Macroeconomics

Based on the textbook by Karlin and Soskice: *Macroeconomics: Institutions, Instability, and the Financial System*

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Open economies are different

Real-world economies differ from the closed economies that are routinely used to introduce the main macro-economic issues by being open:

- They trade. There are exports and imports.
- There are exchange rates. Currency can be exchanged.
- Foreign and domestic securities are purchased by residents and by foreigners.
- Production factors (capital and labor) may move across borders.

The last point is often excluded in open-economy textbook models.

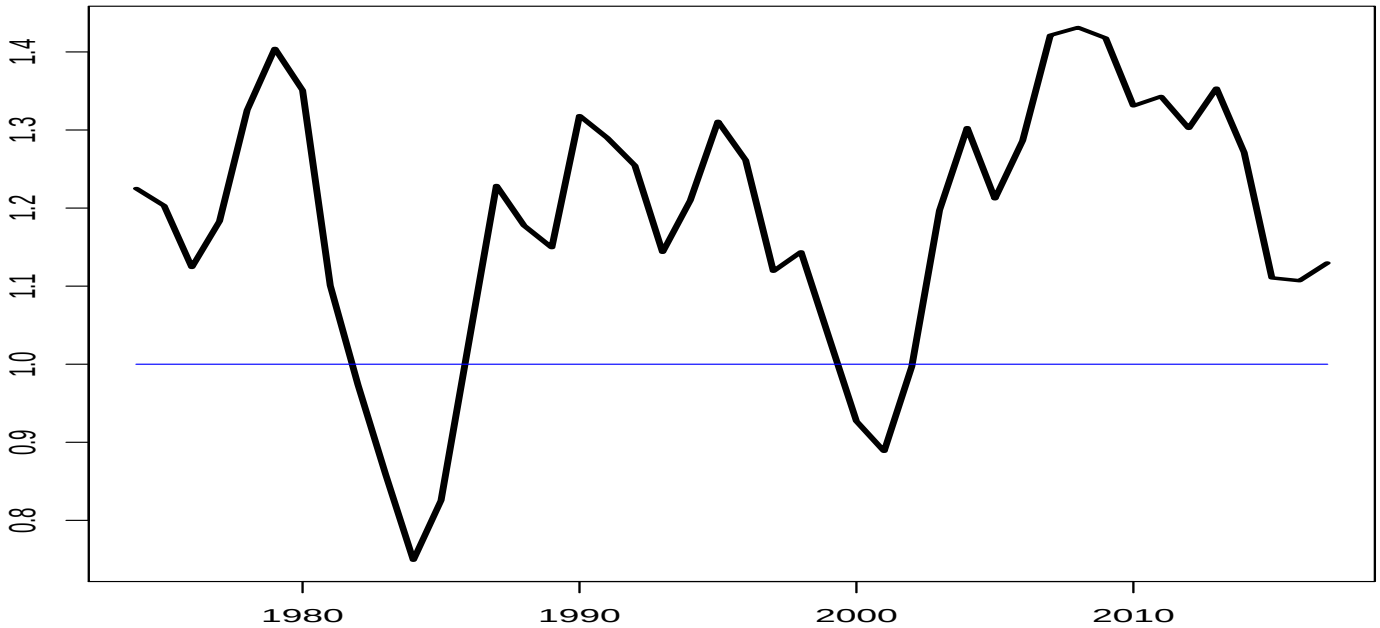
The foreign exchange market

To purchase foreign goods, services, securities, foreign currency is needed. We define the exchange rate as the price of a foreign currency unit in home currency:

$$e \equiv \frac{\texttt{no. units of home currency}}{\texttt{one foreign currency unit}}$$

This is also called the *direct quote*. A unit of foreign currency is treated just like any good or security. Disadvantage is that *higher exchange rate e means lower value for domestic currency means depreciation*. By international convention, today the euro-dollar rate is often given as *indirect quote* from the European perspective, the price of a euro in US dollars.

The dance of the dollar (or of the euro?)



Annual averages of euro-dollar exchange rates, indirect quote.
Variable corresponds to $1/e$.

