Open Economy Macroeconomics

Exchange Rates, Interest Rates and Macroeconomic Policy

Outline

1. Exchange Rates

2. Theories: Purchasing Power Parity and Uncovered Interest Parity

3. 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 sends 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) has 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 (a flow)

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

- 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 NX (or the trade balance), but is not exactly 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

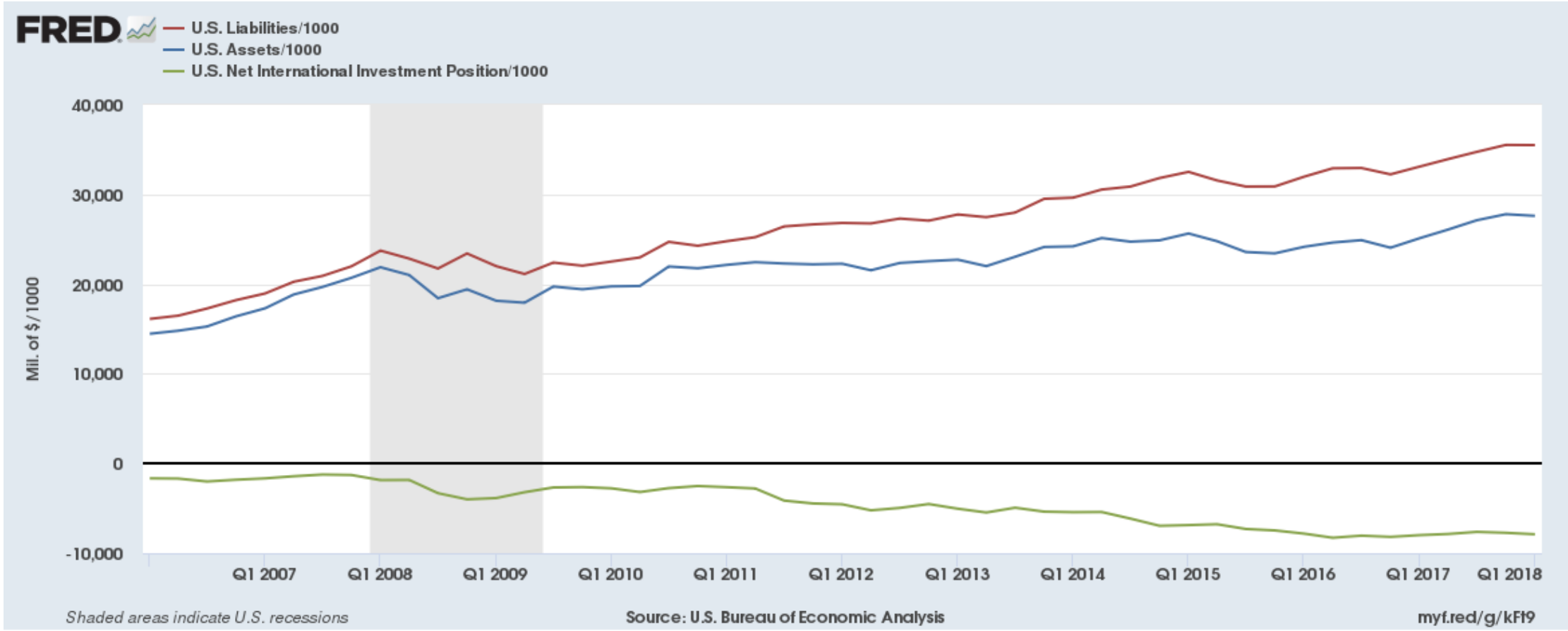
- US is a **net debtor** to the world, China is a **net lender** to the world

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** to 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

- Important because they affect **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

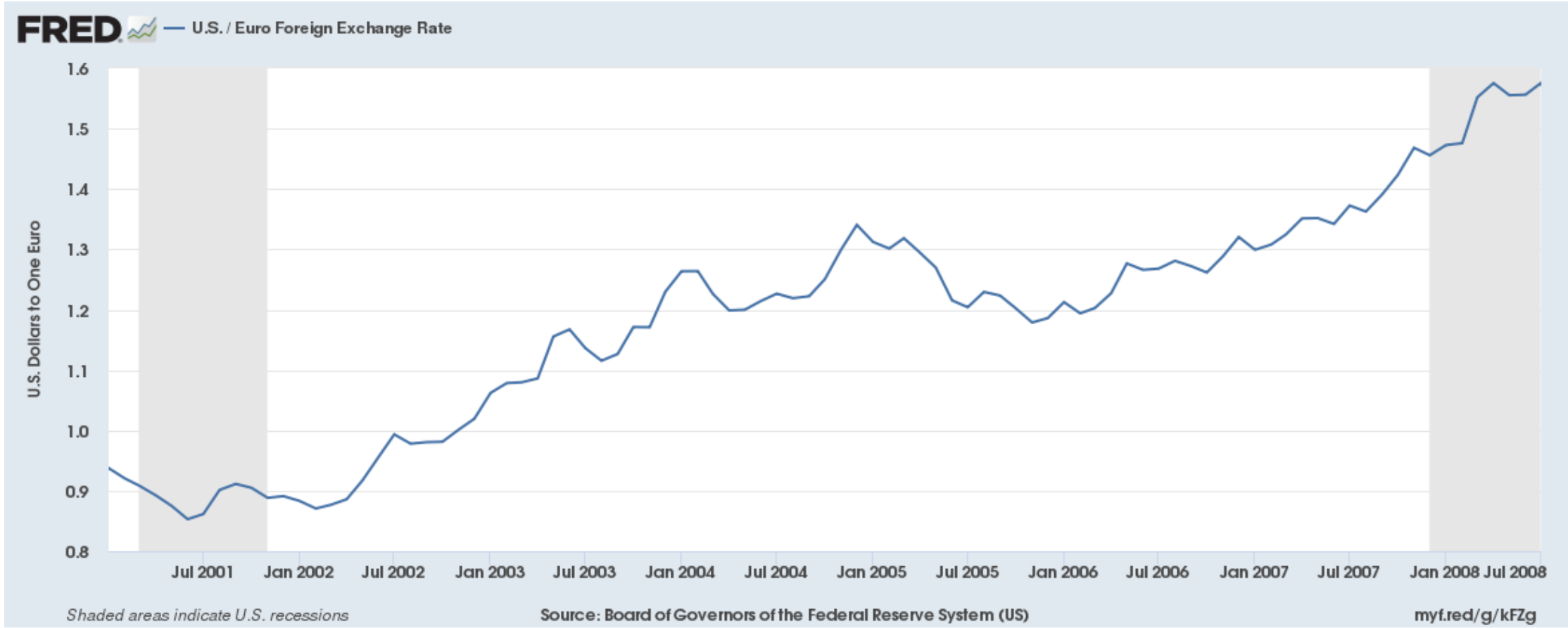
	Euro (Euro area)	Yen (Japan)	Renminbi (China)	Ruble (Russia)
Q4:2006	1.32$/€	120Y/$	7.8R/$	26.3RB/$
Q4:2012	1.32$/€	85Y/$	6.3R/$	30.3RB/$
Q4:2016	1.07$/€	109Y/$	6.9R/$	64.8RB/$

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 but may be misleading

- **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?



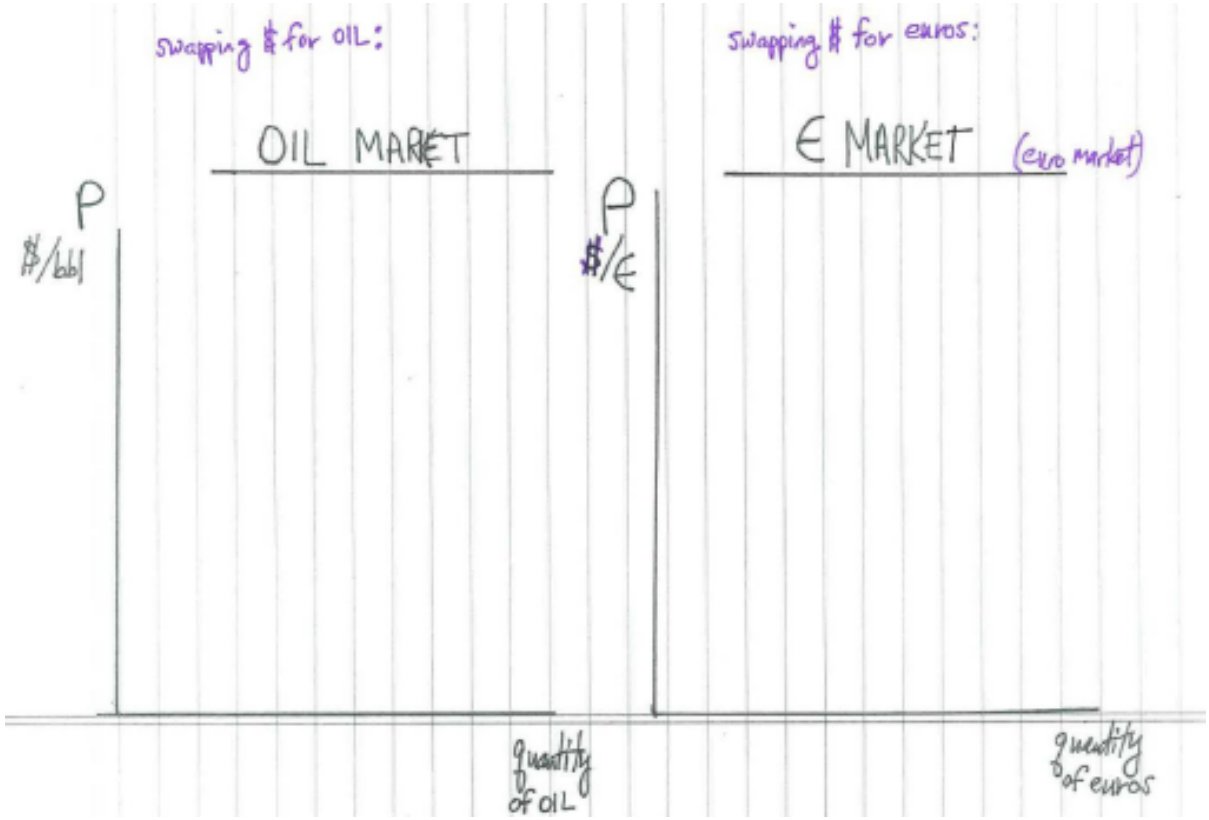
Is a Strong Dollar Better than a Weak Dollar?

