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Anticipated disinflation and recession in the New Keynesian model under learning

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HIGHLIGHTS

- Under adaptive learning an anticipated disinflation causes a recession.
- This resolves the disinflationary-booms anomaly to the standard New Keynesian model.
- Agents' econometric model is based on the rational expectations equilibrium solution.

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ABSTRACT

In the New Keynesian model under rational expectations a disinflation announced in advance causes an expansion. This anomaly is robust to the assumption that monetary policy follows a Taylor rule. I show that under adaptive learning an anticipated disinflation causes a recession. Thus learning offers a resolution to the disinflationary-booms anomaly.

1. Introduction

When monetary policy is governed by a Taylor (1993) interest-rate rule, the New Keynesian (NK) model under rational expectations (RE) predicts that an anticipated disinflation will cause an expansion. This result, established first by Ball (1994) in a model with monetary targeting, is clearly at odds with the empirical evidence. Under monetary targeting Ascari and Rankin (2002) offer a possible resolution, showing that disinflations are recessionary if money demand is sensitive to the interest rate. However, Merkl (2013) shows that disinflationary booms remain a robust feature of the standard NK model, when policy follows a Taylor rule. Since, inflation targeting via a Taylor rule is both a realistic description and a pervasive modeling assumption, the disinflationary-booms anomaly remains largely unresolved.

In this paper monetary policy follows a Taylor rule and a change in the inflation target is announced several periods in advance. Although the policy change is fully anticipated, agents use an econometric model based on the RE solution to forecast the response of endogenous variables. Under this process of statistical learning the anticipated disinflation causes a recession.

I build on two related innovations in the learning literature. Evans et al. (2009, 2013) examine models in which agents forecast the response of endogenous variables to an anticipated change in taxation. As the change is announced several periods in advance, they necessarily consider forecasts over a long horizon, adopting Preston's (2005) approach of modeling of long-horizon forecasts under learning.

I use Preston's (2005) version of the NK model. I assume that agents use an econometric model that will be true when learning converges to rational expectations. Preston assumes a constant inflation target and derives the relevant stability conditions. I consider calibrations where learning is stable and examine the dynamic response of inflation, output, and interest rates to a pre-announced change in the inflation target.

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2. Model

Preston (2005) shows that the intertemporal optimality condition in the NK model implies that the output gap, x_t, satisfies[1]

$$x_t = \tilde{E}_t \sum_{T=t}^{\infty} \beta^{T-t} \left[(1-\beta) x_{T+1} - \sigma \left(\hat{i}_T - \pi_{T+1} \right) + v_{T+1} \right]. \quad (1)$$

Here $\beta \in (0,1)$ is the discount factor, σ the intertemporal elasticity of substitution, π_t inflation, $\hat{i}_t$ the nominal interest rate as a deviation from the steady-state real rate, and v_t follows

$$v_{t+1} = \rho v_t + \varepsilon_{t+1}, \quad |\rho| < 1, \ \varepsilon_{t+1} \sim \text{i.i.d.} \left(0, \sigma_\varepsilon^2\right). \quad (2)$$

In (1) $\tilde{E}_t$ denotes an average expectation, however, since this is a representative-agent model, average and individual forecasts are the same.

When firms set prices according to the Calvo (1983) mechanism and $\alpha \in [0,1)$ is the probability that a firm holds its price fixed, Preston shows that inflation satisfies

$$\pi_t = \kappa x_t + \tilde{E}_t \sum_{T=t}^{\infty} (\alpha\beta)^{T-t} \left[\kappa \alpha \beta x_{T+1} + (1-\alpha) \beta \pi_{T+1} \right]. \quad (3)$$

Here $\kappa \equiv \frac{(1-\alpha)}{\alpha} \frac{1-\alpha\beta}{1+\omega\theta} \left(\omega + \sigma^{-1}\right) > 0$, θ is the elasticity of substitution among goods, and ω is the elasticity of a firm's real marginal cost.

Let t_a denote the period in which the policy change is announced and t_p the period in which it takes effect ($t_a < t_p$). Denote the inflation target by $\bar{\pi}_t$. Consider a change in the target from π_H to π_L, where $\pi_H > \pi_L$. Prior to t_a agents know that $\bar{\pi}_t = \pi_H$ and assume that $\bar{\pi}_t$ will never change. Similarly in period t_p and after, agents know that $\bar{\pi}_t = \pi_L$ and again assume that $\bar{\pi}_t$ will never change. After the announcement but before implementation, $t_a \le t < t_p$, $\tilde{E}_t \bar{\pi}_t = \cdots = \tilde{E}_t \bar{\pi}_{t_p-1} = \pi_H$ and $\tilde{E}_t \bar{\pi}_{t_p} = \tilde{E}_t \bar{\pi}_{t_p+1} = \cdots = \pi_L$. Monetary policy follows

$$\hat{i}_t = \bar{\pi}_t + \psi_\pi (\pi_t - \bar{\pi}_t) + \psi_x (x_t - x_{st}), \quad \psi_\pi > 0 \text{ and } \psi_x \ge 0, \quad (4)$$

where x_{st} denotes the steady-state output gap.[2]

