# Exchange Rates

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# Introduction: Exchange Rates

- **Exchange Rate is the price of some foreign currency in terms of a home currency**
  - Example 1: units of home currency for one unit of foreign (e.g. $1.34 per Euro)
  - Example 2: units of foreign currency for one unit of home (e.g. €.7425 per dollar)

**Major Currency Cross Rates**
*As of 6pm on June 24, 2007*

| Currency | | U.S. $ | ¥en | Euro | Can $ | U.K. £ | AU $ | Sw. Fr. |
|---|---|---|---|---|---|---|---|---|
| 1 U.S. $ | = | 1 | 123.72 | 0.7425 | 1.0688 | 0.5004 | 1.1806 | 1.2298 |
| 1 ¥en | = | 0.0081 | 1 | 0.006 | 0.0086 | 0.004 | 0.0095 | 0.0099 |
| 1 Euro | = | 1.3467 | 166.61 | 1 | 1.4394 | 0.6739 | 1.59 | 1.6562 |
| 1 Can $ | = | 0.9356 | 115.75 | 0.6947 | 1 | 0.4682 | 1.1046 | 1.1506 |
| 1 U.K. £ | = | 1.9985 | 247.25 | 1.484 | 2.136 | 1 | 2.3596 | 2.4577 |
| 1 AU $ | = | 0.847 | 104.79 | 0.6289 | 0.9053 | 0.4238 | 1 | 1.0416 |
| 1 Swiss Fr. | = | 0.8132 | 100.6 | 0.6038 | 0.8691 | 0.4069 | 0.9601 | 1 |

# Definitions: Nominal Exchange Rate

- $E_{\$/€} = 1.3467$=US exchange rate (in US terms)
- $E_{€/\$} = 0.7425$=Euro exchange rate (in European terms)
  - Thus,

$$E_{\$/€} = \frac{1}{E_{€/\$}}$$

- If a currency can buy more (less) of another currency we say it has appreciated (depreciated)
  - $\uparrow E_{\$/€}$ or $E_{€/\$} \downarrow$ : dollar depreciation, euro appreciation

