entirely different logic than that by which the Fed analyzes quantitative easing. In the Fed's view, it is exploiting segmentation in the Treasury market to influence real rates, but that markets are unsegmented enough that slightly lower long-term Treasury rates will spill into lower rates for borrowers, stimulating "demand".

5.1.4. Quantitative easing III

Well, if buying Treasury debt eventually runs out of steam, the Fed could buy private debt again, as it did in the financial crisis. Above I argued that this action stimulated aggregate demand by exploiting a liquidity premium for government debt. Alas, premiums, like constraints, disappear once satiated. If not now, sooner or later this action runs out of steam as well. Once any special demand for government debt is satiated, then exchanges of private debt for government debt have no effect at all in a fiscal analysis.

5.1.5. Announcements

With every possible *action* the Fed can take running eventually out of steam, the Fed in Fall 2010 is turning to announcements. The FOMC is hoping that announcements such as "exceptionally low levels for the federal funds rate for an extended period[5]" will by themselves have a stimulative effect. Several Fed governors have opined that the Fed should publicly announce a higher inflation target.

I read this move as sign of desperation. Teddy Roosevelt said to speak softly but carrying a big stick. These steps are speaking loudly because you have no stick. What will the Fed *do* if it announces a higher target but inflation does not change? We are here in the first place because the Fed is out of *actions* it can take. This is the "WIN" (Whip Inflation Now) strategy that failed in the 1970s. Worse, since higher *expected* inflation is usually thought to adversely shift the Phillips curve, inducing higher expected inflation implies inducing stagflation, which if desired reveals a breathtaking desire for inflation at any cost.

5.1.6. Helicopter drops

What about a "helicopter drop?" Surely causing inflation is not that hard, and dropping money from helicopters would do the trick?

A helicopter drop is at heart a *fiscal* operation. It is a transfer payment. To implement a drop, the Treasury would borrow money, issuing more debt, and write checks. Then the Federal Reserve would buy the debt, so that the money supply increased. Even a drop of real cash from real helicopters would be recorded as a transfer payment, a fiscal operation.

But even a real helicopter drop does not guarantee inflation. Suppose a helicopter drop is accompanied by the announcement that taxes will be raised the next day, by exactly the amount of the helicopter drop. In this case, everyone would simply sit on the money, and no inflation would follow. The real-world counterpart is entirely possible. Suppose the government implemented a drop, repeating the Bush stimulus via $500 checks to taxpayers, but with explicit Fed monetization. However, we have all heard the well-explained "exit strategies" from the Fed, so supposing the money will soon be exchanged for debt is not unreasonable. And suppose taxpayers still believe the government is responsible and eventually pays off its debt. Then, this conventional implementation of a helicopter drop, in the context of conventional expectations about government policy, will have no effect at all.

Thus, Milton Friedman's helicopters have nothing really to do with money. They are instead a brilliant psychological device to dramatically communicate a *fiscal* commitment, that this cash *does not* correspond to higher future fiscal surpluses, that there is no "exit strategy", and the cash will be left out in public hands, unlike other economically equivalent actions taxpayers may have grown accustomed to.

The larger lesson is that, to be effective, a monetary expansion must be accompanied by a credibly communicated non-Ricardian fiscal expansion as well. People must understand that the new debt or money does *not* just correspond to higher future surpluses. This is very hard to do—and even harder to do just a little bit. Therefore, if deflation breaks out – demand for government debt increases – it is possible that there is little the Fed, and not much the government as a whole, can do about it, at least in the context of current monetary-fiscal arrangements and the expectations they engender.

The last time these issues came up was Japanese monetary and fiscal policy in the 1990s, to escape its long period of low inflation and near-zero interest rates. Quantitative easing and huge fiscal deficits were all tried, and did not lead to inflation or much "stimulus". Why not? The answer must be that people were simply not convinced that the government would fail to pay off its debts. Critics of the Japanese government essentially point out their statements sounded pretty lukewarm about commitment to the inflationary project, perhaps wisely. In the end their "quantitative easing" was easily and quickly reversed, showing those expectations at least to have been reasonable. We will see what happens when a generation of Japanese savers retires and wants to sell their holdings of Japanese government debt to a much smaller new generation.

5.1.7. Why so powerless?

Even if it *could* work, the Fed cannot by law undertake a helicopter drop all on its own. The Fed must always buy some other security in exchange for anything it issues. The essence of the law governing the Fed is that it may not undertake any action with direct fiscal consequences, other than by exploiting return differentials between its assets and liabilities. It cannot issue more $M+B$ overall, and it can do nothing about s. Once the liquidity or other "special" nature of the assets it can buy and sell disappear, it has nothing left.

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[5] September 21 FOMC statement, http://federalreserve.gov/newsevents/press/monetary/20100921a.htm.

There is a good reason for this law. The Fed has already glimpsed the political repercussions of private its debt purchases, i.e. lending to non-banks, purchases of mortgage-backed securities, commercial paper, student loans, and so forth. It is a short step to credit allocation, which is intensely political. The Fed's unorthodox policy in Fall 2008, along with its role in orchestrating bailouts and shotgun mergers, already led to calls for Congressional oversight. Sending checks to people would be orders of magnitude more political. A central bank which writes people checks cannot stay independent in a democracy.

The rule roughly forbidding the Fed from direct fiscal action is the key to its independence. But as a result, the institution charged with maintaining the price level is forsworn from affecting the first-order causes of inflation!

6. Inflation?

Perhaps the concern with deflation in Fall 2010 is overblown. Interpreting events through the fiscal theory, currently high demand for government debt is unlikely to reflect positive news about long-run fiscal surpluses. It more likely corresponds to a low discount rate for government debt, visible in exceptionally low interest rates. But discount-rates pass, and confidence that the U.S. will resolve its long-run fiscal troubles may pass as well.

When the time comes to reverse course, will the Fed be willing to do so? More troubling, will the Fed be *able* to do so, or will we discover the fiscal limits to monetary policy? Will the Fed be as powerless to stop inflation as I argued above it is to stop deflation? Will mounting fiscal deficits instead force the Fed to monetize even more debt? Will we see a fiscal inflation without current monetization, but based on a flight from the dollar, a fear of future monetization, as (3) describes? If so, what will such an event look like?

6.1. Money and inflation

First, let us consider the worry that the Fed's enormous monetary expansion will lead to inflation.

6.1.1. MV=PY
Some inflation hawks simply look at the vast amount of reserves and the smaller but substantial increase in M1 and currency (Figs. 3 and 4), and infer that inflation must follow. Some of these observers, I think, are echoing a view that in $M_t V = P_t Y_t$, velocity is stable, but "long and variable lags" transmit money to inflation, so that past money must imply future inflation no matter what the Fed does subsequently. (Something like the "St. Louis equation" $P_t Y_t = V \sum_{j=0}^{\infty} a_j M_{t-j}$).

In my view, this is simplistic: Velocity does shift, especially at near-zero rates, and today's money need not mean tomorrow's inflation if the Fed soaks that money up fast enough. What the Fed giveth, the Fed can taketh away.

For example, Laffer (2009) thinks M1 is the right aggregate; he worries that the huge expansion in reserves means more M1 expansion to come. Moreover, he worries that this process will then be difficult to reverse. If the Fed tries to soak up reserves, he thinks it will require a massive contraction in bank lending in order to reduce the relevant M1, which will require a sharp recession that the Fed will not be willing to countenance. In the dove's view, we are still in a "liquidity trap" so the extra reserves are not going anywhere in the first place.

