Discussion
of
"Indeterminacy, Causality, and the Foundations of Monetary Policy Analysis"
by Bennett McCallum

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1. Introduction

The issue of determinacy in macroeconomic models is a topic of an active literature. While the topic may appear to be a mere technicality, it is quite relevant for economic policy analysis. For instance, models with multiple solutions open the possibility that the economy may move from one equilibrium to another, or be on a path that does not converge towards a stable allocation. A policy maker focusing on one of many solutions in a model would thus be hard pressed to make sense of economic activity. In addition, economic policies that are appropriate in one equilibrium could be inadequate in another. Selecting among alternative equilibria is then an important exercise.

2. Selecting Equilibria through Causality Assumptions

The literature has proposed several criteria to select one equilibrium among many, such as whether the equilibrium can be learned by the agents. McCallum proposes an alternative criterion that puts the causality assumptions of the model center stage. Economic models are not mere mathematical objects, but instead embody economic assumptions about the direction of causality. In particular, dynamic mechanisms can be inertial, with past values of the variables determining current ones, or expectational, with current values driven by future ones. The proposed criterion uses these assumptions in selecting equilibria.

Specifically, the paper considers a dynamic relation for a variable y of the form:

$$y_t = aE_t y_{t+1} + cy_{t-1} \tag{1}$$

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We solve the dynamic relation (1) using the method of undetermined coefficients, with the solution being of the form: $y_t = \phi_1 y_{t-1}$. Substituting this in (1), the coefficient ϕ_1 is the root of a quadratic polynomial, and can take the following two values:

$$\varphi_1^{(-)} = \frac{1-\sqrt{1-4ac}}{2a}; \ \varphi_1^{(+)} = \frac{1+\sqrt{1-4ac}}{2a} \tag{2}$$

The dynamic system (1) thus has multiple solutions. Figure 1 illustrates the solutions (2) as functions of a, for different values of c. The figure clearly shows that $\phi_1^{(-)}$ (top panel) is less sensitive to the parameters that $\phi_1^{(+)}$ is (bottom panel).

More specifically, consider the case where $c = 0$. In that case (1) has no inertial component and only an expectational one. It then makes little economic sense for y_t to depend on y_{t-1}, so the solution should be $\phi_1 = 0$. The case of $c = 0$ is illustrated by the red line in Figure 1, and we see that $\phi_1^{(-)}$ is indeed zero, whereas $\phi_1^{(+)}$ can pretty much take any value depending on a.[1] If instead we consider the case where $a = 0$, (1) has no expectational component and only an inertial one. It then makes sense for the coefficient in (2) to be a well defined number. This is indeed the case for $\phi_1^{(-)}$: while its value depends on c, the coefficient has a finite value for any c. $\phi_1^{(+)}$ by constrast implies that the coefficient is discontinuous at $a = 0$.

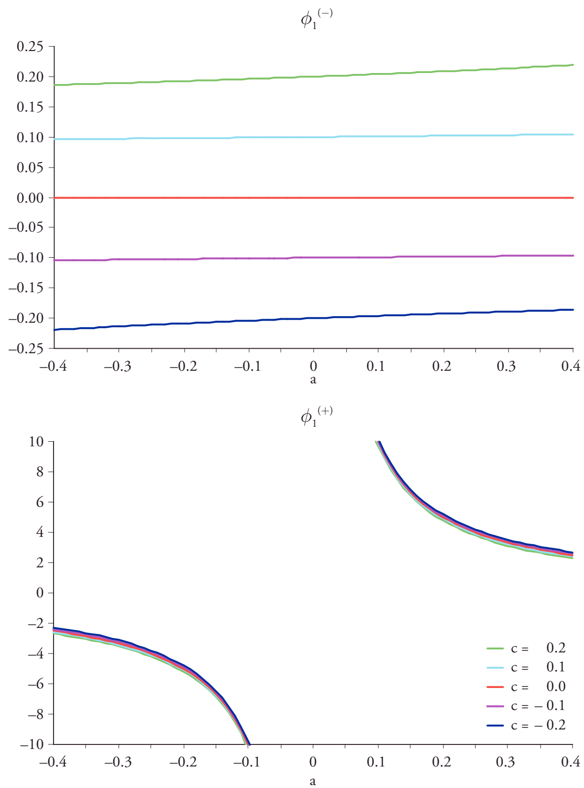
3. Is Dynamic Causality Stable?

Selecting the equilibrium based on dynamic causality is an appealing option for dynamic macroeconomic models, as they include both inertial and expectational elements.

Consider for instance the New Keynesian Phillips Curve that is a keystone of modern monetary models. This relation has a strong expectational element. Intuitively, firms can only reset their price in any given period with a fixed probability. If the firms that reset their price today expect their competitors to increase prices tomorrow, they choose to raise their price now as they may not be able to readjust tomorrow. In addition, the relation includes an inertial element as some prices can be indexed to lagged inflation.

1 The bottom panel shows that the solution is much more sensitive to the value of a than to the value of c.

Figure 1: Coefficients



A limiting aspect of the dynamic process (1) is that it assumes inertial and expectational elements to be a set structural feature (i.e. *a* and *c* are constant coefficient). However, the mix between the two elements could well vary depending on the economic environment. Consider again the example of the Phillips curve. If the central bank manages to keep inflation low and predictable, price setters could be happy to merely index their prices on lagged inflation without going through the trouble of computing expectations on future economic conditions. In that case, the Phillips curve would be dominated by the inertial component. If however inflation is high and volatile, it pays for price setters to spend time estimating future economic conditions, thereby limiting the odds that they would end up with misaligned prices in the future. The Phillips curve would then be dominated by the expectational element. Monetary policy could then influence the very structure of the model, with a more predictable policy inducing agents to behave in a more inertial way. While the appeal of the solution $\phi_1^{(-)}$ is robust to such a shift, an analysis missing it could lead to inaccurate empirical inferences on the inertial – expectational mix.

The expectational element of (1), or of any linear rational expectation model, assumes that agents can as easily compute the expected value of a variable 1 period ahead as 10 periods ahead, or more. In the recent crisis however, expectations of inflation have become more dispersed across forecasters (Leduc et al., 2009). This raises the possibility that in terms of turmoil computing expectations becomes harder. This difficulty could in turn lead agents to effectively shorten their horizon: a firm that plans at a 2 years horizon in normal times could choose to plan only at 1 year horizon in uncertain times, as its assessment of the situation 2 years in the future is to uncertain to rest any planning decision on it.

Such a spillover between uncertainty and the expectation horizon opens the potential for a vicious or virtuous circle for the effectiveness of policy. Consider a situation where economic shocks become less volatile. Agents then lengthen their horizon. The central bank can steer inflation expectations many quarters in the future (assuming that it follows a well understood rule), thereby increasing the effectiveness of monetary policy. A more effective policy in turn lowers economic volatility further. Conversely, a period of heightened volatility reduces the effectiveness of monetary policy as it cannot steer expectations beyond a relatively short horizon, making the economy even more volatile. The reduced ability of monetary policy to affect agents' expectations is especially worrisome if the economy is operating at the zero lower bound of nominal interest rates, as steering expectations is then the only tool left to the central bank.

Reference

Leduc, Sylvain, Glenn Rudebusch and Justin Weidner (2009), "Disagreement about the Inflation Outlook", *Federal Reserve Bank of San Francisco Economic Letter*, 31.