Monetary theory of exchange rate determination

ECON 4330 Lecture 7 Spring 2013

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Plan

- The simple monetary model: Flexible prices (RØ4.1)
- The Dornbusch model: Price rigidity (RØ6.7)
- Playing with UIP and expectations (RØ4.2)

The monetary theory of exchange rate determination

Slides for Chapter 4 of Open Economy Macroeconomics

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Assumptions

Perfect mobility of goods; *purchasing power parity*, $P = EP_*$

Perfect mobility of capital; *interest rate parity*, $i = i_* + e_e$

Wage flexibility; output, Y, supply determined

Exogenous money supply, M

Model-consistent expectations, $e_e = \dot{E}/E$

The basic model

Money market equilibrium

$$\frac{M}{EP_*} = m(i, Y) \tag{1}$$

Foreign exchange market equilibrium

$$\frac{\dot{E}}{E} = i - i_* \tag{2}$$

Endogenous: E and i.
Exogenous: P_*, i_*, Y and M.

Solution

Solve (1) for i:

$$i = i\left(\frac{M}{EP_*}, Y\right) \qquad i_1 < 0, i_2 > 0$$

Insert in (2):

$$\frac{\dot{E}}{E} = i\left(\frac{M}{EP_*}, Y\right) - i_* \tag{3}$$

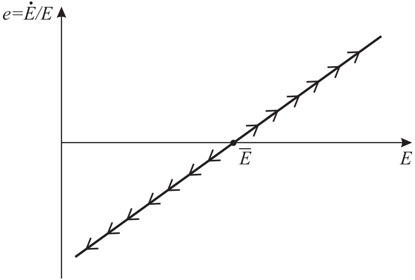
One differential equation in $E(t)$

Given an initial value for E, (3) determines the whole future path of E.

E is free to jump at any time.

How to determine the initial value of E?

Determining the initial value



$$\frac{\dot{E}}{E} = i\left(\frac{M}{EP_*}, Y\right) - i_*$$

$$\frac{d\dot{E}/E}{dE} = -i_1 \frac{M}{E^2 P_*} > 0$$

Equation unstable

Arbitrary starting point yields explosive path

Accelerating depreciation or appreciation

Choose the non-explosive path

Stationary point $\dot{E} = 0$

Solution: $i = i_*$

$E = \frac{M}{P_* m(i_*, Y)}$

Exchange rate proportional to quantity of money

Generalization

Paper money has zero intrinsic value

Its value depends entirely on beliefs

Usually there are several rational expectations paths for the value of money

Several self-fulfilling beliefs

If money supply is exogenous, there is at most one non-explosive rational expectations path for the value of money.

Assumption: Expectations coordinate on the non-explosive path

Confidence in the monetary system

The exogenous money supply acts as *nominal anchor*

Hyperinflation

Monetary model best when inflation very rapid
Hyperinflation: Inflation above 50 per cent per month
Possible causes:

1. Explosive growth in money supply
2. Expectations only

Cagan (1956)

Studied 20th century European hyperinflations

Caused by explosive growth in money supply

Weak governments printing money to finance deficits

Hyper*de*flation?

Never observed
Nominal interest rate cannot be negative
No rational expectations path with $\dot{e} < -i_*$
(Perfect capital mobility)
With $i = 0$ money and bonds become equivalent

Cases where a nominal anchor is missing

1. Exogenous interest rate

$\dot{e} = i - i_*$. No way to pin down the *level* of the exchange rate.

2. "Inflation targeting"

$i = i_* + (\bar{\pi} - \dot{p}_*) + \phi(\dot{p} - \bar{\pi})$

$\bar{\pi}$ = inflation target, $\phi > 1$

$i_* + (\bar{\pi} - \dot{p}_*)$ = normal interest rate

$$\dot{e} = i - i_* = i_* + (\bar{\pi} - \dot{p}_*) + \phi(\dot{e} + \dot{p}_* - \bar{\pi}) - i_*$$

$$(1 - \phi)\dot{e} = (1 - \phi)(\bar{\pi} - \dot{p}_*)$$

$$\dot{e} = \bar{\pi} - \dot{p}_*$$

No way to pin down the *level* of the exchange rate.

The Dornbusch overshooting model

Slides for Chapter 6.7 of Open Economy Macroeconomics

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Motivation

Bretton-Woods system of fixed rates collapsed in 1971

Major countries began floating (USA, Japan, Germany, UK)

Volatility of of exchange rates higher than expected

Extends the monetary model

Home and foreign goods

Price of home goods do not jump (short run nominal price rigidity)

The model

IS	$Y = C(Y) + X(EP_*/P, Y, Y_*)$	(1)
LM	$M/P = m(i, Y)$	(2)
Phillips	$\dot{P}/P = \gamma(Y - \bar{Y})$	(3)
UIP	$\dot{E}/E = i - i_*$	(4)