I argued above that banks are just as happy to hold reserves as to hold government bonds, because interest rates are near zero, and reserves pay interest. So bank lending activity is disconnected from their reserve holdings, and today's reserves need not translate into tomorrow's M1 via the usual multiplier channel. If M1 does increase, that logic works in reverse as well. There is no necessary connection between the amount of bank lending or overall credit and the stock of any monetary aggregate. A cashless economy will still have lots of loans.

6.1.2. The Fed's balance sheet
Feldstein (2009) points out that the Fed has much less short-term Treasury debt than it used to, as you can see in Fig. 4. If the Fed wants to soak up reserves, it may be very hard to sell all the illiquid, long-dated and risky private securities that the Fed has accumulated, and impossible to sell direct loans. Feldstein writes "…the commercial banks may not want to exchange their reserves for the mountain of private debt that the Fed is holding and the Fed lacks enough Treasury bonds with which to conduct ordinary open-market operations…"

I do not think this is much of a constraint—or rather it is an internal political constraint between Fed and Treasury not a fundamental economic constraint on the government as a whole. The Treasury can simply issue new debt to soak up a trillion dollars or so of reserves, even if the Fed has nothing left on its balance sheet. The Treasury can then park the proceeds at the Fed, as it already did in Fall 2008. The Fed need only abstain from lending them out again. As the Fed slowly sells its assets or lets them mature, it pays back the Treasury which retires the debt.

Even easier, by raising the interest rate on reserves, the Fed can essentially create government debt and execute a trillion-dollar open-market operation with the stroke of a pen.

6.1.3. Fiscal constraints on a monetary exit
For the next several years, the Treasury will still be selling trillions of additional debt to finance deficits. If investors and the Treasury are also trying to sell, can the Fed sell additional trillions as well? For example, Laffer (2009) writes "If the Fed were to reduce the monetary base by $1 trillion, it would need to sell a net $1 trillion in bonds. This would put the Fed in direct

competition with Treasury's planned issuance of about $2 trillion worth of bonds over the coming 12 months. Failed auctions would become the norm and bond prices would tumble, reflecting a massive oversupply of government bonds".

By (3), or better (11), this analysis is false. Prospective investors in new government debt were *already* holding currency or reserves, which are just a different maturity of government debt. It takes almost no additional fiscal resources to unwind a reserve or currency expansion. ("Almost" because of the potentially higher interest cost of non-monetary debt, but seigniorage is tiny; 1% of $1 trillion dollars is $10 billion.) Additional resources, new debt issues matched by higher future surpluses, are important to a government that needs *foreign* reserves, gold reserves, etc. in order to unwind a monetary expansion, but not to a government that wants to unwind an expansion of domestic reserves.

6.1.4. Will and ideas

Many inflation hawks really have in mind political rather than economic constraints, which my analysis has little to say about. They question whether the Fed will have the will or political ability to start soaking up reserves or raising short-term interest rates quickly enough. The "credit crunch" and "financial crisis" were over by mid 2009—short-term debt spreads returned if not to normal, at least to functioning levels. Yet the level of economic activity will be low for some time. As of Fall 2010, we seem stuck in economic doldrums. Commercial real estate, state debt, and some pension funds are still in trouble. Mortgage foreclosures are continuing. Unemployment will be high for some time. Many "systemic" financial institutions will still be on the edge, and many of them make a lot of money by borrowing low and short and lending long. To the extent that the Fed's asset purchases lowered specific rates in commercial paper, mortgage and other markets, now there are constituencies who can plead for specific support. Any move that is seen as "tightening" will be difficult in this environment.

Constraints of ideas and information are a more subtle route to inflation. This path is the conventional analysis of inflation in the 1970s (For example, see Sargent, 1999; Samuelson, 2008). Will the Fed's "potential GDP" estimates, as in the 1970s, suggest large and illusory "gaps" remaining to be filled? Will the Fed interpret house and stock prices below their peaks as "asset price deflation" that counteracts goods and services inflation? Will the Fed continue to believe that expectations are "anchored" until they no longer are, when it is too late? The Fed seems to believe in "managing expectations" by announcements in order to control inflation and deflation, without any threat to back up its desires. Will it continue too long to trust in that ability?

The hawks have a point, but commenting on political will is beyond the scope of this paper. On the other hand, if one accepts the emerging conclusion here that the Fed has much less power to control inflation in the face of fiscal pressure than we might have thought, then one must accept that policy mistakes of this sort do less damage than one might previously have thought.

6.2. Fiscal inflation

I conclude that no substantial *monetary* or *economic* problems stop the government from soaking up whatever assets constitute the M in $MV=PY$ and removing monetary stimulus, if it wants to do so and if it can suffer the higher short-term interest rates that this action may provoke. If the fiscal backing that a "Ricardian" regime requires can in fact be provided, there is no reason that the Fed must allow inflation to break out. A fiscal inflation, the consequence of current and future deficits, are therefore, in this analysis, a greater inflation danger than monetary policy and the existence of an "exit strategy".

Reading the commentators, I think there is in fact widespread agreement on this danger, just diverging opinion as to its probability. Even Krugman (2009) admits "others claim that budget deficits will eventually force the U.S. government to inflate away its debt…" The U.S. would "drive up prices so that the real value of the debt is reduced". "Such things have happened in the past. For example, France ultimately inflated away much of the debt it incurred while fighting World War I". The danger is well described by (3); he just does not think it will happen.

How exactly does this work, what are the warning signs? Here again, I think looking at (3) clarifies some issues and points out some common traps.

6.2.1. Debt/GDP ratios and future deficits

Krugman and other inflation doves assure us that the U.S. debt/GDP ratio is below that of many other countries, and our own past experience. The CBO analysis in Elmendorf (2009), for example, shows the U.S. debt/GDP at 40%, and projected to rise to 60% during the current recession. This is small compared to the 110% debt/GDP ratio at the end of WWII, and the ratios over 100% that several European countries and Japan now experience.

The long-term U.S. budget outlook is much more bleak. It is unusual that even the CBO's 10 year forecast does not show steady deficit reduction. *Future* debt/GDP ratios explode in these forecasts.

Most of all, the fiscal equation (3) does not point to any "sustainable" debt/GDP ratio – say 100% – and "everything will be fine until you cross this point". Eq. (3) says that you get inflation *now* as soon as people think that *future* debt/GDP ratios will grow uncontrollably, i.e. the left hand side is greater than the right. If anyone believed the CBO's long-term forecasts, hyperinflation would have already happened. People expect that eventually the government will do something about Social Security, Medicare and entitlements. Even very large debt is possible if people understand there is a plan to pay it off. The U.S. could borrow 120% of GDP at the end of WWII because everyone understood war expenditures were temporary, and that huge deficits would end once that temporary exigency passed. On the other hand, countries have experienced exchange rate collapses – meaning, their governments were unable to pledge enough real resources to borrow foreign exchange

reserves – with much lower than 100% current debt/GDP ratios, when markets saw unsustainable *prospective* deficits. Burnside et al. (2001) analysis of the 1997 Asian currency crashes are a good example. The international literature finds more generally that current debt/GPD ratios are generally not a good forecast of currency crashes or their absence. Finally, the fact that other countries (Japan) have greater debt/GDP ratios could only mean that we will all experience inflation.

