ECON 5110 Class Notes
Sticky Information Versus Sticky Prices

1 Introduction

Mankiw and Reis (2002) present a new model based on the idea that information disseminates slowly through the population. Current New Keynesian models typically rely on either sticky prices (wages) in order for aggregate demand movements to have impacts on both output and inflation. These models are the workhorses of modern macro. The standard models, however, make several predictions that are hard to square with the facts:

1. Announced, credible disinflations can cause booms (Ball, 1994).

2. Inflation is not very persistent (Fuhrer and Moore, 1995).

3. Impulse responses from monetary policy shocks decay monotonically.

The primary problem with the standard models is that although the price level (or wages) are sticky, inflation can freely adjust to economic conditions. In Mankiw and Reis' sticky-information model, however, some firms compute optimal prices based on current information while the remaining firms set prices based on old information. This places restrictions on the adjustment of inflation. In this sense, the paper is a mixture of Calvo's (1972) random adjustment model and Lucas' imperfect information model. As you will see, the sticky-information model successfully addresses the three issues above.

2 Sticky Price versus Sticky Information Models

2.1 Sticky-Price Model: The New Keynesian Phillips Curve

Each period a fraction λ of firms adjust price and $(1-\lambda)$ of the firms keep price fixed. The flexible-price firms maximize profits to get a pricing equation of the form

$$p_t^* = p_t + \alpha y_t \tag{1}$$

where p_t^* is the desired price, p_t is the overall price level and y_t is the output gap. All variables are measured in logs. The adjustment price, x_t, is thus determined by

$$x_t = \lambda \sum_{j=0}^{\infty} (1-\lambda)^j E_t p_{t+j}^*. \tag{2}$$

The final equation specifies that the overall price level, p_t, is an average of all prices in the economy:

$$p_t = \lambda \sum_{j=0}^{\infty} (1-\lambda)^j x_{t-j}, \tag{3}$$

which given the random adjustment, becomes a weighted average of prices set in the past. Combining equations (1) through (3) and defining $\pi_t = p_t - p_{t-1}$ gives the standard New Keynesian Phillips curve:

$$\pi_t = \beta y_t + E_t \pi_{t+1}, \tag{4}$$

where $\beta = \alpha\lambda^2/(1-\lambda)$.

2.2 Sticky-Information Model

Now assume instead that firms gather information and recompute optimal prices in a Calvo manner (i.e., each period a fraction λ recompute optimal prices). The firm's optimal price is still given by (1). If a firm has not recomputed optimal prices for j periods, it charges the price

$$x_t^j = E_{t-j} p_t^*. \tag{5}$$

The overall price level is

$$p_t = \lambda \sum_{j=0}^{\infty} (1-\lambda)^j x_t^j. \tag{6}$$

Putting together (1), (5) and (6), gives

$$p_t = \lambda \sum_{j=0}^{\infty} (1-\lambda)^j E_{t-j}[p_t + \alpha y_t]. \tag{7}$$

The sticky-information Phillips curve is then given by

$$\pi_t = (\beta/\lambda) y_t + \lambda \sum_{j=0}^{\infty} (1-\lambda)^j E_{t-1-j}(\pi_t + \alpha \Delta y_t), \tag{8}$$

where Δy_t is output growth. The main difference between (4) and (8) is

- The sticky-price New Keynesian Phillips curve depends on current expectations of future economic conditions.
- The sticky-information New Keynesian Phillips curve depends on past expectations of current economic conditions.

3 Inflation and Output Dynamics

To close the model, Mankiw and Reis add an aggregate demand (AD) equation

$$m_t = p_t + y_t \tag{9}$$

where m_t can be interpreted as the money supply. They also consider a third (backward-looking) model

$$\pi_t = \beta y_t + \pi_{t-1} \tag{10}$$

which can be interpreted as a version of the sticky-price model with naive expectations: $E_t \pi_{t+1} = \pi_{t-1}$. Now consider three separate experiments.

3.1 Experiment 1. Sudden, Permanent Decrease in AD

Consider an unanticipated permanent 10% decline in m. See Figure 1 for the impulse responses. Below is a summary of the dynamics.

