

## Issues in International Finance

### *Exchange rates in the short run: The asset approach*

UW – Madison // Fall 2018

## Roadmap

### ► Where we have been: Exchange rates in the **long run**

- ► Perfectly flexible prices
- PPP & UIP hold
- Quantity theory of money  $\times$   $P = \frac{M}{L(i)Y}$
- $i_F = r^* + \mu_F$
- Exchange rate determined by prices/inflation

### ► Currently: Exchange rates in the **short run**

- ► Price level is fixed
- Long-run depreciation of fx rate is given
- UIP holds
- Quantity theory of money  $\times$   $i$  adjust
- $i$  determined by  $M/\bar{P}$  and  $L(i)Y$
- Exchange rate determined by interest rates

### ► Coming up: Integrating the short and long run approach

## Recap: UIP

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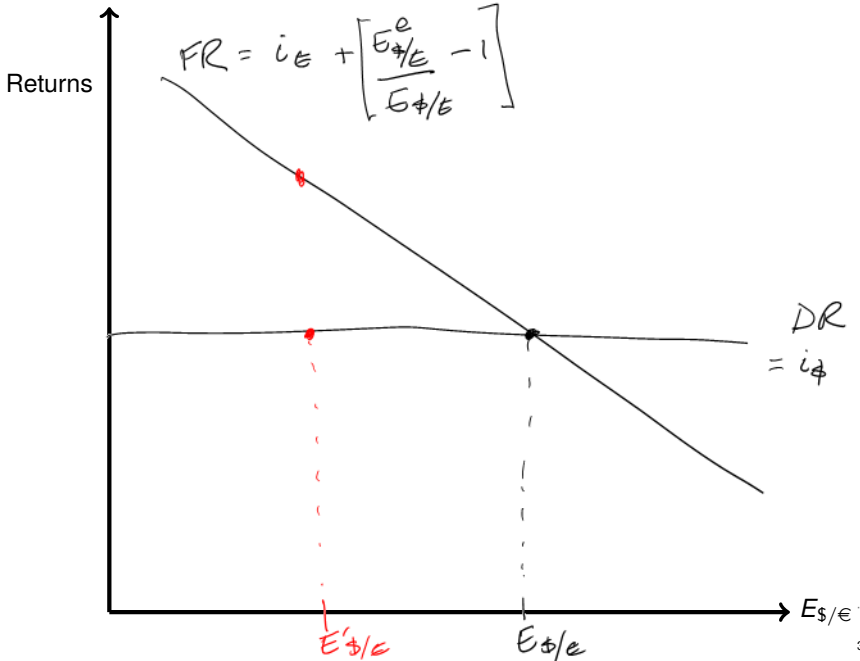
- ▶ Uncovered interest parity

$$i_{\$} = i_{\text{€}} + \left( \frac{E_{\$/\text{€}}^e}{E_{\$/\text{€}}} - 1 \right) \quad (1)$$

*Handwritten annotations:*  
- A bracket above the right-hand side is labeled "FR".  
- A bracket below the left-hand side is labeled "DR".

- ▶ Left-hand side: return to investing in dollars
- ▶ Right-hand side: return to investing in euros
- ▶  $\frac{E_{\$/\text{€}}^e}{E_{\$/\text{€}}} - 1 = d_{\$/\text{€}}^e$  is the expected depreciation rate of the dollar
- ▶ Known variables:  $i_{\$}$ ,  $i_{\text{€}}$ ,  $E_{\$/\text{€}}^e$
- ▶ Solve for:  $E_{\$/\text{€}}$
- ▶ Let's plot the left- and right-hand sides of (1)

# Foreign and domestic returns



## Recap: UIP

- ▶ The foreign return curve (FR)

