Chapter 15

Exchange Rates in the Short Run: The Asset Approach
The “invention” of PPP

• “Our willingness to pay a certain price for foreign money must, ultimately and essentially be due to the fact that this money possess a purchasing power as against commodities and services in that foreign country.”
  —Gustav Cassel, of the Swedish school of economics, 1922
PPP is useful as a long-run theory

- The fundamental things apply
  As time goes by.

  —Herman Hupfeld, songwriter, 1931
  (from the film *Casablanca*, 1942)
PPP is useless as a short-run theory

- The long run is a misleading guide to current affairs. In the long run we are all dead. Economists set themselves too easy, too useless a task if in tempestuous seasons they can only tell us that when the storm is past the ocean is flat again.

  — John Maynard Keynes, A Tract on Monetary Reform, 1923
Chapter 15: Outline

• 15–1 Exchange rates and interest parity in the short run: UIP and FX market equilibrium
  ◦ Equations: Recap UIP
    ▪ Can solve for \( E \) if we know \( E_e \), \( i \) and \( i^* \)
  ◦ Graphical analysis: FX market diagram
    ▪ Equilibrium: domestic return \( DR = \) foreign return \( FR \)

• 15–2 Interest rates and in the short run: money market equilibrium
  ◦ Equations: Recap standard model
    ▪ Can solve for \( i \) if we know \( M/P \) and \( Y \)
  ◦ Graphical analysis: money market diagram
    ▪ Equilibrium: money demand \( MD = \) money supply \( MS \)

• 15–3 Asset Approach: Applications and Evidence
  ◦ Apply models of the two asset markets simultaneously
  ◦ Policy predictions and examples
Chapter 15: Outline

• 15–4 A Complete Theory: Unifying the Monetary and Asset Approaches
  - Put all four building blocks together
    - LR Money: Solve for future P with forecast of M, Y, M*, Y*, i, i*
    - PPP: Solve for future Ee if we know future P, P*
    - SR Money: Solve for i, i* if we know M, Y, M*, Y*, P, P*
    - UIP: Solve for spot E if we know Ee, i, i*
  - Apply the complete model
    - Long run policy analysis & Overshooting

• 15–5 Fixed Exchange Rates
  - So far: assume exchange rate E is floating
  - Now: show how we use same apparatus when E is fixed
  - Key result: The Trilemma
  - Applications and Evidence

• 15–6 Conclusion
LEARNING OBJECTIVES
15–1 Exchange rates and interest parity in the short run

- Recap uncovered interest parity (UIP)
- Understand why FX market is in equilibrium when domestic return DR equals foreign return FR
- Understand how we derive the FX market diagram
- Understand adjustment toward equilibrium and why the equilibrium is stable
- Understand how to apply the FX market diagram
UFP as equilibrium condition for the FX market

- Fundamental equation of the asset approach

\[
i_d = i_e + \left( \frac{E^e_{$/€} - E^e_{$/€}}{E^e_{$/€}} \right) \text{ expected rate of depreciation of the dollar}
\]

\[
i_f = \text{domestic dollar return}
\]

\[
i_e = \text{euro interest rate}
\]

\[
E^e_{$/€} - E^e_{$/€} \text{ expected foreign dollar return}
\]

- Ee: Assume Ee known using model of Chap 14 to make a forecast

- Need to explain i$_d$ and i$_e$ and how the forex market then adjusts so today’s spot E is at the level given by UIP
UIP as a building block

Home country

- Nominal interest rate $i_s$

Foreign country

- Expected future exchange rate $E_{s/\epsilon}^e$
- Nominal interest rate $i_\epsilon$

Exchange rate $E_{s/\epsilon}$
We could do all this using equations
But a clearer way to see what is going on is to use graphs.
In this chapter we introduce
  ✦ Graphical treatment of the short run money market
  ✦ Graphical treatment of the forex market
Bring them both together to provide a full graphical treatment of the short-run asset approach to exchange rates
First, we take some time to familiarize ourselves with these graphical tools
Then use them for prediction and policy analysis
**FX market: equilibrium and adjustment**

**AN EXAMPLE**

<table>
<thead>
<tr>
<th>(1) Interest rate on dollar deposits (annual)</th>
<th>(2) Interest rate on euro deposits (annual)</th>
<th>(3) Spot exchange rate (today)</th>
<th>(4) Expected future exchange rate (in 1 year)</th>
<th>(5) Expected euro appreciation against dollar (in 1 year)</th>
<th>(6) Expected dollar return on euro deposits (annual)</th>
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</thead>
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<tr>
<td>domestic return (in dollars)</td>
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<td>foreign expected return (in dollars)</td>
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<tr>
<th>$i_s$</th>
<th>$i_e$</th>
<th>$E_{S/e}$</th>
<th>$E_{S/e}^e$</th>
<th>$\frac{E_{S/e}^e - E_{S/e}}{E_{S/e}}$</th>
<th>$i_e + \frac{E_{S/e}^e - E_{S/e}}{E_{S/e}}$</th>
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</table>
FX market: equilibrium and adjustment

GRAPHICAL EXPOSITION

FX Market

Expected return, percent per year

Equilibrium is at point 1, where domestic returns equal expected foreign dollar returns, so UIP holds.

