Intermediate Macroeconomics, EC2201

L9: Exchange rates

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Spring 2018
Contents and literature

- Purchasing power parity.
- The monetary approach to the exchange rate.
- The Balassa-Samuelson effect.
- Exchange rate regimes.
- A very brief introduction to the Eurozone crisis.

Road map

- Lecture 8 (last time): an introduction to the open economy.
  - The exchange rate in the short run: Interest Rate Parity.
  - Exchange-rate concerns in the AS-AD model.

- Lecture 9 (today): topics in exchange rate determination.
  - The exchange rate in the long run.
  - Exchange rate regimes.
The exchange rate over different horizons

- The exchange rate in the long run:
  - Purchasing Power Parity.
  - The monetary approach to the exchange rate.
  - The Balassa-Samuelson effect.

- The exchange rate in the short run:
  - Interest Rate Parity.

- The exchange rate in the very short run:
  - Exchange rate overshooting (Dornbusch, 1976).
The exchange rate over different horizons cont’d.

- Short run: asset-market approach.
- Long run: goods-market approach.
Purchasing Power Parity (PPP)

- Theory of long-run exchange rate determination.
- Stresses the importance of goods markets.
- Developed by Swedish economist Gustaf Cassel (1866-1945).
Notation

$E_t$: the nominal exchange rate expressed in units of foreign currency per unit of domestic currency (€/SEK).

$P_{it}$: domestic price of good $i$ in SEK.

$P^*_{it}$: foreign price of good $i$ in €.

$P_t$: domestic aggregate price index.

$P^*_t$: foreign aggregate price index.

$\pi_t$: domestic inflation.

$\pi^*_t$: foreign inflation.
PPP based on the notion of the law of one price for individual goods.

The law of one price for a single good $i$:

$$P^*_it = E_t P_{it} \iff E_t = \frac{P^*_it}{P_{it}}.$$  \hspace{1cm} (1)
Absolute and relative PPP

Absolute PPP:

\[ E_t = \frac{P^*_t}{P_t}. \]  \hspace{1cm} (2)

Relative PPP:

\[ \frac{E_t - E_{t-1}}{E_{t-1}} = \pi^*_t - \pi_t, \]  \hspace{1cm} (3)

where

\[ \pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}. \]  \hspace{1cm} (4)
The monetary approach to the exchange rate

Given that PPP is a good approximation of nominal exchange rates in the long run, how are long-run prices determined?

Let \( M/P \) denote the real money supply, \( i \) the interest rate, \( Y \) income and \( L \) the money demand function.

Money-market equilibrium suggests:

\[
\frac{M}{P} = L(i, Y),
\]  

(5)

Solving for the price level in (5), we obtain:

\[
P = \frac{M}{L(i, Y)}.
\]  

(6)
Assuming that PPP holds, as suggested by (2), and that foreign prices also are determined by (6), we obtain:

\[
E = \frac{P^*}{P} = \frac{M^*}{M} \frac{L(i, Y)}{L(i^*, Y^*)}.
\]

Equation (7), suggests that a permanent increase in the relative money supply, \(M/M^*\), causes a nominal depreciation.
Causes of deviations from PPP

- Transportation costs and trade barriers.
- Differences in consumption baskets.
- Imperfect competition, price discrimination.
- Two types of goods and services: tradables and non-tradables.
## The Big Mac Index

