Open Economy Macroeconomics     Lecture Notes
Department of Economics BOGAZICI EC 208

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Spring 2018
Foreign Exchange (FX) Markets - Definition, Functions and Features

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- 2. Foreign Direct Investment (FDI). Example: US definition: Foreign Direct Investment is defined as whenever a US citizen, organization, or affiliated group takes an interest of 10 percent or more in a foreign business entity. It includes setting up a business, buying an office block etc.
3. Portfolio Investments: This is an investment by individuals, firms or public bodies (ex. national and local governments) in foreign financial instruments. Foreign financial instruments include government bonds and foreign stock.
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"Foreign" in this context means foreign national or entity established in another country. Ex: Garanti Bank International is a foreign firm.
Types of FX Rate

- Bilateral: Between two countries

Real FX rates: Adjusted by price differentials in two countries. Specifically, Nominal Rates multiplied by the relative prices of the same basket of goods in the two countries. Example: If $S_t = 2$ TL/$ is the nominal exchange rate and it takes 10 TL to buy the same basket of goods in TR but 20$ in US, the Real FX rate is $2 \times \frac{20}{10} = 4$

Real Effective FX rates: Adjusted by price differentials in the set of trade partners weighted by trade.

Practice: TCMB reports the real exchange rate such that an increase in Real FX shows an appreciation of the currency. TCMB reports two types of Real Effective FX rate (vs. Developed and vs. Developing Countries).

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- Spot vs. forward rates.
- Buying vs. Selling (Bid vs. Ask). Spread = Bid - Ask ≥ 0. Spread increases during weekends, holidays, turbulent times.
What is the difference between FDI and Foreign Portfolio Investment?
Review

- What is the difference between FDI and Foreign Portfolio Investment?
- What is the difference between real FX rates and real effective FX rates?
What is the difference between FDI and Foreign Portfolio Investment?

What is the difference between real FX rates and real effective FX rates?

TCMB reports Real FX such that an increase in real FX means an appreciation of the TL. True or False?
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Demand for FX

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Total excess demand/supply eliminated instantaneously by exchange rate movement
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- Turkish establishments demand $ in exchange for TL in order to import from or invest in USA (and all other international transactions mentioned above)
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- Speculators buy or sell TL (sell or buy $)

Total excess demand/supply eliminated instantaneously by exchange rate movement
Equilibrium in FX Market: UK Example

Excess supply $X^S$ Excess demand $X^D$

$X_n^D(S)$

50p

40p

$Q^s$ $Q^*$ $Q^D$

Supply (S)

Demand ($)
Appreciation and Depreciation

- $S \uparrow$: means depreciation
Appreciation and Depreciation

- $S \uparrow$: means depreciation
- $S \downarrow$: means appreciation

Exception: Real Effective Exchange Rates reported by TCMB

Suppose $S \downarrow$, there are two possibilities:

1. International Value of TL has gone up or TL has appreciated.
2. US$ vs. TL has gone down. (or Lira gained value against $)

Theorem
If $S \downarrow$ while all other currencies in terms of TL remain the same

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Theorem

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- If $S\downarrow$ while all other currencies in terms of TL $\downarrow$ → 1
Turkish Lira Example
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Formal Definition of the Real Exchange Rate

\[ Q = \frac{SP^*}{P} \]

where \( Q \) is the real exchange rate, \( S \) is the nominal exchange rate \( P \), domestic price level as indicated by a price index (example: a consumption basket) and \( P^* \) is the foreign price level as indicated by the same price index.
Ex: Assume the CPI for the rest of the world (ROW) to be 80 and suppose the bilateral exchange rate between Turkey and ROW is 2. i) Calculate the real exchange rate against $ and Euro. ii) Calculate the effective and real effective exchange rate for Turkish Lira. How does TCMB practice differ?

<table>
<thead>
<tr>
<th>Countries</th>
<th>$S_t$</th>
<th>CPI</th>
<th>TradevolofTUR in %</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey</td>
<td>3.76</td>
<td>330.75</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>1</td>
<td>247.63</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Eurozone</td>
<td>0.80</td>
<td>102.68</td>
<td>47%</td>
<td></td>
</tr>
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</table>

i) $Q^S_t = 3.76 \times \frac{247.63}{330.75} , Q^{Euro}_t = \frac{3.76}{0.8} \times \frac{102.68}{330.75}$

ii) Effective Exchange Rates:

\[
(100\% - 47\% - 15\%) \times 2 + (47\%) \times \left(\frac{3.76}{0.8}\right) + 15\% \times (3.76)
\]

Real effective Exchange rate against the World:

\[
\left(\frac{80}{330.75}\right) \times (100\% - 47\% - 15\%) \times 2 + \left(\frac{247.63}{330.75}\right) \times (15\%) \times 3.76 + \left(\frac{102.68}{330.75}\right) \times 47\% \times \left(\frac{3.76}{0.8}\right)
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Note since we are not given $S^Euro_t$ for Turkey we used bilateral exchange rates between Euro and $ to derive $S^Euro_t for Turkey
Balance of Payments (BOP)

Definition
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It consists of

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1. Current Account,
2. Capital and/or Financial Account
Current account (CA): Here and now. Export receipts (X) as credits, import payments (M) as debits, net = current account balance (goods, services including financial services, interest and dividends, rent, tourism)
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1.4 Transfers: worker’s remittances, aid.
BOP Items: 2. Capital Account (CPA)

- Capital/financial account (CPA): net capital inflows = net purchases of TL by foreigners in order to acquire claims on Turkey residents less net sales of TL by Turkey residents in order to acquire claims on foreigners (Long term including securities – equities, bonds, real estate etc + short term including bank deposits, short term securities)

1. FDI: real estate, buying a Turkish company by foreigners or foreign company by Turkish residents, setting up a factory, purchase of machinery and factory in order to produce within that country.

2. Portfolio Investment: equities, bonds, securities.

3. Other investment: commercial credit lending by banks, nonbank institutions, individuals, IMF loans.

4. Change in Official Reserves: $\Delta CB FX reserves$
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3. Balancing Item: Current Account + Capital Account = -Balancing Item

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Note that income (rent, dividend, etc.) obtained from foreign assets or paid to foreigners are placed under Current Account but actual transfers made in purchasing or selling of these assets are placed under Capital Account.
BOP Items: Capital vs. Current Account

- Note that income (rent, dividend, etc.) obtained from foreign assets or paid to foreigners are placed under Current Account but actual transfers made in purchasing or selling of these assets are placed under Capital Account.

- While the overall BOP accounts will always balance when all types of payments are included, imbalances are possible on individual elements of the BOP, such as the current account, the capital account excluding the central bank’s reserve account.
BOP Items:

- BOP deficit refers to a situation when current account plus the capital account (except the reserves) is negative. In other words, sources of funds (all exports, bonds sold) is less than uses of funds (imports, bonds purchases)

BOP Deficit \neq Current Account Deficit \neq Capital Account Deficit

A BOP deficit leads to a decline in CB reserves. BOP imbalances are due to: the exchange rate, the government's fiscal deficit, business competitiveness, and private behaviour such as the willingness of consumers to go into debt to finance extra consumption. Ben Bernanke argues that the primary driver is the capital account, where a global savings glut caused by savers in surplus countries, runs ahead of the available investment opportunities, and is pushed into the US resulting in excess consumption and asset price inflation.
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BOP imbalances are due to: the exchange rate, the government's fiscal deficit, business competitiveness, and private behaviour such as the willingness of consumers to go into debt to finance extra consumption. Ben Bernanke argues that the primary driver is the capital account, where a global savings glut caused by savers in surplus countries, runs ahead of the available investment opportunities, and is pushed into the US resulting in excess consumption and asset price inflation.

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Relationship Between BOP and FX rate regime

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- Under fixed rates: Government intervenes to fix exchange rate, in which case. Item for 4 in CPA: \( \Delta CB \text{ FX reserves} = CRA + CPA \) to prevent basic balance causing exchange rate to move.
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General Mechanism: Large Capital Inflows over Time (either due to finance high economic growth, in this case to finance investment / or due to excessive consumption, in this case to finance consumption (and lower savings)) → unsustainable levels of debt creates a chain of events: → investors pull out their funds by selling domestic currency denominated assets causing rapid depreciation of home currency → Local banks and firms run into sudden debt problems because their revenues are in local currency but their existing debt is in foreign currency → the central bank can support the currency as long as it has enough FX reserves, but once reserves fall below a certain level chooses to increase interest rates to prevent outflows → prevents currency depreciation and reduces the value of debt in domestic currency → however, the domestic economy is depressed → recession follows.
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List and explain the items of CA, CPA and BOP
Theories about Exchange Rate Determination

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- Empirical Observations: Random Walk, Short-Medium vs. Long-Run, Expectations
Definition

The law of one price: Two goods, if they are identical, must sell for the same price.

- Domestic Economy

\[ P_{I} = P_{A} + C \]

where \( P_{I} \) and \( P_{A} \) are the price of the same good in Istanbul and Ankara respectively and \( C \) is the transaction cost (transportation, local taxes, etc.).

The idea here is that arbitrage opportunities will be eliminated by trade.

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PPP and Real Exchange Rate

Definition

The PPP relation is given by $P_i = SP_i^*$ for $i = 1, \ldots, N$ where $P_i$ is the domestic price of good $i$ and $P_i^*$ is the foreign price of good $i$ and $S$ is the exchange rate or $P = SP^*$ where $P$ is domestic price index and $P^*$ is the foreign price index.

Definition

The real exchange rate, $Q$, between two countries is given by $Q = \frac{SP^*}{P}$.

Corollary

*If PPP holds then $Q = 1$.*

- Example: When PPP adjusted India’s GDP is 3,608 billion dollars as opposed to 1,704 billion dollars calculated with nominal exchange rates. Denmark GDP per head: PPP adjusted: $37,500 vs. Nominal Exch Rate: $62,100
PPP and Inflation

Theorem

If PPP holds then the rate of home currency depreciation rate is equal to difference between home and foreign inflation rates.

Proof.

Taking logarithms and derivatives of both sides of $P = SP^*$

$$\log(P) = \log(S) + \log(P^*)$$
$$\frac{dP}{P} = \frac{dS}{S} + \frac{dP^*}{P^*}$$
$$\frac{dS}{S} = \frac{dP}{P} - \frac{dP^*}{P^*}$$

\[ \text{depreciation} = \text{inflation} - \text{inflation}^* \]

In reality PPP fails most of the time, except in the long-run for a certain set of countries.
PPP and Transaction Costs

Let $K$ be a constant that represents the total costs of conducting international trade including tariffs, etc.

$$P = KSP^*$$

$$\log(P) = \log(K) + \log(S) + \log(P^*)$$

**Theorem**

If trade costs are constant, then they do not affect the currency depreciation rate.

**Proof.**

Taking the derivative above yields

$$\frac{dS}{S} = \frac{dP}{P} - \frac{dP^*}{P^*} - \frac{dK}{K}$$

Depreciation = Inflation - Inflation$^*$ - change in trade costs

but $dK = 0$
Example

Suppose the CPI index, nominal exchange rates, real GDP in local currency (in billions, based on year 2015) and current general price level for two countries, A and B, are given as follows:

\[
\begin{pmatrix}
\text{CPI}_A & \text{CPI}_B & S_{t,A}^\$ & S_{t,B}^\$ & \text{GDP}_A & \text{GDP}_B & P_A & P_B \\
2015 & 220 & 110 & 2.1 & 3.3 & 118 & 500 & 120 & 140 \\
2016 & 242 & 130 & 2.2 & 3.8 & 125 & 520 & 124 & 144 \\
2017 & 248 & 110 & 2.5 & 4.6 & 140 & 530 & 135 & 148 \\
2018 & 270 & 100 & 2.6 & 4.8 & 135 & 540 & 145 & 155 \\
\end{pmatrix}
\]

i) Choose a base year and calculate the GDP deflator for both countries for given years

Nominal GDP based on expenditure approach is calculated by multiplying quantities of domestically produced goods, \(q_i\) and their current prices, \(p_i\) and summing them up.

\[\text{GDP}_{\text{nominal}} = \sum_{i=1}^{n} p_i^{\text{current}} q_i^{\text{current}}.\]

If the total output remains the same but prices increase next year nominal GDP would also increase. In that case, nominal GDP would not be a good measure of how much an economy has actually produced. To overcome this we might assume the prices remained constant and calculate instead real GDP.

\[\text{GDP}_{\text{real}} = \sum_{i=1}^{n} p_i^{\text{base}} q_i^{\text{current}}.\]

GDP deflator is a measure to calculate the effect of the change prices on real GDP by choosing a base year relative to which we can compare the current GDP. We want to answer the following question, If the prices remained constant at the base year how much did output increase or decrease relative to that base year?
We choose a base year (2015), set the deflator to 100 and for the year 2016 calculate
\[ GDP_{\text{deflator},i} = \frac{GDP_{\text{nominal},i}}{GDP_{\text{real},i}} \times 100. \]
(CPI is not the same thing as the general price level, see the below question). We do not have information on individual prices but we are given the general price level so we can use it to calculate GDP deflator. 125 billion \( = q_{\text{current}} \times 120 \). Set 100 for 2015 and for 2016 it is \( 124/120 \times 100 \), etc..
ii) Calculate CPI index or both countries for given years.
If we choose the base year as 2015 set the CPI to 100 for that year, for A, 2015: 100, 2016: 
\((242/220)\times100\), 2017: \((248/220)\times100\), 2018: \((270/220)\times100\). Similar for B. We can use CPI index to calculate consumer inflation rate.

iii) What is the difference between a GDP Deflator and CPI? Which one should we use as a measure of inflation?
CPI includes consumer goods both imported and exported, whereas GDP deflator only includes domestically produced goods (exported or domestically used). CPI is more useful for measuring the cost-of-living. Wage-indexing to CPI or indexing other contracts to CPI can help to keep purchasing power constant. GDP deflator takes into account all aspects, such as plants, machinery, inventory and equipment. CPI can be used to measure headline (a fixed basket of goods) or core inflation (excluding volatile elements such as food and energy). CPI can be used to analyze the inflationary effect of exchange rate pass-through. In comparing countries Real GDP’s GDP deflator might be a better measure.
iv) Calculate real exchange rates for A. Since we do not know CPI for USA, we can only calculate the real exchange rates against B.

\[ Q_A = \frac{S_{PB}}{P_A} = \frac{2.1/3.3}{140/120} \]

where (2.1/3.3) is the amount of A currency that buys a unit of B currency. For the remaining years the calculation is similar. If we were given USA CPI we could calculate both countries real exchange rate against dollar and obtain a better measure of competitiveness in global markets for comparison.
v) Calculate nominal GDP of A PPP adjusted to Currency B. Compare it with exchange rate adjusted nominal and real GDP.

To answer this question we first need to create a PPP index. We ask the question how much does the same basket of goods cost in both countries. In A the basket costs 220 in local currency and in B it costs 110 in local currency. A person in A would pay $\frac{220}{110} = 2$ in currency A for goods that would cost 1 in currency B in B. This is PPP between A and B. To adjust nominal GDP of A with PPP (to B) we divide nominal GDP of A with PPP of A ($\frac{125\text{ billion}}{120} \times 124) / 2 = 59$ which is the PPP adjusted (to B) nominal GDP of A. The exchange rate between A and B is $\frac{2.1}{3.3}$ therefore when we adjust PPP to currency B, i.e divide 2 (in currency A) by the exchange rate ($\frac{2.1}{3.3}$) we get the price level index for A.
Consider the economy of the island nation La Mer. i) Calculate the GDP deflator. ii) Suppose the consumption basket in USA consists of 4 fish and 10 Bananas. Calculate the PPP-adjusted to $ GDP per capita of La Mer using CPI as well as GDP-Deflator. Calculate the exchange rate adjusted GDP per capita. Comment on the difference.

\[
\begin{pmatrix}
\text{Years} & P_{fish} & P_{banana} & Q_{fish} & Q_{banana} & CPI_{usa} & S_t & \text{Population} \\
2015 & 4 & 2 & 10 & 15 & 100 & 2.5 & 10 \\
2016 & 6 & 4 & 12 & 18 & 90 & 2.1 & 12 \\
2017 & 8 & 2 & 10 & 40 & 120 & 2 & 15
\end{pmatrix}
\]

i) 2015: Nominal GDP = 4x10+2x15=70. Since this is our base year GDP deflator is 100 (i.e. nominal GDP = real GDP).

