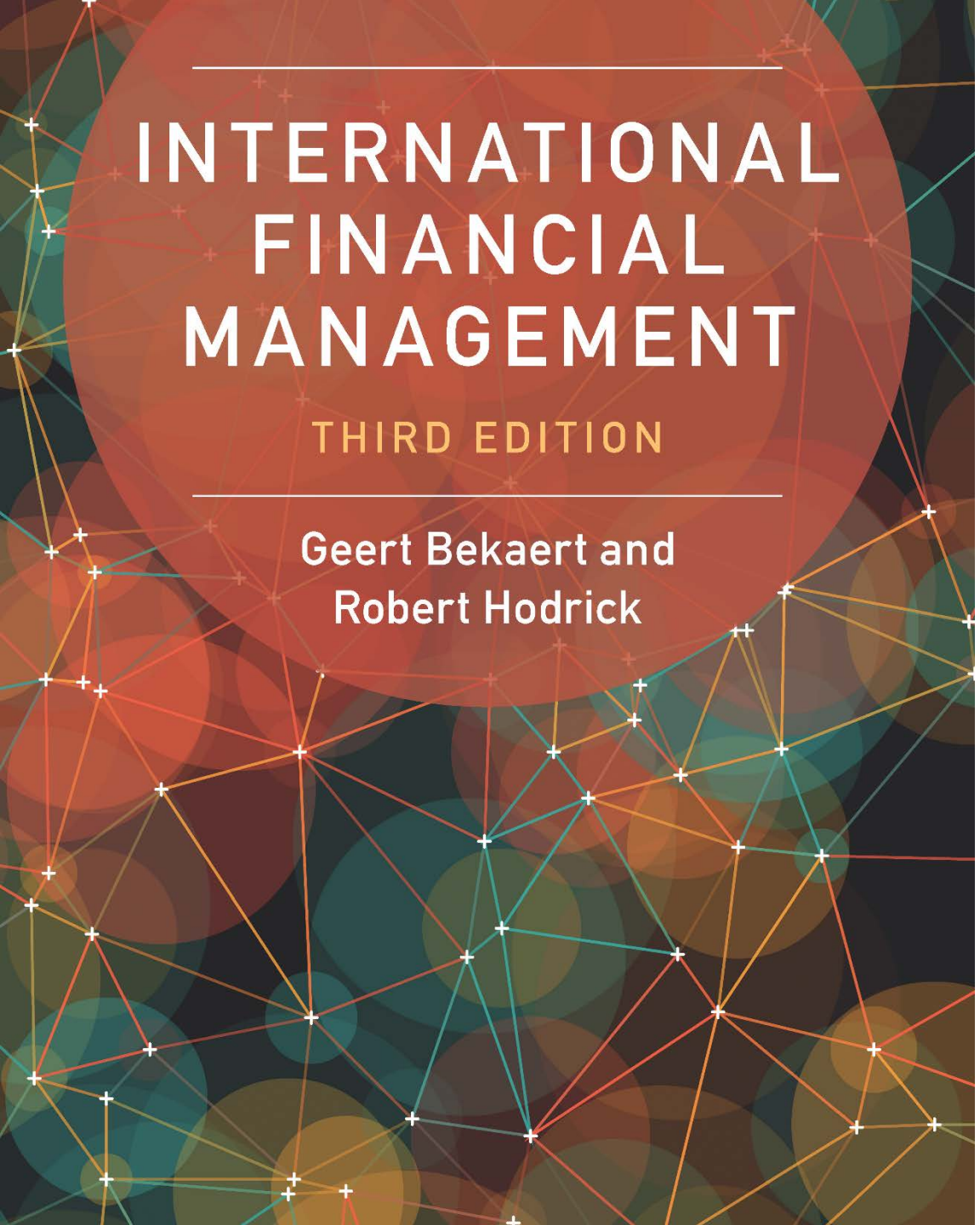


Chapter 10

Exchange Rate Determination and Forecasting

10.1 Parity Conditions and Exchange Rate Forecasts

- The Fisher Hypothesis
  - Interest rates and inflation
  - Real rates of return – measures how much your purchasing power has increased over time
  - The ex post real interest rate
    - $1+r^{ep}=\frac{1+i}{1+\pi}$. Here, *ep* stands for "ex post"
    - Approximated by: $r^{ep}=i-\pi$