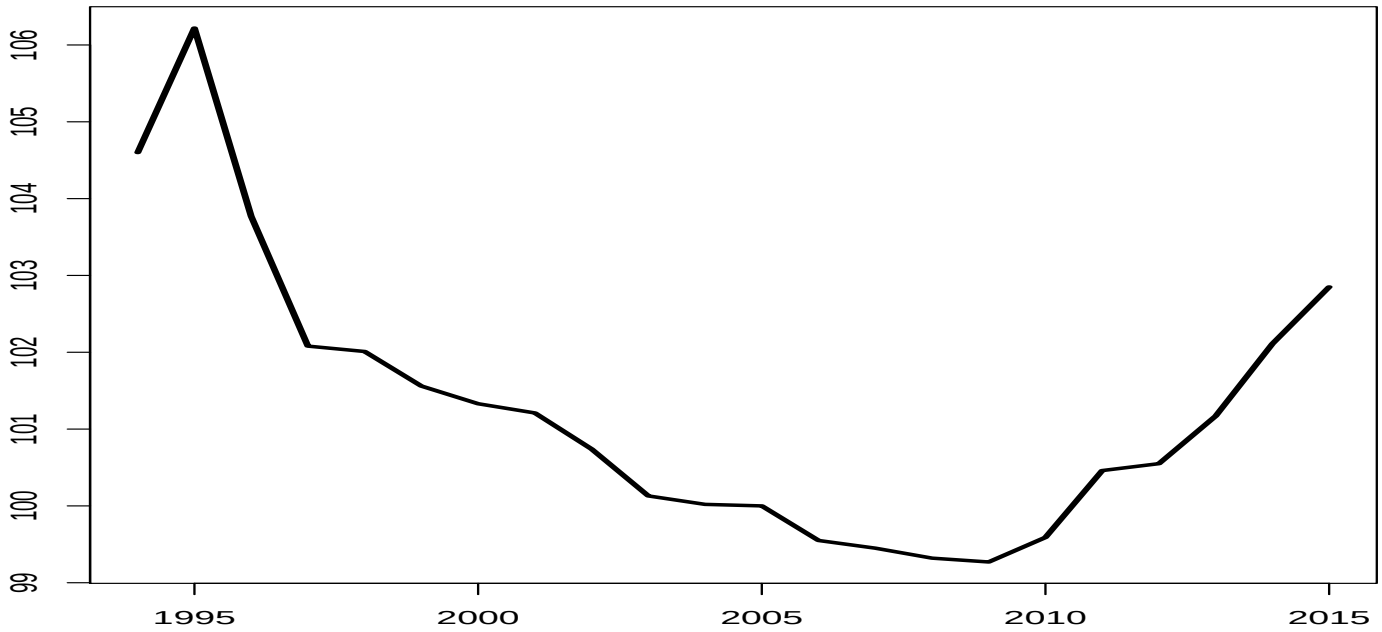
The real exchange rate

The (nominal) exchange rate e is the one available in the media. The concept of the *real exchange rate* measures the value of currency as an international means of exchange, i.e. the price of foreign goods (a basket) in domestic goods. Formally, it is defined by

$$Q \equiv \frac{\texttt{price of foreign goods in home currency}}{\texttt{price of home goods in home currency}} = \frac{P^* e}{P},$$

where P and P^* denote the domestic and foreign price level. P, P^* may be price indexes, as there are many goods. Real exchange rates may differ across sources, due to the weights of products. They are often calculated versus a set of countries, rather than as bilateral rates. (Asterisks $*$ denote foreign economy variables.)

Foreign prices of Austrian products



Annual values for Austrian real exchange rate index versus European trading partners. Rising values indicate a loss in competitiveness. Variable corresponds to $1/Q$.

Depreciation

A *real depreciation* is indicated by an increase of the real rate Q. It may be due to

- A (nominal) depreciation $e \uparrow$;
- Foreign inflation $P^* \uparrow$;
- Low domestic inflation or even deflation $P \downarrow$.

A *real appreciation* is the opposite, i.e. $Q \downarrow$. Remember that *devaluation* and *revaluation* refer to deliberate (upward or downward, respectively) changes of Q or e as a tool of economic policy.

Monetary policy in an open economy

Suppose the central bank raises its interest rate to curb inflation. Two things will happen:

1. Domestic demand (consumption, investment) will fall;
2. Foreigners will purchase domestic bonds rather than foreign bonds, as they promise a higher return. The home currency will appreciate. Export prices will increase and reduce competitiveness on the world market. Exports will fall. The net effect on imports is uncertain.

This means that there are two 'channels' by which the policy works: the *interest rate channel* and the *exchange rate channel*. Both contribute to lowering domestic output.