3. RE equilibrium

Under RE (1) and (3) reduce to the familiar

$$x_t = E_t x_{t+1} - \sigma E_t \left(\hat{i}_t - \pi_{t+1} \right) + \rho v_t \quad (5)$$

and

$$\pi_t = \kappa x_t + \beta E_t \pi_{t+1}. \quad (6)$$

Here, E_t denotes the mathematical expectation. RE equilibrium will be determinate if and only if an increase in inflation causes an increase the *real* interest rate. This is the well-known Taylor principle and it requires that[3]

$$\kappa (\psi_\pi - 1) + (1-\beta) \psi_x > 0. \quad (7)$$

[1] Here x_t is a log deviation from flexible-price output.

[2] With Calvo pricing, steady-state x_t depends on steady-state inflation which here will equal target inflation. Specifically, $x_{st} = \left(\frac{1-\beta}{\kappa}\right) \bar{\pi}_t$.

[3] See Bullard and Mitra (2002).

Table 1
Calibration.

Parameter	Value
β	0.9873
σ	1
α	0.67
θ	10
ω	1.25
ψ_π	1.75
ψ_x	0.25
π_H	1
π_L	−1
ρ	0.5
σ_ε	0.1

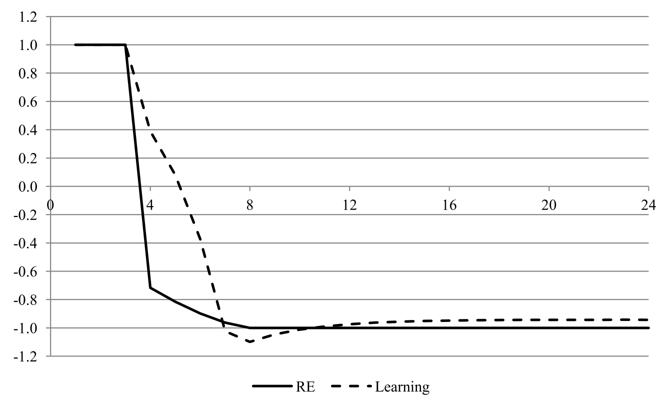

Fig. 1. Inflation.

Proposition I. *Let* $\mathbf{z}_t = \left[\pi_t \quad x_t \quad \hat{i}_t\right]'$ *and assume that* (7) *is satisfied. The equilibrium solution to the RE model is*

$$\mathbf{z}_t = \mathbf{a}\bar{\pi}_t + \mathbf{b}v_t \quad \text{for } t < t_a \text{ and } t \ge t_p \quad (8)$$

and

$$\mathbf{z}_t = \mathbf{a}\bar{\pi}_t + \mathbf{b}v_t + \Gamma_1 \lambda_1^\tau + \Gamma_2 \lambda_2^\tau \quad \text{for } t_a \le t < t_p \quad (9)$$

where $\tau \equiv t_p - t$, *where* $\mathbf{a}$, $\mathbf{b}$, Γ_1, *and* Γ_2 *are* (3×1) *coefficient vectors, and where* λ_1 *and* λ_2 *are eigenvalues that lie within the unit circle.*

Proof in **Online Appendix**.

I use (8) and (9) to simulate the behavior of inflation and output under RE; shown by the solid lines in Figs. 1 and 2. A two percentage-point reduction in $\bar{\pi}_t$ is announced in $t_a = 4$ and implemented in $t_p = 8$. The model is calibrated to a quarterly frequency and parameter values are reported in Table 1. The figures show variables averaged over 10,000 repetitions.

In Fig. 1, prior to the announcement, inflation is at its steady-state. Inflation drops substantially in period t_a as price setters anticipate that future competitors will face lower inflation. Indeed, under rational expectations, firms anticipate that the response of all price setters in t_a through t_p (and beyond) will be to set lower prices and factor this expectation into their optimal price-setting decision.

We see in Fig. 2 the anomalous result that the anticipated disinflation causes an expansion under RE.[4] Merkl (2013) examines the nonlinear version of this model under RE and shows that the disinflationary-boom result is robust. Under RE when the disinflation is announced, the agent expects that inflation will

[4] In Fig. 2, under both RE and learning, the output gap is a deviation from its steady-state value, $x_{st} = \left(\frac{1-\beta}{\kappa}\right) \bar{\pi}_t$. Note that, in the figure, $\bar{\pi}_t = \pi_H$ for $t < 8$ and $\bar{\pi}_t = \pi_L$ for $t \ge 8$.