International Finance 4832
Lecture 4: Exchange Rates in the Short Run - The Asset Approach

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Spring 2024

This Lecture: Exchange Rates

This lecture - Exchange Rates in the Short Run and Integrated theory (LR and SR) (Chapter 15)

1. Last lecture: Exchange Rates in the **long run** - Monetary Approach to the ER
   - Flexible prices. PPP and UIP (both hold)
   - Quantity theory of money (with interest sensitive liquidity) → $L(i)$
   - $i_h = r^* + \pi_h$ (Fisher equation with real rate convergence)
   - Exchange Rate ⟶ determined by prices/inflation
2. Now: Exchange Rates in the **short run** (Chapter 15)
   - Fixed prices (sticky); PPP does not hold.
   - Long-run depreciation of ER is taken as given (as known) → $E^e_{h/f}$
   - Assumptions: UIP holds
   - Quantity theory of money (but with $\bar{P}$)
   - i determined by $M/\bar{P}$ and $L(i)Y$
   - Exchange Rate ⟶ determined by Interest Rates
3. Next: Integrating both approaches (LR and SR) and Open Economy Trilemma (still Chp 15)

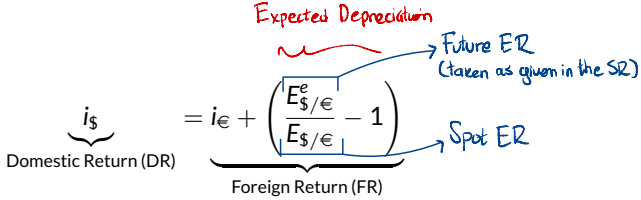
Before: LR → PPP → get $E^e_{h/f}$

Now: SR → UIP, ~~PPP~~ → get $E_{h/f}$ (Spot)

(Prices are sticky)

given $i_h, i_f, E^e_{h/f}$

Recap: UIP

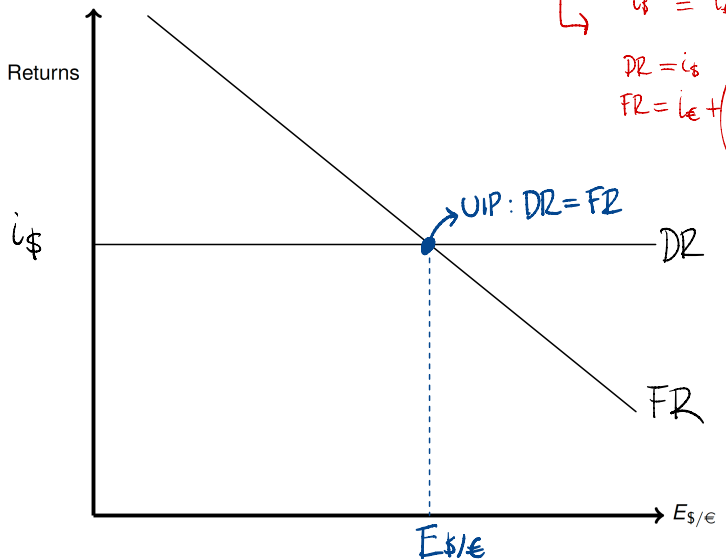


(here we show the approximated UIP after taking logs –yields analogous conclusions to the general case.)

- Left-hand side: return to investing in dollars (at home)
- Right-hand side: return to investing in euros (abroad)
- $\frac{E^e_{\$/€}}{E_{\$/€}} - 1 = d^e_{\$/€} \rightarrow$ Expected depreciation rate of the dollar
- Known/given variables: $i_\$,\ i_€,\ E^e_{\$/€}$
- Unknown (to be solved for): $E_{\$/€}$ (Spot ER)

Plotting both sides of the UIP

Figure: Foreign and Domestic Returns (in UIP)



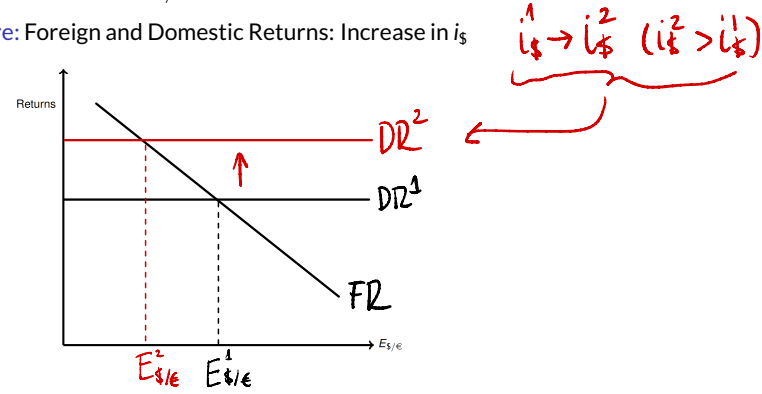
$$DR = FR$$
$$i_\$ = i_€ + \left(\frac{E^e_{\$/€}}{E_{\$/€}} - 1\right)$$