2016: Nominal GDP = 6x12+4x18=144, Real GDP = 4x12+2x18=84, GDP Deflator=(144/84)x100=(12/7)x100

2017: Nominal GDP = 8x10+2x40=160, Real GDP = 4X10+2x40=120, GDP Deflator=(160/120)x100, rest similar
ii) To calculate PPP to$ we need a comparable basket of goods in La Mer and USA. This basket is 4 fish and 10 Bananas for USA which the price of which is given by the $CPI_{usa}$. We have also price and quantity data for La Mer. Price of this basket costs 100 in USA in 2015 and $4 \times 4 + 10 \times 2 = 36$ in La Mer. Therefore A person in La mer would pay $36/100$ in La Mer currency for goods that would cost $1$ in USA. $36/100 = 9/25$ is the PPP between La Mer and USA. To adjust nominal GDP by PPP we divide nominal GDP by this number, $70/(9/25) = 194.4$. To calculate PPP-adjusted to $ GDP per capita of La Mer we further divide by population $194.4/10 = 19.4$. If we adjust by the exchange rate, the exchange-rate-adjusted nominal GDP would be $70/2.5 = 28$ in 2015 and per-capita-GDP (exchange-rate-adjusted) would be $28/10 = 2.8$. The rest is similar. Fill in below

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<th>Pop</th>
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Harrod, Balassa and Samuelson Effect

**Definition**
The observation that consumer price levels in wealthier countries are systematically higher than in poorer ones (the "Penn effect").

**Definition**
An economic model predicting the above, based on the assumption that productivity or productivity growth-rates vary more by country in the traded goods’ sectors than in other sectors (the Balassa–Samuelson hypothesis)

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- Workers in some countries have higher productivity than in others.
- Certain labour-intensive jobs such as those in non-traded services are less responsive to productivity innovations.
- Some of the fixed-productivity sectors are also the ones producing non-transportable goods (for instance haircuts) - this must be the case or the labour intensive work would have been off-shored. In wealthy countries productive capital is matched with skilled workers.
To equalize local wage levels with the (highly productive) Zurich engineers, McDonalds Zurich employees must be paid more than McDonalds Moscow employees, even though the burger production rate per employee is an international constant.
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The CPI is made up of:

1. Local goods/services (which are expensive relative to tradables in rich countries)
2. Tradables, which have the same price everywhere
3. The real exchange rate is pegged (by the law of one price) so that tradable goods follow PPP (purchasing power parity) but not local goods. PPP holds only for tradable goods. Entirely tradable goods cannot vary greatly in price by location (because buyers can source from the lowest cost location). But most services must be delivered locally (e.g., hairdressing) which makes PPP-deviations sustainable.
4. The Penn effect is that PPP-deviations usually occur in the same direction: where incomes are high, average price levels are typically high.

How can we update PPP to take into account the Harrod-Balassa-Samuelson observation?
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Goods arbitrage only profitable when price deviation exceeds transactions costs, $C$, so:

- If price deviation $P - P^*$ $< C$, no trade.
- If price deviation $P - P^*$ $> C$, trade.

But $C$ different for each trader and each type of good.

When price deviation large (small), arbitrage (not) profitable for most traders/goods.

In general, larger the price deviation, greater volume of arbitrage and more rapid is real exchange rate adjustment.

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In general, larger the price deviation, greater volume of arbitrage and more rapid is real exchange rate adjustment

How can we update PPP to take into account the above observation?
Iceberg Model

Does the importer or the exporter pay the shipping cost?

\[ P_C = \frac{S P_C^*}{1 - \tau} \]

where

- \( P_C^* \): price of Brie cheese (produced in France) in France

- \( S P_C \): price of Brie cheese (produced in France) in Turkey

- \( \tau \): proportion of every unit of goods lost due to shipping cost ("melting iceberg")

- \( P_H^* \): price of hazelnut (produced in Turkey) in France

- \( P_H \): price of hazelnut (produced in Turkey) in Turkey.
Iceberg Model

Does the importer or the exporter pay the shipping cost?

\[ P_C = \frac{SP_C^*}{1 - \tau} \]

where

- \( P_C^* \): price of Brie cheese (produced in France) in France
- \( P_C \): price of Brie cheese (produced in France) in Turkey
- \( SP_C \): price of Brie cheese (produced in France) in Turkey
- \( \tau \): proportion of every unit of goods lost due to shipping cost (“melting iceberg”)
Iceberg Model

Does the importer or the exporter pay the shipping cost?

\[
P_C = \frac{SP_C^*}{1 - \tau}
\]

where

- \( P_C^* \): price of Brie cheese (produced in France) in France
- \( P_C \): price of Brie cheese (produced in France) in Turkey
- \( \tau \): proportion of every unit of goods lost due to shipping cost ("melting iceberg")
Does the importer or the exporter pay the shipping cost?

\[
P_{C} = \frac{S P_{C}^{*}}{1 - \tau}
\]

where

- \( P_{C}^{*} \): price of Brie cheese (produced in France) in France
- \( P_{C} \): price of Brie cheese (produced in France) in Turkey
- \( \tau \): proportion of every unit of goods lost due to shipping cost (“melting iceberg”)

similarly
Iceberg Model

Does the importer or the exporter pay the shipping cost?

\[ PC = \frac{SP^*_C}{1 - \tau} \]

where

- \( P^*_C \): price of Brie cheese (produced in France) in France
- \( PC \): price of Brie cheese (produced in France) in Turkey
- \( \tau \): proportion of every unit of goods lost due to shipping cost ("melting iceberg")
- similarly

\[ PH = (1 - \tau) SP^*_H \]
Iceberg Model

Does the importer or the exporter pay the shipping cost?

\[ P_C = \frac{SP^*_C}{1 - \tau} \]

where

- \( P^*_C \): price of Brie cheese (produced in France) in France
- \( P_C \): price of Brie cheese (produced in France) in Turkey
- \( \tau \): proportion of every unit of goods lost due to shipping cost ("melting iceberg")

similarly

\[ P_H = (1 - \tau) SP^*_H \]

- \( P^*_H \): price of hazelnut (produced in Turkey) in France
Iceberg Model

Does the importer or the exporter pay the shipping cost?

\[ P_C = \frac{SP^*_C}{1 - \tau} \]

where

- \( P^*_C \): price of Brie cheese (produced in France) in France
- \( P_C \): price of Brie cheese (produced in France) in Turkey
- \( \tau \): proportion of every unit of goods lost due to shipping cost ("melting iceberg")

similarly

\[ P_H = (1 - \tau) SP^*_H \]

- \( P^*_H \): price of hazelnut (produced in Turkey) in France
- \( P_H \): price of hazelnut (produced in Turkey) in Turkey.
Iceberg Model

Does the importer or the exporter pay the shipping cost?

\[ P_C = \frac{SP^*_C}{1 - \tau} \]

where

- \( P^*_C \): price of Brie cheese (produced in France) in France
- \( P_C \): price of Brie cheese (produced in France) in Turkey
- \( \tau \): proportion of every unit of goods lost due to shipping cost ("melting iceberg")

similarly

\[ P_H = (1 - \tau) SP^*_H \]

- \( P^*_H \): price of hazelnut (produced in Turkey) in France
- \( P_H \): price of hazelnut (produced in Turkey) in Turkey.

How can we update PPP to take into account the above observation?
Combining the above

\[
\frac{P_H}{P_C} = (1 - \tau)^2 \frac{P^*_H}{P^*_C}
\]

Result: Hazelnuts (Brie) are \((1 - \tau)^2 \frac{P^*_H}{P^*_C}\)% expensive relative to Brie (Hazelnuts) in Turkey (France).
Combining the above

$$\frac{P_H}{P_C} = (1 - \tau)^2 \frac{P_H^*}{P_C^*}$$

Result: Hazelnuts (Brie) are \((1 - \tau)^2\) % expensive relative to Brie(Hazelnuts) in Turkey(France). Price distortions multiply
Incomplete Pass-Through: Exporters and/or importers do not reflect changing costs to prices due to menu costs or other reasons.
Incomplete Pass-Through

- Incomplete Pass Through: Exporters and/or importers do not reflect changing costs to prices due to menu costs or other reasons.
- Menu costs are costs associated with changes in pricing structure by sellers.
Uncovered Interest Rate Parity: Risk-Behavior

- Assume investors are *risk-neutral*, i.e. they are indifferent between a safe bet and a lottery that offer the same expected return, $E(x)$. Example: Lottery A: pays 75 with probability $p = 1/2$ and pays 25 with $p = 1/2$ such that $E(x) = \sum_x px = 1/2 \times 75 + 1/2 \times 25 = 50$. Lottery B pays 50 with $p = 1$, i.e. it is a safe bet. Risk neutrality implies an investor is indifferent between A and B which have the same expected return, 50. If the investor is *risk-averse* he prefers B, if he is *risk-lover* he prefers A.
Assume investors are *risk-neutral*, i.e. they are indifferent between a safe bet and a lottery that offer the same expected return, \( E(x) \).

Example: Lottery A: pays 75 with probability \( p = 1/2 \) and pays 25 with \( p = 1/2 \) such that \( E(x) = \sum x \cdot px = 1/2 \times 75 + 1/2 \times 25 = 50 \).

Lottery B pays 50 with \( p = 1 \), i.e. it is a safe bet. Risk neutrality implies an investor is indifferent between A and B which have the same expected return, 50. If the investor is *risk-averse* he prefers B, if he is *risk-lover* he prefers A.

Assume the investor gets utility from wealth, \( x \), where \( U'(x) \neq 0 \). The expected utility is given by \( E(U(x)) = pU(x) + (1 - p)U(x) \). In Lottery A: \( E(U(x)) = 1/2 U(75) + 1/2 U(25) \), In Lottery B: \( E(U(x)) = U(50) \).

If \( U \) is concave, \( U'' < 0 \) and \( U(50) > 1/2 U(75) + 1/2 U(25) \) then the individual is *risk averse*, if \( U \) is strictly convex, \( U'' > 0 \) and \( 1/2 U(75) + 1/2 U(25) > U(50) \), then he is *risk-lover* if \( U \) is linear, \( U'' = 0 \), then he is *risk-neutral*.
Assume investors are *risk-neutral*, i.e. they are indifferent between a safe bet and a lottery that offer the same expected return, $E(x)$. Example: Lottery A: pays 75 with probability $p = 1/2$ and pays 25 with $p = 1/2$ such that $E(x) = \sum_x px = 1/2 \times 75 + 1/2 \times 25 = 50$. Lottery B pays 50 with $p = 1$, i.e. it is a safe bet. Risk neutrality implies an investor is indifferent between A and B which have the same expected return, 50. If the investor is *risk-averse* he prefers B, if he is *risk-lover* he prefers A.

Assume the investor gets utility from wealth, $x$, where $U'(x) \neq 0$. The expected utility is given by $E(U(x)) = pU(x) + (1 - p)U(x)$ In Lottery A: $E(U(x)) = 1/2 U(75) + 1/2 U(25)$, In Lottery B: $E(U(x)) = U(50)$ If $U$ is concave, $U'' < 0$ and $U(50) > 1/2 U(75) + 1/2 U(25)$ then the individual is *risk averse*, if $U$ is strictly convex, $U'' > 0$ and $1/2 U(75) + 1/2 U(25) > U(50)$, then he is *risk-lover* if $U$ is linear, $U'' = 0$, then he is *risk-neutral*.

Examples of risk-averse utility functions: $ln(x)$, $\sqrt{x}$, $x^a$ where $0 < a < 1$, $1 - e^{-ax}$ where $a > 0$. 
Behavioral assumptions

To derive any parity condition we need to have certain assumptions regarding investor characteristics and behavior. We assume investors are rational and they are risk neutral. Overall the market equilibrium parity conditions will be determined by the rationality and risk-neutrality assumption, but individual traits and decisions might differ. Rationality implies agents maximise their utility from wealth when making decisions and risk neutrality is defined as above.
Random walk

In empirical work when one tries to estimate the following equation using exchange rates for $Y_t$,

$$Y_{t+1} = aY_t + \epsilon_{t+1}$$

where $\epsilon_t$ is distributed with $N(0, 1)$ and captures unexpected news, shocks, disturbances, etc., the estimate of $a$, $\hat{a}$, turns out to be 1, i.e. in the statistical test, $H_o : a = 1$, $H_a : a \neq 1$, $H_o$ can not be rejected. This means $Y_{t+1} = Y_t + \epsilon_{t+1}$ forming conditional expectations to find a forecast for $Y_{t+1}$ (see class notes for the difference between conditional and unconditional expectation),

$$E_t(Y_{t+1}|I_t) = E_t(Y_t|I_t) + E_t(\epsilon_{t+1}|I_t)$$

Since $E_t(\epsilon_{t+1}|I_t) = 0$ and $E_t(Y_t|I_t) = Y_t$, therefore $E_t(Y_{t+1}|I_t) = Y_t$, i.e. the best forecast one can make is to predict the exchange rates will remain the same. The link between the market efficiency and the random walk hypothesis will be discussed in class.
Uncovered Interest Rate Parity (UIRP)

Let $r$ be the domestic interest rate of a financial instrument with $N$ periods to maturity.

Let $r^*$ be the foreign interest rate of the same financial instrument with $N$ periods to maturity.

**Definition**

In the absence of hedging opportunities, the relationship between domestic and foreign interest rates are given by

$$(1 + r) = \frac{E_t(S_{t+N})}{S_t}(1 + r^*)$$

where $E_t(S_{t+N})$ is the expected spot exchange rate at $t + N$ as of time $t$. 
Ayşe has 10TL. Let $S_t = 1.6\, (TL/\$)$, $r = 8\%$, $r^* = 5\%(US)$, $E_t(S_{t+1}) = 1.8$. Should Ayşe invest in Turkey or US?
Ayşe has 10TL. Let $S_t = 1.6(\text{TL}/\$)$, $r = 8\%$, $r^* = 5\%(\text{US})$, $E_t(S_{t+1}) = 1.8$. Should Ayşe invest in Turkey or US?

- If Ayse is risk neutral than she will be indifferent if both bets have the same expected return otherwise she will pick the bet with higher return.
Ayşe has 10TL. Let $S_t = 1.6 (TL/$), $r = 8\%$, $r^* = 5\% (US)$, $E_t(S_{t+1}) = 1.8$. Should Ayşe invest in Turkey or US?

- If Ayse is risk neutral than she will be indifferent if both bets have the same expected return otherwise she will pick the bet with higher return.

- $10 \times (1 + 0.08) = 10.8 \, TL$ Return from investing in Turkey
Ayşe has 10TL. Let $S_t = 1.6 (TL/\$), r = 8\%, r^* = 5\% (US), E_t (S_{t+1}) = 1.8$. Should Ayşe invest in Turkey or US?

If Ayse is risk neutral than she will be indifferent if both bets have the same expected return otherwise she will pick the bet with higher return.

- $10 \times (1 + 0.08) = 10.8 \text{ TL} \text{ Return from investing in Turkey}$
- $10 \times \frac{1}{1.6} (1 + 0.05) \times 1.8 = 11.813 \text{ TL} \text{ Expected Return from investing in US.}$
Ayşе has 10TL. Let $S_t = 1.6(\text{TL/\$})$, $r = 8\%$, $r^\ast = 5\%(\text{US})$, $E_t(S_{t+1}) = 1.8$. Should Ayşе invest in Turkey or US?

If Ayse is risk neutral than she will be indifferent if both bets have the same expected return otherwise she will pick the bet with higher return.