Endogenous variables: Y, i, P and E

Exogenous variables: Y_*, P_*, i_*, M

Initial condition: $P(0) = P_0$

The temporary equilibrium

$$
\begin{aligned}
Y &= Y(EP_*/P, Y_*) & (5)\\
i &= i(M/P, EP_*/P, Y_*) & (6)
\end{aligned}
$$

Solves (1) and (2)

The dynamics

$$
\begin{aligned}
\dot{P} &= P\gamma[(Y(EP_*/P, Y_*) - \bar{Y}] = \phi_1(P, E; Y_*, P_*) & (7)\\
\dot{E} &= E[i(M/P, EP_*/P, Y_*) - i_*] = \phi_2(P, E; M, Y_*, P_*, i_*) & (8)
\end{aligned}
$$

Temporary equilibrium inserted in (3) and (4)

The stationary equilibrium

$$\dot{P} = 0 \iff Y = Y(EP_*/P, Y_*) = \bar{Y} \quad (9)$$

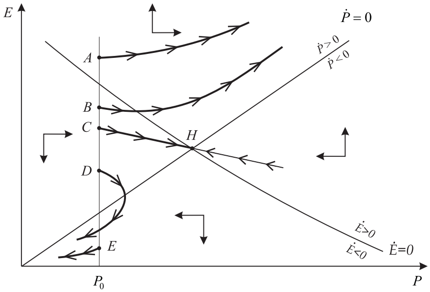
$$\dot{E} = 0 \iff i = i(M/P, EP_*/P, Y_*) = i_* \quad (10)$$

Determines stationary values of P and E.

Questions

- Does the economy move towards the stationary equilibrium in the long run? (Stability?)
- How to determine the initial value of E?
- How is the path from the initial temporary equilibrium to the stationary equilibrium?

The phase diagram



Internal balance: The $\dot{P} = 0$-locus

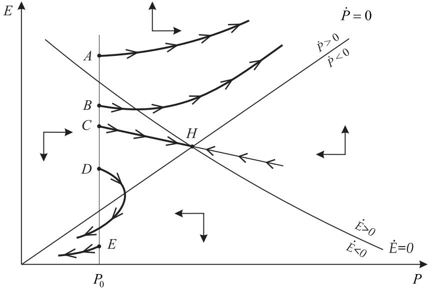
$$\dot{P} = 0 \Longleftrightarrow Y = Y(EP_*/P, Y_*) = \bar{Y}$$

Y depends on ratio P/E

To keep Y constant at $\bar{Y}$, E must increase proportionally with P

P above $\dot{P} = 0$ means Y low, P declining

The phase diagram

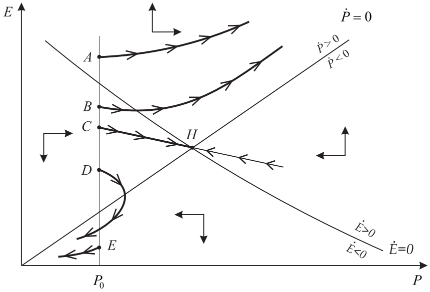


The $\dot{E} = 0$-locus

$$\dot{E} = 0 \iff i(M/P, EP_*/P, Y_*) = i_*$$

Ambiguous slope
$P \uparrow \Longrightarrow Y \downarrow, M/P \downarrow, \Longrightarrow i \downarrow\uparrow?$
$E \uparrow \Longrightarrow Y \uparrow \Longrightarrow i \uparrow$
Assume $P \uparrow \Longrightarrow i \uparrow$
$\dot{E} = 0$-locus slopes downward
E above the $\dot{E} = 0$-locus means i high, and E depreciating

The phase diagram



Arrows point away from $\dot{E} = 0$ and towards $\dot{P} = 0$.

- H is stationary equilibrium
- Starting point anywhere on P_0-line
- A, B accelerating inflation forever
- D, E accelerating deflation until $i = 0$
- C saddle path leading to stationary equilibrium

Along the saddle path

Inflation and appreciation together (left arm)

Deflation and depreciation together (right arm)

External and internal value of currency moves in opposite directions

For the record

All exogenous variables, including M, constant over time
Slope of saddle path (and $\dot{E} = 0$-locus) the opposite if increased P lowers i

A closer look at the stationary equilibrium

$$\bar{Y} = C(\bar{Y}) + X(R, \bar{Y}, Y_*) \qquad (11)$$

$$\frac{M}{P} = m(i_*, \bar{Y}) \qquad (12)$$

$R = EP_*/P$ Real exchange rate

$$E = RP/P_* = RM/P_* m(i_*, \bar{Y})$$

Y determined by supply (resources)

