3543 Fiscal and Financial System in Japan A / KC3002 International Finance

Fall 2013

Lecture 3(Oct 4)
Exchange Rates:
Equilibrium in the FX Market(cont.)

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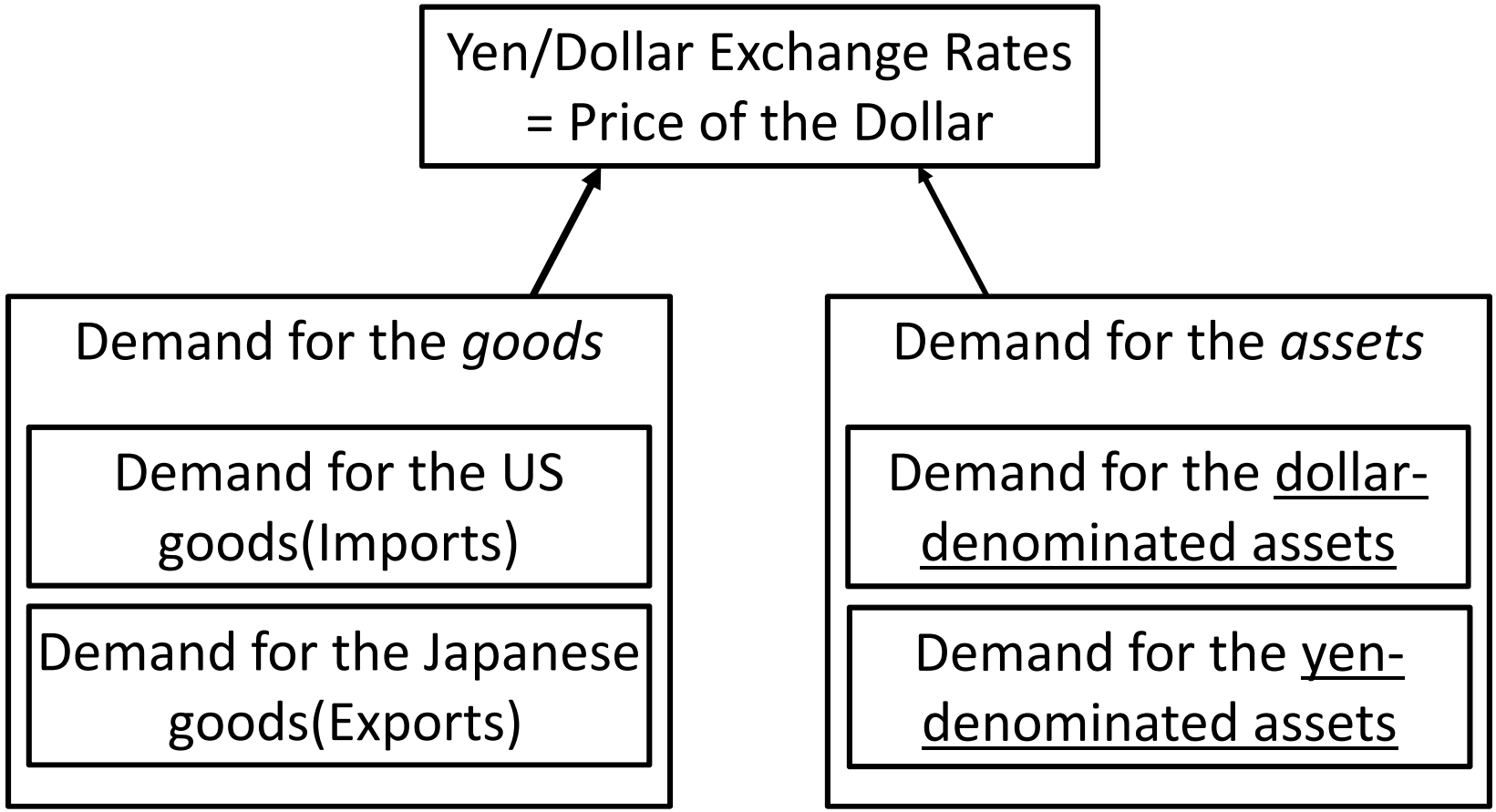
Demand and Supply of Dollars

The exchange rate is the “price” of one currency measured in terms of another currency.



Domestic and Foreign Assets

There exist financial assets denominated in different currencies, and you can diversify your portfolio.

Your total wealth and its composition

Dollar-Denominated Asset（ドル建資産）:

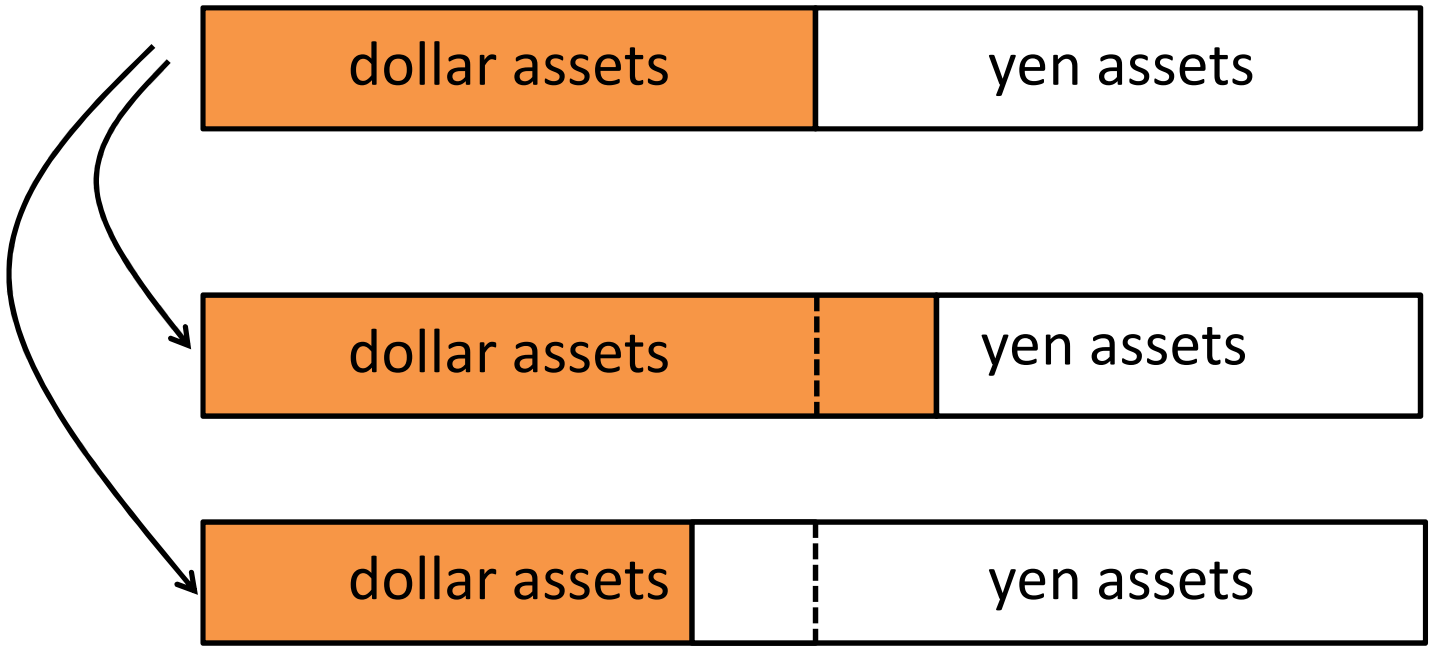
An asset which is bought with dollars, pays out interest in dollars, and is finally redeemed in dollars.