10 \times (1 + 0.08) = 10.8\text{TL} \text{ Return from investing in Turkey}

10 \times \frac{1}{1.6}(1 + 0.05) \times 1.8 = 11.813\text{TL} \text{ Expected Return from investing in US.}

Should invest in US
UIRP example (cont’d)

\[
\frac{E_t(S_{t+N})}{S_t} = \frac{(1+r)}{(1+r^*)}, \text{ subtract } 1 \text{ from both sides}
\]
UIRP example (cont’d)

\[
\frac{E_t(S_{t+N})}{S_t} = \frac{(1+r)}{(1+r^*)}, \text{ subtract 1 from both sides}
\]

\[
\frac{E_t(S_{t+N})-S_t}{S_t} = \frac{(1+r)}{(1+r^*)} - 1 = \text{expected depreciation rate}
\]

\[
= \Delta S^e \ldots \text{Given } r^* = 5\%
\]

![Graph showing the relationship between expected depreciation rate and interest rate](image)

An increase in \(r^*\) results in either \(E_t(S_{t+N})\) ↑ or \(S_t\) ↓ or both. If long-run equilibrium is fixed \(E_t(S_{t+N})\), then only \(S_t\) ↓.
UIRP example (cont’d)

\[
\frac{E_t(S_{t+N})}{S_t} = \frac{(1+r)}{(1+r^*)}, \text{ subtract 1 from both sides}
\]

\[
\frac{E_t(S_{t+N}) - S_t}{S_t} = \frac{(1+r)}{(1+r^*)} - 1 = \text{expected depreciation rate}
\]

\[
= \Delta S^e \quad \text{...Given } r^* = 5%
\]

An increase in \( r \) results in either \( E_t(S_{t+N}) \uparrow \) or \( S_t \downarrow \) or both. If long-run equilibrium is fixed \( E_t(S_{t+N}) \), then only \( S_t \downarrow \).
UIRP example (cont’d)

- Find the expected spot rate that leaves Ayse indifferent between investing in US and Turkey.
Find the expected spot rate that leaves Ayse indifferent between investing in US and Turkey.

\[ E_t\left(S_{t+N}\right) = \frac{(1+r)}{(1+r^*)} S_t = \frac{1.08}{1.05} \times 1.60 = 1.6457 \]
UIRP example (cont’d)

- Find the expected spot rate that leaves Ayse indifferent between investing in US and Turkey.

\[ E_t(S_{t+N}) = \frac{(1+r)}{(1+r^*)}S_t = \frac{1.08}{1.05} \times 1.60 = 1.6457 \]

- An alternative formulation of the UIRP:
Find the expected spot rate that leaves Ayse indifferent between investing in US and Turkey.

\[ E_t(S_{t+N}) = \frac{(1+r)}{(1+r^*)} S_t = \frac{1.08}{1.05} \times 1.60 = 1.6457 \]

An alternative formulation of the UIRP:

- Let \( \frac{E_t(S_{t+N}) - S_t}{S_t} = \Delta S^e \)
Find the expected spot rate that leaves Ayse indifferent between investing in US and Turkey.

\[ E_t(S_{t+N}) = \frac{(1+r)}{(1+r^*)}S_t = \frac{1.08}{1.05} \times 1.60 = 1.6457 \]

An alternative formulation of the UIRP:

- Let \( \frac{E_t(S_{t+N})-S_t}{S_t} = \Delta S^e \)
- \( (1+r) = (1+r^*)(1+\Delta S^e) \) or \( (1+r) = 1 + r^* + \Delta S^e + r^*\Delta S^e \)
Find the expected spot rate that leaves Ayse indifferent between investing in US and Turkey.

\[ E_t(S_{t+N}) = \frac{(1+r)}{(1+r^*)} S_t = \frac{1.08}{1.05} \times 1.60 = 1.6457 \]

An alternative formulation of the UIRP:

- Let \( \frac{E_t(S_{t+N})-S_t}{S_t} = \Delta S^e \)
- \( (1 + r) = (1 + r^*)(1 + \Delta S^e) \) or \( (1 + r) = 1 + r^* + \Delta S^e + r^* \Delta S^e \)
- but \( r^* \Delta S^e \approx 0 \) therefore \( r = r^* + \Delta S^e \) (UIRP approximate version)
In general, agents demand a reward (premium) for the risks they take.

**Definition**

Risk premium is the anticipated excess return agents demand in return for taking the risk. A *risk averter* requires positive risk premium. The higher the risk-averseness the higher the required premium. *Risk neutral* is willing to undertake the risk for zero risk premium. A *risk lover* is willing to pay a premium in order to take the risk.
The above is a simple definition of the risk premium for individual decisions. In international macroeconomics, the word risk premium generally refers to the excess return risky countries offer to international investors. It includes several components, some unobservable and others observable. Some countries have historically higher nominal rates than others due to higher inflation, higher default risk combined with or independent of high political and economic risk. To explain this phenomenon in fully efficient markets with risk-neutral and rational investors, one can utilize parity conditions. For example given the expected inflation and the expected exchange rate depreciation for a risky country A and for a riskless country B, nominal rates for A might be still higher than what the parity conditions implies, this means there are unobservable or unmeasurable factors such as risk-appetite (or the degree of risk averseness) of international investors. Heterogeneous investors with differing degrees of averseness (a distribution of risk-averseness across investors) might be one reason, unobserved or mismeasured expected inflation might be another reason. We will come back to this later.
Forward and Futures Contracts

Definition

A forward contract (or a forward) is a non-standardized contract between two parties to buy or sell an asset at a specified future time at a price agreed today. The party agreeing to buy the underlying asset in the future assumes a long position, and the party agreeing to sell the asset in the future assumes a short position. The price agreed upon is called the delivery price, which is equal to the forward price at the time the contract is entered into.
Definition

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Definition

A futures contract is a standardized financial contract, in which two parties agree to transact a set of standardized financial instruments or physical commodities for future delivery at a particular price. In futures contracts parties can exchange additional property securing the party at gain (margin call) and the entire unrealized gain or loss builds up while the contract is open.
Futures Example

1.60

T T+1 T+2 T+8 T+12

Market Forward Rate and Transactions Timeline

Ali agrees to sell Ayse $10000 at 1.6TL/$ at T +12

1.58

T T+1 T+2 T+8 T+12

TL/$ Spot

Profit Timeline

Both Ali and Ayse deposit $1000 (1/10th of the total exchange) with the broker.
Futures Example

Ali agrees to sell Ayse $10000 at 1.6TL/$ at T +12

Ali’s deposit = $1000 - (1.65 - 1.60) * $10000 = $500
Ayse’s deposit = $1000 + (1.65 - 1.60) * $10000 = $1500
Futures Example

Ali agrees to sell Ayse $10000 at 1.6TL/$ at T +12

Market Forward Rate and Transactions Timeline

TL/$ Spot

Profit Timeline

Ali's deposit = $500 + (1.65 - 1.57) * $10000 = $1300
Ayse's deposit = $1500 - (1.65 - 1.57) * $10000 = $700
Futures Example

Ali agrees to sell Ayse $10000 at 1.6TL/$ at T +12

Ali gets the margin call and is required to increase his deposits by $500 to continue

Ali’s deposit = $1300 - (1.67 - 1.57) x $10000 = $300
Ayse’s deposit = $700 + (1.67 - 1.57) x $10000 = $1700
Futures Example

Ali agrees to sell Ayse $10000 at 1.6TL/$ at T +12

Transaction Closed. Ayse made $400. She can buy at the spot market if she really needs $.

Market Forward Rate and Transactions Timeline

TL/$ Spot

Profit Timeline

Ali’s deposit = $800 + (1.67 - 1.64) * $10000 = $1100
Ayse’s deposit = $1700 - (1.67 - 1.64) * $10000 = $1400
Ali’s profit = $1100 - $1000 - $500 = $400
Ayse’s profit = $1500 - $1000 = $400
Covered Interest Rate Parity (CIRP)

With hedging opportunities, the relationship between domestic and foreign interest rates are given by

\[(1 + r) = \frac{F_t}{S_t}(1 + r^*)\]

where \(F_t\) is the forward rate at \(t + 1\) as of time \(t\). Note that \(F_t = S_t\) at the maturity date.

\[\frac{F_t}{S_t} = \frac{(1+r_t)}{(1+r^*_t)},\] subtract 1 from both sides to get covered interest rate parity (CIRP)
Covered Interest Rate Parity (CIRP)

With hedging opportunities, the relationship between domestic and foreign interest rates are given by

\[(1 + r) = \frac{F_t}{S_t} (1 + r^*)\]

where $F_t$ is the forward rate at $t + 1$ as of time $t$. Note that $F_t = S_t$ at the maturity date.

- \[\frac{F_t}{S_t} = \frac{(1+r_t)}{(1+r^*_t)}\], subtract 1 from both sides to get covered interest rate parity (CIRP)
- \[\frac{F_t - S_t}{S_t} = \frac{(1+r_t)}{(1+r^*_t)} - 1 = f_t = \text{forward premium (discount)}\] if $f_t > 0$
  \[(< 0)\]
Covered Interest Rate Parity (CIRP)

With hedging opportunities, the relationship between domestic and foreign interest rates are given by

$$(1 + r) = \frac{F_t}{S_t}(1 + r^*)$$

where $F_t$ is the forward rate at $t + 1$ as of time $t$. Note that $F_t = S_t$ at the maturity date.

- $\frac{F_t}{S_t} = \frac{(1+r_t)}{(1+r^*_t)}$, subtract 1 from both sides to get covered interest rate parity (CIRP)
- $\frac{F_t}{S_t} - 1 = f_t = forward\ premium\ (discount)\ if\ f_t > 0$
  \[ (< 0) \]
- A forward premium, $f_t$, is the proportion by which a country’s forward exchange rate exceeds its spot rate, $S_t$. 

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Open Economy Macroeconomics  
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Covered Interest Rate Parity (CIRP)

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\[(1 + r) = \frac{F_t}{S_t}(1 + r^*)\]

where \(F_t\) is the forward rate at \(t + 1\) as of time \(t\). Note that \(F_t = S_t\) at the maturity date.

- \(\frac{F_t}{S_t} = \frac{(1+r_t)}{(1+r_t^*)}\), subtract 1 from both sides to get covered interest rate parity (CIRP)
- \(\frac{F_t-S_t}{S_t} = \frac{(1+r_t)}{(1+r_t^*)} - 1 = f_t = forward premium (discount)\) if \(f_t > 0\) (< 0)
- A forward premium, \(f_t\), is the proportion by which a country’s forward exchange rate exceeds its spot rate, \(S_t\).
- Rewriting \((1 + r) = (1 + r^*)(1 + f)\), \(r^*f \approx 0\)
Covered Interest Rate Parity (CIRP)

With hedging opportunities, the relationship between domestic and foreign interest rates are given by

\[(1 + r) = \frac{F_t}{S_t} (1 + r^*)\]

where \(F_t\) is the forward rate at \(t + 1\) as of time \(t\). Note that \(F_t = S_t\) at the maturity date.

- \(\frac{F_t}{S_t} = \frac{(1 + r_t)}{(1 + r^*_t)}\), subtract 1 from both sides to get covered interest rate parity (CIRP)
- \(\frac{F_t - S_t}{S_t} = \frac{(1 + r_t)}{(1 + r^*_t)} - 1 = f_t = \text{forward premium (discount)}\) if \(f_t > 0\) \((< 0)\)
- A forward premium, \(f_t\), is the proportion by which a country’s forward exchange rate exceeds its spot rate, \(S_t\).
- Rewriting \((1 + r) = (1 + r^*)(1 + f)\), \(r^*f \approx 0\)
- \(r_t = r^*_t + f_t\) (CIRP approximate version)
The difference between the forward and spot rates is what the investors have to pay extra at time $t$ to hedge or 'cover' the exchange risk associated with a forward contract to receive or deliver foreign currency at time $t+1$. Therefore the interest rate differential between home and the world should be equal to the extra loss or return one can obtain in choosing the safe (home) currency. Note that if there is also no exchange rate risk then CIRP and UIRP coincide because then $f_t = \Delta S^e$. 
Problems in empirical validation of interest rate parity conditions

- Note that CIRP and UIRP conditions require that all agents are risk-neutral, but in reality we have all types of agents across the risk-spectrum. (i.e. the correct term in economics is 'heterogenous agents', in other words there is a probability distribution of risk-averseness degrees across agents). The conditions, however, assume they are identical.

- Depending on macroeconomic climate agents might behave differently (higher risk appetite during booms vs. lower risk appetite during busts) at different times (i.e. not only there is a probability distribution but also this distribution is not constant)

- There might be a measurement error i) forward rates might not accurately reflect market expectations, because future derivatives are also subject to speculation ii) since observed nominal rates are determined in a secondary bond market, i.e. they might behave like stock prices. Difficult to keep track by keeping a consistent maturity-date time frame, nominal interest rates are themselves are subject to news shocks, therefore it is difficult to separate and identify shocks to different items in CIRP and UIRP conditions.

- Transaction costs: UIRP and CIRP assume no transaction costs. In reality, bid-ask spread and commissions by brokers in forward markets and bid-ask spread in spot markets can constitute a significant cost. These costs might not be observable to outside observers and they might also be change with the volume of transactions making harder to predict.
Empirical estimation of parity conditions and the risk premium

Update CIRP (or UIRP) with a stochastic factor, that includes all the unexplained factors.

\[ r_t = \alpha + \beta r^*_t + \gamma f_t + \epsilon_t \quad \text{or,} \]

\[ r_t = \alpha + \beta r^*_t + \gamma \Delta S^e + \epsilon_t \]

the difference between these two parity conditions is that in UIRP there is a probability distribution around \( \Delta S^e \), whereas in CIRP \( f_t \) is readily observable. therefore when using UIRP any mis-measurement in \( \Delta S^e \) will be captured in \( \epsilon_t \)

If the agents are risk-averse \( \epsilon_t \) might also capture the risk premium in UIRP that is not captured in \( f_t \) or \( \Delta S^e \) because of and in addition to factors mentioned in previous slides. Hence, correct estimation of the risk-premium is difficult.

Testing UIRP and CIRP conditions is equivalent to testing the joint hypothesis \( \alpha = 0, \beta = 1 \) and \( \gamma = 1 \)
Empirical estimation of parity conditions and the risk premium

There are several versions of the risk premium as defined in the literature. If UIRP condition holds, then the risk premium, \( \phi_t \), can be defined as

\[
\Delta S^e + \phi_t = r_t - r^*_t
\]

\( \phi_t \) is the exchange rate premium over and above the interest rate differential such that asset holders are indifferent at the margin between uncovered domestic holdings and foreign bonds. OR if CIRP holds the risk premium over forward premium can be defined as such as:

\[
\Delta S^e + \phi_t = f_t
\]
Consider an importer who has to make a payment of $X$ in foreign currency at some future date: His options are:

1. *pay immediately* (i.e. buy foreign exchange spot) and settle his debt. *Costs*: If he already has the funds: opportunity cost of not holding domestic funds: $i_t X$. If he does not have any funds: interest rate payment when he pays back $i_t X$. (Assume for now borrowing and lending costs are the same) *Benefits*: discount that he will get because he pays now, which will be related to foreign interested rate: $X - \frac{X}{1+i_t^*}$. 

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2. **buy foreign exchange spot and invest in foreign country**: **Costs**: Same as above. **Benefits**: He will earn foreign interest payment $i^*_t X$

3. **buy foreign exchange forward**: The settlement is in the future therefore there is no payment now. His costs will depend on the forward premium (or discount). His total costs are: $F_t X$
Consider an importer who has to make a payment of $X$ in foreign currency at some future date: His options are:

- **pay immediately** (i.e. buy foreign exchange spot) and settle his debt. 

  Total opportunity cost: $S_t \frac{X}{1+i_t} (1+i_t)$
  
  Why? $S_t \frac{X}{1+i_t}$ is the amount he needs to raise now due to discount and $(1+i_t)$ is the cost of not holding domestic funds.
Consider an importer who has to make a payment of $X$ in foreign currency at some future date: His options are:

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- **buy foreign exchange spot and invest in foreign country:** *Total opportunity cost:* $S_t \frac{X}{1+i_t^*}(1+i_t)$ Why? because he will only need to invest $S_t \frac{X}{1+i_t^*}$ now in a foreign bank to raise $S_t X = S_t \frac{X}{1+i_t^*}(1+i_t^*)$ in the future and $(1+i_t)$ is the cost of not holding domestic funds.
An investor who has a liability (an asset) denominated is said to have a short (long) position in that currency. The net position is given by the difference between long and short positions. There are two types of arbitrages:

- **Uncovered** example: investing in US or Turkey for interest arbitrage without forward contracts.

  1. **January 1:**
     - **Investing in Turkey:** Borrow 1.60 TL (short TL) at 8% and place on one year deposit (long TL) with 8% interest.
     - **Investing in US:** Borrow 1.60 TL (short TL) at 8%, buy $ at 1.60, deposit (long $) in US for a year with 5% interest.

