Development Finance: Part 1
Exchange Rate

Reference: P. Krugman, M. Obstfeld and M.J. Meliz, International Economics: Theory and Policy, 11th , Peason ISBN-10:1-292-21487-2

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Exchange rate

- Exchange rates are the price of the currency measured by other currencies.
- How does depreciation affect the domestic exports and imports?
- How does appreciation affect the domestic exports and imports?
- How does depreciation affect the debt repayment to external creditors?
- How does appreciation affect the debt repayment to external creditors?

The Foreign Exchange Market

- Actors:
- Commercial banks: banks buy and sell on behalf of their customers, which is retail sales and to buy and sell among themselves, interbank trading, which are called “wholesales”. Banks serving many customers and dealing a large volume have a advantages in finding someone who wants to buy or sell rather than companies find counterparties to sell and buy.
- Corporations: corporations who have operations in different countries need to make payment and receive payments in different currencies.
- Non-bank Financial Institutions: As financial market globalizes, non-bank financial institutions such as mutual funds, insurance firms and pension funds offer a broader range of financial services indistinguishable to those offered by banks
- Central Banks: central banks intervene the foreign exchange markets particularly in case of countries which employ fixed or pegged exchange rate regime.

Arbitrage

- Europe/US　　Gold　　1g=10g　Silver
- Japan　　Gold　　1g=5g　Silver

- Which one is more expensive in Japan than Europe and US?
- What business opportunity is there if any?
- What is the reason why silver was more expensive in Japan than Europe and US?

Arbitrage: Buy Cheap and Sell High

- To take advantages of different prices. For example, the exchange rate in Tokyo is 100JPY/$ while 50JPY/$ in NY. What would you do?

- Because investors are watching foreign exchange market for 24 hours, the arbitrage opportunities are very few and short-lived.

- The US$ is a vehicle currency since US$ involves in more than 85% of transactions. JPY holders who want to exchange Jordan Dinar with JPY, first exchange JPY with US$, and then with JD. Why1?

Spot and Forward Rate

- Spot Transaction: Exchange rates at which two parties agree to an exchange of bank deposits and execute the deal immediately are called “on-the-spot” .

- Forward Transaction: Foreign exchange deals sometimes specify a future transaction date—one that may be 30 days, 90 days, 180 days, or even several years away. The exchange rates quoted in such transactions are called “forward exchange rates”. When you agree to sell JPY for dollars on a future date at a forward rate agreed on today, you have “sold JPY forward” and “bought dollars forward.” The future date on which the currencies are actually exchanged is called the value date. Forward contract is OTC (Over-the-Counter) and have to execute the contract (settlement) on a specified day.

Hedging

- TOYOTO exports a car at US$100 to USA. The car is sold three months later, July 1 2021 and the retailer will send you US$100. The current exchange rate is JPY100/1US$. TOYOTO is afraid that the exchange rate could be JPY50/1US$ in July 1. The profit is 100x50=5000. TOYOTA's profit will be squeezed.
- However, what if you find someone who agree to buy your JPY10,000 at 100 on July 1 2021. TOYOTA pay JPY500 for this contract will receive JPY100/US$1=10,000. TOYOTA exchange US$100 for JPY10,000 with This person. TOYOTA receives JPY10,000-500=JPY9,500. This operation is called "Hedging".

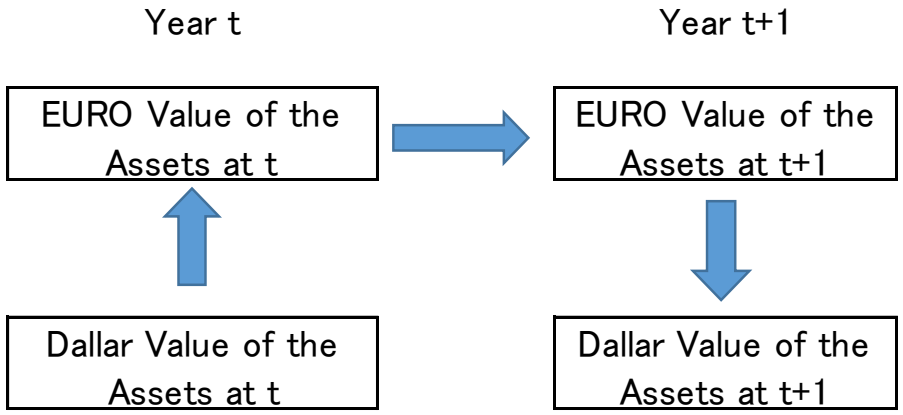
- Would it be possible to find someone who sell the dollars at JPY100?

Foreign Exchange Swap

- A foreign exchange swap is a spot sale of a currency combined with a forward repurchase of that currency.
- For example, suppose the US Toyota auto company has 1 million dollars of idle cash now and will have to pay 1 million dollars to a California supplier in year t+1. US Toyota borrows 1 million € for one year from KKR while collateralizing 1 million dollars for one year (secured borrowing). TOYOTA pays commissions at 1%of 1 million $ to KKR. KKR gets 1 thousand $.
- US Toyota invests 1 million € in EURO bonds for one year. In year t+1, US Toyota repurchases 1 million dollars as swap contract pledges.
- This usually involves two transaction, buying € and selling € and requires US Toyota pays two transaction fees, 1% foe each transaction, to brokers. However, swap transaction requires only comission fee.
- Swaps makes up a significant proportion of all foreign exchange trading.

- You have US$1 and now the exchange rate is 1 EURO /US$. However, EURO is expected to appreciate by 10% in one year time. EURO interest rate is 20%. Compute the return if you invest US$1 into EURO deposit for one year. You pay commission of 5% each time in original currency, which means US$ when you convert from US$ to EURO and EURO when converted from EURO to US$.

- (1- 1*0.05)*1 EURO /US$. in t
- (1- 1*0.05)*1 *1.2 in t+1 in EURO
- ((1- 1*0.05)*1 *1.2 *0.95)/0.9 in t—1



- Q3. You have US$1 and now the exchange rate is 1 EURO /US$. However, EURO is expected to appreciate by 10% in one year time. EURO interest rate is 20%. Now, you borrow 1 EURO from KKR with a commission of 3% so that you do not have to convert US$1. You pay commission when you repay in t+1. But, you have to convert your return in EURO into US$. The commission for conversion fee from EURO to US$ is 5% of original currency value. Compute the return.

You borrow 1 EURO in t

Your asset in t+1 1*1.2

You repay 1 EURO and pay commission

1.2 - 1 - 1*0.03 in t+1 in EURO

(1.2 - 1 - 1*0.03)*(1-0.05)/0.9=0.179

Foreign Exchange Swap with Interest rate for Toyota

- TOYOTA have 1$ while KKR has 1EURO. US interest rate is 5% while EURO interest rate is 20%. TOYOTA invest in US market and gets 5% while it gets 20% if invested in EURO market. TOYOTA has a swap at ex=1$/€ in one year later while KKR expect 1.2 $/€.