# US dollar depreciation vs Euro

- Makes US residents relatively poorer
- Makes US products cheaper to foreigners

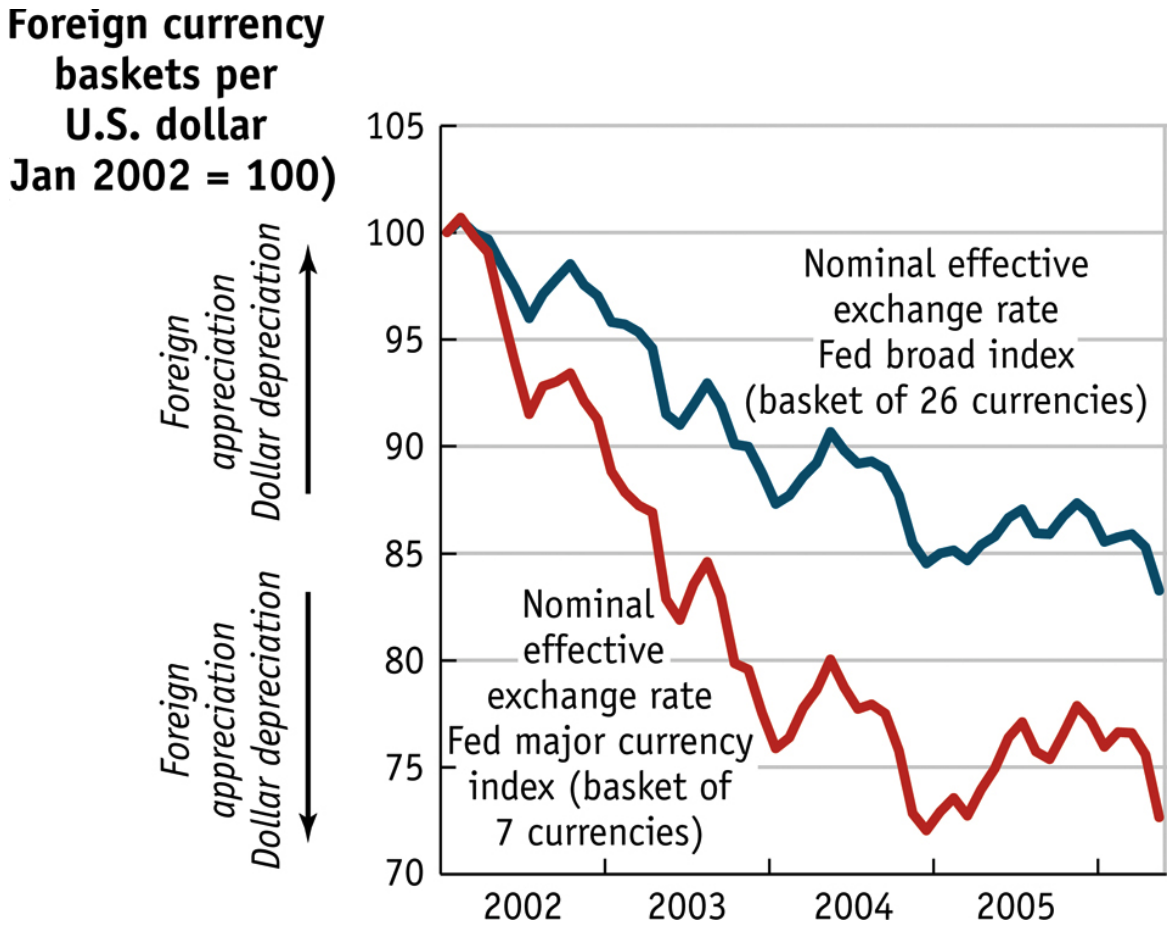


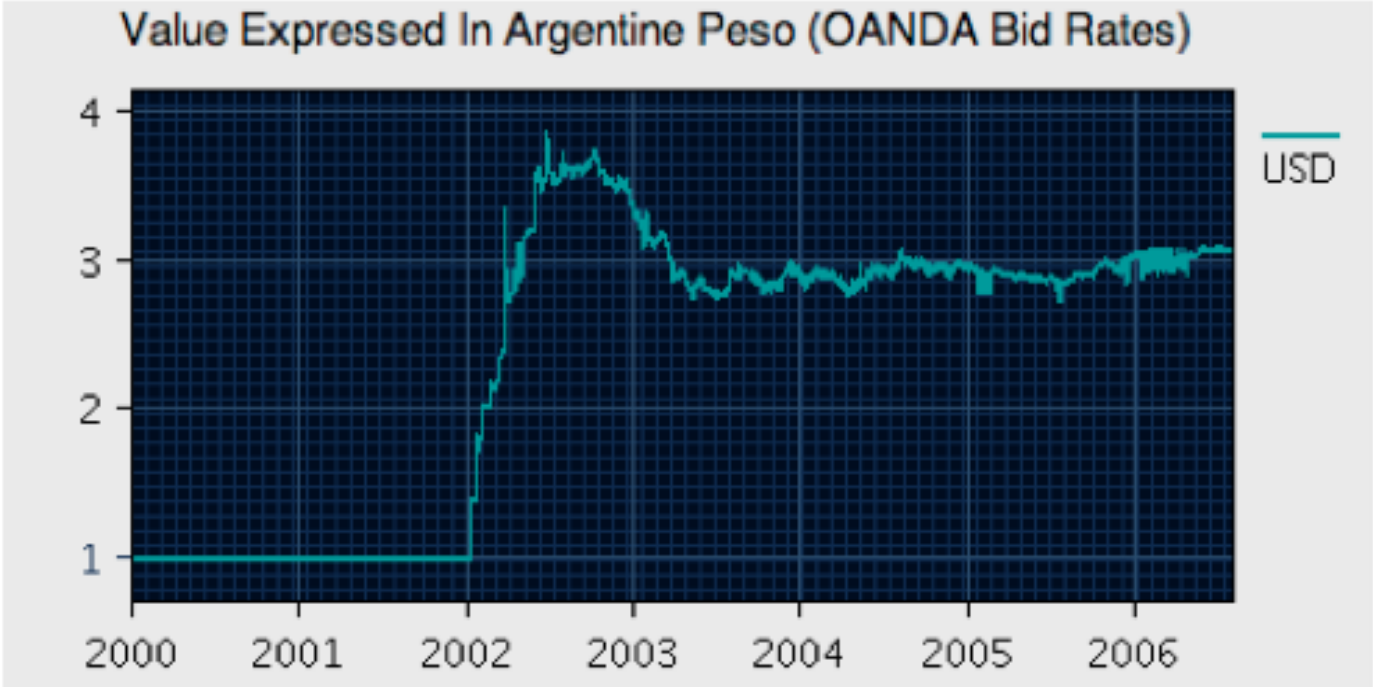

Figure: Source: Feenstra and Taylor 2010

# US dollar depreciation vs Euro

- Makes US residents relatively poorer
- Makes US products cheaper

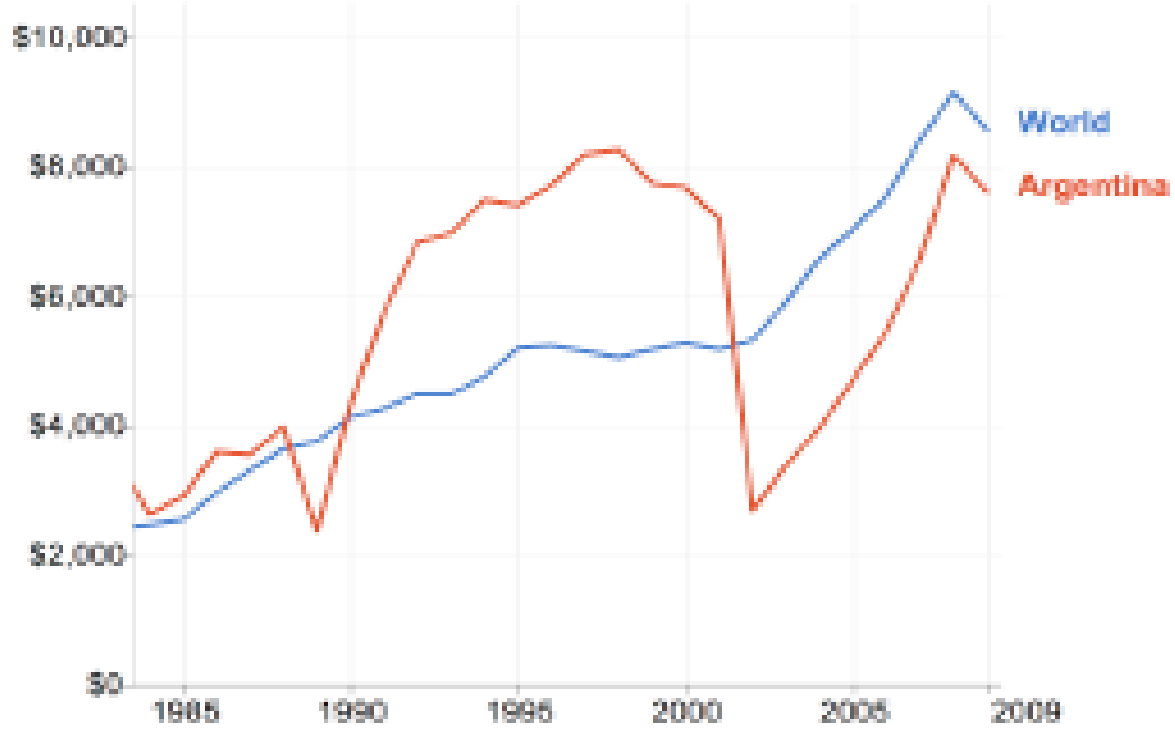
# Headline News: Peso depreciation

- **Between Jan and Jul '02 Argentine Peso depreciated 70%**
  - What does it mean for Argentinians?



# Headline News: Effects on Argentinians

- **Lost >70% of their wealth, in $. Also real GDP in pesos fell dramatically**
  - Jan 2002, Argentine gov. announced default on $155 billion in debt.
  - As of 2006, unemployment rate was still 10%.
  - Summer 2002: each day 11,200 people fell into poverty (earn <$3 a day).
  - Unrest, political upheaval: 5 presidents in 2 weeks!



# Headline News (2): What Should Greece Do?

- **Greece joined the Euro in Jan 2002**
  - For many years after that faced extremely low interest rates
    - Stability of Euro, offered amazing opportunity for consumption smoothing
    - ...or for over-borrowing!
- Because of the stability of Euro, common European currency
  - Some countries established strongly competitive export sector,eg. Germany
  - Greece lost "opportunity" to became more competitive
  - Relied on low interest rate to finance extremely high trade/fiscal deficits
    - Euro such a strong currency, we end up importing tomatoes & onions!
    - '97-'07 GDP growth 4%, (but large part of GDP, EU transfers!)
- After 2009 interest rates sky-rocketed, Greece is still not competitive
  - But cannot devaluate
  - Even if it could, should it?

