Fifth TA Session: Exchange Rate Overshooting & Expectation

Macroeconomics 2

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Highlights

- Expectations
  - Static Expectation
  - Adaptive Expectation
  - Perfect Foresight
  - Rational Expectation
- Dornbusch Overshooting Model

Types of Expectation

- Expectation matters when we start examining our model intertemporally
- Expectation of **future** shapes agents' actions **today**
- Some example: if you think that interest rate will go up next month, will you be confident to apply for mortgage today?
- Types of expectations:
  - Static
  - Adaptive
  - Perfect Foresight
  - Rational

Static Expectations

- Basically saying that agents expect price level or inflation is static over time. Assuming price level to be unity:

$$
\begin{aligned}
P_t^e &= 1 \\
p_t^e &= \log(P_t^e) = 0
\end{aligned}
$$

- Obviously one can see that despite its mathematical simplicity, static expectation yields is very unrealistic
- It basically assumes that agent is always shocked by change in price level and agents are basically irrational or incapable of deducing the relationship between policy action and its effect on market equilibrium

Adaptive Expectations

- Basically saying that agents expect price level to follow trend of previous period:

$$p_t^e = p_{t-1}^e + \lambda(p_t - p_{t-1}^e)$$

- While better than static expectation, it is also still unrealistic, as one can easily recall the classic disclaimer: **"Past performance is no guarantee of future results"**
- Agents can extract information that may be salient to their prior about future prices other than past realization. Example: if I know that effective vaccine will be widely available by next quarter, does it make sense to apply downward GDP trend of the past 3-4 quarters?

Perfect Foresight

- I.e.: the assumption that agents are omniscient

$$p_{t-1}^{e} = p_t$$

- Obviously unrealistic but not far off from its related concept, rational expectation
- Useful for various applications, such as Dornbusch's overshooting model

Rational Expectation

- TL;DR: agents incorporate all information and do not make systematic forecasting error

$$
\begin{aligned}
p^e_{t-1} &= E_{t-1} p_t \\
p_t &= p^e_{t-1} + \varepsilon_t \\
\mathbf{E}[\varepsilon_t] &= 0
\end{aligned}
$$

- Consistent with underlying economic assumption that agents are rational and incorporate all available signals to make their intertemporal decisions

Dornbusch's Overshooting Model: A Primer

- Objective: reconciling observation large exchange rate fluctuation with rational expectation framework
- Paradigm shift brought by Dornbusch's paper:
    - Exchange rate market volatility is not necessarily consequence of market asymmetry or imperfect market
    - ER volatility is in fact a result of stickiness in goods market and flexibility in money market
- Exchange rate depreciate more than its long-run new level would suggest to compensate for price stickiness in goods market, and adjust to its long run equilibrium as price unstick in goods market

Model Construction: Key Assumptions

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- Perfect capital mobility, such that uncovered interest parity holds $(r = r^* + x)$
- Price is sticky in the short run and flexible in the long run
- Investors are risk-neutral and financial markets adjust to shocks instantaneously
- Agents have perfect foresight
- Expectation formation follows $x = \theta(\bar{e} - e)$. x represents expected depreciation/apreciation, $\bar{e}$ represents the long-run exchange rate, e represents spot rate, and θ represents adjustment coefficient for exchange rate

Constructing the Model: Money Market

The demand for real money balance follows

$$
\begin{aligned}
p - m &= \lambda r - \psi y \\
&= -\psi y + \lambda r^* + \lambda\theta(\bar{e} - e) \qquad (1)
\end{aligned}
$$

We obtain (1) by restating r as a function of x and e. Furthermore, by assuming that $r = r^*$ in the long run (s.t. $\bar{e} - e = 0$) assuming stationary money supply, we obtain

$$p = m + (\lambda r^* - \psi y) \qquad (2)$$

$$e = \bar{e} - \frac{1}{\lambda\theta}(p - \bar{p}) \qquad (3)$$

Constructing the Model: Goods Market (1)

The demand for goods follows:

$$\log D = u + \delta(e - p) + \gamma y + \sigma r \tag{4}$$

We accept that inflation is a function of excess demand measure, such that

$$\dot{p} = \pi(d - y) = \pi \log\left(\frac{D}{Y}\right) = \pi[u + \delta(e - p) + (\gamma - 1)y - \sigma r] \tag{5}$$

The long run equilibrium exchange rate can be obtained by setting $\dot{p} = 0$ and $(e - \bar{e}) = (p - \bar{p} = 0$

$$\begin{aligned} 0 &= \pi[u + \delta(e - p) + (\gamma - 1)y - \sigma r] \\ -\delta(e - p) &= u + (\gamma - 1)y - \sigma r \\ -\delta\left(\bar{e} - \bar{p}\right) &= u + (\gamma - 1)y - \sigma r^{*}) \\ \bar{e} &= \bar{p} + \frac{1}{\delta}\left[\sigma r^{*} + (1 - \gamma)y - u\right] \end{aligned} \tag{6}$$

Constructing the Model: Goods Market (2)

We can substitute equation (6) to equation (5), thus obtaining

$$
\begin{aligned}
\dot{p} &= \pi[u + \delta(e - p) + (\gamma - 1)y - \sigma r] \\
&= \pi[u + \delta((\bar{e} - \frac{1}{\lambda\theta}(p - \bar{p})) - p) + (\gamma - 1)y - \sigma(r^* + \theta(e - \bar{e}))] \\
&= \pi[\delta(-(p - \bar{p}) - \frac{1}{\lambda\theta}(p - \bar{p})) - \frac{\sigma\theta}{\lambda\theta}(p - \bar{p})] \\
&= -\pi\left[\frac{(\delta + \sigma\theta)}{\lambda\theta} + \delta\right](p - \bar{p}) = -v(p - \bar{p}) \qquad (7) \\
v &\equiv \frac{(\delta + \sigma\theta)}{\lambda\theta} + \delta \qquad (8)
\end{aligned}
$$

Constructing the Model: Goods Market (3)

If expectation is consistent with perfect foresight, we should get $v = \tilde{\theta}$. Notice, however, that this renders θ to be a quadratic equation

$$v = \theta \equiv \frac{(\delta + \sigma\theta)}{\lambda\theta} + \delta$$

$$\lambda\theta^2 - \delta - \sigma\theta - \delta\lambda\theta = 0 \tag{9}$$

By taking the positive square root of (9), we obtain

$$v = \theta \equiv \pi(\sigma/\lambda + \delta)/2 + [\pi^2(\sigma/\lambda + \delta)^2/4 + \pi\delta/\lambda]^{1/2} \tag{10}$$

Monetary Policy Implication of Overshooting

From equation (3) (equation (6) in Dornbusch (1976)), we obtain the following

$$
\begin{aligned}
e &= \bar{e} - \frac{1}{\lambda\theta}(p - \bar{p}) \\
de &= d\bar{e} - \frac{1}{\lambda\theta}(dp - d\bar{p}) \qquad (11)
\end{aligned}
$$

Assuming that $dr^* = dy = 0$, and by noting that $d\bar{e} = dm = d\bar{p}$, we obtain

$$\frac{de}{dm} = 1 + \frac{1}{\lambda\theta} > 1 \qquad (12)$$

Compare this to $d\bar{e}/dm = 1$; this means that exchange rate will overshoot relative to its long run equilibrium level, and the rate of overshoot depends on parameter λ and θ, or the speed of adjustment of the system