- TOYOTA, initial position is 1$ and is 1.20$ in one year later.

For TOYOTA	$	EURO/$	€
Now	1 $	1	1 €
Interest rates	5%		20%
1 year later	1.20 $	1	1.20 €

Foreign Exchange Swap with Interest rate for KKR

- KKR: initial position is 1 € but 1.167 $ in on year time. What will happen if 1.1 $/€. What if the commission is 0.05US$ after one year from Toyota to KKR.

For KKR	$	EURO/$	€
Now	1 $	1	1 €
Interest rates	5%		20%
1 year later	1.05 $	1.2	1.26 €

Future Contract

- You are in Japan and will have US$ 100 on Jan 10. In case that as of today, Oct 10, you buy a three month forward contact for US$100 at JPY120/1US$ on the settlement day of Jan 10, you are entitled to exchange US$100 at JPY120/1US$ and receive JPY12,000 on Jan 10. But what if the exchange rate is JPY140/1US$?

- In future contract, you buy a promise that a specified amount of currency, JPY12,000 is delivered in exchange for US$100 at a specified rate, JPY120/USD$ on specified day, Jan 10, three month from the deal.
- What if the exchange rate is JPY140/USD as of Dec 10. In case of future contract, you can sell future contract on an organized future exchange to someone in the future market, who expects the exchange rate will be less than JPY120/USD, i.e., JPY100/USD in one month time of Jan 10. On Jan 10, the exchange rate is JPY130/USD if not JPY140/USD and this person receivesJPY13,000 and sold USD100.

Options

- As of Oct 10, the JPY is JPY100/USD. You expect to pay USD 1 on Jan 10 and you assume the JPY will be 120/USD. You pay JPY5 and buy a call option, the right to buy US dollars at JPY110 on Jan 10. On Jan 10, the JPY is in fact 120/USD. Your total payment is JPY110+JPY5=JPY115, lower than JPY120. You saved 5 JPY.

- As of Oct 10, the JPY is JPY100/USD. You expect to receive USD 1 on Jan 10 and you assume the JPY will be JPY80/USD on Jan 10. You pay JPY5 and buy a put option, the right to sell US dollars at JPY90 on Jan 10. On Jan 10, the JPY is in fact 80/USD. Your total payment is JPY90-JPY5=JPY85, lower than JPY80. You saved 5 JPY.

- American option can be exercised at any point of time during three month while European option can on the specified data, Jan 10.

Assets Return

- What are the determinants for the demand for foreign currencies?

1. Future changes in foreign currency against other currencies.
2. Interest rates.

What are assets? The asset is an instrument to transfer the purchasing power into the future.

What is the asset return?: the percentage increase in value of the assets over some time period.

Q: Asset A increased from 100 in January 1 to 120 at April 1. Asset B from 100 in January 1 to 140 at September 1. Derive annualized return of the asset in %.

Real Return

- The expected real rate of return is, the rate of return computed by measuring asset values in terms of some broad representative basket of products that savers regularly purchase. Only the real return can measures the goods and services a saver can buy in the future in return for giving up some consumption (that is, saving) today.

- The dollar prices of all goods and services (rate of inflation) also increase by 10 percent. What is the real return of a rare bottle of wine whose dollar price rises by 25 percent during the same period? What is a real return of bond whose dollar value rises by 20 percent?

$$(1+i) = (1+r)(1+\pi) \approx i = r + \pi$$

Where i= nominal interest rate, r= real interest rate and π = rate of inflation.

MR=MC

	Labor	Wage/Labor	Cost	Revenue	Production	Price
2020	10	9,000	90,000	90000	90	1000
2021	11	9,000	99,000	99000	99	1000

	Labor	Wage/Labor	Cost	Revenue	Production	Price
2020	10	9,000	90,000	90000	90	1000
2021	11	9,000	99,000	98000	98	1000

- In 2021, the factory will employ one labor, market wage is 10,000 JPY/Day.
- What is the marginal cost and marginal revenue?
- Would you like to employ?
- What about the case at the bottom?

Real Interest Rate

You borrow $100 at 2% in Year t, buy the machines, produce two apples(1$), sell the machines(no depreciation) and two apples and repay.

		Assets				Liabiities		
No inflation	Inflation %	Asset Value	Apple Production	Apple Price $	Maginal Revenues $	Interest Payment $=MC	Interest Rate	Loan $
Year t	0%	100	0	1.00	0.00	0.00	2.00%	100
t+1	0%	100	2	1.00	2.00	2.00	2.00%	100

With Inflation	Inflation %	Asset Value	Apple Production	Apple Price $	Maginal Revenues $	Interest Payment $=MC	Interest Rate	Loan $
Year t	0%	100	0	1.00	0.00	0.00	0.00%	100
t+1	3%	103	2	1.03	5.06	5.06	5.06%	100

Another Determinants: Risk and Liquidity

- Risk WHY?: An asset's real return is usually unpredictable and may turn out to be quite different from what savers expected when they purchased the asset.
- Which assets would you buy? Asset A has a mean annual return of 5% with the 95% of probability of getting returns for 4.5% to 5.5%. Asset B has a mean annual return of 6% with 30% of probability of getting 4% to 8%.

- Liquidity: Assets also differ according to the cost and speed at which savers can dispose of them. A house, for example, is not very liquid because its sale usually requires time and the services of brokers and inspectors. To sell a house quickly, one might have to sell at a relatively low price. In contrast, cash is the most liquid of all assets: It is always acceptable at face value as payment for goods or other assets.

Interest Rate

- When you buy two currencies, what factors do you consider?
- Current and future exchange Rate is crucial.

- How do investors keep or store their assets after they buy the currencies?

- What does saving account offer you?

You are in the USA. Which one would you buy to invest in one year? The exchange rate of USD and EURO is 1EURO/1USD, now. It is expected to be 1.1 EURO/1USD in one year later. Appreciation or depreciation for USD? Saving account of USD offers 10% of interest rates while EURO saving account offers 20%.

How to Compare Return of the Currencies?

- You are in the USA. Suppose that today's exchange rate (quoted in American terms) is $1.10 per euro, but that you expect the rate to be $1.165 per euro in a year (perhaps because you expect unfavorable developments in the U.S. economy). Suppose also that the dollar interest rate is 10 percent per year while the euro interest rate is 5 percent per year. This means a deposit of $1.00 pays $1.10 after a year while a deposit of € 1 pays € 1.05 after a year. Which of these deposits offers the higher return?

How to Convert the Currencies?