GDP is not even a very good divisor. U.S. Federal tax revenues are about 15% of GDP, so a 60% debt/GDP ratio is a 400% debt/revenue ratio. Comparing debt to GDP only makes sense across countries with comparable tax systems. To harvest European taxes, the U.S. would have to institute a national VAT, which will hardly be politically painless. To put the observation another way, we can ask what changes in tax rates under the current U.S. tax system would eliminate forecasted deficits. Congressional Budget Office Director Peter Orzag (2008) did this, concluding that the lowest bracket would have to rise from 10% to 25%; the 25% bracket would have rise to 63%; and the top rate would have to rise from 35% to 88%, *before* considering any effort or evasion effects. Including such effects, the needed tax revenues are beyond the top of the Laffer curve: "Such tax rates would significantly reduce economic activity and would create serious problems with tax avoidance and tax evasion. Revenues would probably fall significantly short of the amount needed to finance the growth of spending; therefore, tax rates at such levels would not be feasible".

Bond rating agencies use other ratios as well. Graham (2010) reports that Moody's may downgrade US government debt from AAA status as soon as 2013, based on CBO projections that interest will climb to 20% of revenue. Interest expense/revenue is not a sure sign of fiscal trouble or security as well, but can point in a quite different direction from current debt/GDP.

6.2.2. Crowding out

Much discussion of the dangers of deficits focuses on the *flow* of spending, and its potential effect on interest rates through a "crowding out" mechanism; higher deficits compete for savings. The fact that international debt markets are huge and there is little historical association between deficits and interest rates has always argued against this mechanism.

In any case, nothing like this mechanism is mirrored in the fiscal equation (3). One can have high inflation with no current deficits at all, if expected future deficits are high. The size of U.S. debt relative to international markets is irrelevant; what matters is the size of U.S. debt relative to the U.S. ability to run surpluses. Long-term nominal rates do not rise because flow deficits crowd out private investment. They simply reflect expected future inflation and a risk premium for government debt.

6.2.3. Seigniorage, monetization, "chicken"

Most writing about the dangers of deficits focuses on the idea that the Fed will have to monetize deficits, this action will raise the money stock, and only *then* will inflation break out. Eq. (3) emphasizes that we can have inflation *now* when people expect future monetization. We do not have to wait for seigniorage. There does not even have to be any seigniorage.

Now, $MV(i,\cdot) = PY$ reminds us that even a fiscal inflation has to be accommodated by monetary authorities. If P in the fiscal equation rises, but the Fed adamantly refuses to raise M, we have an "uncoordinated policy". One side must give way in a "game of chicken". The Fed gives way automatically when it follows an interest rate target or otherwise passively adjusts money in response to liquidity needs, as it has been explicitly and aggressively doing for the past year. Whether it can prevail in a serious fiscal exigency is an interesting and open question. Would the Fed refuse to monetize if the U.S. ran into very high interest rates when trying to roll over debt? Or would it quickly give in, as the ECB did in purchasing junk-rated Greek bonds? Is the Fed's threat of "chicken", in the U.S., enough to push Congress to address our long-run budget issues, especially social security and medicare?

6.2.4. The picture

In sum, the fiscal valuation equation

$$\frac{M_t + B_t - D_t}{P_t} = E_t \int_{\tau=0}^{\infty} \frac{1}{R_{t,t+\tau}} s_{t+\tau} \, d\tau$$

and experience of past fiscally-induced collapses paints a far different picture of a fiscal inflation than in most commentator's scenarios. This equation looks (and is) a lot like the valuation equation for a stock. Hence, a fiscal inflation may well look like a stock market collapse. The tipping point, where investors change expectations of long-term future surpluses s, valuations of government-held assets D, or require larger real risk premiums R to hold them, can come quickly and unpredictably, without necessarily large current debt/GDP, large current deficits, large current monetization; without strong "demand" and small "gaps". It can come as a surprise to a Federal Reserve, and to economists unused to thinking about fiscal limits to monetary policy, or who think in terms of one-year flows rather than thinking through the lens of modern, intertemporal macroeconomics. Since the long present value results from rolling over short-term debt, difficulties in that roll over may be one of the first signs of trouble.

Where is the fiscal limit? I do not know. But there *is* a fiscal limit, and wherever it is, we are a few trillion dollars closer to it than we were last year, and we will be another few trillion dollars closer next year. The next two considerations suggest it is closer than we think.

6.3. Credit guarantees, nominal commitments, and the fiscal limit

If official debt-to-GDP ratios are "only" headed to 100% or so, there is still a lot of off-the-books nominal debt. Defined-benefit pensions, unused nominal depreciation allowances, and even nominally sticky government salaries are all forms of nominal debt.

The U.S. government has made very large credit guarantees. The government has explicitly guaranteed Fannie and Freddie debt and underlying mortgages, the TARP banks debt, student loans, and many others. Implicit guarantees are potentially as large or larger.[6] Fed Chairman Ben Bernanke[7] has pretty much guaranteed that no large financial firm will fail. Immense bailouts loom of state and local governments, defined-benefit pension plans, and foreign sovereign debt either directly or via the IMF. For example, Novy-Marx and Rauh (2009) estimate that state pension obligations are underfunded by $3.23 trillion, dwarfing the states' publicly traded debt of $0.94 trillion. The Federal Government is unlikely to let states or their pensions default.

Credit guarantees have two effects. First, and most obviously, having to make good on these guarantees on top of large budget deficits can be the piece of bad news that kicks expectations over the fiscal limit.

Second, nominal credit guarantees and other nominal or poorly indexed commitments, mean that government finances are much better if there is inflation. Higher nominal real estate prices will surely make the government's mortgage and banking guarantees much easier to fulfill. We can treat these guarantees as additional nominal debt, or we can count the flows, and recognize that surpluses are not independent of the price level. In this treatment, our equation is really

$$\frac{M_t + B_t}{P_t} = E_t \int_{\tau=0}^{\infty} \frac{\Lambda_{t+\tau}}{\Lambda_t} s_{t+\tau}(P_{t+\tau}) \, d\tau$$

with $s'(P) > 0$. For example, Burnside et al. (2006) find that the Korean devaluation helped government finances largely by lowering the real value of nominal wages paid to government workers, rather than devaluing domestically denominated nominal debt—the mechanism was $s(P)$ not B/P. More deeply, guarantees are options with a nonlinear payoff, making deflation much worse than inflation is helpful for government finances.

This consideration means that a smaller inflation can solve a larger budget problem, since a rise in P makes the right side larger as well as the left side smaller. This is good news. The U.S. problem, large prospective deficits with a (yes) relatively small stock of outstanding debt, would otherwise put us in a real fiscal pickle, since we cannot devalue debt we have not issued yet. Even an infinite price level – a default of all outstanding U.S. debt, cutting future interest payments on today's debt to zero – is not enough to pay for the CBO's projections of Social Security and Medicare deficits. On the other hand, the fact that real surpluses increase with inflation makes it much more likely that the government will choose inflation rather than explicit spending cuts. Again, one should not think of surpluses as exogenous in this fiscal analysis. Really we should think of the Government's *decision* to inflate, trading off distorting taxes, useful or politically popular spending, and the distortions caused by inflation, and the ability to place blame elsewhere in making this decision.

6.4. The dynamic Laffer curve and the fiscal limit

One fiscal limit is the point at which higher taxation simply cannot raise any more revenue—the top of the "Laffer curve".[8] Since *present values* matter, small effects of tax rates on growth can put us at the fiscal limit much sooner than static analysis suggests. Thus, a high marginal tax and interventionist policy which stunts growth can be particularly dangerous for setting off a fiscal inflation.