$$DR = i_\$$$
$$FR = i_€ + \left(\frac{E^e_{\$/€}}{E_{\$/€}} - 1\right)$$

Recap: UIP (cont.)

- Foreign Return (FR) curve: $FR = i_{€} + \left(\frac{E^e_{\$/€}}{E_{\$/€}} - 1\right)$
- Domestic Return (DR) curve: $DR = i_{\$}$
- How do the curves shift and what happens to $E_{\$/€}$ when:
  - (i) $i_{\$}$ increases?, (ii) $i_{€}$ decreases?, (iii) $E^e_{\$/€}$ decreases?

Figure: Foreign and Domestic Returns: Increase in $i_{\$}$

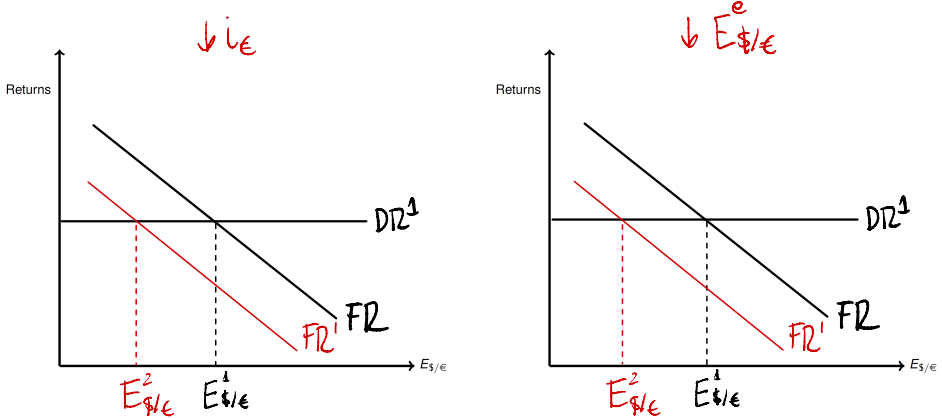


Recap: UIP (cont.)

$DR = i_\$$

$FR = i_\epsilon + \left(\frac{E^e_{\$/\epsilon}}{E_{\$/\epsilon}} - 1\right)$

Figure: Foreign and Domestic Returns: Decrease in i_ϵ (left), and decrease in $E^e_{\$/\epsilon}$ (right)



Determining the Spot Exchange Rate

UIP: given known $i_{\$}$, $i_{€}$ and $E^e_{\$/€}$ we can determine: $E_{\$/€}$

But where do $i_{\$}$, $i_{€}$ and $E^e_{\$/€}$ come from?

- $i_{\$}$, $i_{€}$: come from Quantity Theory of Money in the Short Run
- $E^e_{\$/€}$: from the Quantity Theory and the PPP in the Long Run

This is why we analyze first the LR model and later the SR model

We solve for $E^e_{\$/€}$ first in the LR model and given that, we later get the Spot ER ($E_{\$/€}$)

Short Run nominal interest rates

Assumptions:

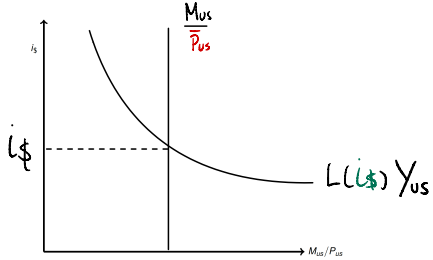
1. Prices level is fixed (sticky): $\bar{P}_{us}, \bar{P}_{eu}$
2. Nominal interest rate (i) adjusts to clear money market

Quantity Theory of Money with fixed prices:

$$\frac{M_{us}}{\bar{P}_{us}} = L(i_{us})Y_{us} \qquad \frac{M_{eu}}{\bar{P}_{eu}} = L(i_{eu})Y_{eu}$$

Here we focus on the US, but analogous results hold for EU (or any other location)