- Convert $ to €,

$$€ \left(\frac{\$}{€}\right) = \$$$

$$€ \left(\frac{€}{\$}\right) = \$$$

How to Convert the Currencies?

- Convert $ to €,

$$€ \not{/} \quad X \quad \left(\frac{\$}{\not{€}}\right) = \$$$

$$€ \qquad \left(\frac{€}{\$}\right) = \$$$

How to Convert the Currencies?

- Convert $ to €,

$$€ \times \left(\frac{\$}{€}\right) = \$$$

$$€ \div \left(\frac{€}{\$}\right) = \$$$

- The exchange rate is 0.5$/ €, compute how much in $ is 1 €?

$$1\ € * 0.5\ (\$/\ €) = 0.5\$$$

- The exchange rate is 0.5 € /$, compute how much in $ is 1 €?

$$1\ € \div 0.5\ (€\ /\$) = 0.5\$$$

- The exchange rate is 1.5€ /$, compute how much in $ is 10 €?

$$10\ € \div 1.5\ (€\ /\$) = 6.66\cdots\$$$

- The exchange rate is 1.5$/ €, compute how much in $ is 10€?

$$10\ € * 1.5\ (\$/\ €) = 1.5\$$$

- The exchange rate is 0.8 € /$, compute how much in $ is 56€?

$$56\ € \div 0.8\ (€/\$) = 70\$$$

- The exchange rate is 0.8 $/ €, compute how much in $ is 56€?

$$56\ € * 0.8(\$/€) = 44.8\$$$

- The exchange rate is 0.8 € /$. You have to pay 10% of commission when you convert € to $. Compute how much in $ is 56€?

$$56\ € \div \{0.8(€/\$)*1.1\} = 63.6\$$$

- The exchange rate is 0.8 € /$. You have to pay 10% of the dollar value after you convert € to $. Compute how much in $ is 56€?

{ 56 € ÷ 0.8 ($/ €)) }*0.9=63$

- The exchange rate is 0.8 $/ €. You have to pay 10% of commission when you convert € to $. Compute how much in $ is 56€?

56 € * 0.8($/ €) =44.8$

{56 € * 0.8 ($/ €) *0.9=40.3$

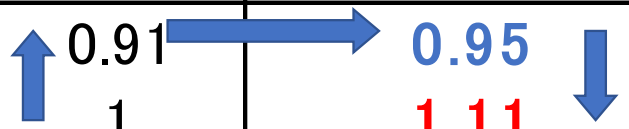
How to Compare Return of the Currencies?

- You have one ＄ today and what is the EURO value of one ＄ today in one year later?
- What is the US$ value of one ＄ today invested in EURO in one year later?
- Exchange rates change from 1.1 to 1.165. Has the $ depreciated or appreciated?

	Today	One Year Later
ex_US/EU	1.1	1.165
i_USD	0.1	
i_EURO	0.05	
EURO Valu	?	?
US$ Value	1	?

How to Compare Return of the Currencies?

	Today	One Year Later	Return	EURO Appreciation Rate
ex_US/EU	1.1	1.165		0.06
i_USD	0.1			
i_EURO	0.05			
EURO Valu	0.91	0.95		
US$ Value	1	1.11	0.11	



- What is the return of the USD currency in one year?
- What is the return of the EURO currency in one year?
- Which currency would you hold?

- What is the percentage change of US $ depreciation?
- Sum up the rate of US$ depreciation and the EURO interest rates.
- Is this foreign exchange market between EURO and USD at equilibrium?

Fill in using the exchange rate in previous slide but in EURO/USD.

	Today	One Year Later	Return	EURO Appreciation Rate
ex_EURO/US	?	?		?
i_USD	0.1			
i_EURO	0.05			
EURO Value	?	?		?
US$ Value of 1 EURO today	1	?	?	

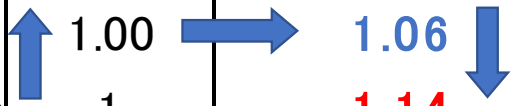
	Today	One Year Later	Return	EURO Appreciation Rate
ex_EURO/US	0.91	0.86		0.06
i_USD	0.1			
i_EURO	0.05			
EURO Value	0.91	0.95		1.11
US$ Value of 1 EURO today	1	1.11	0.11	

Interest Parity

- The foreign exchange market is in equilibrium when deposits of all currencies offer the same expected rate of return. The condition that the expected returns on deposits of any two currencies are equal when measured in the same currency is called the interest parity condition.

- Suppose the dollar interest rate is 10 percent and the euro interest rate is 6 percent, but that the dollar is expected to depreciate against the euro at an 8 percent rate over a year.
- In the circumstances described, no one will be willing to continue holding dollar deposits, and holders of dollar deposits will be trying to sell them for euro deposits. There will therefore be an excess supply of dollar deposits and an excess demand for euro deposits in the foreign exchange market.

	Today	One Year Later	Return	EURO Appreciation Rate
ex_US/EURO	1	1.08		0.08
i_USD	0.1			
i_EURO	0.06			
EURO Value	1.00	1.06		
US$ Value of 1 EURO today	1	1.14	0.14	



Interest Parity

- Suppose that dollar deposits again offer a 10 percent interest rate but euro deposits offer a 12 percent rate and the dollar is expected to appreciate against the euro by 4 percent over the coming year. Now the return on dollar deposits is 2 percent higher. In this case no one would demand euro deposits, so they would be in excess supply and dollar deposits would be in excess demand.

	Today	One Year Later	Return	Depreciation Rate
USD/EURO	1.000	0.96		−0.04
i_USD	0.1			
i_EURO	0.12			
EURO Value	1	1.12		
US$ Value of	1.000	1.08	0.08	

Interest Parity II

- Only when all expected rates of return are equal—that is, when the interest parity condition holds—is there no excess supply of some type of deposit and no excess demand for another. The foreign exchange market is in equilibrium when no type of deposit is in excess demand or excess supply.

$$0 = R_{\$} - R_{EURO} - \frac{ex_{t+j}^{\$/€} - ex_t^{\$/€}}{ex_t^{\$/€}} \text{ or } R_{\$} = R_{EURO} + \frac{ex_{t+j}^{\$/€} - ex_t^{\$/€}}{ex_t^{\$/€}}$$

What if US interest rises? Investors buy which currency and what will happen to the exchange rate as a consequence?

Find today's exchange rate UIP suggests.

	Today	One Year Later	Return	EURO Appreciation Rate
ex_US/EURO	1	1.1		0.10
i_USD	0.1			
i_EURO	0.06			
EURO Value	1.00	1.06		
US$ Value of 1 EURO today	1	1.17	0.17	

Interest Parity: What will happen to exchange rates?