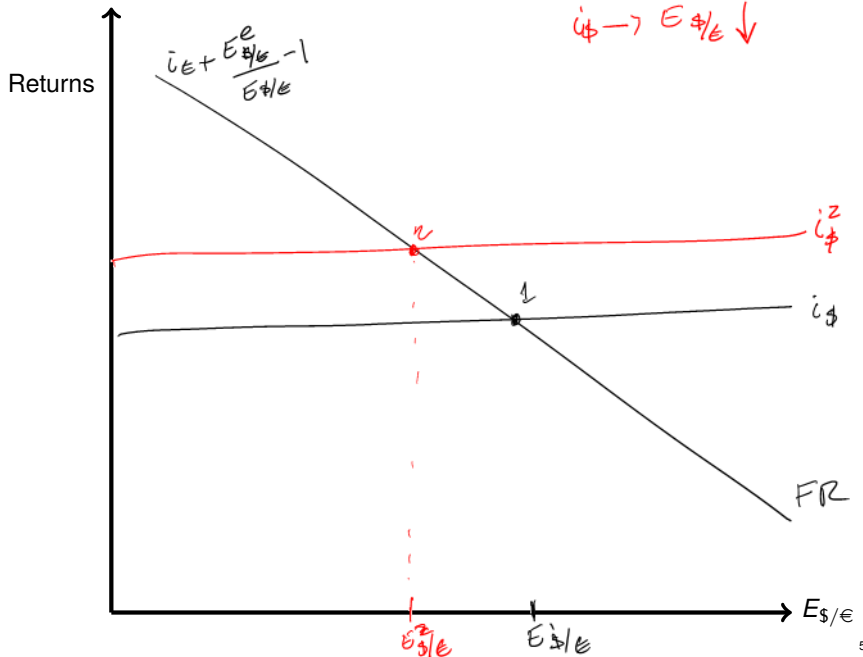
$$FR = i_{\text{€}} + \left( \frac{E_{\$/\text{€}}^e}{E_{\$/\text{€}}} - 1 \right)$$

- ▶ The domestic return curve (DR)

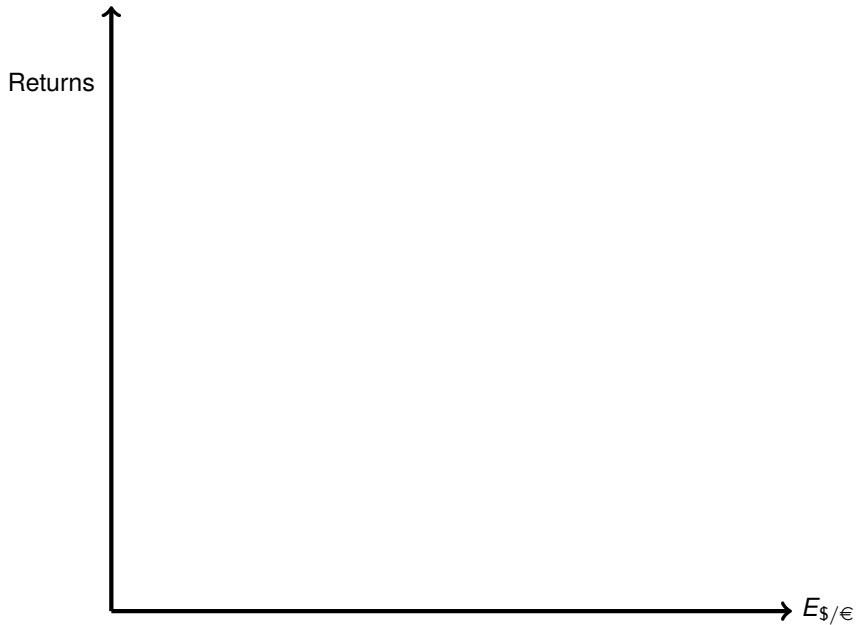
$$DR = i_{\text{\$}}$$

- ▶ How do the curves shift and what happens to  $E_{\$/\text{€}}$  when
  - ▶  $i_{\text{\$}}$  increases?
  - ▶  $i_{\text{€}}$  decreases?
  - ▶  $E_{\$/\text{€}}^e$  decreases?