Domestic return = \( i_s \)

Foreign return = \( i_e + \frac{E_{S/E}^e - E_{S/E}}{E_{S/E}} \)

Today’s dollar/euro spot exchange rate, \( E_{S/E} \)
Adjustment to FX market equilibrium

- Suppose €/$ exchange rate is “too high” at point 2.
  - FR is below DR and arbitragers want to sell € and buy $.
  - This puts the euro under selling pressure and bids down the price of the euro.
  - In other words the €/$ exchange rate starts to fall (horizontal axis) and we move from point 2 toward point 1 causing FR to rise (vertical axis).

- Suppose €/$ exchange rate is “too low” at point 3.
  - FR is above DR and arbitragers want to buy € and sell $.
  - This puts the euro under buying pressure and bids up the price of the euro.
  - In other words the €/$ exchange rate starts to rise (horizontal axis) and we move from point 3 toward point 1 causing FR to drop (vertical axis).
FX market: equilibrium and adjustment

1. A decline in the foreign interest rate moves the FR curve down.

2. Dollar deposits look more attractive and the dollar appreciates. The new equilibrium is at point 5.

Today’s dollar/euro spot exchange rate, $E_{s/e}$
FX market: equilibrium and adjustment

CHANGE IN EXPECTED E

FX Market

Expected return, percent per year

1. A decline in the expected future exchange rate moves the FR curve down.

2. Dollar deposits look more attractive and the dollar appreciates. The new equilibrium is at point 5.

Today’s dollar/euro spot exchange rate, $E_{S/E}$
What the FX market diagram tells us

- Knowing home interest rate (vertical axis) in the home market tells us the domestic return (DR)
- Knowing Ee and foreign interest rate tells us the position of the foreign return (FR) curve
  - Both returns are measured in domestic currency terms

FX market has a unique equilibrium where DR & FR intersect. This is where UIP holds.

- From this point we trace down to the horizontal axis and read off the equilibrium spot rate E.
- So all we need to do now is figure out the interest rate(s).
- For this we need the money market diagram…
LEARNING OBJECTIVES
15–2 Interest rates and in the short run

- Recap standard model of money demand
- Understand why money market is in equilibrium when money supply MS equals money demand MD
- Understand how we derive the money market diagram
- Understand adjustment toward equilibrium and why the equilibrium is stable
- Understand how to apply the money market diagram
• The remaining tool we need
• Describes short run equilibrium in money market
  ♦ Applies to each country, but we focus on the home country
• For our short run analysis we assume
  ♦ Price levels are sticky (use overbar notation)
  ♦ Nominal interest rates adjust to clear the money market
• To proceed we need to know
  ♦ Money supply and money demand
  ♦ Use same model of demand as Ch. 14 (standard model)
  ♦ But this time use assumptions suitable for the short run
Key differences
Short-Run vs Long-Run assumptions

• Important to understand key difference between the way we approach money market equilibrium in the short run (here) and the way we approached it in the long run (chapter 14).
• In Chapter 14 we made the following long-run assumptions:
  - In the long run the price level $P$ is fully flexible and adjusts to bring the money market to equilibrium;
  - In the long run the interest rate $i$ is determined by the Fisher effect.
• In this chapter, we make quite different short-run assumptions:
  - In the short run the price level is sticky; it is treated as a known predetermined variable, fixed at $\bar{P}$ (bar denotes a fixed value);
  - In the short run the interest rate $i$ is fully flexible and adjusts to bring the money market to equilibrium.
Key differences
Short–Run vs Long–Run assumptions

- First, why assume prices are now sticky?
  - The “Keynesian” assumption of sticky prices is common to the study of macroeconomics in the short run. Economists have many explanations for price stickiness or so-called “nominal rigidity.” Nominal wages may be sticky due to long–term labor contracts. Nominal product prices may be sticky due to “menu costs,” whereby firms find it costly to frequently change their output prices. Thus, whilst we think it is reasonable to assume prices are flexible in the long run, this cannot be taken for granted in the short run.
Key differences
Short-Run vs Long-Run assumptions