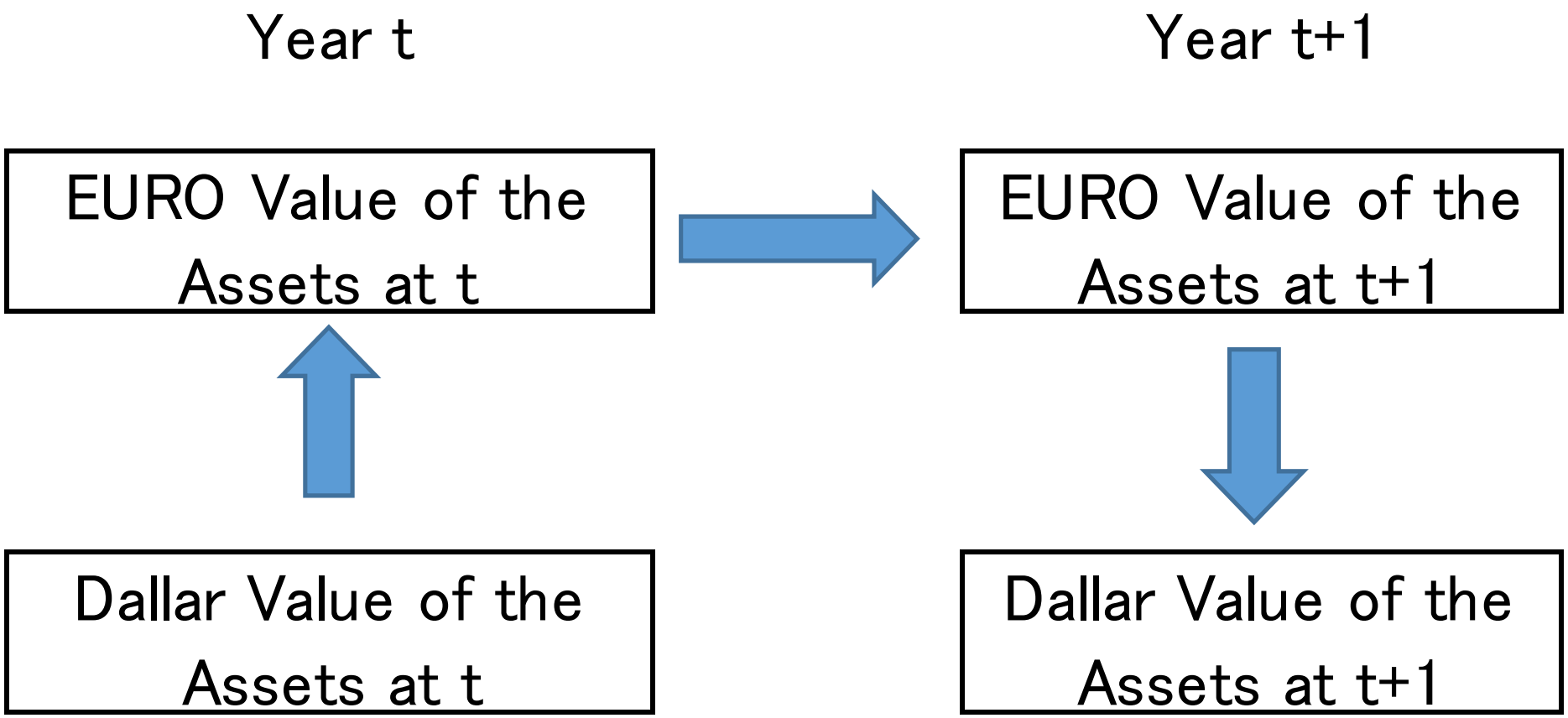
	Today	One Year Later	Return	Depreciation Rate
ex_US/EURO	1.1	1.165		0.06
i_USD	0.1			
i_EURO	0.05			
EURO Value	1	1.050		
US$ Value of 1 EURO today	1.1	1.223	0.11	

	Today	One Year Later	Return	Depreciation Rate
ex_US/EURO	1.1	1.210		0.10
i_USD	0.1			
i_EURO	0.05			
EURO Value	1	1.050		
US$ Value of 1 EURO today	1.1	1.271	0.16	

Interest Parity: how changes in today's exchange rate affect the expected return on a foreign currency deposit when interest rates and expectations about the future exchange rate do not change. What will happen if the market is on the upper table?

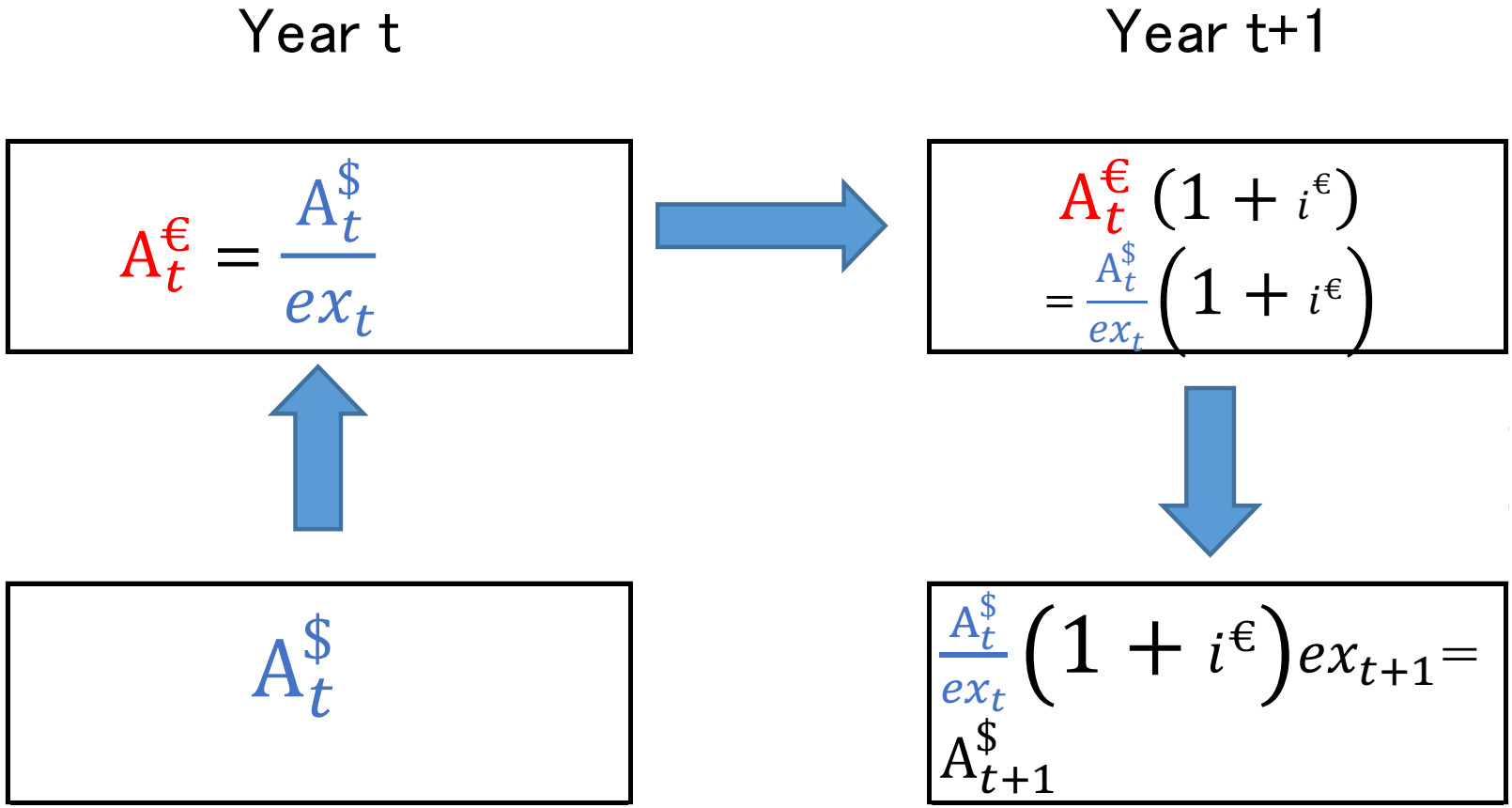
	Today	One Year Later	Return	Depreciation Rate
ex_US/EURO	1.1	1.165		0.06
i_USD	0.1			
i_EURO	0.05			
EURO Value	1	1.050		
US$ Value of 1 EURO today	1.1	1.223	0.11	