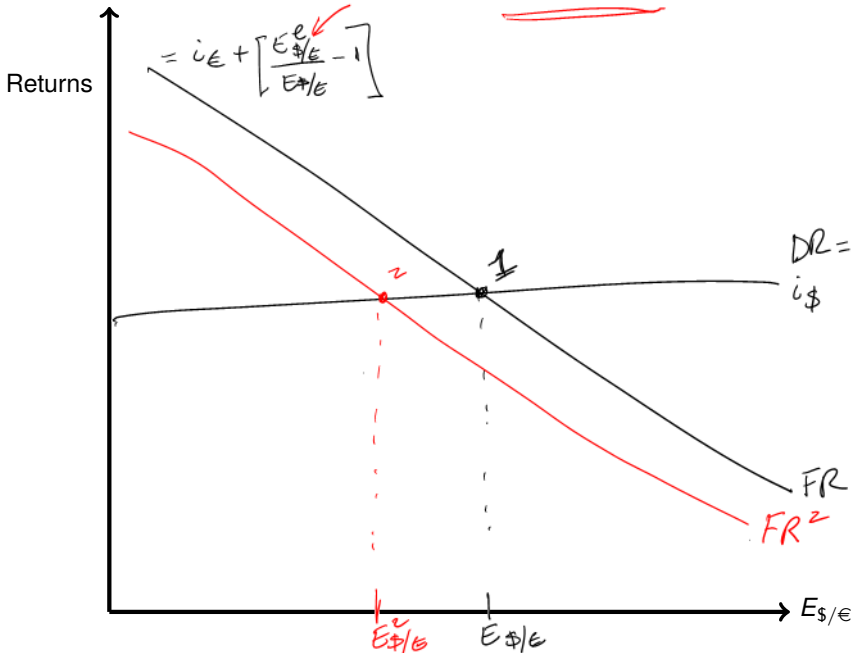
Foreign and domestic returns (increase  $i_{\$}$ )



Foreign and domestic returns (decrease  $i_{\epsilon}$ )



Foreign and domestic returns (decrease  $E_{\$/\epsilon}^e$ )





## Determining the spot exchange rate

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► UIP tells us that  $i_{\$}$ ,  $i_{\text{€}}$ ,  $E_{\$/\text{€}}^e$  determine  $E_{\$/\text{€}}$

► Where do  $i_{\$}$ ,  $i_{\text{€}}$ ,  $E_{\$/\text{€}}^e$  come from?

1. Quantity theory in the short run:  $i_{\$}$ ,  $i_{\text{€}}$

2. Quantity theory + PPP in the long run:  $E_{\$/\text{€}}^e$

*Work on these.*

*fix this*

## Short run nominal interest rates

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► Short-run assumptions

1. Price level is fixed (sticky) at  $\bar{P}_{US}, \bar{P}_{EU}$
2. Nominal interest rate adjusts to clear money market

► Quantity theory with fixed prices

$$\frac{M_{US}}{\bar{P}_{US}} = L(i) Y_{US}$$

$\uparrow$   
 $i_{US}$

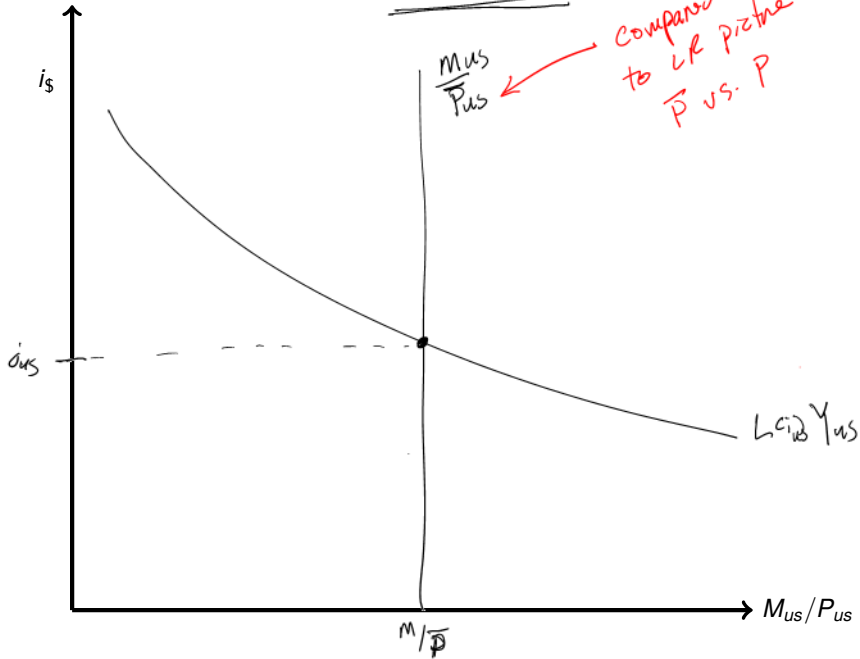
$$\frac{M_{EU}}{\bar{P}_{EU}} = L(i) Y_{EU}$$