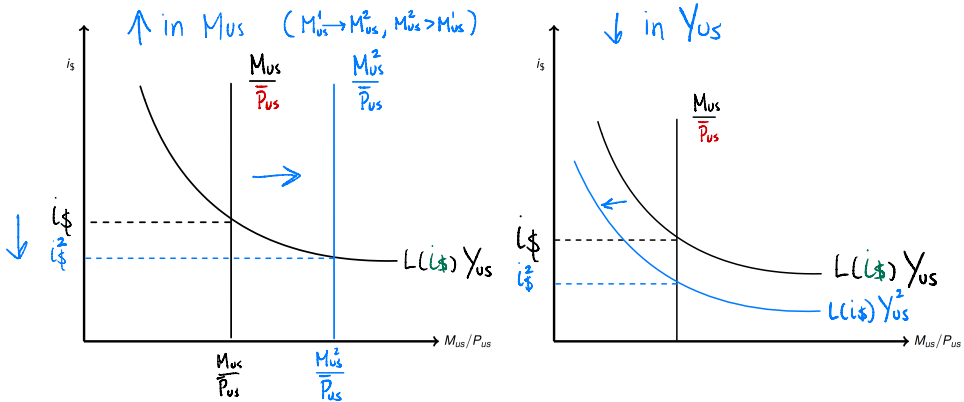
Figure: Home (US) money market



Home money market

How do the curves shift and what happens to $i_\$$ when: M_{us} increases? Y_{us} decreases?

Figure: Home (US) money market: Increase in M_{us} (left) and Decrease in Y_{us} (right)



Determining the Spot Exchange Rate (cont.)

UIP: given $i_\$$, $i_€$ and $E^e_{\$/€} \longrightarrow$ get $E_{\$/€}$

But where do $i_\$$, $i_€$ and $E^e_{\$/€}$ come from?

- $i_\$$, $i_€$: come from Quantity Theory of Money in the Short Run (last slide)
- $E^e_{\$/€}$: from the Quantity Theory and the PPP in the Long Run

$$E^e_{h/f} = \frac{P_h}{P_f}$$

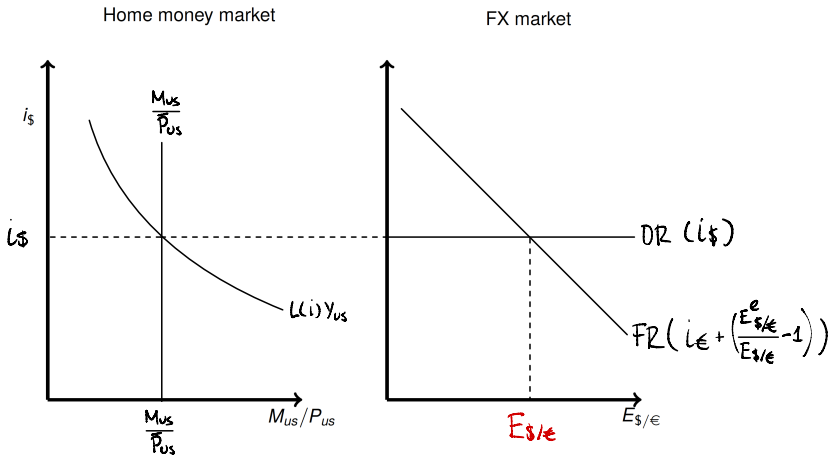
Now: Put together quantity theory and UIP in the short run.

(Short run analysis only in this step: Thus take $E^e_{\$/€}$ as given for now)

Short run part of the model

Markets in which $E^e_{\$/€}$ is taken as given (see how axes do not change with $E^e_{\$/€}$)

Figure: Joint determination of Interest rates and Spot ER



Determining the Spot Exchange Rate

The central bank in each economy determines M (Money Supply)

The equilibrium interest rate i will be such that real supply of money equals demand: $\frac{M}{P} = L(i)Y$