Yen-Denominated Asset（円建資産）:

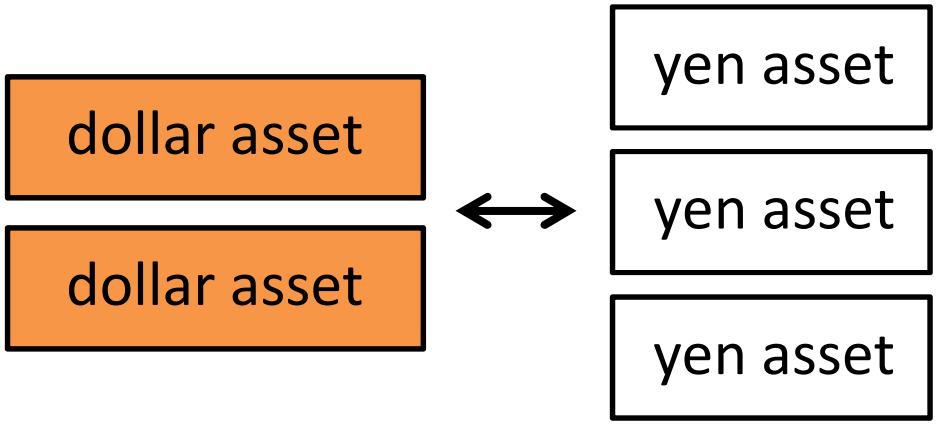
An asset which is bought with yens, pays out interest in yens, and is finally redeemed in yens.

Demands for Assets

When, for some reason, you want to have more[fewer] dollar assets, you need to exchange part of your yen[dollar] assets for someone else's dollar[yen] assets.



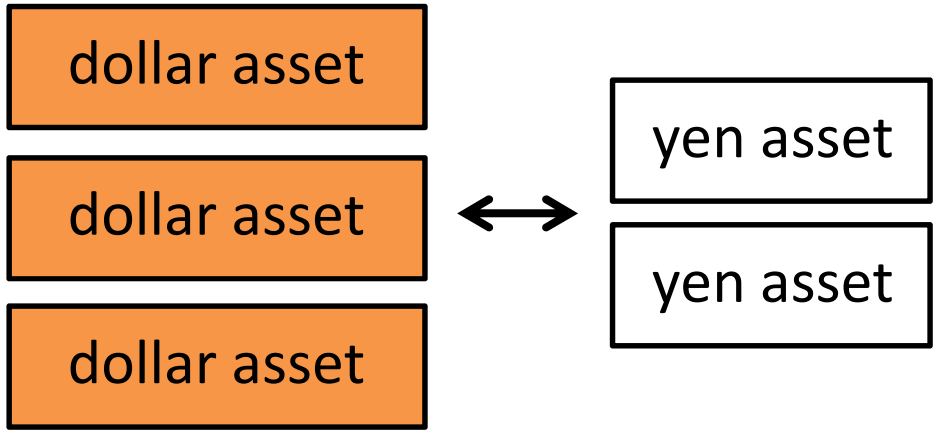
Asset Demand and Exchange Rates



People want to have more *dollar* assets.

The dollar is relatively scarce.

→ The dollar appreciates.



People want to have more *yen* assets.

The dollar is relatively abundant.

→ The dollar depreciates.

Asset Approach

"(Goods) export and import transactions are small relative to the amount of domestic and foreign assets at any given time. For example, foreign exchange transactions in the United States each year are well over 25 times greater than the amount of U.S. exports and imports (of goods). "
(Mishkin, p.511)

In the short run, the price of the dollar is mainly affected by the demand for the dollar and yen **assets**, rather than the demand for the US and Japanese **goods**.

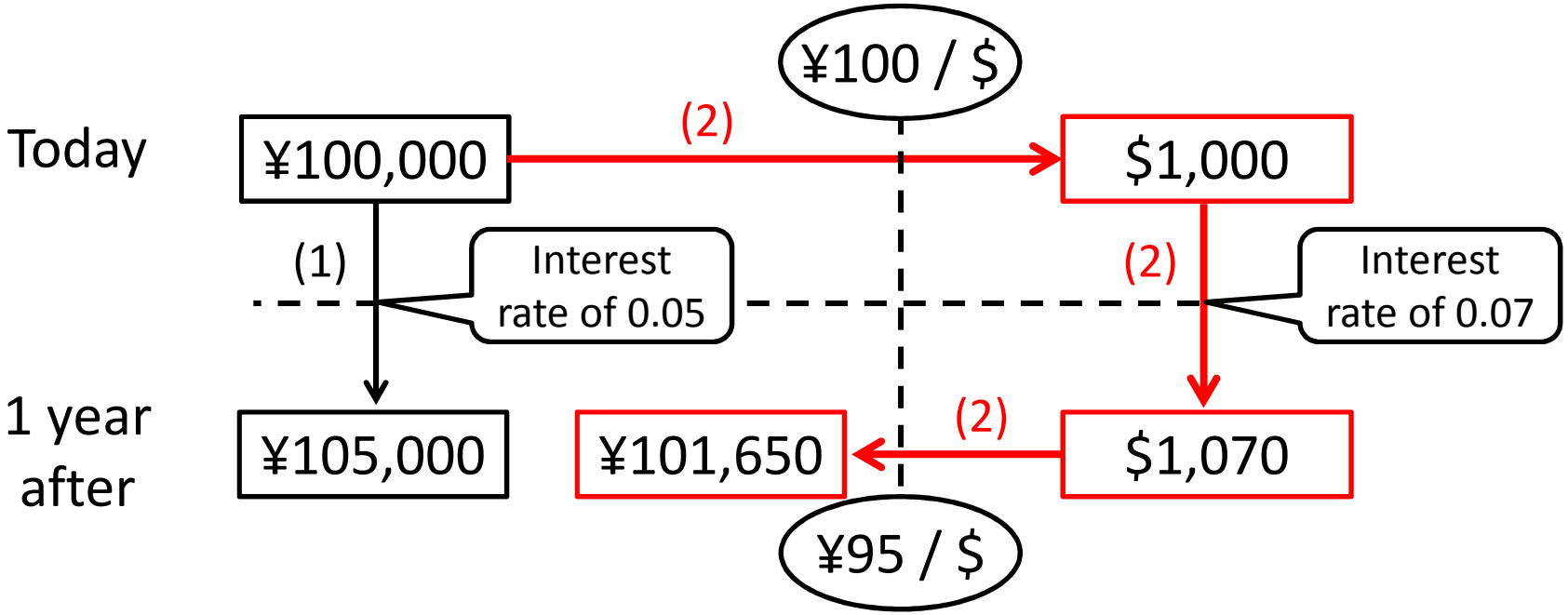
➔ *Asset Approach* to the Short-term Exchange Rate Determination

