International Economics
Fall 2011
Exchange Rate Determination, Part 2

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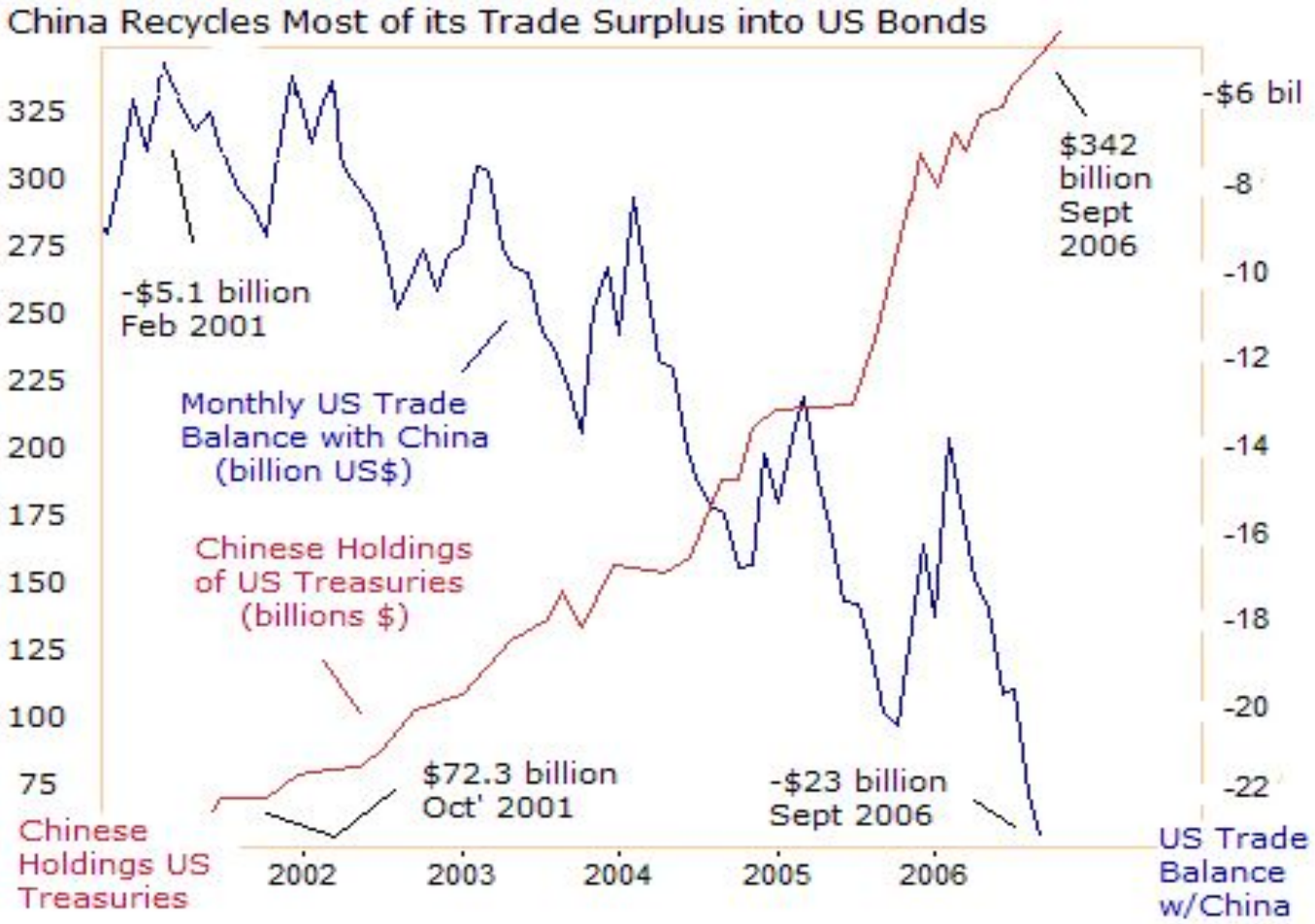
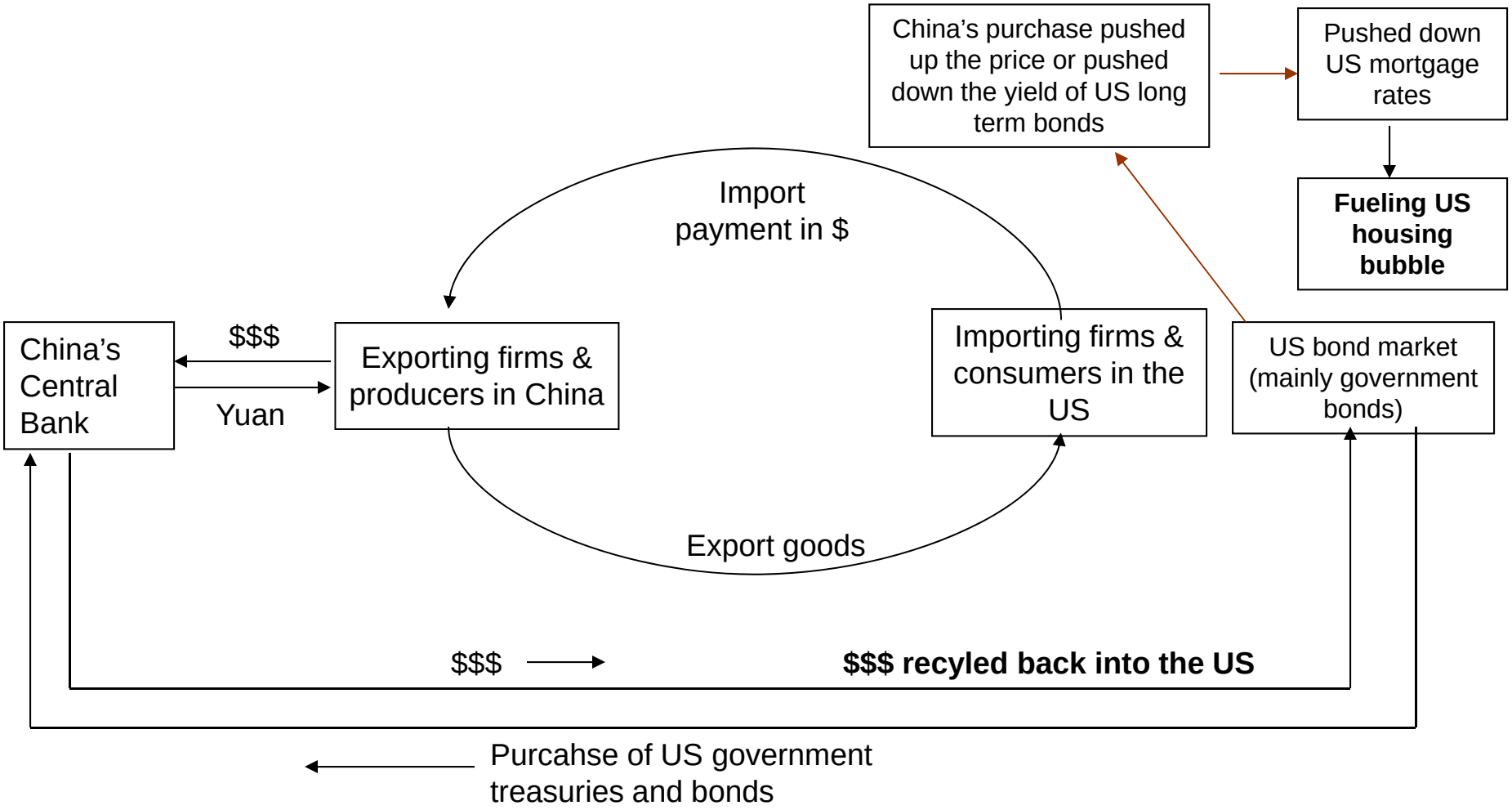
What to Do With The Huge Trade Surplus?