10.1 Parity Conditions and Exchange Rate Forecasts

- The ex ante real interest rate – investors must form expectations of inflation
- Expected real interest rate

$$E_t r_{t+1} = i_t - E_t \pi_{t+1}$$

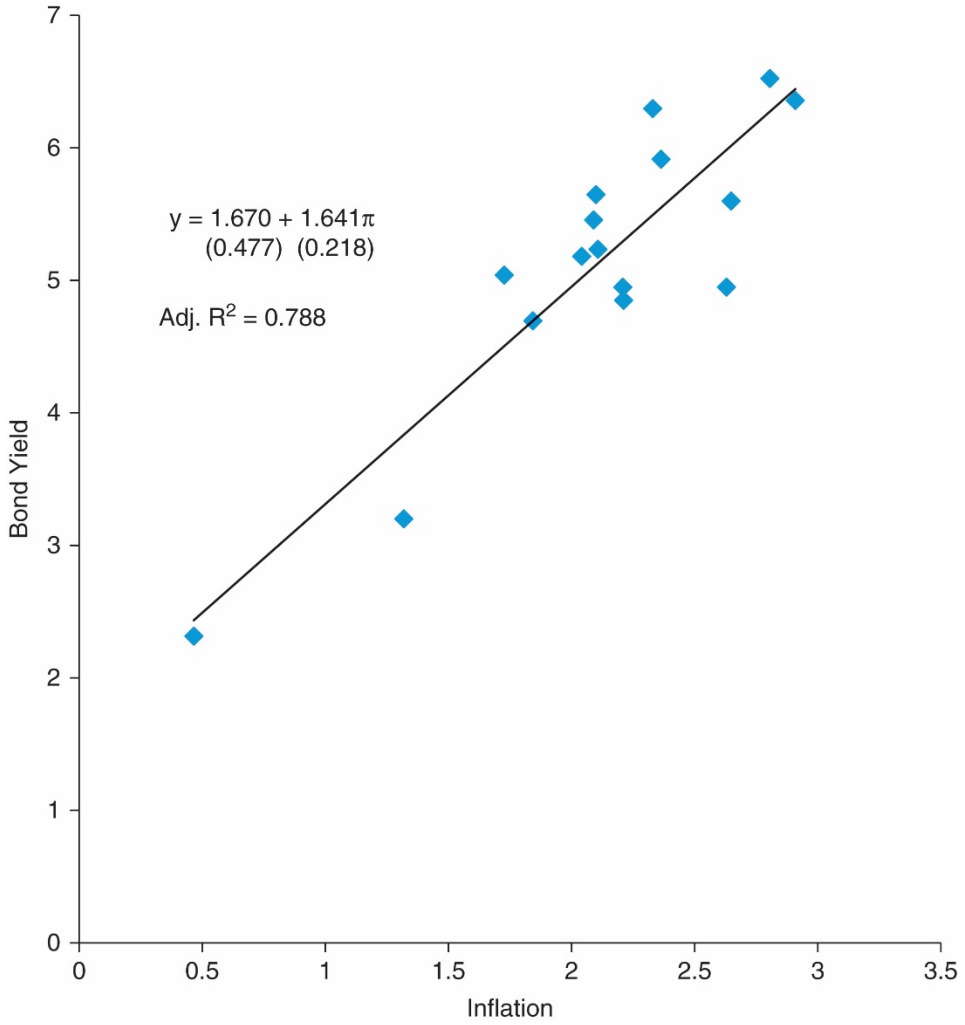
- Fisher hypothesis – decomposition of nominal int. rates

$$i_t = E_t r_{t+1} + E_t \pi_{t+1}$$

- One version of the Fisher hypothesis says $E_t r_{t+1}$ is constant over time
- Even if not, many claim in the international context that

$$E_t r_{t+1} = E_t r^*_{t+1}$$

Exhibit 10.1 Average Long-Term Government Bond Yields and Inflation Rates



10.1 Parity Conditions and Exchange Rate Forecasts

- The International Parity Conditions
  - CIRP – Covered Interest Rate Parity
    - Links forward rates, spot rates, and interest rate differentials
  - UIRP or Unbiasedness – Uncovered Interest Rate Parity
    - Sometimes called International Fisher Effect / Relationship
    - Links expected exchange rate changes and interest rate differentials
  - PPP
    - Links inflation rates and rates of changes in forex rates