$\uparrow$   
 $i_{EU}$

graph this

- We will focus on the US, but the analogous relationships are true in EU

Home money market



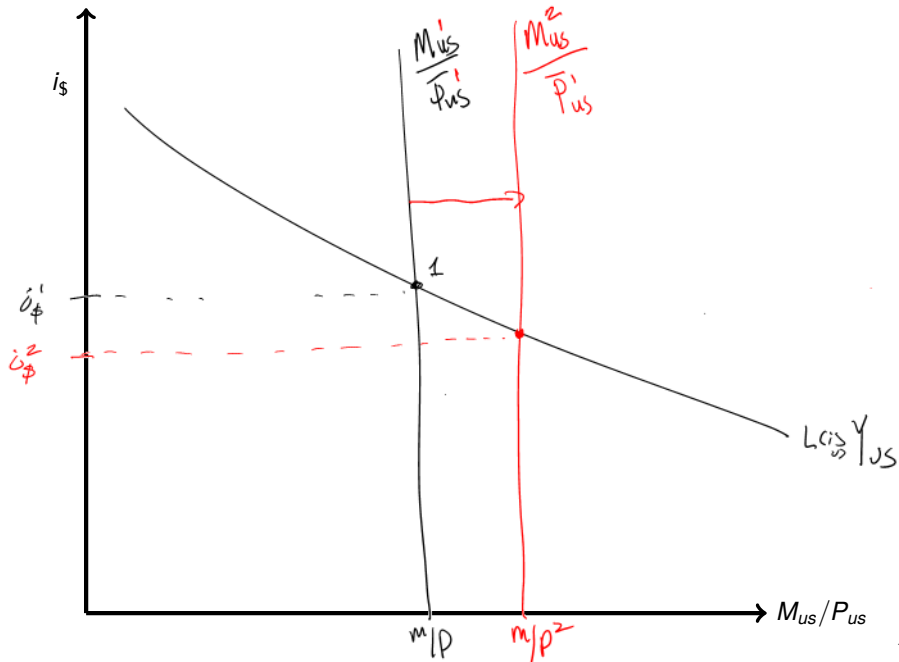
## Home money market

▶ How do the curves shift and what happens to  $i_{\$}$  when

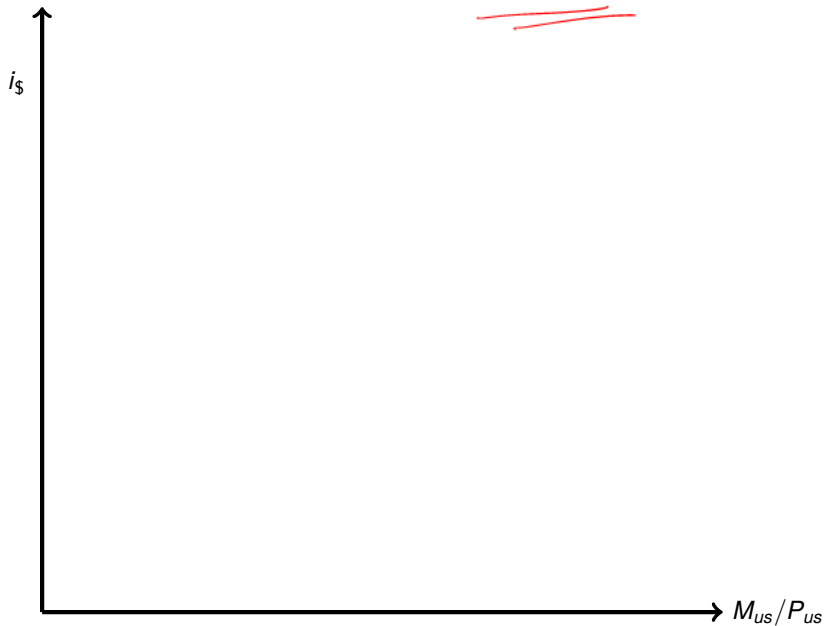
▶  $M_{US}$  increases?

▶  $Y_{US}$  decreases?