Comparison of the Dollar and Yen Assets

Two alternatives:

(1) to hold the yen asset with a 5% interest or

(2) to exchange it for a dollar asset with a 7% interest.



To compare the two alternative assets(investments), the values must be expressed *in the same currency*.

Formula for the Yen Return on Dollar Asset

$$\text{Expected rate of } \textit{yen} \text{ return on a dollar asset} \approx i^{*} + \frac{E_1^e - E_0}{E_0}$$

$$\approx \boxed{\text{Interest rate on a dollar asset}} + \boxed{\text{Expected rate of dollar appreciation}}$$

Generally, the *yen* return on a dollar denominated asset is **not** equal to the interest rate of a dollar denominated asset.

It's because, while the asset earns *dollar* interest, the dollar itself *gains or loses its value(appreciates or depreciates) against the yen*.

Examples

$E_1^e = 98 \quad E_0 = 100 \quad i^* = 0.03$

Expected y*en* return on a dollar asset $\approx 0.03 + \frac{98-100}{100} = 0.03 + (-0.02) = 0.01$

$E_1^e = 98 \quad E_0 = 95 \quad i^* = 0.01$

Expected y*en* return on a dollar asset $\approx 0.01 + \frac{98-95}{95} = 0.01 + 0.0316 = 0.0416$

$E_1^e = 95 \quad E_0 = 95 \quad i^* = 0.01$

Expected y*en* return on a dollar asset $\approx 0.01 + \frac{95-95}{95} = 0.01 + 0 = 0.01$

What Affects Return on Dollar Assets?

$$\text{Expected rate of } \textit{yen} \text{ return on a dollar asset} \approx \underset{(1)}{i^*} + \frac{\overset{(3)}{E_1^e} - \overset{(2)}{E_0}}{E_0}$$

All else equal;

1. an increase in the interest paid on dollar-denominated assets raises the expected rate of yen return;
2. a depreciation of the "current" dollar raises the expected rate of yen return;
3. a depreciation of the "future" dollar lowers the expected rate of yen return.

