LECTURE 24:
Dornbusch Overshooting Model
Intuition of the Dornbusch model:
Although adjustment in financial markets is instantaneous, adjustment in goods markets is slow.

Interpretation:
• prices are sticky:
  – can’t jump at a moment in time
  – but adjust gradually
    • in response to excess demand:
      – \( \dot{p} = -v(p - \bar{p}) \).

• One theoretical rationale:
  – Calvo overlapping contracts.
DORNBUSCH OVERSHOOTING MODEL

PPP holds only in the Long Run, for $\bar{S}$. In the SR, $S$ can be pulled away from $\bar{S}$.

Consider an increase in real interest rate $r \equiv i - \pi^e$ (e.g., due to sudden $M$ contraction; as in UK or US 1980, or Japan 1990)

$\Rightarrow$ Domestic assets more attractive

$\Rightarrow$ Appreciation: $S \downarrow$

until currency “overvalued” relative to $\bar{S}$

$\Rightarrow$ investors expect future depreciation.

When $\Delta s^e$ is large enough to offset $i - i^*$, that is the overshooting equilibrium.
Dornbusch Overshooting Model

Financial markets

(UIP) $i - i^* = s^e$

+ Regressive expectations $s^e = -\theta (s - \bar{s})$

⇒ interest differential pulls currency above LR equilibrium.

$(s - \bar{s}) = -\frac{1}{\theta} (i - i^*)$

See table for evidence of regressive expectations.

We could stop here.
Some evidence that expectations are indeed formed regressively:

\[ \Delta s^e = a - \theta (s - \bar{s}). \]

Forecasts from survey data show a tendency for appreciation today to induce expectations of depreciation in the future, back toward long-run equilibrium.
Dornbusch Overshooting Model

Financial markets

Money market equilibrium:

\[ m - p = \varphi y - \lambda i \] (SR)

\[ m - \bar{p} = \varphi \bar{y} - \lambda \bar{i} \] (LR)

\( \Rightarrow \ (p - \bar{p}) = \) [

\( (s - \bar{s}) = -\frac{1}{\theta} (i - i^*) \)

The change in \( m \) is one-time:

\( \bar{m} = m; \)

\( \bar{y} = y; \) & \( \bar{i} = i^* \)

\[ \Rightarrow \ \text{Inverse relationship between} \ s \ \text{&} \ p \ \text{to satisfy financial} \]

\( \text{market equilibrium.} \)
The Dornbusch Diagram

Because $P$ is tied down in the SR, $S$ overshoots its new LR equilibrium.

$$(p - \bar{p}) = -\lambda \theta (s - \bar{s}).$$

Experiment: a one-time monetary expansion

$$(m/p) \uparrow \Rightarrow i \downarrow$$

Sticky $p \Rightarrow$

In the SR, we need not be on the goods market equilibrium line (PPP), but we are always on the financial market equilibrium line (inverse proportionality between $p$ and $s$):

$$s = \bar{s} - \frac{1}{\lambda \theta} (p - \bar{p}).$$

If $\theta$ is high, the line is steep, and there is not much overshooting.
In the instantaneous overshooting equilibrium (at C), S rises more-than-proportionately to M to equalize expected returns.

Excess Demand at C causes P to rise over time until reaching LR equilibrium at B.
How do we get from SR to LR? I.e., from inherited $P$, to PPP?

$P$ responds gradually to excess demand:

Solve differential equations for $p$ & $s$:

$$\dot{p} = -v(p - \bar{p})$$

$$p_t = \bar{p} + (p_0 - \bar{p})\exp(-vt)$$

$$\dot{s} = -v(s - \bar{s})$$

$$s_t = \bar{s} + (s_0 - \bar{s})\exp(-vt)$$

We now know how far $s$ and $p$ have moved along the path from C to B, after $t$ years have elapsed.

Goods markets

The experiment: a permanent $\Delta m$

LR PPP $\bar{s} = \bar{p} - \bar{p}^*$

LR $\Delta \bar{s} = \Delta \bar{p} = \Delta m$

Neutrality

at point B

at point C

= overshooting from a monetary expansion

$\Rightarrow$

$\Rightarrow$

|SEE APPENDIX I|
Now consider a special case: rational expectations

The actual speed with which $s$ moves to LR equilibrium:

$$\dot{s} = -\nu (s - \bar{s})$$

matches the speed it was expected to move to LR equilibrium:

$$\dot{s^e} = -\theta (s - \bar{s})$$

in the special case: $\theta = \nu$.

In the very special case $\theta = \nu = \infty$, we jump to B at the start -- the flexible-price case.

=>Overshooting results from instant adjustment in financial markets combined with slow adjustment in goods markets: $\nu < \infty$. 
SUMMARY OF FACTORS DETERMINING THE EXCHANGE RATE

(1) LR monetary equilibrium:
\[ \bar{S} = \left( \frac{P}{P^*} \right) \bar{Q} = \frac{M/M^*}{L(,)/L^*(,)} \bar{Q}. \]

(2) Dornbusch overshooting:
SR monetary fundamentals pull \( S \) away from \( \bar{S} \), in proportion to the real interest differential.

