# Open Economy Macroeconomics

## Exchange Rates, Interest Rates and Macro Policy

# Outline

1. Exchange Rates
2. Purchasing Power Parity
3. Uncovered Interest Parity
4. Monetary and Fiscal Policy in Open Economies

- Textbook Readings: Ch. 18 & Ch. 19 pp. 676-681

# How Economies Are Connected?

- **Goods** flow between nations
  - USA send corn to China
  - China sends flat screen TVs to USA
- **Services** flow between nations
  - USA processes European transactions via Mastercard
  - India fields questions on iPad usage via call centers
- **Financial assets** flow between nations
  - China's central bank (PBoC) bought billions of U.S. Treasuries
  - U.S. companies invest billions of dollars building factories in China

# Balance of Payments

- Records all transactions with foreign economic agents over a period of time

- 3 main types of transactions:
  - Exports and imports of **G&S** → Current Account (CA)
  - Sale and purchase of **financial assets** → Financial Account (FA)
  - Certain **transfers of wealth** (small) → Capital Account (KA)

- Balance of payments (BoP) has to balance:

$$BoP = CA + FA + KA = 0$$

# Why Does the BoP Has to Balance?

- CA captures transactions of G&S → Think EX – IM
  - Related to net exports (or the trade balance), but is not the same
  - Recall how do we go from GDP to GNP?
  - NFIA (Net Factor Income from Abroad) = FP from ROW – FP to ROW
  - To obtain GNP, we add NFIA to GDP
  - CA = NX + NFIA

- FA captures how that is financed → Think Inflows – Outflows
  - A measure of international lending and borrowing
  - International financial flows

# Why Does the BoP Has to Balance? Example

- US people buy $475b worth of Chinese goods every year
- Chinese people buy $115b worth of US goods every year
- What does China do with the rest $360b?
- China receives $360b of US assets
  - PBoC buys T-bonds,
  - Chinese elites buy US stocks and Seattle real state

# CA Deficit/Surplus → FA Surplus/Deficit

- A **CA deficit** must be offset by an **FA surplus** (e.g. US)
  - In September 2017, US bought $43b more G&S than sold to ROW
  - Therefore, ROW purchases of US assets must have been $43b higher than US purchases of ROW assets
    - US invests in factories in China and buys European stocks
    - ROW buys US Treasuries, shares of US companies, houses in Florida
- A **CA surplus** must be offset by an **FA deficit** (e.g. China)

# Saving and Investment in an Open Economy

- In a closed economy, we saw that:

$$S = I$$

- In an open economy we have (CA identity):

$$CA = S - I \qquad \text{or} \qquad I = S - CA$$

- What does the CA identity say?

# Net Foreign Asset Position

- BoP records a **flow** (not a stock)

- Net foreign asset (NFA) position is a **stock**
  - Value of US-owned foreign assets - Value of foreign-owned US assets
  - Also called Net International Investment (NII) position or External Wealth
  - A CA deficit reduces NFA position and vice versa
  - NFA < 0 ⟶ Debtor country

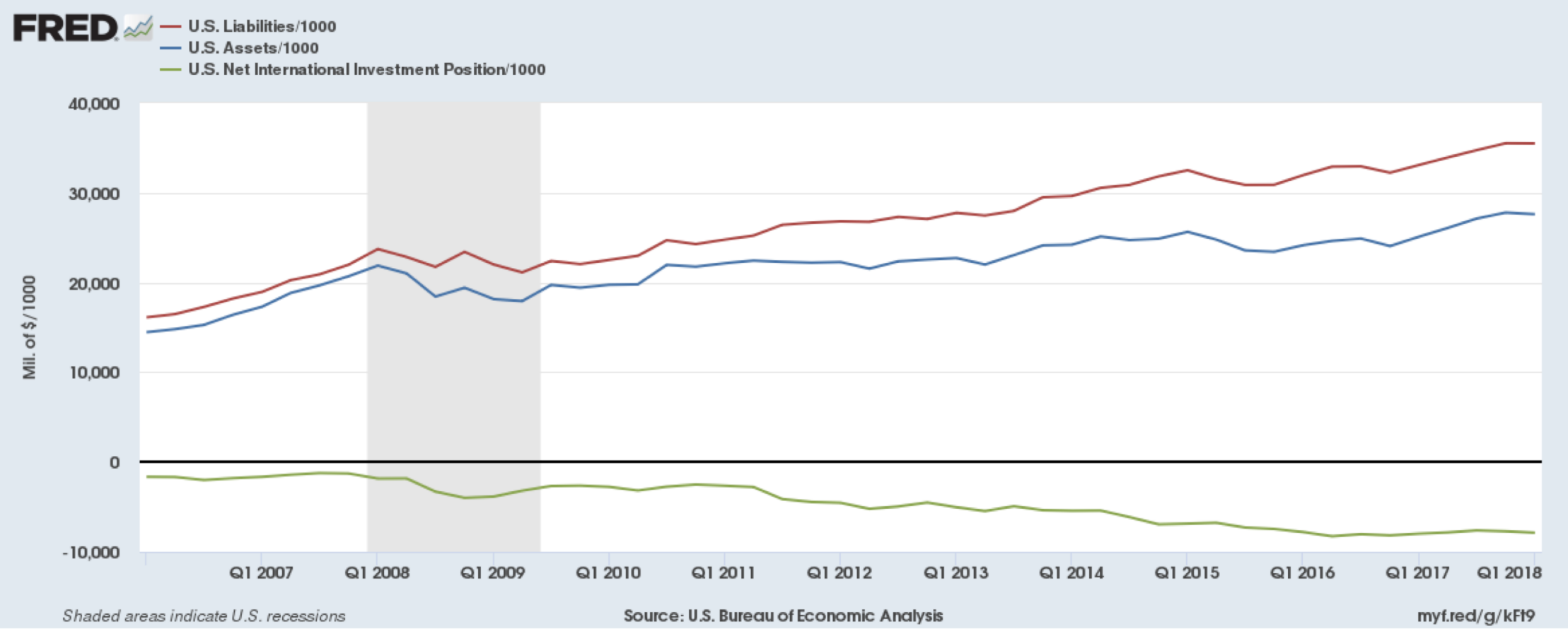
- US is a **net debtor** to the world, China is a **net lender** to the world

# The World is Much More "Inter-Owned"

- US consistently has CA deficits ➞ Net debtor position has grown
- However, US also owns a large sum of ROW assets
- Net debtor position is small relative to gross assets and liabilities
  - Surge in gross flows

| | 2000 | 2017 |
|---|---|---|
| U.S. net debtor status ($ trillions) | -1.3 | -8.1 |
| U.S. net debtor status (share of GDP) | -0.10 | -0.43 |
| | | |
| U.S. owned foreign assets ($ trillions) | 6.2 | 26.1 |
| U.S. owned foreign assets (share of GDP) | 0.49 | 1.36 |
| | | |
| | | |
| Foreign owned U.S. assets ($ trillions) | -7.6 | -34.4 |
| Foreign owned U.S. assets (share of GDP) | -0.61 | -1.80 |

# U.S. As A Net Debtor



# NFA Position: Return on Assets

- Despite the US **net debtor** status, it collects more on its assets than what it pays on its liabilities
  - **Income received** in US investments abroad:

    $783bn in 2015 on $25tr → US Return of Assets: 3.1%
  - **Income paid** of foreign owned US assets:

    $600.5b in 2015 on $33tr → ROW Return of Assets: 1.8%

- Why does the US have a much better ROA?
  - US owns factories around the world
  - Foreigners own US Treasury securities

# Exchange Rates

- When selling a good, a service or a financial asset, foreigners will often want to be paid in their own currency

- **Nominal exchange rate**: Value of one currency in terms of another

- They matter because they affect the **relative prices** in different markets:
  - Labor → Employment
  - Goods → International trade
  - Financial assets → International finance

# Notation

- Exchange rates can be **expressed in two ways**
  - **Example**: If one US dollar can purchase 100 Japanese yen, then the exchange rate is ¥100 = $1; or alternatively ¥1 = $0.01

- Our **notation**:

$$E_{¥/\$} = 100 \quad \text{or} \quad E_{\$/¥} = 0.01$$

- **Warning**: Convention in the market uses the opposite notation
  - **Example**: Our $E_{¥/\$}$ is quoted as $E_{USDJPY}$ in the market

# Exchange Rate Quotations

| August 14, 2015 | | |
|---|---|---|
| Currency (XYZ) | Units of Foreign Currency per USD (How many XYZ can be purchased with $1 or how many XYZ are needed to buy $1) | USD per Unit of Foreign Currency (How many dollars can be purchased with 1 XYZ or how many dollars are needed to buy 1 XYZ) |
| Japanese yen | **124.32** | 0.008 |
| Chinese renminbi (or yuan) | **6.39** | 0.156 |
| British pound | 0.64 | **1.56** |
| Euro (used by 19 countries) | 0.90 | **1.11** |

# Using Exchange Rates

- Assume the value of euros **in terms of dollars** is $E_{\$/€} = 1.25$
- A foreigner has €40, how many dollars can she buy?

$$€40 \times E_{\$/€} = €40 \times 1.25 = \$50$$

- If you have $65, how many euros can you buy?

$$\$65 \times \frac{1}{E_{\$/€}} = \$65 \times E_{€/\$} = \$65 \times 0.8 = €52$$

- If you want to buy €100, how many dollars do you need?