We are used to thinking of the static Laffer curve, in which tax revenue T_t is generated by a tax rate τ_t from income Y_t as

$$T_t(\tau_t) = \tau_t Y_t.$$

The marginal revenue generated from an increase in taxes is

$$\frac{\partial \log T_t}{\partial \log \tau_t} = 1 + \frac{\partial \log Y_t}{\partial \log \tau_t}.$$

The second term is negative—higher taxes lower output (and, more so, reported income), so the elasticity of tax revenues with respect to tax rates is less than one. The top of the Laffer curve is where the elasticity is equal to zero, so higher tax rates raise no revenue.

Many economists think the U.S. is comfortably below that point. For example, a rise in the tax rate from $\tau = 0.30$ to 0.35 is a 15% ($\log(0.35/0.30) = 0.15$) increase, so it would have to result in a 15% decline in taxable output before it generates no additional revenue. (Yes, this calculation is too simple. The point is to contrast this calculation with the dynamic calculation below, not to assess realistically the U.S. tax system. Trabandt and Uhlig (2009) offer a detailed Laffer calculation with fixed productivity growth and no migration, yielding the result that the U.S. is substantially below the Laffer limit.) More people voiced concern that the U.K.'s recent move to a 50% marginal rate plus VAT put it above the top, especially since high-wealth people can leave. When tax rates are already high, the same percentage point tax rate rise is a smaller percentage (log) rise, so smaller output effects of each percentage point tax rise are necessary to offset the tax rate increase.

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[6] For one estimate, see http://www.econbrowser.com/archives/2009/07/offbalancesheet.html.

[7] See Bernanke (2009a), and in particular, "…government assistance to avoid the failures of major financial institutions has been necessary to avoid a further serious destabilization of the financial system, and our commitment to avoiding such a failure remains firm".

[8] See Piergallini and Rodano (2009) for a model of the Laffer limit in fiscal theory.

The *present value* of future tax revenues is what matters for the fiscal valuation equation, however. For a simple calculation, suppose growth of taxable income is steady at rate g and the interest rate is a constant r. Then, the present value of future tax revenues is

$$PV_t = \int_{s=0}^{\infty} \frac{1}{e^{rs}} \tau Y_{t+s} e^{gs} \, ds = \frac{\tau Y_t}{r-g}$$

Taking the same derivative,

$$\frac{\partial \log PV}{\partial \log \tau} = 1 + \frac{\partial \log Y}{\partial \log \tau} + \frac{1}{r-g}\frac{\partial g}{\partial \log \tau}$$

We see there is an additional term, which is also negative.

Since $r-g$ is a small number, small growth effects can have a big impact on the fiscal limit. For example, if $r-g=0.02$, then $\partial g/\partial \log \tau = -0.02$ puts us at the fiscal limit immediately. Thus, if a rise in τ from 30% to 35% only implies a $0.02 \times 0.15 = 0.3\%$ reduction in long-term growth, then we are at the fiscal limit already, disregarding the flow effect $\partial \log Y/\partial \log \tau$ entirely. (Here I am holding r fixed. Of course, if tax rates affect real interest rates in general equilibrium, another important effect appears.)

For an example in the other direction, the "supply siders" in the Reagan administration advocated lower tax rates and larger short-term deficits, arguing that lower tax rates would spur growth and lead to larger tax revenues. The lower tax rates of the Reagan administration were in fact followed by two decades of economic growth, leading to strong surpluses as shown in Fig. 1. The present values of the surpluses that occurred validated the quick end of inflation in the early 1980s. (This graph does not prove that lower tax rates caused the spurt in growth, of course, but the event does illustrate that possibility.)

I do not digress here to the economics by which marginal tax rates lower the level or growth rate of output. The disincentive effects of working, saving or investing, and the incentives for tax evasion, are widely discussed. Migration of high-wealth people and businesses is perhaps even more important, especially to small countries: Even if growth per capita is not affected by distorting taxes, fewer capitas mean less tax revenue. Growth theory points to accumulation of knowledge as the main driver of long run per-capita growth rates, but I do not want to stop here to model how distorting taxes interfere with that process, nor tie the calculation to one particular such model.

6.5. An inflation scenario

If a fiscal inflation does come, what will it look like? To get a sense of the scenario, I examine here some simple dynamic possibilities in response to a single shock to the value of surpluses. To do this, we have to examine the maturity structure of U.S. debt, and think about the government's likely choice of how much to postpone inflation, at the cost of larger eventual inflation.

If the U.S. only had overnight or floating-rate debt, a shock to the present value of future surpluses implies a jump in the price level P_t, by (3). However, the government can still choose any path $\{E_t(1/P_{t+j})\}$ after that, by appropriately choosing the path of nominal debt. It could choose to reverse the price level jump. More plausibly, it choose to absorb the jump and choose no additional expected inflation or deflation.

Long-term debt allows the government to avoid the initial price-level jump. First, as we saw in (8), long-term debt acts as a shock-absorber. Long-term bond prices fall with less immediate effect on the price level. This suggests a slower, more drawn out response of inflation to the fiscal shock. Second, long-term debt allows the government to postpone inflation even more, by actively selling long-term debt on the date of the shock, as summarized in (9). Since most models suggest that highly volatile inflation is not desirable, these features make long-term debt very attractive. They give a reason why governments issue long-term debt, and perhaps why they should issue more of it.

To evaluate the effects of a surplus shock, I measure the maturity structure of U.S. Federal debt using the CRSP mbx database. Then, I calculate paths of expected future price levels consistent with the constraint (9) that the government can achieve by debt purchases and sales. I present the calculation in the Appendix.

Fig. 7 plots three possible (i.e. consistent with (9)) responses to a 10% shock to the present value of surpluses. First, I plot (red triangles) a one-time 11% price-level jump, followed by no further inflation. This is the solution with no long-term debt, and it remains available in the presence of long-term debt; it is a solution of (9) (and its simpler form, (17) in the Appendix).

Next, I plot (blue circles) a steady 2.75% inflation starting immediately. This is a much more plausible path. To arrange it, the government sells long-term debt to meet the surplus shock. This inflation path soon brings about higher future price *levels* than the one-time jump, which is how it still satisfies (9) and (17).

Finally, I plot (black triangles) a postponed inflation. Here, the government sells even more long-term debt immediately, so as to have no inflation at all for four years. In the fifth year, it allows the necessary inflation to emerge. Since there is not that much long-term debt outstanding at this maturity, the resulting inflation and cumulative price-level increases are also much larger.