- 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 IM are expensive	$NX \uparrow$
With an appreciation of the dollar	EX are expensive IM are cheaper	$NX \downarrow$

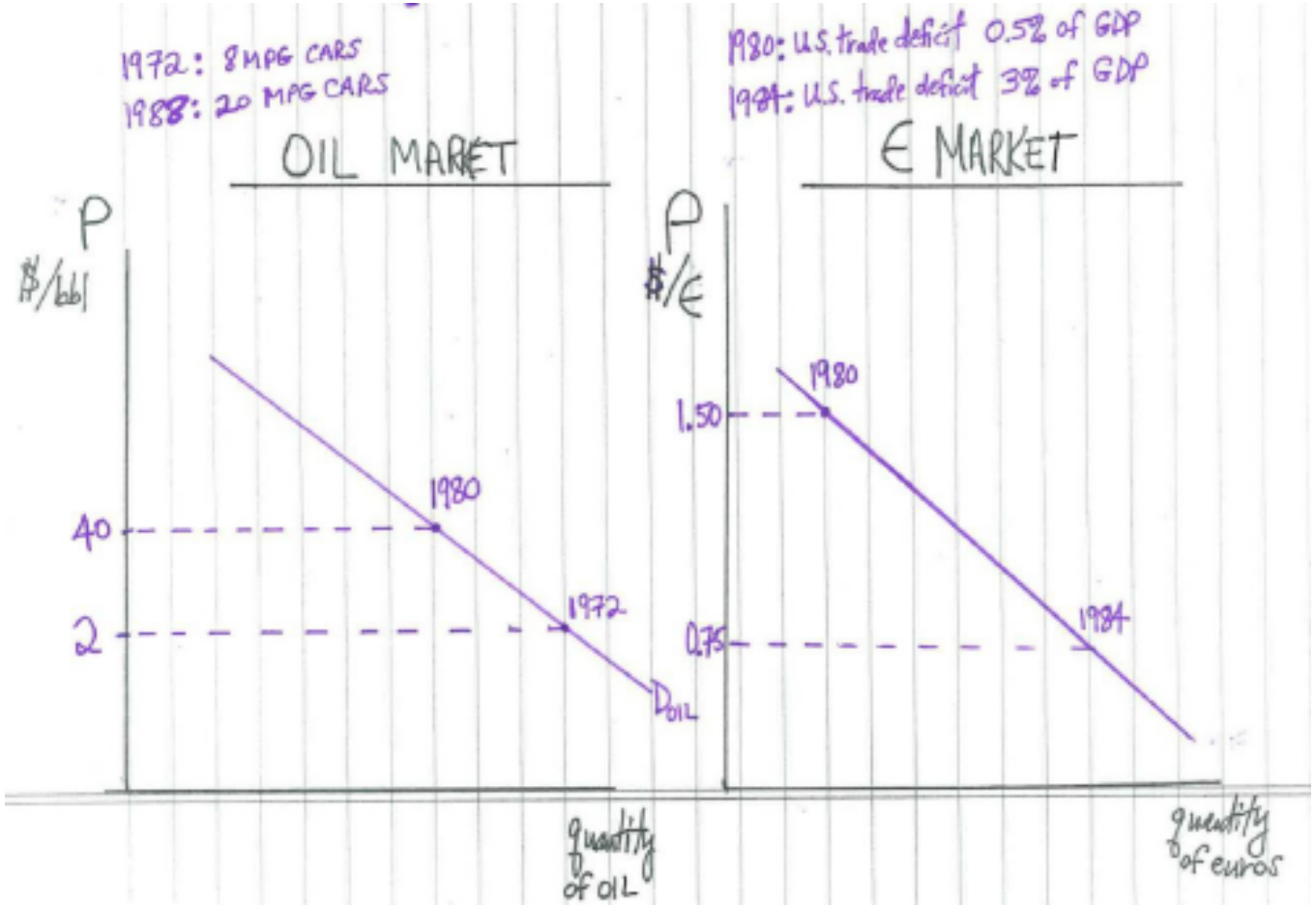
The Market for Euros

- 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

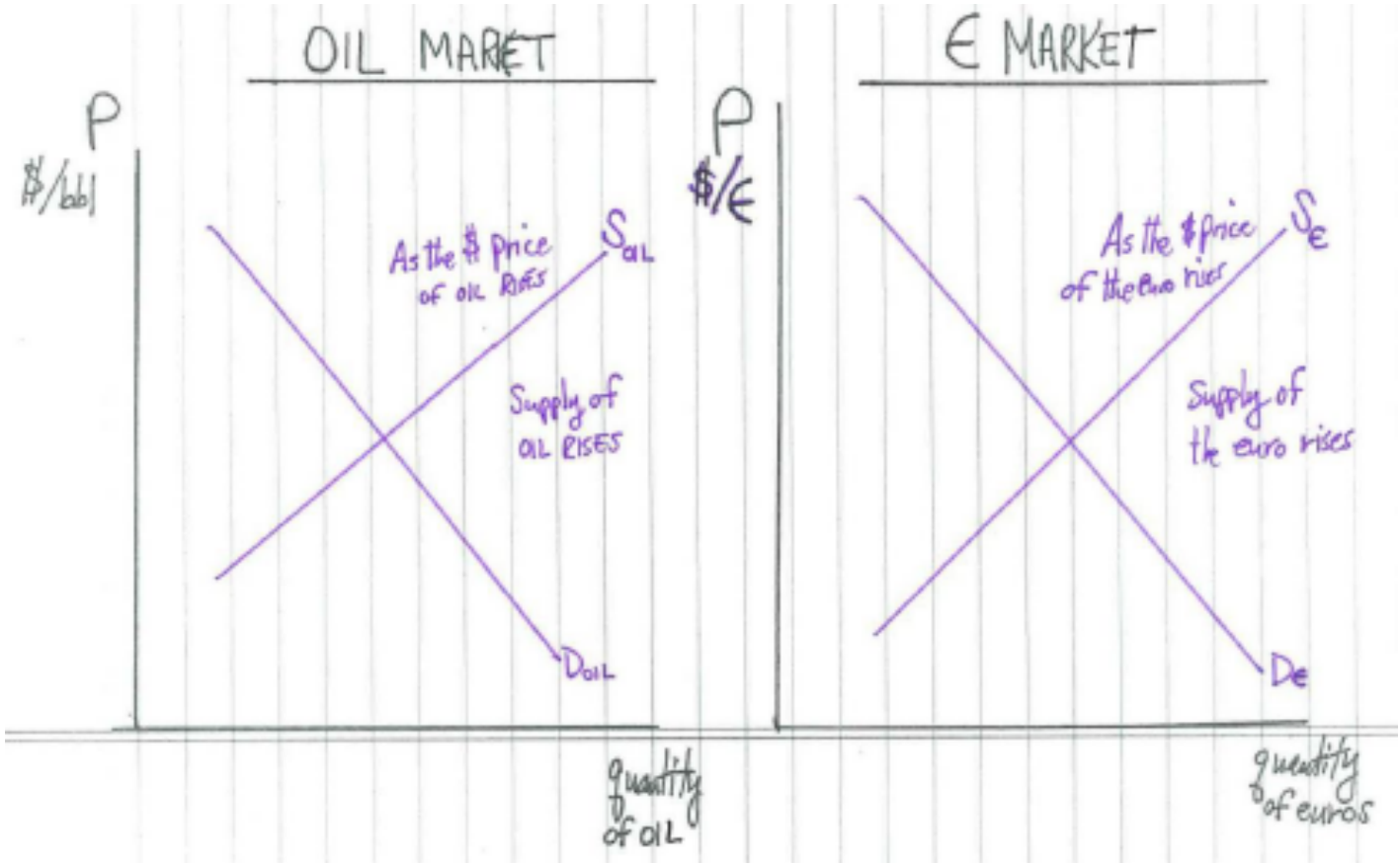


Upward Sloping Supply for Currency