- China's FX reserves reached $3.2 trillion in 2011
- 70% of those reserves is estimated to be in assets denominated in the US dollar
- As of July 2011, China holds nearly $1.2 trillion of US treasury securities.

How Dollar Recycling Works



See how much the US owes the rest of the world, go to
http://economistonline.muogao.com/2011/09/put-us-government-debt-int-perspective.html

How exchange rate is determined in the long run?

What is exchange rate, exactly?

- You buy a hamburger in Denmark for 30 kr…naturally, some of you probably expect to pay the same price for the same hamburger in the US,

  i.e., 30 kr-equivalent in US dollar.

- If that's the case, using exchange rate of 1 US $ = 6 DKK, then you should expect that a 30-kr hamburger in Denmark would sell for about $5 in the US. But…

- The same hamburger actually sells for only $3.5 in the US. This implies an exchange rate of 8.6 (=30/3.5) DKK per $, which is well above 6 DKK per $, the official exchange rate. At this rate, you eat a hamburger, and you still have $1.5 (=$5-$3.5) extra to spend. In other words, your 30 Kroner has more purchasing power in the US than in Denmark.

- As Danish consumers, your welfare improves when you travel to the US. In contrast, when US consumers travel to Denmark, for $3.5 they could not buy a hamburger in Denmark ($3.5x6=21kr < 30kr), and they suffer a loss of real purchasing power.

What is exchange rate, exactly?