  2. **Net position in Turkey**
     \[ \text{Net position in Turkey} = \text{long} (1.60 \times 1.08) - \text{short} (1.60 \times 1.08) = 0. \]

  3. **Net position in US**
     \[ \text{Net position in US} = E_{t} (S_{t+1} + 1) S_{t} \times 1.60 \times 1.05 - (1.60 \times 1.08) \neq 0 \]

  2. **December 31.**
     - **Investing in Turkey:** Liquidate deposit (1.60 TL \times 1.08 = 1.728 TL) pay back loan (1.60 \times 1.08 = 1.728 TL).
     - **Net profit** = 0 TL

     - **Investing in US:** Liquidate deposit ($1 \times 1.05 = $1.05), convert it to TL at the spot price (e.g. 1.70), $1.05 \times 1.70 = 1.785 TL, pay back loan (1.60 \times 1.08 = 1.728 TL).
     - **Net profit** = 1.785 - 1.728 = 0.057 TL
An investor who has a liability (an asset) denominated is said to have a short (long) position in that currency. The net position is given by the difference between long and short positions. There are two types of arbitrages:

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Borrowing and Lending (Optional Topic)

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3. **December 31. Investing in Turkey:** Liquidate deposit(1.60 TL × 1.08 = 1.728 TL) pay back loan (1.60 × 1.08 = 1.728 TL) **Net profit = 0 TL** **Investing in US:** Liquidate deposit($1 × 1.05 = $1.05), convert it to TL at the spot price (e.g. 1.70), $1.05 × 1.70 = 1.785 TL , pay back loan (1.60 × 1.08 = 1.728 TL) **Net profit = 1.785 - 1.728 = 0.057 TL**
Covered.

January 1:
Investing in Turkey:
Borrow 1.60TL (short TL) at 8% and place on one year deposit (long TL) with 8% interest.
Investing in US:
Short 1.60TL at 8%, buy 1$ at 1.60, deposit (long $) in US for a year with 5% interest and enter a short forward contract in $.

Net position in Turkey = long (1.60 × 1.08) - short (1.60 × 1.08) = 0.
Net position in US = \( F_t S_t \times 1.60 \times 1.05 - 1.60 \times 1.08 \) If CIRP holds then \( F_t = \left(1 + r^*\right) \left(1 + r\right) S_t \) and the net position in US = 0.

December 31.
Investing in Turkey:
Liquidate deposit (1.60 TL × 1.08 = 1.728 TL) pay back loan (1.60 × 1.08 = 1.728 TL)
Net profit = 0 TL
Investing in US:
Liquidate deposit (\$1 × 1.08 = \$1.05), convert it to TL at the forward price (\(1.08 \div 1.05 \times 1.60 = 1.6457\)), \$1.05 \times 1.6457 = 1.728 , pay back loan (1.60 × 1.08 = 1.728 TL)
Net profit = 1.728 - 1.728 = 0 TL
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- example: investing in US or Turkey for interest arbitrage with forward contracts
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2 Net position in Turkey = \(\text{long} (1.60 \times 1.08) - \text{short} (1.60 \times 1.08) = 0\). Net position in US = \(\frac{F_t}{S_t} \times 1.60 \times 1.05 - 1.60 \times 1.08\) If CIRP holds then \(F_t = \frac{(1+r)}{(1+r^*)} S_t = \frac{1.08}{1.05} \times S_t\) and the net position in US = 0.
Borrowing and Lending (cont’d) (Optional Topic)

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In the UIRP example the currency risk associated with investing in Turkey is 0, and in US it is
\[ A_t \times (1 + r) - A_t \times (1 + r^*) \times E_t(\frac{S_{t+1}}{S_t}) \] where \( A_t \) is the initial asset.

In the CIRP example the currency risk associated with investing in Turkey and US is 0. In the above example the currency risk is 0 because of the assumption that CIRP holds. In reality, the forward rates reflect the risk premium associated with investing in that particular country. While the currency risk is zero, the profits are still uncertain. If \( S_{t+1} > F_t \) then investing in US without hedging would have resulted in greater profits.
In the UIRP example the currency risk associated with investing in Turkey is 0, and in US it is
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- Explain law of One Price and PPP
- Why does PPP does not hold most of the time?
- What are extensions to PPP. Explain each of them.
- How can one calculate PPP adjusted GDP of Turkey expressed in US $
- Explain the steps need to be take to compare PPP adjusted GDP of India and Denmark
- Explain UIRP and CIRP
- Explain the relationship between concavity of a utility function and risk-averseness
- The risk-premium of a country depends on the risk-averseness of the people who live in that country. True or false?
- Explain the problems in empirical testing of interest rate parity conditions. Use equations
- Explain how UIRP and CIRP can be estimated. Use equations
- What is risk premium in open economy macroeconomics? How can it be estimated. Use equations
Real Interest Rate Parity

- Future sacrifice required per unit of extra consumption today
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**Definition**

The relationship between real, $i_{\text{real}}$, and nominal interest rate, $i$, is given by $(1 + i) = (1 + i_{\text{real}})(1 + \Delta p^e)$ or in approximate form by $i = i_{\text{real}} + \Delta p^e$ (Fisher equation) where $\Delta p^e$ is the expected inflation rate.
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**Corollary**

Take two countries $i - i^* = (i_{real} - i_{real}^*) + (\Delta p^e - \Delta p^{e*})$ by UIP. $i - i^* = \Delta S^e$ therefore $\Delta S^e = (i_{real} - i_{real}^*) + (\Delta p^e - \Delta p^{e*})$. If there is perfect capital mobility, $i_{real} = i_{real}^*$ and $\Delta S^e = (\Delta p^e - \Delta p^{e*})$ (PPP in expectations).
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- Note that $\Delta p^e$ is unobservable therefore at any given time $r$ is also unobservable. $r$ is ex-ante whereas as the nominal rate is ex-post.
- Methods of estimating $\Delta p^e$ : Use surveys, or econometric forecast methods.
Rational expectations as we discussed implies that agents form their expectations conditionally based on the information set available at t. Above, we also showed that when agents form their expectations rationally, $S_t$ can be shown to have a random walk. If agents risk averseness implies $f = \Delta S^e$.

If all investors are fully informed about market conditions all the time, then prices fully reflect all available information and there are no arbitrage opportunities. For example,
National Income Accounting in Open Economy

- **C**: Consumption Expenditure on Domestic and Foreign Goods and Services.
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- **X**: Exports
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3. Inventory investment: the change in the value of all firms’ inventories
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Three Approaches To Calculate National Income
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1. Expenditure
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2. Income
Three Approaches To Calculate National Income

1. Expenditure
2. Income
3. Production
Expenditure Approach

- Households, Business, Government and Foreign Sector Expenditures.

National Income Identity in an open economy is given by:

\[ Y = C + I + G + X - M \]

where \( Y \) is gross domestic product. \( M \), imports, are subtracted to prevent double counting.

\[ S_{pri} = Y_{d} - C \]

is private savings where \( Y_{d} \) is the disposable income.

\[ Y_{d} = Y - T + TR \]

\( T \) is taxes collected by the government, \( TR \) transfers made by the government to private sector.

\[ S_{pri} - I = G - T + TR + X - M \]

Private Surplus = Gov. Deficit + CA Balance

Note GDP is a flow variable and not a stock variable.

GDP is product produced within a country's borders; GNP (Gross National Product) is product produced by enterprises owned by a country's citizens.

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- Total Savings $S = S_{private} + S_{government}$
Expenditure Approach

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- Total Savings $S = S_{\text{private}} + S_{\text{government}} = (Y - T + TR - C) + (T - G - TR) = Y - G - C$

where $(T - G - TR)$ is the fiscal balance

In an open economy $Y = C + I + G + X - M$

Therefore total Savings $S_{\text{total}} = C + I + G + X - M - G - C = I + X - M$

or $S - I \equiv NX$ (Identity condition)

S - I - NX = 0

total savings must cover required finance for investment and trade

$S_{\text{private}} = Y - T + TR - C = C + I + G + X - M - T + TR - C = I + (G + TR - T) + NX$

$S_{\text{private}} - I = (G_{\text{net}} + NX)$ (Private Sector Balance)

if $NX > 0$ Total investment can be higher than savings.
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Understanding National Income Account Identity

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- The larger the deficit spending of households and firms as a share of GDP, and the faster the domestic private sector is either increasing its debt to income ratio, or reducing its net worth to income ratio (absent an asset bubble). One sector's financial balance cannot be viewed in isolation. If a nation wishes to run a persistent fiscal surplus and thereby pay down government debt, it needs to run an even larger trade surplus, or else the domestic private sector will be left in a deficit spending mode.
The income approach divides GDP according to types of income generated. GDP consists of:

- Wages and salaries
- Corporate profits (dividends, corporate income taxes, undistributed profits)
- Proprietors income (the profits of partnerships and solely owned businesses, like a family restaurant)
- Farm income
- Rent
- Interest (interest payments by businesses only)
- Sales taxes (it is an income but later get paid to the gov't)
- Depreciation (the amount of capital that has worn out during the year)

GDP = compensation of employees + gross operating surplus + gross mixed income + taxes less subsidies on production and imports
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Example

1. Farmer buys seeds and produces wheat. Value added\(^1\) = Sale of Wheat = Value of producing and collecting wheat
2. Whole retailer packages wheat and transports the wheat to factory. Value added\(^2\) = Sale of Wheat - Cost of Wheat = Value of packaging and shipping wheat
3. Baker cooks bread. Value added\(^3\) = Sale of Bread - Cost of Wheat = Value of baking a bread
4. GDP = \(\sum_{i} \text{Value added}_i\)
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Expenditure Approach revisited

- Examples of GDP component variables

If a person spends money to renovate a hotel to increase occupancy, the spending represents private investment, but if he buys shares in a consortium to execute the renovation, it is saving. The former is included when measuring GDP (in I), the latter is not. However, when the consortium conducted its own expenditure on renovation, that expenditure would be included in GDP.

If a hotel is a private home, spending for renovation would be measured as consumption, but if a government agency converts the hotel into an office for civil servants, the spending would be included in the public sector spending, or G.
Expenditure Approach revisited

- Examples of GDP component variables
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Expenditure Approach revisited

If the renovation involves the purchase of a chandelier from abroad, that spending would be counted as C, G, or I (depending on whether a private individual, the government, or a business is doing the renovation), but then counted again as an import and subtracted from the GDP so that GDP counts only goods produced within the country.
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- If a domestic producer is paid to make the chandelier for a foreign hotel, the payment would not be counted as C, G, or I, but would be counted as an export.
national = S + S = (Y - T + TR) - C + (T - G - TR) = Y - C - G - I = X - M = CA
Defining Variables of Interest

- Assumptions
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- Define \( B = X(Q) - M(Q, y) \)
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Define $B = X(Q) - M(Q, y)$

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where $Q = \frac{SP^*}{P}$ and $\frac{\partial B}{\partial Q} > 0, \frac{\partial B}{\partial y} < 0$
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Defining Variables of Interest

Assumptions

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$G + TR - T$ is exogenously given
\[ S(y, r) - I(r) = G + TR - T + B(Q, y) \text{ (IS curve).} \]
IS Curve

\[ S(y, r) - I(r) = G + TR - T + B(Q, y) \] (IS curve).

Definition

IS curve is the combination of income and interest rate pairs such that the net private savings cover the financing requirements of government and the foreign sector. LEAKAGES (T + S + M) out of the system must equal INJECTIONS (G + TR + I + X) for the circular flow to balance (be in EQUILIBRIUM).
\[ S(y,r) - I(r) = G + B(Q,y) \]
$S(y, r) - I(r) < G + B(Q, y)$
IS Curve

\[ S(y, r) - I(r) = G + B(Q, y) \]
The IS Curve is a graphical representation of the relationship between the real interest rate ($r$) and the real GDP ($y$). It is defined by the equation:

$$S(y, r) - I(r) = G + B(Q, y)$$

The IS curve is downward sloping, indicating that as the real interest rate increases, the real GDP decreases. This is because higher interest rates discourage investment ($I(r)$), which shifts the IS curve to the left, and lower GDP levels are associated with lower income ($Q$), which shifts the IS curve downward. The equilibrium is found at the point where the IS curve intersects with the vertical line representing the predetermined real interest rate ($r^*$) and the horizontal line representing the predetermined real GDP ($y^*$).
An increase in Government Expenditure
An increase in Real Exchange Rate.

\[ IS(G_0, Q_1 > Q_0) \]

\[ IS(G_0, Q_0) \]
Relationship between the demand for money and national income (ignoring the opportunity cost)
LM Curve

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Relationship between the demand for money and national income (ignoring the opportunity cost)

\[ M_d = kY \]

where \( M_d \) is the demand for money and \( Y \) national income, both measured in nominal terms.

\( k \) positive constant.
Define nominal national income $Y$ as follows:
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$Y = Py$ where $y$ is real income and $P$ is the price level.
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- We can also introduce opportunity costs.
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$\frac{M_d}{P} = ky - lr$
Define nominal national income $Y$ as follows:

$Y = P_y$ where $y$ is real income and $P$ is the price level.

We can also introduce opportunity costs

$$\frac{M_d}{P} = ky - lr$$

or $\frac{M_d}{P} \equiv \frac{M_d}{P}(y,r)$ Note that $\frac{\partial M_d(y,r)}{\partial y} > 0$, $\frac{\partial M_d(y,r)}{\partial r} < 0$
Let $M_s$ be the nominal money supply and $m_s = \frac{M_s}{P}$ be the real money supply.
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**Definition**

The Equilibrium condition in the money market is given by $m_s = ky - lr$
or $m_s = m(y, r)$
LM Curve

\[ \frac{M_s}{P} = ky - lr \]

The equation represents the LM curve in the context of open economy macroeconomics, where \( M_s \) is the supply of money, \( P \) is the price level, \( k \) is a constant, \( y \) is real GDP, and \( r \) is the interest rate. The point \( y^* \) indicates a specific equilibrium level of output.
LM Curve

Ms/P > ky - Ir
LM Curve

\[
\frac{M_s}{P} = k y - L_r
\]
An increase in Money Supply.

\[ \frac{M_s}{P} > ky - lr \]
Excess Supply

\[ \frac{M_s}{P} = ky - lr \]

\[ \frac{M_s}{P} < ky - lr \]
Excess Demand
Flow of Funds in an Open Economy

- Businesses
- Households
- Foreign Sector
- Government

Commercial Banks and Government, Households, Foreign Sector
Commercial Banks, Businesses, Government, Foreign Sector
Government, Commercial Banks, Households, Businesses, Central Bank
Central Bank, Foreign Sector, Households, Businesses, Commercial Banks
The equilibrium on the demand side is given by \((y, P)\) pairs such that

\[
S(y, r) - I(r) = (G - T + TR) + B(Q, y)
\]

where \(Q = SP^*P\) (IS)

\[
M_sP = m(y, r)\) (LM)
\]

We want to express the equilibrium in \((y, P)\) plane because prices will form the link between aggregate demand and aggregate supply. Interest rates form the link between goods and the money markets. So one can solve for \(r\) in (2) and substitute in 1 or vice versa and end up in an equation in \((y, P)\) with \(M_s, G, T, TR\) and \(S\) as exogenous variables.
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Deriving Aggregate Demand

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We want to express the equilibrium in \((y, P)\) plane because prices will form the link between aggregate demand and aggregate supply.