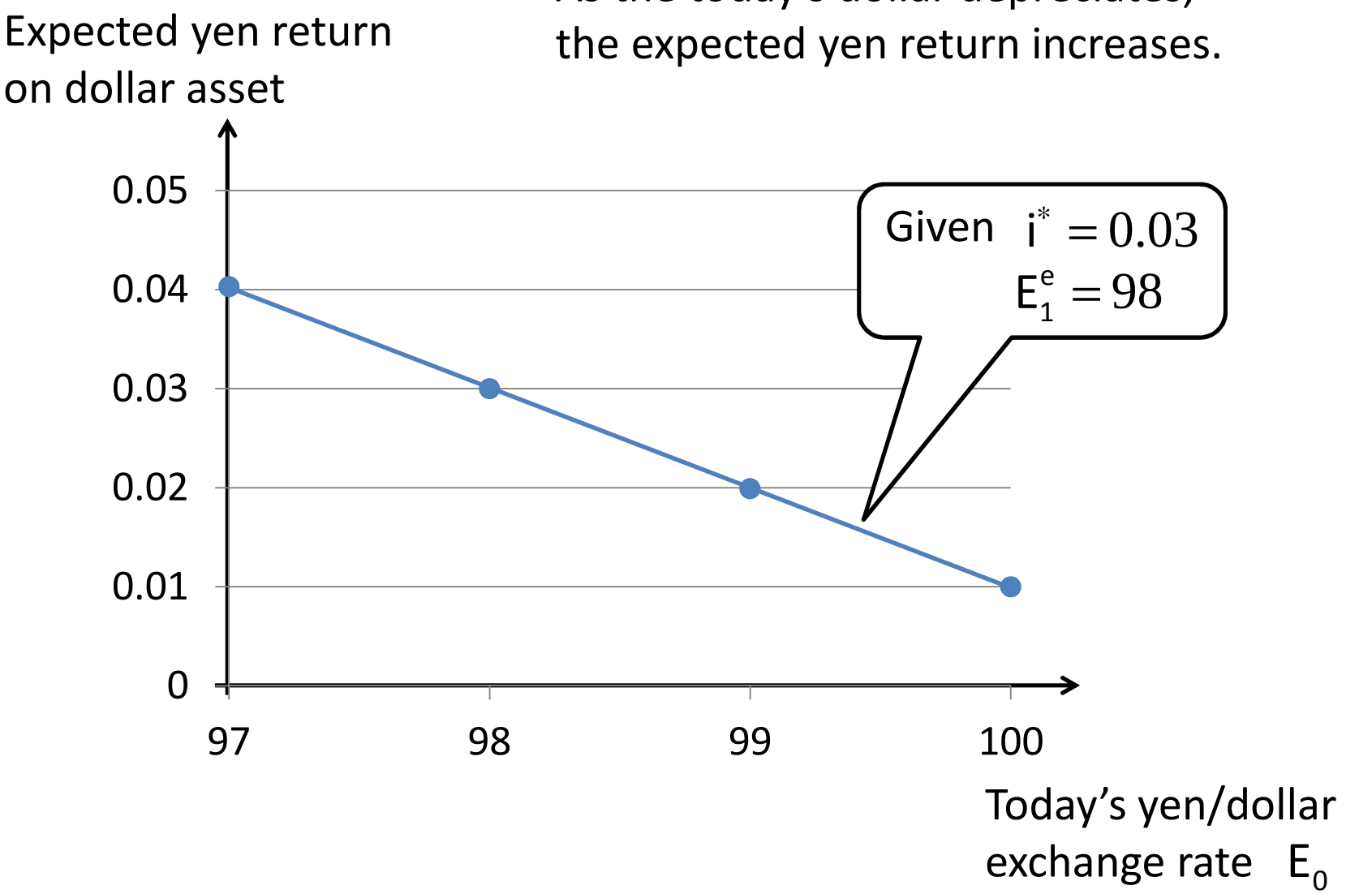
Depreciation of the Current Dollar

How do changes in the current exchange rate affect the expected yen return on a dollar asset, holding the dollar interest rate and the future exchange rate constant, $i = 0.03, E_1^e = 98$?

$$\text{Expected } y\textit{en} \text{ return on a dollar asset} \approx 0.03 + \frac{98 - E_0}{E_0}$$

Today's yen/dollar exchange rate	Expected yen/dollar exchange rate	Expected yen return on a dollar assets
100	98	0.01
99	98	0.02
98	98	0.03
97	98	0.04

As the today's dollar depreciates, the expected yen return increases.



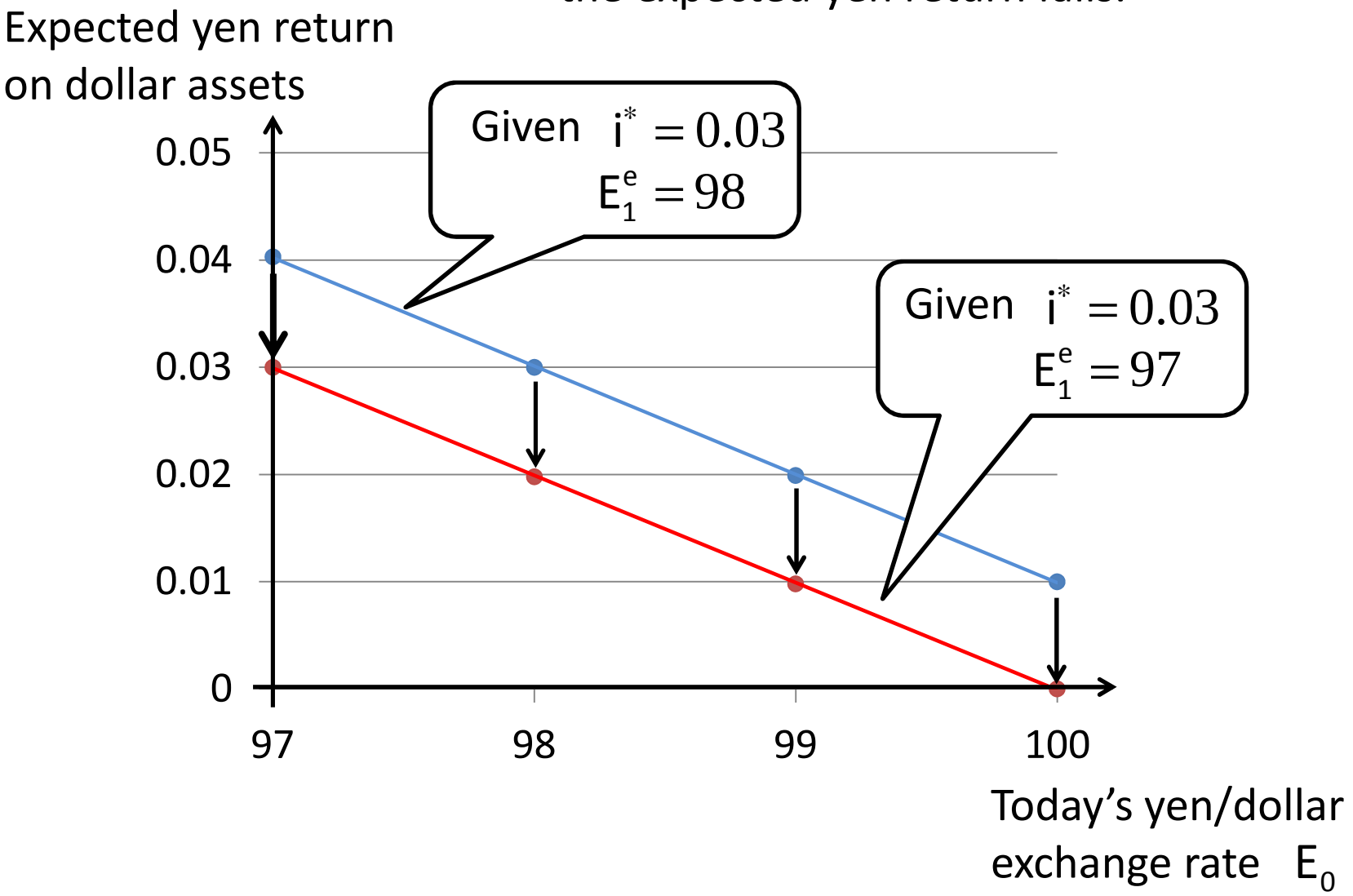
Depreciation of the Future Dollar

How do changes in the expected future exchange rate affect the expected yen return on a dollar asset, holding the interest rate and the today's exchange rate constant, $i^* = 0.03, E_0 = 100$?

$$\text{Expected } y\textit{en} \text{ return on a dollar asset} \approx 0.03 + \frac{E_1^e - 100}{100}$$

Today's yen/dollar exchange rate	Expected yen/dollar exchange rate	Expected yen return on a dollar asset
100	100	0.03
100	99	0.02
100	98	0.01
100	97	0

As the future dollar depreciates, the expected yen return falls.



Assumptions on Investors' Behavior

Assumption 1: Perfect Substitutes

Investors view the dollar and yen denominated assets as equally desirable, if the returns are equal.
Investors do not prefer assets denominated in one particular currency to those denominated in another currency.

Assumption 2: Risk Neutrality

Investors care only about the expected returns, though uncertain.

