

# A Response to Sims (2013)

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January 9, 2015

## 1 Introduction

Chris Sims' (2013) "Paper Money" nicely exposts many applications of the Fiscal Theory of the Price Level. Its major point is that one must recognize and understand fiscal backing to understand price level determination.

In a section starting on p. 575, Sims seems to criticize my 2010 JPE paper "Determinacy and Identification with Taylor Rules." I don't think there is any basic disagreement between my paper and what Sims has written. However, it looks like there is one, so it's worth clearing up the issues. (Also, several referees of a subsequent paper have asked me to address this seeming controversy. It is better to do so here carefully rather than squash a few sentences into footnotes of papers on other subjects.)

## 2 Sims' proposal

A main point of my paper is that, in a class of models with forward-looking optimizing agents (i.e. new-Keynesian DGSE, not old-Keynesian ISLM), an "active" Taylor-type rule with completely passive fiscal policy is not enough to determine the price level or inflation.

This fact is easy to see in a simple case. Let the model consist of a Taylor-type rule

$$i_t = \phi_\pi \pi_t, \tag{1}$$

and a linearized Fisher equation, the first order condition for inter temporal optimization,

$$i_t = r + E_t \pi_{t+1}. \tag{2}$$

With passive fiscal policy, the only equilibrium condition is

$$E_t (\pi_{t+1}) = \phi_\pi \pi_t \tag{3}$$

(Sims uses notation  $r$  for  $i$ , and  $\theta$  for  $\phi_\pi$ .) There are multiple equilibria.

True, all equilibria but  $\pi_t = 0$  explode to hyperinflation or deflation. But my point is, there is nothing in economics to rule out such solutions. "Local determinacy" does not imply "global

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determinacy.” So, without something else, we do not have determinacy. I argued that the only “something else” that has been found to work is to add an active fiscal policy.

Sims’ main point in this section is (p. 575)

...the simple model of this section shows that we can also justify uniqueness of the price level with a Taylor rule by invoking fiscal backing that is always in play, even in equilibrium, but is negligibly small in size.

Sims’ model is on the bottom of his p. 576 and the top of p. 577. Sims introduces a response of the primary surplus to inflation, his (28), which I will simplify slightly to

$$\tau = \tau_0 + \phi_2 \pi \tag{4}$$

where  $\tau$  is the primary surplus.

This is now an active-fiscal policy. If paired with a Taylor rule, of any coefficient, then only one value of initial inflation will satisfy the government debt valuation equation. This is the main point of Sims’ model.

To see that fact, the government debt valuation equation (what Sims calls, wrongly in my view, the “government budget constraint” – see Cochrane 2005) becomes

$$b_t = E_t \sum_{j=0}^{\infty} \beta^j (\tau_0 + \phi_2 \pi_{t+j}) \tag{5}$$

$$b_t = E_t \sum_{j=0}^{\infty} \beta^j (\tau_0 + \phi_2 \phi_{\pi}^j \pi_t) \tag{6}$$

$$b_t = \frac{1}{1 - \beta} \left( \tau_0 + \frac{\phi_2}{1 - \beta \phi_{\pi}} \pi_t \right) \tag{7}$$

Here,  $b_t$  denotes the real value of the debt, and all debt is real. Thus, we have determined inflation  $\pi_t$  uniquely, for any value of the Taylor parameter  $\phi_{\pi}$ .

In Cochrane (2014), I called this sort of policy, in which budgets adapt to inflation or price levels, a “fiscal Taylor rule.” It can give fiscal price-level determination even with indexed or foreign currency debt, and it can be a useful part of a fiscal-monetary regime.

But where is the argument? To reiterate, my main proposition was that even “active” Taylor rules do not determine the price level without active fiscal policy. Sims’ example has active fiscal policy. It does not overturn my proposition, nor does Sims claim to overturn that proposition.

Now, Sims points out that with with a large Taylor rule coefficient  $\phi_{\pi}$  the coefficient  $\phi_2$  can be small, so that we seldom see much influence of inflation on budgets:

These arguments do not depend on the size of  $\phi_2$ , so long as it is positive. In equilibrium,  $\pi$  will be zero or (if people are imperfectly foresighted, or if we add random disturbances to the system) fluctuate in a narrow range. If  $\phi_2$  is small enough, its presence might be difficult to detect from data. In any case its presence would have no effect on the first two equations of the system or on the equilibrium time path of prices and interest rates, except for its elimination of the unstable solutions as equilibria of the economy. (p. 577).

One could ask whether this is a *reasonable* policy configuration as a model for how monetary-fiscal policy institutions in the US and Europe work.  $\phi_\pi > 1$  still means that our central banks deliberately destabilize the economies, now in a game of chicken to force fiscal authorities to start raising taxes in response to inflation. But Sims does not make this case.