# Home money market (increase $M_{US}$ )



Home money market (decrease  $Y_{us}$ )

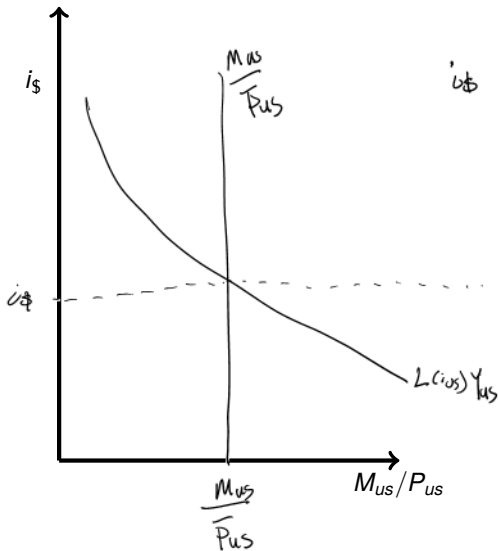


## Determining the spot exchange rate

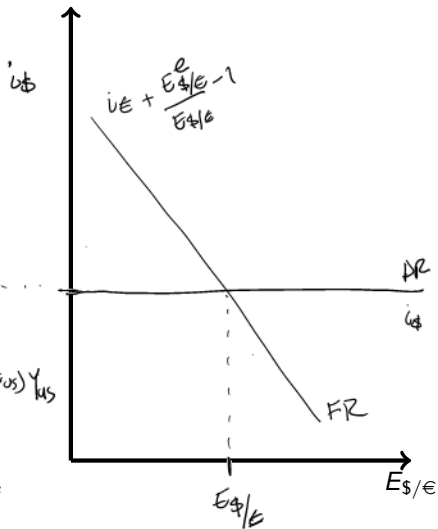
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- ▶ UIP tell us that  $i_{\$}$ ,  $i_{\text{€}}$ ,  $E_{\$/\text{€}}^e$  determine  $E_{\$/\text{€}}$
- ▶ Where do  $i_{\$}$ ,  $i_{\text{€}}$ ,  $E_{\$/\text{€}}^e$  come from?
  1. Quantity theory in the short run:  $i_{\$}$ ,  $i_{\text{€}}$
  2. Quantity theory + PPP in the long run:  $E_{\$/\text{€}}^e$
- ▶ We can now put together quantity theory and UIP in the short run.
- ▶ We still take  $E_{\$/\text{€}}^e$  as exogenous for now.

Home money market



FX market





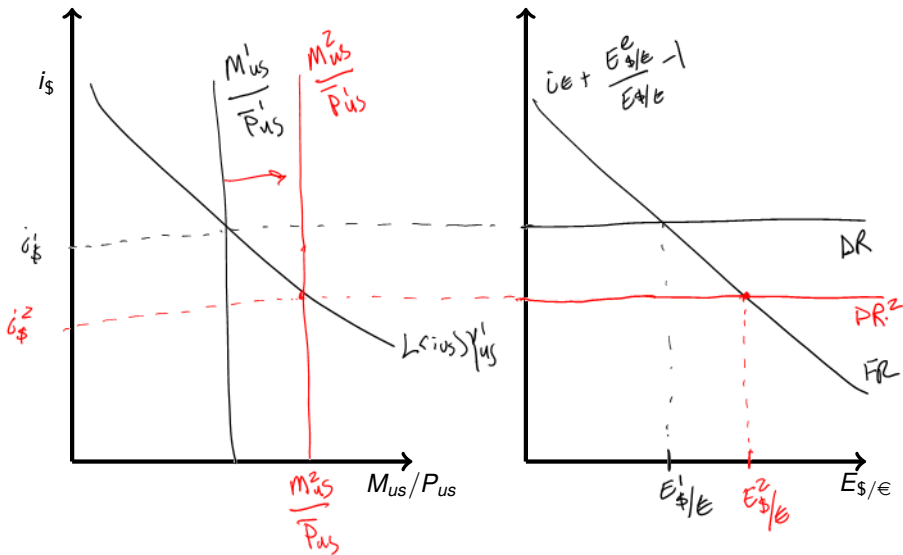
## Determining the spot exchange rate

- ▶ The central bank in each country determines  $M$
- ▶  $M/\bar{P} = L(i)Y$  in each country determines  $i_{\$}$  and  $i_{\text{€}}$  ← qty theory of money
- ▶  $i_{\$}$  and  $i_{\text{€}}$  (and  $E_{\$/\text{€}}^e$ ) determine  $E_{\$/\text{€}}$   
    ↳ UIP
- ▶ What happens when  $M_{us}$  **temporarily** increases?
- ▶ Temporary is important: a permanent change would lead to changes in the long run and changes in  $E_{\$/\text{€}}^e$  (through PPP)

