# Open Economy Macroeconomics
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## News and Volatility of Exchange Rates

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# Introduction

- Previously we focused on the relationship between the spot exchange rate and the previous period's forward rate
- We know that the spot rate can be expressed as the sum of the forward rate, risk premium and *a random error*
- We will now focus on the last term, ie. the random error
- Random errors represent mistakes in trying to forecast future values
- So, under rationality, this error must be attributable to newly-arrived information - 'news' for short

# News: hard to quantify and isolate

- Despite the world flooding with information, it is not easy to quantify news items or to actually isolate or identify the surprise elements
- Let's look at a very simple example illustrating the news approach (and the role of RE): for the spot rate assume

$$s_t = \gamma z_t \tag{1}$$

  where $z_t$ denotes the (set of) variable(s) determining the spot rate - fundamentals for short
- Assume RE and find the predicted value of the period t spot rate

$$\mathbb{E}_{t-1} s_t = \gamma \mathbb{E}_{t-1} z_t$$

  so that forming a rational expectation of the spot exchange rate involves, as a prerequisite, forecasting the fundamentals
- Forecast errors are now

$$s_t - \mathbb{E}_{t-1} s_t = \gamma \left( z_t - \mathbb{E}_{t-1} z_t \right) \tag{2}$$

# News and RE

- Note that the relationship between the forecast errors is exactly the same as that between the *level* of the spot rate and fundamentals
- RE assumption is critical in two respects here:
  - since agents are assumed to know the true structural model linking the spot rate and fundamentals, the same structure prevails between expected spot rate and expected fundamentals
  - RE allows us to deduce that *news* is that part of the fundamentals not only unforeseen, but *unforeseeable*, at least using the information contained in $I_{t-1}$
    - any non-random component that is not 'priced in' would represent a potentially predictable element unexploited by market agents using the information available at the time
- Our ultra simple model illustrates two further points

# News and Efficient Markets

- First, eq. (3) bears a straightforward relationship to the efficient market model analyzed previously

$$\begin{aligned} s_t &= \mathbb{E}_{t-1} s_t + \gamma \left( z_t - \mathbb{E}_{t-1} z_t \right) \\ &= f_{t-1}^{t} - \rho_{t-1} + \gamma \left( z_t - \mathbb{E}_{t-1} z_t \right) \end{aligned} \tag{3}$$

- This equation is a general version of the efficient market model with the expectational error written explicitly in terms of 'news' regarding the fundamentals
    - many researchers have preferred to deal with the 'news' model in this setting, at least for the purpose of empirical testing
    - however, it is quite possible to formulate the 'news' model without reference to forward market efficiency
    - the key central buiding block is RE, and it is by this assumption that the 'news' approach stands or falls

# News model, really?

- Secondly, the simple model illustrates the sense in which the 'news' approach is just that and no more - hardly a model at all, more a methodology or an approach to modelling
- The fact that nothing has been said about the content of $z_t$ bears wittness to this
- The news approach is essentially agnostic about the fundamentals of exchange rate determination, with the choice being based on the particular researcher's theoretical predilections or on purely *ad hoc* criteria
- Whatever considerations guide the choice of fundamental variables, the ultra simple model ignores one inescapable feature of real world forex markets: the importance of prospective capital gains and losses from holding a currency
- We will rectify this assumption and, in the process, tie up a loose end from previously analyzed monetary model

# Monetary Model Revisited

- According to the monetary model, the exchange rate depends on three basic variables: relative money stocks, income and interest rates
- Writing the relevant relationship in logs

$$s_t = \widetilde{m}_t - c\widetilde{y}_t + b\widetilde{r}_t \tag{4}$$

- CIP states

$$\widetilde{r}_t = r_t - r_t^f = \mathbb{E}_t s_{t+1} - s_t + \rho_t$$

which can be used to eliminate the interest rate differential from exchange rate equation (5)

$$\begin{aligned} s_t &= \widetilde{m}_t - c\widetilde{y}_t + b\left[\mathbb{E}_t s_{t+1} - s_t + \rho_t\right] \\ &= \gamma z_t + b\left[\mathbb{E}_t s_{t+1} - s_t\right] && (5) \\ z_t &= \frac{1}{b}(\widetilde{m}_t - c\widetilde{y}_t) + \rho_t && (6) \end{aligned}$$