Interest rates form the link between goods and the money markets. So one can solve for \(r\) in (2) and substitute in 1 or vice versa and end up in an equation in \((y, P)\) with \(Ms\), \(G\), \(T\), \(TR\) and \(S\) as exogenous variables.
Deriving Aggregate Demand (Ex: A reduction in prices)
Deriving Aggregate Demand

\[ IS(G, Q_1) \]
\[ IS(G, Q_0) \]

\[ LM \ (M_s / P_0) \]

\[ r^* \]

\[ y^0 \]

\[ P^0 \]
Deriving Aggregate Demand
Deriving Aggregate Demand

\[ r^* \]

\[ LM \left( \frac{M}{s, P_0} \right) \]

\[ LM \left( \frac{M}{s, P_1} \right) \]

\[ IS(G, Q_1) \]

\[ IS(G, Q_0) \]

\[ y^0 \]

\[ y^1 \]

\[ P^0 \]

\[ P^1 \]

\[ AD \]
Policy Analysis: Relaxation of Monetary Policy

Suppose $M_s^0 \uparrow$, $M_s^0 \rightarrow M_s^1$ where $M_s^1 > M_s^0$
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$\frac{M_s^1}{P} > ky - lr$, : Excess money supply, So quantity of money demanded has to increase, money demanded increases when $r \downarrow$ or $y \uparrow$ or both.
Policy Analysis: Relaxation of Monetary Policy

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- But $y_0, r_1$ can not be an equilibrium in goods market because:
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$S(y_0, r_1) - I(r_1) < G - T + TR + B(Q, y_0)$

Therefore $y_0 \rightarrow y_1$ where $y_1 > y_0$ and $r_1 \rightarrow r_2$ where $r_2 > r_1$
Policy Analysis: Relaxation of Monetary Policy

- Suppose $M^{0}_{s} \uparrow$, $M^{0}_{s} \rightarrow M^{1}_{s}$ where $M^{1}_{s} > M^{0}_{s}$
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- $S(y_{0}, r_{1}) - I(r_{1}) < G - T + TR + B(Q, y_{0})$
- Therefore $y_{0} \rightarrow y_{1}$ where $y_{1} > y_{0}$ and $r_{1} \rightarrow r_{2}$ where $r_{2} > r_{1}$
- The latest is a movement on $LM$. $\frac{M^{1}_{s}}{P} = ky_{1} - lr_{2} = ky_{0} - lr_{1}$
Policy Analysis: Relaxation of Monetary Policy

- Suppose $M_s^0 \uparrow$, $M_s^0 \rightarrow M_s^1$ where $M_s^1 > M_s^0$
- $\frac{M_s^1}{P} > ky - lr$, : Excess money supply, So quantity of money demanded has to increase, money demanded increases when $r \downarrow$ or $y \uparrow$ or both.
- If $y = y_0$ is constant than $r_1 < r_0$ where $r_0$ is the original interest rate and $\frac{M_s^1}{P} = ky_0 - lr_1$
- But $y_0, r_1$ can not be an equilibrium in goods market because:
  - $S(y_0, r_1) - I(r_1) < G - T + TR + B(Q, y_0)$
  - Therefore $y_0 \rightarrow y_1$ where $y_1 > y_0$ and $r_1 \rightarrow r_2$ where $r_2 > r_1$
- The latest is a movement on $LM$. $\frac{M_s^1}{P} = ky_1 - lr_2 = ky_0 - lr_1$
- No shift in $IS$ curve because $S(y, r) - I(r) = G - T + TR + B(Q, y)$. No exogenous change here.
Policy Analysis: Relaxation of Monetary Policy

- Suppose $M_s^0 \uparrow$, $M_s^0 \rightarrow M_s^1$ where $M_s^1 > M_s^0$

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\frac{M_s^1}{P} > ky - lr, \text{ Excess money supply, So quantity of money demanded has to increase, money demanded increases when } r \downarrow \text{ or } y \uparrow \text{ or both.}
\]

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- But $y_0, r_1$ can not be an equilibrium in goods market because:

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S(y_0, r_1) - I(r_1) < G - T + TR + B(Q, y_0)
\]

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- The latest is a movement on $LM$. $\frac{M_s^1}{P} = ky_1 - lr_2 = ky_0 - lr_1$

- No shift in $IS$ curve because

\[
S(y, r) - I(r) = G - T + TR + B(Q, y). \text{ No exogenous change here.}
\]

- The exact change in $r$ and $y$ is determined by the slopes of $IS$ and $LM$ curves.
Policy Analysis: Relaxation of Monetary Policy

The diagram illustrates the IS-LM model in an open economy. The IS curve represents the intersection of the aggregate supply (AS) and aggregate demand (AD) in the economy. The LM curve represents the money market equilibrium, with the interest rate (r) and money supply (M) as variables. The IS curve is determined by the government spending (G), taxes (T), and net exports (X - M). The LM curve is determined by the money market where the money supply equals the money demand.

The equilibrium is found at the intersection of the IS and LM curves, which determines the interest rate (r) and the level of output (y). The diagram shows the initial equilibrium at (r^0, y^0), and a relaxation of monetary policy could shift the LM curve, potentially leading to a new equilibrium at (r^1, y^1).

Key points:
- IS curve: IS(G,Q)
- LM curves: LM (M s^0/ P), LM (M s^1/ P)
- Initial equilibrium: (r^0, y^0)
- New equilibrium: (r^1, y^1)
Policy Analysis: Relaxation of Monetary Policy

[Graph showing the IS-LM model with changes in monetary policy from r^0 to r^1, affecting the price level P and output y.]
Policy Analysis: Increase in G

- Suppose $G \uparrow$, $G^0 \rightarrow G^1$ where $G^1 > G^0$
Policy Analysis: Increase in G

- Suppose $G \uparrow$, $G^0 \rightarrow G^1$ where $G^1 > G^0$
- $S(y_0, r_0) - I(r_0) < G^1 - T + TR + B(Q, y_0)$. 

As $r \uparrow$, investment crowds out. $I(r_1) < I(r_0)$
Policy Analysis: Increase in G

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- $S(y_0, r_0) - I(r_0) < G^1 - T + TR + B(Q, y_0)$.
- IS curve shifts right. To retain eq., $r \uparrow$ or $y \uparrow$ or both.
Policy Analysis: Increase in G

- Suppose $G \uparrow, G^0 \rightarrow G^1$ where $G^1 > G^0$
- $S(y_0, r_0) - I(r_0) < G^1 - T + TR + B(Q, y_0)$.
- IS curve shifts right. To retain eq., $r \uparrow$ or $y \uparrow$ or both.
- If $r = r_0$ is constant than $y_1 > y_0$ where $y_0$ is the original interest rate and $S(y_1, r_0) - I(r_0) = G^1 - T + TR + B(Q, y_1)$. 
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Policy Analysis: Increase in G

- Suppose $G \uparrow$, $G^0 \to G^1$ where $G^1 > G^0$
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- This is a movement on IS
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Policy Analysis: Increase in $G$

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  - $S(y_0, r_1) - I(r_1) < G - T + TR + B(Q, y_0)$
- No shift in LM curve there is no exogenous change.
- The exact change in $r$ and $y$ is determined by the slopes of IS and LM curves.
Policy Analysis: Increase in G
Policy Analysis: Increase in G
Example 1

Assume PPP holds. i.e. $S$ moves such that $Q = 1$. Using Comparative Statics (ceteris paribus) Fill in the blanks in partial equilibrium (i.e. use only demand side). Use ↑, ↓, constant, shifts left or shifts right.

<table>
<thead>
<tr>
<th></th>
<th>$S$</th>
<th>$Q$</th>
<th>IS</th>
<th>LM</th>
<th>AD</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P^\uparrow$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$P^*$ $\downarrow$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$G^\uparrow$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S^\uparrow$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assume UIRP holds. Also assume long-term exchange rate expectations are static unless stated otherwise. Using Comparative Statics Fill (ceteris paribus) in the blanks in partial equilibrium (i.e. use only demand side). Use ↑, ↓, constant, shifts left or shifts right.

<table>
<thead>
<tr>
<th></th>
<th>S</th>
<th>Q</th>
<th>IS</th>
<th>LM</th>
<th>AD</th>
</tr>
</thead>
<tbody>
<tr>
<td>r↑</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r* ↑</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r↓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$E_t(S_{t+1})$ ↑</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
## Monetary System and the Banking Sector

### Central Bank

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold and Foreign Currency</td>
<td>Currency Issued (monetary base)</td>
</tr>
<tr>
<td>Reserves FX</td>
<td>MB</td>
</tr>
<tr>
<td>Lending to Government LG</td>
<td></td>
</tr>
</tbody>
</table>

### Commercial Banks

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency plus Deposits</td>
<td>Deposits by Public</td>
</tr>
<tr>
<td>with Central Bank MB&lt;sup&gt;b&lt;/sup&gt;</td>
<td>D</td>
</tr>
<tr>
<td>Loans to Personal and Corporate Sector L</td>
<td></td>
</tr>
</tbody>
</table>

### Consolidated Banking Sector

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold and Foreign Currency</td>
<td>Currency in Circulation: MB-MB&lt;sup&gt;b&lt;/sup&gt; = MB&lt;sup&gt;p&lt;/sup&gt;</td>
</tr>
<tr>
<td>Reserves FX</td>
<td>Deposits by Public</td>
</tr>
<tr>
<td>Domestic Credit: L+LG= DC</td>
<td></td>
</tr>
<tr>
<td><strong>MONEY SUPPLY: FX+DC= M&lt;sup&gt;s&lt;/sup&gt;</strong></td>
<td><strong>MONEY SUPPLY: MB&lt;sup&gt;p&lt;/sup&gt; + D= M&lt;sup&gt;s&lt;/sup&gt;</strong></td>
</tr>
</tbody>
</table>
Monetary System and the Banking Sector

For the Central Bank: \( FX + LG = MB \)
For the Central Bank: $FX + LG = MB$

For Commercial Banks $MB^b + L = D$, Given $D$, $L$ is determined by $MB^b$. 
Monetary System and the Banking Sector

- For the Central Bank: $FX + LG = MB$
- For Commercial Banks $MB^b + L = D$, Given $D$, $L$ is determined by $MB^b$.
- The reserve requirement, $RR$, is the percentage of Commercial Banks deposits to be held with Central Bank as a precaution or the the percent of deposits banks are not allowed to lend.
For the Central Bank: \( FX + LG = MB \)

For Commercial Banks \( MB^b + L = D \), Given \( D \), \( L \) is determined by \( MB^b \).

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Combining both balance sheets \( FX + LG + MB^b + L = MB + D \)
Monetary System and the Banking Sector

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- The reserve requirement, $RR$, is the percentage of Commercial Banks deposits to be held with Central Bank as a precaution or the the percent of deposits banks are not allowed to lend
- Combining both balance sheets $FX + LG + MB^b + L = MB + D$
- or $FX + DC = MB^p + D$ where $DC = L + LG$ is total domestic credit and $MB^p = MB - MB^b$ is currency circulation.
ECB balance sheet

- ECB total assets - trillion euros (Latest: 2.648)

Source: Thomson Reuters Datastream

Reuters graphic/Scott Barber 3/20/2013
Control of Money Supply

- \( FX + DC = MB^p + D = Money\ Supply = M^s \)
Control of Money Supply

- \( FX + DC = MB^p + D = \text{Money Supply} = M^s \)
- \( \Delta FX + \Delta DC = \Delta M^s \)
Control of Money Supply

- \( FX + DC = MB^p + D = Money \ Supply = M^s \)
- \( \Delta FX + \Delta DC = \Delta M^s \)
- Money supply can be controlled by Central Bank via changes in

1. Reserve/Borrowing Requirements (through reserve requirement ratio (\(DC\) and \(MB^p\)) or discount interest rate (\(MB^p\)))
2. Open Market Operations (selling and buying Reserves (\(FX\)), or via buying and selling Treasury Bills (\(MB^p\)))
3. Public Cash Holding (not really a policy tool but CB may pursue policies to increase confidence in the banking system)
Control of Money Supply

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Control of Money Supply

- \( FX + DC = MB^p + D = Money ~ Supply = M^s \)
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Central Bank Roles

- monetary policy (control inflation, economic growth, employment, financial stability)
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  There might be conflicts among roles such as controlling inflation and creating employment or growth.
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- control money supply
- managing FX and gold reserves
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- lender of last resort
- issue currency
- regulator and supervisor of commercial banks (now BDDK setting capital requirements for banks)
Under pure float: $\Delta FX = 0$ only $DC$ affects $M^s$, therefore $\Delta DC = \Delta M^s$. $M^s$ is exogenous and $S_t$ is endogenous.
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Under fixed rates: $\Delta FX \neq 0$, CA balance-CAP balance determine $\Delta FX$ therefore $M^s$ is endogenous and $S_t$ is exogenous and $\Delta S_t = 0$. Under fixed rates independent (independent of exchange rate movements) monetary policy is \textit{impossible}. 
Taylor Rule is invented by John Taylor (1993) and based on his paper ”Discretion vs. Policy Rules in Practice”. It is a reduced form approximation to the solution of an optimization problem by the Central Bank given its preference between inflation prevention and maximizing employment. Latest research shows that it changed the Central Banking practice in the world since its invention. It can be written as:

\[ i_t = r_t + \pi_t + \alpha(\pi_t - \bar{\pi}_t) + \beta(y_t - \bar{y}_t) \]

where \( i_t \) are nominal rates, \( r_t \) are real rates, \( \pi_t \) is the actual inflation, \( \bar{\pi}_t \) is the inflation target, \( y_t \) is the actual output and \( \bar{y}_t \) is the potential output, all in logs. When \( \alpha > 0 \), the central Bank responds to a 1 per cent change in inflation by changing the nominal rates more than by one per cent, specifically by \( 1 + \alpha \). Taylor’s suggestion was to set \( \alpha = \beta = 0.5 \) as this was a compromise between keeping inflation in check by responding to an increase in inflation as well as to inflationary pressures from an ”overheating economy”, which refers to increasing output gap, \( (y_t - \bar{y}_t) \uparrow \), or actual output rising above the full-employment level.
Taylor rule can also be used to empirically evaluate how a Central Bank responds to changes in inflation (and expected inflation) and actual output (and output gap). Using data one can estimate the magnitudes of $\alpha$ and $\beta$ to check what policy a central bank is following. For small open market economies an adaptation of the Taylor Rule is as follows:

$$i_t = r_t + \pi_t + \alpha(\pi_t - \bar{\pi}_t) + \beta(y_t - \bar{y}_t) + \gamma(S_t - \bar{S}_t)$$

where $\bar{S}_t$ is an implicit exchange rate target that the CB might be following to control the "effect of the exchange rate increase on domestic inflation" (also called exchange rate pass through, note that as $S \uparrow$ the CPI rises because of imported goods inclusion in the CPI) as well as the effect of exchange rate on demand side effects (See the IS equation).
Assumptions: Firms take prices, $P$, as given and hire capital, $\bar{K}$, at a rental rate, $r$, and labor, $N$, at nominal wage, $W$, to maximize profits. To concentrate on labor demand, we will assume capital is fixed in the short run and firms choose only labor to maximize profits. Firms have access to a production technology, $F(\bar{K}, N)$ with the following properties: $F_{\bar{K}} > 0$, $F_N > 0$, $F_{KK} < 0$, $F_{NN} < 0$ where $F_N = \frac{\partial F}{\partial N}$, $F_{NN} = \frac{\partial^2 F}{\partial N^2}$, etc. Firms maximization problem can be written as:

$$\max_N PF(\bar{K}, N) - wN$$  (1)
First order condition can be written as:

$$PF_N(\bar{K}, N) = W \quad (2)$$

or simply

$$W = PF_N(N) \quad (3)$$

Since $F_{NN} < 0$ the labor demand curve is downwardly sloped in $(N,W)$ space.
**Assumptions:** Workers decide between how much to work and how much to consume. Their aim is to maximize their utility $U(y^e, l)$ where $y^e$ is expected real income and $l$ is leisure. The utility function has the following properties: $U_{y^e} > 0$, $U_l > 0$, $U_{y^e y^e} < 0$, $U_{ll} < 0$ Here, real expected income can be thought of as expected real consumption since income will be spent on goods and services. Leisure is the amount of time spent outside work. Given the worker has $T$ hours available to her each day, she chooses how much to work, $T - l$, by choosing the leisure amount, $l$. We further define workers’ price expectations as $P^e$ where $P^e = E_t(P_{t+1})$ is an expectation formed today, at $t$, about future prices, $P_{t+1}$. We assume the workers adjust their expectations according to a function $p$ where $P^e = p(P)$. We will distinguish between three types of workers.

i) Extreme Keynesian (myopic), here $\frac{dp}{dP} = p'(P) = 0$

ii) Neoclassical and/or Monetarist (perfect foresight) $p'(P) = 1$

iii) New Keynesian (sluggish adjustment) $0 < p'(P) < 1$
The workers decision problem can be written as:

$$\max_{y^e, l} U(y^e, l)$$ \hspace{1cm} (4)

subject to:

$$y^e \leq \frac{W}{P^e}(T - l)$$ \hspace{1cm} (5)
Aggregate Supply: Labor Supply

Forming the lagrangian

\[ L = U(y^e, l) - \lambda (y^e - \frac{W}{P^e} (T - l)) \]  \hspace{1cm} (6)

First order conditions:

\[ \frac{\partial L}{\partial y^e} : U_y(y^e, l) = \lambda \] \hspace{1cm} (7)

\[ \frac{\partial L}{\partial l} : U_l(y^e, l) = \lambda \frac{W}{P^e} \] \hspace{1cm} (8)

\[ \frac{\partial L}{\lambda} : \frac{W}{P^e} (T - l) = y^e \] \hspace{1cm} (9)
We also have the following slackness conditions (Kuhn-Tucker)
\[ \lambda \frac{\partial L}{\partial \lambda} = 0, \lambda \neq 0 \text{ and } \frac{\partial L}{\partial \lambda} = 0, \text{ or } \lambda = 0 \text{ and } \frac{\partial L}{\partial \lambda} \neq 0 \]
Note that \( \lambda = 0 \) is ruled out because of (7). Marginal utility is zero only if \( y^e \to \infty \).