- 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**

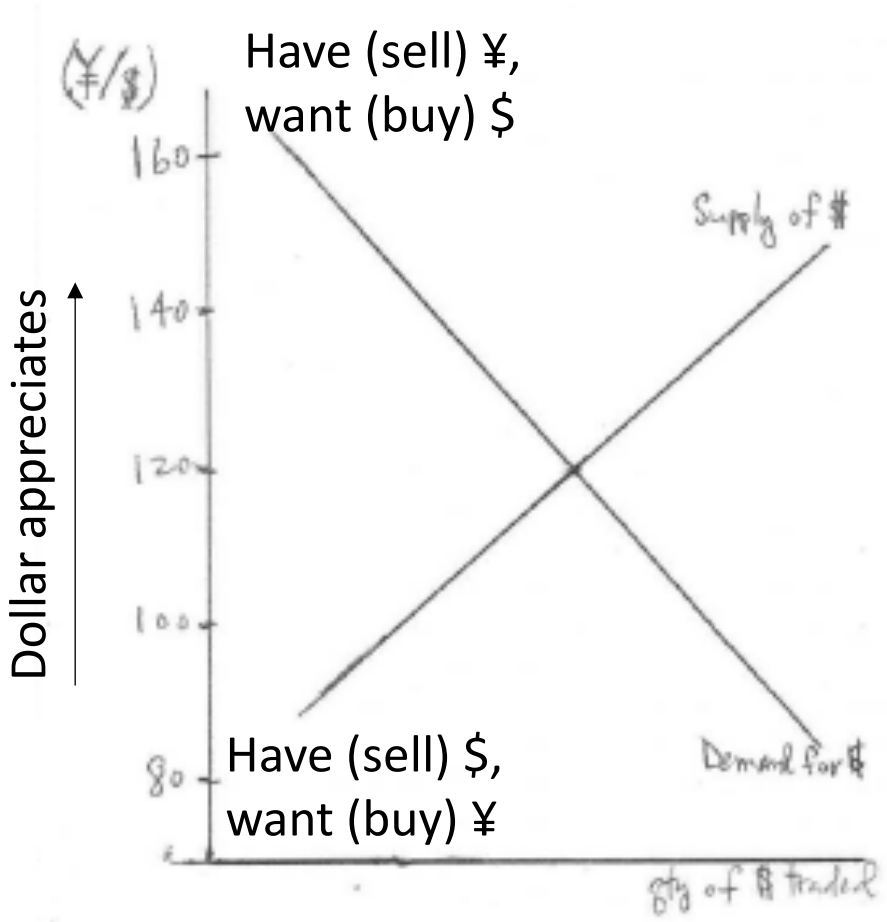
Equilibrium in the Market for Euros

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

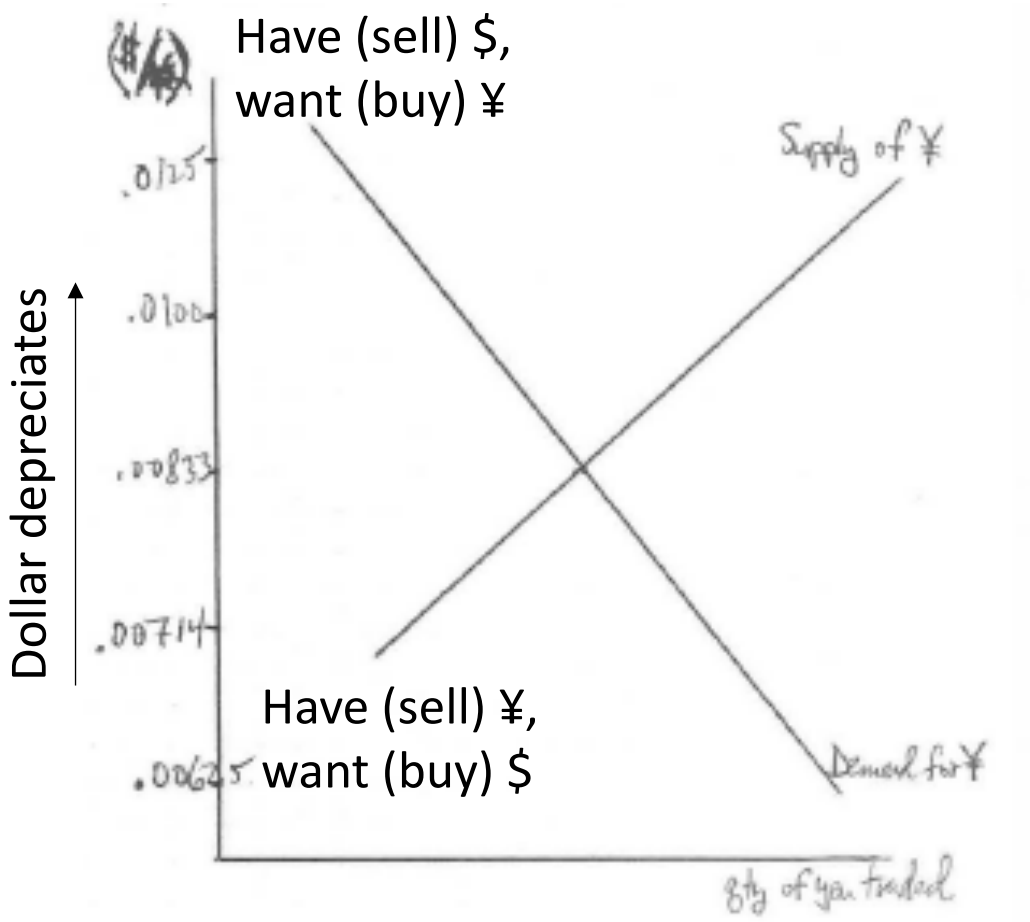


Forex Markets

Market for Dollars



Market for Yen

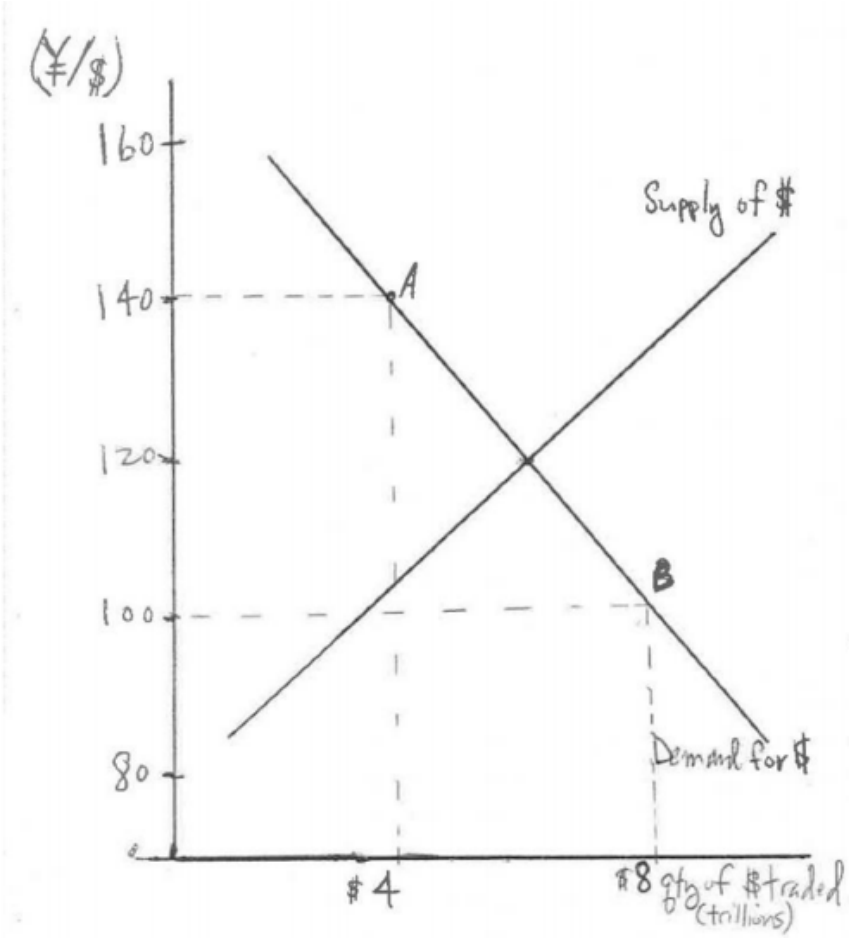


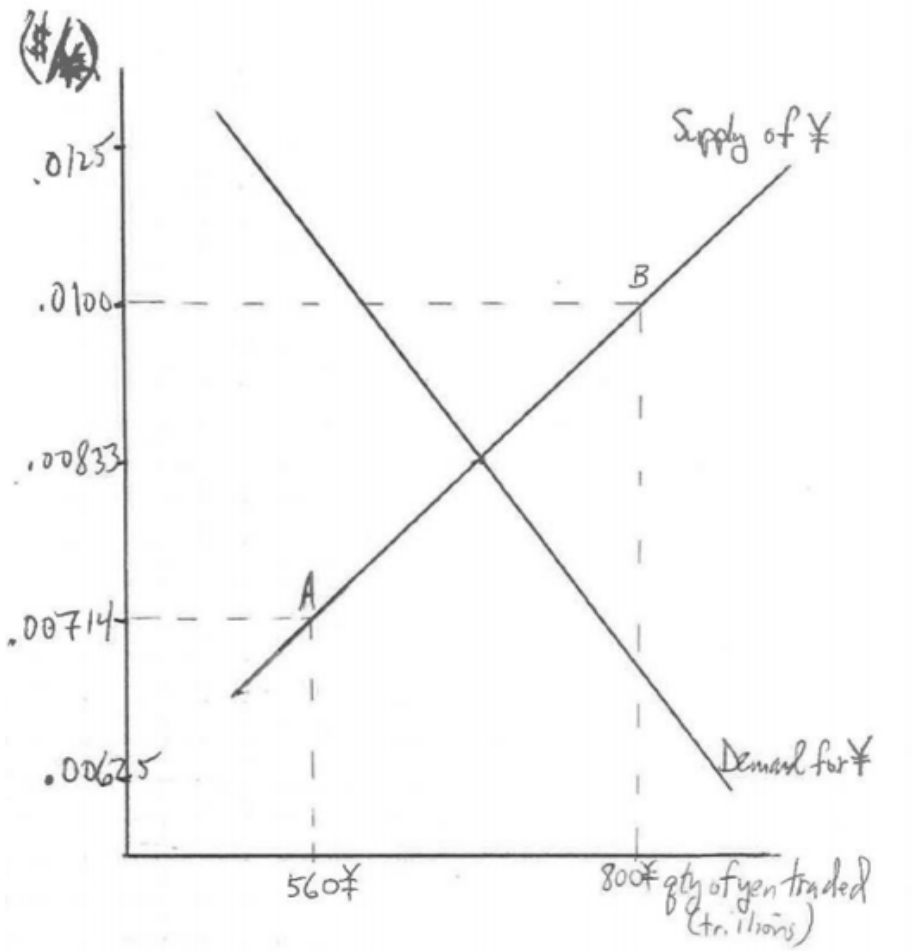
Supply and Demand in Forex: Two Sides of Same Coin

