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Comment

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Overview

This paper revisits a classic question in macroeconomics—what was the cause of the Great Inflation of the 1970s? The specific hypothesis is that low-frequency movements in inflation over this period were due to fiscal disturbances. The paper presents a striking model suggesting that two particular episodes of fiscal history—defined by the Great Society initiatives of President Johnson and tax cuts enacted by President Ford—can capture much of the Great Inflation. While this is an intriguing finding in its own right, the analysis has further merit as part of a growing literature seeking to relocate fiscal policy in discussions of US monetary history. The insights garnered are informative about current policy and future macroeconomic developments.

To arrive at these findings the paper builds on recent research on monetary and fiscal policy interactions. The basic building blocks are the existence of multiple policy regimes. Regime 1 is Ricardian and called "virtuous." In the language of Leeper (1991), monetary policy is active and fiscal policy is passive. Fiscal policy has no monetary consequences. Regimes 2 and 3 are non-Ricardian, distinguished only by their persistence, with regime 2 being less persistent than regime 3. Here monetary policy is passive and fiscal policy is active. The existence of two non-Ricardian regimes is the first important assumption. Suggested in the labeling of regime 1, these regimes are less "virtuous" by degrees. These regimes have the property that fiscal policy has monetary consequences.

Asserting the existence of multiple regimes is not novel in itself. There is a body of evidence supporting the notion of occasional

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switches in policy regime from Ricardian to non-Ricardian—see, for example, Davig and Leeper (2006) for an important contribution. Moreover, employing multiple regimes to understand the potential risks to macroeconomic stability has been an active agenda—see, as one of many examples, Davig, Leeper, and Walker (2011). The novel part of the analysis lies in an additional second important assumption: agents must learn which non-Ricardian regime is operating when policy departs from the Ricardian regime. The two important assumptions combine to create situations in which agents become pessimistic over time about policy "virtue." Greater pessimism induces stronger inflation consequences from past fiscal developments through the standard logic of the fiscal theory of the price level. This is the key insight of the paper.

At an intuitive level the necessity of these two assumptions is immediate. Suppose there are only two regimes—one Ricardian, one non-Ricardian—and that there is a one-time switch to the non-Ricardian regime in which there are no further shocks to the economy. The fact that the fiscal policy is no longer adjusted to ensure intertemporal solvency of the government accounts requires immediate adjustment in the price level to revalue the public debt. The monetary effects of fiscal policy are immediate and potentially large depending on the size of past deficit shocks. To fit the long gradual buildup in inflation pressure in the 1970s, this adjustment needs to be pushed out over time. This is cleverly achieved by the two assumptions. Assuming a nonnegligible probability of returning to the Ricardian regime, a non-Ricardian regime with limited persistence has dynamics dominated by the Ricardian regime to which agents expect to return. A non-Ricardian regime with considerable persistence has dynamics dominated by the non-Ricardian regime itself—there is smaller probability of return to the Ricardian regime. By slowly shifting probability weight from the less persistent to the more persistent non-Ricardian regime, learning permits inflation pressures to build slowly in response to past deficit shocks. The paper gives considerable emphasis to such "dormant shocks," though they are really an example of a broader principle of rational expectations modeling with multiple regimes. In any given regime, beliefs about alternative regimes will affect dynamics. The degree to which this is true depends on the relative probability weights agents attach to each regime. Future or past shocks particular to a given regime will be telescoped to the present, with greater impact the more likely the regime.

This is an interesting paper providing an elegant example of how the stance of policy can have fundamentally different implications for the propagation of shocks. The notion of dormant shocks, and the role of multiple regimes and agents' beliefs over them, are clearly drawn out in a series of exercises. Most notable is the explanatory power of the two assumptions made by the authors. The idea that just two fiscal episodes can capture much of the low-frequency developments in the Great Inflation is powerful and appealing, and deserves to be studied further. Perhaps the major weakness of the paper is that it only constitutes an example. No formal evidence is adduced or alternative hypotheses entertained, despite being a well-studied episode. In making this remark understand that estimation of this class of model constitutes frontier work to which the authors are contributors. The notion that inflation developments are linked to the stance of fiscal discipline resonates with the world of practical men, and presents a warning that current fiscal conditions may yet frustrate monetary policy in its pursuit of price stability.