(3) LR real exchange rate \( \bar{Q} \) can change, e.g., Balassa-Samuelson or oil shock.

(4) Speculative bubbles.
Appendix I: (1) Solution to Dornbusch differential equations

How do we get from SR to LR? I.e., from inherited $P$, to PPP?

$P$ responds gradually to excess demand:

Solve differential equation for $p$:

Use inverse proportionality between $p$ & $s$:

Use it again:

Solve differential equation for $s$:

We now know how far $s$ and $p$ have moved along the path from C to B, after $t$ years have elapsed.

Neutrality

LR PPP

\[ \bar{s} = \bar{p} - \bar{p}^\ast \]

\[ \implies \text{LR } \Delta \bar{s} = \Delta \bar{p} = \Delta m \]

stickey $p$

\[ \implies \text{SR } \Delta s = (1 + \frac{1}{\lambda \theta}) \Delta m \]

at point B

at point C

= overshooting from a monetary expansion

\[ \dot{p} = -\nu (p - \bar{p}) \]

\[ p_t = \bar{p} + (p_0 - \bar{p}) \exp(-\nu t) \]

\[ \dot{s} = -\frac{1}{\lambda \theta} \dot{p} = \frac{1}{\lambda \theta} \nu (p - \bar{p}) \]

\[ = \frac{1}{\lambda \theta} \nu [-\lambda \theta (s - \bar{s})] = -\nu (s - \bar{s}) \]

\[ \implies s_t = \bar{s} + (s_0 - \bar{s}) \exp(-\nu t) \]
(2) Extensions of Dornbusch overshooting model

- **Endogenous y** *(pp. 1171-75 at end of RD 1976 paper)*
- **Bubble paths**
- **More complicated M supply processes**
  - Random walk
  - Expected future change in M
  - Changes in steady-state M growth, $g_m = \pi$:
    - Regressive expectations: $\dot{q}^e \equiv (s^e - \pi^e + \pi^*e) = -\theta (q - \bar{q})$ (1)
    - UIP: $i - i^* = \hat{s}^e$ (2)
    - $\Rightarrow (q - \bar{q}) = -\frac{1}{\theta} [(i^e - \pi^e) - (i^* - \pi^*e)]$

I.e., real exchange rate depends on real interest differential.
Appendix II:  How well do the models hold up?

(1) Empirical performance of monetary models

At first, the Dornbusch (1976) overshooting model had some good explanatory power. But these were in-sample tests.

In a famous series of papers, Meese & Rogoff (1983) showed all models did very poorly out-of-sample. In particular, the models were “out-performed by the random walk,” at least at short horizons. I.e., today’s spot rate is a better forecast of next month’s spot rate than are observable macro fundamentals.

Later came evidence monetary models were of some help in forecasting exchange rate changes, especially at long horizons. E.g., N. Mark (1995): a basic monetary model beats RW at horizons of 4-16 quarters, not just in-sample, but also out-of-sample.
At short horizons of 1-3 months the random walk has lower prediction error than the monetary models.

At long horizons, the monetary models have lower prediction error than the random walk.

(2) Forecasting


Table 3.8

Comparing the Random Walk Model and the Structural Models (with their best representative parameter configuration when realized values of the explanatory variables are used)

<table>
<thead>
<tr>
<th>Model</th>
<th>Horizon</th>
<th>MAE/mark</th>
<th>RMSE/mark</th>
<th>MAE/pound</th>
<th>RMSE/pound</th>
<th>MAE/yen</th>
<th>RMSE/yen</th>
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<td>4.8</td>
<td>6.2</td>
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<td>12</td>
<td>9.4</td>
<td>10.9</td>
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<td>11.5</td>
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<tr>
<td></td>
<td>36</td>
<td>18.1</td>
<td>21.0</td>
<td>23.4</td>
<td>25.4</td>
<td>19.4</td>
<td>23.3</td>
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<td>-5.4</td>
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<td>(-1.3)</td>
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<td>11.1</td>
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<td>10.2</td>
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</table>

'MAE (mean absolute error) and RMSE (root-mean-squared error) are approximately in percentage terms, since “forecasts” are for the logarithm of the exchange rate. Forecasts are compared over the period March 1973–June 1981.'
Nelson Mark (AER, 1995): a basic monetary model can beat a Random Walk at horizons of 4 to 16 quarters, not just with parameters estimated in-sample but also out-of-sample.

Cerra & Saxena (JIE, 2012), too, find it in a 98-currency panel.
Possible Techniques for Predicting the Exchange Rate

Models based on fundamentals

- Monetary Models
  - Monetarist/Lucas model
  - Overshooting model
- Other models based on economic fundamentals
  - Portfolio-balance model...

Models based on pure time series properties

- “Technical analysis” (used by many traders)
- ARIMA, VAR, or other time series techniques (used by econometricians)

Other strategies

- Use the forward rate; or interest differential;
- random walk ("the best guess as to future spot rate is today’s spot rate")