Three equations in an open economy

Out of the three equations, two remain essentially as in a closed setup: the Phillips curve (PC) and the central bank's monetary reaction curve (MR) will not change, as long as *domestic inflation* is targeted in π (inflation for home-produced goods, not the domestic consumer price level that may be affected by P^*).

The IS curve changes. The multiplier decreases, as part of any additional demand is satisfied by imports, thus the IS curve will be *steeper*: changes in the interest rate have a smaller effect on output. On the other hand, monetary policy becomes more effective, as it works through two channels (interest and exchange-rate) instead of one. This is captured in the *flatter* RX curve that replaces the IS curve in the open economy.

Simplifying assumptions

Typical textbook assumptions in order to focus on the essential issues:

1. Perfect international capital mobility: transaction costs or regulations do not imply any preference for domestic bonds;
2. Home country is *small*: changing i will not affect i^* (*small open economy, SOE*);
3. There are only money and bonds to store wealth;
4. Risk is identical in domestic and foreign bonds: only i and i^* affect the choice between the two (rational agents will not show emotional support for their home country).

The uncovered interest parity

Home bonds and foreign bonds must pay the same expected return, otherwise one of the two would not be purchased by anybody:

Interest gain from holding domestic bonds must equal expected depreciation of home currency. Consider the time point t, so all variables are indexed:

$$i_t = i_t^* + \frac{e_{t+1}^E - e_t}{e_t},$$

with e_{t-1}^E the exchange rate in $t+1$ expected in t, $\mathrm{E}(e_{t+1}|\mathcal{I}_t)$. Countries with weak currencies must offer high interest rates.

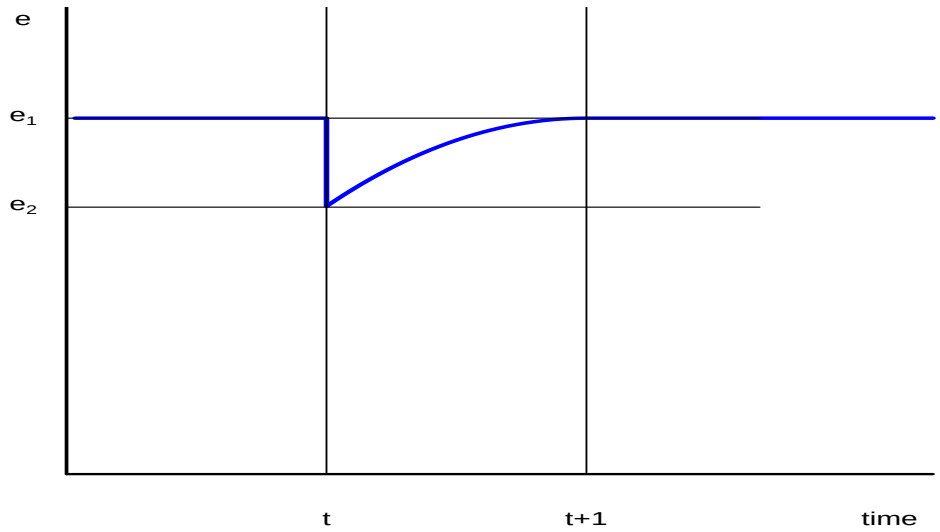
This is the *uncovered* interest parity (UIP), as it does not use any variables observed on futures markets, such as currency futures.

Overshooting reaction to monetary policy

Presume that, in order to fight inflation, the central bank raises i such that $i > i^*$.

According to UIP, a depreciation must be expected by the market.

This implies that the home currency must *appreciate* such that a depreciation can be expected over the following year.



A useful approximation to UIP

Because of

$$\exp(x) = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \ldots,$$

it holds that

$$\begin{aligned} \frac{e^E_{t+1} - e_t}{e_t} &= \log\{\exp(\frac{e^E_{t+1} - e_t}{e_t})\} \\ &\doteq \log(\frac{e^E_{t+1}}{e_t}) = \log(e^E_{t+1}) - \log(e_t) \end{aligned}$$