10.1 Parity Conditions and Exchange Rate Forecasts

- UIP says $i_t - i_t^* = E_t s_{t+1} - s$, using the log approximation
- Relative PPP says $q_{t+1} - q_t = s_{t+1} - s_t + \pi_{t+1}^* - \pi_{t+1} = 0$, where q_t is the log of the real exchange rate
- Take expectations: $E_t q_{t+1} - q_t = E_t s_{t+1} - s_t + E_t \pi_{t+1}^* - E_t \pi_{t+1} = 0$
- Combine with UIP: $E_t q_{t+1} - q_t = i_t - i_t^* + E_t \pi_{t+1}^* - E_t \pi_{t+1} = E_t r_{t+1} - E_t r_{t+1}^* = 0$
- If UIP and Relative PPP hold then $E_t r_{t+1} = E_t r_{t+1}^*$ and

$$E_t s_{t+1} - s_t = i_t - i_t^* = E_t \pi_{t+1} - E_t \pi_{t+1}^*$$

10.1 Parity Conditions and Exchange Rate Forecasts

- If UIP and relative PPP held, the world would be simple
  - The forecasted change in the log of the exchange rate would equal the nominal interest differential
  - That would equal the difference between expected home and foreign inflation
  - Ex ante real interest rates would be equal
- But UIP and PPP do not hold.
  - Relative PPP fails badly. Even if UIP held, we would have

$$E_t q_{t+1} - q_t = i_t - i_t^* + E_t \pi_{t+1}^* - E_t \pi_{t+1} = E_t r_{t+1} - E_t r_{t+1}^* \neq 0$$

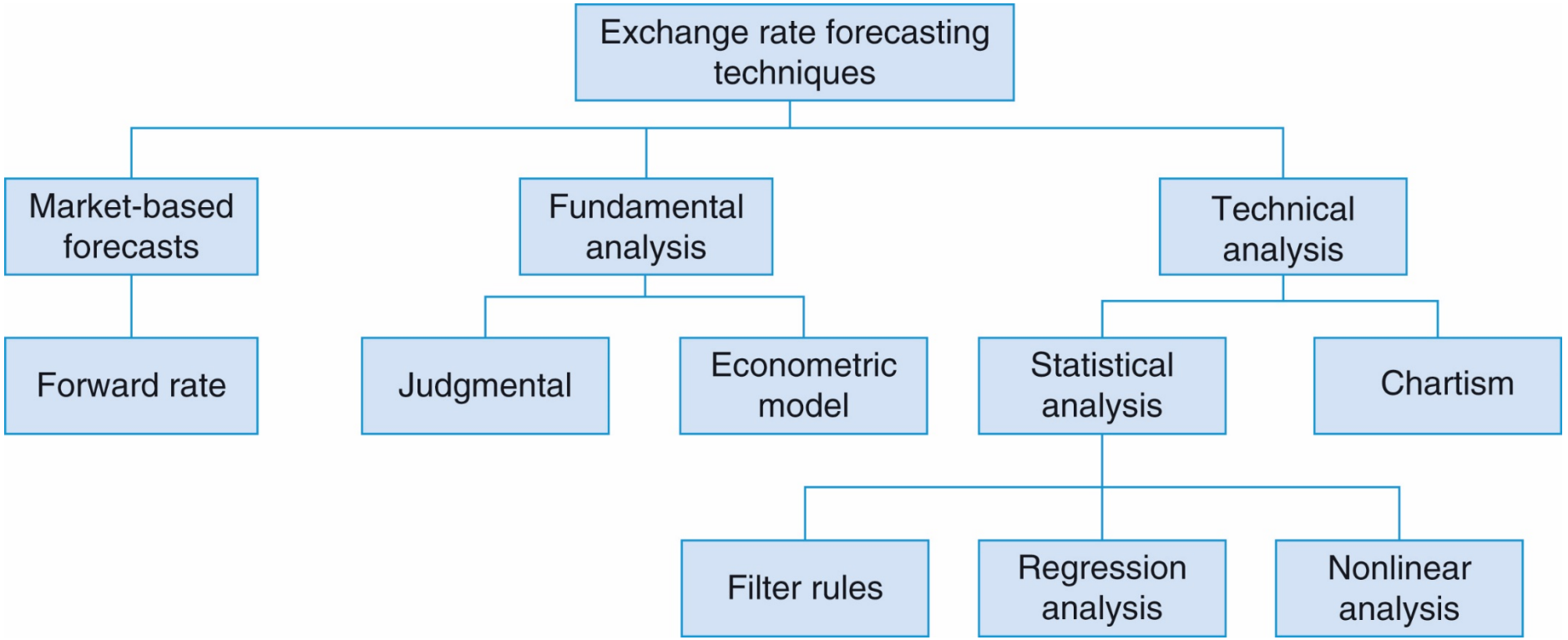
  - But UIP also does not hold, so we cannot forecast exchange rates with nominal interest rate differentials:

$$E_t s_{t+1} - s_t \neq i_t - i_t^*$$

10.2 Currency Forecasting Techniques

- Fundamental exchange rate forecasting
  - Uses fundamentals in econometric models (e.g., money supply, inflation, productivity growth rates, current account)
- Technical analysis
  - Using historical data to find patterns
  - Academics criticize it, but a survey suggests this is used often by traders
    - This suggests that there might be something to it, especially since other models also have shortcomings
    - Fundamental analysis is flawed as well
    - Forward rate may not be an unbiased predictor of the future spot rate, even in an efficient market
    - If enough of the trading world uses it, it will matter through trade pressure

Exhibit 10.3 Categories of Exchange Rate Forecasting Techniques



10.2 Currency Forecasting Techniques

- Evaluating forecasts
  - Accuracy

$$e(t+k) = s(t+k) - \hat{s}(t+k)$$

    - Mean absolute error (MAE)

$$MAE = \frac{1}{T}\sum_{t=1}^{T}\left|e(t+k)\right|$$

    - Root mean squared error (RMSE)

$$RMSE = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(e(t+k)\right)^2}$$

10.2 Currency Forecasting Techniques

- Being on the right side of the forward rate
  - Making right decision as to whether to go long or short on currency could be sufficient
  - Percentage correct – beat probability and statistics, i.e., 50% chance of being right

- Profitability
  - How often can be you be wrong if you lose small when you are wrong and win big when you are right?

10.2 Currency Forecasting Techniques

- Fancy Foods can seek the advice of two forecasting companies to help it predict future forex rates: Forexia and Trompe Le Monde. Which forecast is more accurate?

	Forexia	Trompe Le Monde
Forecast	\$1.65/£	\$1.51/£
Forecast relative to forward rate (forward rate: £1.53/\$)	Higher	Lower
Decision	Hedge	Do not hedge
Forecast error	–\$0.10/£	\$0.04/£
Ex post cost relative to forward rate	Zero	Positive

More inaccurate but suggests hedging, which proves to be less costly

Technically more accurate but suggests no hedging, which proves to be costly: $£1M \times (\$1.55 - \$1.53)/£ = \$20{,}000$

10.3 Fundamental Exchange Rate Forecasting

- Many exchange rate models take the form of:

$$s_t = b\left(x_t - s_t\right) + E_t s_{t+1} \qquad 0 < b < 1$$

- x_t represents some economic "fundamental" variables that determine the exchange rate in the long run, such as from monetary policy
- The equation says that the exchange rate at time *t* partially adjusts toward the fundamental value, but is also determined by expectations.
- We can rewrite this equation as:

$$s_t = \frac{b}{1+b} x_t + \frac{1}{1+b} E_t s_{t+1} = \left(1-a\right) x_t + a E_t s_{t+1} \qquad a \equiv \frac{1}{1+b} \qquad 0 < a < 1$$