Again, the government can *choose* which one of these paths to follow, with no difference in surpluses, by its long-term debt operations. Which one will our government choose? Certainly not the price-level jump. The delayed-inflation scenario seems plausible to me. Of course, one could try to estimate this behavior, or solve an optimal inflation-smoothing exercise after adding some frictions, but either is a lengthy exercise.
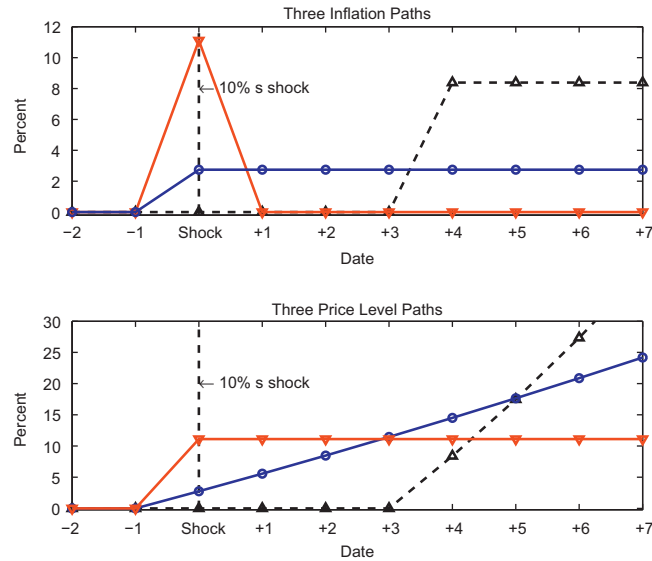
Fig. 7. Three possible reactions to a 10% expected-surplus shock $\Delta S_t = (E_t - E_{t-\Delta}) \int_{\tau=0}^{\infty} e^{-r\tau} s_{t+\tau} \, d\tau$. Red triangles display a time-t price-level jump followed by no additional inflation. Blue circles display a steady inflation starting at time t. Black triangles display a steady inflation starting 4 years after the shock. The choices are calibrated to an estimate of the US Federal debt maturity structure. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
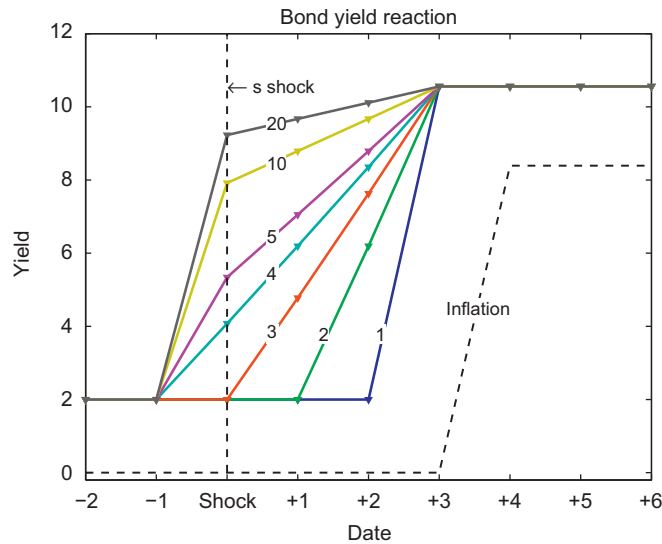

Fig. 8. Bond yields and inflation, from a 10% shock to expected surpluses ΔS, when the government sells debt to postpone inflation for 5 years. Numbers indicate the maturity of the bond yields. The vertical line indicates the date of the surplus shock. I assume a 2% constant real rate.

   To further bring the postponed-inflation possibility to life, Fig. 8 plots the corresponding time series of inflation and bond yields. The vertical line indicates the date of the surplus shock. First, long-term bond yields rise. As the inflation approaches, shorter term rates rise as well. Finally, 5 years after the surplus shock, the steady inflation actually materializes.

   When you think of fiscal inflation, then, think at least of this possibility, not a price-level jump. The "news" here is a collective decision by investors that the US is likely not to solve its long-term deficit problems, or a rise in the discount rate applied to U.S. debt, a "flight". We are likely first to see a puzzling rise in long-term interest rates. Since the "news" that shifts expectations is seldom independently visible, or is of the quantitatively small "straw that broke the camel's back" variety, politicians and central bankers are likely to decry unstable markets and speculators, as they did in the Greek crisis. Rises in shorter rates will follow, and steady inflation will follow that, on a time scale roughly coincident with the average maturity of

government debt. The longer the government puts off the inevitable inflation, the larger the cumulative price increase must be. Price stickiness or other frictions can further delay the inevitable inflation.

7. Phillips curves—Will inflation "stimulate?"

The point of stimulus is not to inflate, of course, but to boost output in the short run. Many economists argue that a little inflation is not such a bad thing in the current circumstance, as they argued for deliberate inflation in Japan in the 1990s. For example, Greg Mankiw and Ken Rogoff are quoted in Miller (2009) as being in favor of inflation, on Phillips curve grounds to raise output as well as to bail out borrowers at the expense of nominal debt holders. Surely the Fed's Fall 2010 efforts to raise expected inflation are also motivated by the hope that this will have positive output effects.

I have not described a particular mechanism for output effects, in part because both the theory and experience of Phillips curves under fiscal inflations is not well studied. But it is worth remembering that not all inflations come with output booms either in theory or in practical experience. There is no guarantee that inflation will "stimulate" the real economy. Inflation with real stagnation is a possibility too.

7.1. Experience

We have many precedents against a rigid Phillips curve in traditional monetary analyses and historical experience. Of course we all understand that currency reforms (exchanging old currency for new, with fewer zeros, or moving to the Euro) change the price level with no output effects at all.

The 1970s had inflation with recession or stagnation. This experience is captured in two ideas: "aggregate supply" shifted adversely, and inflation expectations rose, or its "anchoring" disappeared, shifting the Phillips curve up and to the right. As a visual reminder of how weak even the Phillips curve correlation is, Figs. 9 and 10 present a history of U.S. inflation and unemployment, broken up into two subperiods for visual clarity.

The larger history of fiscal inflations and currency collapses does not inspire hope that a fiscal inflation always results in prosperity. The hyperinflations that follow wars (Sargent, 1992), Latin American fiscal collapses, currency crashes, or the recent hyperinflation in Zimbabwe were associated with sharp declines in economic conditions, not the spectacular booms that a simple Phillips curve might predict.

7.2. Fiscal anchor. Fiscal stagflation? Explicit models

In any monetary-fiscal analysis, the fiscal Eq. (3) is a central part of the "anchoring" of inflation expectations necessary for successful monetary policy. This insight suggests that a fiscal inflation is likely to correspond to a "Phillips curve shift", which would lead to stagflation, not inflation with a boom. A fiscal inflation may also correspond to poor output through an "aggregate supply shift"; Governments resort to distorting taxes before they "default" through inflation.
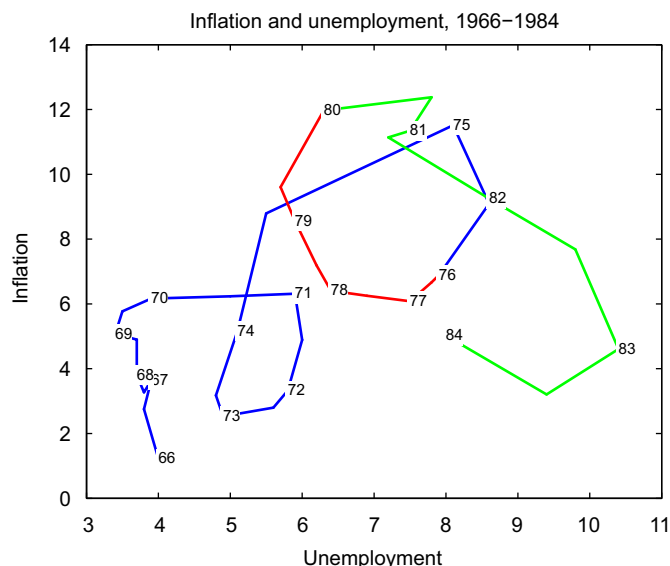

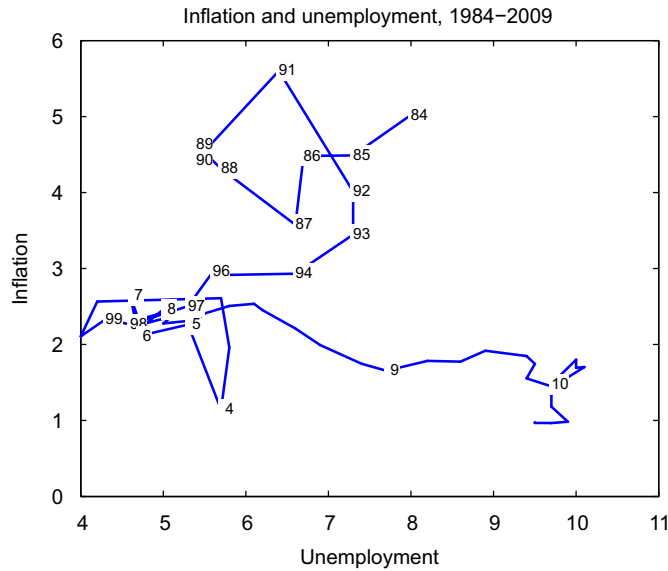Fig. 9. CPI inflation and unemployment, 1966–1984.