<table>
<thead>
<tr>
<th>Country</th>
<th>Big Mac price in local currency</th>
<th>Exchange rate per dollar ($)</th>
<th>Big Mac price in dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>4.93 dollars</td>
<td>1.00 dollars/$</td>
<td>4.93</td>
</tr>
<tr>
<td>Norway</td>
<td>46.80 kroner</td>
<td>8.97 kroner/$</td>
<td>5.22</td>
</tr>
<tr>
<td>Euro area</td>
<td>3.72 euros</td>
<td>0.93 euros/$</td>
<td>4.00</td>
</tr>
<tr>
<td>Japan</td>
<td>370.00 yen</td>
<td>118.65 yen/$</td>
<td>3.12</td>
</tr>
<tr>
<td>Mexico</td>
<td>49.00 pesos</td>
<td>17.44 pesos/$</td>
<td>2.81</td>
</tr>
<tr>
<td>China</td>
<td>17.60 yuan</td>
<td>6.56 yuan/$</td>
<td>2.68</td>
</tr>
<tr>
<td>Russia</td>
<td>114.00 rubles</td>
<td>74.66 rubles/$</td>
<td>1.53</td>
</tr>
<tr>
<td>South Africa</td>
<td>28.00 rand</td>
<td>15.81 rand/$</td>
<td>1.77</td>
</tr>
<tr>
<td>India</td>
<td>127.00 rupees</td>
<td>66.80 rupees/$</td>
<td>1.90</td>
</tr>
</tbody>
</table>

*Source: www.economist.com/content/big-mac-index (January 2016).*

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The Balassa-Samuelson effect

- Theory of how relative prices across countries are affected by productivity differences across countries.
- Stems from a two sector model where some goods are tradables and some are non-tradables.
- Interesting predictions for relative prices, inflation rates across countries and real exchange rates.
Notation

\( E \): the nominal exchange rate expressed in \( \text{€}/\text{SEK} \).

\( P_T \): price of tradables in SEK.

\( P_T^* \): price of foreign tradables in \( \text{€} \).

\( P \): domestic aggregate price index.

\( P^* \): foreign aggregate price index.

\( A_T \): productivity in the tradables sector.

\( A_N \): productivity in the non-tradables sector.

\( L_T \): labour input in the tradables sector.

\( L_N \): labour input in the non-tradables sector.

\( W_T \): nominal wage in the tradables sector.

\( W_N \): nominal wage in the non-tradables sector.
The Balassa-Samuelson effect

Consider a small open economy, consisting of a tradables sector, indexed $T$, and a non-tradables sector, indexed $N$.

The law of one price holds for traded goods, so that:

$$P^*_T = E P_T.$$  \hspace{1cm} (8)

The aggregate price level, $P$ is given by:

$$P = P_T^\alpha P_N^{1-\alpha},$$  \hspace{1cm} (9)

where $\alpha \in (0,1)$. 

Production

Production in sector \( j \), is given by \( Y_j = A_j L_j \).

Letting \( W_j \) denote the wage, profits in sector \( j \) are given by

\[
\Pi_j = P_j A_j L_j - W_j L_j. \tag{10}
\]

On perfectly competitive markets:

\[
A_T = \frac{W_T}{P_T}, \tag{11}
\]

and

\[
A_N = \frac{W_N}{P_N}. \tag{12}
\]
The relative price, $P_N/P_T$

An assumption of perfect labour mobility across sectors implies:

$$W_N = W_T. \quad (13)$$

Let us solve for $P_N/P_T$. Dividing (11) by (12) implies:

$$\frac{A_T}{A_N} = \frac{W_T/P_T}{W_N/P_N} = \frac{P_N}{P_T}, \quad (14)$$

where the last equality follows from imposing $W_N = W_T$ according to (13).
The equilibrium price level, $P$

Equation (8) implies: $P_T = P_T^*/E$.

Equation (14) implies: $P_N = P_T A_T / A_N$.

Plugging in the expression for $P_N$ in (9):

$$P = P_T^\alpha \left( \frac{A_T}{A_N} P_T \right)^{(1-\alpha)} = \left( \frac{A_T}{A_N} \right)^{(1-\alpha)} P_T. \quad (15)$$
Consider equation (15).

\( P_T \) is determined by the law of one price, implying that \( P \) is driven by the productivity ratio, \( A_T/A_N \).

Productivity in the non-tradeables sector, \( A_N \), tends to be the roughly the same across countries.

Productivity in the tradeables sector, \( A_T \), the main determinant of the aggregate price level.
Why is this interesting?

Productivity *levels* in the tradables sector, $A_T$, tends to be higher in rich countries than in poor countries.

Productivity *growth* in the tradables sector, the change in $A_T$, tends to be higher in poor countries than in rich countries.