$$\$?? \times 0.8 = €100 \rightarrow \$125$$

# Exchange Rates: Volatile Relative Prices of Currencies

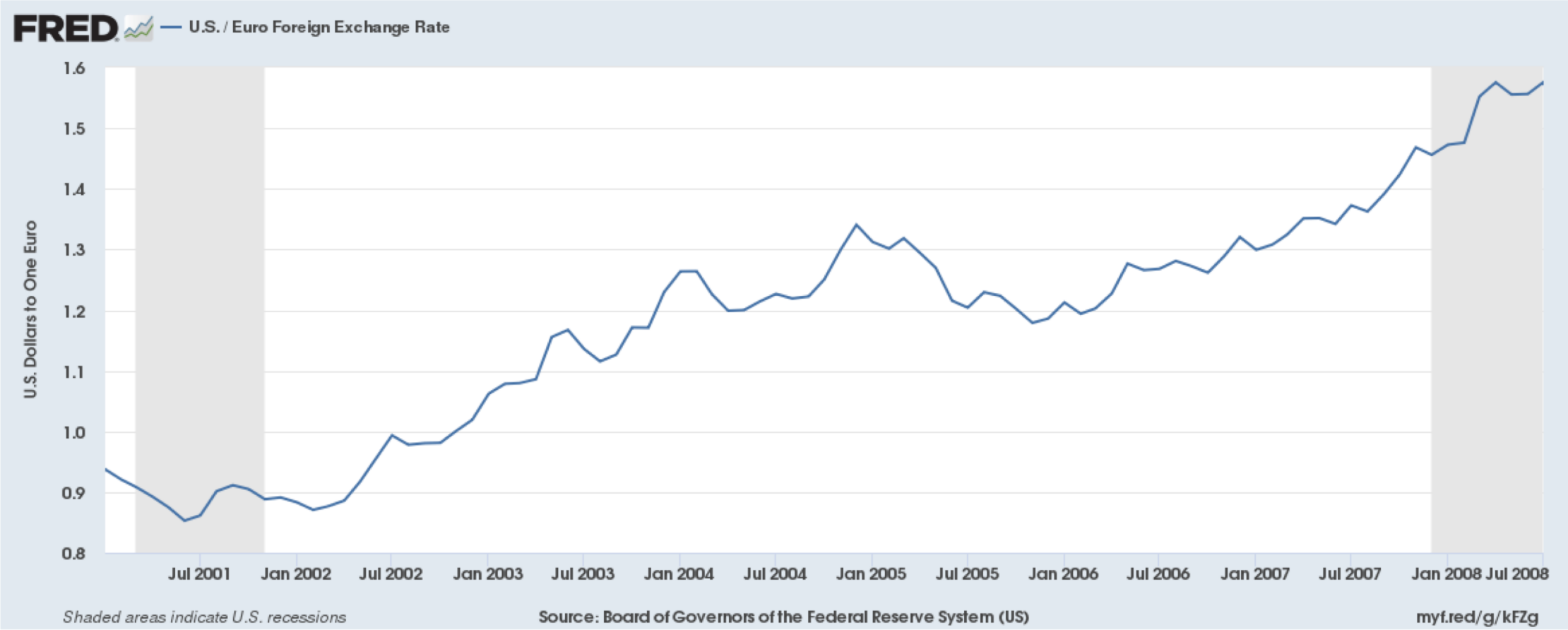
| | Euro (Euro area) | Yen (Japan) | Renminbi (China) | Ruble (Russia) |
|---|---|---|---|---|
| Q4:2006 | 1.32$/€ | 120Y/$ | 7.8R/$ | 26.3RB/$ |
| Q4:2012 | 1.32$/€ | 85Y/$ | 6.3R/$ | 30.3RB/$ |
| Q4:2016 | 1.07$/€ | 109Y/$ | 6.9R/$ | 64.8RB/$ |

# Appreciation and Depreciation

- Currency **appreciates** when it **increases** in value relative to another
- Currency **depreciates** when it **decreases** in value relative to another
- Sometimes ‘stronger’ and ‘weaker’ is used

- **Example**:
  - If the exchange rate changes from ¥ 100 = $1 to ¥ 120 = $1, which currency **appreciated**?
  - If the exchange rate changes from ¥ 1 = $ 0.010 to ¥ 1 = $ 0.015, which currency **depreciated**?

# What Happen to the US Dollar 2001-2008?



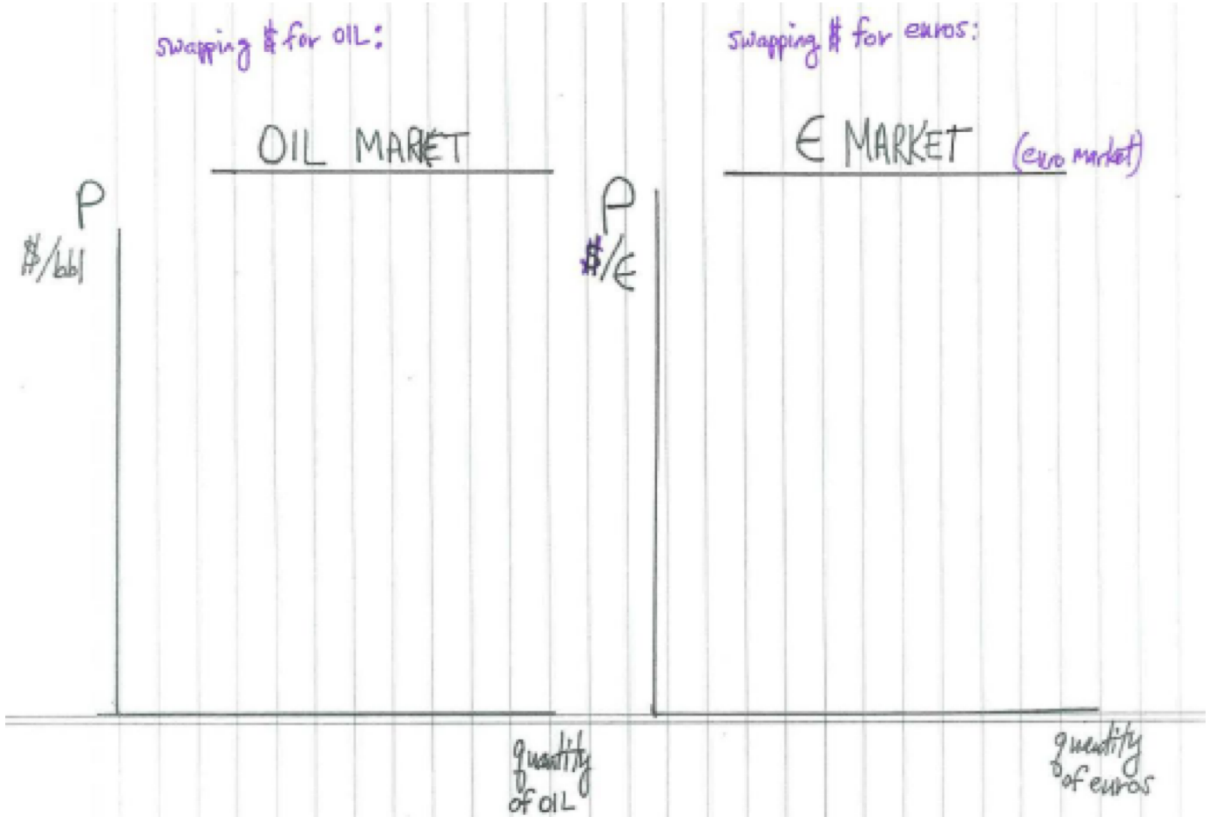
# Is a Strong Dollar Better than a Weak Dollar?

- The words “strong” and “weak” can **mislead** people to believe that an appreciating currency is always better for the economy
- There is no simple connection between the strength of a country’s currency and the strength of its economy
- **Swings in exchange rates** create **both winners and losers**

| | | |
|---|---|---|
| With a depreciation of the dollar | EX are cheaper<br>IM are expensive | $NX \uparrow$ |
| With an appreciation of the dollar | EX are expensive<br>IM are cheaper | $NX \downarrow$ |