Fig. 10. CPI inflation and unemployment, 1984–2009.

To give one simple quantitative assessment of a fiscal inflation's output effects, I use a textbook New-Keynesian model, for example see Woodford (2003),

$$y_t = E_t y_{t+1} - \sigma r_t, \tag{13}$$

$$\pi_t = \beta E_t \pi_{t+1} + \gamma y_t, \tag{14}$$

$$i_t = r_t + E_t \pi_{t+1}, \tag{15}$$

where each symbol represents deviations from a steady state. y is output, r is the real rate, π is inflation, and i is the nominal rate. The second equation is the New-Keynesian Phillips curve. Given the response of inflation to a shock, and in particular a choice of one of the inflation scenarios in Fig. 8, we can simply compute the corresponding paths for output, and real and nominal interest rate responses to the shock, $\{y_t\}, \{r_t\}$ and $\{i_t\}$, from (14), (13) and (15) in turn.[9] We can regard the interest rate path as a calculation of an interest rate policy which picks that particular inflation outcome, among the choices shown in Fig. 7.

Fig. 11 presents the results. In response to a time-zero surplus present value shock, I specify a path for inflation similar to that in the delayed-inflation scenario of Fig. 8, but with rounded corners to avoid otherwise large movements in output and real and nominal interest rates. (The latter are essentially first and second derivatives of inflation in (13)–(15).)

The major news of Fig. 11 is that output *declines* through the entire inflation episode. This is stagflation, not a boom; a march of the Phillips curve up and to the right as in the 1970s. The reason is transparent: The inflation is all expected; expected inflation rises before actual inflation. The forward-looking Phillips curve $\pi_t = \beta E_t \pi_{t+1} + \gamma y_t$ implies lower output; $E_t \pi_{t+1}$ is a "Phillips curve shift".

Real interest rates decline in the stagflation, and rise again when output recovers. The nominal rate is a simple sum of expected inflation and the real rate. Since the nominal rate falls with output growth and then rises in the recovery, the overall rise in nominal rate is greater than the rise in inflation. An observer might well conclude that the Fed is properly following a "Taylor rule" with interest rates declining in the recession, rising faster than inflation, and rising with rising output growth. Yet a mysterious inflation coming from "loss of anchoring" bedeviled its efforts. In a sense, that is exactly what happened.

Of course, there are many different versions of the Phillips curve, with slightly different timing. But expected inflation is a "shift" in almost all of them, so this scenario, of a widely anticipated inflation, is unlikely to give much of an output boom in any model.

In this scenario, the government delayed and smoothed inflation from a surplus shock at time zero, accepting a larger eventual increase in the price level. This analysis points to an apparent further cost of delay. A time-zero price-level jump is unexpected, and could be followed by a return to zero inflation; that path would lead to more output. However, such a policy would also lead to an equal number of negative innovations, and more output instability in general.

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[9] With "active" fiscal policy of the form (3) solving new-Keynesian models is easy, as the fiscal constraint (3) picks the unique equilibrium. We also do not have to specify policy as a function of endogenous variables in the form of a Taylor rule; the equilibrium is the same given the eventual value of the interest rate whether that interest rate varies with off-equilibrium values of endogenous variables or not. An "active" fiscal policy solves the global indeterminacy problems of New Keynesian models, see Cochrane (2010a).
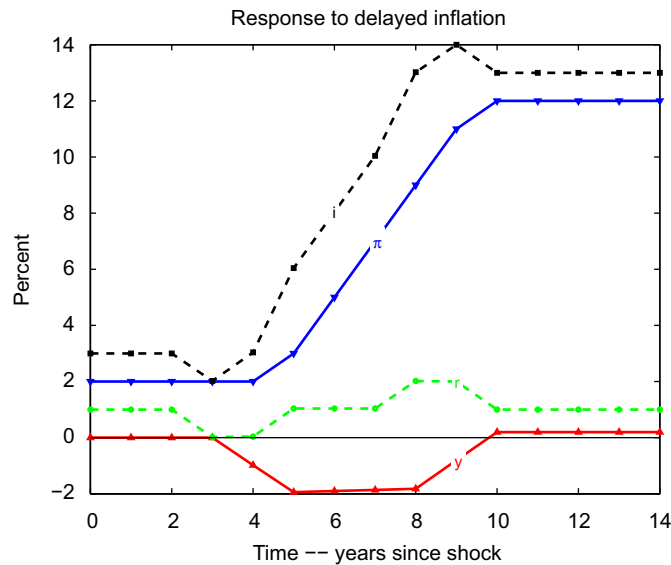
Fig. 11. Output and real and nominal rates in a "delayed inflation" scenario. I assume the path of inflation. Given that path, I calculate output y, the real rate r and the nominal rate i respectively, using $\pi_t = \beta E_t \pi_{t+1} + \gamma y_t$; $y_t = E_t y_{t+1} - \sigma r_t$; $i_t = r_t + E_t \pi_{t+1}$ respectively. I use $\beta = 0.98, \gamma = 1$, $\sigma = 1$. These expressions represent deviations from a steady state. I plot r, π and i around steady-state values 1%, 2%, and 3%, respectively, for clarity.

Though this example is suggestive, it is not clear that all fiscal inflations will have the same output effects. In the fiscal context,

$$\frac{M_t + B_t}{P_t} = E_t \int_{\tau=0}^{\infty} \frac{1}{R_{t,t+\tau}} s_{t+\tau} \, d\tau,$$

inflation can follow from issuing more money M_t or debt B_t (or long-term debt $B_t^{(j)}$) without changes in surpluses; from shocks to prospective deficits s_{t+j}, causing a flight from debt, or from a rise in the risk premium $R_{t,t+\tau}$. It is not at all obvious that each of these changes is accompanied by a boom or by the same boom. We have some sense that unexpectedly printing up a lot of money – a fiscal helicopter drop – might give a short-term output boost, especially if it were done as a surprise. However, the experience of fiscal inflations caused by current and prospective deficits – currency collapses – is not comforting.

7.3. Standard views

Here I part company with most of the inflation/deflation commentators and the Federal Reserve. All of them link inflation tightly to increased "demand" and hence tighter markets.

In a revealing statement, Chairman Bernanke (2009b) said to Congress,

> Even after a recovery gets under way, the rate of growth of real economic activity is likely to remain below its longer-run potential for a while, implying that the current slack in resource utilization will increase further. …In this environment, we anticipate that inflation will remain low. The slack in resource utilization remains sizable, and, notwithstanding recent increases in the prices of oil and other commodities, cost pressures generally remain subdued. As a consequence, inflation is likely to move down some over the next year relative to its pace in 2008. That said, improving economic conditions and stable inflation expectations should limit further declines in inflation.