		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 (¥140) will be greater than its value today (¥120), they will buy dollars

    Example: Sell ¥120M in t → Buy $1M in t → Buy ¥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**, • Interest rates in the **US** rise, or • Speculators expect the future value of the dollar to be **higher** than its current value	• Recession in **Japan**, • Interest rates in the **US** fall, or • Speculators expect the future value of the dollar to be **lower** than its current value

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

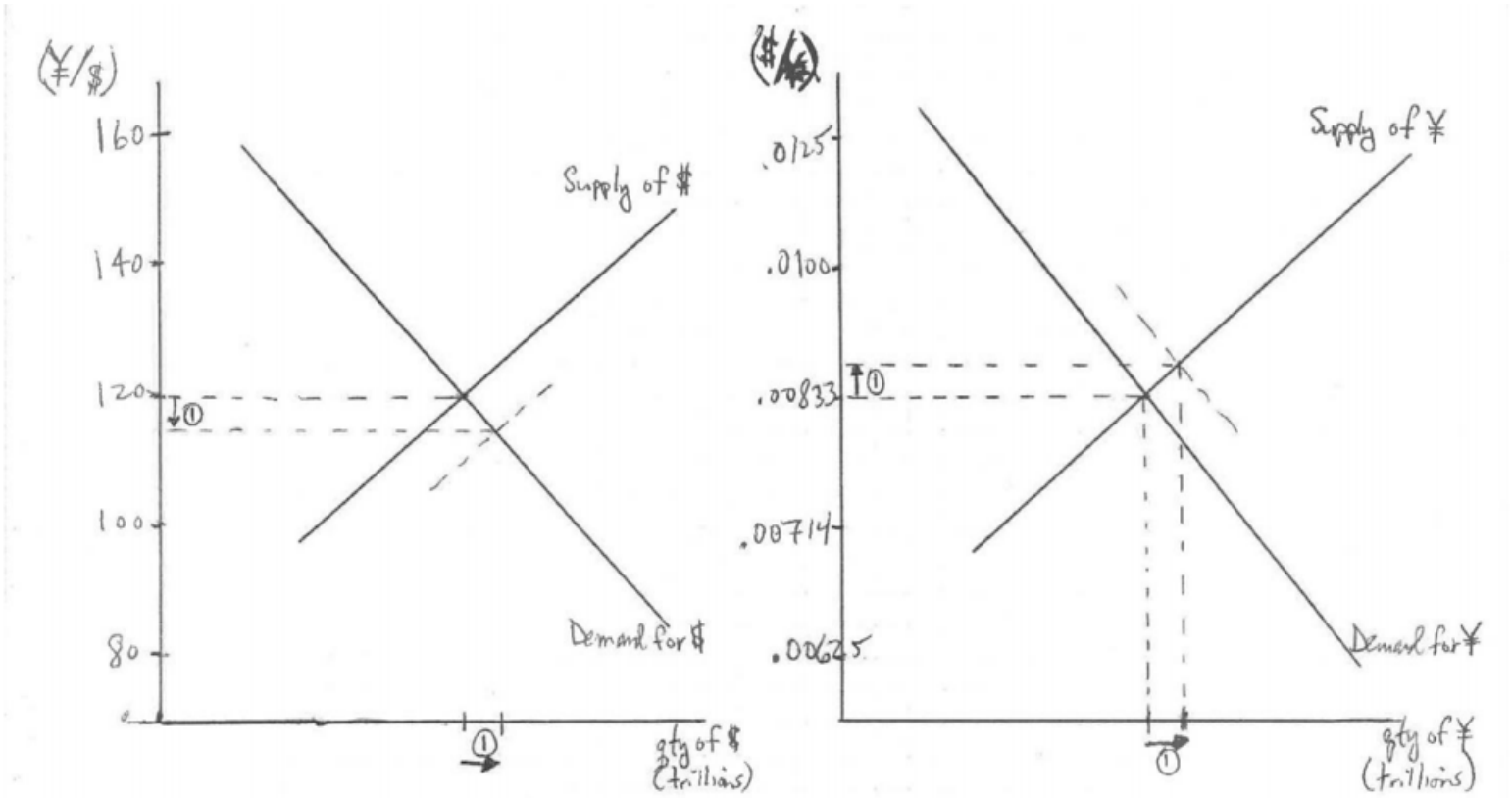
Shifts in Demand and Supply in Forex Market

- 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

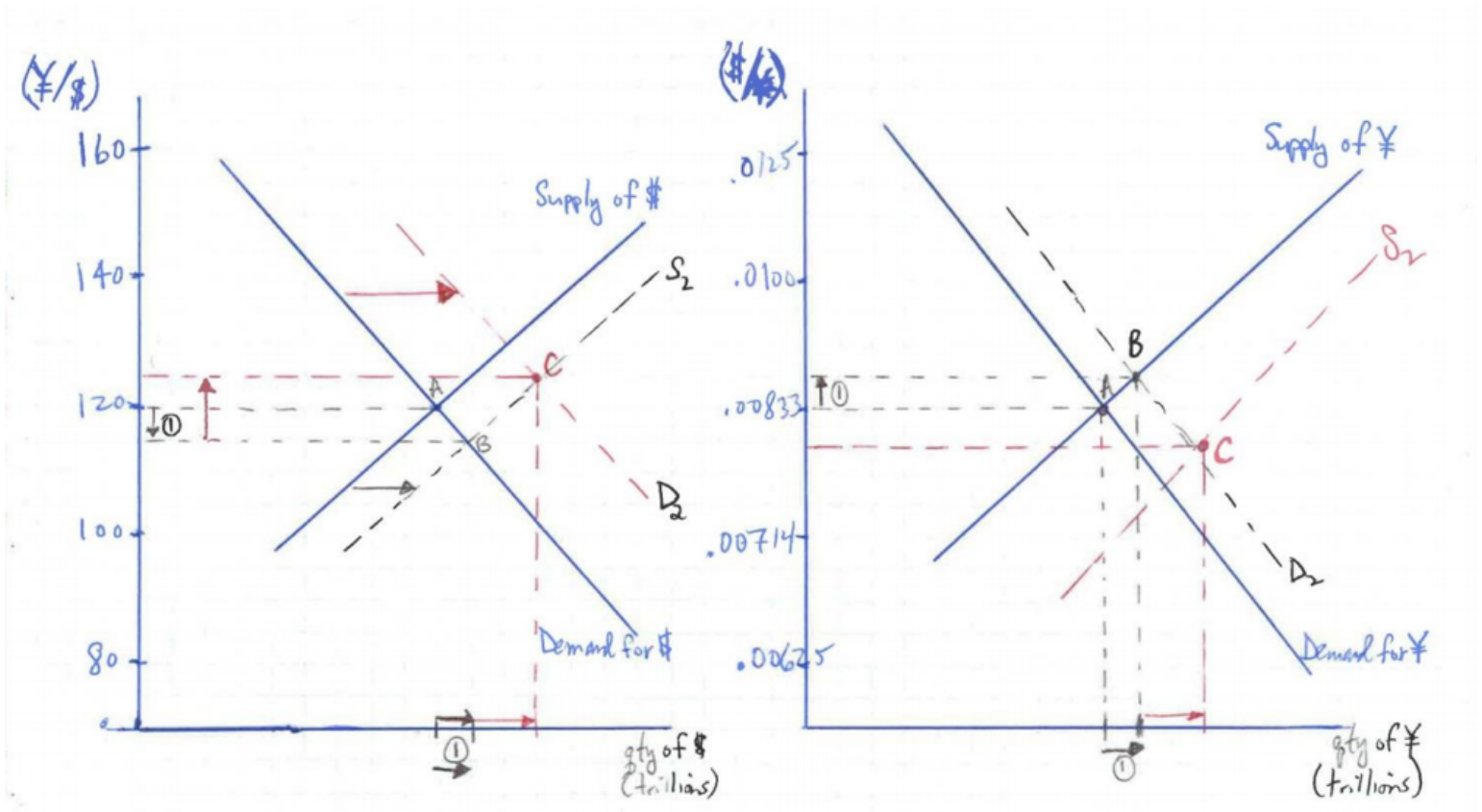
Example: Boom in the US

- **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 $



Exchange Rate Regimes

- **Exchange rate regimes**: How countries **manage** their exchange rates

- Two general categories:
  - **Fixed** exchange-rate regimes
  - **Floating** exchange-rate regimes