Via UIP: $i_\$$ and $i_€$ (and $E^e_{\$/€}$) determine the spot ER: $E_{\$/€}$

Eq determines i

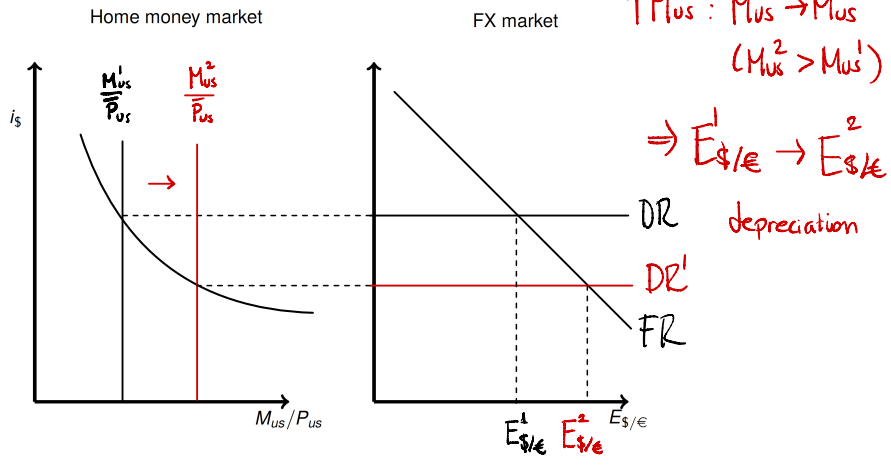
What if M_{us} temporarily increases?

Can analyze "temporary" increase case here because expectations of future ER won't change
(so we can keep taking expected ER as given)

If permanent (increase): we have to change $E^e_{\$/€}$ as well and the resulting spot ER will differ
(we check this case some slides ahead)

Temporary increase in home money supply (M_{us})

Figure: Joint determination of Interest rates and Spot ER



Determining the Spot Exchange Rate (cont.)

Temporary increase in M_{us}:

(Key) **temporary**: $E^e_{\$/€}$ does not change (expected future ER is the same)

1. Real money supply curve shifts (prices are fixed and M rises) $\uparrow \frac{M}{P}$
2. $i_\$$ lowers to new equilibrium $\downarrow i_\$$
3. DR curve shifts down $\downarrow DR = \downarrow i_\$$
4. Dollar depreciates (spot) $\uparrow E_{\$/€}$: from $E^1_{\$/€}$ to $E^2_{\$/€}$

Putting the Long Run and Short Run theories together

Outline

Exchange rates in the **long run**

- Flexible prices
- PPP and UIP hold
- Quantity theory of money (with P)
- $i_h = r^* + \pi_h$ (Fisher)
- Exchange rate determined by prices/inflation (we use this block to get expected future ER)

$$E^e_{h/f} = P^e_h / P^e_f$$

Exchange Rates in the **short run**

- Fixed prices (sticky)
- Long-run depreciation is given (exogenous)
- UIP holds, PPP does not
- Quantity theory of money (with $\bar{P}$)
- i determined by $\frac{M}{\bar{P}}$ and $L(i)Y$
- Exchange rate determined by interest rates (we use this block to get Spot ER)

$$i_\$ - i_€ = d_{\$/€}$$

$$\frac{E^e_{\$/€} - 1}{E_{\$/€}}$$

Integrated approach (SR and LR)

Now we integrate the long-run (LR) and short-run (SR) models

- LR model (PPP) pins down expectations ($E^e_{\$/€}$)
- SR model takes expectations from LR model and pins down Spot ER (with UIP gets $E_{\$/€}$)

With a model that also includes the LR we can think about permanent changes in the variables.

Before we could only check temporary ones with the SR model only.

In a nutshell:

SR Model: $E^e_{h/f}$ Fixed	SR and LR Model: $E^e_{h/f}$ can change

↳ ⇒ Now we can also analyze Permanent Policy changes

Short-run model

UIP:

$$i_{\$} = i_{€} + \left(\frac{E^e_{\$/€}}{E_{\$/€}} - 1 \right)$$

Quantity theory with theory with sticky prices ($\bar{P}$):

$$\bar{P}_{us} = \frac{M_{us}}{L_{us}(i_{\$})} Y_{us} \qquad \bar{P}_{eu} = \frac{M_{eu}}{L_{eu}(i_{€})} Y_{eu}$$

$E^e_{\$/€}$ is given (in reality comes from LR model but from SR perspective is just exogenous)

Solution given inputs above:

i comes from money market equilibrium, $E_{\$/€}$ is obtained from FX market equilibrium

Long-run model

Purchasing power parity (PPP):

$$E^e_{\$/€} = \frac{P^e_{us}}{P^e_{eu}}$$

P is flexible in the LR

Quantity theory with flexible prices: (i.e. with P instead of $\bar{P}$)

$$P_{us} = \frac{M_{us}}{L_{us}(i_\$)} Y_{us} \qquad P_{eu} = \frac{M_{eu}}{L_{eu}(i_€)} Y_{eu}$$

Model is set in terms of expected future variables

(if it holds today, we can just think of the whole thing in terms of expectations)