Throughout 2009 and 2010 the FOMC has been issuing nearly identical statements. This one is from March 16, 2010:

> "With substantial resource slack continuing to restrain cost pressures and longer-term inflation expectations stable, inflation is likely to be subdued for some time.

So, inflation is caused by "tightness" and deflation by "slack" in the economy. This is not just *a* cause and forecasting variable, it is *the* cause, because given "slack" we apparently do not have to worry about inflation from other sources, notwithstanding the weak correlations of Figs. 9 and 10.

These statements do mention "stable inflation expectations". How does the Fed know expectations are "stable" and would not come unglued once people look at deficit numbers? As I read Fed statements, almost all confidence in "stable" or "anchored" expectations comes from the fact that we have experienced a long period of low inflation (adaptive expectations). To a lesser extent, the Fed relies on survey data and interest rate data. For example the semiannual report on monetary policy (Federal Reserve, 2010) accompanying Chairman Bernanke (2010b) testimony mentions "stable" inflation expectations three times. The first points to a graph (its Fig. 2) of actual inflation. The second (under "prices") summarizes median survey data,

excusing a jump in short-term expectations by energy prices and pointing to more stable long-term expectations. The third infers expectations from Treasury vs. TIP yields, again arguing that "short-term" expectations might have risen but "long-term" expectations had not changed much.

But neither surveys nor long-term yields gave any warning of inflation in the 1970s nor disinflation in the 1980s. These considerations are the *only* mention of expectations in the document. Occasionally, sophisticated Fed statements allude to the New-Keynesian idea that expectations are anchored by a belief that the Fed will respond quickly to inflation, though not why people should have such a belief[10]. The volume of popular press coverage of deficits and inflation – clearly about expected future inflation – and even the ads for gold on cable TV suggest at least a more widespread concern about inflation than has been present for some time.

Fed statements make no mention of fiscal constraints on monetary policy, the possibility that fiscal inflation can erupt and there is little the Fed can do about it, or that uncontrolled deficits may quickly induce higher inflation expectations.

It is true that Fed Chairman Bernanke has been more and more vocal about the need to solve our fiscal problem. For example, his (Bernanke, 2009c) July 21, 2009 testimony:

> …maintaining the confidence of the public and financial markets requires that policymakers begin planning now for the restoration of fiscal balance… Addressing the country's fiscal problems will require difficult choices, but postponing those choices will only make them more difficult. Moreover, agreeing on a sustainable long-run fiscal path now could yield considerable near-term economic benefits in the form of lower long-term interest rates and increased consumer and business confidence. Unless we demonstrate a strong commitment to fiscal sustainability, we risk having neither financial stability nor durable economic growth.

On April 27, 2010, he (Bernanke, 2010c) went further,

> Increasing levels of government debt relative to the size of the economy can lead to higher interest rates, which inhibit capital formation and productivity growth—and might even put the current economic recovery at risk. To the extent that higher debt increases our reliance on foreign borrowing, an ever-larger share of our future income would be devoted to interest payments on federal debt held abroad. Moreover, other things being equal, increased federal debt implies higher taxes in the future to cover the associated interest costs—higher taxes that may create disincentives to work, save, hire, and invest. High levels of debt also decrease the ability of policymakers to respond to future economic and financial shocks; indeed, a loss of investor confidence in the ability of a government to achieve fiscal sustainability can itself be a source of significant economic and financial instability, as we have seen in a number of countries in recent decades.

His (Bernanke, 2010d) October 4, 2010 speech is the most emphatic yet on the need for fiscal reform yet. He emphasized tax reform rather than higher tax rates, and advocated budget rules. He said that looming deficits pose "a real and growing threat. … The only real question is whether these adjustments will take place through a careful and deliberative process… or whether the needed fiscal adjustments will be a rapid and painful response to a looming or actual fiscal crisis".

These are all important points. Still, the main danger Chairman Bernanke sees from an unsustainable debt path is higher long-term interest rates, from a flow crowding-out argument, and less "confidence" and "stability". We only get a glimmer of the fiscal equation's warning—that when investors question fiscal sustainability, inflation can break out despite ample "slack" and there is nothing the Fed can do about it.

Other commentators on both sides evoke similar views. Krugman (2009) writes "[in ordinary times]…banks, flush with reserves, would increase loans, which would drive up demand, which would push up prices". Laffer (2009) describes the same mechanism. Feldstein (2009) describes a more general "demand" based mechanism: "The key fact is that inflation rises when demand exceeds supply. A fiscal deficit raises demand when the government increases its purchase of goods and services or, by lowering taxes, induces households to increase their spending…" Again, he is worried about crowding out, not a flight from the debt and stagflation.

All of these analyses ignore the stagflation experience of the 1970s, in which inflation was high even with "slack" markets and little "demand", and "expectations" moved quickly. They ignore the experience of hyperinflations and currency collapses, which happen in economies well below "potential".

The Phillips curve does shift; a fiscal inflation may well correspond to a shift, not a movement along that curve; such shifts in expectations can happen very rapidly; and there may be very little the central bank can do about it.

8. Alternative arrangements

My analysis of the possibilities we currently face, based on the fiscal equation (3) is pretty depressing. If demand for government debt rises – if the discount rate continues to fall in "flight" to quality or dollar – there eventually is nothing the Fed can do about it, and little the government as a whole can do about it. Changing expectations to slightly lower the present value of future surpluses without causing a panic is very difficult, and really beyond any policy steps with current institutional arrangements. If demand for government debt falls – if investors come to a gloomy assessment of long-run growth, long-run

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[10] Cochrane (2010b) expands on the multiple equilibria of New Keynesian models and the difficulty of inferring its policy rules.

surpluses, and fly from US debt raising its discount rate – we could face bond-market turmoil followed by intractable stagflation. Again there is little the Federal Reserve can do about it, and calming expectations of long-run surpluses while restoring the low discount rate for U.S. government debt may become very difficult once these are lost. If either of these events comes to pass, we will undoubtedly be looking for better monetary arrangements.

More deeply, the fiscal equation (3) paints an ultimately unfortunate analogy between inflation and stock prices. When it operates, prices inherit the unpredictability and uncertainty associated with stock prices. While it is nice to have a theory that predicts our ignorance – one that *predicts* inflation will be hard to forecast – one wonders if there are better monetary arrangements that would not expose us to such instability. As the coins were followed by gold standard, interest rate pegs, Bretton Woods, floating rates, monetary targets, Taylor rules, and now unconventional policy, one might ask, if we face one of these events, what is next? The post-Greece Euro is already ripe for redesign.

The instability in our current arrangements comes, first, from the fact that our government does not have a very good way to make and communicate fiscal commitments. If it could commit to and communicate a path of surpluses that led to a stable present value, we would face neither the risk of inflation or deflation. Small inflations, apparently now desired by the Fed, would be easy to achieve; small deflations, as prescribed by the Friedman rule, could be achieved without fear that the government would then lose control of inflation. Corporations are supposed to maximize profits, so lowering earnings to stabilize stock prices makes no sense. The government does not have to maximize surpluses, so finding an arrangement to commit to a stable present value of surpluses is possible.

From a fiscal point of view, a successful Ricardian regime, with prices determined by $MV=PY$ or interest-rate policy is exactly such a commitment and communication mechanism: $MV=PY$ or interest rate policy communicate and commit the government to a *fiscal* path which leads to a stable price level. The trouble is, neither of these conventional approaches is particularly effective, either at communication or at commitment.