The remainder of this comment examines core assumptions regarding beliefs and learning in greater detail, and compares them to other recent work interested in the fiscal foundations of inflation.

Beliefs: Some Details

Given that learning is central to the authors' narrative it is worth discussing underlying assumptions in greater detail. This section underscores the basic components driving the learning dynamics and compares model implications to an alternative but closely related theory with similar implications. The intention here is not so much to identify fault with the paper, but to elucidate the consequences and limitations of certain assumptions. There are three core ingredients in this analysis:

1. Policy regimes are given, but uncertain.
2. Agents engage in Bayesian inference about the objects that are uncertain.
3. Beliefs are exogenous: they have no consequences for the statistical properties of objects to be learned.

Assuming multiple policy regimes that are uncertain is appealing and more compelling perhaps than models of time-varying shocks to policy. It seems to capture better the idea that policymakers themselves often face pervasive uncertainty about the macroeconomic environment, and might experiment with different policies over time. These effects are presumably of first-order importance to macroeconomic dynamics.

The assumption of Bayesian learning locates the analysis firmly in the domain of rational expectations modeling. It avoids the anticipated utility approach common to many analyses of learning, but does come at a cost. Agents can only learn about a limited set of objects, and indeed, in the present model, agents learn only about a single parameter. The nature of structural uncertainty that defines the scope of learning is very narrow, relating only to the persistence of regime 2 relative to regime 3. In practice, uncertainty is not only present in the existence of multiple regimes, but plausibly in the precise details of policy in each of those regimes. Bayesian learning restricts the feasible state space of the analysis and therefore the classes of uncertainty that can be handled at any one time. Do we really think the Great Inflation is the outcome of learning about the relative persistence of two non-Ricardian regimes?

Finally, that the idea that beliefs are exogenous—in the sense of not affecting the probability that any given regime will occur—while tractable is restrictive, particularly in regards to questions about macroeconomic stability and debt sustainability. Agents' beliefs, and the dynamics they induce, will have implications for the probability that any given regime will occur. This relates to earlier criticism of regime-switching models, which, like this paper, assume policy switches are taken to be purely exogenous. Surely endogenous developments have some role in determining switches between policy regimes.

Alternative Beliefs

To make concrete some of these remarks and give further understanding, consider an alternative closely related theory of imperfect knowledge and the interactions of monetary and fiscal policy. The discussion here is based on recent work by Eusepi and Preston (2012b), to which the reader is referred for greater detail, which in turn builds on various papers in the learning literature that study the interaction of monetary and fiscal policy. See, for example, Evans and Honkapohja (2007) and Eusepi and Preston (2012a).

There are three analogous assumptions:

1. The policy regime is fixed, but uncertain.
2. Kalman-filter learning under anticipated utility.

3. Beliefs are endogenous: they affect the statistical properties of objects to be learned.

In contrast to the paper there is only one policy regime. However, agents are unsure about the details of the monetary and fiscal policy rules in place. They must forecast policy variables that are exogenous to their decision problem using an atheoretical statistical model. While not pursued below, in principle beliefs can be consistent with alternative regimes capturing succinctly the notion of regime uncertainty. Economic decisions are based on the anticipated utility approach—agents do not take into account that beliefs will be revised in subsequent periods when making current decisions. Cogley and Sargent (2008) argue that in a canonical consumption problem little is lost by considering the anticipated utility solution. More recently, Adam and Marcet (2011) demonstrate in the context of an asset pricing model with Bayesian learning that a first-order approximation to Bayesian beliefs delivers an anticipated utility model. Accounting for subsequent revisions in beliefs only has second-order effects on dynamics. While this property needs to be verified in richer contexts it suggests that the anticipated utility approach might come without great sacrifice of generality, so long as the assumption of a first-order approximation remains valid.