10.3 Fundamental Exchange Rate Forecasting

- This equation shows that the exchange rate is "forward looking"

$$s_t = (1-a)x_t + aE_t s_{t+1}$$

- Now note that $s_{t+1} = (1-a)x_{t+1} + aE_{t+1}s_{t+2}$
- Take expectations: $E_t s_{t+1} = (1-a)E_t x_{t+1} + aE_t\left(E_{t+1}s_{t+2}\right) = (1-a)E_t x_{t+1} + aE_t s_{t+2}$
- Substitute into the first equation:

$$s_t = (1-a)x_t + a\left((1-a)E_t x_{t+1} + aE_t s_{t+2}\right) = (1-a)\left(x_t + aE_t x_{t+1}\right) + a^2 E_t s_{t+2}$$

- Continue to iterate, and we get:

$$s_t = (1-a)\sum_{j=0}^{\infty} a^j E_t x_{t+j}$$

10.3 Fundamental Exchange Rate Forecasting

- The asset market approach to exchange rate determination
  - The exchange rate as an asset price – based on current fundamentals and expectations of future exchange rates
    - Just like stocks – linked to current / future fundamentals
    - Even a small change in current fundamentals can cause a large change in the forex rate if it also changes expectations
    - Conversely, news about the future matters a lot

10.3 Fundamental Exchange Rate Forecasting

- News and exchange rates
  - The performance of the monetary exchange rate model is that exchange rate changes are unpredictable but they still reflect news about fundamentals
  - News is incorporated into exchange rates very quickly (typically less than 15 minutes)
    - Strange reaction to news about inflation/increases in money supply: the dollar appreciates when the money supply increases or inflation increases – one interpretation is that this reaction anticipates central bank responses of aggressive monetary policies (i.e., higher interest rates)

10.3 Fundamental Exchange Rate Forecasting

- Monetary model:

$$x_t = m_t - m_t^* - \left(y_t - y_t^* \right)$$

- The “fundamental” is relative money supplies less relative income (all of these are in logs).
  - A greater supply of money will work to depreciate the currency
  - If income is higher, people demand more money, which will work to appreciate the currency

10.3 Fundamental Exchange Rate Forecasting

- In some models (which assume nominal price stickiness), we have

$$x_t = m_t - m_t^* - \left(y_t - y_t^*\right) + q_t$$

- The nominal exchange rate will tend to be high when the real exchange rate is high. But what factors drive the real exchange rate?
- Slow adjustment of prices leads to slow adjustment of the real exchange rate:

$$E_t q_{t+1} - q_t = -\kappa q_t$$

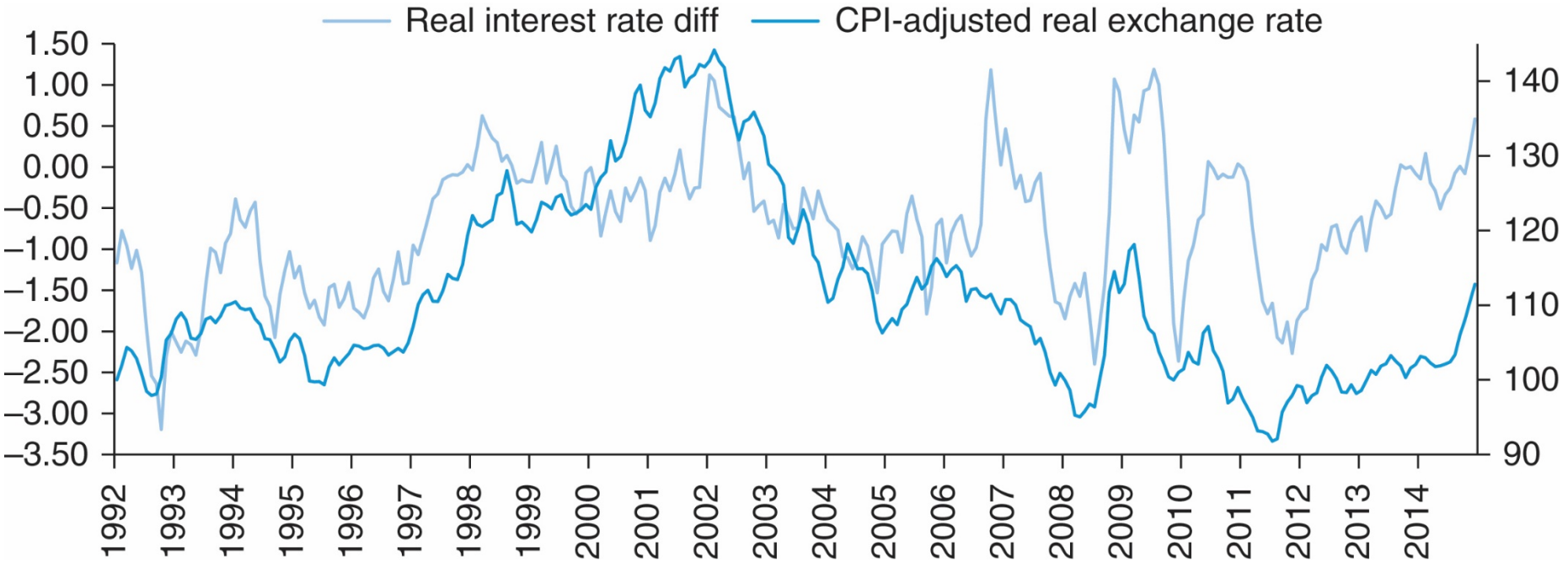
- We saw earlier that if UIP holds, $E_t q_{t+1} - q_t = E_t r_{t+1} - E_t r_{t+1}^*$
- These equations then imply:

