Journal of Macroeconomics 48 (2016) 117–126

Contents lists available at ScienceDirect

Journal of Macroeconomics

journal homepage: www.elsevier.com/locate/jmacro

Short-sighted managers and learnable sunspot equilibria

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ARTICLE INFO

Article history:
Received 8 September 2015
Revised 3 February 2016
Accepted 4 February 2016
Available online 27 February 2016

JEL classification:
D83
D84
E13
E32

Keywords:
Multiple equilibria
Finite horizons
Adaptive learning
Sunspots

ABSTRACT

This paper assumes that firm managers make choices over a finite horizon while households plan over an infinite horizon. Following Shea (2013), I assume that labor exhibits firm-specific learning by doing so that newly employed labor is less productive than experienced labor. In the model, optimization requires that firm managers make conjectures about how their choices affect the labor demand choices of their successors. The model yields two steady states; one where the firm manager behaves as if she cares only about the present period and another where she is forward looking. The former (myopic) steady state usually exhibits higher output than the non myopic steady state. The non-myopic steady state also exhibits two regions of indeterminacy where extraneous, self-fulfilling expectational errors add volatility. One of these regions of indeterminacy is usually stable under adaptive learning while the other never is stable under learning.

1. Introduction

Most modern macroeconomic models assume that agents maximize over an infinite horizon. At first glance, finite horizon models, such as the overlapping generations framework, appear to be more plausible. The infinite horizon approach, however, enjoys a strong defense based on the well known result that overlapping generation models with agents who are altruistic toward their children behave identically to infinite horizon models.[1] This result, however, applies far better to households than firms whose managers are unlikely to care about the well-being of their successors. This paper formalizes this distinction by modeling households as maximizing over an infinite horizon, but firm managers as maximizing only over the period where they are being compensated.

The paper's key result is that the model exhibits two distinct types of multiple equilibria. First, there are typically two steady states including a steady state where firm managers behave myopically that exhibits (sometimes dramatically) higher consumption and output than the other, non-myopic steady state. Second, the steady state that usually has lower output frequently exhibits indeterminacy whereby extraneous expectational errors affect the model's dynamics. These sunspots usually add considerable volatility to employment and the wage, and sometimes to output, consumption, and investment as well. Furthermore, this steady state exhibits two distinct regions of indeterminacy. One is usually stable under adaptive learning while the other is always unstable under adaptive learning.

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[1] See, for example, Barro (1974).

http://dx.doi.org/10.1016/j.jmacro.2016.02.001
0164-0704/

This paper builds on the modeling approach of Shea (2013). That paper makes two modifications to an otherwise ordinary Real Business Cycle (RBC) Model. First, it assumes that labor exhibits firm-specific learning by doing where newly employed labor is less productive than experienced labor. This assumption makes firms' labor demand problem intertemporal and often yields an indeterminate wage rate.[2] By further assuming that firms and households discount at different rates, this indeterminacy also has important effects on quantities in the model, most notably adding considerable volatility to the labor market. That paper simply assumes heterogeneous discount factors and does not explicitly consider different planning horizons as a source of that heterogeneity.[3]

This paper alters (Shea, 2013) by modeling firm managers as living for only two periods. They work in the first period and are retired in the second. It then analyzes the effects on the aggregate economy of alternate incentive compatible contracts that potentially compensate firm managers with a share of firm profits over both periods of their lives. As a result, the firm manager no longer faces a standard recursive problem. Instead, optimization requires that they make conjectures about how their labor demand decisions will affect the future stock of experienced (more productive) labor and the decisions of their successors. I borrow the concept of a *consistent conjecture* from an older literature that examines duopoly in Industrial Organization models.[4] I define a consistent conjecture as a Markov perfect Nash Equilibrium where a firm manager expects that her successor will respond to a change in experienced labor just as she herself would.

A key result is that two distinct consistent conjectures exist. Under one, the firm manager behaves as if she maximizes profits in only the first period, even though she is generally compensated with a share of firm profits in her second period of life. I refer to this case as the *myopic steady state*. Under the second, the manager does act as if she maximizes profits over two periods. I refer to this case as the *non-myopic steady state.*

These two steady states exhibit three important differences. First, they yield different levels of output, consumption, employment, etc. This distinction is most dramatic when newly employed labor is relatively unproductive. Here, the myopic steady state exhibit much higher levels of economic activity and lower levels of household utility. Second, while the myopic steady state is always determinate, the non-myopic steady state yields two separate regions of indeterminacy: one where newly employed labor is relatively productive but where second period (of the firm manager's life) compensation is low, and another when newly employed labor is relatively unproductive and where second period compensation is high. Within each of these regions of indeterminacy, extraneous expectational errors destabilize the labor market. In the former region, they also add considerable volatility to output, consumption, and investment.

The model's two steady states differ in a third important aspect. If the extreme informational assumptions of rational expectations are relaxed, and agents are instead assumed to form expectations through adaptive learning, then the rational expectations equilibria are not always learnable in the non-myopic steady state. Under adaptive learning, agents are assumed to estimate the model using least squares. They then use their coefficients to form expectations, and they update these coefficients as new data become available. A solution is learnable if these regression coefficients converge toward their rational expectations values. While the model is learnable whenever it is determinate (in either steady state), it is never learnable in one of the regions of indeterminacy (where newly employed labor is productive) and part of the other (where newly employed labor is unproductive).[5] The model is thus unusual in that it yields a large region of indeterminacy where sunspot solutions are learnable.

This model thus yields multiple types of multiple equilibria. The significance of multiple stable steady states is straightforward as these steady states may exhibit important differences over the level of key variables. The most prominent example in macroeconomics is Evans et al. (1998).[6] In that paper, complimentary capital goods and the presence of distinct capital and consumption sectors result in separate steady states that differ in the growth rate. The learning process allows the model to endogenously transition between the neighborhoods of each steady state. In the present paper, the difference between the steady states is over the level, not the growth rate, of output.

1.1. Related literature on indeterminacy

It is well known that macroeconomic models may exhibit indeterminacy of equilibrium where a continuum of stable equilibrium paths exist in the neighborhood of a steady state. Indeterminacy has generated considerable interest because random expectational shocks may be self-fulfilling, providing the model with an additional and endogenous source of volatility. These expectational shocks, also known as sunspots, may be viewed as a modern presentation of Keynes's "animal spirits" which he believed importantly contributed to macroeconomic volatility.

Many papers seek to identify plausible assumptions that yield indeterminacy, while also yielding reasonable empirical fit. By far, the most common approach is to assume some type of production externality, or other distortion from complete markets, that causes the aggregate production function to exhibit increasing returns to scale. Early examples

[2] In the New Keynesian setting, firms also face an intertemporal problem which is crucial to generating that literature's main results. See, for example, Woodford (2003).

[3] Assuming heterogeneous discount factors is common in the literature on credit constraints. See, for example, Iacoviello (2005).

[4] See Bresnahan (1981); Perry (1982), and Dixon and Somma (2003) for microeconomic applications of consistent conjectures.

[5] Throughout the paper, learnability is evaluated using the related concept of E-Stability. Evans and Honkapohja (2001) show that, under general conditions, which apply here, a model is learnable if and only if it is E-Stable.

[6] Macroeconomic models often exhibit a steady state with zero economic activity. These, however, tend to be unstable and are not of great interest.