Let us define \( N = \bar{L}(T - I) \) where \( \bar{L} \) is the labor force. Therefore we have from (9)

\[ \frac{W}{P^e} \frac{N}{\bar{L}} = y^e \]  

(10)

and combining (7) and (8)

\[ \frac{U_{y^e}(y^e, I)}{U_l(y^e, I)} = \frac{P^e}{W} \]  

(11)
Aggregate Supply: Labor Supply

Note that we are trying to achieve relation between $N$ and $W$ so that we can find equilibrium in the labor market by combining supply and demand. Let us suppose there in an increase in nominal wages, $W$, Equation (10) dictates that $N$ should go down if $y^e$ is constant. But an increase in $W$ also causes $y^e$ to go up because of (11) since $U_{y^e y^e} < 0$. Going back to (10), an increase in $W$ causes also $y^e$ to go up. We will assume that utility is more elastic with respect to real income (real consumption) such that a one percent increase in wages, $W$, causes a comparatively larger increase in expected real income, $y^e$, and therefore by (10) $N$ goes up. In other word we are operating on the positively sloped side of the labor supply curve and we can summarize the labor supply curve as follows:

$$W = P^e g(N)$$

(12)

where $\frac{\partial g(N)}{\partial N} = g'(N) > 0$.

Combining (3) and (12) we achieve the labor market equilibrium.
To derive the aggregate supply curve we have to form an equilibrium relationship between prices and real output on the supply side. To do this we look at how labor market reacts in terms of employment, $N$, with respect to changes in prices, $P$ and how this affects total output, $y = F(\bar{K}, N)$. The end result will depend on the nature of $P^e = p(P)$ in the following way:
Here, \( \frac{dp}{dP} = p'(P) = 0 \). \( P \uparrow \) implies in (3) that given wages \( N \) should go up and (12) dictates that \( N \) stays constant because workers do not adjust their expectations (\( P^e \) is constant). There is a rightward shift in labor demand but there is not a shift in labor supply. Therefore \( N \uparrow \) as a result, and therefore output, \( y = F(\bar{K}, L) \) increases. \( P \uparrow \) and \( y \uparrow \) imply an **upward sloping** supply curve.
Here, $p'(P) = 1$. $P \uparrow$ implies in (3) that given wages $N$ should go up and (12) dictates that $N$ should go down by the same amount because workers fully adjust their expectations ($P^e$ moves up by the same percentage as $P$ therefore $g(N)$ moves down by the same percentage to retain eq in (12)). There is a rightward shift in labor demand and there is an upward shift in labor supply. We have a \textit{vertical} supply curve.
Here, $0 < p'(P) < 1$. $P \uparrow$ implies in (3) that given wages $N$ should go up and (12) dictates that $N$ should go down by a lesser amount because workers partially adjust their expectations. Overall, $N$ increases and therefore output, $y = F(\bar{K}, L)$ increases. $P \uparrow$ and $y \uparrow$ imply an upward sloping supply curve.
Aggregate Supply: Neoclassical and/or Monetarist (perfect foresight)

\[ W = P_1 e g(N) \]
\[ W = P_0 e g(N) \]
\[ W = P_1 f'(N) \]
\[ W = P_0 f'(N) \]

\[ Y = f(K, N) \]
Extreme Keynesian

\[ W = P_0 e^g(N) = P_1 e^g(N) \]

\[ W = P_0 f'(N) \]

\[ Y = f(K,N) \]

\[ \text{AS} \]
Short Run vs. Long Run

\[ \text{LR AS} \]
\[ \text{MR AS} \]
\[ \text{Extreme SR AS} \]
\[ \text{AD}^0 \]
\[ \text{AD}^1 \]
Monetarist/Neoclassical Long-Run

\[ W = P_1 \cdot g(N) \]
\[ W = P_0 \cdot g(N) \]
\[ W = P_1 f(N) \]
\[ W = P_0 f(N) \]

\[ Y = f(K,N) \]
Extreme Keynesian Short-Run

\[ W = P_0 f(N) \]
\[ W = P_1 f(N) \]
\[ W = P_0^e g(N) = P_1^e g(N) \]

\[ Y = f(K, N) \]
Short Run vs. Long Run

![Graph showing Short Run (SR) and Long Run (LR) Aggregate Supply (AS) and Aggregate Demand (AD) curves.]

- **LR AS**: Long Run Aggregate Supply
- **MR AS**: Market Rate Aggregate Supply
- **SR AS**: Short Run Aggregate Supply
- **AD**: Aggregate Demand
- **AD^0**, **AD^1**: Different levels of Aggregate Demand
Example: Demand vs. Supply Shocks

Exercise: Are the following demand side or supply side shocks for the current Turkish economy in an open economy framework? Use savings-investment balance
\[ S(y, r) - I(r) = G - T + TR + X(Q) - M(Q, y) \]
as well as money market and supply equations. Comment on how they might qualify as a demand or a supply shock. Determine if they are positive or negative shocks. Explain the mechanism. Redo the exercise when we write the investment-savings balance as
\[ S(y, r) - I(r) = G - T + TR + B(Q, y) \]
where B now includes both the capital account and current account. In this case, you can assume capital account dominates the current account in the short-run. Give your answers for the short-run only. Note: You need to be able to answer all of these questions in order to proceed to next topics. Do a self-check, re-study previous lectures if necessary.

1) A Fed rate increase.
2) A drop in Eurozone inflation.
3) An increase in the euro-dollar exchange rate basket.
4) A drop in real effective exchange rate
5) An increase in nominal exchange rate.
6) An increase of Turkish Central Bank overnight lending rate.
7) An increase in potential output
8) A change in the savings behavior of Turkish consumers.
9) An increase in Chinese savings in the absence of Chinese domestic investment opportunities
10) An increase in the number of emigrants.
11) A decrease in the number of immigrants.
12) An increase in domestic credit.
13) Introduction of tax-free industrial zones.
14) A reduction of tariffs in England on cars imported from Turkey
15) Donald J. Trump’s tariff policy on steel.
16) An increase in borrowing-lending interest rate gap by Turkish CB.
17) A speculative attack of Turkish currency
18) A positive technological shock
19) Arrival of a general purpose technology (such as steam engine, electricity, computers, 3d printing, robotics) (this might be tricky)
Exchange Rate Regimes

- Pure float \((\Delta CB\ reserves=0)\)
Exchange Rate Regimes

- Pure float ($\Delta$CB reserves=0)
- Managed Float ($\Delta$CB reserves≠0)
Exchange Rate Regimes

- Pure float \((\Delta \text{CB reserves}=0)\)
- Managed Float \((\Delta \text{CB reserves} \neq 0)\)
- Target Zone
Exchange Rate Regimes

- Pure float ($\Delta$CB reserves = 0)
- Managed Float ($\Delta$CB reserves $\neq$ 0)
- Target Zone
- Fixed
Exchange Rate Regimes

- Pure float \((\Delta \text{CB reserves}=0)\)
- Managed Float \((\Delta \text{CB reserves} \neq 0)\)
- Target Zone
- Fixed
- Currency Board (Domestic currency backed 100% by foreign currency)
Exchange Rate Regimes

- Pure float \((\Delta \text{CB reserves}=0)\)
- Managed Float \((\Delta \text{CB reserves} \neq 0)\)
- Target Zone
- Fixed
- Currency Board (Domestic currency backed 100% by foreign currency)
- Full Dollarization
Pure Float

[Diagram of supply and demand for exchange rate]

- Points A and B
- Lines representing demand and supply
- Axis for exchange rate (S,t £ per $)
- Axes for supply (X^S) and demand (X^D)
Some Exchange Rate Regimes

1. Pure float (Flexible Float): exchange rate at any moment determined by net demand for currency.
Some Exchange Rate Regimes

1. **Pure float** (*Flexible Float*): exchange rate at any moment determined by net demand for currency.

2. **Fixed exchange rate**: central bank (CB) intervenes by
   - buying up excess supply of $ with TL (when TL strong, $ weak). This operation adds $ to FX reserves, adds to TL in circulation or satisfying excess demand for $ by selling $ for TL (when TL weak, $ strong), so as to prevent excess demand/supply affecting the rate. This operation takes $ out of FX reserves, reduces TL in circulation.
   - Sometimes fixed rate regimes are associated with restrictions on FX transactions such as a ban on FX holdings.

3. **Managed Float** (*Dirty Float*): CB intervenes at its discretion.
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Prior to 1939: Gold Standard. Change in money supply = Change in gold reserves. Huge increases in gold reserves after 1890. Period described by high inflation, protectionism and competitive devaluation.
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Exchange Rates in 20th Century

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- Mechanism of Bretton Woods: Gold Exchange Standard. 1944-68 US $ fixed at 1 oz gold = $35, all other currencies fixed to $ with 1% fluctuation bands, devaluations to correct persistent deficits. (Gold Window) Other currencies fixed to dollar. Foundation of IMF to police FX rate system to assure convertibility.
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EMS tied to a basket of currency.(DM, Fr) EMU 1998 onward response to failure of fixed exchange rates
Exchange Rates in 20th Century (cont’d)

- Floating Era 1973 onward managed floats for most convertible currencies at first, but later experiments with limited fixed systems e.g. EMS in Europe, currency boards in Hong Kong, Argentina,
- EMS tied to a basket of currency (DM, Fr) EMU 1998 onward response to failure of fixed exchange rates
- Increasing importance of Asian exchange rates 2000 onward especially RMB, Won, Rupee (varying degrees of flexibility/convertibility, increasingly linked to $/€/Yen currency basket)
Before and After EMU

![Graph showing currency fluctuations over time, with labels for different currencies: Australian Dollar (AUD), Canadian Dollar (CAD), Swiss Franc (CHF), Swedish Krona (SEK), Euro (EUR), and Japanese Yen (JPY). The x-axis represents years from 1990 to 2004, and the y-axis shows currency values ranging from 40 to 160. Each currency line is color-coded for easy differentiation.]
Exchange Rates in Turkey

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Free float with CB intervention compatible with inflation target.
Monetary Model of Floating Exchange Rates

Assumptions:

1. Perfect foresight in labor markets, i.e. $P'(P) = 1$
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Definition

The equilibria in this economy is given by \((y, P)\) pairs such that \( AS=AD\) and where \( AD\) is given by \((y, P)\) pairs such that \( M^s = kPy = kSP^*y \) or \( S = \frac{M^s}{kP^*y} \)
Note that early quantity theory of money postulates that $M^s v = PY$ where $v$ is the velocity of money, defined as number of times one unit of money is spent to buy goods and services per unit of time, and $M^s$ is money in circulation. In other words an increase in money supply causes prices to rise (inflation) as they compensate for the decrease in money’s marginal value. The higher the velocity of money the higher the inflationary pressure caused by a money supply increase. This theory is problematic since velocity might also respond to changes in money supply. Keynes argued that $v$ decreases in response increases in money supply. Whether $v$ changes or not monetary model of exchange rates assumes that money demand is a function of nominal income and money supply is matches that when in equilibrium.

**Corollary**

Assumptions 1 $\rightarrow$ vertical AS, therefore $\frac{\Delta M^s}{M^s} = \frac{\Delta P}{P}$
Monetary Model of Floating Rates

\[ P = SP^* \]

\[ P_0 \]

under-competitive

\[ P > SP^* \]

over-competitive

\[ P < SP^* \]

\[ P_0 \]

\[ S_0 \]

\[ Y_0 \]

\[ AD \]

\[ AS \]
Theorem

A given percentage increase in domestic $M^s$ leads to a depreciation of the domestic currency at the same proportion
Monetary Model of Floating Rates

Theorem

A given percentage increase in domestic $M^s$ leads to a depreciation of the domestic currency at the same proportion.

Proof.

$M^s = kPy$, taking logs, $\ln M^s = \ln k + \ln P + \ln y$

taking derivatives: $\frac{dM^s}{M^s} = \frac{dP}{P} + \frac{dy}{y}$

but $\frac{dy}{y} = 0$ Since $Q = 1$, $P = SP^*$ and $\frac{dM^s}{M^s} = \frac{dS}{S} + \frac{dP^*}{P^*}$ and $\frac{dP^*}{P^*} = constant$
An increase in $M^s$ creates excess demand but $y$ is fixed so $P \uparrow$. Since PPP holds $S \uparrow$. Inflation and Depreciation.
Policy Analysis. An Increase in Real Income

\[ M^s = kPy. \] Since \( M^s \) is constant, \( P \downarrow \). If \( P \) were constant there will be an excess demand for money at \( b \). Since PPP holds, a decrease in domestic prices causes the currency to appreciate. Deflation, Appreciation.
Two Country Model

- \( M^s = kPy \) (home)
Two Country Model

- $M^s = kPy$ (home)
- $M^s^* = k^*P^*y^*$ (foreign)
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- $M^s = kPy$ (home)
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- $\frac{M^s}{M^s*} = \frac{kPy}{k^* P^* y^*}$

relative real money demand

Ozan Hatipoglu (Department of Economics)  Open Economy Macroeconomics  Spring 2018
Two Country Model

- $M_s = kPy$ (home)
- $M_{s*} = k^*P^*y^*$ (foreign)
- $\frac{M_s}{M_{s*}} = \frac{kPy}{k^*P^*y^*}$

Under PPP $\frac{P}{P^*} = S$ therefore
Two Country Model

- \( M_s = kPy \) (home)
- \( M_s^* = k^* P^* y^* \) (foreign)
- \( \frac{M_s}{M_s^*} = \frac{kPy}{k^* P^* y^*} \)
- Under PPP \( \frac{P}{P^*} = S \) therefore
- \( \frac{M_s}{M_s^*} = S \frac{ky}{k^* y^*} \)
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Under PPP \( \frac{P}{P^*} = S \) therefore

- \( \frac{M^s}{M^{s*}} = S \frac{ky}{k^*y^*} \)

\[ S = \left( \frac{k^*y^*}{ky} \right) \left( \frac{M^s}{M^{s*}} \right) \]

*relative real money demand* \quad *relative money supply*
Monetary Model of Fixed Rates

Assumptions:

1. $y, P^*$ given

Under fixed rates money supply is endogenous and since rates are fixed, given $\Delta M_s = \Delta FX + \Delta DC$, the only policy variable is $DC$. The adjustments are through changes in $FX$. $S$ is fixed by authorities.
Monetary Model of Fixed Rates

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2. Under fixed rates money supply is endogenous and since rates are fixed, given $\Delta M^s = \Delta FX + \Delta DC$, the only policy variable is $DC$. The adjustments are through changes in $FX$.