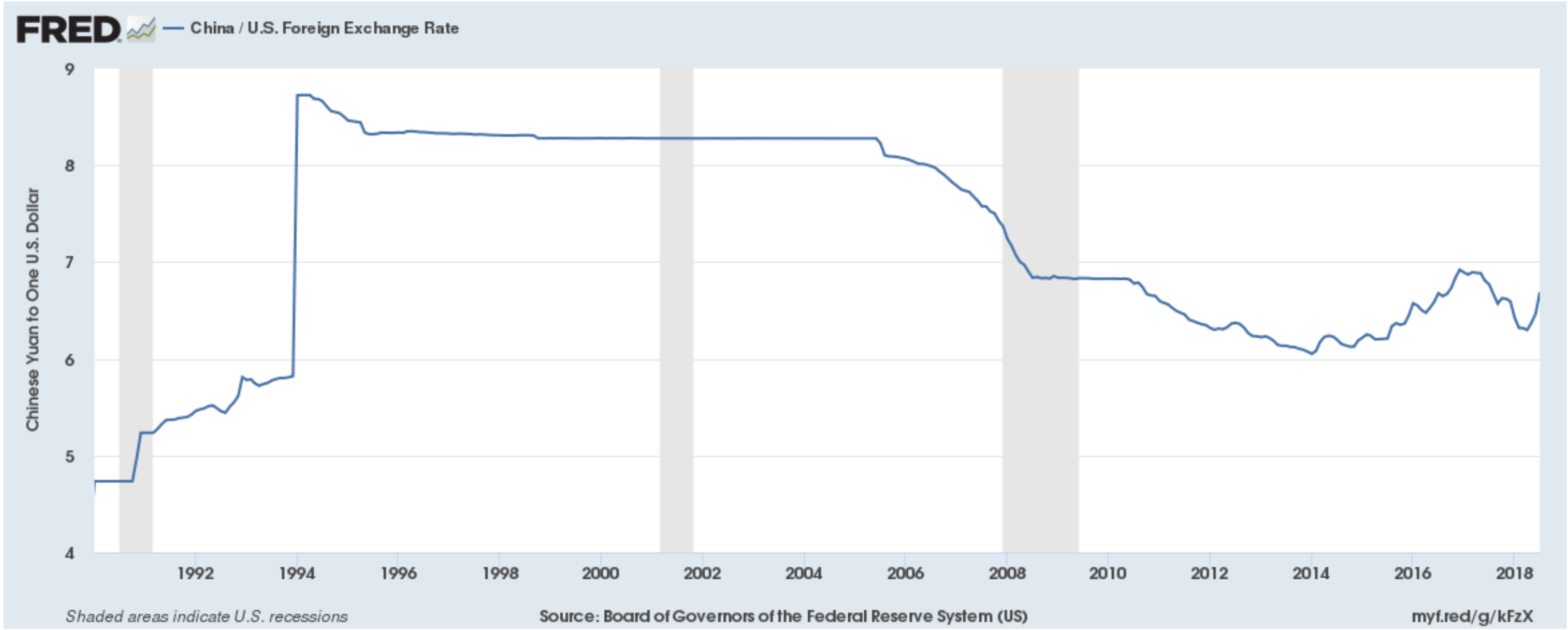
- Some countries fix their exchange rates