A1 and A2 jointly imply that if the expected return on dollar assets is higher than that on yen assets, both US and Japanese investors want to hold only dollar assets and are never willing to hold yen assets.

Determination of the Exchange Rate: Interest Parity Condition

Given E_1^e, i, i^*,
if the current exchange rate satisfies the interest parity condition,

$$\begin{pmatrix}\text{Expected } \textit{yen} \text{ return} \\ \text{on a yen asset}\end{pmatrix} \quad i \quad = \quad i^* + \frac{E_1^e - E_0}{E_0} \quad \begin{pmatrix}\text{Expected } \textit{yen} \text{ return} \\ \text{on a dollar asset}\end{pmatrix}$$

assets of both currencies offer the same expected rate of return measured in yens, no one has the incentive to exchange assets in one currency with another, and the exchange rate stays.

Given E_1^e, i, i^*, the interest parity condition determines the yen/dollar exchange rate.

Numerical Example 1

$E_1^e = 98 \qquad i = 0.02$

$E_0 = 100 \qquad i^* = 0.03$

Expected y*en* return on a dollar asset $\approx 0.03 + \dfrac{98 - 100}{100} = 0.01 \; < \; i = 0.02$

1. Investors try to exchange their dollar assets for someone else's yen assets.
2. More dollar assets must be exchanged for yen assets.
3. The dollar begins to depreciate against the yen.

4. As the dollar depreciates, the expected yen return on dollar assets rises.
5. When the dollar depreciates to ¥99/$, the expected yen return on dollar assets is equal to the yen interest rate.

$$\text{Expected y}\textit{en}\text{ return on a dollar asset} \approx 0.03 + \frac{98 - 99}{99} = 0.02$$

The dollar and the yen assets are perfectly the same, and no one wants to exchange one for another.

Then, the exchange rate no more changes at ¥99/$.

Numerical Example 2

$E_1^e = 98 \qquad i = 0.02$

$E_0 = 98 \qquad i^* = 0.03$

Expected y*en* return on a dollar asset $\approx 0.03 + \dfrac{98 - 98}{98} = 0.03 \quad > \quad i = 0.02$

1. Investors try to exchange their yen assets for someone else's dollar assets.
2. Less dollar assets must be exchanged for yen assets.
3. The dollar begins to appreciate against the yen.

4. As the dollar appreciates, the expected yen return on dollar assets falls.
5. When the dollar appreciates to ¥99/$, the expected yen return on dollar assets is equal to the yen interest rate.

$$\text{Expected y}\textit{en}\text{ return on a dollar asset} \approx 0.03 + \frac{98 - 99}{99} = 0.02$$

The dollar and the yen assets are no different, and no one needs to exchange one for another.
Then, the exchange rate no more changes and stays at ¥99/$.

Equilibrium in the FX Market

$E_1^e = 98 \qquad i = 0.02$

$E_0 = 99 \qquad i^* = 0.03$

Expected y*en* return on a dollar asset $\approx 0.03 + \frac{98 - 99}{98} = 0.02 \quad = \quad i = 0.02$

1. The dollar and yen assets are equivalent for investors.
2. Investors are willing to hold both assets.
3. No pressure on the exchange rates to change.

The market is *in equilibrium*, when people are all satisfied and have no incentive to take another action.

- At a higher exchange rate than ¥99/$, investors are never willing to hold the dollar assets, and the dollar depreciates.

- At a lower exchange rate, investors are never willing to hold the yen assets, and the dollar appreciates.

- At an exchange rate of ¥99/$, investors are willing to hold both assets, and the yen/dollar rate stays unchanged.

The yen/dollar rate is determined such that the expected yen returns on the dollar and yen assets are equal, given the yen and dollar interest rates and the expected future rate.

→ *Equilibrium* Exchange Rate

Equilibrium Exchange Rate: Example

Given $E_1^e = 102, i = 0.02, i^* = 0.03,$

what should be the current exchange rate in theory?

1. Substitute E_1^e, i, i^* into the interest parity condition.

$$0.02 = 0.03 + \frac{102 - E_0}{E_0}$$

2. Find E_0 that satisfies the equation.
   Mathematically, it' equivalent to solving the equation with respect to E_0.

$$0.02 = 0.03 + \frac{102 - E_0}{E_0}$$ Subtract 0.03 from both sides.

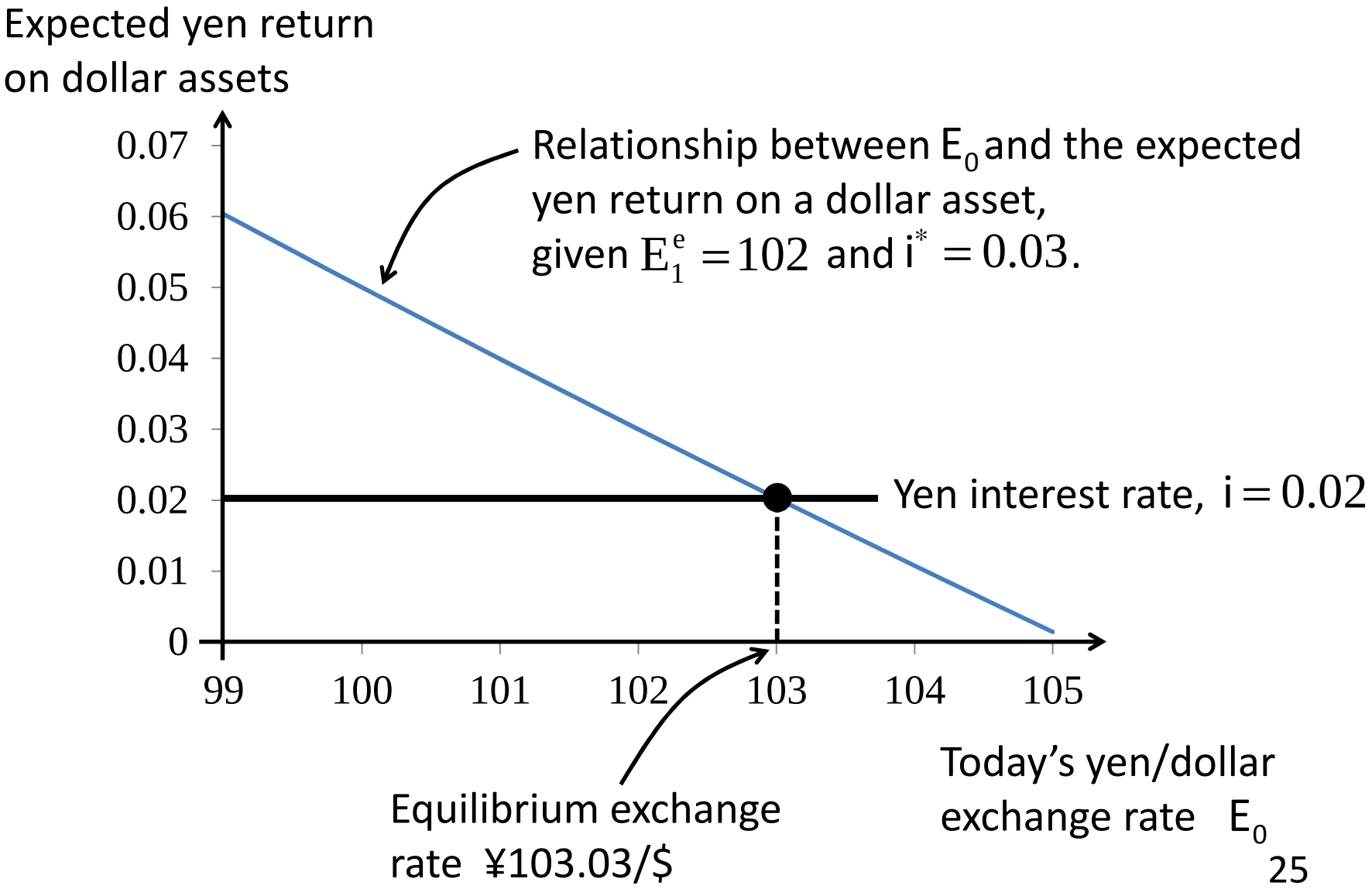
$$-0.01 = \frac{102 - E_0}{E_0}$$ Multiply both sides by E_0.