$$q_t = -\frac{1}{\kappa}\left(E_t r_{t+1} - E_t r_{t+1}^*\right)$$

10.3 Fundamental Exchange Rate Forecasting

- In that model, then, factors that raise the real interest rate in the home country (such as tighter monetary policy) will raise real interest rates, which in turn will lead to a real depreciation
  - In turn that feeds into a nominal depreciation
- But none of these models turn out to be helpful in forecasting exchange rates
  - For one thing, they require forecasting the economic fundamentals
- Why the random walk works
  - But the models actually imply the exchange rate is not forecastable!
  - Current exchange rates adequately reflect the expected value of future fundamental values
    - In order for this to be true exchange rate should also predict future fundamental values (Engel, Mark and West, 2007 show this to be true)

Exhibit 10.4 The Real Exchange Rate and the Real Interest Differential



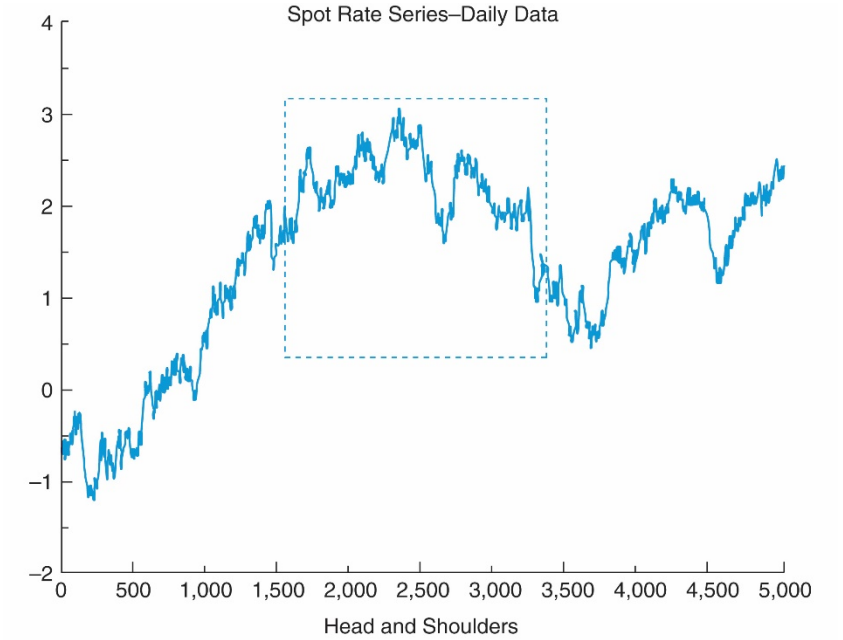
10.3 Fundamental Exchange Rate Forecasting