3. $\overline{S}$ is fixed by authorities.
An increase in DC will increase $M^s$ (and $P$ as a result of excess money supply), rendering domestic economy uncompetitive. There is a BOP deficit at A and reserves fall. As a result $M^s$ will decrease to its original level and so is $P$. 
Increase in Money Supply

- Demand:  \( M^d = kPy = k \bar{S} \bar{P^*}y \)
Increase in Money Supply

- **Demand:** \( M^d = kPy = k \bar{S} \bar{P^*}y \)
- **Supply:** \( M^s = FX + DC \)
Increase in Money Supply

- Demand: $M^d = kPy = k \bar{S} \bar{P}^* \bar{y}$
- Supply: $M^s = FX + DC$
- Equilibrium: $k \bar{S} \bar{P}^* \bar{y} = FX + DC$
Increase in Money Supply

- **Demand:** \( M^d = kPy = k \bar{S} \bar{P}^* \bar{y} \)
- **Supply:** \( M^s = FX + DC \)
- **Equilibrium:** \( k \bar{S} \bar{P}^* \bar{y} = FX + DC \)
- \( FX = k \bar{S} \bar{P}^* \bar{y} - DC \)
Increase in Money Supply

- Demand: \( M^d = kPy = k \overline{S} \overline{P^*y} \)
- Supply: \( M^s = FX + DC \)
- Equilibrium: \( k \overline{S} \overline{P^*y} = FX + DC \)
- \( FX = k \overline{S} \overline{P^*y} - DC \)

**Theorem**

*Under fixed exchange rates changes in domestic credit are neutralized by changes in reserves. Any change in domestic credit will change the composition of money supply.*
The above mechanism is an auto-stabilization, because reserves act as a buffer to equilibrium distortions.
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Suppose the authorities insist on increasing in $M^s$. They can do so by further increasing $DC$, to offset the effect of the decline in reserves.
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**Definition**

*Sterilization* is neutralizing the effects of BOP deficit(surplus) by creating (cancelling) extra domestic credit to offset the decrease(increase) in foreign reserves.
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**Definition**

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Q: Can sterilization work under fixed rate systems?
Domestic Income and Foreign Price Increase

Theorem

Under fixed rates, an increase in real income will increase reserves. Prices will return to PPP levels.
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Theorem
Under fixed rates, an increase in foreign prices will increase reserves. Prices will increase. A small open economy will import foreign inflation under this scenario.
Mundell-Fleming Model Assumptions

- A Short-Run (SR) Model. AS is flat. Prices are fixed:

\[ Q \sim B(Q, y) = X(Q) - M(Q, y) \approx X(S) - M(S, y) \]

Since prices are fixed, PPP does not necessarily hold

\[ m(y, r) = ky - lr \neq kPy \]

Interest rates do affect demand for money unlike the monetary model.

Exchange Rate expectations are static

Capital mobility is less than perfect:

\[ r \neq r^* \text{ in SR} \]

Non-zero Capital Account Balance in SR:

\[ K(r) = k(r - r^*) \text{ with } K' \geq 0, r^* \text{ exogenously given.} \]
Mundell-Fleming Model Assumptions

- A Short-Run (SR) Model. AS is flat. Prices are fixed:
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\[
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$(S, r)$ (call this FF curve) or $(y, r)$ plane also called the BP curve
Mundell-Fleming Model with Floating Rates

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\frac{\partial F(S, y, r)}{\partial S} > 0
\]
Mundell-Fleming Model with Floating Rates

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- \( \frac{\partial F(S, y, r)}{\partial S} > 0 \)
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\frac{\partial F(S, y, r)}{\partial S} > 0 \\
\frac{\partial F(S, y, r)}{\partial y} < 0 \\
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\]

and if interest rate parity condition holds true (UIRP) then \( \frac{\partial F(S, y, r)}{\partial r^*} < 0 \) (Capital Account dominates Current Account)
BOP eq. in Mundell-Fleming Model

\[ r = S_F \gamma (y) - A \]

\[ r = S_F (y_1 > y_0) \]

\[ r = S_F (y_0) \]

\[ y_0 \]

\[ CA \text{ deficit} \]

\[ CA \text{ surplus} \]

\[ BP(S_0) \]

\[ BP(S_1 > S_0) \]

OR

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Summary of Mundell-Fleming Assumptions

- An increase in $S$
Summary of Mundell-Fleming Assumptions

- An increase in $S$
  - IS shifts right, BP shifts right, FF does not shift,
Summary of Mundell-Fleming Assumptions

- An increase in $S$
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Summary of Mundell-Fleming Assumptions

- An increase in $S$
  - IS shifts right, BP shifts right, FF does not shift,
- An increase in $y$
  - BP does not shift, FF shifts right.
Summary of Mundell-Fleming Assumptions

- An increase in $S$
  - IS shifts right, BP shifts right, FF does not shift,
- An increase in $y$
  - BP does not shift, FF shifts right.
- If capital is perfectly mobile, BP and FF curves are flat.
Mundell-Fleming Model

\[ IS(S_0) \]
\[ LM(M_0) \]

\[ CA \text{ Eq: } B(y,s) = 0 \]
Increase in Money Supply (with floating rates)
Increase in Money Supply (with floating rates)

Consider the graphs illustrating the effects of an increase in the money supply with floating interest rates. The graphs depict the changes in the money market and the IS-LM model.

1. **Money Market Graph**
   - The money market equilibrium shifts from point A to point B as the money supply increases.
   - The interest rate adjusts from $r_0$ to $r_1$, and further to $r_2$.
   - The supply of money ($S$) and the demand for money ($S_1$) are illustrated.
   - The money demand function $FF(y)$ is shown.

2. **IS-LM Model Graph**
   - The IS curve shifts from $IS(S_0)$ to $IS(S_1)$ as a result of the money supply increase.
   - The LM curve, representing the relationship $LM(M)$, also shifts due to the change in money supply.
   - The BP curves $BP(S_0)$ and $BP(S_1)$ reflect the changes in the balance of payments.
   - The equilibrium point moves from $y^0$ to $y^1$ as the economy adjusts to the new money supply.

3. **Additional Graph**
   - The graph illustrates the constant sum $y^0 + y^1 = 2y^1$.
   - This equation is derived from the IS-LM model equations.

4. **Graph with 45° Line**
   - The 45° line represents the identity $y^1 = y^0$.
   - The graph shows the adjustment in output $y_1$ as the economy moves from $y_0$ to $y_1$.

These graphs demonstrate the dynamic effects of an increase in money supply on interest rates, output, and the balance of payments in an open economy.
An increase in $M_s$
Summary of Monetary Policy Intermediate Effects

- An increase in $M_s$
  - LM shifts right, real income $y \uparrow$. To have money market eq. $r$ also has to come down (see also Slide 315). Now, we have Capital account in addition to only Current Account in slide 315.
An increase in $M_s$

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- As a result: $y \uparrow, r \downarrow \Rightarrow F(S, y, r) < 0$ because $K(r) \downarrow$ (capital account deficit) and $B(S, y) \downarrow$ (current account deficit).
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- To retain BOP eq. $S \uparrow$
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- To retain BOP eq. $S \uparrow$
- If $S \uparrow$ then $S(y, r) - I(r) < (G - T) + B(S, y)$ So IS shifts right such that $r \uparrow$ to bring the capital account deficit down.
An increase in $M_s$

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- If $S \uparrow$ then $S(y, r) - I(r) < (G - T) + B(S, y)$ So IS shifts right such that $r \uparrow$ to bring the capital account deficit down.
- The adjustment through the goods market (i.e private surplus($S(y, r) - I(r)$) (or deficits) not being matched by injections (or leakages) causes an increase in $r$ and the mismatch is eliminated) prevents a steep decrease in $r$ (i.e. $r \rightarrow r_2$ and $r_2 > r_1$)
An increase in $M_s$
Summary of Monetary Policy Final Effects

- An increase in $M_s$
  - a depreciation of the currency
Summary of Monetary Policy Final Effects

- An increase in $M_s$
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  - increase in real income
Summary of Monetary Policy Final Effects

- An increase in $M_s$
  - a depreciation of the currency
  - increase in real income
  - decrease in domestic interest rates assuming capital is not perfectly mobile

How about the effects of monetary policy if there is perfect capital mobility?
Summary of Monetary Policy Final Effects

- An increase in $M_s$
  - a depreciation of the currency
  - increase in real income
  - decrease in domestic interest rates assuming capital is not perfectly mobile
  - improvement in current account and a deterioration in capital account, no effect on BOP eq.
An increase in $M_s$
- a depreciation of the currency
- increase in real income
- decrease in domestic interest rates assuming capital is not perfectly mobile
- improvement in current account and a deterioration in capital account, no effect on BOP eq.

How about the effects of monetary policy if there is perfect capital mobility?
Fiscal Expansion with floating rates

\[ r_f(y_0) \]

\[ S \]

\[ y^0 \]

\[ IS(S_0) \]

\[ LM(M_0) \]

\[ BP(S_0) \]

\[ y^0 \]

\[ r \]

\[ y \]

\[ S \]

\[ S_0 \]

\[ y^0 \]

\[ 45^\circ \text{ line} \]

\[ CA \ Eq: B(y, s) = 0 \]

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Fiscal Expansion with floating rates

\[ IS(G_0, S_0) \]
\[ LM(M_0) \]
\[ BP(S_0) \]
\[ IS(G_1, S_0) \]

45° line

CA Eq: \( B(y, s) = 0 \)
Fiscal Expansion with floating rates

\[ S = S_0 \]

\[ IS(G_0, S_0) \]

\[ LM(M_0) \]

\[ y = y_0 \]

\[ 45^\circ \text{ line} \]

\[ CA \text{ Eq: } B(y, s) = 0 \]
An increase in $G$
Summary of Fiscal Policy Intermediate Effects

- An increase in $G$
  - IS shifts right, since AS is flat, real income $y \uparrow$. To have money market eq. $r$ has to increase since money supply is fixed. $r$ has to increase due to higher equilibrium borrowing requirement of the government.

- As a result: $y \uparrow, r \uparrow \Rightarrow$ capital account surplus ($K(r) \uparrow$) and a current account deficit ($B(S, y) \downarrow$). Since funds flows much faster than goods and services it must be the case that $K(r) > B(S, y)$ such that $F(S, y, r) > 0$.

- To retain BOP eq. $S \downarrow$.
  - If $S \downarrow$ then $S(y, r) - I(r) > (G - T) + B(S, y)$ so IS shifts left such that $r \downarrow$ to bring the capital account surplus down.

The adjustment through the goods market prevents a steep increase in $r$ (i.e. $r \rightarrow r_2$ and $r_2 < r_1$).
Summary of Fiscal Policy Intermediate Effects

- An increase in $G$
  
  - IS shifts right, since AS is flat, real income $y \uparrow$. To have money market eq. $r$ has to increase since money supply is fixed. $r$ has to increase due to higher equilibrium borrowing requirement of the government.
  
  - As a result: $y \uparrow, r \uparrow \Rightarrow$ A capital account surplus ($K(r) \uparrow$) and a current account deficit ($B(S, y) \downarrow$). Since funds flows much faster than goods and services it must be the case that $K(r)$ dominates $B(S, y), K(r_1) > B(S, y_1)$ such that $F(S, y, r) > 0$
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A summary of Fiscal Policy Intermediate Effects

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- An increase in $G$
Summary of Fiscal Policy Final Effects

- An increase in $G$
  - an appreciation of the currency
Summary of Fiscal Policy Final Effects

- An increase in $G$
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  - increase in real income
Summary of Fiscal Policy Final Effects

- An increase in $G$
  - an appreciation of the currency
  - increase in real income
  - increase in domestic interest rates assuming capital is not perfectly mobile
Summary of Fiscal Policy Final Effects

- An increase in $G$
  - an appreciation of the currency
  - increase in real income
  - increase in domestic interest rates assuming capital is \textbf{not} perfectly mobile
  - improvement in capital account and a deterioration in current account, no effect on BOP in eq.
An increase in $G$

- an appreciation of the currency
- increase in real income
- increase in domestic interest rates assuming capital is not perfectly mobile
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- crowding out of private investment $I(r) \downarrow$
Summary of Fiscal Policy Final Effects

- An increase in $G$
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  - increase in domestic interest rates assuming capital is not perfectly mobile
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  - crowding out of private investment $I(r) \downarrow$

- How about the effects of fiscal policy if there is perfect capital mobility?
Mundell-Fleming: Increase in Money Supply (with fixed rates)
$M_s \uparrow$: In SR a fall in $r$ and an increase in real income, $y$. Since $F(r) < 0$ and $B(S, y) < 0$ there is a BOP deficit.
Summary of Monetary Policy Effects: with Fixed Rates

- $M_s \uparrow$: In SR a fall in $r$ and an increase in real income, $y$. Since $F(r) < 0$ and $B(S, y) < 0$ there is a BOP deficit.
- Since $S$ is fixed the CB has to sell $FX$ to counter the flight from domestic currency. And LM shifts back. Decrease in $FX$, no change in $r, y$ or $S$. 
Fiscal Expansion with fixed rates

\[ S(r, y_0) \]

\[ A \]

\[ y^0 \]

\[ S_0 \]

\[ IS(S_0) \]

\[ LM(M_0) \]

\[ BP(S_0) \]

\[ CA \text{ Eq: } B(y, s) = 0 \]

\[ 45^\circ \text{ line} \]
Fiscal Expansion with fixed rates

\[ S(y_0) \]

\[ FF(y_0) \]

\[ IS(G_0) \]

\[ LM(DC_0, FX_0) \]

CA Eq: \( B(y, s) = 0 \)

45° line

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Fiscal Expansion with fixed rates

\[ S(y) \]

\[ IS(G_0) \]

\[ LM(DC_0, FX_0) \]

CA Eq: \( B(y,s) = 0 \)

45° line

Y0 Y1 Y2

\[ r \]

\[ y \]
Summary of Fiscal Policy Effects

- $G \uparrow$: an increase in $r$ and an increase in real income, $y$. $F(r) > 0$ and $B(S, y) < 0$. In SR capital account dominates current account and there is a BOP surplus.
Summary of Fiscal Policy Effects

- $G \uparrow$: an increase in $r$ and an increase in real income, $y$. $F(r) > 0$ and $B(S, y) < 0$. In SR capital account dominates current account and there is a BOP surplus.

- Since $S$ is fixed the CB has to buy $FX$ to counter the effects of hot money inflows. (i.e. to prevent appreciation) And LM shifts right (Increase in $FX$) $r$ decreases and $y$ increases even further deteriorating CA deficit even more.
Summary of Fiscal Policy Effects

- \( G \uparrow \): an increase in \( r \) and an increase in real income, \( y \). \( F(r) > 0 \) and \( B(S, y) < 0 \). In SR capital account dominates current account and there is a BOP surplus.

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- Higher \( r \), higher \( y \), BOP eq, significant \( CA \) deficit.
Impulse Response Functions (M-F model: Mont. Policy with floating Rates)

- **Graphs:**
  - **Graph 1:**
    - $r_t$: Interest Rate
    - $y_t$: Income
    - $s_t$: Savings
    - Initial values: $r_0, y_0, s_0$
    - Y-axis: $r, y, s$
  - **Graph 2:**
    - $r_t$: Interest Rate
    - $y_t$: Income
    - $s_t$: Savings
    - Initial values: $r_0, y_0, s_0$
    - Y-axis: $r, y, s$

- **Variables:**
  - $y$: Income
  - $r$: Interest Rate
  - $s$: Savings
  - $S$: Spreads
  - $CA, CPA$: Current Account, Capital Account

- **Equations:**
  - $y_t = f(r_t, s_t)$
  - $s_t = g(r_t, y_t)$
  - $CA, CPA_t = h(r_t, s_t)$

- **Interpretation:**
  - The graphs illustrate the dynamic responses of income, interest rates, and savings to shocks in the M-F model with monetarist policy and floating rates.
  - The initial conditions and the paths of the variables are shown over time ($t$).

- **Instructor:** Ozan Hatipoglu (Department of Economics)
1) Draw the impulse response functions of domestic Current Account, Capital Account, interest rates \( r \), real income \( y \), nominal exchange rates, \( S \) and FX reserves of the Central Bank when there is
   i) A positive fiscal shock in Mundell-Fleming Model (M-F) with floating rates
   ii) A positive fiscal shock in M-F model with fixed rates
   iii) A negative money supply shock in Mundell-Fleming Model with fixed rates
   iv) An increase in foreign interest rate in M-F model with fixed rates
   v) A negative aggregate supply shock foreign interest rate in M-F model with fixed rates and floating rates
   vi) Come up with one modern scenario for what might constitute the shock in each i)-v). Example: iv) ECB does not give in to currency wars and competitive devaluation with China and continues to sell bonds raising fears of recession.
   vii) How should a domestic central bank respond to the following in a floating exchange rate regime if it prefers inflation prevention to growth in M-F model.
     - A world interest rate increase
     - A negative supply shock
     - An inflow of funds maybe due to an IS disequilibrium in a large foreign country.
     - An outflow of hot money due to political risk.
   vii) Redo vi) if the central bank prefers growth and employment over inflation.
Some weaknesses of preceding models:
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- Monetary Model: exchange rates are far more volatile than monetary variables (and prices) than implied by data
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Dornbusch Model

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- Short run properties of Keynesian models
Some weaknesses of preceding models:

- Monetary Model: exchange rates are far more volatile than monetary variables (and prices) than implied by data
- M-F Model: with fixed prices policy conclusions are valid only in short run,

Dornbusch (1976) hybrid:

- Short run properties of Keynesian models
- Long run properties of Monetary Model
Empirical observation: financial markets adjust to shocks far more rapidly than goods markets. Exchange rates fluctuations more violent than could be explained by movements in relative real money supplies or real incomes that are rather sluggish.
Dornbusch Model

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- Consequence for modeling: in the short run, financial markets have to overadjust in order to compensate for sluggish goods markets. For example exchange rates overshoot.
Empirical observation: financial markets adjust to shocks far more rapidly than goods markets. Exchange rates fluctuations more violent than could be explained by movements in relative real money supplies or real incomes that are rather sluggish.