The Big Mac Index

The hamburger standard

	Big Mac prices		Implied PPP* of the dollar	Actual exchange rate: Jan 30th	Under (-)/over(+) valuation against the dollar, %
	in local currency	in dollars			
United States†	$3.54	3.54	-	-	
Argentina	Peso 11.50	3.30	3.25	3.49	-7
Australia	A$3.45	2.19	0.97	1.57	-38
Brazil	Real 8.02	3.45	2.27	2.32	-2
Britain	£2.29	3.30	1.55‡	1.44‡	-7
Canada	C$4.16	3.36	1.18	1.24	-5
Chile	Peso 1,550	2.51	438	617	-29
China	Yuan 12.5	1.83	3.53	6.84	-48
Czech Republic	Koruna 65.94	3.02	18.6	21.9	-15
Denmark	DK 29.5	5.07	8.33	5.82	43
Egypt	Pound 13.0	2.34	3.67	5.57	-34
Euro area§	€3.42	4.38	1.04**	1.28**	24
Hong Kong	HK$13.3	1.72	3.76	7.75	-52

What is exchange rate, exactly?

- This implied exchange rate in Big Mac Index is called PPP exchange rate (or Purchasing Power Parity). It's the exchange rate under the assumption that prices for the same goods in different countries should be the same, after currency conversion.

- This principle is called **The Law of One Price**.

- If the law holds in reality, PPP exchange rate between Denmark and the US should be: 30DKK/3.5$ = **8.6** DKK/$, which means at current exchange rate, Danish Krone is overvalued against US dollar.

Purchasing Power Parity, or PPP

- **Purchasing power parity** is the application of **the law of one price** across countries for *all* goods and services, or for a representative group ("basket") of goods and services.

$$P_{US} = (E_{US\$/DKK}) \times (P_{DK})$$

P_{US} = level of average prices in the US

P_{DK} = level of average prices in Denmark

$E_{US\$/DKK}$ = exchange rate of DKK in terms USD

Purchasing Power Parity (cont.)

- More sophisticated PPP calculation uses a basket of goods and services:
  - Use the same basket, say a basket that consists of 40% pork, 40% beer, 20% haircut.
  - In Denmark, 1 kilo pork costs 30DKK, 1 liter beer 100DKK, 1 haircut 150DKK
  - In the US, 1 kilo pork costs $5, 1 liter beer $10, 1 haircut $20.
  - We have P_{DK} = 30x0.4 + 100x0.4 + 150x0.2 = 82DKK
    P_{us} = 5x0.4 + 10x0.4 + 20x0.2 = $10
  - Thus, if we follow the law of one price, the PPP exchange rate implied by above calculation is: 82/10 = 8.2 DKK/US$

Purchasing Power Parity (cont.)

- Purchasing power parity implies that

$$E_{US\$/DKK} = P_{US}/P_{DK}$$

  - Levels of average prices determine the exchange rate.
  - If the price level in the US is US$200 per basket, while the price level in Denmark is DKK1,600 per basket, PPP implies that the DKK/US$ exchange rate should be 1,600DKK/200$ = 8DKK/$
  - **Purchasing power parity** says in the long run the equilibrium exchange rate should reflect people's real purchasing power: 8 DKK in Demark buys the same amount of goods/services as 1 US dollar in the US.

Purchasing Power Parity (cont.)

- Purchasing power parity comes in two forms:
  - **Absolute PPP**: Exchange rates equal to the *level* of relative (average) prices across countries.