• Second, why assume that interest rates are now flexible?
  ♦ In the long run, we have shown in the last chapter that interest rates are pinned down by the Fisher effect (or RIP), but remember that this result does not hold in the short run. After all, it was derived from PPP, and PPP is a poor guide to the short run. And we saw ample evidence that real interest rates fluctuate in ways that deviate from simple RIP in the short run.
Short-run money market equations

- Using the same notation as before

\[ \frac{M_{US}}{P_{US}} = \frac{L(i_\$) \times Y_{US}}{Y_{US}} \]

U.S. supply of real money balances

\[ \frac{M_E}{P_E} = \frac{L(i_€) \times Y_E}{Y_E} \]

European supply of real money balances

U.S. demand for real money balances

European demand for real money balances
Short-run money market diagram

Home Money Market

Nominal interest rate $i_s$

Real money supply, $M_{US}^i / P_{US}$

Real money demand, $M_{US}^i / P_{US} = L(i_s)Y_{US}$

Real money balances, $M_{US} / P_{US}$
Adjustment to money market equilibrium

- Suppose interest rates are “too high” at point 2 on the real money demand curve. Real money demand is less than real money supply. The public will desire to reduce its cash holdings by exchanging money for assets such as bonds, saving accounts etc. That is, they will save more and seek to lend their money to borrowers. But borrowers will not want borrow more unless the cost of borrowing falls. So the interest rate will be driven down as eager lenders compete to attract scarce borrowers. As this happens, back in the money market, in Figure 15–3, we move from point 2 back toward equilibrium at point 1.

- A similar story can be told if the money market is initially at point 3, where there is an excess demand for money. In this case, the public wishes to reduce their interest bearing assets and turn them into cash. Fewer loans are extended. But borrowers will not want borrow less unless the cost of borrowing rises. So the interest rate will be driven up as eager borrowers compete to attract scarce lenders. These adjustments come to a halt only when point 1 is reached.
Predictions
Change in home money supply

Home Money Market

Nominal interest rate \( i_s \)

1. An increase in real income causes an increase in real money demand...

2. … and raises the interest rate.

1 2

1

2

1. An increase in real income causes an increase in real money demand...

2. … and raises the interest rate.

\[
\frac{M_{US}^t}{P_{US}^t} \quad \frac{M_{US}}{P_{US}}
\]
Predictions
Change in home real income

Home Money Market

1. An increase in the money supply...
2. ... lowers the interest rate.

Nominal interest rate $i_s$

\[
\begin{align*}
MS_1 & \quad MS_2 \\
\frac{M_{US}^1}{P_{US}^1} & \quad \frac{M_{US}^2}{P_{US}^1} \\
M_{US}^2 & \quad P_{US}^2 \\
MD & \\
\end{align*}
\]

Real money balances, $\frac{M_{US}}{P_{US}}$
Predictions

- In the short run, all else equal, an increase in a country’s money supply will lower the country’s nominal interest rate; a decrease in a country’s money supply will raise the country’s nominal interest rate.
- In the short run, all else equal, an increase in a country’s real income will raise the country’s nominal interest rate; a decrease in a country’s real income will lower the country’s nominal interest rate.
Short run money market model: The final building block

**Home country**
- Money supply: $M_{US}$
- Real income: $Y_{US}$
- Nominal interest rate: $i_s$

**Foreign country**
- Money supply: $M_E$
- Real income: $Y_E$
- Nominal interest rate: $i_e$
EXAMPLE

A central bank that had previously kept the money supply constant, now lets $M$ grow at 5% per year.

- In the long run, the predictions of the long-run monetary model and Fisher effect are clear. All else equal, a 5 percentage point increase in the rate money growth causes a 5 percentage point increase in the rate of inflation, and a 5 percentage point increase in the nominal interest rate. The home interest rate will rise in the long run.

- In the short run, the short-run model tells a very different story: if the money supply expands, the immediate effect is an excess supply of real money balances. The home interest rate will fall in the short run.
Long run versus short run
How Policy Impacts Can Differ

• These different outcomes illustrate the importance of the assumptions we make about price flexibility.
• They also underscore the importance of the nominal anchor in monetary policy formulation, and the limits that central banks have to confront.
  - In the short run, if the central bank can temporarily manipulate its money supply policies without causing prices to become unstuck (triggering inflation), then looser money means lower interest rates, which might be temporarily desirable for certain purposes.
  - But if the same looser monetary policies were to persist in the long run, prices will not remain stuck, and eventually looser money will mean higher inflation rates and higher interest rates.
Long run versus short run
How Policy Impacts Can Differ

• Apparently puzzling linkages between money, interest rates and exchange rates.
  ♦ In both of the above cases, a expanded money supply leads to a weaker currency.
  ♦ However: in the short run, low interest rates and a weak currency go together; whereas in the long run, high interest rates and a weak currency go together.