The Balassa-Samuelson effect predicts:

- When expressed in the same currency, price levels should be higher in rich countries than poor countries.
- If the nominal exchange rate is held constant, inflation should be higher in poor countries than in rich countries.
Implications for the real exchange rate

Recall the definition of the real exchange rate from lecture 8:

\[ Q = \frac{EP}{P^*}. \]  \hspace{1cm} (16)

Suppose that the above model applies also to the foreign country so that:

\[ P^* = \left( \frac{A^*_T}{A^*_N} \right)^{(1-\alpha)} P_T^*. \]  \hspace{1cm} (17)

Plugging in the price levels (15) and (17) in (16), we obtain:

\[ Q = \frac{\left( A_T / A_N \right)^{(1-\alpha)} EP_T}{\left( A^*_T / A^*_N \right)^{(1-\alpha)} P_T^*}. \]  \hspace{1cm} (18)
Implications for the real exchange rate

Imposing (8) on (18) and simplifying:

\[ Q = \left( \frac{A_T/A_N}{A_T^*/A_N^*} \right)^{1-\alpha}. \]  

(19)

Recalling that \( A_N \approx A_N^* \), the main determinant of \( Q \) is \( A_T/A_T^* \).

Countries with high productivity growth should experience real appreciations.
Fig. 20.3

The Real Exchange Rate for Japan
Index (value in 1971 = 100)

The Balassa-Samuelson effect: summary

1. When expressed in the same currency, price levels should be higher in rich countries than poor countries.

2. If the nominal exchange rate is held constant, inflation should be higher in poor countries than in rich countries.

3. Real exchange rates driven by relative productivity in the tradables sectors across countries: fast-growing countries should experience real appreciations.
So far today we discussed how exchange rates are determined in the long run.

Next: exchange rate regimes.

To understand why fixed exchange rates (or a monetary union) might be deemed desirable, let us digress and briefly revisit the short run.
Fig. 20.1

The U.S. Exchange Rate versus the Yen and the Euro

Yen per dollar (left scale)
Euros per dollar (right scale)

Year

Exchange rate volatility

- Nominal exchange rates are extremely volatile in the short run.
- Exchange rates seem to overreact in response to policy changes or other shocks: they overshoot their new long-run equilibrium values.
- In Dornbusch (1976) this is a consequence of price rigidity. For a simplified exposition, see Klein (2017e).
- Volatility may discourage trade and be harmful for growth.
Exchange rate regimes

- Floating exchange rates: reasonable description of many industrialised countries today.

- Systems of fixed exchange rates prevalent for most of the 20th century.

- Analyses of fixed exchange rates still relevant:
  - Currency unions and regional currency arrangements.
  - Managed floats and pegs to other currencies common.
  - Need to understand why fixed exchange rates failed.
A very brief history

- The gold standard: 1871-1915.
- The Economic and Monetary Union (EMU): 1999-
## Sweden

<table>
<thead>
<tr>
<th>Regime</th>
<th>Period</th>
<th>Description</th>
<th>Devaluations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed</td>
<td>1945-73</td>
<td>Bretton Woods</td>
<td>1949</td>
</tr>
<tr>
<td></td>
<td>1973-77</td>
<td>European Currency Snake</td>
<td>1976</td>
</tr>
<tr>
<td></td>
<td>1977-91</td>
<td>Currency Basket</td>
<td>1977, 81, 82</td>
</tr>
<tr>
<td></td>
<td>1991-92</td>
<td>Fixed against the ECU</td>
<td></td>
</tr>
<tr>
<td>Floating</td>
<td>1992-</td>
<td>Free float combined with inflation target</td>
<td></td>
</tr>
</tbody>
</table>
Interest rate parity under a fixed exchange rate

Recall the interest rate parity condition from Lecture 8:

\[ i_t = i_t^* - \frac{(E_{t+1}^e - E_t)}{E_t}. \]  

(20)

Under a (credibly) fixed exchange rate, \( E_{t+1}^e = E_t \) in (20), so that the interest rate parity condition becomes:

\[ i_t = i_t^*. \]  

(21)

The central bank must make sure that (21) holds and can therefore not adjust domestic interest rates in attempts to achieve other policy goals.