$$E_{\$/€} = P_{US}/P_{EU}$$

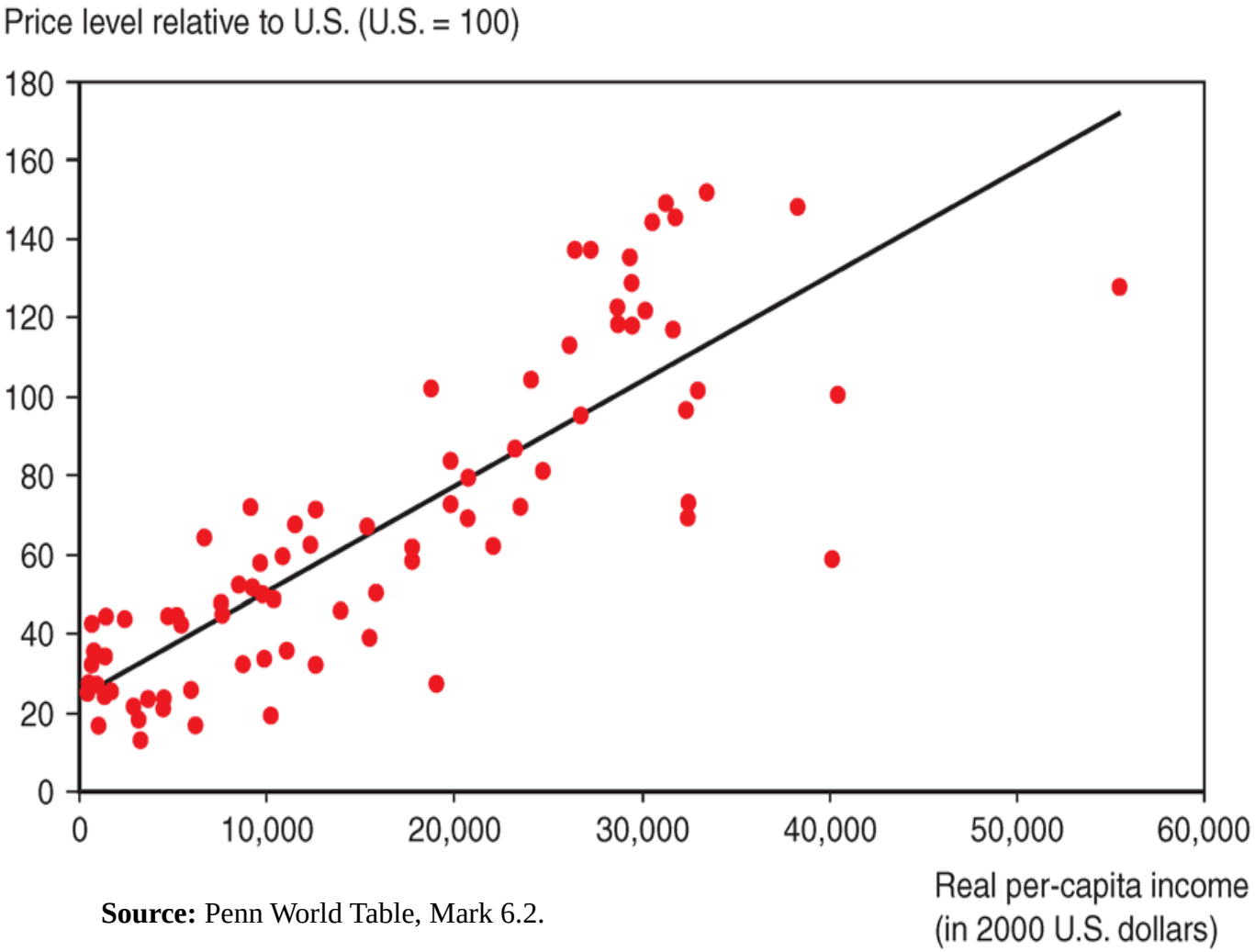
  - **Relative PPP**: the percentage *change* in exchange rate between two currencies over any period equals to the difference of percentage *change* in prices (or inflation) at national level, i.e.,

$$(E_{\$/€,t} - E_{\$/€,\, t-1})/E_{\$/€,\, t-1} = \pi_{US,\, t} - \pi_{EU,\, t}$$

where π_t is inflation rate, or price change from period *t-1* to *t*

  - Relative PPP simply says if US inflation is 1% higher than Europe, then US dollar should depreciate by 1% against Euro, during the same period. Vice versa…
  - Relative PPP establishes a long-run link between inflation and exchange rate movements.

Price Levels and Real Incomes, 2004



Source: Penn World Table, Mark 6.2.

→Higher per capita income is highly correlated with higher price level. Why??

→Similarly, lower per capita income corresponds to lower price level. Why???

Why price levels are lower in poorer countries?

- Because of lower productivity?
  - Two sectors: tradables vs. non-tradables
  - In tradable sector, with international trade, prices tend to be similar, so the main price differences exist in non-tradable sector, or the services sector.
  - Yes, in some services sector, such as banking and insurance, productivities in developed countries are definitely higher, but do you expect that barbers earn much higher wages in developed countries because they have much higher productivity than their counterparts in developing countries? -- How many haircuts can barbers do in one hour across countries? NOT much difference.
  - We need a better explanation.

Why price levels are lower in poorer countries?

- Because of lower cost? Or lower wage?
- What if we just pay workers in developing countries more? Handing out more money? Will that be the solution?
- Have you ever thought about – what makes their cost/wage in developing countries much lower?

Why price levels are lower in poorer countries?

- Because of lower productivity? (cont.)
  - The link between the tradable and non-tradable sectors
    - In rich countries, labor productivity in *tradable* sector is higher and people earn higher wages. This tends to push up wages in services sectors, as higher wage in tradable sector drives up demand for more and better services.
    - In poor countries, labor productivity in *tradable sector* is lower and people earn lower wages, although tradable sector also has the similar push-up effect on services sector, but the push is not as big as in developed countries.
    - So as a whole, price level in developing countries is lower than that in developed countries.
  - This spillover effect, from tradable sector to non-tradable sector, is called *Balassa-Samuelson Effect*.

Why price levels are lower in poorer countries?