$$-0.01 \times E_0 = 102 - E_0$$ Add E_0 to both sides.

$$0.99E_0 = 102$$ Divide both sides by E_0.

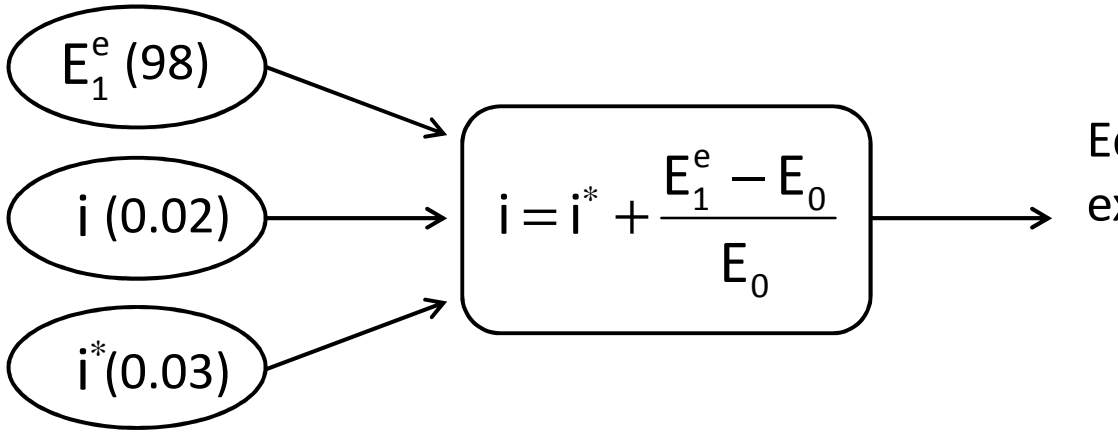
$$E_0 = \frac{102}{0.99} \approx 103.03$$

Equilibrium Exchange Rate: Graphical Representation



Changes in Equilibrium Exchange Rates

Given E_1^e, i, i^*, the interest parity condition determines the equilibrium yen/dollar exchange rate.



Changes in E_1^e, i, or i^* change the equilibrium yen/dollar exchange rate.

Rise in Yen Interest Rate

$E_1^e = 98$ $\quad i = 0.02 \rightarrow 0.03$

$E_0 = 99$ $\quad i^* = 0.03$

1. A rise in the yen interest rate raises the return on yen assets above the yen return on dollar assets.

$$\text{Expected } y\textit{en} \text{ return on a dollar asset} \approx 0.03 + \frac{98 - 99}{99} = 0.02 \quad < \quad i = 0.03$$

2. Investors try to exchange their dollar assets for yen assets, then the dollar begins to depreciate.
3. When the dollar depreciates to ¥98/$, the expected returns are equal again and the exchange rate stays unchanged.

The equilibrium exchange rates declines from 99 to 98.

Rise in Dollar Interest Rate

$E_1^e = 98 \qquad i = 0.02$

$E_0 = 99 \qquad i^* = 0.03 \rightarrow 0.04$

1. A rise in the dollar interest rate raises the yen return on dollar assets above the return on yen assets.

   Expected y*en* return on a dollar asset $\approx 0.04 + \dfrac{98 - 99}{99} = 0.03 \quad > \quad i = 0.02$

2. Investors try to exchange their yen assets for dollar assets, then the dollar begins to appreciate.
3. When the dollar appreciates to ¥99.99/$, the expected returns are equal again and the exchange rate stays unchanged.

   The equilibrium exchange rates rises from 99 to 99.99.

Rise in Future Exchange Rate

$E_1^e = 98 \rightarrow 99 \qquad i = 0.02$

$E_0 = 99 \qquad\qquad i^* = 0.03$

1. A appreciation of the future dollar raises the yen return on dollar assets above the return on yen assets.

$$\text{Expected } y\textit{en} \text{ return on a dollar asset} \approx 0.03 + \frac{99 - 99}{99} = 0.03 \quad > \quad i = 0.02$$

2. Investors try to exchange their yen assets for dollar assets, then the dollar begins to appreciate.
3. When the dollar appreciates to ¥100/$, the expected returns are equal again and the exchange rate stays unchanged.

The equilibrium exchange rates rises from 99 to 100.

Events/Shocks	Effects on the equilibrium exchange rate
Rise in yen interest rate	Dollar's appreciation
Fall in yen interest rate	Dollar's depreciation
Rise in dollar interest rate	Dollar's appreciation
Fall in dollar interest rate	Dollar's depreciation
Appreciation of future dollar	Dollar's appreciation
Depreciation of future dollar	Dollar's depreciation

Do not just memorize the results.
You are expected to be able to derive them by yourself.