• What is the intuition for this?
  ♦ In short run, when we study impact of a lower interest rate and we say “all else equal”, we assumed that expectations have not changed concerning future exchange rates.
  ♦ In other words, we envisage (implicitly) a temporary policy that does not tamper with the nominal anchor.
  ♦ In the long run, if the policy turns out to be permanent, this assumption is inappropriate; prices are flexible and money growth, inflation, and expected depreciation now all move in concert—the “all else” is no longer equal.
LEARNING OBJECTIVES
15–3 Asset Approach: Applications and Evidence

• Understand that general equilibrium requires equilibrium in each of the two asset markets simultaneously
• Understand how to derive the combined FX–money market diagram
• Understand equilibrium in the combined diagram
• Understand how to apply the combined diagram to generate policy predictions
• Look at some evidence
A combined graph can be used to summarize the FX and money markets.

FX market diagram
- Horizontal axis $E$
- Vertical axis $i$

Money market diagram
- Horizontal axis $M/P$
- Vertical axis $i$

Since $i$ is common on vertical axis of both diagrams we place them side by side
- Capital mobility (arbitrage) is key. Home interest rate $i$ in home money market is the domestic return (DR) compared to foreign returns to arbitragers.
The Complete Model
Linking FX and money markets

(a) Home Money Market

1. The home real money supply...

\[ M_{1H} / P_{1H} \]

2. ...determines the home nominal interest rate in the money market...

\[ i_s^1 \]

3. ...which equals the relevant domestic return in the foreign market,...

\[ E_{1s} = \frac{E_{s/e} + E_{S/e}}{E_{s/e}} \]

(b) FX Market

1. Effective home money balances, \( M_{1H} / P_{1H} \)

2. Expected returns

3. Domestic Return \( DR \)

4. Foreign Return \( FR \)

4. ...and the equalization of domestic and foreign returns in equilibrium determines the spot exchange rate.

\[ E_{s/e} \]
Policy Prediction
Temporary increase in home money supply

(a) Home Money Market
Nominal interest rate, $i_s$

1. A rise in U.S. money supply...

Real money balances, $M_{US}/P_{US}$

(b) FX Market
Exchange rate, $E_{S/E}$

2. ...lowers the domestic return (the U.S. nominal interest rate)...

Expected returns

3. ...causing the dollar to depreciate

$i_e + \frac{E_{S/E} - E_{S/E}}{E_{S/E}}$
Policy Prediction
Temporary increase in home money supply

- The result is intuitive, and we have seen each of the steps previously. We now just put them all together:
  - A home monetary expansion lowers the home nominal interest rate; this is also the domestic return; this makes foreign deposits more attractive; because capital mobility allows it, traders sell home deposits and buy foreign deposits; the home exchange rate increases (the home currency depreciates); but this depreciation makes foreign deposits less attractive (all else equal); so equality of foreign and domestic returns is restored, UIP holds, and the forex market moves back to equilibrium.
Policy Prediction
Temporary increase in foreign money supply

(a) Home Money Market
Nominal interest rate, $i_s$
Real money balances, $M_{US}/P_{US}$

(b) FX Market
Expected returns
Exchange rate, $E_{S/E}$

1. A rise in Euro money supply lowers the foreign return...

2. ...causing the dollar to appreciate
Policy Prediction
Temporary increase in foreign money supply

• This result is also intuitive:
  • A foreign monetary expansion lowers the foreign nominal interest rate; this lowers the foreign return; this makes foreign deposits less attractive; because capital mobility allows it, traders wish to sell foreign deposits and buy home deposits; the home exchange rate decreases (the home currency appreciates); but this appreciation makes foreign deposits more attractive (all else equal); so equality of foreign and domestic returns is restored, UIP holds, and the forex market moves back to equilibrium.
APPLICATION

The fall of the US dollar 2000–04

Interest rates, percent

Fed funds rate \(i_s\)

ECB refinancing rate \(i_e\)

Exchange rate, \$/€

U.S. exchange rate \(E_{s/€}\)

appreciation dollar depreciation

EXTRA APPLICATION
Another fun example

- One country starts with a low interest rate but tightens it a lot over 2 years: money market rate goes from 1% to over 5%.
  - Guess who?