- Because of lower capital-labor ratio?
  - Developed countries are relatively capital intensive, and developing countries are relatively labor intensive.
  - This is another way of saying developed countries have higher capital-labor ratio or capital intensity than developing countries.
  - With higher capital-labor ratio, this would imply higher labor productivity in developed countries, which leads to higher wages.
  - The lower wage in developing countries will imply lower price levels in *non-tradable* sectors (lower cost), and leads to lower price levels as a whole in developing countries (note the prices in tradable sectors tend to be quite similar).

Compare Purchasing Power Across Countries

- Because prices in developing countries tend to be much lower than in developed countries, $1 will have more purchasing power in developing countries than in the US.

- When using official (nominal) exchange rate, instead of PPP,
  - Tourists from developed countries will instantly feel richer in developing countries;
  - And tourists from developing countries will feel instantly poorer when visiting developed countries.

- Also, as a general rule,
  - GDP per capita (or living standards) of a developing country, when converted into US $, tends to understate the real purchasing power of that country;
  - GDP per capita of a developed country, when converted into US$, tends to overstate the real purchasing power of that country.

Compare Purchasing Power Across Countries

2008 List by the World Bank [2]

Rank	Country	GDP (millions of USD)
—	*World*	**60,115,459**
1	United States	14,204,322
—	*Eurozone*	13,565,479[a]
2	Japan	4,909,272
3	People's Republic of China	3,860,039
4	Germany	3,652,824
5	France	2,853,062[b]
6	United Kingdom	2,645,593
7	Italy	2,293,008
8	Brazil	1,612,539
9	Russia	1,607,816
10	Spain	1,604,174

List by the World Bank (2008)

Rank	Country	GDP (PPP) $M
—	*World*	69,697,646
1	United States	14,204,322
—	*Eurozone*	10,899,815[b]
2	China	7,903,235
3	Japan	4,354,550
4	India	3,388,473
5	Germany	2,925,220
6	Russia	2,288,446
7	United Kingdom	2,176,263
8	France	2,112,426
9	Brazil	1,976,632
10	Italy	1,840,902

Compare Purchasing Power Across Countries

World Bank (2008)[2]

Rank	Country	US$
1	Luxembourg	111,182
2	Norway	94,359
3	Switzerland	64,011
4	Ireland	63,178
5	Denmark	62,327
6	Iceland	52,549
7	Netherlands	52,322
8	Sweden	52,057
9	Finland	51,060
10	Austria	49,902
11	Australia	47,498
12	United States	46,716
13	Belgium	46,486
14	France	45,982
15	Germany	44,471

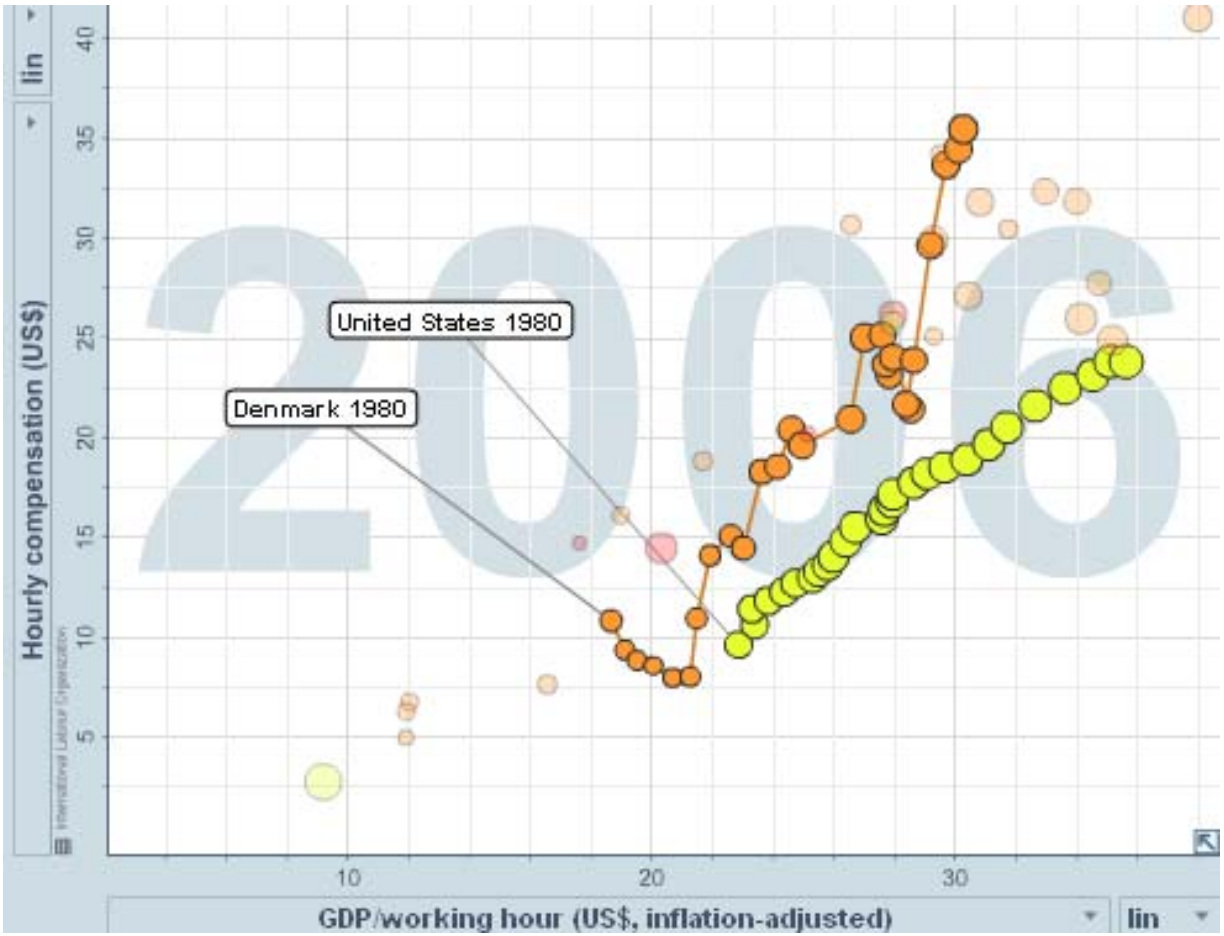
World Bank (2008)[2]