# Nominal vs Real Exchange Rates

- **Real exchange rate**
  - Dollar pound real exchange rate

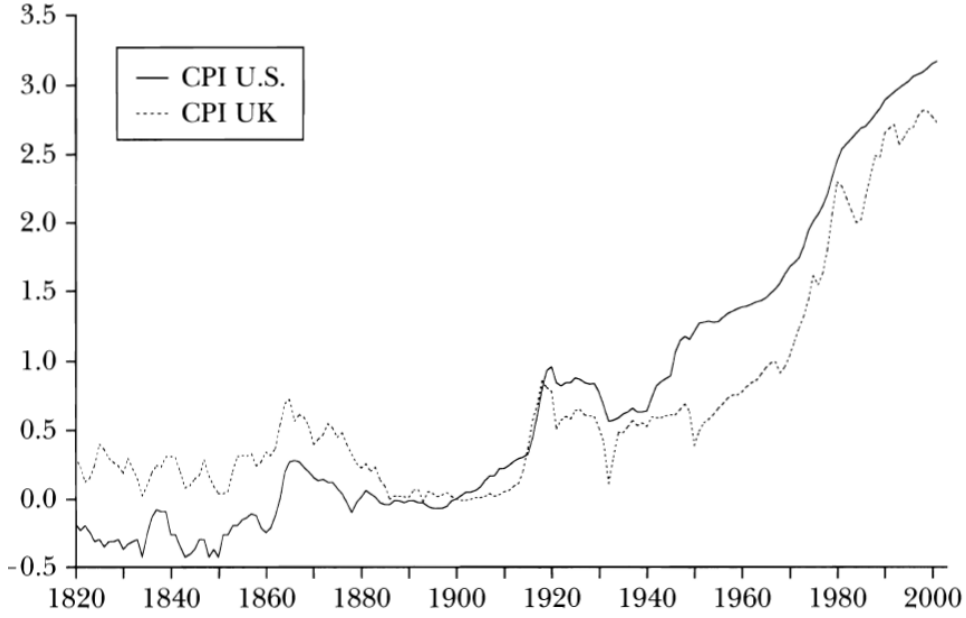
$$e_{\$/£} = E_{\$/£}\frac{P_{UK}}{P_{US}}$$

    where $E_{\$/£}$ :dollar price of 1 pound, $P_{UK}$: is the price level in UK, $P^{US}$ price level in US
  - $e_{\$/£}$: the relative price of a consumption basket in the UK in terms of consumption in US

# Real Exchange Rates

- **Real exchange rates are persistent**
  - Dollar pound real exchange rate (logged graph)
    - Difference between $\log(E_{\$/£}P_{UK})$ and $\log(P_{US})$. (See graph below:)

Figure: Consumer Price Indices (CPI) for UK and US in US dollar terms (log scale). Taylor and Taylor, Journal of Economic Perspectives, 2004.



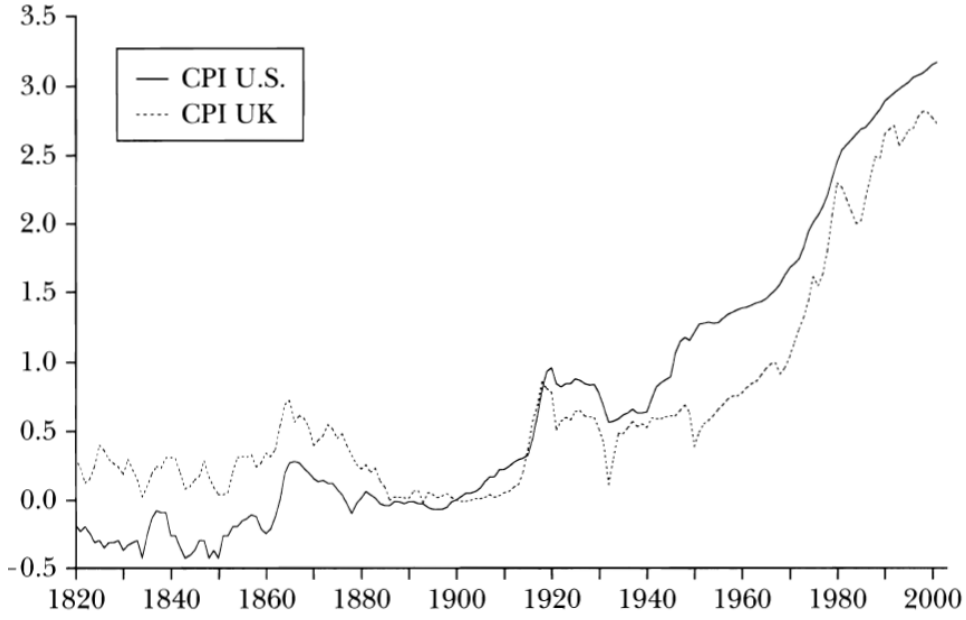
# Purchasing Power Parity (PPP)