Perhaps most important is that beliefs are endogenous. Permitting beliefs to affect the statistical properties of objects to be learned admits more complex and interesting dynamics. Agents' beliefs about policy affect the actual evolution of policy choices. The model exhibits what the learning literature refers to as self-referential dynamics. The following shows that this set of assumptions generate interesting dynamics of the kind delivered by the assumptions of Bianchi and Melosi.

Some Implications

To keep things simple, consider the flexible price limit of the canonical New Keynesian model developed by the authors. For generality, also permit long-term debt as modeled by Woodford (1998). This gives the following model to a log-linear approximation:

$$\hat{\imath}_t = \phi_\pi \hat{\pi}_t$$

$$\hat{s}_t = \phi \hat{b}_t^m$$

$$\hat{b}_t^m = \beta^{-1}(\hat{b}_{t-1}^m - \hat{\pi}_t) + (1 - \rho)P_t^m - (\beta^{-1} - 1)\hat{s}_t$$

$$\hat{P}_t^m = -\hat{E}_t \sum_{T=t}^{\infty} (\rho\beta)^{T-t} \hat{\imath}_T$$

$$\hat{y}_t = \hat{C}_t(i)$$

and

$$\begin{aligned}\hat{C}_t(i) = &(1-\beta)\,\hat{y}_t - \sigma^{-1}\beta\hat{E}_t^i \sum_{T=t}^{\infty} \beta^{T-t}(\hat{\imath}_T - \hat{\pi}_{T+1}) \\ &+ \delta\left(\hat{b}_{t-1}^m(i) - \hat{\pi}_t - \rho\beta\hat{P}_t^m + \beta\hat{E}_t^i \sum_{T=t}^{\infty} \beta^{T-t}(\hat{\imath}_T - \hat{\pi}_{T+1} - (\beta^{-1}-1)\hat{\tau}_t)\right).\end{aligned}$$

Equations (1) and (2) give the monetary and fiscal policy rules. Interest rates, $\hat{\imath}_t$, are adjusted to inflation, $\hat{\pi}_t$, and taxes, $\hat{\tau}_t$, are adjusted in response to outstanding long-term debt, $\hat{b}_t^m$. Equations (3) and (4) give the flow budget constraint of the government, which determines the evolution of the outstanding quantity of debt, and its associated price, $\hat{P}_t^m$. Government purchases are assumed to be constant. Here $0 < \beta < 1$ is the discount factor of households in the underlying microfoundations and ρ indexes the average duration of outstanding debt $(1 - \beta\rho)^{-1}$. Varying ρ delivers different average durations. For example, $\rho = 0$ would deliver a portfolio of one-period debt. Equation (5) states the goods market-clearing condition equating individual consumption with aggregate output, exogenously determined given the assumption of flexible prices. Equation (6) gives consumption demand. It follows directly from permanent income theory. An important distinction from rational expectations is for arbitrary beliefs about future monetary and fiscal policy holdings of the public debt will in general be net wealth. This is reflected in the terms captured in the second line of the expression whose scale is determined by the parameter $0 < \delta < 1$, the steady-state debt-to-income ratio. It is these wealth effects on consumption demand that generate interesting inflation dynamics, just as in the fiscal theory of the price level. Attempts to convert wealth into goods is inflationary. In contrast to the paper, wealth effects arise from imperfect information about the present discounted value of tax obligations. Nonetheless, the resulting discrepancy between debt holdings and perceived tax obligations engenders an identical mechanism to the fiscal theory of the price level. See Evans, Honkapohja, and Mitra (2012), Eusepi and Preston (2012a), and Woodford (2012) for further discussion on imperfect knowledge and departures from Ricardian equivalence.

Combine these expressions, apply market-clearing and aggregate to give the following system for inflation and debt

$$z_t = A_1 z_{t-1} + \sum_{j=1}^{2} A_{j+1} \hat{E}_t \sum_{T=t}^{\infty} (\beta\rho^{j-1})^{T-t} z_{T+1} + A_4 \hat{y}_t. \tag{1}$$

Where

$$z_t = \begin{bmatrix} \hat{\pi}_t \\ \hat{b}_t^m \end{bmatrix}$$

and the matrices A_1, A_2, and A_3 depend on composites of the parameters ψ, ρ, ϕ_b, and ϕ_π where

$$\psi = \frac{\delta}{\sigma^{-1}}.$$

Assume the endowment process is given by an i.i.d. process. Implicit in deriving these expressions is that agents know the form of the policy rules. For example, knowledge of the monetary policy rule implies forecasts of inflation and interest rates are necessarily consistent with the strategy of the Central Bank. The following discussion will focus on uncertainty about the long-run average levels of debt and inflation. Extension to the more general case where policy rule response coefficients are unknown enhances the role of imperfect knowledge.