From this model we get: $E^e_{\$/€}$

Permanent change in M_{us}

Short-run model: $E^e_{\$/€}$ had to be fixed. Then it only could describe temporary shocks

A permanent shock would change $E^e_{\$/€}$

Now: with LR and SR $\rightarrow$ Can study permanent shocks

Example: money grows permanently in the US to a new level (from M^1_{us} to M^2_{us})

We solve this model "backwards":

1. We solve the long-run $\rightarrow$ getting $E^e_{\$/€}$
2. We solve the short-run with the new value of $E^e_{\$/€}$ and with constant prices

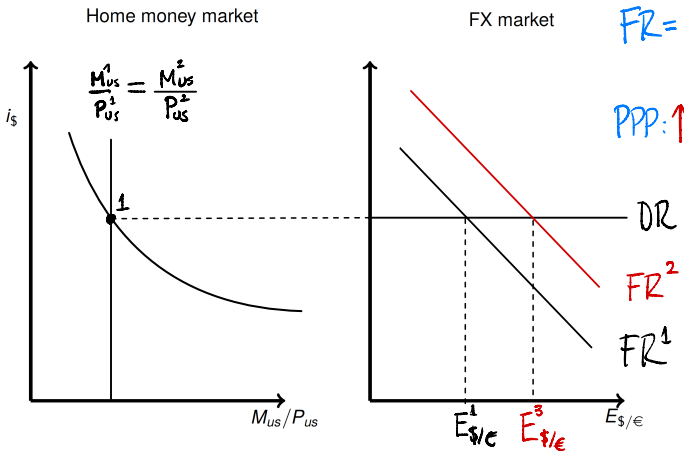
we get $E_{\$/€}$

After the second step we get the new interest rate ($i_\$$) and the new spot ER ($E_{\$/€}$)

Once we get everything we work out the adjustment from short-run values to the long-run

Permanent increase in home money supply (M_{us})

Figure: Long-run (permanent increase in money supply)



$M: M^1_{US} \rightarrow M^2_{US}$ (↑)

$P: P^1_{US} \rightarrow P^2_{US}$ (↑)

$FR = i_€ + \frac{\uparrow E^e_{\$/€}}{E_{\$/€}} - 1$

$PPP: \uparrow E^e_{\$/€} = \frac{\uparrow P^e_{US}}{P^e_{EU}}$

Equilibrium interest rate is the same (in LR), but notice: Spot ER is different (USD depreciates)

Permanent change in M_{us}

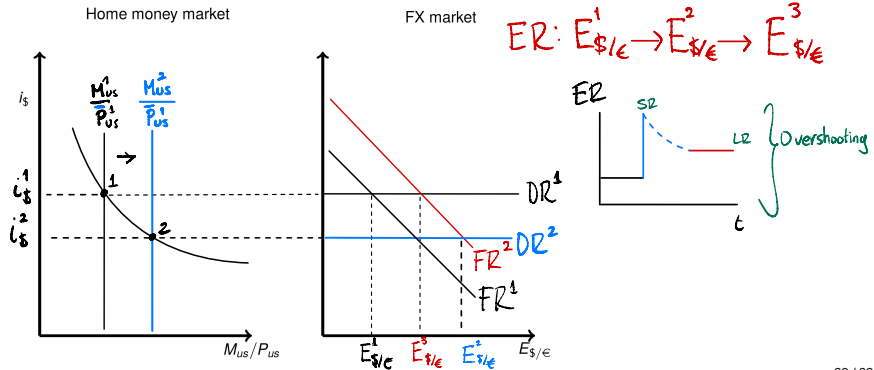
1. We solve the long-run → getting $E^e_{\$/€}$: Done! LR Exchange Rate goes from $E^1_{\$/€}$ to $E^3_{\$/€}$ (↑)

   Money market won't change (because P adjusted to change in M).

   However, FR curve shifts permanently and the ER is permanently depreciated

2. Now: We solve the short-run with the new value of $E^e_{\$/€}$ and with constant prices

Figure: Short-run (permanent increase in money supply)[fig. 15-12 in FT]



Permanent change in M_{us} (cont.)

1. We solve the long-run → getting $E^e_{\$/€}$

   Done! the LR Exchange Rate goes from $E^1_{\$/€}$ to $E^3_{\$/€}$ (increased)

   The money market won't change (because P adjusted to change in M).