- Another country has been mired in a long recession and its central bank has had a “zero interest rate policy” (ZIRP) for several years
  - Guess who?

- What does our model predict?
  - And does it fit the facts?
Another fun example

Interest rates (3 month LIBOR)

USD

JPY
EXTRA APPLICATION

Another fun example

JPY/USD

1/1/04  1/1/05  1/1/06
LEARNING OBJECTIVES
15–4 A Complete Theory

• Understand how we unify the Monetary and Asset Approaches in one complete theory
• Understand how to apply the complete theory to generate long and short run policy predictions
• Understand the exchange rate “overshooting” phenomenon
• Look at some evidence
All four building blocks

The Long Run (Monetary Approach)
  LR Money Market Model and PPP
  Assume: Fisher Effect allows us to solve for i in LR (if needed)

  • 1. Long-Run Monetary Model
     ♦ M and Y allow us to solve for price levels P in LR.

  • 2. Purchasing Power Parity (PPP) as a long-run theory
     ♦ Expected future prices P allow us to solve for future E

The Short Run (Asset Approach)
  SR Money Market Model and UIP
  Assume: P is sticky and given (predetermined)

  • 3. Short-run model of money market
     ♦ If we know M and Y we can forecast interest rates i in SR.

  • 4. Uncovered Interest Parity (UIP) as a short-run theory
     ♦ Use expected E to predict spot E, given interest rates
### All at once…

#### Models

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<tr>
<th>Asset Approach</th>
<th>Home country</th>
<th>Foreign country</th>
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<td><strong>Short-Run Model of Current Exchange Rate</strong>&lt;br&gt;Variables dated t (current period)</td>
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<td><strong>Current Data</strong>&lt;br&gt;M1&lt;br&gt;Real income&lt;br&gt;Nominal interest rate&lt;br&gt;Exchange rate&lt;br&gt;Expected future exchange rate</td>
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<td><strong>Money Market Equilibrium</strong> (Figure 15-4)</td>
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<td>[ P_{e,t} = \frac{M_{1t}}{L_{e,t}}(i_{e,t}) ]</td>
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<th>Monetey Approach</th>
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PPP (Figure 14-1)
Our model can be used for analysis of short run policy experiments
- Key assumption: Temporary policy
- Hence $E_e$ is unchanged
- Ignores the long run building blocks, uses short run only

Can it also be used for analysis of long run policy?
- Yes, can study permanent monetary policy shocks
- As long as we remember that $E_e$ will change
  - This will shift the FR curve
  - Note: these shocks will violate the nominal anchor, all else equal
- Uses all of the building blocks, long run and short run
Permanent increase in money supply

- Assumptions (as before)
  - Identical economies, output $Y$ fixed
  - Start in long run equilibrium
  - Home money supply increases $x\%$ at time $T$
  - Unexpected
  - Price level $P$ sticky in the short run

- Solution?
  - Must work backwards
  - First figure out what happens in the long run
    - How does $E_e$ change?
  - Why?
    - Because $E_e$ also affects the short run
  - Answer?

- One of the more complex problems we’ll study
Permanent increase in money supply
SHORT RUN RESPONSE

(a) Home Money Market

Nominal interest rate, $i_s$

1. A permanent rise in U.S money supply...

2. ...lowers the domestic return (the home nominal interest rate)...

3. ...and raises the foreign return (via expected long-run depreciation)...

4. ...so the dollar depreciates substantially in the short run.

(b) Forex Market

Expected returns

Exchange rate, $E_{s/e}$
Permanent increase in money supply
LONG RUN RESPONSE

(c) Home Money Market

Nominal interest rate, $i_s$

1. Inflation means that prices rise, real money supply returns to its original level

\[ \frac{M^1_{US}}{P^1_{US}} = \frac{M^2_{US}}{P^2_{US}} \]

Real money balances, $M_{US} / P_{US}$

(d) Forex Market

Expected returns

 Exchange rate, $E_{S/€}$

2. ... the domestic return returns to its original level

3. ... the foreign return is unchanged (the depreciation persists)...

3. ... and the dollar now appreciates back towards its long-run level

\[ \frac{E_{S/€}^1}{E_{S/€}^1} = \frac{E_{S/€}^4}{E_{S/€}^2} \]
The exchange rate $E$ **overshoots** its long run equilibrium after a permanent $M$ shock

- What’s going on?