It remains to specify beliefs. Under rational expectations agents possess the following forecasting model

$$\begin{bmatrix} \hat{\pi}_t \\ \hat{b}_t^m \end{bmatrix} = \underbrace{\begin{bmatrix} 0 \\ 0 \end{bmatrix}}_{\omega_0^*} + \underbrace{\begin{bmatrix} 0 & 0 \\ 0 & \beta^{-1}(1 - \phi_\tau(1-\beta)) \end{bmatrix}}_{\omega_1^*} \begin{bmatrix} \hat{\pi}_{t-1} \\ \hat{b}_{t-1}^m \end{bmatrix} + \begin{bmatrix} -\dfrac{\sigma}{\phi_\pi} \\ 0 \end{bmatrix} \hat{y}_t.$$

All coefficients are known, and in particular, it is understood that deviations of inflation and debt, relative to steady state, are on average zero. Under learning assume agents learn *only about the long-run trends* so that beliefs are given by

$$\begin{bmatrix} \hat{\pi}_t \\ \hat{b}_t^m \end{bmatrix} = \omega_{0,t-1} + \omega_1^* \begin{bmatrix} \hat{\pi}_{t-1} \\ \hat{b}_{t-1}^m \end{bmatrix}$$

where

$$\omega_{0,t} = \omega_{0,t-1} + t^{-1}\nu_t$$

and

$$\nu_t = z_t - (\hat{\omega}_{0,t-1} + \omega_1^* z_{t-1})$$

specifies beliefs as being revised according to ordinary least squares written in recursive form. Beliefs include all variables in the minimum-state-variable solutions up to the i.i.d. component. Shifting beliefs, $\omega_{0,t}$, capture shifting evaluations of the long-run level of debt and inflation. In this sense the analysis, like Bianchi and Melosi's, speaks directly to notions of policy credibility and the potential importance of communication. Given these beliefs, the true data-generating process is

$$\begin{bmatrix} \hat{\pi}_t \\ \hat{b}_t^m \end{bmatrix} = T(\omega_1^*) \cdot \hat{\omega}_{0,t-1} + \omega_1^* \begin{bmatrix} \hat{\pi}_{t-1} \\ \hat{b}_{t-1}^m \end{bmatrix} + \begin{bmatrix} -\dfrac{\sigma}{\phi_\pi} \\ 0 \end{bmatrix} \hat{y}_t.$$

The actual drift $T(\omega_1^*) \cdot \hat{\omega}_{0,t-1}$ does not coincide with the perceived drift $\hat{\omega}_{0,t-1}$. Only under rational expectations will this be true, in which case $\hat{\omega}_{0,t} = \mathbf{0}$. This underscores that the model is self-referential. Agents make systematic forecast errors which, partially validated by the data, have non-Ricardian effects. Changes in government debt are not necessarily perceived to be covered by the same expected discounted value of taxes. While this is obvious enough, the question is whether this matters.

Under what conditions will this learning process converge if agents estimate average inflation and debt simply by averaging the past history of available debt? The conditions required for convergence under learning are called expectational stability, and were pioneered by Marcet and Sargent (1989) and further developed and detailed by Evans and Honkapohja (2001). Their theorems state convergence under least-squares learning occurs if and only if the associated ordinary differential equation

$$\dot{\omega}_0 = T(\omega_1^*) \cdot \omega_0 - \omega_0$$

is locally stable at the rational expectation equilibrium of interest: $\omega_0 = 0$. Eusepi and Preston (2012b) provide various analytical results for the previous model. More constructive is to present the stability conditions graphically. Figure C1 plots the "stability frontiers" of the model, highlighting the interaction between monetary policy and the average maturity of debt. The discount factor β is set to 0.99. Regions above each contour delineate policy configurations consistent with the stability of the rational expectations equilibrium. Each frontier corresponds to different values of ψ, which measures the size of debt scaled by the intertemporal elasticity of substitution for consumption. The values considered are: 0.1, 0.2, 0.3, 0.4, and 0.5, with larger values corresponding to