In theory, price-level determination and stopping inflations or deflations is not hard: just switch to a commodity standard. From a fiscal point of view, a commodity standard works because it communicates a fiscal commitment. If the government pegs the price of gold at $100, and inflation looms, the government will sell lots of gold. Crucially, the government will have to raise taxes in order to obtain that gold. Gold purchases commit and communicate the need to run greater surpluses. If deflation looms, the government will buy lots and lots of gold with newly created money. The standard clearly commits that this money will not be redeemed by future taxes. Of course, commodity standards fall apart when governments cannot or choose not to follow up on the implied fiscal commitments (again showing that the standards are ultimately all about fiscal commitments not commodities), but they remove unneeded volatility as long as the government is fundamentally sound.

A gold standard, or even a commodity standard are not practical for a modern economy. Gold and commodity prices diverge too much from the broader measures of inflation that we really care about, and opening a Fed-Mart to buy and sell the entire CPI is not feasible. However, once we recognize that the fiscal commitment rather than direct purchases or sales of the commodity is the key ingredient for inflation determination a little financial engineering can create the same commitment. If the Fed targeted CPI futures, or the TIP-Treasury spread, it would be targeting the thing it really cares about – CPI inflation or expected inflation – rather than the price of commodities only loosely linked to those measures. If, say, deflation occurred, the Fed would lose a lot on its CPI futures or TIP-Treasury bets, just as it would lose a lot of money buying gold. If inflation occurred, the Fed would make a lot of money on the same bets, just as money would flow in when buying gold. These measures would communicate and commit the same fiscal commitments as a CPI purchase program, without requiring actual CPI purchases. They are also fiscal commitments that a central bank can make, unlike helicopter drops.

The second source of instability in our current arrangements is the lack of an alternative form of government equity. In (3), when the present value of surpluses is wanting, the value of nominal government-debt falls by increasing the price level, dragging every other price and nominal contract with it. Shifting to real, foreign currency debt, or a modern commodity standard means that when the present value of surpluses must change, the only adjustment mechanism is explicit default, which is chaotic. A "shock absorber" which functions like government equity would allow variation in the present value of surpluses without default. Far greater reliance on long-run debt is a good first step. If surplus shocks could express themselves in long-term interest rate variation rather than roll-over difficulties and immediate pressure on aggregate demand, there would at least be more time to address underlying problems. Similarly, the first step for the Euro ought to be to demand far greater long-term financing from countries expecting a bailout.

9. Conclusion

The government debt valuation equation

$$\frac{M_t + B_t}{P_t} = E_t \int_{\tau=0}^{\infty} \frac{1}{R_{t,t+\tau}} s_{t+\tau} \, d\tau \tag{16}$$

is at the center of macroeconomic events right now, from understanding the recession, to stimulus, to monetary policy, to the inflation/deflation debate, to the redesign of monetary arrangements and the future of the Euro.

Will we get deflation? The fiscal analysis suggests that if discount rates for government debt fall, and demand for that debt rises, in additional "flight to quality", there may be very little that the Fed or even the government as a whole can do about it. However, the fear of a "deflationary spiral" comes from a view that deflation is caused by gaps, and gaps by real interest rates. The fiscal analysis denies this channel, so there is no fear of such a self-fulfilling "spiral".

Will we get inflation? The scenario leading to inflation starts with poor growth, possibly reinforced by to larger government distortions, higher tax rates, and policy uncertainty. Lower growth is the single most important negative influence on the Federal budget. Then, the government may have to make good on its many credit guarantees. A wave of sovereign (Greece), semi-sovereign (California) and private (pension funds, mortgages) bailouts may pave the way. A failure to resolve entitlement programs that everyone sees lead to unsustainable deficits will not help.

When investors see that path coming, they will quite suddenly try to sell government debt and dollar-denominated debt. We will see a rise in interest rates, reflecting expected inflation and a higher risk premium for U.S. government debt. The higher risk premium will exacerbate the inflationary decline in demand for U.S. debt. A substantial inflation will follow—and likely a "stagflation" not inflation associated with a boom. The interest rate rise and inflation can come long before the worst of the deficits and any monetization materialize. As with all forward-looking economics, no obvious piece of news will trigger these events. Officials may rail at "markets" and "speculators". Economists and the Fed may scratch their heads at the sudden "loss of anchoring" or "Phillips curve shift".

This is a scenario, not a forecast. Whether it happens depends on the actions of our public officials, which are very hard to forecast.

In the meantime, as I have outlined, the intellectual landscape for the analysis of monetary and fiscal policy is changed deeply by a world in which fiscal issues crystallized in (16) exert stronger influence on the advanced economies than they have for generations.

Acknowledgements

Appendix A

This Appendix gives the calculations behind Figs. 7 and 8. I suppose that the economy starts at a steady-state price level P, and there is a single expected-surplus shock ΔS_t at date t,

$$\Delta S_t \equiv (E_t - E_{t-\Delta}) \int_{\tau=0}^{\infty} e^{-r\tau} s_{t+\tau} \, d\tau.$$

With long-term debt from (9), the subsequent price-level paths $\{P_{t+j}\}$ must satisfy

$$\int_{j=0}^{\infty} e^{-rj} \left(\frac{1}{P_{t+j}} - \frac{1}{P} \right) B_t^{(j)} \, dj = \Delta S_t.$$

We can rewrite this condition in a convenient dimensionless form as

$$\int_{j=0}^{\infty} \left(\frac{\frac{1}{P_{t+j}} - \frac{1}{P}}{\frac{1}{P}} \right) W_t^{(j)} \, dj = \frac{\Delta S_t}{S} \tag{17}$$

where

$$W_t^{(j)} \equiv \frac{e^{-rj} B_t^{(j)}}{\int_{j=0}^{\infty} e^{-rj} B_t^{(j)} \, dj}$$

denotes the fraction of the market value of debt due to maturity-j debt.

Holding the path of surpluses constant, the government can choose any path $\{P_{t+j}\}$ consistent with (17). With outstanding long-term debt $W_t^{(j)} > 0$, the government can trade less inflation now P_t for more inflation later P_{t+j}. To display the response to a surplus shock, then, we have to take a stance on which path the government will choose. Our government seems to prefer steady inflation to highly variable inflation or price-level jumps, and for good reasons. To get a sense of the possibilities, I suppose the government holds inflation to zero for T years, and then allows a constant inflation π_T,

$$P_{t+j} = P, \quad j < T,$$
$$P_{t+j} = Pe^{\pi_T(t-j)}, \quad j \geq T.$$

To find the required inflation π_T for a given surplus shock ΔS_t, we must have

$$\int_{j=T}^{\infty} \left(\frac{1}{e^{\pi_T(j-T)}} - 1 \right) W_t^{(j)} \, dj = \frac{\Delta S_t}{S}. \tag{18}$$

I suppose a 10% negative shock to the present value of expected surpluses, $\Delta S_t = -10\%$. I form an estimate of the maturity structure of outstanding debt $W_t^{(j)}$. Then, for each T, I find the value of π_T that solves Eq. (18).

To estimate the maturity structure $W_t^{(j)}$, I use every bond, bill, or note in the CRSP mbx database on January 31, 2009. I assign coupons to the month in which they come due, so $B_t^{(j)}$ includes both principal and coupon payments coming due at time $t+j$. This is a very crude measure: I do not include Federal Reserve liabilities, nor offsetting government or Federal Reserve assets. I do not include credit guarantees, nor the nominal value of unused depreciation allowances and other nominal commitments. I do not include nominally sticky salaries and pension or health benefits of government workers. However, this is a useful starting place. It lets us begin to think about how much of a long-term debt cushion the U.S. government has, and thus how quickly surplus shocks must feed in to inflation.

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