- **Real exchange rate is always expected to be 1 (in the long run)**
  - **Purchasing power parity:** $\log\left(E_{\$/£}P_{UK}\right) = \log\left(P_{US}\right)$
- PPP based on the law of one price: idea that in the absense of transaction costs prices should be the same across markets because of arbitrage
  - In the short run, obviously not true.

# Purchasing Power Parity

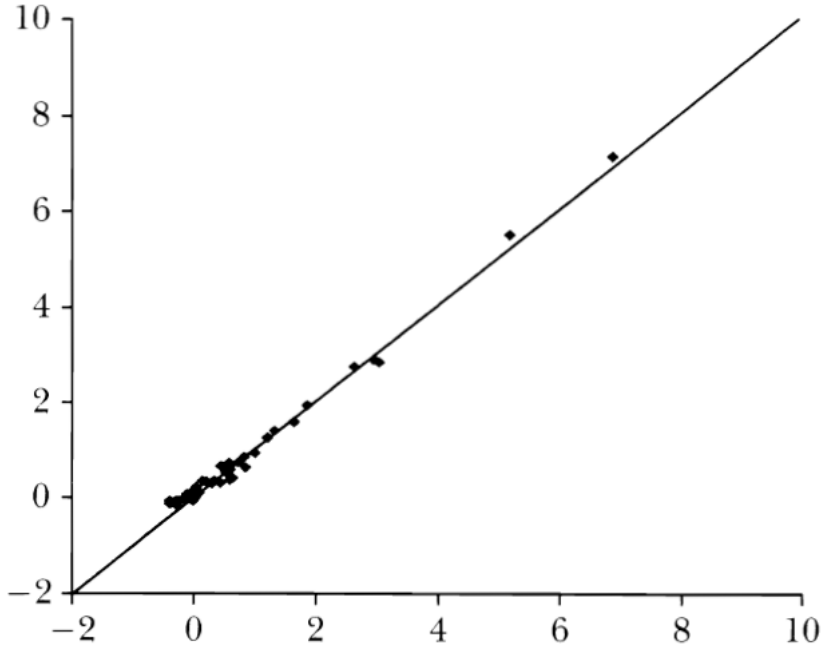
- **If all the goods were instantly tradeable PPP theory should be true!**
  - **Not true in the short run.** Approximately true in the long-run

Figure: Consumer Price Indices (CPI) for UK and US in US dollar terms (log scale). Taylor and Taylor, Journal of Economic Perspectives, 2004.



# Real Exchange Rates (RER)

- **If all the goods were instantly tradeable PPP theory should be true!**
  - Not true in the short run. **Approximately true in the long-run**




Note: The figure shows countries' cummulative inflation rate differentials against the United States in percent (vertical axis) plotted against their cumulative depreciation rates against the U.S. dollar in percent (horizontal axis). The sample includes data from 20 industrialized countries and 26 developing countries. Source: Alan M. Taylor and Mark P. Taylor, "The Purchasing Power Parity Debate," *Journal of*

# Failure to generate PPP

- **Obvious: not all goods are tradeable**
  - Example of non-tradeable goods: haircuts, restaurant meals, education
  - For many countries non-tradeable goods are more than 1/2 of GDP