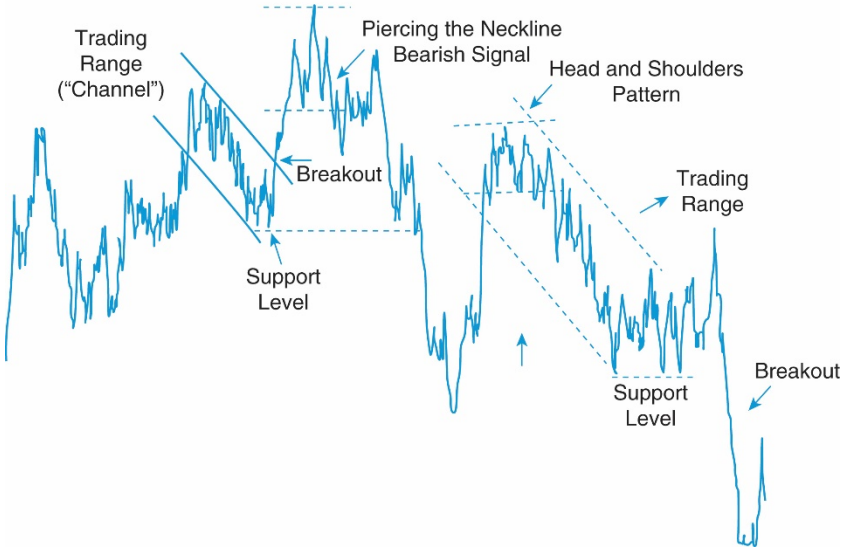
- PPP-based forecasts
  - Most popular fundamental exchange rate models
  - “Fair value” exchange rate models used by most brokers / banks
    - They adjust PPP for various effects, such as productivity trends, which is particularly important for developing countries
    - They use the deviation between current value and fair value of the exchange rate to predict the direction of change
  - Academic studies suggest there is some predictive power, though it is limited to medium-to-long horizons
    - For example, the Big Mac index

10.4 Technical Analysis

- "Pure" technical analysis: Chartism
  - Support level – level price has trouble falling below
  - Resistance level – level price has trouble rising above
  - Breakout – a sudden break of a trading range
  - Potentially spurious patterns
  - Trading on a random walk
  - Does charting work?

Exhibit 10.5 Exchange Rate Patterns Described by Chartists





10.4 Technical Analysis

- Filter rules
  - x% rules
    - Buy (go “long”) the currency if it appreciates by x% above its most recent trough (or support level)
    - Sell (go “short”) the currency when it falls x% below its most recent peak (or resistance level)
  - Moving-average crossover rules
    - Go long (short) in the foreign currency when the short-term moving average crosses the long-term moving average from below (above)
    - 1 and 5 days; 1 and 20 days; 5 and 20 days
  - Filter rule profitability
    - Used to be profitable (i.e., 6.2%/year for Swiss franc and 13.94% for yen before 1994) but not so much any more
    - Since 2000, studies suggest using simple moving average rules works better

10.4 Technical Analysis

- Regression analysis
  - This framework is used each trading period to find the expected forward market return
  - If the expected return is positive (negative), the strategy is to long (short) the foreign currency
- Non-linear models
  - More sophisticated models which take non-linearity into consideration
    - Use computer techniques such as algorithms to search for optimal trading rules
    - Apply Darwinian-like, natural-selection process to filter rules on past data to breed the “best” trading rules

10.5 Predicting Devaluations (Pegged Regimes)

- What causes a currency crisis?
  - Macroeconomic conditions
    - Government follows policies inconsistent with its currency peg – speculative attack is unavoidable
      - Government will exhaust reserves defending peg
    - Events that should precede devaluations
      - Growing budget deficits
      - Fast money growth
      - Rising wages and prices
      - Currency overvaluation
      - Current account deficits (caused by budget deficits combined with currency overvaluation)

10.5 Predicting Devaluations

- Self-fulfilling expectations
  - Group of investors begin speculative attack
  - Other investors see this and think that the currency will collapse so they convert out of currency
- Contagion
  - If group successfully attacks one currency, they might as well try another
  - If one currency is attacked, other currencies will appreciate relative to that currency and their domestic firms suffer a loss of competitiveness
  - Other countries in similar position – obvious targets (e.g., Asian crisis)