And this is to me the curious part of Sims' discussion. This example does not revive the theorem that an active Taylor rule alone can determine the price level. This example does, however, revive the spirit of new-Keynesian models, in which one does not need any serious analysis of fiscal policy to understand monetary affairs, except as a footnote about unverifiable ("hard to detect") assumptions that a theorist can add to trim multiple equilibria.

But what is that example doing in this paper, mentioned approvingly, which otherwise is all about how serious analysis of monetary policy must understand, measure, consider, and design appropriate fiscal backing? It seems that the fiscal-monetary coordination of this example is exactly the sort that Sims must argue is implausible, if the rest of the paper, and the research program that it advocates, and which we both are pursuing matters at all. If he won't, I will, but he should!

### 3 Pruning equilibria

A second point of my paper was that attempts to restore global determinacy *without* adding an active fiscal policy don't work. They require the government to credibly threaten to blow up the economy.

The first part of Sims' section reads

Cochrane (2007) has argued against attempts to claim a determinate price level in models with Taylor-rule monetary policy by invoking "fiscal backing" that comes into play only off the equilibrium path. I don't understand his reasoning,

Again, as I will show, there is no argument between us here.

Sims cites a 2007 working paper. Perhaps the 2010 published version is more understandable. In any case, anything that Chris Sims doesn't understand is worth a clarification.

My claim requires a long survey of the attempts, which are in the paper and appendix, and which I will not repeat here. But the basic logic is simple: The repair attempts in question add to the Taylor rule some policy prescription of what will happen in a very high inflation or deflation, to cut off those inflations or deflations as equilibrium paths. Logically, those attempts must do one of two things

a) They can fix the inflation/deflation. An inflation/deflation breaks out, and when it gets too big the government does something like switch to a monetary growth rule or active-fiscal regime that stops the inflation/deflation.

Fine, that's what governments do. But the whole path remains an equilibrium. Inflation starts, government changes policy, inflation stops. The economy obeys first-order, market-clearing and transversality conditions on the whole path. There is nothing to stop the economy from going down that path. So though the government will change policy (quite reasonable) to fix the inflation / deflation, that fact does not rule out the initial  $\pi_t \neq 0$  that starts us down the inflationary/deflationary path, and that initial inflation or deflation is not ruled out as an equilibrium.

b) They assume that the government changes policy in a way in which equilibrium cannot form. Agents cannot satisfy first order conditions or markets cannot clear.

I called that a threat to “blow up the economy.” They violate the Ramsey tradition that policy settings must take equilibrium as a constraint, and they violate subgame-perfection that “equilibrium cannot form” is disastrous for the government’s objectives ex-post.

The logic is pretty inescapable. If you stop inflation in such a way that the path is an equilibrium every step of the way, then it isn’t ruled out. If you want to rule out the path, it has to violate equilibrium conditions at some point.

In particular, the “ ‘fiscal backing’ that comes into play only off the equilibrium path” which Sims did not understand likely refers to my section titled “Fiscal Equilibrium Trimming” starting on p. 586. This section analyzed Benabib Schmitt-Grohé and Uribe (2002), and Woodford (2003, sec. 4.2). (Sims did not cite a particular result.)

In those proposals, the government switches to a fiscal-active regime when inflation gets too low. Though that sounds reasonable, “reasonable” brings the economy back out of a deflation and equilibrium conditions hold along the path, so the path is not ruled out. To rule out equilibria, the government must specify policy somehow so that an equilibrium cannot form. p. 587 explains how their proposals actually work:

... The proposal does not “lift the economy out of a deflationary trap” back to  $\Pi^*$ . Their proposal sits at  $\Pi_L$  with an uncoordinated policy and lets government debt explode. If their proposal did successfully steer the economy back to  $\Pi^*$ , then the whole path to and back would have been an equilibrium. Benhabib et al. change tax policy *while also maintaining the Taylor rule*  $\Phi(\Pi)$  and the dynamics of figure 1. In Woodford’s page 132 quote, “*while monetary policy is described by the Taylor rule*” is the key. We are switching to a Ricardian regime, which demands higher inflation, while simultaneously keeping the Taylor rule in place, which demands continued low inflation. The transversality condition is a consumer first-order condition. We are setting policy parameters for which consumer first-order conditions cannot hold.

It is not a switch to fiscal-dominant policy that rules out the equilibrium. It is the threat to impose a policy configuration that requires simultaneously two different values of inflation that does the trick. It is a threat to impose uncoordinated policy that does the trick. Now, we’ve known that equilibrium cannot form if the government doggedly insists on uncoordinated policy, since Leeper (1991). But does it mean anything for the government to threaten such a policy configuration?