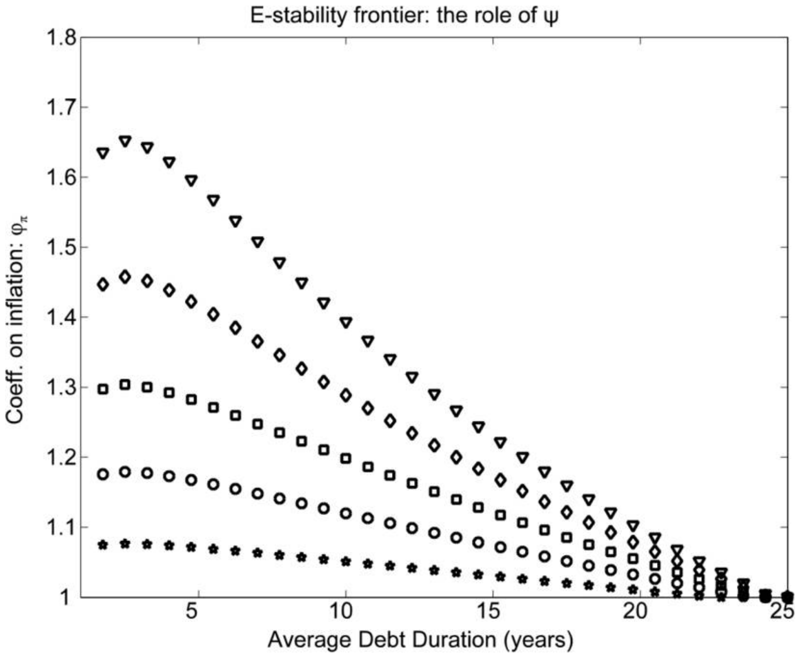

Fig. C1. Expectations stability regions under adaptive learning

higher frontiers. The results are independent of tax policy so long as it delivers a Ricardian equilibrium under rational expectations. For a given average maturity of debt, higher average levels of indebtedness require more aggressive monetary policy. For a given scale of public debt, variation in the average maturity of public debt engenders non-monotonic constraints on monetary policy. Fiscal regimes with average-debt durations between two to seven years are conducive to instability.

Discussion

The importance of the stability results is immediate. Under rational expectations the Taylor principle is sufficient for a unique bounded rational expectations equilibrium. Under imperfect knowledge, fiscal policy can constrain the efficacy of monetary policy. The source of instability is the self-referential property of the model. The price of long-term debt depends on inflation expectations. As inflation expectations shift, bond prices adjust, affecting the quantity of debt issued period by period. This leads to shifting wealth effects on consumption demand that feedback into inflation dynamics. The extent of feedback depends on both the scale and composition of the public debt. All else equal, the greater the average level of debt, the greater the expenditure effects. The nonmonotonicity observed in the average duration of debt stems from the fact that with one-period debt the bond price does not depend on inflation expectations. However, as the average duration rises, bond price becomes increasingly sensitive to inflation expectations. At the same time, the fraction of outstanding debt rolled over in any period diminishes. These two countervailing effects—the first destabilizing and the second stabilizing—deliver the nonmonotonicity. In the limit of consol bonds debt is never rolled over so the price effects vanish. The Taylor principle is restored.