Rank	Country	Intl. $
1	Luxembourg	78,559
—	*Macau*	59,451
2	Norway	58,141
3	Singapore	49,288
4	United States	46,716
5	Ireland	44,195
—	*Hong Kong*	43,922
6	Switzerland	42,534
7	Netherlands	40,850
8	Austria	38,153
9	Sweden	37,383
10	Iceland	36,770
11	Denmark	36,604
12	Canada	36,444
13	Australia	35,677
14	Germany	35,613
15	United Kingdom	35,445

Compare Purchasing Power Across Countries

- Some questions to think about:
  - Why huge price differences even in developed countries?
  - Is it because labor productivity difference? Do you think Denmark's labor productivity is much higher than the US?
  - Or because the cost is much higher in Denmark? But then why Denmark's cost is much higher? Again, the wage is higher because Danish workers are more productive?
  - Denmark's cost is higher. But if Denmark's salary/wage is also proportionally higher too, then it'll be just enough to offset the high-cost, then the real purchasing power will not change. But in reaility, it's not.

Labor Productivity and Wage



Go play the chart at: http://www.bit.ly/r06IOm

Long-run Exchange Rate: the Monetary Approach

- **Overview**
  - It is a long-run exchange rate model combining theory of PPP and theory of money demand/supply
  - It looks at how factors that affect money demand and supply drive long-run exchange rate.
  - In this long-run model, price is flexible, i.e., no price rigidities.

- According to PPP,

$$E_{\$/€} = P_{US}/P_{EU}$$

Also, when money market is in equilibrium, we have:

$$P_{US} = M^s_{US}/L\ (R_{\$},\ Y_{US})$$

$$P_{EU} = M^s_{EU}/L\ (R_{€},\ Y_{EU})$$

So the long-run exchange rate is:

$$E_{\$/€} = P_{US} / P_E = \frac{M^s_{US} / L(R_{\$}, Y_{US})}{M^s_E / L(R_{€}, Y_E)}$$

Monetary Approach to Exchange Rate

$$E_{\$/€} = P_{US} / P_E = \frac{M^s_{US} / L(R_\$, Y_{US})}{M^s_E / L(R_€, Y_E)}$$

How exchange rate will change in the long run when you have,

1. **a permanent rise of the US money supply**
   - causes a proportional increase in domestic price level,
   - causing a proportional **depreciation of the US dollar**
2. **a rise of US interest rate**
   - lowers the real demand for money in the US → a rise in US prices
   - causing a proportional ***depreciation*** **of the US dollar (this is puzzling,** quite contrary to the short-run prediction)
3. **a rise of the US output**
   - raises domestic demand of real money assets → with money supply fixed, US price level has to fall to restore equilibrium in money market
   - The fall of US prices causes a proportional **appreciation of US$**

Monetary Approach to Exchange Rate

- The **Fisher effect** (named after economist Irving Fisher) describes the long-run relationship between nominal interest rates and inflation expectations.
- Derive the Fisher effect:

  From the interest parity condition, we have,

  $$R_{\$} - R_{€} = (E^{e}_{\$/€} - E_{\$/€})/E_{\$/€}$$

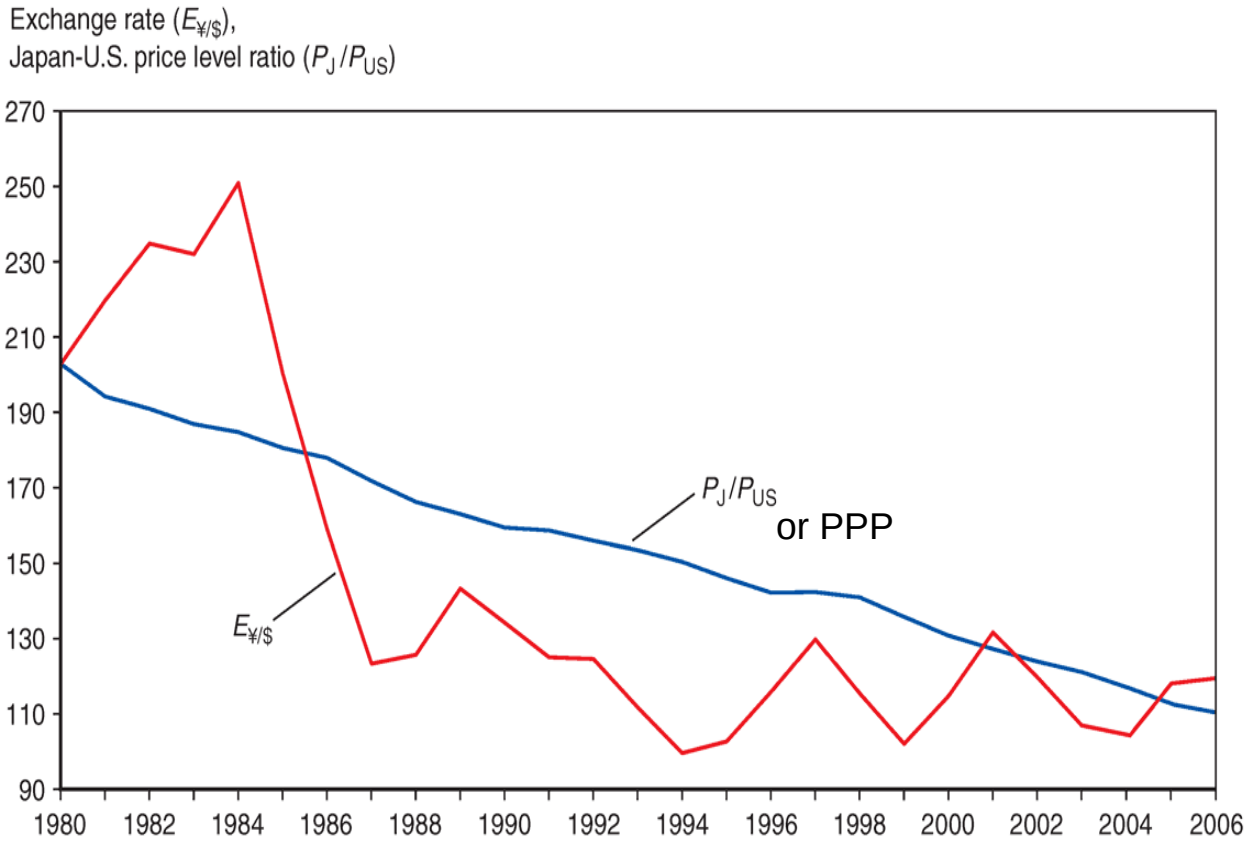
  If financial markets expect *relative PPP* to hold, then expected exchange rate changes will equal the difference of the expected inflation in the two countries:

  $$(E^{e}_{\$/€} - E_{\$/€})/E_{\$/€} = \pi^{e}_{US} - \pi^{e}_{EU}$$

  ➔ Thus we have, $\boldsymbol{R_{\$} - R_{€} = \pi^{e}_{US} - \pi^{e}_{EU}}$

- **The Fisher effect**
  - It says a rise in a country's expected inflation rate (relative to the other country) will eventually (in the long run) cause an equal rise of that country's interest rate, everything else being equal. Vice versa.
  - Since interest rate eventually catches up with long-run inflation expectation, the real return is unchanged. Thus, inflation won't have effect on the long-run exchange rate.

How closely does PPP match the nominal exchange rate? Not very close.



➔The PPP (or PJ/PUS) exchange rate does not match very closely to the actual exchange rate.

➔ The actual exchange rate tends to have more variations.

Source: IMF, *International Financial Statistics*. Exchange rates and price levels are end-of-year data.

Shortcomings of PPP

- Reasons why PPP (or the law of one price) may not hold in reality, because:
  - Trade barriers
  - Some goods, and most services are not tradable
  - Imperfect competition and domestic market distortions
  - Differences in the measurement of average prices for baskets of goods and services
  - Different countries have different consumption patterns or different consumption basket, which in turn will affect the relative price of goods/services.