$$\uparrow M_{us}^1 \rightarrow M_{us}^2$$

Home money market

FX market



## Determining the spot exchange rate

- ▶ The central bank in each country determines  $M$
- ▶  $M/\bar{P} = L(i)Y$  in each country determines  $i_{\$}$  and  $i_{\text{€}}$
- ▶  $i_{\$}$  and  $i_{\text{€}}$  (and  $E_{\$/\text{€}}^e$ ) determine  $E_{\$/\text{€}}$
  
- ▶ What happens when  $M_{US}$  temporarily increases?
- ▶ Temporary is important: a permanent change would lead to changes in the long run and changes in  $E_{\$/\text{€}}^e$  (through PPP)
  1. Real money supply shifts (prices are fixed)
  2. Lowers  $i_{\$}$  to new equilibrium rate ✓
  3. Shifts DR curve down ✓
  4. Dollar depreciates ✓


## Summary: Short run fx rates

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- ▶ Quantity theory + UIP
- ▶ Price level is fixed, expected deflation is known
  - ▶ Money supply determines real money supply ( $M/P$ )
  - ▶ Quantity theory determines the interest rate
  - ▶ Interest rates determine spot exchange rate through UIP
- ▶ A **temporary** increase in the US money supply
  - ▶ Does nothing in the long run
  - ▶ Decreases nominal interest rates in US
  - ▶ Depreciates the dollar

## Issues in International Finance

### *Exchange rates in the short and the long run*



UW – Madison // Fall 2018

## Roadmap

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- ▶ Where we have been: Exchange rates in the **long run**
  - ▶ Perfectly flexible prices
  - ▶ PPP & UIP hold
  - ▶ Quantity theory of money
  - ▶  $i_F = r^* + \mu_F$
  - ▶ Exchange rate determined by prices/inflation
  
- ▶ Where we have been: Exchange rates in the **short run**
  - ▶ Price level is fixed
  - ▶ Long-run depreciation of fx rate is given
  - ▶ UIP holds
  - ▶ Quantity theory of money
  - ▶  $i$  determined by  $M/\bar{P}$  and  $L(i)Y$
  - ▶ Exchange rate determined by interest rates

## Roadmap

Want: model the exchange rate  $E_{H/F}$

- ▶ Currently: Integrate the long- and short-run models
  - ▶ Long-run model (PPP) pins down expectations
  - ▶ Short-run model takes expectations from long-run model and (UIP) pins down current exchange rates
- ▶ Allows us to think about permanent and temporary changes
  - ▶ In the short-run model, we could only consider temporary changes, because we held  $E_{H/F}^e$  fixed.
  
- ▶ Let's review the two models first. . .

## Recap: Short-run model

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- ▶ Uncovered interest parity

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

- ▶ Quantity theory with sticky prices (bars on  $P$ )

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

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

- ▶  $E_{\$/\text{€}}^e$  is given

- ▶  $i$  comes from money market.  $E_{\$/\text{€}}$  comes from fx market

from IR model

$E_{\$/\text{€}}$



## Recap: Long-run model

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- ▶ Purchasing power parity

$$E_{\$/\epsilon}^e = \frac{P_{us}^e}{P_{eu}^e}$$

- ▶ Quantity theory with flexible prices

$$P_{us}^e = \frac{M_{us}^e}{L_{us}(i_{\$}^e)Y_{us}^e}$$

$$P_{eu}^e = \frac{M_{eu}^e}{L_{eu}(i_{\epsilon}^e)Y_{eu}^e}$$

SR = FIXED PRICE  
LR = FLEXIBLE PRICE

- ▶ Notice everything is in expectation. The idea is that people today believe that the long-run model is true in the future, so all our long-run results are expected to hold today.
- ▶ This model determines  $E_{\$/\epsilon}^e$