Rise in Yen Interest Rate: Graphical Representation

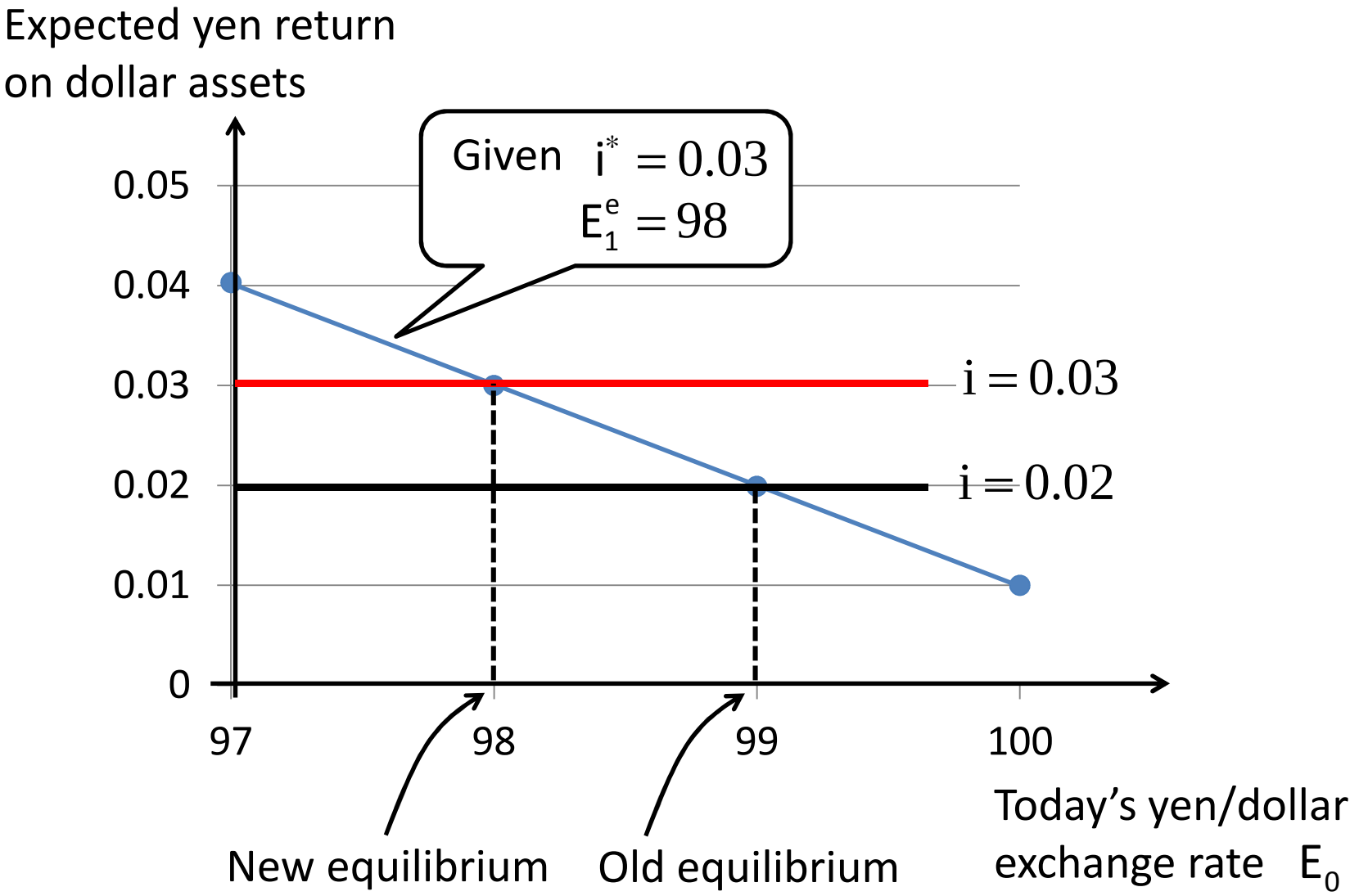
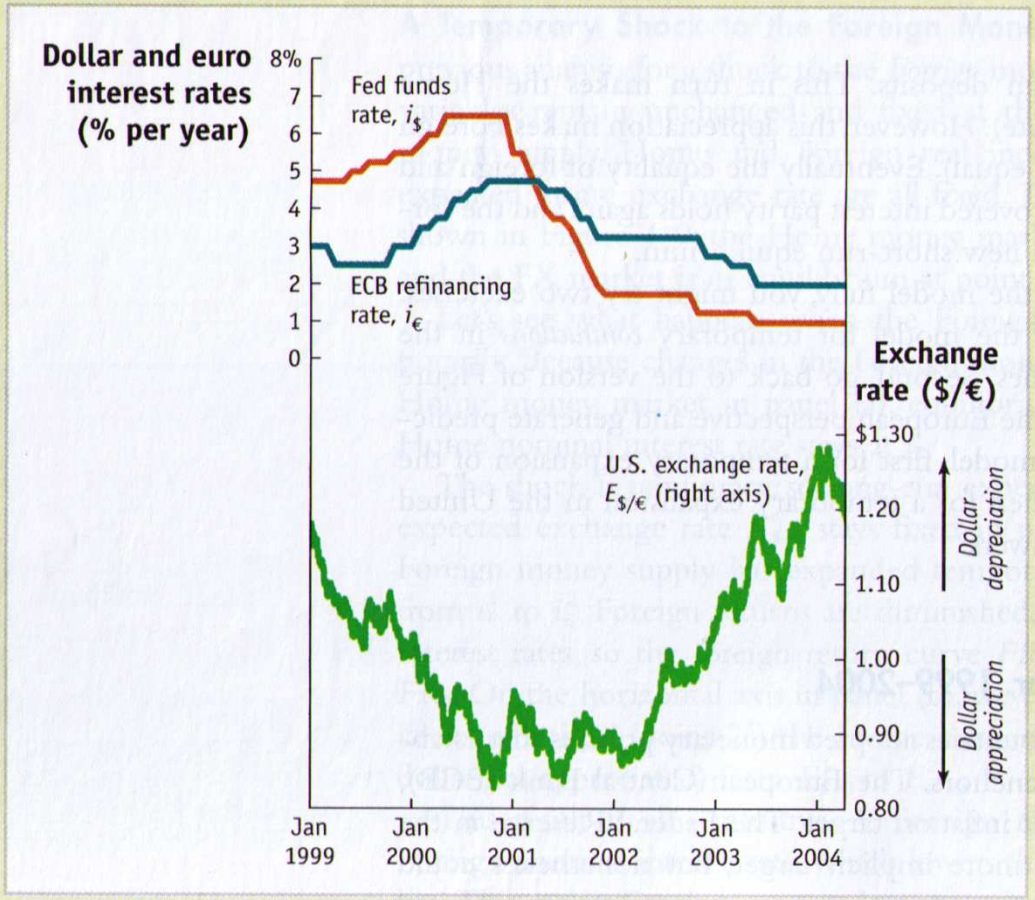