This “works” exactly in the same way as a related proposal by Bassetto (2004): why not just threaten to violate the zero bound? If the government follows a Taylor rule all the way to negative rates, but currency exists, then it introduces an arbitrage opportunity into the economy and no equilibrium can form. That’s brilliantly clear. But what does it mean to doggedly insist on an arbitrage opportunity for which no equilibrium can form?

Perhaps this is still hard to understand. I won’t go on, as my (2010) paper goes on at length, and if you weren’t persuaded there, you won’t be persuaded here.

But again, there is no argument with any of this in Sims’ paper. Sims does not try to rescue proposals in which government switches policy to prevent equilibrium from falling. any of this. His proposal has “fiscal backing that is always in play, even in equilibrium.”

## 4 Maybe?

There may be a hint of an actual disagreement on p. 576,

Leeper assumed that such explosive paths for the price level [my (3)] were not equilibrium paths and focused on the one stable solution... This equation can be solved for a unique value of  $p_o$ .

If the initial price level [inflation in my example] should be below this level... inflation tends to  $-\infty$  at an exponential rate. The policy rule (21) cannot possibly be maintained on such a path, as it would require pushing  $r$  to negative values. It is natural to suppose that there would be a shift in the rule at very low inflation rates, with fiscal policy ruling out such a path...

Actually, in the literature, except Bassetto's (2004) clever idea, it is monetary policy that changes, leaving local indeterminacy around the liquidity trap. We've already dealt with the idea that fiscal policy rules out this path. Continuing,

If the initial price level and inflation rate are above the steady state level, the inflation rate rises at an exponential rate. The opportunity costs of holding non-interest-bearing money balances become arbitrarily high. If real balances are essential (utility is driven to  $-\infty$  as  $M/P \rightarrow 0$ ), these explosive paths may be viable equilibria. If not, there may be an upper bound on the interest rate above which real balances become zero. Paths on which real balances shrink to zero in finite time may also be viable equilibria...

So far so good, they are still viable equilibria. My p. 589 section E. "Residual Money Demand: Letting the Economy Blow Up" treats these issues at length, including Sims (1994). Appendix B, p. 609 treats the Obstfeld-Rogoff (1983) shift to a money target in great detail. Sims hasn't argued with any of this.

Continuing, though,

...Here again, though, we can postulate a shift in policy at very high inflation rates that eliminates these unstable paths, while leaving the stationary  $\dot{p} = 0$  equilibrium viable.

Cochrane finds these hypothetical policy shifts at high and low inflation rates, which then never are observed in equilibrium, implausible.

Now, here is a sentence which does amount to a whiff of disagreement. But now it is my turn not to understand. *Which* shifts in policy at high inflation rates is Sims talking about? I covered a lot of them! I didn't just offer an opinion that the "shifts" are implausible, I looked hard at each one, at the nature of an economy in which government policy steadfastly does not allow first order conditions or market clearing to hold, before commenting that such policy amounted to blowing up the world, and looked sublime imperfect. Which ones would Sims like to argue for? How? I don't know.

But this is a thoroughly minor issue. In a long section of a long delightful paper, based on a speech, we have one off-the-cuff comment that looks like a slight disagreement, and is probably quickly explained.

## 5 References

- Bassetto, Marco. 2004. "Negative Nominal Interest Rates." *American Economic Review Papers and Proceedings* 94, 104-108.
- Cochrane, John H., 2005. "Money as Stock." *Journal of Monetary Economics* 52, 501-528.
- Cochrane, John H., 2011. "Determinacy and Identification with Taylor Rules." *Journal of Political Economy* 119, 565-615.
- Cochrane, John H., 2014. "Monetary Policy with Interest on Reserves." *Journal of Economic Dynamics and Control* 49, 74-108.
- Obstfeld, Maurice, and Kenneth Rogoff. 1983. "Speculative Hyperinflations in Maximizing Models: Can We Rule Them Out?" *Journal of Political Economy* 91, 675-687.
- Sims, Christopher, 2013. "Paper Money." *American Economic Review* 103, 563-584. <http://dx.doi.org/10.1257/aer.103.2.563>
- Sims, Christopher, 1994. "A Simple Model for Study of the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy." *Economic Theory* 4, 381-399.
- Schmitt-Grohé, Stephanie, and Martín Uribe. 2000. "Price Level Determinacy and Monetary Policy under a Balanced Budget Requirement." *Journal of Monetary Economics* 45, 211-246.
- Woodford, Michael. 2003. *Interest and Prices*. Princeton, NJ: Princeton University Press.