and hence

$$i^*_t - i_t \doteq \log(e^E_{t+1}) - \log(e_t),$$

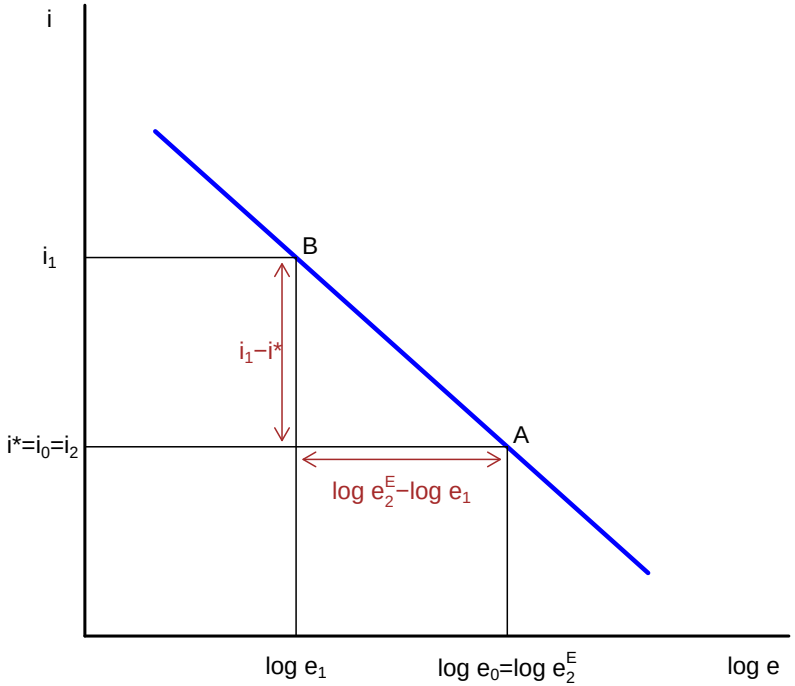
a useful and applicable approximate version of UIP.

Does UIP hold in the real world?

Empirical research on UIP is inconclusive. Some maintain that UIP holds in the longer run, but it is violated in the short run. Main problems are:

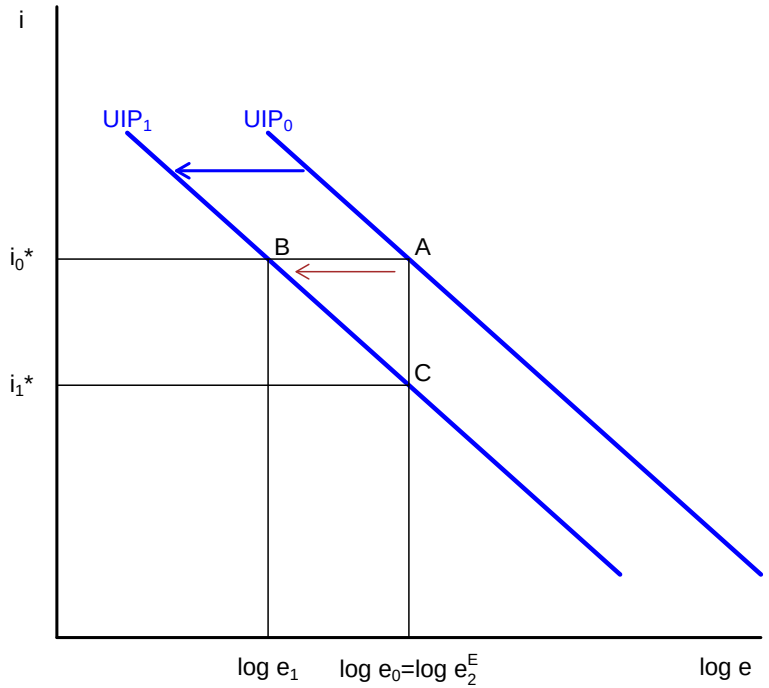
- Often, bonds emitted in different countries have substantial differences in their risks;
- The UIP in the version here assumes that the expected exchange rate e^E_{t+1} is the same as the recently observed exchange rate e_{t-1}. For the major currencies (dollar, euro, pound sterling), there is no reason to believe that their exchange rates will return to a recently observed 'normal' value. Exchange rates can differ from the values suggested by purchasing power parity for very long periods.

A graphical representation of UIP



Foreign interest i^* and expected 'normal' exchange rate are assumed constant. Starting in A, assume the home interest rate rises to i_1. An appreciation to B ensues, followed by a slow depreciation to A.

The foreign interest rate changes



Starting in A, foreign interest falls from i_0^* to i_1^*, such that $i > i_1^*$, an appreciation shoots the economy to B. If the central bank follows and reduces i, C will be eventually attained.

Medium-run equilibrium in the open economy

In the closed-economy $(y, W/P)$ diagram, the intersection of WS and PS curves determines a medium-run equilibrium with equilibrium unemployment and constant inflation. The same holds in the open economy.

