**Exchange Rates in the Long Run**

- **What determines exchange rates? Supply + Demand!**
  - Flow models:
    - Demand & supply of FX to purchase goods and services
  - Stock models, or asset models
    - Demand & supply of available stock of foreign currency assets

- **Purchasing Power Parity (PPP)**
  - Relates exchange rate changes to inflation differences
  - A measure of currency “over” and “under-valuation”
  - A link to the Real Exchange Rate (RER)

- **Monetary approach to exchange rate determination**
  - Builds on PPP
  - Exchange rates depend on money supply, real income, and velocity of money

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**The Spot Exchange Market:**

**Without Intervention**

<table>
<thead>
<tr>
<th>Exchange Rate</th>
<th>Demand (D)</th>
<th>Supply (S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.80/£</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>$1.60/£</td>
<td></td>
<td>E</td>
</tr>
<tr>
<td>$1.40/£</td>
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</tbody>
</table>

- The demand and supply curves for £ have the “normal” slopes
- The intersection of D & S determines the equilibrium price ($1.60/£ in chart)
- At prices > $1.60/£, excess supply of £, spot rate ↓
  - £50 sweater had cost $80, now cost $90 ⇒ Demand for £ falls
- At prices < $1.60/£, excess demand for £, spot rate ↑
- E is a stable equilibrium
The Spot Exchange Market:
Comparative Statics

- An increase in the demand for €, from D to D₁, raises the price of €: from E₀ to E₁
  - What factors promote D↑?
  - Low inflation in UK so goods are cheaper
  - Faster real growth in UK draws in investment funds
- An increase in the supply of €, from S to S₂ lowers the price of €: from E₀ to E₂
  - What factors promote S↑?
  - High money growth, higher inflation in UK
  - Faster real growth outside the UK promotes outflows

The Spot Exchange Market:
With Intervention

- D & S are demand and supply of private agents
- Suppose the Bank of England wants to peg the pound at $1.80/€?
  - Bank must buy € (with $)
  - Note: if Bank of England does not have enough $ to support € at $1.80, the price must fall (€ depreciates)
- Suppose the Bank of England wants to peg the pound at $1.40/€?
  - Bank must sell € (in exchange for $)
  - Any problem with this?
How Much Have Exchange Rates Fluctuated?

Index: March 1973 = 100

March 1973 rates, US$/unit
DM = 0.3523
JY = 0.003762
SFr = 0.3089

March 1985 rates, US$/unit
C$ = 1.0010
IL = 0.001717
UK = 2.4777
Purchasing Power Parity (PPP) [1 of 2]

- PPP associated with Gustav Cassel in 1920s - where to set exchange rates at end of WWI and resumption of international trade?
- Theory: exchange rate change (pre-war to post-war) should reflect relative inflation, one country vs. others
- Building blocks of PPP
  - Law of One Price:
    - Price wheat (US) = Price wheat (UK) x Spot rate (US/£)
    - $4.50 / bushel = £3.00 / bushel x $1.50 / £
  - Absolute PPP
    - Price US market basket = Price UK market basket x Spot ($/£)
    - $150 / US market basket = £100 / UK market basket x $1.50/£

Deviations from the Law of One Price

Big Mac Prices in US$ Relative to US Price

US$ Price is $2.30/Big Mac

Source: The Economist, April 3, 1994 and author's calculations
Deviations from the Law of One Price

Purchasing Power Parity (PPP) [2 of 2]

- Law of One Price is very often violated
- Absolute PPP is often violated because composition of market baskets differ across countries
- Economists rely on the relative version of PPP
  - From absolute PPP: Spot ($/£) = P($) / P(£)
  - Relative version (approximation for low inflation rates):
    % change in spot rate($/£) = % US inflation - % UK inflation

Numerical example:
- US inflation = 4%
- UK inflation = 6%
- % change in spot rate needed to preserve PPP = -2%
Nominal and “Real” Magnitudes - A Review

- Real magnitudes are constructed from nominal magnitudes by adjusting for the price level or inflation
- Real ⇒ “real goods and services”
- Example 1: Nominal and real income
  - Nominal income: $55,000 / year
  - Real income: ($55,000 / year) / ($250 / market basket) = 220 market baskets / year
  - Real income usually an index
    - Example: Define 220 market basket/year as real income 100
    - Let nominal income rise by 10% to 60,500
    - Let the price of a market basket rise by 8% to $270
    - Real income = (60,500/270) / 220 = 1.0185; real income ↑ by 1.85%

Link Between PPP and the “Real” Exchange Rate

- Example 2: Nominal and real exchange rates (RER)
  - Nominal exchange rate: $1.50 / £
  - Real exchange rate: ($1.50 / £) / (P$ / P £)
  - When PPP holds:
    - $1.50 / £ = ($1,500/US good) / (£1,000/UK good)
    - 1 US good / UK good
    - Units of real exchange rate are US goods / UK good
  - Real exchange rate usually an index
    - Example: Assume US inflation is 4% while UK inflation is 8%, and spot rate changes to $1.40. WHAT IS THE NEW RER?
    - RER = (1.40/1.50) / [1.04 / 1.08] = 0.9692 [fewer US goods / UK good]
    - RER < 1.0 ⇒ US$ has appreciated in real terms vs. £
    - RER > 1.0 ⇒ US$ has depreciated in real terms vs. £
Important Points about PPP and the Real Exchange Rate

- **When PPP holds, the real exchange rate is constant.**
  - **Intuition:** When PPP holds, the exchange rate change equals the inflation differential. So the country that has experienced high inflation (making its products appear expensive) has also experienced currency depreciation (that makes its products cheaper to foreign buyers).