Consequence for modeling: in the short run, financial markets have to overadjust in order to compensate for sluggish goods markets. For example exchange rates overshoot.

Why? With prices fixed in the short run, and any change in the nominal money is a change in real money supply and requires the interest rate to adjust to clear the money market, because output is also fixed in the very SR. (Liquidity Effect).
However, deviations from the world interest rate is only temporary (UIRP holds). As product prices adjust, real money stock reverses itself, in fact the whole process goes into reverse.

Exchange rate expectations are not static. If exchange rates below its long run equilibrium value it will up towards it. It will converge faster the further away (to LR equilibrium value) it is at any moment.

Dornbusch model further offers a specific way of determining exchange rate expectations as explained below.
Dornbusch Model

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Dornbusch Model Assumptions

- Small open economy (so $P^*$, $r^*$ exogenous)
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Theorem

Investors' exchange rate expectations formed adaptively, i.e. by 

$$\Delta S_e^t = \theta (S - S_t)$$

where $\theta > 0$ is the sensitivity of market expectations to over- or undervaluation of currency from equilibrium level, $S$, therefore UIRP can be written as $r = r^* + \theta (S - S_t)$. 

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**Theorem**

Investors’ exchange rate expectations formed adaptively i.e. by $\Delta S^e_t = \theta(\bar{S} - S_t)$ where $\theta > 0$ is the sensitivity of market expectations to over- or undervaluation of currency from equilibrium level, $\bar{S}$, therefore UIRP can be written as $r = r^* + \theta(\bar{S} - S_t)$. 
Dornbusch Model: Expectations

If $S_t > \bar{S}$ then $\Delta S_t^e < 0$ and if $S_t < \bar{S}$ then $\Delta S_t^e > 0$. A tendency for appreciation today induces expectations of depreciation in the future, back toward long-run equilibrium. LR equilibrium is determined by both PPP and UIRP. (Regressive expectations. Supported by data)

![Graphs showing the relationship between exchange rate and interest rate under different conditions.](image-url)
Dornbusch Model

\[
\begin{align*}
S & \rightarrow r \\
\bar{S}^0 & \rightarrow P \\
P & \rightarrow \bar{Q}_0 = SP_0^* / P \\
S_0 & \rightarrow p^0
\end{align*}
\]

\[
\begin{align*}
\text{S} & \rightarrow r \\
\text{IS}(G_0, Q_0) & \rightarrow y \\
\text{LM}(M^0 / P^0) & \rightarrow r \\
\text{AD}(G_0, M_0, \bar{S}_0 P^*_0) & \rightarrow y
\end{align*}
\]
Dornbusch Model: Monetary Expansion

![Graph showing the Dornbusch Model](image)

- **Monetary Expansion**
  - LM (M₀/P₀)
  - IS(G₀, Q₀)
  - IS(G₀, Q₁)

- **Price Level**
  - Q₀ = SP₀^* / P

- **Nominal Interest Rate**
  - R₀
  - R₁

- **Real Interest Rate**
  - R₀^*
  - R₁^*

- **Output**
  - Y₀
  - Y₁

- **Policies**
  - AD(G₀ M₀ S₀₁ P₀^*)
  - AD(G₀ M₀ S₀₁ P₀^*)

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Long Run effects:

- AS is vertical which means that in LR there is no change in eq. real income $y_0$ and $P \uparrow$ such that to accommodate the increase in money supply such that we have eq in both money (an increase in money demand to match the increase in money supply) and goods markets (an increase in interest rates $r$ starting from the initial lower rates that result from an increase in $M_s$).

- In LR PPP holds, i.e. $Q = \frac{SP}{P}$, since prices are higher therefore $S \uparrow$ in the long run.

- RP curve shifts right.

- We have current account equilibrium due to adjustment of CPA and PPP.
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We have current account equilibrium due to adjustment of \( CPA \) and \( PPP \).
Impact Effects:

$$r \downarrow (\text{liquidity effect})$$

Starting from

$$r = r^* + \theta (S_0 - S_t)$$

where $$r_1 < r_0$$. And due to LR effects on prices we have

$$S \uparrow, S_0 \rightarrow S_1$$

where $$S_1 > S_0$$. As a result

$$r_1 < r^* + \theta (S_1 - S_t)$$

It must be the case that current exchange rate $$S_t > S_1$$, to have interest rate parity equilibrium immediately. e. even higher than the long-run depreciated rate. This is called **overshooting**. It results in over-competitiveness at least in SR.
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Impact Effects:
- \( r \downarrow \) (liquidity effect)
- \( S \uparrow \): Starting from \( r = r^* + \theta(\bar{S}_0 - S_t) \), \( r \downarrow \), \( r_0 \to r_1 \) where \( r_1 < r_0 \). And due to LR effects on prices we have \( S \uparrow \), \( \bar{S}_0 \to \bar{S}_1 \) where \( \bar{S}_1 > \bar{S}_0 \). As a result \( r_1 < r^* + \theta(\bar{S}_1 - S_t) \). It must be the case that current exchange rate \( S_t > \bar{S}_1 \), to have interest rate parity equilibrium immediately, e. even higher than the long-run depreciated rate. This is called overshooting. It results in over-competitiveness at least in SR.
Dornbusch Model: Monetary Expansion Impact Effects

- $LM$ and $IS$ shifts right.

Note that $Q_1 = S_p^* p$ is higher initially because the $S$ rises and overshoots its new long-run equilibrium value $\bar{S}_1$, even though $P$ is fixed. This shifts the $IS$ curve right.

As prices adjust, i.e. the supply curve becomes positively sloped, $P$ rises. At the same time $S$ falls from its initial overshooting position to reach its new long-run equilibrium value, $\bar{S}_1$. So both $P$ and $S$ make sure $Q = 1$ again (PPP holds).
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- Note that \( Q_1 = \frac{S^* p}{p} \) is higher initially because the \( S \uparrow \) and overshoots its new long-run eq. value \( \bar{S}_1 \), even though \( P \) is fixed. This shifts the IS curve right.
\begin{itemize}
  \item LM and IS shifts right.
  \item Note that \( Q_1 = S \frac{p^*}{p} \) is higher initially because the \( S \uparrow \) and overshoots its new long-run eq. value \( \bar{S}_1 \), even though \( P \) is fixed. This shifts the IS curve right.
  \item As prices adjust, i.e. supply curve becomes positively sloped, \( P \uparrow \). At the same time \( S \downarrow \) from its initial overshooting position to reach its new long-run equilibrium value, \( \bar{S}_1 \). So both \( P \uparrow \) and \( S \downarrow \) (after overshooting) make sure \( Q = 1 \) again (\( PPP \) holds).
\end{itemize}
Adjustment Effects:

- Prices start to increase as workers adjust their expectations.

Inflation starts to shift the LM back. At the same time, because of inflation, the real exchange falls, which starts to shift the IS curve back.

As real money stock falls, interest rates rise, reducing the money demand which leads to an appreciation of the domestic currency up to the new equilibrium.

As the domestic currency falls further, IS shifts further back, and AD shifts back but still to the right of the original. Real income returns to its original level, but prices remain higher.
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Adjustment Effects:

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- \( AD \) shifts back but still to the right of the original.
- Real income back to its original level, \( y_0 \) but prices remain higher.
Dornbusch Model

\[ IS(G_0, Q_0) \]

\[ IS(G_0, Q_1) \]

\[ AS(SR) \]

\[ AS(LR) \]

\[ P \]

\[ P^0 \]

\[ P^1 \]

\[ r \]

\[ r_0 \]

\[ r_1 \]

\[ y \]

\[ y^0 \]

\[ y^1 \]

\[ \bar{Q}_0 = SP^*_0 / P \]

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\[ 45^0 \text{ line} \]

\[ AD(G_0, M_0, S_0P^*_0) \]

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3. Find out how variables above adjust as AS becomes vertical. (Adjustment Phase)
How do people diversify their portfolios?
Portfolio Balance Model: Assumptions

- How do people diversify their portfolios?
- Risk aversion: How do people choose between two assets with different returns and risks.
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Risk aversion: How do people choose between two assets with different returns and risks.

With utility maximization investors diversify their holdings of risk assets.
Demand for money generalised to demand for assets i.e. proportions of wealth allocated to three markets
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Risk aversion

Investors diversify their holdings of risk assets. Portfolio share of a particular asset will increase as its return relative to competing assets increase.
Portfolio Balance Model: Assumptions

- Imperfect capital mobility (as in M-F), so risk aversion prevents UIRP

Current account surplus/deficit $\rightarrow$ capital in/outflow + increasing/decreasing stock of FX assets + changing equilibrium wealth allocation
Portfolio Balance Model: Assumptions

- Imperfect capital mobility (as in M-F), so risk aversion prevents UIRP
- Sticky prices (as in Dornbusch), so balance of payments in temporary disequilibrium

Current account surplus/deficit → capital in/outflow + increasing/decreasing stock of FX assets + changing equilibrium wealth allocation


- $\overline{M}, \overline{B}$ are exogenous (issued by domestic government)

- $r^*$ is exogenous (set in the rest of the world)

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Domestic investors hold foreign assets, but not vice versa i.e. foreigners hold no domestic assets.
Portfolio Balance Model: Assumptions

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- Other forms of wealth (e.g. equity, human capital) can be ignored: all wealth is allocated to money, domestic or foreign bonds.
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- Other forms of wealth (e.g. equity, human capital) can be ignored: all wealth is allocated to money, domestic or foreign bonds.
- Bonds short term – so capital gains/losses resulting from interest rate changes are negligible.
Risk averse agents will take account of both risk and return, diversifying their asset portfolio to attain best (i.e. utility-maximising) risk-return combination.
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- Given risks associated with each asset class, small increase in return on asset $j$ (relative to competing assets) increases demand for $j$.
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- Given risks associated with each asset class, small increase in return on asset $j$ (relative to competing assets) increases demand for $j$.
- Given wealth is fixed in short run, increase in demand for $j$ implies fall in demand for other assets cet par.
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- $\frac{SF}{W} = f(r, r^* + \Delta s^e)$, $f_1 < 0, f_2 > 0$, 

In SR, $W$ is constant $\Rightarrow m_1 + b_1 + f_1 = 0$ and $m_2 + b_2 + f_2 = 0$. 

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Open Market Purchase of Dom. Bonds

- Buy domestic bonds $\rightarrow$ excess supply of money and excess demand for bonds. Price of bonds $\uparrow$ and rates $\downarrow$. Foreign assets become more attractive: $S \uparrow$. How about open market purchase of foreign bonds? how about an increase in the stock of FX assets?
Portfolio Balance Model: Long Run Effects

- Similar to monetary model
Portfolio Balance Model: Long Run Effects

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- i.e. rate of inflation = percentage change in money supply
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Portfolio Balance Model: Long Run Effects

- Similar to monetary model
- i.e. rate of inflation = percentage change in money supply
- but rate of depreciation < percentage change in money supply. Why?
- Impact effect: $S\uparrow$ but prices are constant in SR. Therefore there is real depreciation and current account surplus. A rising foreign currency stock implies appreciation. And in the adjustment phase prices increase reducing competitiveness, but CA surplus remains until long run.
Differences in risk between foreign and domestic asset are caused by:

- Tax treatment,
- Default risk,
- Political risk,
- Inflation risk,
- Exchange rate risks,
- Business cycle risks.
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Determinants of Risk Premium

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    - There is no perfect capital mobility
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Money vs. Bonds vs. Shares

- Money is a low risk asset in the short run. The associated risks are:
  - Inflation risk.
  - Price risk (if one buys and sells on a secondary market).
  - Default risk.

- Bonds are low risk assets.

- Shares are high risk assets: The associated risks are:
  - Dividend Risk
  - Price Risks (Market Risks)
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A simple model

Assume investor can invest in two assets: Money or bonds. Assume money is riskless and bonds are risky. Bonds pay a return of $i$ on the capital invested at the maturity. Let $\gamma$ be the share of the individual’s portfolio invested in bonds. Let $\pi$ be the capital gain (or loss), i.e. gain obtained by changes in the price of the bond. The rate of return, $r$ on the portfolio is given by

$$r = \gamma (i + \pi)$$

Assume $E(\pi) = 0$ then $E(r) = E(\gamma (i + \pi)) = \gamma E(i) = \gamma i$ because $i$ is fixed at the maturity.

The variance of the rate of the return on bonds

$$E(r - E(r))^2 = \sigma_r^2$$

because $r - E(r) = \gamma \pi$ and $(r - E(r))^2 = \gamma^2 \pi^2$.
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- \( U(r) = E(r) - \frac{1}{2} \rho \text{var}(r) \) where \( \rho \) is the relative risk aversion given the relative return-riskiness of asset, i.e. \( \frac{E(r)}{\sigma_r} = \frac{\gamma i}{\gamma \sigma_\pi} = \frac{i}{\sigma_\pi} \)
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A simple model: Domestic vs. foreign bonds.

\[ r = (1 - \gamma)(\pi + i) + \gamma(\pi^* + i^*) \]
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- If \( \sigma_{\pi,\pi^*} < 0 \) Capital loss in one asset is offset by the other reducing overall risk.
- If \( \sigma_{\pi,\pi^*} > 0 \) Capital loss in one asset is reinforced by the other
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Empirical evidence \( \sigma_{\pi, \pi^*} \) is lower than the covariance between domestic assets which implies that international diversification reduces the riskiness of portfolios.
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- Empirical evidence $\sigma_{\pi,\pi^*}$ is lower than the covariance between domestic assets which implies that international diversification reduces the riskiness of portfolios.
- If $\sigma_{\pi}^2 = \sigma_{\pi^*}^2$, then $\sigma_{r}^2 = 2\gamma(1-\gamma)\sigma_{\pi,\pi^*}$.
Consider the following standard present value model with risk neutral agents:

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P_t = \frac{1}{1 + r_t} E_t (P_{t+1} + d_t)
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\(P_t\) : the real stock price at time \(t\)

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\[ P_t = \left( \frac{1}{1+r_t} \right)^2 E_t(P_{t+2} + D_{t+2}) + \frac{1}{1+r_t} D_t = \ldots \]

\[ = \sum_{i=0}^{\infty} \left( \frac{1}{1+r_t} \right)^i E_t D_{t+i} + \lim_{i \to \infty} \left( \frac{1}{1+r_t} \right)^i E_t (P_{t+i}) \quad (1) \]
Intrinsic Rational Bubbles

If the transversality conditions hold, i.e. \( \lim_{i \to \infty} \left( \frac{1}{1 + r_t} \right)^i E_t(P_{t+i}) = 0 \) or if \( E_t(P_{t+i})/P_t \leq 1 + r_t \) then \( P_t = \sum_{i=0}^{\infty} \left( \frac{1}{1 + r_t} \right)^i E_t D_{t+i} \).
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Uncertainty about fundamentals: \( \sum_{i=0}^{\infty} \left( \frac{1}{1+r_t} \right)^i E_t D_{t+i} \). Froot and Obstfeld (1991) assumption of a constant random walk with drift is shown to be invalid by Driffill and Sola (1998).
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- For each time the hypothesis of bubbles is not rejected, there might be other fundamental processes that explain the price volatility.
Intrinsic Rational Bubbles

**Figure**: Prices and bubble percentages: USA.
Intrinsic Rational Bubbles

Figure: Prices and bubble percentages: Turkey.
Figure: Prices and bubble percentages: World.
Intrinsic Rational Bubbles

Figure: Crises in US.
Intrinsic Rational Bubbles

Figure: Crises in Turkey.