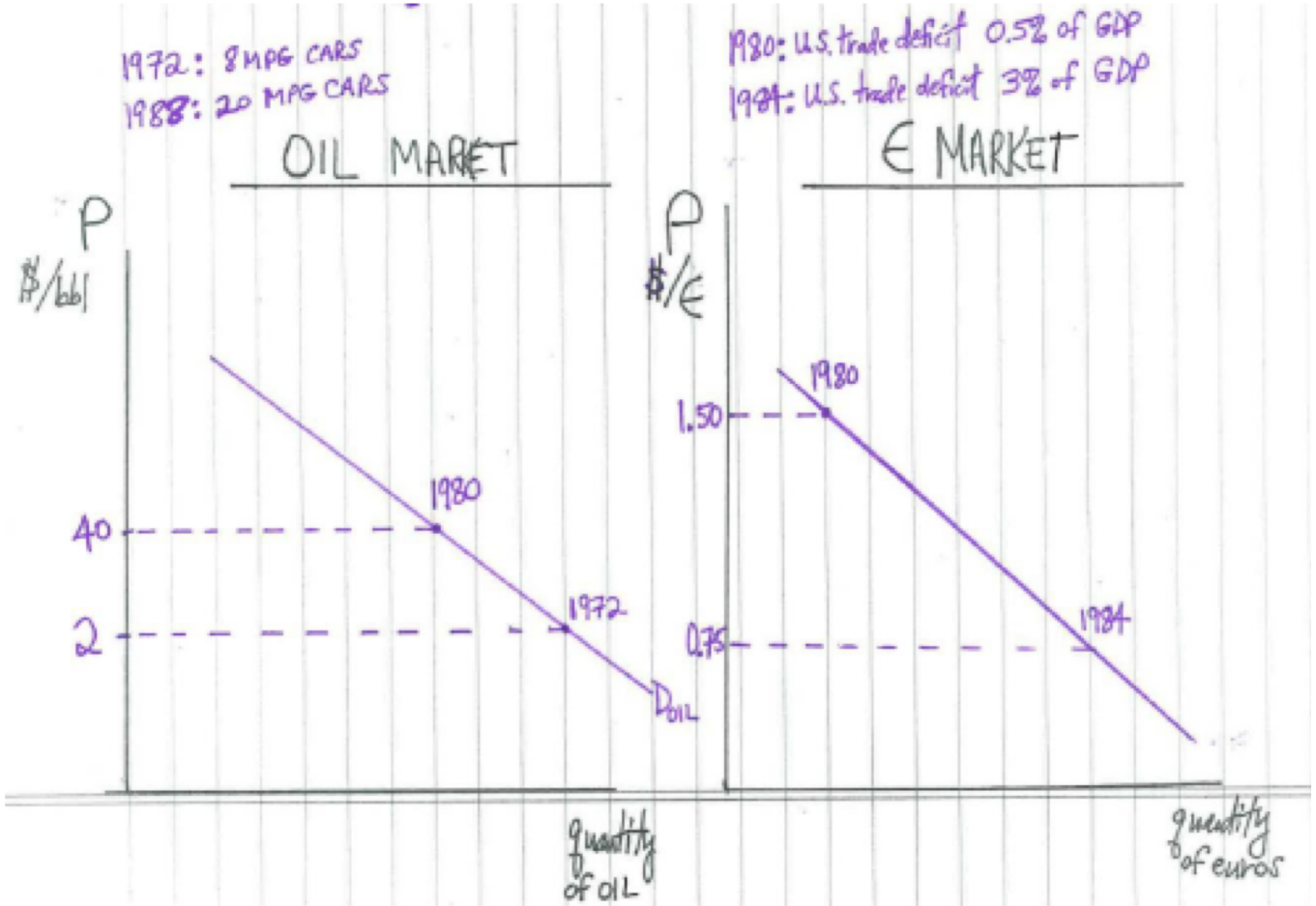
# The Market for Euros

- We can think about exchange rates using supply/demand curves
- The market for euros is just like any other market



# Downward Sloping Demand for Currency

- 1972-1980 surge in oil prices
  - Sharp reduction in demand
- 1980-1984 price of European currencies plunged
  - Surge in buying of those currencies
  - Facilitated buying of European goods by US citizens

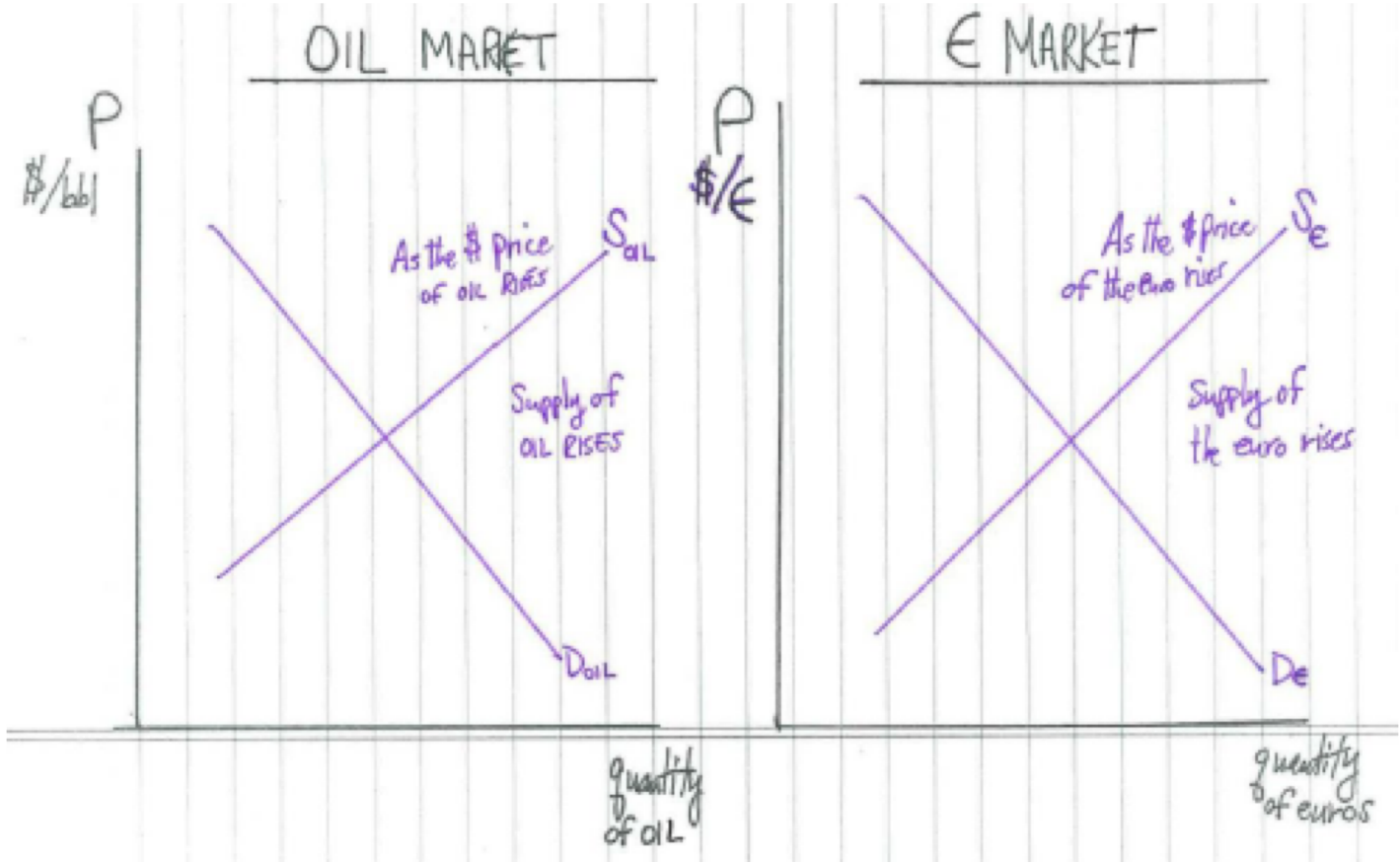


# Upward Sloping Supply for Currency

- If oil price leaps (e.g. $100), output soars
- If the price of the euro soars, it means that you get more dollars per euro
  - The **purchasing power** of the € **jumps**
  - You swap your euros for dollars to buy **cheap US goods**