**Short run: a double whammy**
- Home interest rate falls (MS shifts out)
- Plus a rise in $E_e$ of home currency (FR shifts out)
  - 2 reasons to dump home currency deposits!
  - Compared to initial level, $E$ rises (depreciates) a great deal

**Long run: only a single whammy**
- Home interest rate back to normal (MS back to normal)
- But rise in $E_e$ of home currency remains (FR shift remains)
  - Only 1 reason to dump home currency deposits!
  - Compared to initial level, $E$ rises (depreciates) a bit less
Permanent increase in money supply

TIME SERIES DIAGRAMS

(a) home money supply

1. Money supply increases.

$M^{1}_{US}$

$M$

$M^{2}_{US}$

1. Money supply increases.

2. Interest rate falls in the short run, but is unchanged in the long run.

3. Price level is sticky in the short run. In the long run it rises in the same proportion as the money supply.

4. In the short run the exchange rate overshoots its long run level. Traders learn that the currency will depreciate in the long run, but in the short run it is even weaker because the home interest rate is temporarily low. This is overshooting.

$E_{\$/\€}^{1}$

$E_{\$/\€}^{2}$

$E_{\$/\€}^{3}$

$E_{\$/\€}^{4}$

and real money balances rise too, but only in the short run.

$P^{1}_{US}$

$P^{2}_{US}$
Permanent increase in money supply

**TIME SERIES DIAGRAMS**

- **(b) home real money balances and nominal interest rate**

  - Money supply increases.
  - Real money balances rise too, but only in the short run.
  - Interest rate falls in the short run, but is unchanged in the long run.

  - Interest rate falls in the short run, but is unchanged in the long run.
  - Real money balances rise too, but only in the short run.

  - Interest rate falls in the short run, but is unchanged in the long run.

  - Real money balances rise too, but only in the short run.

  - In the short run the exchange rate overshoots its long run level. Traders learn that the currency will depreciate in the long run, but in the short run it is even weaker because the home interest rate is temporarily low. This is overshooting.

  - But in the long run the exchange rate rises only in the same proportion as the money supply and prices.
3. Price level is sticky in the short run. In the long run it rises in the same proportion as the money supply.

4. In the short run the exchange rate overshoots its long run level. Traders learn that the currency will depreciate in the long run, but in the short run it is even weaker because the home interest rate is temporarily low. This is overshooting.

1. Money supply increases. and real money balances rise too, but only in the short run

2. Interest rate falls in the short run, but is unchanged in the long run.

\[ P_{US}^1 = P_{US}^2 \]
1. Money supply increases. and real money balances rise too, but only in the short run.
2. Interest rate falls in the short run, but is unchanged in the long run.

3. Price level is sticky in the short run. In the long run it rises in the same proportion as the money supply.

4. In the short run the exchange rate overshoots its long run level. Traders learn that the currency will depreciate in the long run, but in the short run it is even weaker because the home interest rate is temporarily low. This is overshooting.

..but in the long run the exchange rate rises only in the same proportion as the money supply and prices.

(d) home exchange rate
“Dornbusch Overshooting”

• The exchange rate $E$ overshoots its long run equilibrium after a permanent $M$ shock
  - $E$ is more volatile than the standard monetary model would predict
  - Result discovered in 1970s by the distinguished economist Rudi Dornbusch (1942–2002)

• Why this matters
  - In the 1970s the fixed exchange rates (of the “Bretton Woods system”) collapsed
  - Nobody could understand why floating rates were so volatile, given the very small changes in monetary fundamentals
  - The Dornbusch model supplied an explanation where none existed
The Collapse of Bretton Woods

1973: collapse of the Bretton Woods system of fixed dollar exchange rates

Exchange rate
($ per local currency unit)


U.K. ($/£)
Italy ($/1000 lira)
Canada ($/C$)
Germany ($/DM)
Japan ($/100¥)
France ($/FFr)
LEARNING OBJECTIVES
15–5 Fixed Exchange Rates

• Understand how to apply the complete theory to the case of a fixed exchange rate
• Understand why the model is the same but the causality is different
  ◆ Floating: the money supply is exogenous and exchange rate is endogenous
  ◆ Fixed: the exchange rate is exogenous and money supply is endogenous
• Understand a key policy prediction
  ◆ The Trilemma
• Applications and Evidence
Fixed Exchange Rate Regimes

• Can our model work for fixed as well as floating regimes?
  ✷ “Can we fix it? Yes we can.”
  ✷ The model stays the same, but the interpretation changes

• Suppose the peg is credible (i.e., it will exist not just today but in the future)
  ✷ In the LR the monetary authority must choose level of M to ensure exchange rate is at chosen level E
    ▪ This M will be dictated by the long run monetary approach
  ✷ And in the SR the monetary authority must choose level of M to ensure exchange rate is at chosen level E
    ▪ This M will be dictated by the short run asset approach