   However, FR curve shifts permanently and the ER is permanently depreciated

2. Then, we solve the short-run with the new value of $E^e_{\$/€}$ and with constant prices

   Done! In the short run:

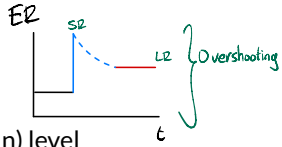
   - FR shifts up as in the long-run
   - interest rates fall because real money supply increases

   Short-run ER depreciates to $E^2_{\$/€}$ → larger depreciation than obtained in the LR: $E^2_{\$/€} > E^3_{\$/€}$

   We then say the short-run ER "overshoots" the long-run ER

   i.e., it instantly overreacts in same expected direction and later converges to new long-run equilibrium

Adjustment from SR to LR



The economy eventually adjust from the SR to the LR:

- As P slowly changes $\rightarrow \frac{M}{P}$ falls until it returns to its initial (and long-run) level
- As $\frac{M}{P}$ falls, *i* increases until it is back to its initial level
- FR curve **does not return** to its original position: The change in expected inflation is permanent (likewise for LR depreciation) because increase in money supply is permanent
- The ER eventually **appreciates** to $E^2_{\$/€}$ (From $E^2_{\$/€}$ to $E^1_{\$/€}$)

↳ PPP: P goes up to a new permanent level P^2

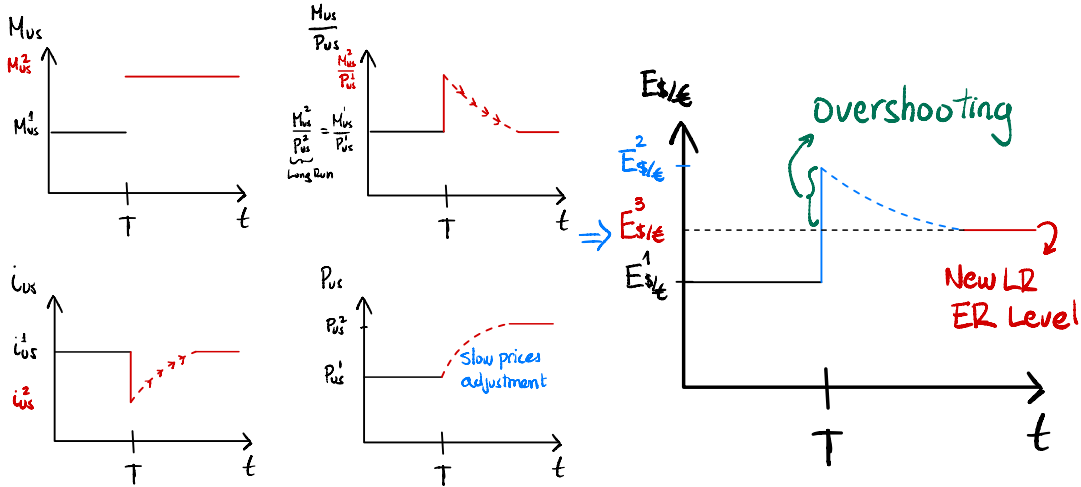
$\Rightarrow \uparrow E_{\$/€} = \frac{\uparrow P^2_h}{P_f}$

Notice the "appreciates" of the last point. How is this possible? wasn't the ER supposed to depreciate with the increase in money supply?

Well, in the SR the ER overreacts and depreciates too much (**overshooting**) ... from there: ER gradually lowers (appreciates) to new LR value (which is higher than the ER before the money change)

We can see the trajectory of these variables over time in the next slide

Permanent increase in M_{US}: Path of variables over time



Overshooting

- Key to *overshooting*: change in expectations
- Expectations change because the change in money supply (M) is permanent
- With a temporary change, the only change in the FX market is $i_\$$ ... (DR curve) Changes temporarily
- In contrast, with a permanent change the shift of FR provides the extra depreciation in the SR

Why did the FR shifted? because of the increase in the expected (future) ER

Reminder: $$FR = i_€ + \left(\frac{E^e_{\$/€}}{E_{\$/€}}\right) - 1$$

Changes via PPP: $E^e_{\$/€} = P^e_{US} / P^e_{EU}$

Summary

- Long Run model: can handle permanent changes
- Short Run model: can handle temporary changes
- LR and SR models together: allows us to study the effect of permanent shocks (in the short run)
- What is new: the long run model lets people forecast the future ER
  - In the SR this makes FR shift $\rightarrow$ prompting a larger depreciation of the USD.
- In the SR: the exchange rate **overshoots** its new LR level (over reacts in the same direction of the LR change)
- Monetary policies (and shocks) that are expected to last longer create more ER volatility.