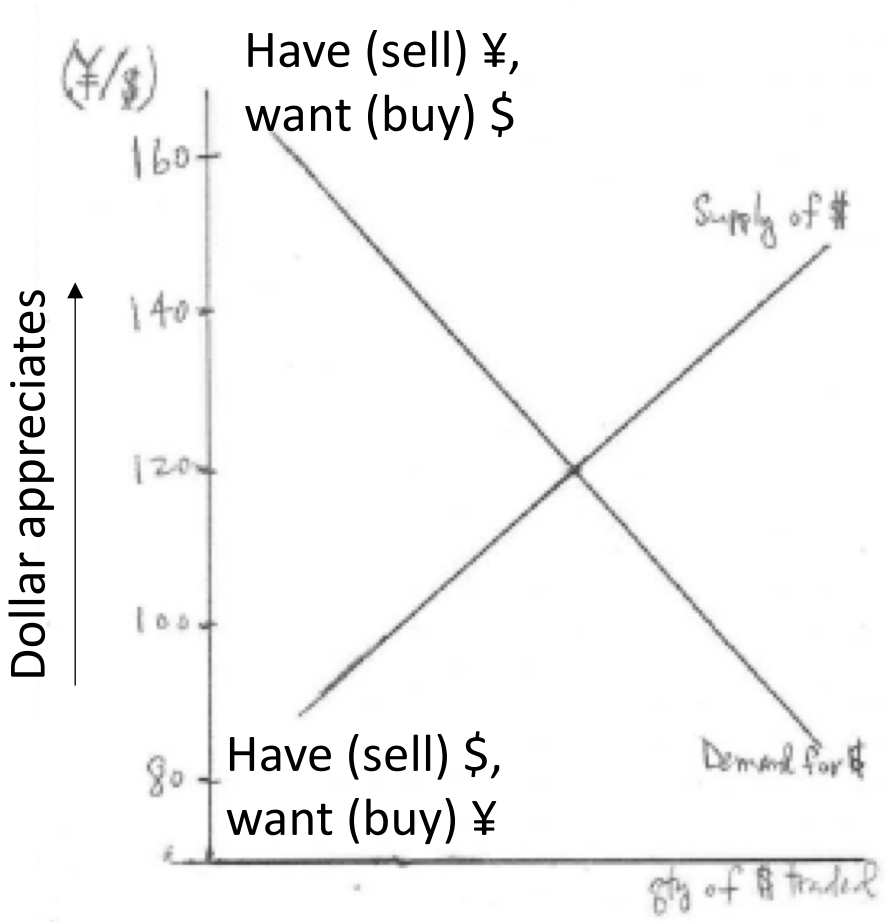
# Equilibrium in the Market for Euros

- Market exchange rate is determined by the interaction of demand and supply

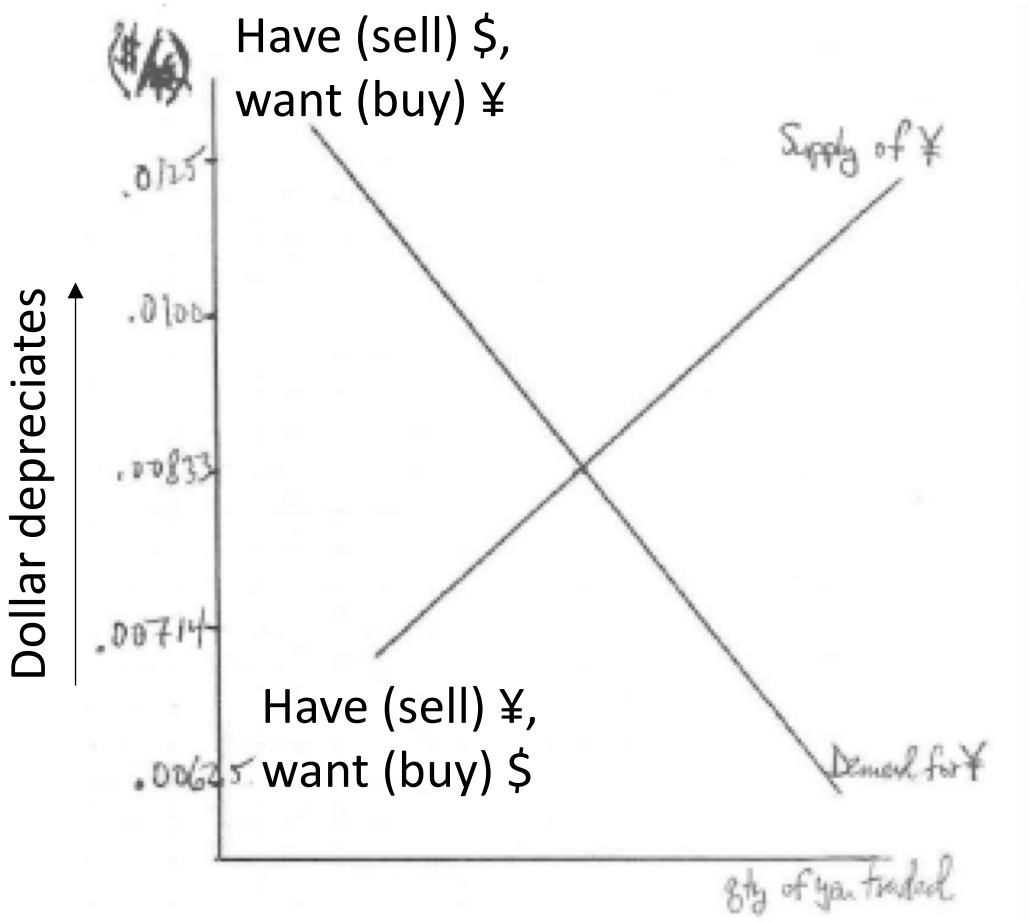


# Forex Markets

## Market for Dollars




## Market for Yen

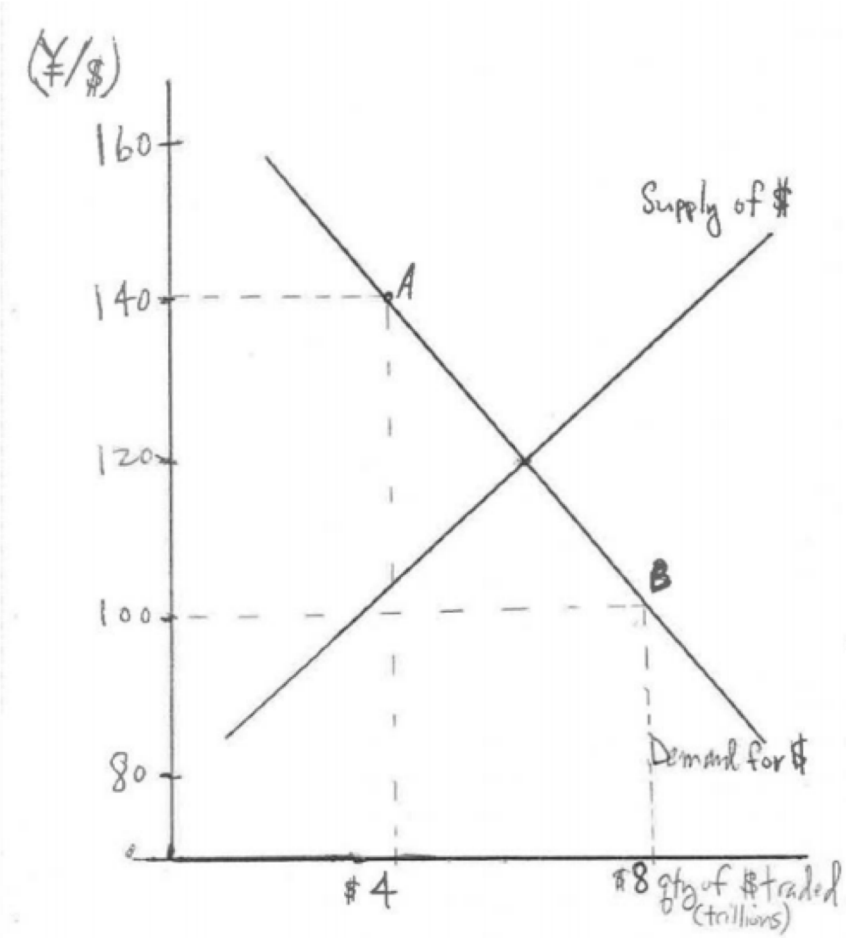


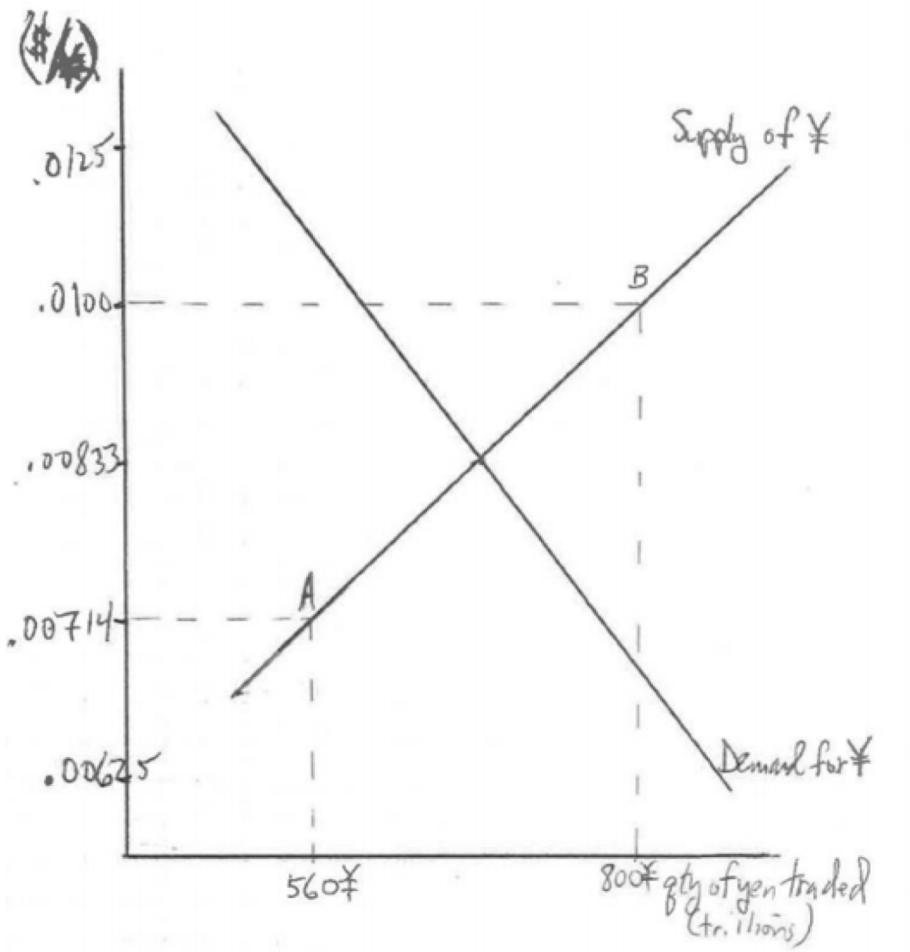
# Supply and Demand in Forex: Two Sides of Same Coin

| | | dollars | yen |
|---|---|---|---|
| | | traded | traded |
| yen per | dollar | (dollar | (yen |
| dollar | per yen | demand) | supply) |
| 160 | 0.0063 | 2 | 320 |
| 140 | 0.0071 | 4 | 560 |
| 120 | 0.0083 | 6 | 720 |
| 100 | 0.0100 | 8 | 800 |
| 80 | 0.0125 | 10 | 800 |

# Forex Markets

- Demand curve in USD market **equals** supply curve in Yen market



# Who Demands a Currency?

- Demand for dollars (= Supply of yen) composed by:
  - Foreign firms and HH that want to buy **G&S** produced in the US
  - Foreign firms and HH that want to buy **financial assets** issued in the US
  - Currency traders: If they **believe** that the value of the $ in the future will be greater (¥140) than its value today (¥120), they will buy dollars

    Example: ¥120M in t → $1M in t → ¥140M in t+1

- Similar for the demand for yen (= Supply of dollar)

# Shifts of Curves in Forex Market

- Shifts in demand and supply curves cause the equilibrium exchange rate to change

- 3 main factors cause the curves in the forex market to change:
  - Changes in demand for **US-produced G&S** vs **foreign-produced G&S**
  - Changes in desire to buy **US financial assets** vs **foreign financial assets**
  - Changes in **expectations** of currency traders about the likely future value of currencies

# Example: Shifts in Demand for $ (= Supply of ¥)

- Demand for $ (= Supply of ¥) shift to the

| Right when: | Left when: |
| --- | --- |
| • Expansion in Japan,<br>• Interest rates in the US rise, or<br>• Speculators expect the future value of the dollar to be higher than its current value | • Recession in Japan,<br>• Interest rates in the US fall, or<br>• Speculators expect the future value of the dollar to be lower than its current value |