- All three models (forward-looking sticky price, backward-looking sticky price, and sticky information) predict sudden recessions.
- All three models predict the recession is over after 4 years.
- The backward-looking model predicts a cyclical response to output.
- The sticky-price model predicts a sudden disinflation with a fairly quick return to price stability.
- The sticky-information model predicts a delayed disinflation with more inflation inertia. (This is due to a relatively small calibrated value of $\alpha = 0.1$.)

3.2 Experiment 2. Sudden, Permanent Disinflation

In this experiment, there is a sudden decrease in the money growth rate (Δm) from 10% per year to 0% per year. See Figure 2 for the impulse responses. Below is a summary of the dynamics.

- The sticky-price model predicts a painless disinflation. Inflation jumps immediately from $\pi = 10\%$ to $\pi = 0\%$ but output stays constant. Although prices are sticky, inflation is free to jump and is not inertial.
- The disinflation occurs gradually in the sticky-information model because firms are still basing pricing decisions on outdated information. The economy falls into a recession with the trough occurring about 1.5 years after the announcement. (This matches much of the empirical evidence suggesting that the effects of monetary policy occur with a lag.)
- The backward-looking model displays similar behavior to the sticky-information model, however the disinflation and recession occur more gradually.

3.3 Experiment 3. Anticipated, Permanent Disinflation

In this experiment, the decrease in the money growth rate from Experiment #2 is announced two years in advance and is fully credible. See Figure 3 for the impulse responses. Below is a summary of the dynamics.

- The backward-looking model has the same dynamics as in Experiment #2.
- In the forward-looking (rational expectations) sticky-price model, we get the result that agents begin decreasing inflation prior to the money growth slowdown, increasing real money balances, and creating a boom. This is an unappealing result.
- In the sticky-information model, the pre-announced policy does not generate a disinflation until money growth falls. Consequently, there is no boom. However, the pre-announcement does impact agents' future plans and generates a quicker and more painless disinflation.

3.4 Inflation Persistence

Fuhrer and Moore (1995) claim that the standard sticky price models of Phelps (1978) and Taylor (1980) deliver too little inflation persistence. They present a new contracting scheme (whereby agents are concerned

with relative real wages) that fits the data better.[1] However, for realistic AR(1) money growth processes, Mankiw and Reis show that all three models (backward-looking, sticky-price and sticky information) actually deliver reasonable amounts of inflation persistence (see Table 1). Critics could argue, however, that much of the inflation persistence in these models comes from the exogenously specified persistence in money growth rather than through endogenous propagation mechanism.

4 Acceleration Phenomenon

Table 2 shows correlation between detrended real GDP and changes in inflation. The U.S. data show a clear positive relationship – times of high economic activity are associated with rising inflation. The three models make very different predictions about the acceleration phenomenon:

- The backward-looking model automatically builds in a very strong positive correlation. The Phillips curve for this model (equation 10) is

$$\pi_t - \pi_{t-1} = \beta y_t$$

  which implies a correlation equal to 1.

- The sticky-price model does not satisfy the acceleration principle. This is seen clearly in Figures 2 and 3.

- The sticky-information model, on the other hand, does a good job of replicating the acceleration phenomenon found in U.S. data. This can also be seen clearly in Figures 2 and 3.

5 Responses to the Skeptics

Critics of the sticky-information model are most likely to ask: "Why would agents ever use outdated information in forming forecasts of the future?" Here are Mankiw and Reis' responses.

- A recent study by Zbaracki et al. (2000) shows that the most important costs associated with changing prices are "managerial and customer costs" associated with information gathering, decision-making, negotiation and communication.

[1] Recently, Holden and Driscoll (2005) have shown that Fuhrer and Moore's (1995) inflation persistence results disappear if agents care about *current* relative real wages rather than *past* relative real wages.

- Another recent study by Carroll (2001) shows that expectations of the general public respond in a lagged fashion to the expectations of professional forecasters.
- Mankiw (1985) shows that when firms with monopoly power do not update prices (or information) it can impose large costs on the macroeconomy, even though the loss to firms may be very small.