The vertical line that represents the medium-run equilibrium output y_e in a (y, q) chart with the log real exchange rate q on the y–axis can be called the **ERU** curve for *equilibrium rate of unemployment*. Formally, one may write $y = y_e(z^W, z^P)$ to say that the equilibrium depends on wage and price characteristics.

To the left of the vertical ERU curve, it holds that $WS < PS$ and there is a downward pressure on inflation. To the right of the ERU curve, $WS > PS$ holds and there is upward pressure on inflation.

The IS curve in an open economy

Remember the IS curve derived for the closed economy

$$y = A - ar;$$

its open-economy counterpart includes a reaction to the exchange rate q:

$$y = A - ar + bq \qquad \textbf{(IS)}$$

To determine an equilibrium, one has to take the UIP condition into account. A real version of the UIP is

$$r_t - r^* = q^E_{t+1} - q_t,$$

which yields the open-economy **AD curve** (*aggregate demand*)

$$y = A - ar^* + bq.$$

This AD curve is upward sloping in the (y, q) space. Depreciation boosts output.

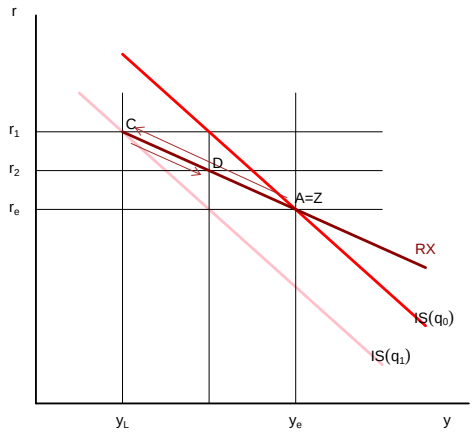
AD and RX: Remarks on terminology

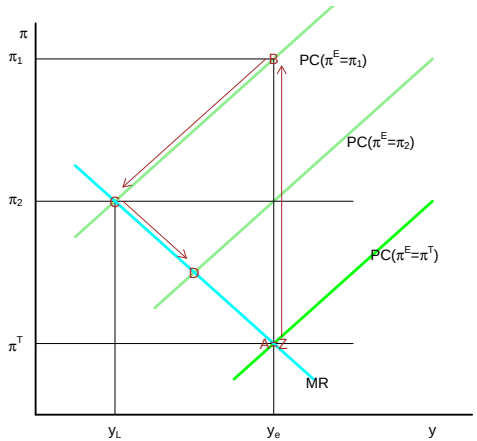
Traditionally (KEYNES-HICKS), the AD curve is a falling curve in a (y, P) diagram that summarizes the IS curve (for fiscal policy) and another curve that represents monetary policy.

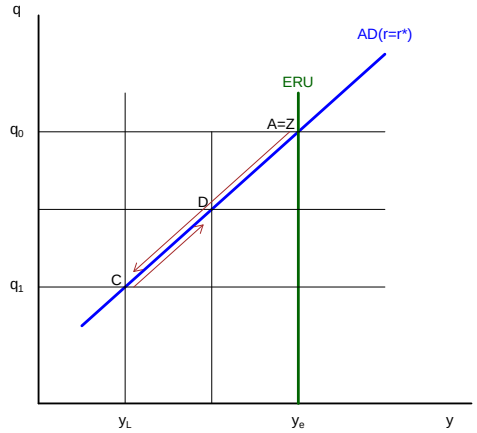
The AD curve used here is a rising curve in the (y, q) space. It summarizes the IS curve and the real version of UIP. It can also be seen as the IS relationship for $r = r^*$ kept constant.

The **RX curve** is its counterpart, obtained by substituting out q from the IS curve and the real UIP. The RX curve is a falling curve in the (y, r) diagram. It is considerably flatter than the IS curve.

Inflation shock in an open economy







The positive inflation shock is counteracted by an interest rate increase to r_1 on the RX curve, not on the IS curve. The appreciation leads to deflationary pressure in the AD-ERU graph, and it also shifts the IS curve.

Workings in more detail

1. In state A, the economy experiences an inflation shock to the high value π_1. The central bank targets y_L at the intersection of the new Phillips curve and the MR curve. The central bank reads the corresponding reaction interest rate r_1 from the RX curve. This is a lesser increase than in a closed economy.
2. The real exchange rate appreciates to q_1. The IS curve reacts to the appreciation and shifts left. Output falls to the low level y_L.
3. Eventually, output will be back at its original equilibrium level y_e, and real interest as well as the real exchange rate will be at their original positions.