## Permanent change in $M_{US}$

- ▶ In the short-run model we had to keep  $E^e$  fixed, so we could only study temporary policy shocks. A permanent shock would change  $E^e$ . Now, we can handle a permanent shock.
- ▶ Suppose we have a permanent shock to the level of money in the U.S.
- ▶ We approach the problem backwards
  1. Solve the long run. This gives us  $E^e$ .
  2. Solve the short run with the new value of  $E^e$  and constant prices.
- ▶ We can then work out the adjustment from the short run to the long run

+  $\Delta M_{US}$

$\uparrow M_{US} \rightarrow \uparrow P_{US}$

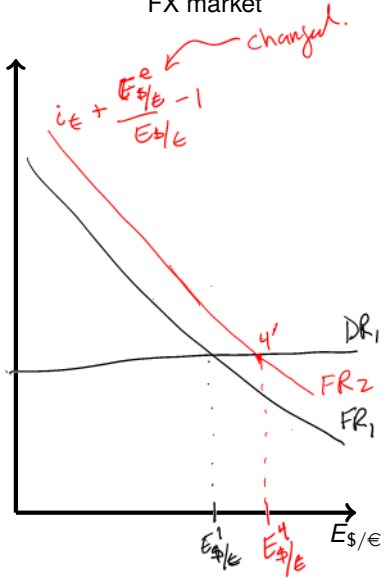
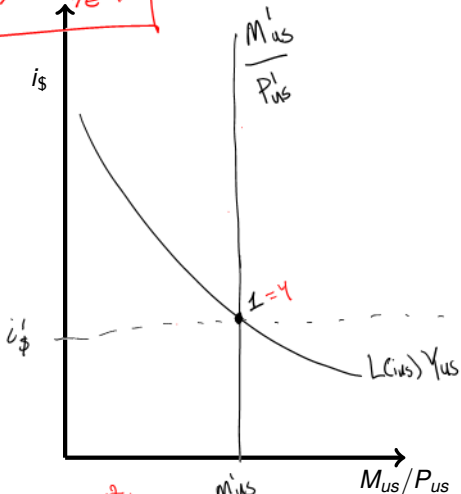
The long run (increase  $M_{US}$ ) <sup>permanent</sup>  
 (all else constant)

PPP  $\rightarrow E_{\$/\text{€}}^e \uparrow$

Home money market

FX market

$\Rightarrow E_{\$/\text{€}}^e \uparrow$




$$\frac{M_{US}}{P_{US}} = \frac{M'_{US}}{P'_{US}}$$

## Permanent change in $M$

1. Solve the long run. This gives us  $E^e$ .

Done! In the long run, the money market will not change. The FR curve permanently shifts up and exchange rate is permanently depreciated.

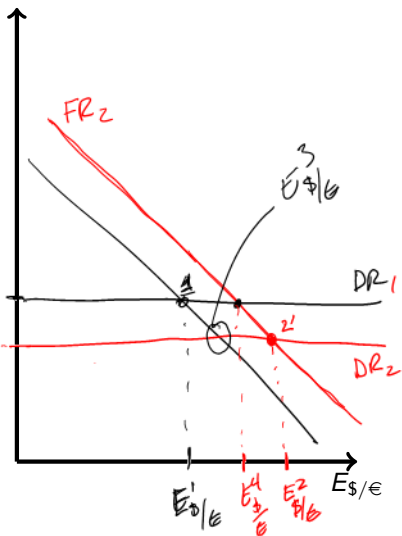
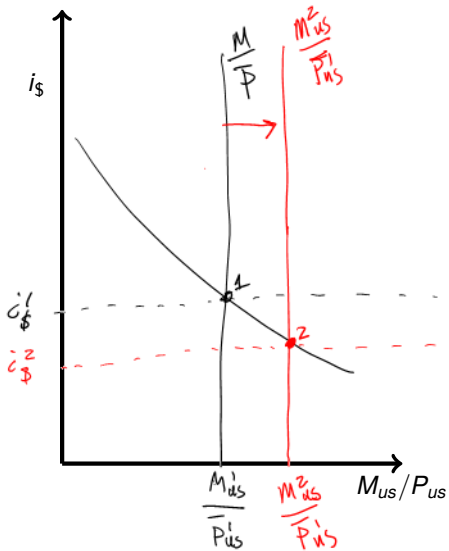


2. Solve the short run with the new value of  $E^e$  and constant prices.

Two changes:  
 1.  $M_{us} \uparrow$   
 2.  $E_{\$/\epsilon} \uparrow$

The short run (increase  $M_{us}$ ) permanent  
 Fig 15-12  
 FX market

Home money market



## Permanent change in $M$

1. Solve the long run. This gives us  $E^e$ .

Done! In the long run, the money market will not change. The FR curve permanently shifts up and exchange rate is permanently depreciated.