- Similar for shifts in the demand for ¥ (= supply of $)

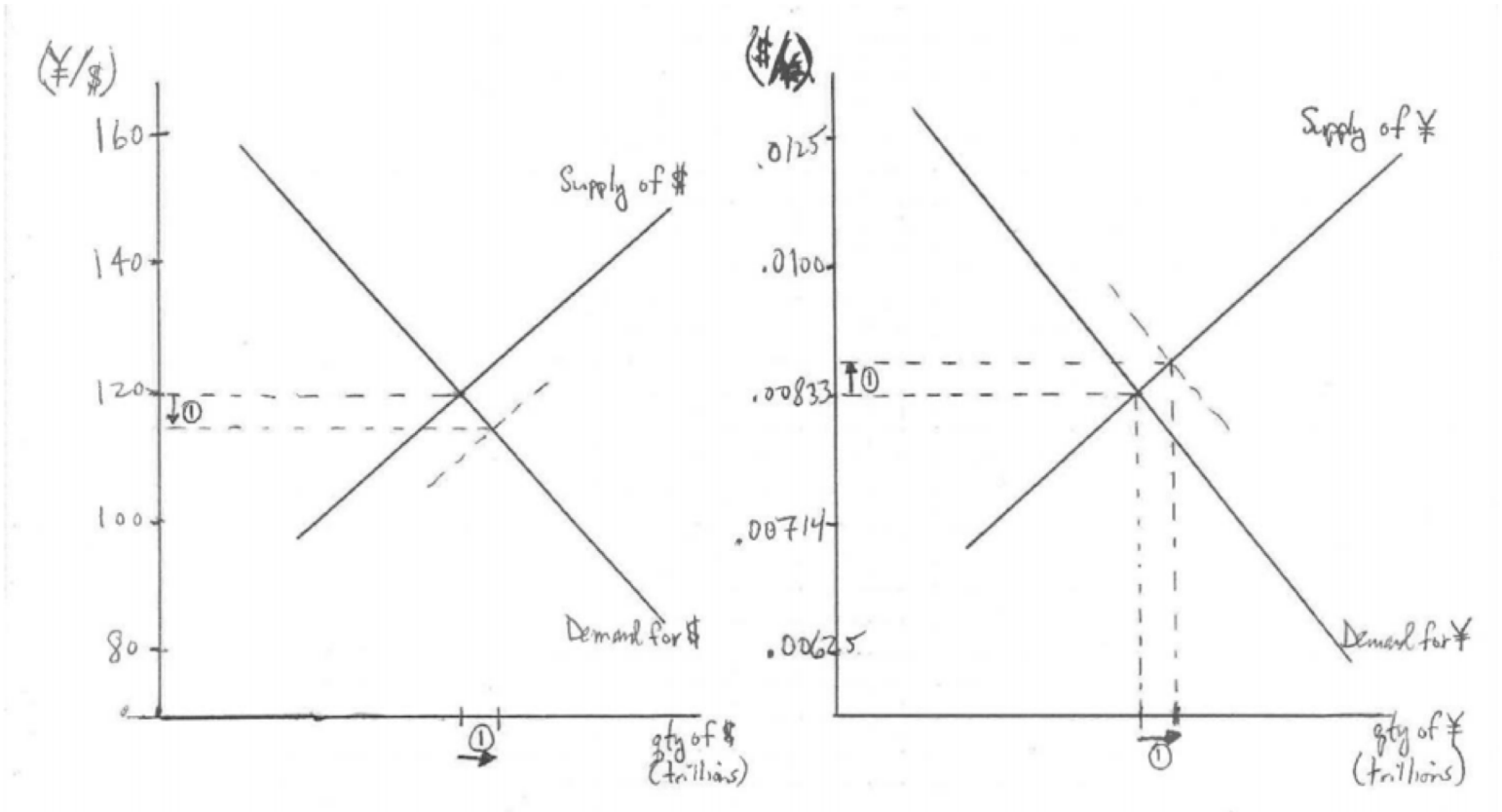
# Shifts in Demand and Supply in Forex Market

- There can be shifts in **both** the demand and supply curves for one currency

- Whether the exchange rate increases or decreases depends on the **direction** and **size** of the shifts in both curves

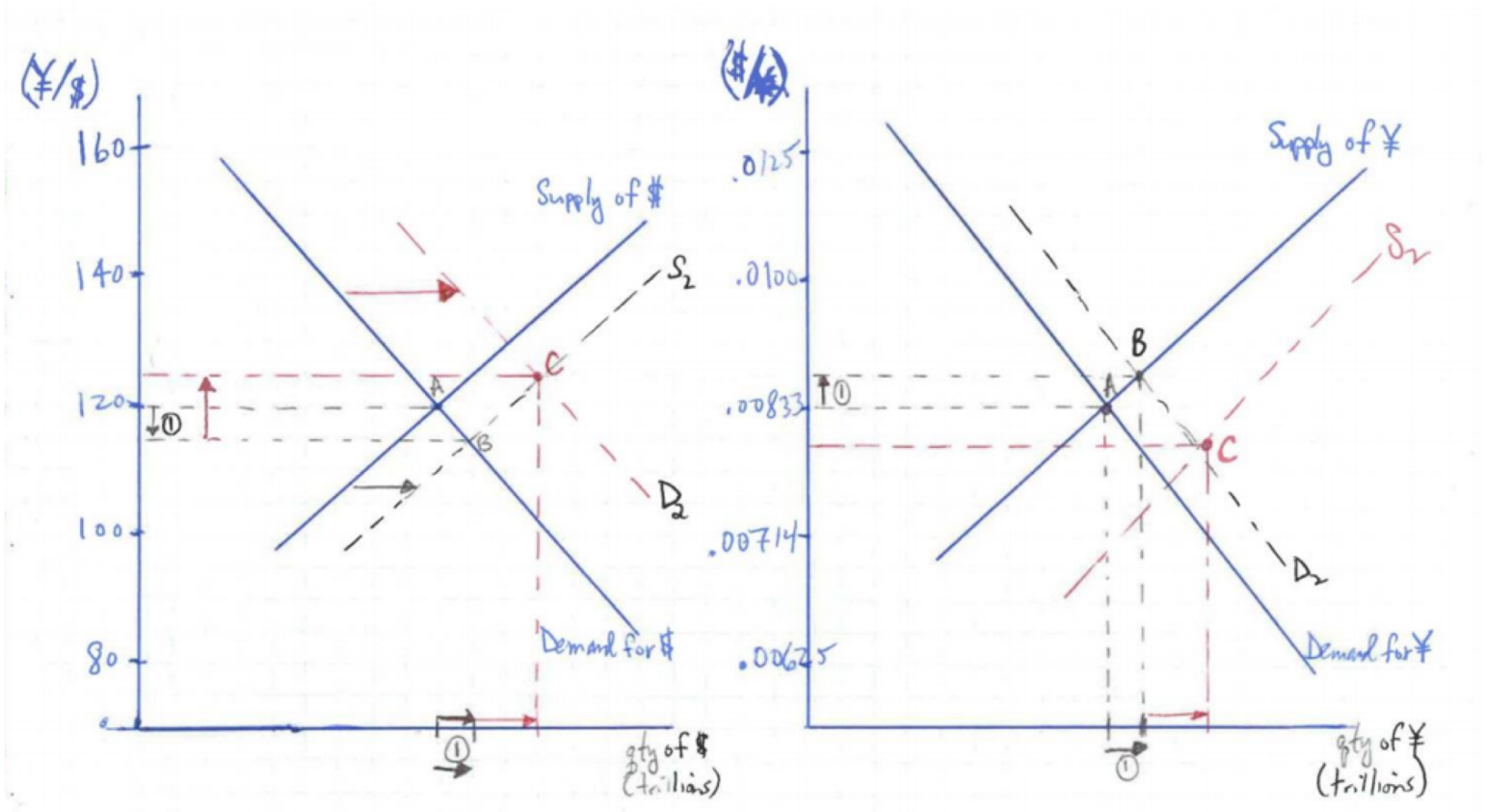
# Example: Boom in the US

- **Effect 1**: US demand goes up for all goods, including Japanese goods → Increased demand for ¥



# Example: Boom in the US

- **Effect 2**: With strong US economy, US interest rates will rise and so Japanese demand for US assets ➞ Increased demand for $