- **When the real exchange rate is constant, a country maintains its international price competitiveness.**
  - **Intuition:** Countries that experience inflation should lose international competitiveness. But when their currencies depreciate and offset the higher rate of inflation, they maintain their prior level of competitiveness.

- **A country needs a real depreciation, not simply a nominal depreciation to gain competitiveness.**

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### Real Effective Exchange Rates: U.S. and JAPAN

**Monthly Data, Jan 1976 - June 1999**

- **Index:** 1990 = 100

Source: J.P. Morgan
Calculating the PPP Exchange Rate

- Assume there is a “base period” where PPP holds
  \[
  \text{Spot} (\text{\$/£, base period}) = \frac{P(\text{US, base period})}{P(\text{UK, base period})}
  \]
- Now consider another time (t) where prices in the US and UK have changed to \(P(\text{US, t})\) and \(P(\text{UK, t})\). To find the PPP rate at time (t):

\[
\text{Spot(PPP, t)} = \text{Spot(\$/£, base period)} \times \frac{\text{Prices(US, t)}}{\text{Prices(UK, base period)}}
\]

- Example:
  - Base period: Spot = $1.50/£; US-CPI = 124.5; UK-CPI = 137.5
  - Time t: US-CPI up 4% (129.40); UK-CPI up 8% (148.5)
  - \(S(\text{PPP, t}) = 1.50 \times \frac{129.40/124.5}{148.5/137.5} = 1.4444 \text{ $/£}\)

- “Overvaluation” & “Undervaluation”
  - Suppose actual spot rate is $1.50/£ ⇒ $ undervalued, £ overvalued
  - Suppose actual spot rate is $1.40/£ ⇒ $ overvalued, £ undervalued
From PPP to the Monetary Approach (1 of 3)

- PPP does not mean that commodity price changes are the underlying fundamental cause of exchange rate changes.
- PPP is an “equilibrium” condition, not a model of cause and effect.
- Examples:
  - Under pegged rates, a country experiences inflation, loss of international competitiveness, then devalues home currency
    - Inflation comes before devaluation
  - Or country devalues, imports more expensive, workers feel poorer, wage demands, home country inflation accelerates
    - Devaluation comes before inflation
From PPP to the Monetary Approach (2 of 3)

- What determines the price level in an economy?
  - Relationship between Money Supply ($M^S$) and Money Demand ($M^D$)
  - $M^D = f(\text{velocity}, \text{price level}, \text{real income}) = k \times P \times Y$
  - In equilibrium, $M^S = M^D = k \times P \times Y$
  - $\Rightarrow P = \frac{M^S}{k \times Y}$

- Assume the above relationship exist in the US & UK
  - $P(\$) = \frac{M(\$)}{k(\$) \times Y(\$)}$
  - $P(\£) = \frac{M(\£)}{k(\£) \times Y(\£)}$

- Returning to PPP, we had $\text{Spot (\$/£)} = \frac{P(\$)}{P(\£)}$

- By substitution
  - $\text{Spot (\$/£)} = \left(\frac{M(\$)}{M(\£)}\right) \times \left(\frac{k(\£)}{k(\$)}\right) \times \left(\frac{Y(\£)}{Y(\$)}\right)$

From PPP to the Monetary Approach (3 of 3)

- Repeating:
  - Interpretation:
    - Spot rate (in \$/£) positively related to:
      - Increases in $M(\$)$ and $Y(\£)$
    - Spot rate (in \$/£) negatively related to:
      - Increases in $M(\£)$ and $Y(\$)$
  - $M^S$, $Y$, $k$ and their determinants are more fundamental causes (drivers) of spot exchange rate.
  - Changes in $M^S$, $Y$, and $k$ [at home or other country] will impact the exchange rate in the long run (& perhaps short-run).
Summary: Exchange Rates in the Long Run

Spot rates display large changes over last 25 years
» Some currencies appreciated vs. US$, others depreciated
» Changes in nominal rates, real rates, real effective rates

What factors lie behind exchange rate changes?
» Inflation differences are a “proximate” factor (not a cause)
» PPP works well in the long run for many exchange rates
» Money, income, and velocity are more fundamental factors

Critical to understand difference between nominal and real exchange rate changes
» Possible to have nominal exchange rate change without real exchange rate change (or vice versa)
» Only real exchange rate $\Delta \Rightarrow$ change in competitiveness