	Today	One Year Later	Return	Depreciation Rate
ex_US/EURO	1.112	1.165		0.05
i_USD	0.1			
i_EURO	0.05			
EURO Value	1	1.050		
US$ Value of 1 EURO today	1.112	1.223	0.10	


Year t
Year t+1
EURO Value of the Assets at t
EURO Value of the Assets at t+1
Dallar Value of the Assets at t
Dallar Value of the Assets at t+1

Algebra of Measuring Investment in the EURO asset by Dollar

A_t: Initial Asset, ex_t exchange rate (\$/€) at year t, $i^{€}$: Interest rate in EURO area



Linearization

- $YC = P * YK$ where YC=nominal GDP, P = GDP deflator and YK= real GDP

$$YC_t = P_t * YK_t \quad \text{and} \quad YC_{t+1} = P_{t+1} * YK_{t+1}$$

$$YC_{t+1} = YC_t\left(1 + g_{t+1}^{YC}\right), \quad P_{t+1} = P_t(1 + g_{t+1}^{P}), \quad YK_{t+1} = YK_t(1 + g_{t+1}^{YK})$$

$$YC_t(1 + g_{t+1}^{YC}) = P_t(1 + g_{t+1}^{P}) * YK_t(1 + g_{t+1}^{YK})$$

Where g stands for growth rates.

- $YC_t(1 + g_{t+1}^{YC}) = YC_t(1 + g_{t+1}^{P}) * (1 + g_{t+1}^{YK})$

- $(1 + g_{t+1}^{YC}) = (1 + g_{t+1}^{P}) * (1 + g_{t+1}^{YK})$

Linearization

- $g_{t+1}^{YC} \approx g_{t+1}^{P} + g_{t+1}^{YK}$

Algebra

- $\frac{A_t}{ex_t}\left(1+i^{€}\right)ex_{t+1} = A_t\left(1+i^{€}\right)\frac{ex_{t+1}}{ex_t} = A_{t+1}$

$$\left(1+i^{€}\right)\frac{ex_{t+1}}{ex_t} = \frac{A_{t+1}}{A_t} = 1+i^{\$}$$

Taking a natural log,

$$ln\left(1+i^{€}\right) + \ln\left(\frac{ex_{t+1}}{ex_t}\right) = \ln\left(\frac{A_{t+1}}{A_t}\right) = ln\left(1+i^{\$}\right)$$

- This can be further approximated as

$$i^{€} + \Delta ex_{t+1} = \Delta A_{t+1} = i^{\$}$$

$/€ Today	i_EURO	$/€ in t+1	Expected Return on EURO assets
1.000	0.05	1.1	0.16
1.020	0.05	1.1	0.13
1.040	0.05	1.1	?
1.060	0.05	1.1	0.09
1.080	0.05	1.1	0.07
1.100	0.05	1.1	?
1.120	0.05	1.1	0.03
1.140	0.05	1.1	0.01
1.160	0.05	1.1	0.00

$/€ Today	i_EURO	$/€ in t+1	Rate of € Appreciation	Expected Return on EURO assets
1.000	0.05	1.1	0.10	0.16
1.020	0.05	1.1	0.08	0.13
1.040	0.05	1.1	0.06	?
1.060	0.05	1.1	0.04	0.09
1.080	0.05	1.1	0.02	0.07
1.100	0.05	1.1	0.00	?
1.120	0.05	1.1	−0.02	0.03
1.140	0.05	1.1	−0.04	0.01
1.160	0.05	1.1	−0.05	0.00