• How?
## Models

### Asset Approach

**Short-Run Model of Current Exchange Rate**

Variables dated $t$ (current period)

<table>
<thead>
<tr>
<th>Home country</th>
<th>Foreign country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>Present</td>
</tr>
</tbody>
</table>

Money supply $\frac{M_{DEN}}{Y_{DEN}}$

Real income $Y_{DEN}$

Nominal interest rate $i_{DEN}$

Fixed Exchange rate $E^{DEN/EC}$

\[
\begin{align*}
\Delta M_{DEN} &= \frac{M_{DEN}}{Y_{DEN}} \Delta Y_{DEN} \\
\frac{\Delta Y_{DEN}}{Y_{DEN}} &= \frac{\Delta M_{DEN}}{M_{DEN}} \\
\Delta M_{EC} &= \frac{M_{EC}}{Y_{EC}} \Delta Y_{EC} \\
\frac{\Delta Y_{EC}}{Y_{EC}} &= \frac{\Delta M_{EC}}{M_{EC}} \\
\end{align*}
\]

\[
\begin{align*}
i_{DEN} &= i_{EC} + \frac{y_{DEN} - y_{EC}}{p_{E}} \\
p_{DEN} &= p_{EC} \\
E^{DEN/EC} &= E^{EC/DM}
\end{align*}
\]

<table>
<thead>
<tr>
<th>Home country</th>
<th>Foreign country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>Present</td>
</tr>
</tbody>
</table>

### Money Approach

**Long-Run Model of Future Exchange Rate**

Variables dated $t+1$ (future period)

<table>
<thead>
<tr>
<th>Home country</th>
<th>Foreign country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Future</td>
<td>Future</td>
</tr>
</tbody>
</table>

Money supply $\frac{M_{DEN}}{Y_{DEN}}$

Real income $Y_{DEN}$

Price level $p_{DEN}$

Fixed Exchange rate $E^{DEN/EC}$

\[
\begin{align*}
\Delta M_{DEN} &= \frac{M_{DEN}}{Y_{DEN}} \Delta Y_{DEN} \\
\frac{\Delta Y_{DEN}}{Y_{DEN}} &= \frac{\Delta M_{DEN}}{M_{DEN}} \\
\Delta M_{EC} &= \frac{M_{EC}}{Y_{EC}} \Delta Y_{EC} \\
\frac{\Delta Y_{EC}}{Y_{EC}} &= \frac{\Delta M_{EC}}{M_{EC}} \\
\end{align*}
\]

\[
\begin{align*}
E^{DEN/EC} &= E^{EC/DM}
\end{align*}
\]

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For example
- Let * denote foreign variable
- Assume no inflation in either country, so that in the long run \( i = i^* = r(\text{world}) \)
- Assume real incomes \( Y \) and \( Y^* \) are fixed
- Let \( E \) be fixed at some level (credibly)

In the long run there is a unique home price level \( P \) such that
- \( P = EP^* \) \hspace{1cm} (PPP)

And there is a unique level of the home money supply \( M \) such that
- \( P = M / L(i)Y \) \hspace{1cm} (LRMM)

M must be set at that level in the long run
Short run implications (math)

- For example
  - Let * denote foreign variable
  - Assume no inflation in either country, so that in the long run $i = i^* = r(\text{world})$
  - Assume real incomes $Y$ and $Y^*$ are fixed
  - Let $E$ be fixed at some level (credibly)
- In the short run UIP says that
  - $i = i^*$ \quad (UIP)
- And there is a unique level of the home money supply $M$ such that
  - $P = \frac{M}{L(i)Y}$ \quad (SRMM)
    where price level is sticky
- **M must be set at that level in the short run**
Implications for monetary autonomy

- If a country has any long-run nominal anchor it has to **sacrifice monetary autonomy in the long run**
  - M policy devoted to a series of intermediate targets to try to achieve price stability goal (M target, E target, or inflation target). All nominal variables are related.

\[
E = P/P^* = \frac{[M/LY]}{[M^*/L^*Y^*]}
\]

- Most countries don’t consider this to be a “sacrifice” and this is now an established goal
  - Downside unacceptable
    - price instability not desirable
  - No upside
    - long run money neutrality means money can have no long-run real effects
Implications for monetary autonomy

• But a fixed exchange rate means the country has to sacrifice monetary autonomy in the short run
  ▪ UIP condition is very clear: \( i = i^* \) (with zero depreciation)

\[
\frac{i_d}{(\text{dollar interest rate})} = \frac{i_e}{(\text{euro interest rate})} + \left( \frac{E_{S/\epsilon}^e - E_{S/\epsilon}^s}{E_{S/\epsilon}} \right)
\]

  \[\text{domestic dollar return} \quad \text{expected rate of depreciation of the dollar} \]

  \[\text{expected foreign dollar return} \quad \text{expected foriegn dollar return} \]