2. Solve the short run with the new value of  $E^e$  and constant prices.

Done! In the short run, two things happen: 1)  $FR$  shifts up as in the long-run 2) interest rates fall because real money supply increases.

The short-run exchange rate depreciates to  $E_{\$/\epsilon}^2$  which is a larger depreciation than will occur in the long run:  $E_{\$/\epsilon}^2 > E_{\$/\epsilon}^4$ . We say the short run exchange rate “overshoots” the eventual long run exchange rate.

## Permanent change in $M$ : Adjustment

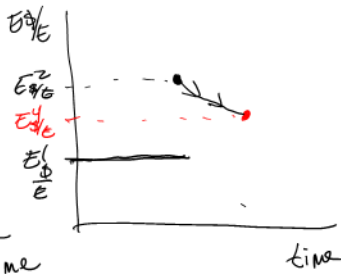
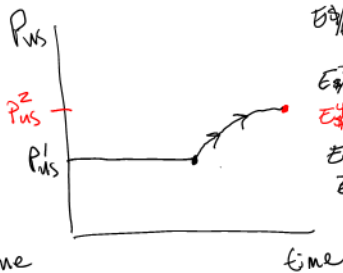
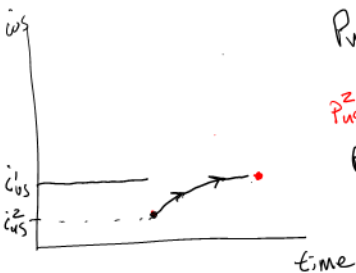
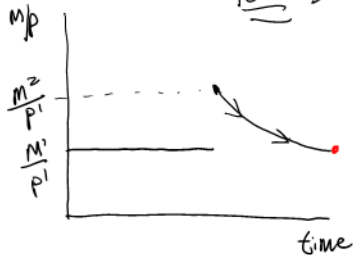
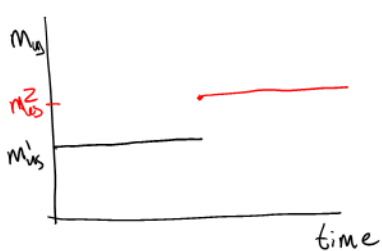
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- ▶ The economy eventually adjusts from the short run to the long run. How?
  - ▶ As  $P$  slowly changes,  $M/P$  falls until it returns to its initial and long run level
  - ▶ As  $M/P$  decreases,  $i$  increases until it is back to its initial and long run level
  - ▶ The  $FR$  curve does not return to its original position — there has been a permanent change in expected inflation because the increase in the U.S. money supply is permanent
  - ▶ The exchange rate eventually appreciates to  $E_{\$/\epsilon}^4$ .
- ▶ Let's look at this as a time series

# Permanent increase in $M_{us}$

Why is LR  $\neq$  SR?

Perm shock changes expectations





## Permanent increase in $M$ : Overshooting

- ▶ The key to overshooting is the change in expectations
- ▶ Expectations change because the change in  $M$  is permanent
- ▶ With a temporary change, the only change in the FX market is  $i_{\$}$ . The shift of  $FR$  provides the extra depreciation in the short run.
- ▶ The extent to which monetary policy is viewed as temporary or permanent determines how large the short-run change in the exchange rate will be

## Summary

- ▶ We could handle permanent changes in the long run model
- ▶ We could handle temporary changes in the short run model
- ▶ Putting the two models together let's us see the effect of a permanent change in the short run
- ▶ The big innovation: The long run model lets people forecast the future exchange rate. In the short run, this causes  $FR$  to shift, causing a larger depreciation of the dollar compared to a temporary change in  $M$
- ▶ In the short run, the exchange rate **overshoots** its long run level
- ▶ Monetary policy shocks that are expected to change the long run (permanent shocks) generate more fx volatility than temporary shocks that are not expected to change the long run