I he relation between currency exchange rates and $ values of return

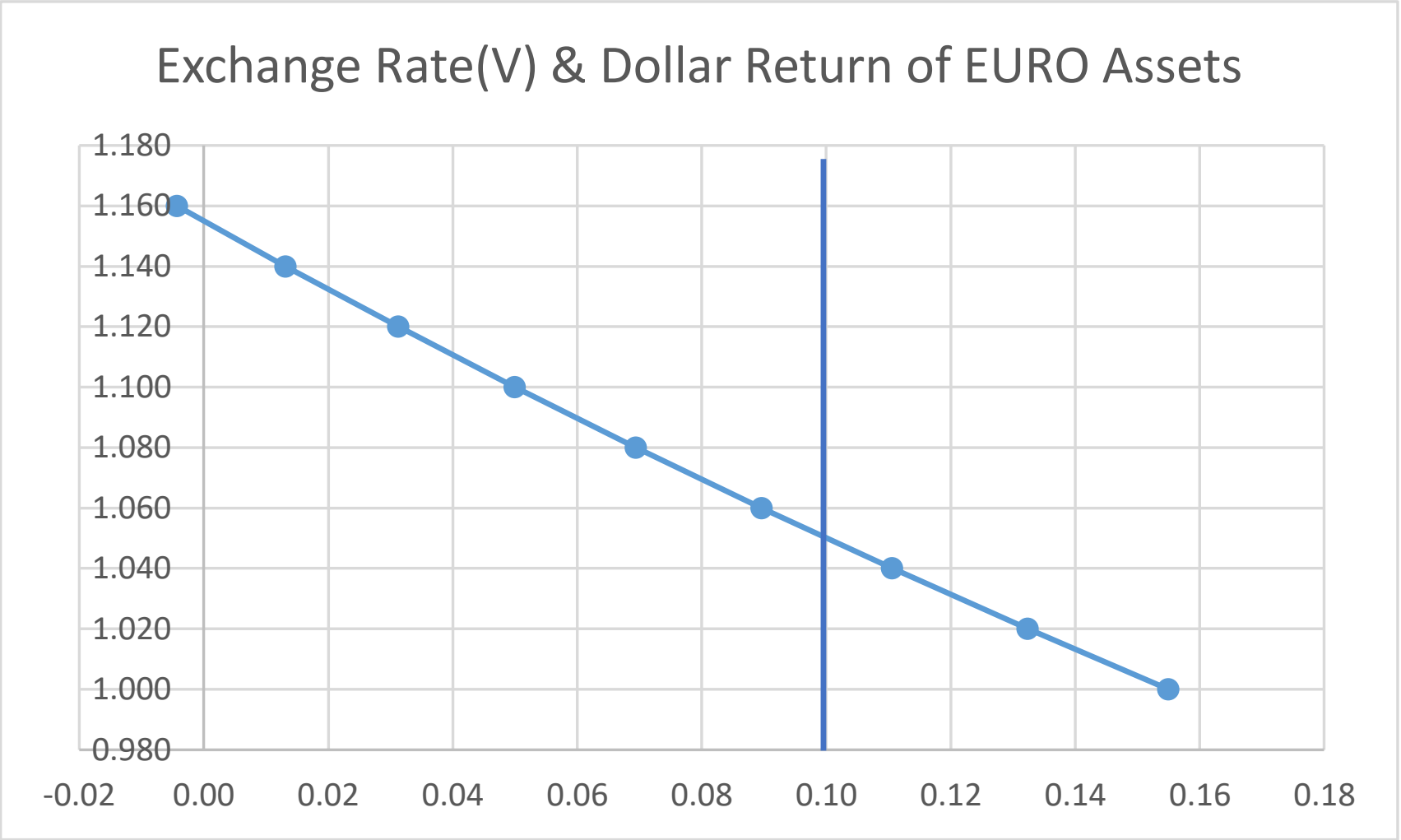
Previous tables show that the more the currency today appreciates, the lower the return of the currency is, which describe downward sloping schedule between the exchange rate and return of the currency today provided that expected exchange rates and interest rates of both currencies are the same.

A current **€ appreciation** raises the cost of acquiring 1 **€.** This change naturally makes euro deposits less attractive relative to dollars since expected future exchange rate and interest rate are the same.

Expected return of EURO assets lowers as the EURO today appreciates as in the previous slide.

The return of dollar assets is vertical. WHY?

$$i^{€} + \Delta ex_{t+1} = \Delta A_{t+1}$$

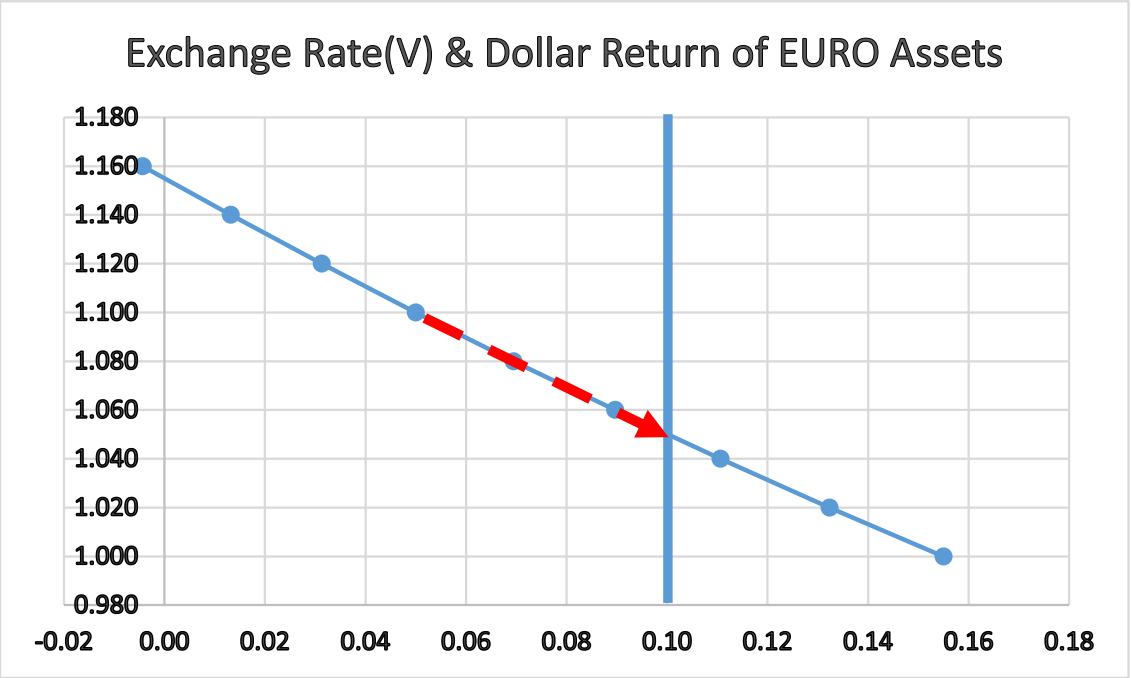


What happen if the exchange rates is at ex=1.1 and return of EURO=0.05?

$$i^{€} + \Delta ex_{t+1} = \Delta A_{t+1}$$

$$i^{€} + \frac{ex_{t+1}^{\$/€}}{ex_{t}^{\$/€}} - 1 = \Delta A_{t+1}$$

The return of EURO asset is lower than that of the dollar asset, which creates excess demand for dollar assets and leads to depreciation of EURO, which is a decrease in $ex_t^{\$/€}$. As a consequence, returns of the EURO asset rise until both returns from dollar asset and EURO assets are the same.