# The Impact of Non-Tradeables in the RER

- $P_T$ : Price of tradeables, $P_N$ price of non-tradeables, * indicates foreign variable
- Law of one price holds $P_T = EP_T^*$
- For nontraded goods, in general, $P_N \neq EP_N^*$
- Assume $P = \phi\left(P_T, P_N\right)$ where $\phi$ is homogeneous of degree 1
  - Homogeneous of degree 1: $\phi\left(x, y\right) = \lambda\phi\left(x/\lambda, y/\lambda\right)$, or $\lambda\phi\left(x, y\right) = \phi\left(\lambda x, \lambda y\right)$

# The Impact of Non-Tradeables in the RER

- Law of one price holds $P_T = EP_T^*$
- Assume $P = \phi\left(P_T, P_N\right)$ where $\phi$ is homogeneous of degree 1

$$\begin{aligned} e &\equiv \frac{EP^*}{P} \\ &= \frac{E\phi\left(P_T^*, P_N^*\right)}{\phi\left(P_T, P_N\right)} \\ &= \frac{EP_T^*\phi\left(1, \frac{P_N^*}{P_T^*}\right)}{P_T\phi\left(1, \frac{P_N}{P_T}\right)} \end{aligned}$$

  - Law of one price implies $e = \phi\left(1, \frac{P_N^*}{P_T^*}\right) \Big/ \phi\left(1, \frac{P_N}{P_T}\right)$

# The Impact of Non-Tradeables in the RER

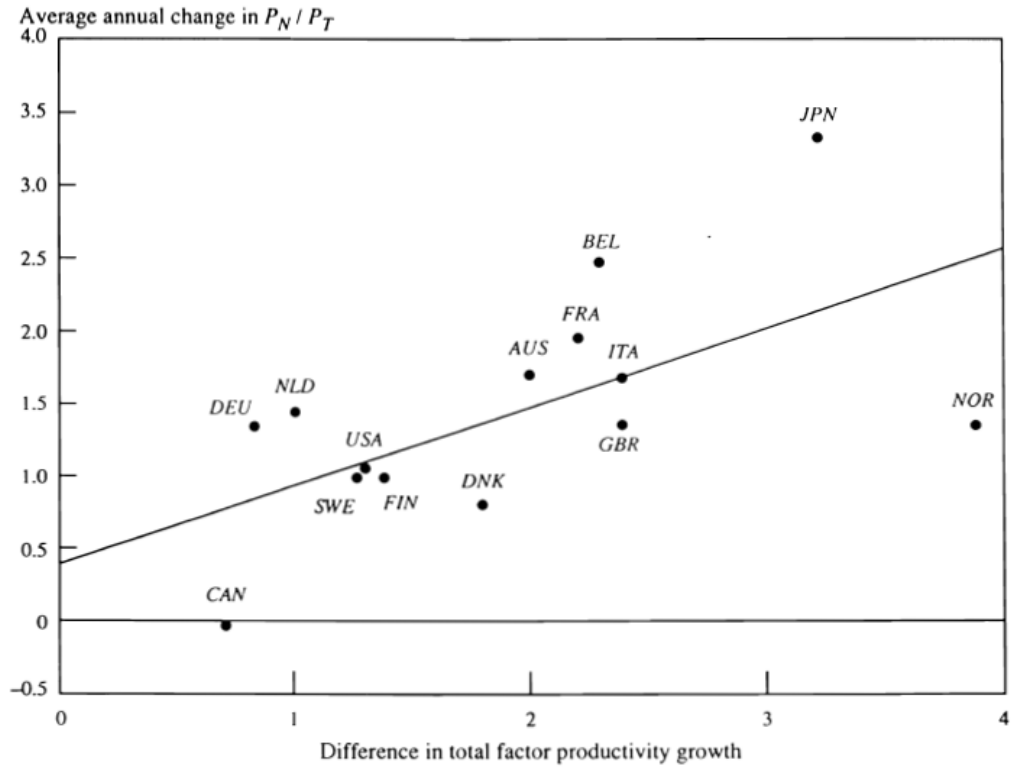
- Law of one price implies $e = \phi\left(1, \frac{P_N^*}{P_T^*}\right) \Big/ \phi\left(1, \frac{P_N}{P_T}\right)$
  - Therefore $e > 1$ if $\frac{P_N^*}{P_T^*} > \frac{P_N}{P_T}$
- The Balassa-Samuelson effect:
  - A theory of how the ratio $\frac{P_N}{P_T}$ is determined