FIGURE 4-10



U.S.-Eurozone Interest Rates and Exchange Rates, 1999–2004 From the euro's birth in 1999 until 2001, the dollar steadily appreciated against the euro, as interest rates in the United States were raised well above those in Europe. In early 2001, however, the Federal Reserve began a long series of interest rate reductions. By 2002 the Fed Funds rate was well below the ECB's refinancing rate. Theory predicts a dollar appreciation (1999–2001) when U.S. interest rates were relatively high, followed by a dollar depreciation (2001–2004) when U.S. interest rates were relatively low. Looking at the figure, you will see that this is what occurred.

Sources: Websites of central banks; OANDA. Exchange rate is monthly average.

Feenstra and Taylor, *International Macroeconomics*, Worth Publishers, 2008.

Exercises(Homework, due on Oct 11)

$E_1^e = 98 \qquad i = 0.01 \qquad i^* = 0.04$

1. What is the equilibrium exchange rate?
2. Suppose the yen interest rate rises to 0.02. Find a new equilibrium exchange rate. Explain how the new equilibrium is attained.
3. Suppose the dollar interest rate falls to 0.03. Find a new equilibrium exchange rate. Explain how the new equilibrium is attained.
4. Suppose the expected future exchange rate rises to 100. Find a new equilibrium exchange rate. Explain how the new equilibrium is attained.

Anouncement

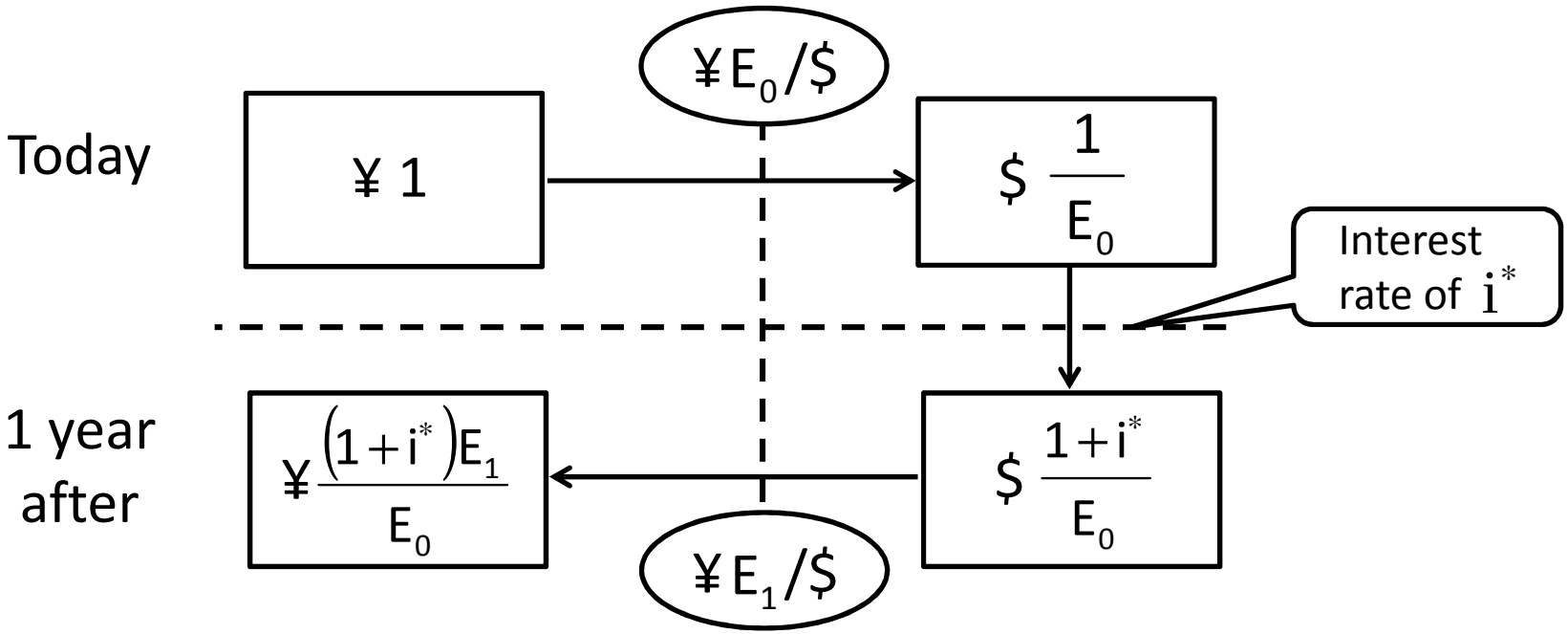
- Submit homework at the beginning of next class, typed and stapled.
- A quiz will be held at the beginning of next class (Oct 11). Covers Lecture 2 and 3 (exchange rate determination). Takes 10 minutes. Includes multiple choice questions and numerical calculations.

Derivation of the Formula

E_0 Today's yen/dollar rate

E_1 Yen/dollar rate a year after

i^* Interest rate on a dollar asset



Derivation of the Formula (cont.)

$$
\begin{aligned}
\frac{(1+i^\star)\,E_1}{E_0} - 1 &= (1+i^\star)\left(\frac{E_1 - E_0 + E_0}{E_0}\right) - 1 \\
&= (1+i^\star)\left(\frac{E_1 - E_0}{E_0} + \frac{E}{E_0}\right) - 1 \\
&= (1+i^\star)\left(\frac{E_1 - E_0}{E_0} + 1\right) - 1 \\
&= i^\star + \frac{E_1 - E_0}{E_0} + \underbrace{i^\star\left(\frac{E_1 - E_0}{E_0}\right)} \\
&\approx i^\star + \frac{E_1 - E_0}{E_0}
\end{aligned}
$$

Very minor and negligible.