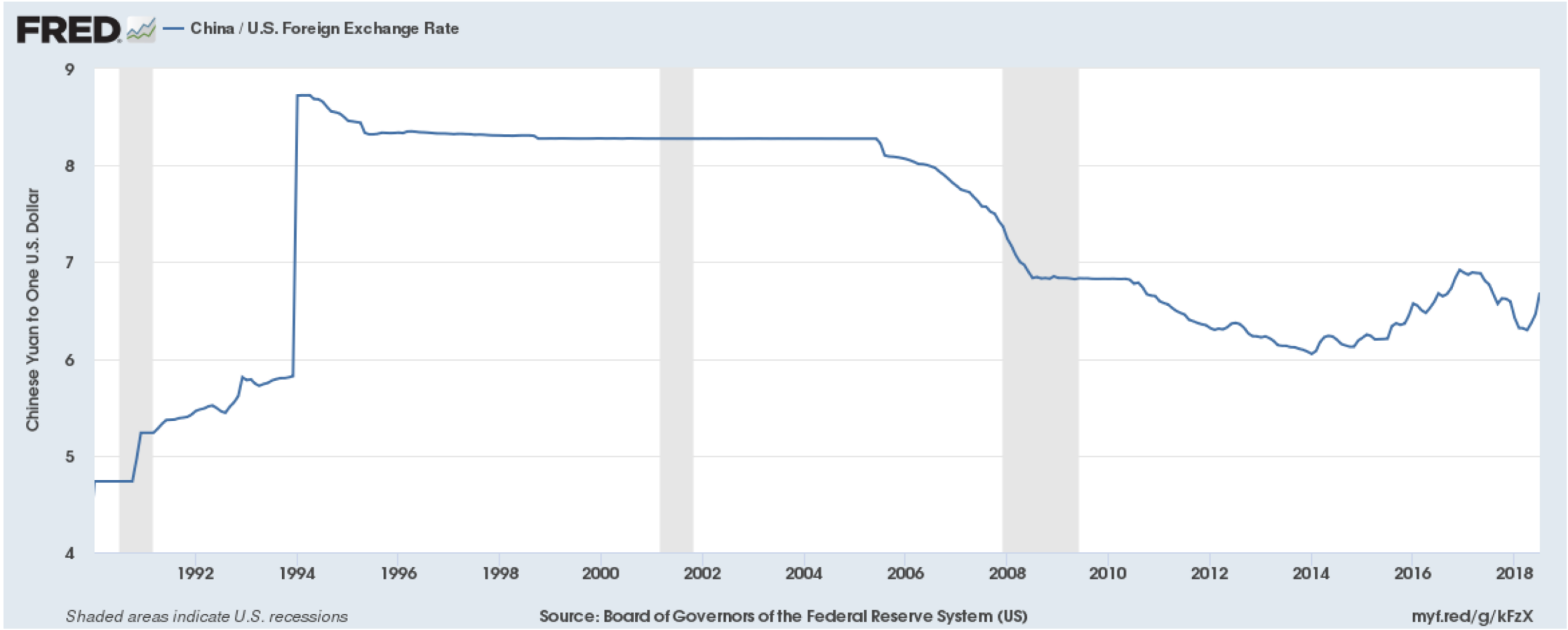


# Central Bank's Role in the Forex Market

- With a **closed economy** perspective, we said central banks focus on one of two targets
  - Target the money supply and use the quantity equation
  - Target an interest rate, think in a loanable funds model and use Taylor rule

- In an **open economy**, CBs can use monetary policy to guide their exchange rate
  - **Example**: China kept the renminbi at RM8.3/$ for 10 years