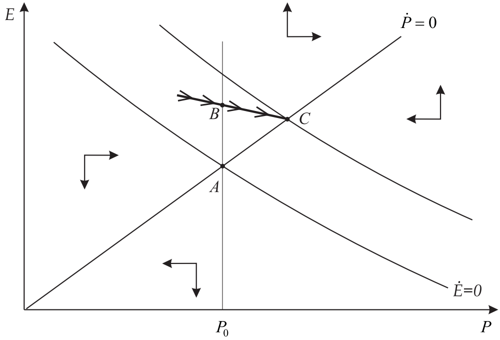
R by demand for home goods

i in international capital markets

P, E by monetary policy

Dichotomy between monetary and real side

A monetary expansion: Overshooting



Starting from A

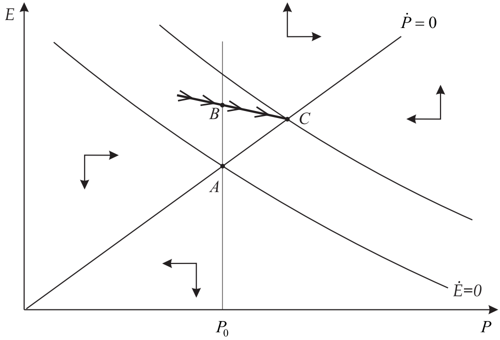
Locus for internal balance unaffected

Locus for $\dot{E} = 0$ shifts upwards

Same price level, lower interest rate, higher E needed to keep $i = i_*$

C new stationary equilibrium

A monetary expansion: Overshooting



Look for saddle path leading to C

Immediate depreciation from A to B

Gradual appreciation from B to C

Along with gradual inflation and $i < i_*$

Overshooting

Occurs because other prices are slow to change

Also happens in response to shocks to money demand or foreign interest rates

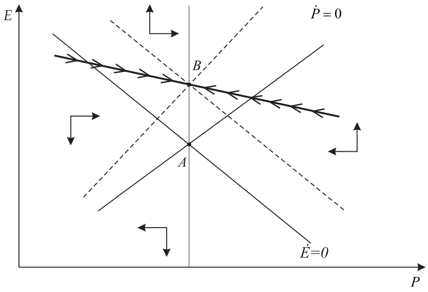
Increases the short-run effect on output of monetary disturbances

May explain the high volatility of floating rates

Empirical evidence mixed

May occur in other flexible prices too?

A negative shock to the trade balance



Depreciation needed to keep Y at $\bar{Y}$ constant $\rightarrow$

$\dot{P}=0$-locus shifts up

Same depreciation keeps $i = i_*$ $\rightarrow$

$\dot{E}=0$-locus shifts up equally

Exchange rate jumps from A to B

Results

- A floating exchange rate insulates against demand shocks from abroad
- A floating exchange rate also stops domestic demand shocks from having output effects

Caution!

- Studied only permanent shocks
- Less damping of temporary shocks (see Ch 6.4)
- Less damping if money supply deflated by index containing foreign goods
- Structural change may meet real obstacles

Extending the analysis

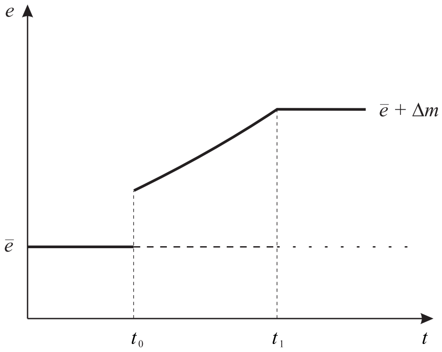
Can be solved for any time paths for the exogenous variables.
(Log)linearization necessary for closed-form solutions. (OR Ch 9))
As in monetary model, the present exchange rate depends on the whole future of the exogenous variables.
Phillips-curve problematic in inflationary environment.

With UIP and rational expectations

Four useful principles

- Never expected jumps in the exchange rate
- Exchange rate is forward looking, reflects all expected future changes in exogenous variables
- The exchange rate jumps on news
- Begin with the distant future and reason backwards

A preannounced permanent increase in the money supply



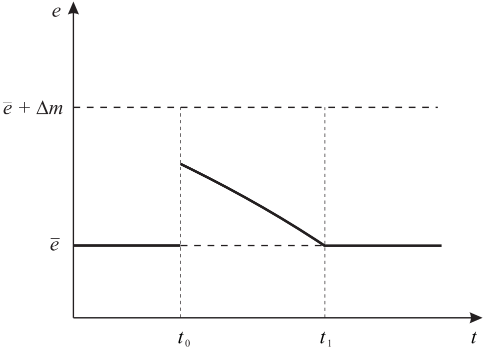
At t_0 it is announced that m will increase by Δm from t_1.

Initial depreciation followed by more.

Interest rate up at t_0

$$e(t) = \int_t^\infty [\frac{1}{\eta}(m - p_* - \kappa y) + i_*] e^{-(1/\eta)(\tau - t)} d\tau$$

An unexpected, temporary increase in the money supply



Money supply increased by Δm at t_0, reversed at t_1.

Regressive expectations
Interest rate down at t_0

$$e(t) = \int_t^\infty [\frac{1}{\eta}(m - p_* - \kappa y) + i_*] e^{-(1/\eta)(\tau - t)} d\tau$$

Term structure of interest rates reveals exchange rate expectations

- Expected depreciation over three months from now is equal to the difference between domestic and foreign three-month interest rates
- Are central banks determining expectations or are investor expectations determining interest rates?