• This is a most important idea: the trilemma

• Country must sacrifice 1 out of 3 potential goals
  ▪ 1. Sacrifice autonomy \((i = i^*)\)
  ▪ 2. Sacrifice the fixed rate \((\text{i.e. float})\) or
  ▪ 3. Sacrifice capital mobility \((\text{i.e. impose capital controls})\)
The Trilemma

1. Fixed Exchange Rate
2. Capital Mobility
3. Monetary Policy Autonomy

Capital controls

3 + 1

1 + 2

2 + 3

Floating Exchange Rate

No monetary policy autonomy
APPLICATION
The Trilemma in Europe

Introduction of euro, January 1999

- Germany (repo rate)
- Eurozone (ECB refinancing rate)
- Austria (discount rate), until 1999
- Denmark (discount rate)
- Netherlands (discount rate), until 1999
- UK (base rate)
Estonia prepares to join the euro

- Estonian Central Bank **only** buys and sells euros in exchange for kroon in forex market at the set parity
  - No policy rate, no other monetary activity; this is the purest form of fixed exchange rate regime: a **currency board**
  - The trilemma bites in the Estonian money market
The Trilemma: Examples

- **U.S.A.**
- **BRITAIN**
- **SWEDEN**
- **DENMARK**
- **ESTONIA**
- **HONG KONG**
- **CHINA**
Theory emphasizes how expectations can affect E (as well as interest rate changes)

- Can we find evidence?
- Search for response of E to “news” (what is “news”?)
- A good example is provided by the behavior of exchange rates in wartime

Remember the LR monetary model

- E.g., * = foreign country
- \( E = \frac{[M/LY]}{[M^*/L^*Y^*]} = (M/M^*) \times (L^*/L) \times (Y^*/Y) \)
- Suppose \( L^* \) is expected to be zero in the future
  - With some nonzero probability
  - What happens to E in the future?
- This is sometimes a consequence of war
APPLICATION
Exchange Rates and “News”: US Civil War
APPLICATION
Exchange Rates and “News”: US Civil War

Confederate exchange rate, dollars per Union (U.S.) dollar
APPLICATION
Exchange Rates and “News”: Iraq
APPLICATION

Exchange Rates and “News”: Iraq

Note: inverted scale
APPLICATION
Exchange Rates and “News”: Iraq
Chapter 15: Summary

1. Our theory of exchange rates builds on two ideas: arbitrage and expectations. We developed the theory first for the case of floating exchange rates.

2. In the short run, we assume prices are sticky and the asset approach to exchange rates is valid (Chapter 13). Interest-bearing accounts in different currencies may offer different rates of nominal interest. In addition, currencies may be expected to depreciate or appreciate against one another. There is an incentive for arbitrage: investors will shift funds from one country to another until the expected rate of return (measured in a common currency) is equalized. Arbitrage in the foreign exchange (FX) market determines today’s spot exchange rate, and the FX market is in equilibrium when the uncovered interest parity condition holds. To apply the UIP condition we need the expected exchange rate in the long run, so a forecast is needed.
Chapter 15: Summary

• 3. In the long run, we assume prices are flexible and the monetary approach to exchange rates is valid (Chapter 14). This approach states that in the long run purchasing power parity (PPP) holds so that the exchange rate must equal the ratio of the price levels in the two countries. Each price level in turn depends on the ratio of money supply to money demand in each country. The monetary approach can be used to forecast the long-run future expected exchange rate, which in turn feeds back into short-run exchange rate determination via the UIP equation.

• 4. Putting all of these ingredients together yields a complete theory of how exchange rates are determined in the short run and the long run (this Chapter).

• 5. This model can be used to analyze the impact of changes to monetary policy as well as other shocks to the economy.
Chapter 15: Summary

6. A temporary home monetary expansion causes home interest rates to fall and the home exchange rate to depreciate. It can be consistent with a nominal anchor in the long run.

7. A permanent home monetary expansion causes home interest rates to fall and the home exchange rate to depreciate and, in the short run, overshoot what will eventually be its long-run level. This policy is inconsistent with a nominal anchor in the long run.

8. The case of fixed exchange rates can also be studied using this theory. Under capital mobility, interest parity becomes very simple. In this case, the home interest rate equals the foreign interest rate. Home monetary policy loses all autonomy compared to the floating case. The only way to recover it is to impose capital controls. This is the essence of the trilemma.