Under a fixed exchange rate, stabilisation policy must be pursued using fiscal policy measures.
Maintaining a fixed exchange rate

- Under a fixed exchange rate, the central bank buys and sells foreign assets to meet the demand for domestic currency.

- The central bank’s transactions affect the money supply and therefore the domestic interest rate, which must be in parity with foreign rates according to (21).

- Crucial that the central bank maintains sufficient foreign exchange reserves.
Currency crises

• A currency crisis,\(^1\) can occur if suspicion arises that the central bank has insufficient reserves to maintain the fixed exchange rate.

• If investors expect that the fixed exchange rate will be devalued, they will demand foreign assets instead of domestic assets (whose value is expected to fall).

• When investors start exchanging domestic currency for foreign currency, the central bank’s foreign exchange reserves are depleted further and the crisis is exacerbated.

\(^1\)Often referred to as a balance of payments crisis.
Defending a fixed exchange rate

- Always technically possible to defend the fixed exchange rate by raising the interest rate in an attempt to prevent capital flight.
- Problem: the high interest rate implies great costs to the economy.
Key features of the EMU

- Attempt to make the regime immune to expectations of devaluations by relinquishing all monetary autonomy.

- Monetary policy delegated to the European Central Bank to circumvent the $N-1$-problem.
  - If $N$ countries maintain a fixed exchange rate between them, one country is free to pursue monetary policy.
  - The choice of money supply, and thereby interest rate, of this country affects the others according to (20).
Pros and cons of the EMU in a nutshell

Pros:

- Exchange rate uncertainty resolved.
- Efficiency gains from lower transaction costs.
- Conducive to trade and, potentially, growth.

Cons:

- Europe not an Optimal Currency Area (OCA): member countries susceptible to asymmetric shocks.
- Limited ability to pursue stabilisation policy when monetary policy tool relinquished.
- Costs to macroeconomic stability.
The Eurozone as of January 1, 2014

A very brief introduction to the Eurozone crisis

- What caused the Eurozone crisis?
- Hotly debated topic.
- In Baldwin and Giavazzi (2015), Charles Wyplosz notes that this is an area where: "... authors typically focus on their pet explanations, using a slew of carefully selected data".
- Consensus view?
Any crisis: rapid unwinding of economic imbalances.

Size and duration of the crisis depends on:

1. The size of the initial imbalances.
2. To what extent the initial shock is amplified.
3. How rapidly and effectively policy responds.
The initial imbalances

- Environment of low (real) interest rates following the launch of the euro, 2001-2007.

- Bond yields in peripheral countries converged to German levels, encouraging spending and borrowing in e.g. Greece, Portugal and Spain.

- Large capital flows from Germany, France and the Netherlands (running current account surpluses) to Ireland, Portugal, Spain and Greece (running current account deficits).

- High inflation in peripheral countries lead to real appreciations and losses in competitiveness.
The shock(s)

1. The global financial crisis: financial system in trouble due to exposure to the US real estate market.

2. Greece’s fiscal problems revealed in late 2008: fiscal deficit of 12.7 per cent of GDP.
The amplifiers

1. No lender of last resort.

2. Thinly capitalised too-big-to-fail banks that created a "double-drowning" scenario (Ireland).

3. Fears of insolvent governments spur fears of insolvent banks (Portugal) and general contagion across countries.

4. Rigid product markets that failed to generate real depreciations by means of wage and price adjustments.
The policy responses

• Unprepared for a crisis of this magnitude.

• Greece: fiscal tightening (austerity). Triggered a deep recession.

• Eurozone governments, the ECB and the IMF (the troika): bailout packages.

• Mario Draghi in 2012: "Whatever it takes".
What we did

• Purchasing power parity.
• The monetary approach to the exchange rate.
• The Balassa-Samuelson effect.
• Exchange rate regimes.
• A very brief introduction to the Eurozone crisis.


Next time: Review.