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

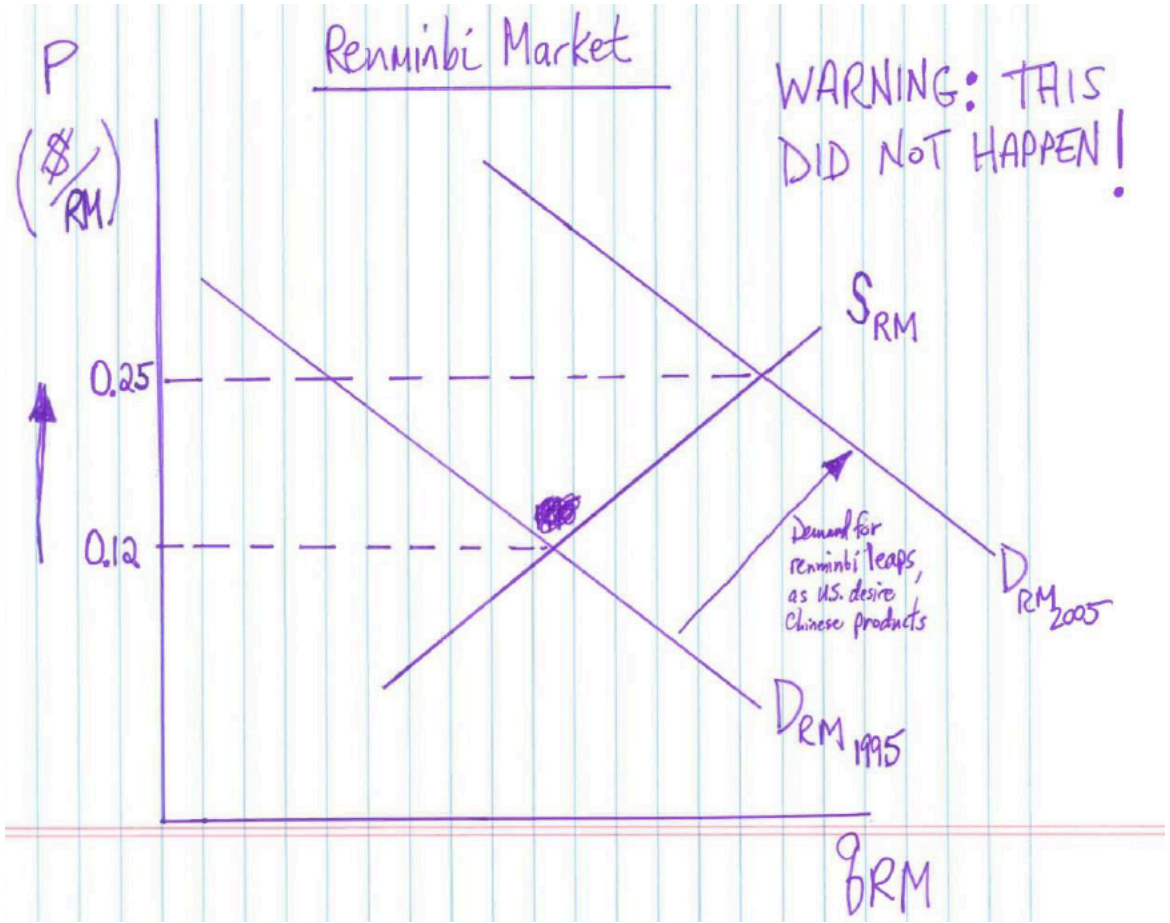
RM/$ Exchange Rate

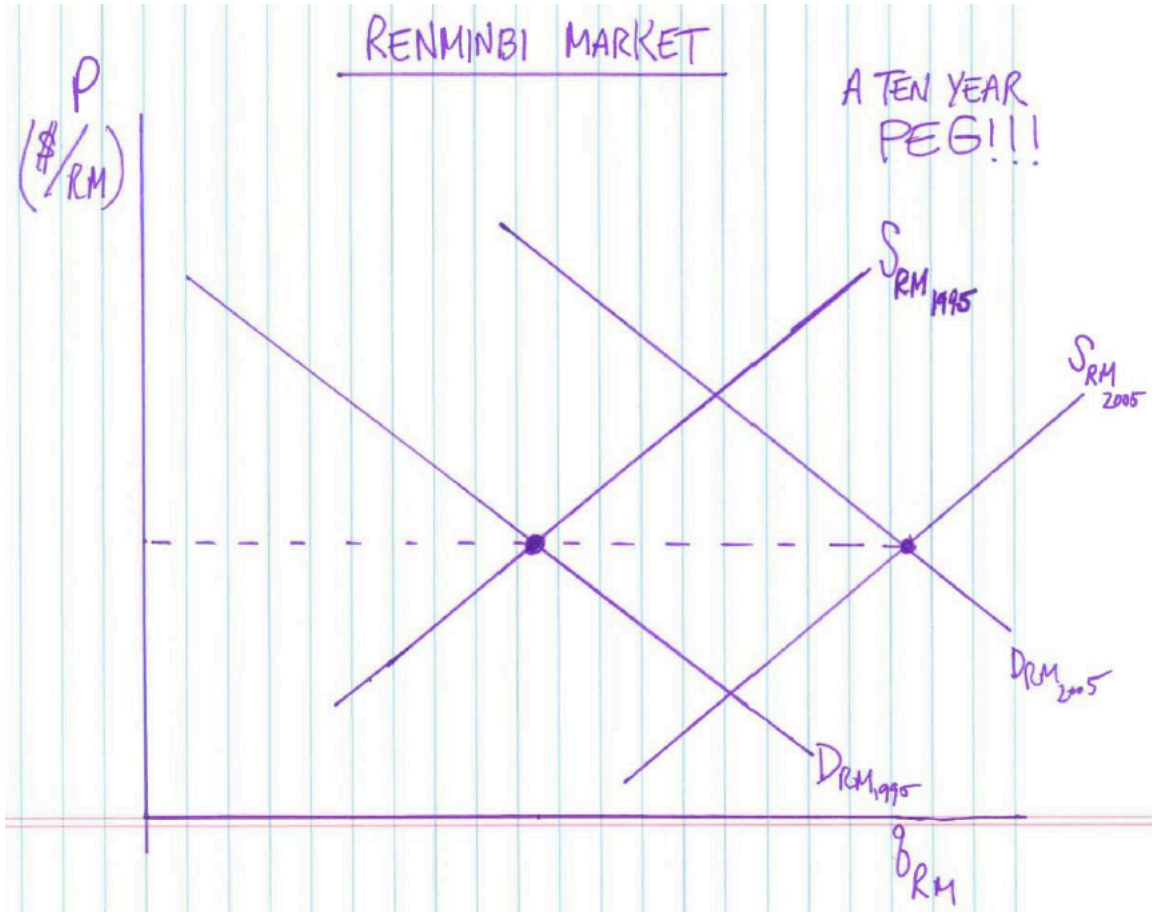


US-China Trade and Exchange Rate

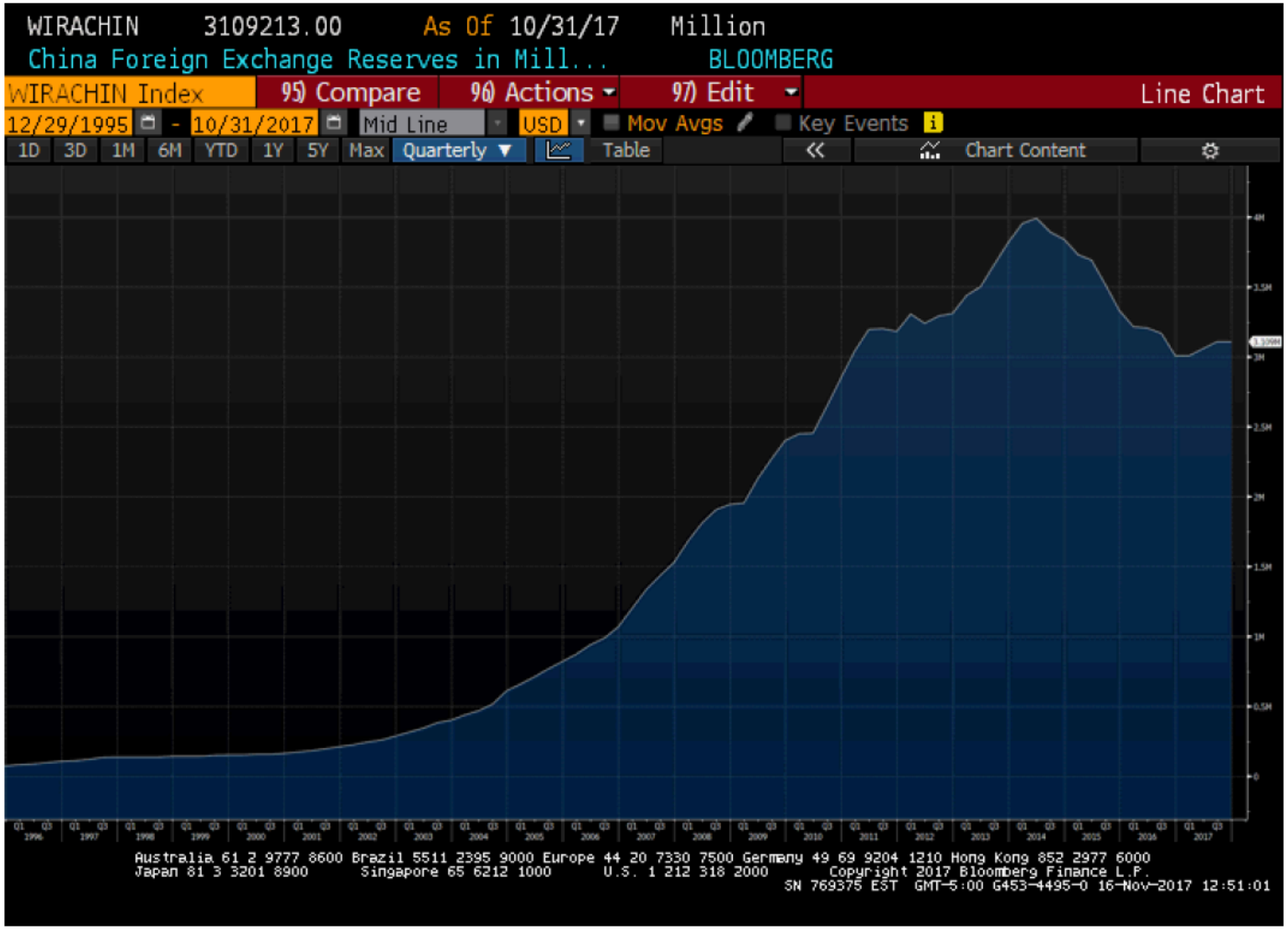
- US bought zillion TVs and PBoC bought trillions of T-bonds
- US demand for China's goods soared
  - 1995-2005: US trade deficit with China climbed from $20bn to $200bn
- US demand for Chinese renminbi soared
  - Value of renminbi vs $ should have soared
  - A dime for a RM (0.12$/RM = 8.3RM/$) in 1995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



Real Exchange Rate

- Relative prices of two countries' G&S 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** (RER): Price of domestic goods in terms of foreign goods

Real Exchange Rate: Formula

- RER **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

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

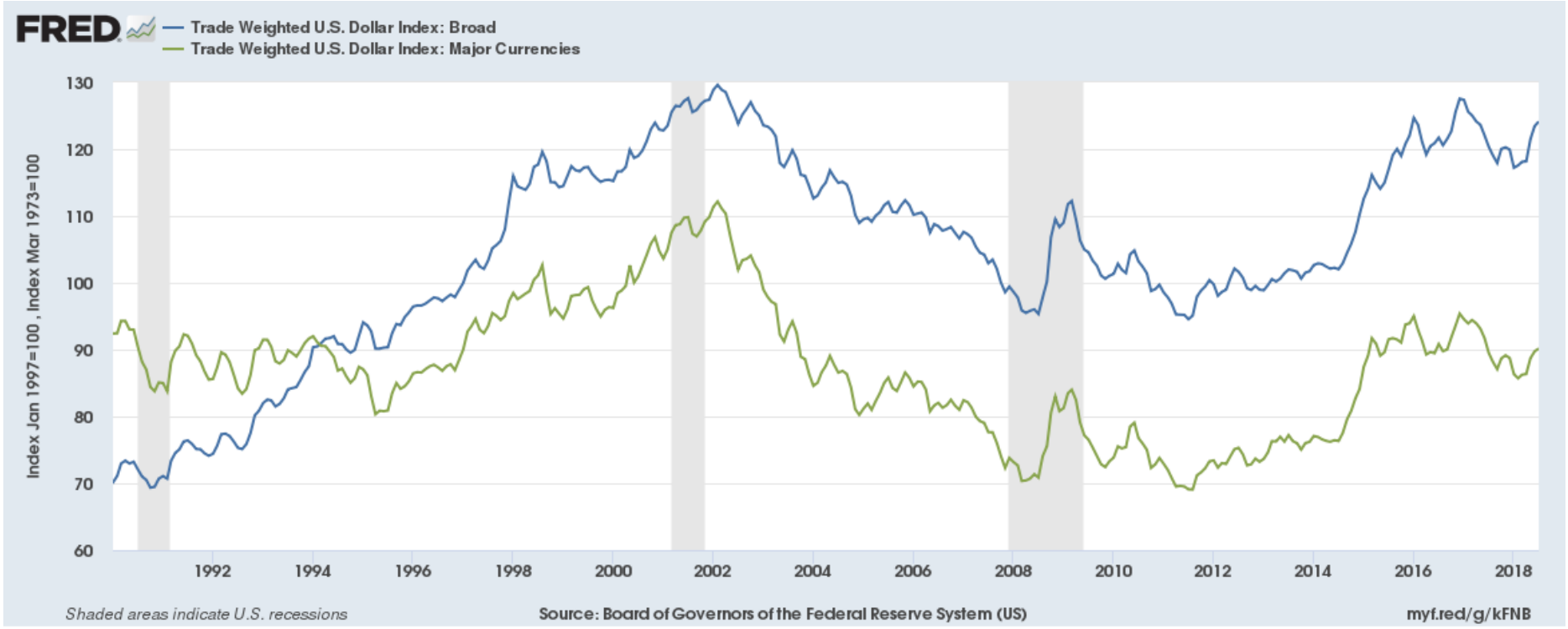
- RER says **how many units** of the basket you can buy in the US per unit of basket in the euro area
  - $q_{US/EU} > 1 \rightarrow$ G&S are **more expensive in the Eurozone** than in the US

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**

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



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 **$130,000** per year in house, car, food, drinks
  - In country B, I spend **€100,000** per year in house, car, food, drinks
  - What *nominal* 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 say 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 $16.7 tr
- China's economy uses yuan or renminbi, how did we get Chinese GDP in US dollars?
- What is the 2016 value for Chinese real GDP in renminbi?
  - RM66.5 tr
- What if we use the **nominal** (forex market) exchange rate **RM/$** to convert China's real GDP from RM into $?