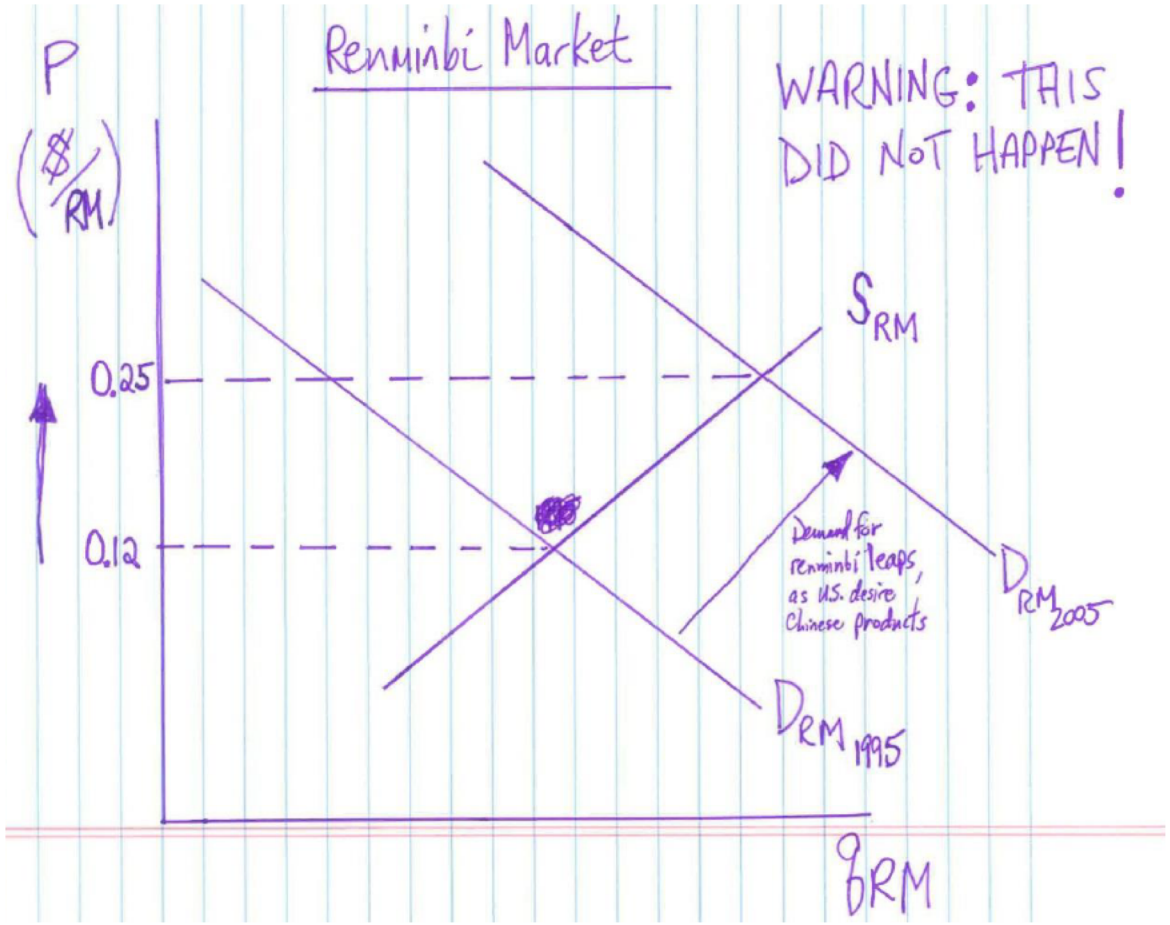
# RM/$ Exchange Rate

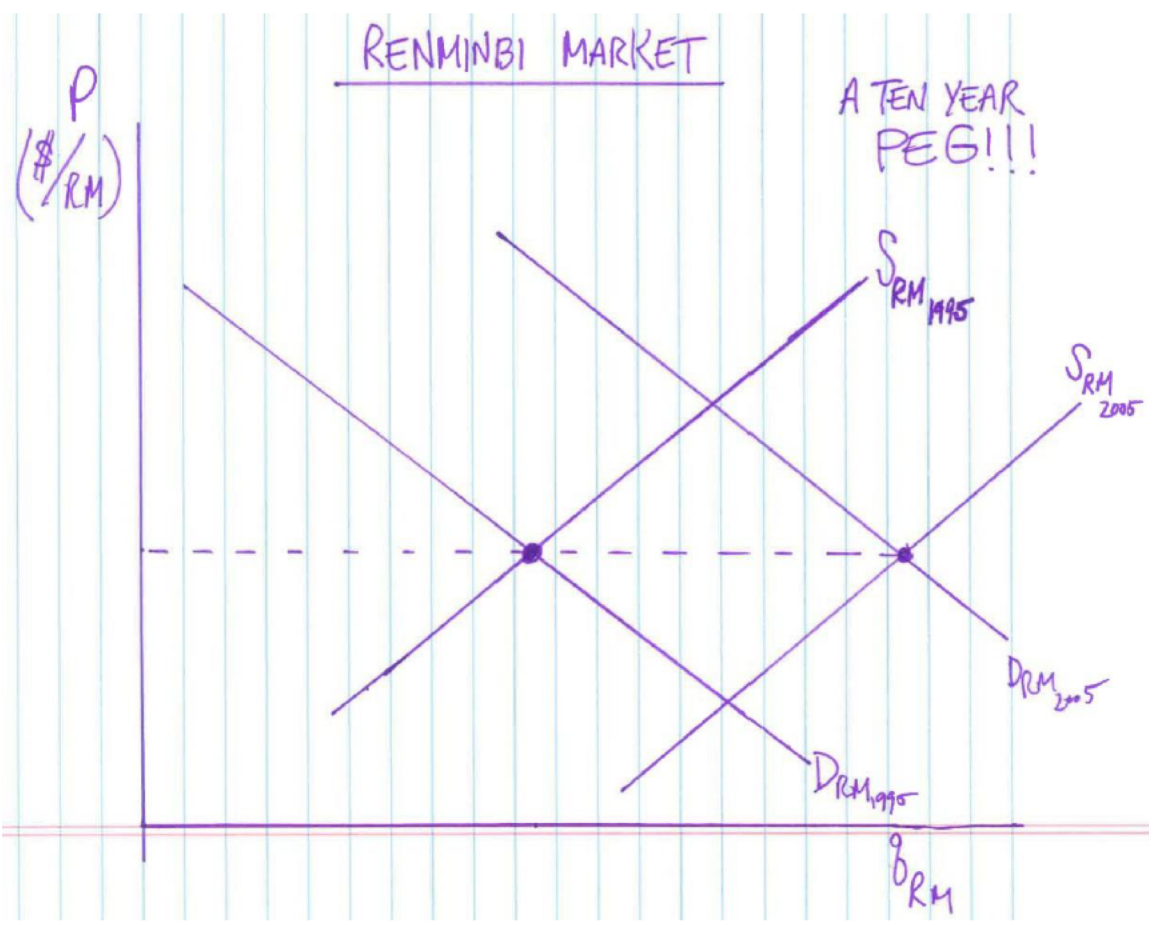


# US-China Trade and Exchange Rate

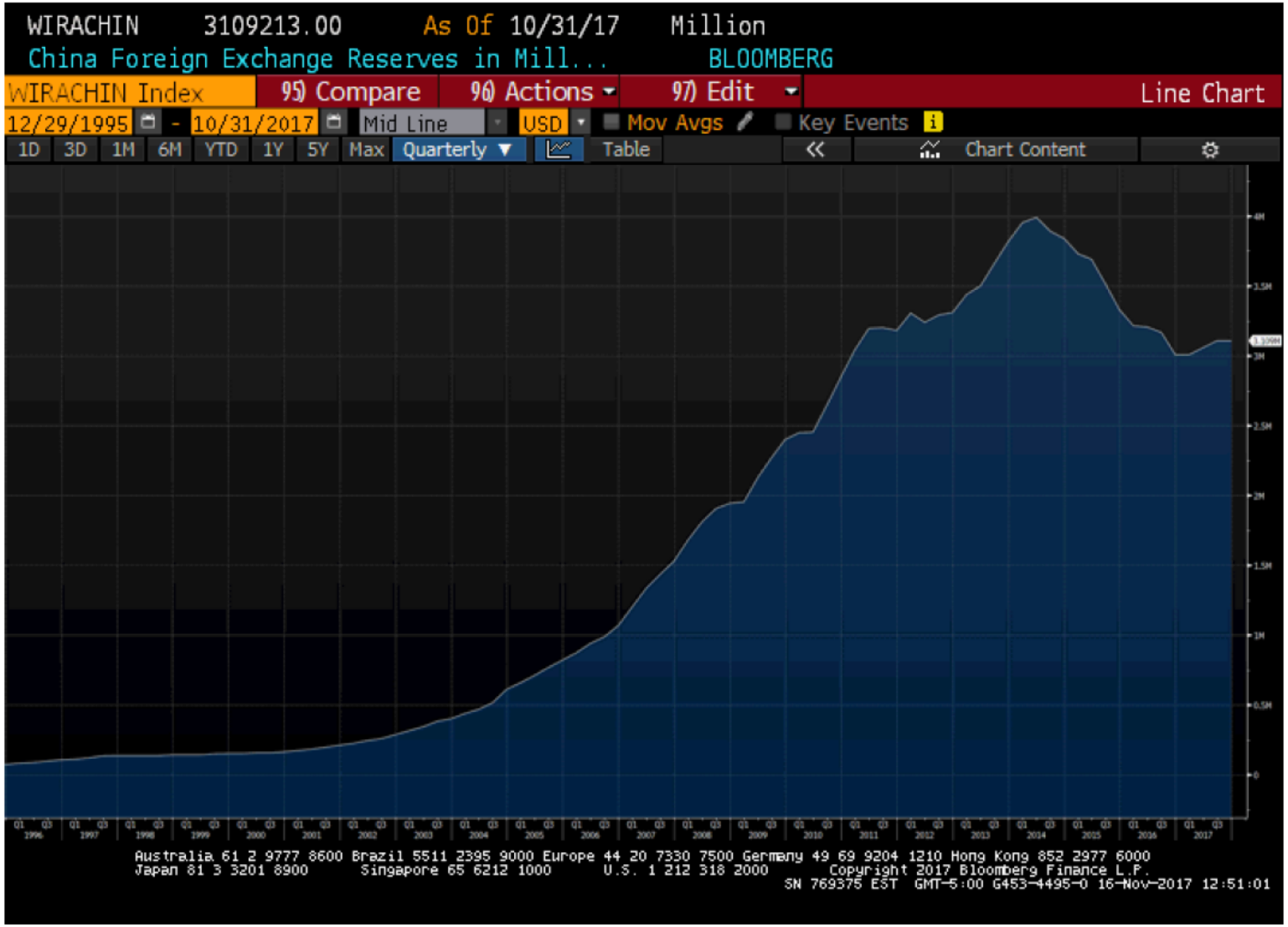
- US bought zillion TVs and PBoC bought trillions of T-bonds
- US demand for China's goods soared
  - 1995-2005: US trade deficit with China climbed from $20bn to $200bn
- US demand for Chinese renminbi soared
  - Value of renminbi vs $ should have been soared
  - A dime for a RM (0.12$/RM = 8.3RM/$) in 1995 could have been a quarter for a RM in 2005
- How did the RM stay steady vs $ while the US trade deficit with China soared?

# Monetary Policy and Exchange Rates



# What Did the PBoC Did with All Those Dollars?



# Exchange Rate Regimes

- Not all countries fix their exchange rates
- **Exchange rate regimes**: How countries manage their exchange rates
- Two general categories:
  - **Fixed** exchange-rate regimes
  - **Floating** exchange-rate regimes

# Real Exchange Rate

- Relative prices of two countries' goods are determined by:
  - **Relative price levels** in the two countries
  - **Nominal exchange rate** between the two countries' currencies
- These two factors are combined to obtain the real exchange rate
- **Real exchange rate**: Price of domestic goods in terms of foreign goods

# Real Exchange Rate: Formula

- Corrects the nominal exchange rate for differences in prices of G&S between countries
  - Useful to evaluate real change in **value of a currency's purchasing power**
- **Definition**:

$$q = E \times (P^{€}/P^{\$})$$

$q_{US/EU}$ – real exchange rate
$E_{\$/€}$ – nominal exchange rate
$P^{€}$ – average price level in the euro area
$P^{\$}$ – average price level in the US

# Real Exchange Rate: Example

- Assume you need €100 to buy a broad basket of G&S in euro area
- Assume that if you exchange your €100 for $, you can buy **25% more** of the same basket of G&S in the US
- Then the RER between the US and the Eurozone is

$$q_{US/EU} = 1.25$$

- RER says **how many units** of the basket you can buy in the US per unit of basket in the euro area
  - $q_{US/EU} > 1 \rightarrow$ G&S are **more expensive in the Eurozone** than in the US

# Nominal vs Real Exchange Rate

- Difference between nominal and real exchange rate?
- Real exchange rate, q, is the relative price of (baskets of) **goods**
- Nominal exchange rate, E, is the relative price of **currencies**

# Purchasing Power Parity Theory

- **Purchasing Power Parity (PPP)** : In the long run, goods should have about the same price everywhere when expressed in terms of a given currency

- Implication for nominal exchange rates?

  - What nominal exchange rate allows the two currencies to have the **same purchasing power**

# Purchasing Power Parity Theory

- **Example**:
  - In country A, I spend **$100,000** per year in house, car, food, drinks
  - In country B, I spend **¥500,000** per year in house, car, food, drinks
  - What exchange rate gives me the same purchasing power?

- PPP implies q = 1

$$1 = E \times (P^{€}/P^{\$})$$

$$E_{\$/€} = P^{\$}/P^{€}$$

# The Big Mac Index

- *The Economist* magazine compares Big Mac prices across countries
- We compare hamburger prices and infer the currency value that makes them equal

| | **Price of a Big Mac** |
|---|---|
| | Local Currency Price (as of 7/17) |
| US | $5.30 |
| China | RM19.30 |

- What RM/$ exchange rate equalizes the cost of a burger?

$$E_{RM/\$} = RM19.3/\$5.3 = RM3.64/\$$$

# Undervalued and Overvalued Currencies

- According to the Big Mac index, $E_{RM/\$}$ should be RM3.64 = 1$

- If the current market exchange rate were RM6.6 = $1, what does the Big Mac index says about the RM? Is it undervalued or overvalued?

- To go from RM6.6 = $1 to RM3.64 = 1$, **RM would need to appreciate** → Today's value (RM6.6 = $1) is **undervalued** relative to RM3.64 = 1$

# PPP: Application

- IMF provides a summary table of economic performances

| | Real GDP 2001 (trillions of $) | Real GDP 2016 | annualized growth rate |
|---|---|---|---|
| United States | 12.7 | 16.7 | 1.9% |
| Germany | 2.7 | 3.6 | 2.0% |
| China | 7.2 | 19.0 | 6.7% |
| India | 2.8 | 7.8 | 7.1% |
| Russia | 1.5 | 3.4 | 5.4% |

# Application

- From table: China **$19 tr** vs US $16.7 tr
- China's economy uses yuan or renminbi, how did we get Chinese GDP in US dollars?
- What is the 2016 value for Chinese real GDP in renminbi?
  - RM66.5 tr
- What if we **use the forex market's exchange rate RM/$** to convert China's real GDP from RM into $?