Details on the RX curve

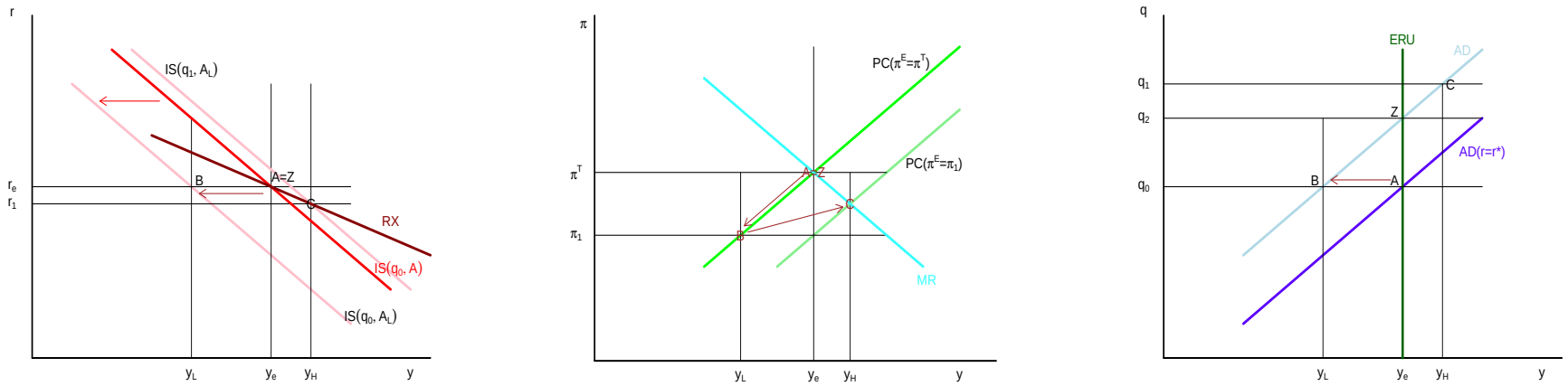
The RX curve can be derived from the open-economy IS curve

$$y = A - ar + bq,$$

in its dynamic version, usually $y_t = A - ar_{t-1} + bq_{t-1}$, by substituting out q from a real-version UIP. It has some characteristics:

- It passes through the point (y_e, r^*), where $r = r^*$ and output is at its medium-run equilibrium.
- It is downward sloping but much flatter than the IS curve for fixed q.
- Large b makes it even flatter. The more influential is the exchange rate, the easier it is to control output.
- Its slope also depends on the central bank preferences expressed in the MR curve.

A negative demand shock in an open economy



The negative demand shock shifts down the Phillips curve and decreases inflation. It also shifts the AD curve. The MR-PC graph determines the new target output that is obtained by exchange-rate overshooting. The final new exchange rate will be $q_2 < q_1$, with q_1 the rate after the initial shock.

Negative demand shock: details

1. The negative demand shock is interpreted as a decline in the autonomous demand A. IS and AD curves shift left. Output falls from the equilibrium y_e in A to y_L in state B.
2. State B is not on the central bank's MR curve. Inflation has fallen to π_1. The Phillips curve adapts expectations and shifts. The new targeted point has the high output y_H and is state C.
3. State C and y_H can be attained by a lower interest rate determined on the RX curve. Additional demand shifts the IS curve right. The AD curve shows that a strong and overshooting depreciation results.
4. State C is not on the ERU line. Inflation pressure shifts up the Phillips curve. Appreciation ensues, finally state Z is attained.
5. State Z is similar to A: same output y_e, same interest rate, same inflation, but depreciation relative to initial state.

Technical issue: When do curves shift?

Curves in a (x, y) diagram never shift if x or y change. These are movements *on* the curve. They shift after changes in other variables that determine the curve position, or after changes in parameters.

- The ERU curve only shifts if PS or WS characteristics change, such as mark-up or productivity.
- The RX curve only shifts if IS slope parameters change.
- The AD curve shifts if IS characteristics such as autonomous demand change.
- The Phillips curve shifts if price expectations adjust.
- The IS curve shifts if demand parameters change; in the open economy it also shifts if q changes.
- The MR curve shifts if the central bank changes its preferences.