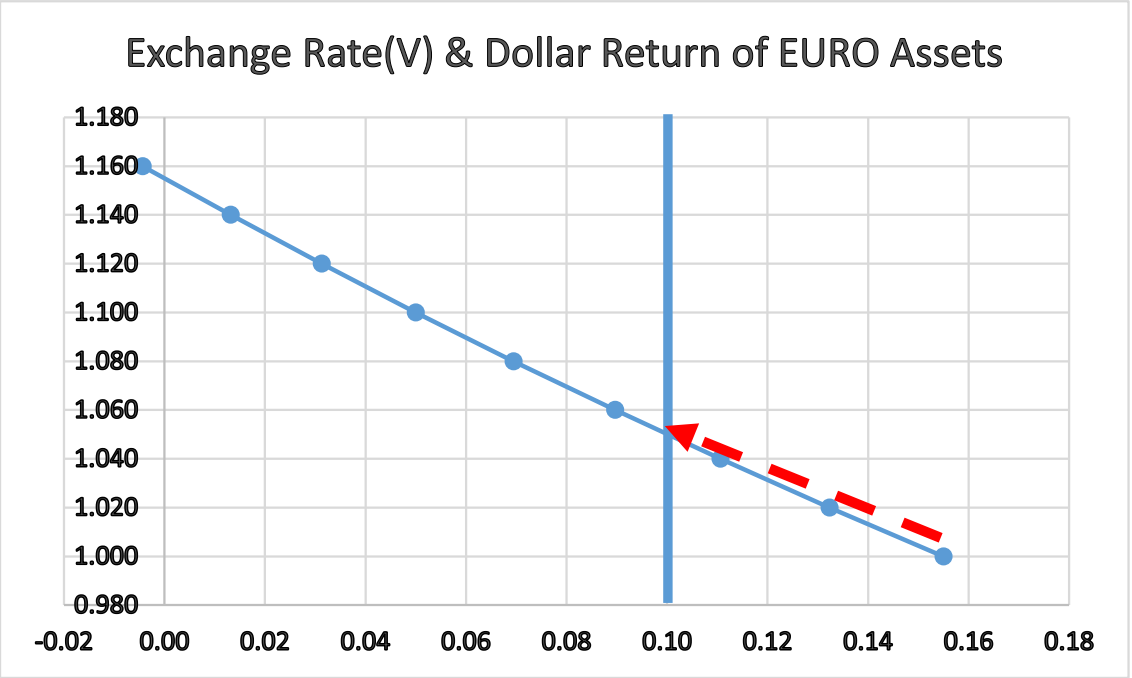


What happen if the exchange rates, $/€, is at ex=1.0 and return of EURO=0.155?

$$i^{€} + \Delta ex_{t+1} = \Delta A_{t+1}$$

$$i^{€} + \frac{ex_{t+1}^{\$/€}}{ex_{t}^{\$/€}} - 1 = \Delta A_{t+1}$$

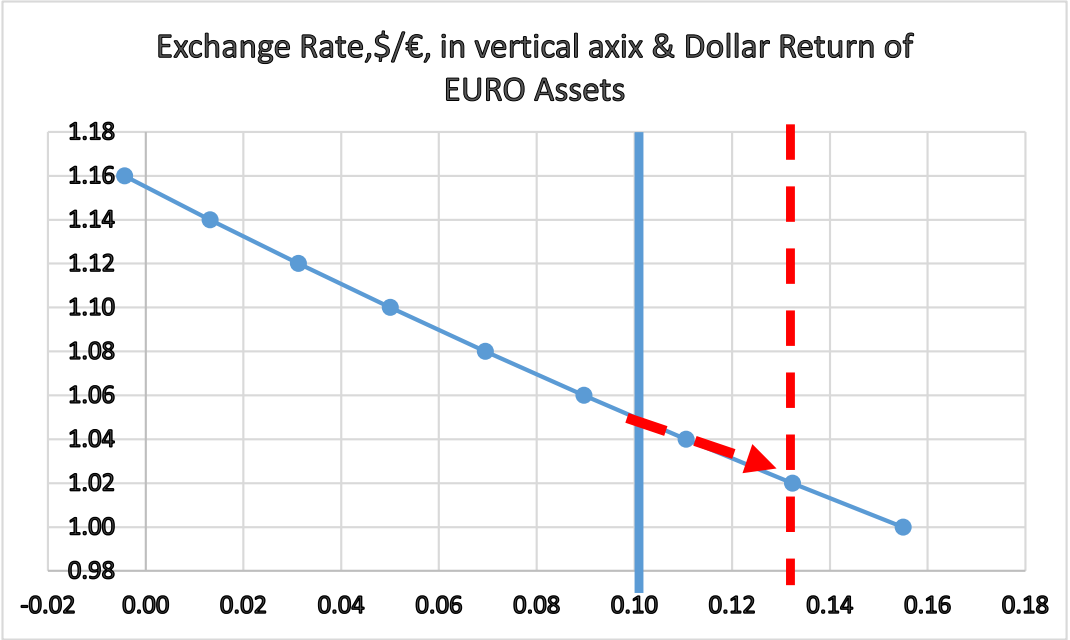
The return of EURO asset is higher than that of the dollar asset, which creates excess demand for EURO assets and leads to appreciation of EURO. At year t, appreciation of EURO is an increase in $ex_t^{\$/€}$. As a consequence, returns of the EURO asset falls until both returns from dollar asset and EURO assets are the same.



What happen to the exchange rates, $/€, if the US interest rates is raised to 13% from 10%?

$$i^{€} + \frac{ex_{t+1}^{\$/€}}{ex_{t}^{\$/€}} - 1 = \Delta A_{t+1}$$

The return of EURO asset is 10% while that of the dollar asset is now 13%, higher than that of the EURO asset, which creates excess demand for dollar assets and leads to depreciation of EURO. The depreciation of EURO is an decrease in $ex_t^{\$/€}$, which implies higher rate of return in EURO asset in year t+1. As a consequence, returns of the EURO asset rises until both returns from dollar asset and EURO assets are the same.



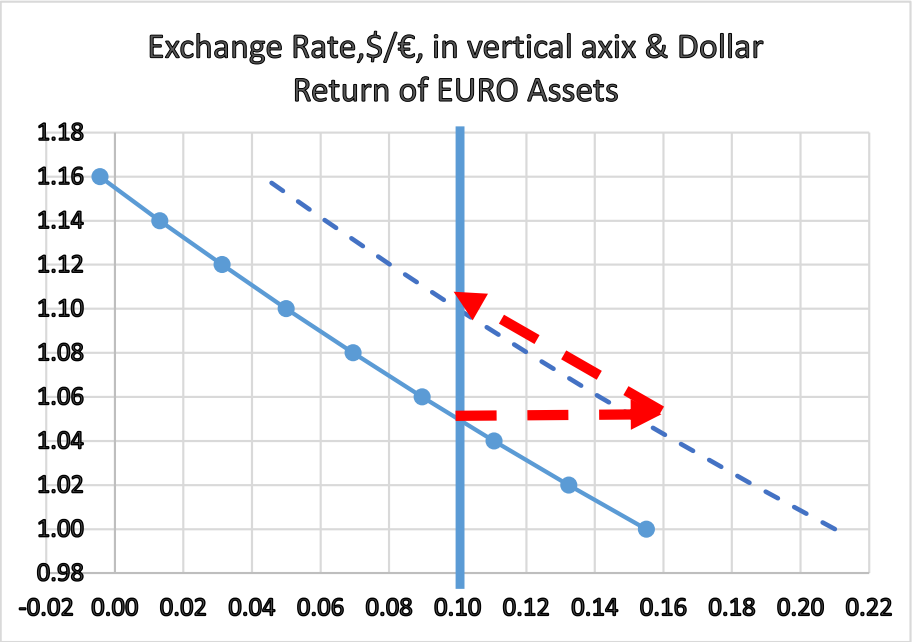
$/€ Today	i_EURO	$/€ in t+1	Rate of Depreciation	Expected Return on EURO assets
1.000	0.05	1.1	0.10	0.16
1.020	0.05	1.1	0.08	0.13
1.040	0.05	1.1	0.06	0.11
1.060	0.05	1.1	0.04	0.09
1.080	0.05	1.1	0.02	0.07
1.100	0.05	1.1	0.00	0.05
1.120	0.05	1.1	−0.02	0.03
1.140	0.05	1.1	−0.04	0.01
1.160	0.05	1.1	−0.05	0.00