# The Balassa-Samuelson Effect

- Deviations from PPP are due to cross-country differentials in Nontradeables to Tradeables
  - 2 goods, traded: $Q_T$, non-traded: $Q_N$
  - Production functions $Q_T = a_T L_T$, $Q_N = a_N L_N$
    - $a_i$ :productivity, $L_i$ : labor used
- Profits in each sector $P_i Q_i - wL_i$, $i = N, T$
  - Zero profit: $P_i Q_i = wL_i$ for $i = N, T$
  - Using production functions $P_i a_i L_i = wL_i \implies$
    - $w = P_i a_i$
- Therefore

$$\frac{P_N}{P_T} = \frac{a_T}{a_N}$$

# The Balassa-Samuelson Effect




Note: The figure plots the average annual percentage change in the relative price of nontradables in terms of tradables (vertical axis) against the average annual growth in total factor productivity differential between the traded sector and the nontraded sectors (horizontal axis) over the period 1970-1985 for 14 OECD countries. Source: José De Gregorio, Alberto Giovannini, and Holger C. Wolf, "International Evidence on Tradable and Nontradable Inflation," *European Economic Review* 38, June 1994, 1225-1244.

# The Money Demand

- Assume a money demand of the form

$$\frac{M_t}{P_t} = L\left(\bar{C}, i_t\right)$$

  - $M_t$ denotes money
  - $P_t$ denotes price level
  - $\bar{C}$ denotes consumption
  - $i_t$ denotes nominal interest rate
  - $L\left(.,.\right)$ is liquidity preference increasing in $\bar{C}$, decreasing in $i$

# Purchasing Power Parity

- No barriers to international trade
- PPP implies that $P_t = E_t P_t^*$
  - Normalize $P_t^* = 1 \implies P_t = E_t$

$$\frac{M_t}{P_t} = L(\bar{C}, i_t)$$

  - $M_t$ denotes money
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  - $i_t$ denotes nominal interest rate
  - $L(.,.)$ is liquidity preference increasing in $\bar{C}$, decreasing in $i$
- Combining PPP with money demand we have

$$\frac{M_t}{E_t} = L(\bar{C}, i_t)$$

# Uncovered Interest Parity

- No uncertainty and free capital mobility

$$1 + i_t = (1 + r^*) \frac{E^e_{t+1}}{E_t}$$

  - $E^e_{t+1}$: expected nominal exchange rate at time $t + 1$
  - In the absense of uncertainty we have $E^e_{t+1} = E_{t+1}$:

$$\underbrace{1 + i_t}_{\text{gross return of domestic bond}} = \underbrace{(1 + r^*) \frac{E_{t+1}}{E_t}}_{\text{return of foreign bonds in domestic currency}}$$

# Government Budget Constraint

- Govenrment has three sources of income
  - tax revenues, $P_t T_t$, money creation, $M_t - M_{t-1}$, interest from foreign bonds $E_t r^* B^g_{t-1}$
- Spending on new bonds $E_t \left(B^g_t - B^g_{t-1}\right)$, government expenditure, $P_t G_t$

$$\underbrace{E_t \left(B^g_t - B^g_{t-1}\right)}_{\text{change in bond holdings}} + P_t G_t = P_t T_t + \left(M_t - M_{t-1}\right) + E_t r^* B^g_{t-1}$$

- Divide by $P_t = E_t$

$$B^g_t - B^g_{t-1} = \underbrace{\frac{M_t - M_{t-1}}{P_t}}_{\text{seignorage revenue}} - \underbrace{\left[G_t - T_t - r^* B^g_{t-1}\right]}_{\text{real secondary deficit}}$$

  - Fiscal deficit, must be accompanied by money creation or decline in assets

# Fixed Exchange Rate Regime

- Govenrment intervenes so that $E_t = E$
  - Given $E$ , PPP implies that $P_t = E$.
  - Also, PPP and interest rate parity imply $i_t = r^*$.
  - Money demand is thus, $EL\left(\bar{C}, i_t\right)$, and by equilibrium in the money market $M_t = M_{t-1}$

$$B_t^g - B_{t-1}^g = -\underbrace{\left[G_t - T_t - r^* B_{t-1}^g\right]}_{\text{real secondary deficit}}$$

  - Seignorage revenue is lost

# Floating Exchange Rate Regime

- In this case, under certain conditions

$$\frac{E_{t+1}}{E_t} = \frac{P_{t+1}}{P_t}$$

- As we have seen there is a strong connection between the exchange rate and the growth of prices