# Monetary Model Revisited

- Hence, the exchange rate depends not only on fundamentals $z_t$, but also on *expected capital gain or loss from holding the currency* - which is simply $-\left[\mathbb{E}_t s_{t+1} - s_t\right]$
- Note also that the more the exchange rate is expected to depreciate in the coming period the weaker the currency is today - its current level depends on its expected rate of change, which is a typical feature of asset markets
  - other things equal (= ceteris paribus), asset prices are high when they are expected to grow even higher and thereby yield capital gains to current holders
- Actually, we will show that the current level of the exchange rate depends on the hold future path of the fundamentals: start by rewriting eq. (5)

$$
\begin{aligned}
(1+b)s_t &= \gamma z_t + b\mathbb{E}_t s_{t+1} \\
s_t &= \frac{\gamma}{(1+b)} z_t + \frac{b}{(1+b)} \mathbb{E}_t s_{t+1}
\end{aligned}
$$

# Solution to the exchange rate

- But note that

$$\mathbb{E}_t s_{t+1} = \frac{\gamma}{(1+b)}\mathbb{E}_t z_{t+1} + \frac{b}{(1+b)}\mathbb{E}_t s_{t+2}$$

where we have used the *law of iterated expectations*: for a random variable/stochastic process $X_t$

$$\mathbb{E}_t \left[\mathbb{E}_{t+s}(X_{t+s+k})\right] = \mathbb{E}_t \left[X_{t+s+k}\right], \;\; s, k > 0 \tag{7}$$

- So

$$s_t = \frac{\gamma}{(1+b)} z_t + \frac{\gamma b}{(1+b)^2}\mathbb{E}_t z_{t+1} + \frac{b^2}{(1+b)^2}\mathbb{E}_t s_{t+2}$$

- Keep *iterating forward* ...

# Solution to the exchange rate

- ... and you arrive at the *fundamental solution to the exchange rate*

$$\frac{\gamma}{1+b}\sum_{j=0}^{\infty}\beta^{j}\mathbb{E}_{t}z_{t+j}, \quad \beta=\frac{b}{1+b} \tag{8}$$

- This solution is valid under the following technical condition

$$\beta^{T}\mathbb{E}_{t}z_{t+T}\rightarrow 0, \text{ as } T\nearrow\infty$$

  which is called the t*ransversality condition* (TC)

- Interpreting TC: the rate of growth of the fundamentals $z_t$ cannot exceed that of $\beta$

# News?

- One can furthermore show that

$$s_t - \mathbb{E}_{t-1}s_t = \frac{\gamma}{1+b}\sum_{j=0}^{\infty}\beta^j\left[\mathbb{E}_t z_{t+j} - \mathbb{E}_{t-1}z_{t+j}\right] \tag{9}$$

  which serves to show that the 'news' model is really a way of rewriting a generalized asset pricing model, with RE imposed
- The l.h.s. of (9) is the 'news' surprise part of the exchange rate in period t (relative to period t-1 expectatons), while the r.h.s. is a weighted sum of 'news' about future fundamentals
- Note that the 'news' items about future fundamentals are *random* from the point of view of period t-1

$$\mathbb{E}_{t-1}\left[\mathbb{E}_t z_{t+j} - \mathbb{E}_{t-1}z_{t+j}\right] = \mathbb{E}_{t-1}z_{t+j} - \mathbb{E}_{t-1}z_{t+j} = 0$$

  (law of iterated expectations!)

# Forward rate again and ... bubbles

- Since $\mathbb{E}_{t-1}s_t = f_{t-1}^t - \rho_{t-1}$ we can conclude that there is a relationship between eq. (9) and the forward rate model

$$s_t = f_{t-1}^t - \rho_{t-1} + \frac{\gamma}{1+b}\sum_{j=0}^{\infty}\beta^j\left[\mathbb{E}_t z_{t+j} - \mathbb{E}_{t-1}z_{t+j}\right] \qquad (10)$$

- Hence, the current exchange rate can be thought of as made up of three components: the previous period's forward rate and the risk premium (when the forward contract was signed) and the impact of 'news' about future values of fundamentals
- The reason that eq. (8) is called the fundamental solution to the underlying expectational difference equation is that when solving difference equations *fully* we need to appreciate that the full solution consists of the sum of two components: solution to the homogenous equation and the particular solution

# Bubbles

- The particular solution corresponds to the fundamental solution, while the solution to the homogenous equation

$$s_t = \frac{b}{1+b}\mathbb{E}_t s_{t+1} \tag{11}$$

is called the *bubble*

- A bubble may look like this

$$s_t^b = A(1+\frac{1}{b})^t$$

for any $A$

- Compute $\mathbb{E}_t s_{t+1} = A(1+\frac{1}{b})^{t+1}$ so that

$$\frac{b}{1+b}\mathbb{E}_t s_{t+1} = A(1+\frac{1}{b})^t = s_t$$

- Hence, the proposed bubble satisfies eq. (11)