$$RM66.5\ tr \times \left(\frac{\$1}{RM6.6}\right) = \mathbf{\$10\ tr}$$

# Application

- IMF did not use market exchange rates
  - Not be the best guide to equate countries' real GDP levels
  - IMF evaluates purchasing power of currencies
  - IMF looks at the prices of thousands of G&S to calculate PPP
- Instead of using market exchange rates, we can use the implied PPP exchange rate obtained using the Big Mac index

$$RM66.5\ tr \times \left(\frac{\$1}{RM3.4}\right) = \mathbf{\$18.3\ tr}$$

- The PPP-adjusted exchange rate gets us close to the **$19 tr**

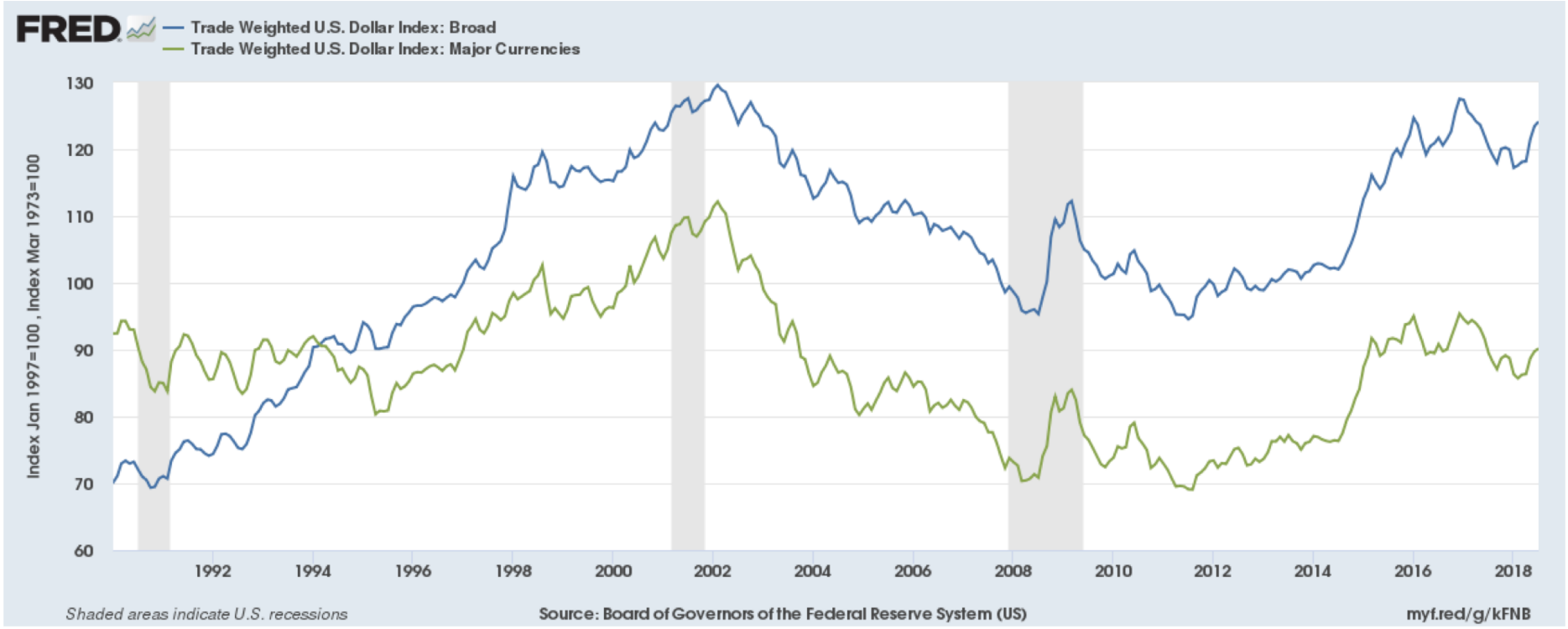
# Is PPP Supported in the Data?

- In practice, PPP **does not hold exactly**
  - Not all products can be traded internationally
  - Products and consumer preferences are different across countries
  - There are barriers to trade

- PPP applies **in the long run on average** between countries that have a *similar* level of development
  - **Example**: US and UK
  - However, deviations are relatively persistent

# Effective Exchange Rate

- An exchange rate is between **two** currencies
- We can create an index (weighted by trade) to see whether a currency appreciates or depreciates against **many** currencies



# Exchange Rates and Interest Rates

- What is the relationship between interest rates and the exchange rate?

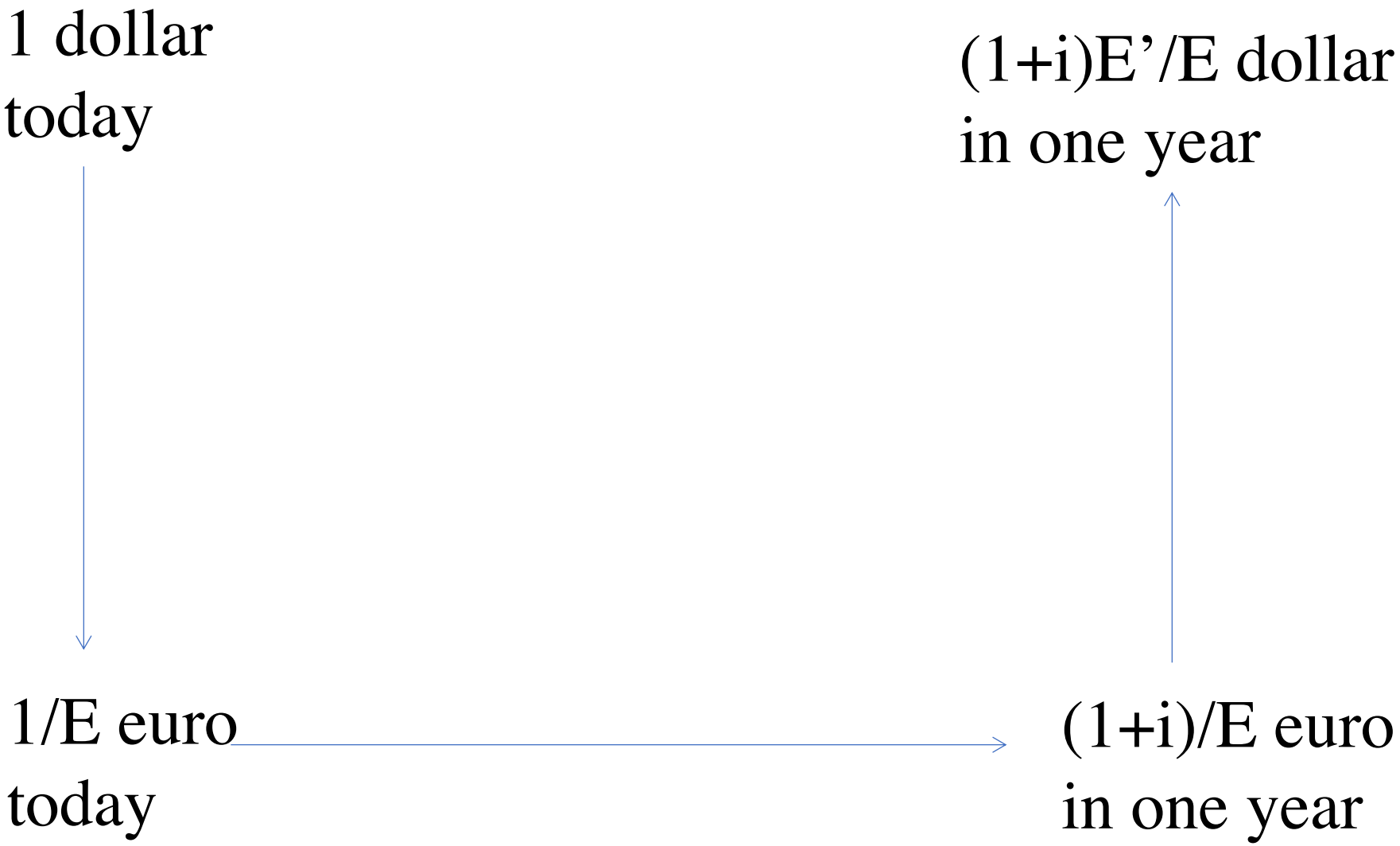
- Bonds **denominated in different currencies** yield different interest rates

- **Arbitrage**: All bonds should have the **same expected dollar return**
  - Interest rate differential between bonds in two countries should equal the expected change in the exchange rate

# International Bond Investment

- $E_{\$/€}$ - Current dollar per foreign currency (say euro) exchange rate
- E’ - Exchange rate ($/€) in one year
- $i_€$ - Foreign interest rate for one year
- $i_\$$ - Dollar interest rate for one year

- Let’s start with $1. You have two options to invest it:
  1. You can invest your $1 at the dollar interest rate $i_\$$
  2. You can invest it at the foreign interest rate $i_€$ after you exchange your dollar for foreign currency using E ➞ After receiving your interests, you exchange your money back into $ using E’


1 dollar
today
(1+i)E'/E dollar
in one year
1/E euro
today
(1+i)/E euro
in one year

- If you invest in the foreign bond:

1 dollar today → $(1 + i_€)\frac{E'}{E}$ dollars in one year

- If you invest in the US bond:

1 dollar today → $(1 + i_\$)$ dollars in one year

# Uncovered Interest Parity

- Global investors should expect foreign currency bonds to have approximately the same dollar return as dollar bonds
  - What would happen otherwise?
- **UIP** says all bonds should have the same **expected** dollar return

$$1 + i_{\$} = (1 + i_{€}) \frac{E^e}{E}$$

$E^e$ – Exchange rate **expected in one year**

- **Uncovered** because the exchange rate risk ($E' \neq E^e$) is not hedged

# What Does UIP Say?

$$\underbrace{1 + i_{\$}}_{\text{Gross US deposit}} = \underbrace{(1 + i_{€})\frac{E^{e}}{E}}_{\text{Gross euro deposit}}$$

**dollar return** (expected) **dollar return**

# UIP: Approximate Formula

$$1 + i_{\$} = (1 + i_{€})\frac{E^e}{E}$$

$$i_{\$} \approx i_{€} + \frac{\Delta E^e}{E}$$

$$i_{€} - i_{\$} = -\frac{\Delta E^e}{E}$$

# What Does the Approximate Formula Say?

$$i_{€} - i_{\$} = -\frac{\Delta E^{e}}{E}$$

- **Note**: Since $E = E_{\$/€}$, $E^{e} \uparrow$ means that € is expected to depreciate
- A foreign currency that is expected to depreciate must yield a higher interest rate than the dollar
- A foreign currency that yields a high interest rate is likely to depreciate
  - The opposite would be too good to be true

# What Does the Data Say About UIP?

$$i_{€} - i_{\$} = -\frac{\Delta E^{e}}{E}$$

- **Implication**: The interest rate differential should be a good predictor of currency depreciation against the dollar
- Approximately true for survey data on **market expectations**
- Not so good when use **realized** exchange rates