While these observations are interesting, the question is whether they matter and importantly, how they relate to theories of the kind proposed by Bianchi and Melosi. Eusepi and Preston show that models of the kind developed earlier have a number of interesting properties. They imply fundamentally different impulse and propagation mechanisms to shocks than a model under rational expectations. Importantly, the effects of a given disturbance are highly persistent. Shocks to inflation expectations that lead to a monetary tightening can ultimately lead to a burst in inflation, an example of the "stepping on a rake" phenomenon emphasized by Sims (2011). Similarly, persistent dynamics are observed in response to shocks to expectations about future deficits. Such models also have the property that fiscal policy may be important to understanding US monetary history. Eusepi and Preston (2013) show in an estimated New Keynesian model that the stability results have implications for stabilization policy. Relabel the vertical axis in figure C1 as inflation volatility and interpret each point on a plotted contour as the inflation volatility observed in an economy with a specific scale and composition of debt. Then counterfactual experiments, using shocks estimated from the Great Moderation period in the United States, reveal that higher average levels of debt and more moderate maturities of debt imply substantially greater volatility relative to the observed volatility, interpreted as the horizontal line at unity. If the United States had average debt levels of the kind observed in many industrialized countries in recent years, and shorter average maturity structures now witnessed in the advent of various large-scale asset purchase programs, then much of the Great Moderation would disappear—macroeconomic volatility would be comparable to the 1960s and 1970s. Like Melosi and Bianchi, uncertainty about the policy regime renders macroeconomic stability susceptible to volatility stemming from beliefs about the stance of policy. For a given set of disturbances, economies with higher average debt and more moderate maturity structures are more susceptible to instability from shifting expectations due to policy uncertainty. The prevalence of such uncertainty, particular in recent times, underscores the importance of the credibility and communication of policy.

The purpose of this example is to highlight that a distinct but related set of assumptions about beliefs and policy uncertainty generates similar predictions about the interactions of fiscal and monetary policy. The intention is not to assert that one theory is better than the other, but to underscore that policy uncertainty will in general impose constraints on what can be achieved by monetary and fiscal policy. Understanding the connections between these approaches, and what any one approach has to say about stabilization policy, would usefully advance understanding of current policy as emphasized by the authors.

Endnote

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References

Adam, K., and A. Marcet. 2011. "Internal Rationality, Imperfect Knowledge and Asset Prices." *Journal of Economic Theory* 146:1224–52.

Cogley, T., and T. J. Sargent. 2008. "Anticipated Utility and Rational Expectations as Approximations of Bayesian Decision Making." *International Economic Review* 49 (1): 185–221.

Davig, T., and E. Leeper. 2006. "Fluctuating Macro Policies and the Fiscal Theory." In *NBER Macroeconomics Annual 2006*, vol. 21, edited by D. Acemoglu, K. Rogoff, and M. Woodford, 247–98. Cambridge, MA: MIT Press.

Davig, T., E. M. Leeper, and T. B. Walker. 2011. "Inflation and the Fiscal Limit." *European Economic Review* (55):31–47.

Eusepi, S., and B. Preston. 2012a. "Debt, Policy Uncertainty and Expectations Stabilization." *Journal of the European Economics Association* 10 (4): 860–86.

———. 2012b. "Fiscal Foundations of Inflation: Imperfect Knowledge." Unpublished Manuscript. Monash University.

Evans, G. W., and S. Honkapohja. 2001. *Learning and Expectations in Economics*. Princeton, NJ: Princeton University Press.

———. 2007. "Policy Interaction, Learning and the Fiscal Theory of Prices." *Macroeconomic Dynamics* 11:665–90.

Evans, G. W., S. Honkapohja, and K. Mitra. 2012. "Does Ricardian Equivalence Hold When Expectations Are Not Rational?" *Journal of Money, Credit and Banking* 44 (7): 1259–83.

Leeper, E. 1991. "Equilibria under 'Active' and 'Passive' Monetary and Fiscal Policies." *Journal of Monetary Economics* 27:129–47.

Marcet, A., and T. J. Sargent. 1989. "Convergence of Least-Squares Learning in Environments with Hidden State Variables and Private Information." *Journal of Political Economy*: 1306–22.

Sims, C. A. 2011. "Stepping on a Rake: The Role of Fiscal Policy in the Inflation of the 1970s." *European Economic Review* 55 (1): 48–56.

Woodford, M. 1998. "Public Debt and the Price Level." Unpublished Manuscript. Columbia University.

———. 2012. "Macroeconomic Analysis without the Rational Expectations Hypothesis." Unpublished Manuscript. Columbia University.