The Trilemma and the Fixed Exchange Regime

Outline

- (Recap of) the Floating Exchange Rate regime

- the Fixed Exchange Rate regime model

- The Trilemma (or impossible trinity in -international- economics)

  Examples

Floating Exchange Rate regimes

Focus so far: **floating** exchange rate tegimes with **capital mobility** (UIP holds)

Short run: central bank chooses M (money supply) $\Rightarrow$ i and $E_{h/f}$ determined via UIP (in FX market)

$$M_h \rightarrow \frac{M_h}{\bar{P}_h} \rightarrow i_h \quad \Rightarrow \quad i_h = i_f + \frac{E^e_{h/f}}{E_{h/f}} - 1$$

(can get spot ER here because money market determines i_h, and i_f and the expected ER is taken as given)

Long run: central bank chooses $M \Rightarrow$ determines P (flexible) $\Rightarrow E_{h/f}$, i determined by PPP + Fisher:

(from quant. theory): $P_h = M_h/(L(i_h)Y_h)$

(in PPP): $E_{h/f} = P_h/P_f$

(in Fisher eq.): $i_h = \pi^e_h + r^*$

Now: Fixed Exchange Rate regimes

Fixed exchange rate regime: set ER at a Fixed level

Central bank chooses an exchange level $\bar{E}_{h/f}$ (e.g., $\bar{E}_{dk/€} = 1$)

Why? to implement a nominal anchor: "Imports" inflation of f country

Assumption: capital moves freely across borders $\rightarrow$ **international capital mobility**

What changes?

Economy compromises its monetary policy to maintain ER peg (in every horizon: LR, SR)

Fixed exchange rate regimes in the *Short Run*

A fixed exchange rate (+ capital mobility) determines the interest rate

Fixed $\rightarrow$ ER does not change: $\bar{E}_{h/f} = \bar{E}^e_{h/f}$, *then* :

$$i_h = i_f + \left(\frac{\bar{E}^e_{h/f}}{\bar{E}_{h/f}} - 1 \right) \overset{0}{\Rightarrow} \quad \Rightarrow i_h = i_f$$

Home loses control of i_h as it now follows i_f (controlled by a foreign country)

What about money supply at home? $\rightarrow$ the same:

$$M_h = \bar{P}_h L(i_f) Y_h$$

Money supply now only depends on foreign variables (i_f) (or on variables that are not changing)

Takeaway: with fixed ER the central bank sets M_h at level that keeps $i_h = i_f$ (it has no other choice)

Fixed exchange rate tegimes in the *Long Run*

Central bank chooses an exchange rate level $\bar{E}_{h/f}$

P_h still determined via PPP:

$$P_h = \frac{\bar{E}_{h/f}}{P_f}$$

But exchange rate is fixed (at $\bar{E}_{h/f}$) and foreign prices are determined abroad (P_f).

Then, in the LR home prices P_h are also completely determined in the foreign country (f)
(or by foreing factors, no matter what happens at home)

(By UIP) $i_h = i_f$ and money supply is:

$$M_h = P_h L(i_f) Y_h$$

$$M_h = \frac{\bar{E}_{h/f}}{P_f} L(i_f) Y_h$$

Again, in the LR the money supply is stuck at the level dictated by the variables of other countries
(no policy choice)

Recap

Flexible exchange rates

- Central bank chooses M_h
- Long Run: policy choice determines P_h and $E_{h/f}$ (PPP)
- Short Run: policy determines i_h and spot rate $E_{h/f}$ (sticky prices and UIP)

Fixed exchange rates

- Central bank chooses peg $\bar{E}_{h/f}$ (commits to maintain ER at such level)
- Long Run: P_h and M_h must ensure that $i_h = i_f$
- Short Run: M_h must ensure $i)h = i_f$

Then, central bank's policies are compromised to ensure the peg holds ($E_{h/f} = \bar{E}_{h/f}$ or $i_h = i_f$)

That is, we get a loss of monetary policy autonomy in both the short and long run

The Open Economy Trilemma

Also called "Impossible Trinity" (of international economics) or Mundellian trilemma

Out of these 3, can pick at most 2:

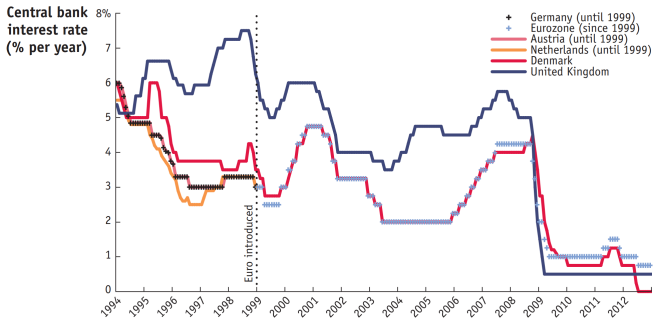
1. Fixed Exchange Rate
2. International capital mobility (UIP holds)
3. Moneatry policy independence (allowing $i_h \neq i_f$)

Examples:

1. Fixed ER + capital mobility: UK in the 1990s, Denmark today
2. Fixed ER + monetary policy autonomy: China today
3. Capital mobility + monetary policy: USA today

Example: the trilemma in Europe

Figure: Central Banks' interest rates (1994-2012)



Two different regimes in action:

UK: Float against German mark (and then vs. the Euro) $\rightarrow$ interest rate can change independently

Denmark: Peg krone to the mark (to Euro) $\rightarrow$ interest rate decided for them in Germany (ECB)

Example: UK in 1992

Fixed exchange rate & free movement of capital $\implies$ No monetary policy independence:

UK and Germany had a fixed exchange rate as part of a system of European Fixed rates (the ERM I)

Germany wants to increase interest rate to fight inflation

That means UK must adopt higher interest rates to defend the peg (UIP: $i_{gr} = i_{uk}$)

But with a weak UK economy $\rightarrow$ high interest rates are not desirable
This lowers UK credibility (of its compromise with peg) and invites speculation on its currency

BoE can: (i) $\uparrow$ interest rates, (ii) devalue currency or (iii) intervene in FX mkt & use reserves to prevent devaluation (let $i_{uk} < i_{gr}$ and make up shortage of German marks)

Speculative attack: Given costs of (i)/(iii) investors speculate BoE would rather devalue the GBP
they borrow in pounds and sell pounds for marks massively

BoE must act by increasing rates, draining reserves, or devalue (no way out)

UK in 1992 (cont.)

Black Wednesday: September 16, 1992

UK raises interest rates from 10% to 12% and promises to raise rate to 15% later that day

This does not stop speculators from selling pounds → Government abandons Fixed ER regime

A likely self-fulfilling crisis: Fixed ER may have held if not attacked

("attacked": speculative private agents trading against the currency in flocks)

Figure: Black Wednesday (20% devaluation)

China, today

Fixed rate + independent monetary policy $\Rightarrow$ No free movement of capital

China fixes ER against dollar: yuan appears stable and undervalued vs. what the floating ER would be

PBC can change its monetary policy

can raise (lower) interest rates to lower inflation (raise output)

capital controls keep UIP from forcing ER rate to change
(even if there are arbitrage opportunities, agents can't use them)

Costs of capital controls:

- hinders efficient use of capital (limits financial development)
- overvaluation can lead to black market for currency
- can discourage foreign investment

In principle, may be affecting economic growth (by hindering investment)

United States, today

Capital mobility + independent monetary policy $\rightarrow$ floating exchange rate

Federal Reserve's mandate (what they commit to do)

- low and stable inflation
- maximum sustainable employment

  $\Rightarrow$ no rule/constraint regarding ER

Monetary policy based on domestic conditions (feasible, as mon. pol. is independent to that of foreign countries)

Free movement of capital (into/out of country)

Changes in interest rates $\rightarrow$ changes in expectations $\rightarrow$ changes in ER

Exchange rates in these countries

Exchange rate variation (1999 - 2014)

	Floating rates			Fixed rates		
	euro-usd	yen-usd	pound-usd	yuan-usd	hkd-usd	dk-usd
mean	0.84	105.12	0.61	7.50	7.78	7.45
st. dev.	0.14	14.48	0.06	0.84	0.02	0.01
var. coef.	0.17	0.14	0.10	0.11	0.003	0.001

Volatility: More variation in floating exchange rates

At times, maintaining peg is hard and a new (more sustainable) peg has to be defined

The trilemma: overview

The Trilemma: **Impossible to have all three** of

1. Fixed Exchange Rate (or very stable ER)
2. International Capital Mobility
3. Independent Monetary Policy

Benefits of a Fixed ER:

- Serves as nominal anchor (e.g., to stabilize inflation by setting it at the level of the foreign country)
- Facilitates cross-border trade and investment (stable international prices of goods and assets)

Costs of a Fixed ER:

- Sacrifice of monetary policy or capital mobility
- Subject to speculative attacks (hard to maintain)