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

Application

- Why does the IMF don't 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* levels of development
  - **Example**: US and UK
  - However, deviations are relatively persistent

Exchange Rates and Interest Rates

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

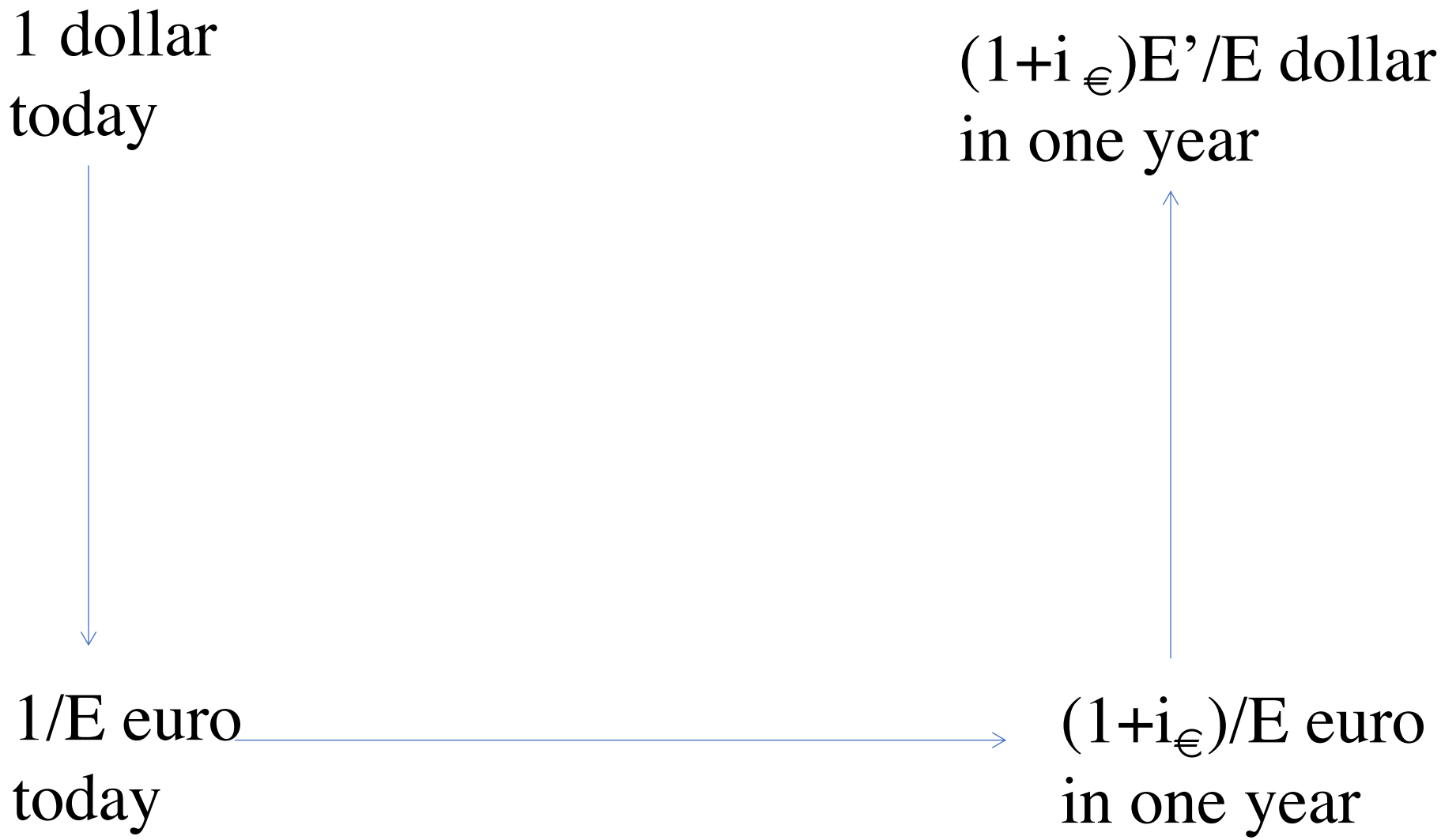
- Bonds **denominated in different currencies** yield different interest rates

- **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 $E = E_{\$/€}$, $E^{e} \downarrow$ 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

Comparing PPP and UIP

- Exchange rates are complicated because they determine the *relative* prices of objects traded **in different markets**
- **PPP** links exchange rates to the equilibrium in the market for **G&S**
- **UIP** links exchange rates to the equilibrium in the market for **financial assets**, especially bonds

UIP and Monetary Policy

- "Dollar surges as March Fed rate hike comes into view" FT, 02/07/2017

Monetary Policy, Interest Rates and Exchange Rates

- Market commentary about exchange rates mostly about central bank actions
  - Interest rates
- A higher interest rate leads to an appreciation of the currency
- What is the nexus between exchange rates, interest rates and news?

Comparative Statics

- Looking for the impact of one variable on another, ***other things equal***
  - What does this mean?
  - Take all the other variables of the model **as given**

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

- What is the impact of an increase in euro interest rate $i_€$ on the exchange rate $E_{\$/€}$ taking $i_\$$ and E^e **as given** (unchanged)?

Effect of $i_€$ on the US Dollar (Other things equal)

- Assume $i_€$ increases by 1% (other things equal)
- By how much does the dollar appreciate or depreciate against the euro?
- Increasing the euro interest rate depreciates the dollar (other things equal)
- Intuition?
  - Lower demand for US bonds relative to euro bonds (other things equal)
  - US dollar depreciates by 1%

Effect of $i_€$ on the US Dollar: Subtle Points

$$1 + i_\$ = (1 + i_€)\frac{E^e}{E}$$

- Today's euro appreciation generates an **expected depreciation** of the euro over time which offsets the higher euro interest rate

- The "other things equal" assumption is not always appropriate
  - For example, what if expected US inflation and $i_\$$ increase at the same time?

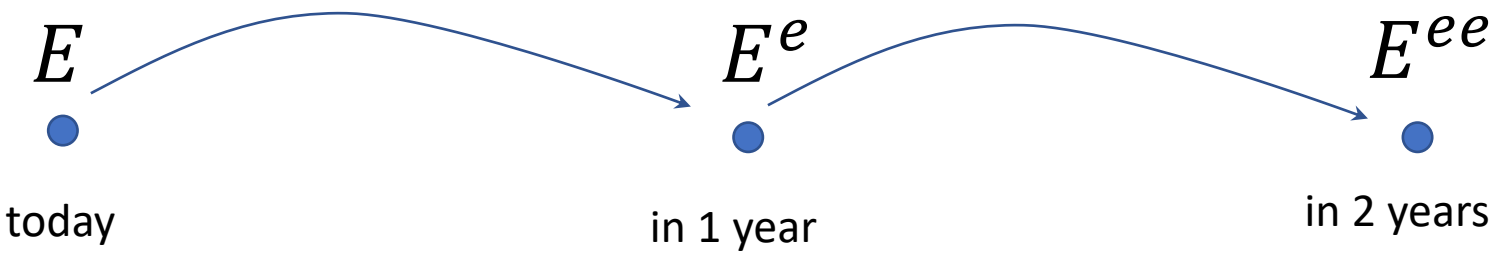
Exchange Rates and Expectations

- Like any asset price, exchange rates are **forward looking** and **influenced by expectations**
- UIP can help us to understand why
- Assume that we suddenly learn that the ECB is going to raise its interest rate $i_{€}$ by 1% in **one year**: What is the impact on the exchange rate $E_{\$/€}$ **today**?

Iterated Expectations

- Assume rational and forward-looking investors

$$E = \frac{1 + i_{€}}{1 + i_{\$}} E^{e} \longrightarrow E^{e} = \frac{1 + i_{€}^{e}}{1 + i_{\$}^{e}} E^{ee}$$



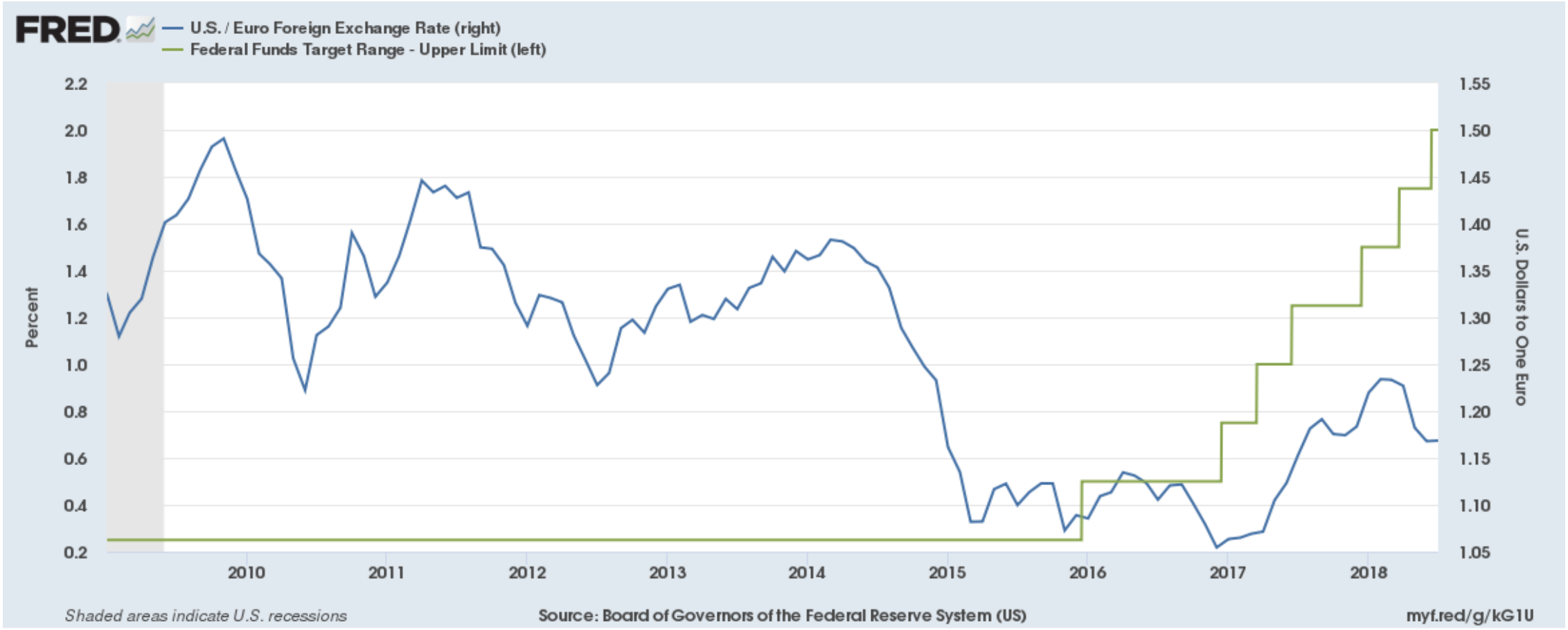
Effects of News on Exchange Rates

- Importance of "news"
  - Exchange rate is **moved by changes in expectations** ("news") about future monetary policy
  - Same as for any price in financial asset markets