Beyond PPP: The Real Exchange Rate Approach

- Why do we need another approach?
  - PPP's prediction is not accurate
  - But PPP serves as a starting point for better modeling - the law of one price is, however, quite intuitive
  - Better exchange rate models should consider why PPP-based model deviates from the reality so much
- Can we do better?
  - PPP ➔ Real Exchange Rates

Real Exchange Rate

- Real exchange rate, or $q_{\$/€}$, is defined as:

$$q_{\$/€} = (E_{\$/€} \times P_E)/P_{US}$$

$P_{US:}$ the dollar price of an unchanging basket of typical purchase of US households or firms

$P_{E:}$ the euro price of an unchanging basket of typical purchase of European households or firms

$E_{\$/€} \times P_{E:}$ is the dollar price of the same consumption basket in P_F

- In words,
  - $q_{\$/€}$ is the exchange rate between two typical consumption bundles specific to <u>each</u> country, i.e., these are two different consumption baskets.
    - For example, Danes may consume more pork, more beer than Americans.
  - The ratio measures how many "baskets" of typical US consumption can buy with ONE basket of typical European consumption bundle, both expressed in dollar terms. (<u>VERY IMPORTANT</u>)

Real Exchange Rate

$$q_{\$/€} = (E_{\$/€} \times P_E)/P_{US}$$

- When $q_{\$/€}$ *increases*, we say that US$ is *depreciated* against the Euro, because now ONE typical European consumption basket can exchange for *more* US consumption baskets.

- When $q_{\$/€}$ *decreases*, we say that US$ is *appreciated* against Euro, because ONE typical European consumption basket can now exchange for *less* US consumption baskets.

  (**note**: This is a quite difficult concept. It will take a while for you to get the intuition, so spend more time on it.)

Real Exchange Rate: An Example

If a typical EU consumption basket costs P_E =€100, and a typical U.S. basket costs P_{US} = $120, and the nominal exchange rate is $E_{\$/€}$ = $1.35 per Euro, then what's the real exchange rate between dollar and euro?

$$q_{\$/€} = (E_{\$/€} \times P_E)/P_{US}$$
$$= \$1.35 \times 100 / \$120$$
$$= 1.125 \text{ US baskets per European basket}$$

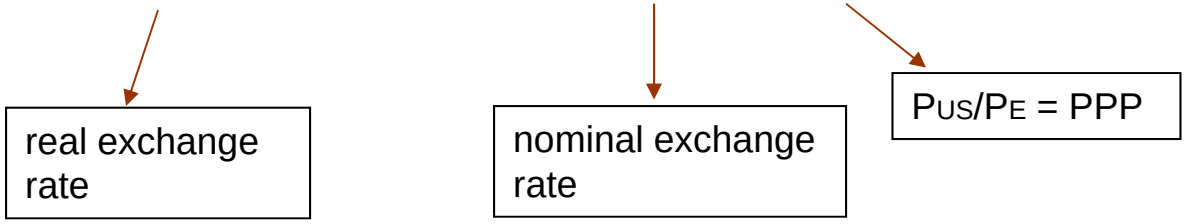
Real Exchange Rate (RER) vs. PPP

- According to PPP, the long-run exchange rate is determined by relative average prices of the same consumption basket:

$$E_{\$/€} = P_{US}/P_E$$

- According to the more general real exchange rate (RER) approach,
  - the consumption **basket is different** in each country, but both are **typical** to the households' consumption pattern of that country.
  - also, in real exchange rate, the price of foreign consumption basket is converted into local currency. So, nominal exchange rate is embedded as a component in the real exchange rate.

$$q_{\$/€} = (E_{\$/€} \text{ x } P_E)/P_{US} = E_{\$/€} \text{ x } (P_E/P_{US})$$



What affects real exchange rate, RER

$$q_{\$/€} = (E_{\$/€} \times P_E)/P_{US}$$

How real exchange rate will change in the long run when you have:

- **an increase in relative demand of US products**
  - An increase in relative demand of U.S. products causes the value (price) of U.S. goods relative to the value (price) of foreign goods to rise.
  - P_{US} rises relative to $E_{\$/€} \times P_{EU}$, thus $q_{\$/€}$ decreases, indicating **a real appreciation of the US dollar.**

- **an increase in relative output supply of US products**
  - An increase in relative supply of US products (can result from an increase in U.S. productivity) causes the price of U.S. goods relative to the price of foreign goods to fall.
  - P_{US} drops relative to $E_{\$/€} \times P_{EU}$, thus $q_{\$/€}$ increases, indicating **a real depreciation of the US dollar.**

For the next class…

- Check course website for details