$/€ Today	i_EURO	$/€ in t+1	Rate of Depreciation	Expected Return on EURO assets
1.000	0.10	1.1	0.10	0.21
1.020	0.10	1.1	0.08	0.19
1.040	0.10	1.1	0.06	0.16
1.060	0.10	1.1	0.04	0.14
1.080	0.10	1.1	0.02	0.12
1.100	0.10	1.1	0.00	0.10
1.120	0.10	1.1	−0.02	0.08
1.140	0.10	1.1	−0.04	0.06
1.160	0.10	1.1	−0.05	0.04

What happen to the exchange rates, $/€, if the € interest rates is raised to 10% from 5%?

$$i^{€} + \frac{ex_{t+1}^{\$/€}}{ex_{t}^{\$/€}} - 1 = \Delta A_{t+1}$$

The schedule for the return of EURO asset shifts rightward by 5%. At the exchange rate at 1.05, the return on EURO assets is now 0.15, higher than that of the US asset and creates excess demand for the EURO assets. This excess demand leads to an appreciation in EURO today in year t, which makes EURO appreciation smaller from year t to year t+1. As a consequence, the return on EURO assets fall back to 10%.



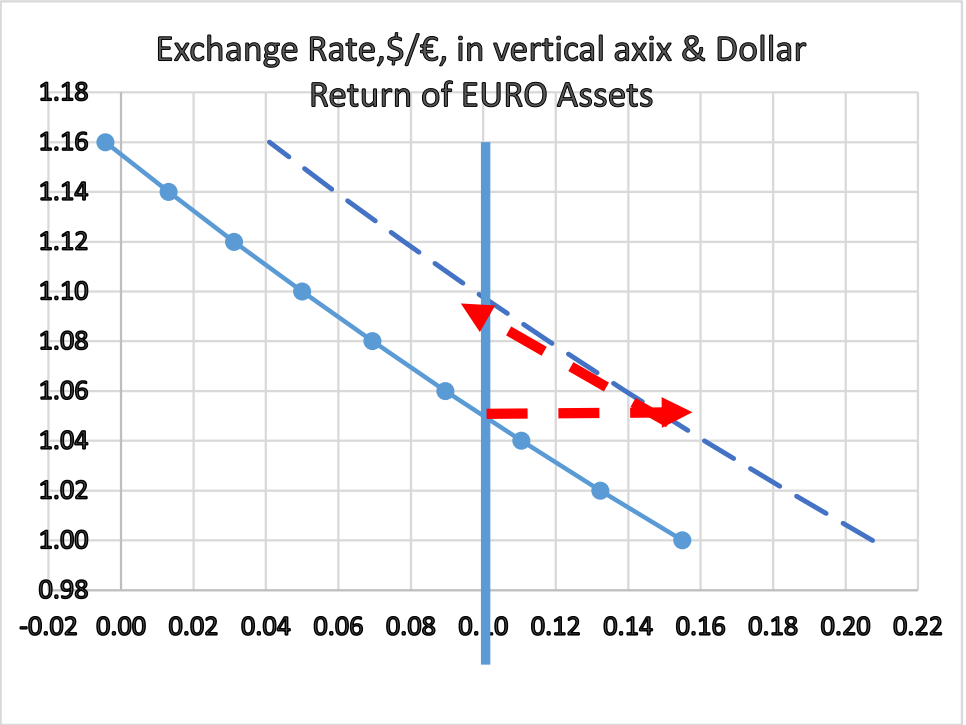
$/€ Today	i_EURO	$/€ in t+1	Rate of Depreciation	Expected Return on EURO assets
1.000	0.05	1.1	0.10	0.16
1.020	0.05	1.1	0.08	0.13
1.040	0.05	1.1	0.06	0.11
1.060	0.05	1.1	0.04	0.09
1.080	0.05	1.1	0.02	0.07
1.100	0.05	1.1	0.00	0.05
1.120	0.05	1.1	−0.02	0.03
1.140	0.05	1.1	−0.04	0.01
1.160	0.05	1.1	−0.05	0.00

$/€ Today	i_EURO	$/€ in t+1	Rate of Depreciation	Expected Return on EURO assets
1.000	0.05	1.15	0.15	0.21
1.020	0.05	1.15	0.13	0.18
1.040	0.05	1.15	0.11	0.16
1.060	0.05	1.15	0.08	0.14
1.080	0.05	1.15	0.06	0.12
1.100	0.05	1.15	0.05	0.10
1.120	0.05	1.15	0.03	0.08
1.140	0.05	1.15	0.01	0.06
1.160	0.05	1.15	−0.01	0.04

What happen if the expected exchange rate changes, expected appreciation of EURO?

$$i^{€} + \frac{ex_{t+1}^{\$/€}}{ex_{t}^{\$/€}} - 1 = \Delta A_{t+1}$$

EURO is expected to appreciate more from 1.1 to 1.15 (EURO/$) in year t +1 even more, shifting the EURO return schedule rightward. With the same exchange rate 1.05 in year t as before and 1.15 in year t+1 , the EURO return is higher than that on the US asset and creates excess demand for EURO asset. This leads to appreciation of EURO which lower the return of EURO assets in year t+1. The appreciation of EURO continues until the return on EURO asset is equal to that on the US asset.



Interest Parity Condition

$$(1 + i^{€}) \frac{ex_{t+1}}{ex_t} = \frac{A_{t+1}}{A_t} = (1 + i^{\$})$$

Assets

- Assets are the form of wealth, a way of transferring purchasing power from the present to the future.

- The price of an asset is related to the purchasing power over gods and services that buyers expect them to yield in the future.