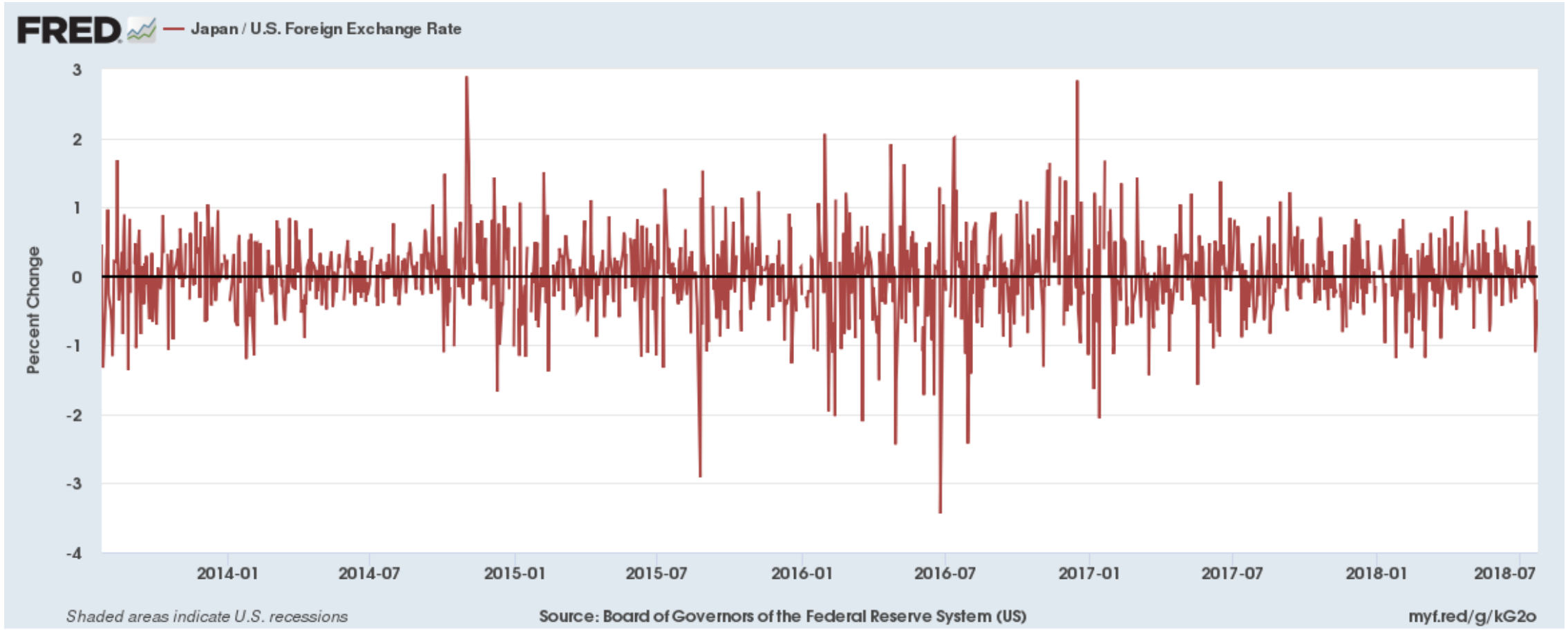
- **Implication 1**: Changes in exchange rates are not necessarily correlated with **observed** changes in economic fundamentals

- **Implication 2**: Exchange rates are volatile

Implication 1: FFR vs Exchange Rate



Implication 2: Exchange Rate Volatility



News Announcements

- One way of identifying **impact of change in expectations** on exchange rates is to **measure "news" at high frequency** (intra-day data)
  - Policy announcements
  - Data release
  - Etc.

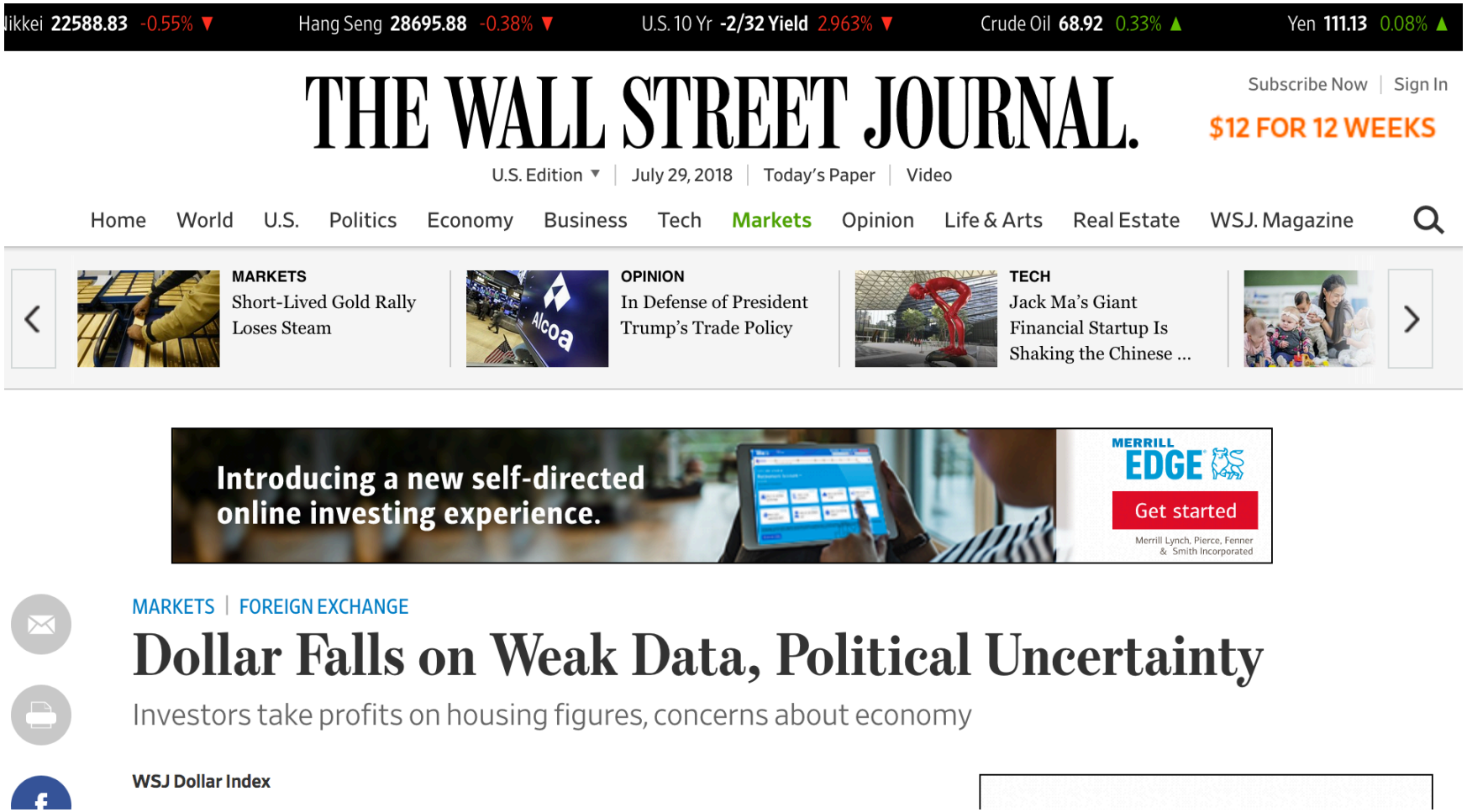
- **Example**: **Brexit**
  - Vote June 23, 2016
  - If $E_{\$/£}$ ➞ what does E ↓ mean?

Effect of Brexit on $/£ Exchange Rate

Exchange Rate Trading

- Currency forecasters spend a lot of time **speculating** about what central banks will do in the future
  - "Fed watching"
- Changes in market views about future monetary policy is a **primary driver** of short-run fluctuations in exchange rates
- Two key factors:
  - News about the state of the economy, and
  - How central banks will respond to these developments
- Importance of central bank **communication**

June 16, 2017


ikkei 22588.83 -0.55% ▼
Hang Seng 28695.88 -0.38% ▼
U.S. 10 Yr -2/32 Yield 2.963% ▼
Crude Oil 68.92 0.33% ▲
Yen 111.13 0.08% ▲
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Macroeconomic Policy in an Open Economy

- **Aggregate Expenditure** model can be extended to an open economy
- In a **closed economy**, we had a consumption function and investment was a function of the real interest rate
- In an **open economy**, in addition we will have factors affecting NX

Key Drivers of Net Exports

- P^{US} Relative to P^{ROW}
  - If $\pi^{US} < \pi^{ROW}$, prices of U.S. products increase more slowly than prices of products of other countries ➞ NX will rise
- Growth Rate of GDP^{US} Relative to the Growth Rates of GDP^{ROW}
  - When incomes in the US rise **more slowly** than incomes in other countries ➞ NX will rise
- Exchange Rate Between the Dollar and Other Currencies
  - As the value of the **U.S. dollar rises**, the foreign currency price of U.S. products sold in other countries rises, and the dollar price of foreign products sold in the United States falls ➞ NX will fall

Monetary and Fiscal Policy in an Open Economy

- By affecting domestic GDP, **fiscal policy** will also affect NX
  - If your income increases, you will demand both more domestic and foreign goods
- **Monetary policy** will influence the economy through two channels
  - Investment and spending
  - Effect on the exchange rate
- Both policies will not only affect GDP but also NX
  - Manage internal and external **imbalances**