ISSUES IN EXCHANGE RATE MANAGEMENT

1. MODELS OF SPECULATIVE ATTACK

Models of speculative attack attempt to explain why and how speculative pressures might force a country which operates a fixed exchange rate between its own currency and that of another country or group of countries either to:

Abandon the fixed value and switch to a free float

or

Devalue the domestic currency

The first models of speculative attack were developed by Krugman (1979), and Flood and Garber (1984).

They consider an economy operating a fixed exchange rate, but within which the monetary authorities are expanding domestic credit more quickly than the demand for money is growing. This excessive monetary growth is the underlying cause of the speculative attack.

The excessive monetary growth causes a balance of payments deficit for the country and a gradual fall in its foreign exchange reserves.

In the absence of a speculative attack, the country would (given an unchanged monetary policy) have to switch to a floating rate at the point its reserves were exhausted.

The key insight provided by Krugman and by Flood and Garber is that speculative pressures will force the country to abandon its fixed rate earlier than in their absence, i.e. before the country's reserves are exhausted.

We examine this result using Agenor, Bhandari and Flood's framework.

AGENOR, BHANDARI AND FLOOD'S (1992) MODEL OF SPECULATIVE ATTACK

The underlying economic structure is provided by a monetary model of the balance of payments/exchange rate determination.

Money market equilibrium and uncovered interest parity are the asset market equilibrium conditions.

The country produces a single good which is a perfect substitute for foreign output and therefore the law of one price holds, implying absolute PPP.

Continuous full employment is assumed.

Agents operating in the foreign exchange market have rational exchange rate expectations and exploit all available opportunities for profit.

This latter consideration means that 'jumps' (i.e. discrete changes) in the exchange rate can only occur when an unforeseeable shock materialises.

Any predictable jump in the exchange rate would imply, for agents with rational expectations, the possibility of an infinite capital gain. This leads them to purchase or sell domestic currency denominated assets at the time the future exchange rate change is foreseen. These transactions produce a current (previously unanticipated) jump in the exchange rate, rather than a predicted future jump.

The Model

Money Market Equilibrium

$$m_t = p_t + \phi y_F - \lambda r_t \qquad (1$$

(Note output is assumed to be at its full employment level)

Law of one price/PPP

$$p_t = e_t + p^* \qquad (2$$

Uncovered interest parity (UIP)

$$r_t = r^* + x_t \qquad (3)$$

Where

x_t = expected rate of depreciation of the domestic currency

Rational Expectations/Perfect Foresight

The expected rate of depreciation is equal to the actual rate of depreciation, except at the instant an unforeseen shock occurs. Hence:

$$x_t = \dot{e}_t \qquad (4)$$

Where $\dot{e}_t$ = actual rate of depreciation of domestic currency.

Combining with the UIP condition.

$$r_t = r^* + \dot{e}_t \qquad (5)$$

Note that when the exchange rate is fixed, i.e. before the speculative attack, $\dot{e}_t = 0$ implying $r_t = r^*$

Substituting the PPP relationship and the UIP condition into the money market equilibrium condition we obtain:

$$m_t = e_t - \lambda \dot{e}_t + p^* + \phi y_F - \lambda r^*$$

Normalising by setting $p^* + \phi y_F - \lambda r^* = 0$

$$m_t = e_t - \lambda \dot{e}_t \qquad (6)$$

The first term on the RHS identifies the effect of the price level on the demand for money, the second term the influence of the domestic interest rate.

The role of the MME condition (6) is different under fixed and flexible exchange rates:

Fixed Exchange Rate

The money supply is endogenous and adjusts, through induced BOP disequilibria and consequent foreign exchange market intervention to maintain money market equilibrium. With $\dot{e}_t = 0$, (6) can be written as:

$$m_t = \overline{e} \qquad (7)$$

where $\overline{e}$ is the fixed value of e

(7) indicates that given the fixed rate regime, the money supply is constant (since the determinants of the demand for money are all constant).

Flexible Exchange Rate

Now the money supply is exogenous, and the exchange rate adjusts to maintain money market equilibrium. The appropriate way to write (6) is:

$$e_t = m_t + \lambda \dot{e}_t \qquad (6')$$

> Note the role of $\dot{e}_t$. If $\dot{e}_t > 0$, i.e. the domestic currency is depreciating, UIP implies $r_t > r^*$, reducing the demand for money below the value associated with $\dot{e}_t = 0$ and requiring a higher value of e_t to maintain money market equilibrium.

Money Supply Determination

Changes in the domestic money supply reflect changes in domestic credit and foreign exchange market intervention, the latter leading to changes in foreign exchange reserves. We can write:

$$\dot{m}_t = \gamma \dot{D}_t + (1-\gamma)\dot{R}_t \qquad (8)$$

$\dot{m}_t$ = rate of growth of money supply
$\dot{D}_t$ = rate of growth of domestic credit
$\dot{R}_t$ = rate of growth of foreign exchange reserves
γ = initial share of domestic credit in money supply
$1-\gamma$ = initial share of reserves in money supply

Domestic Credit Expansion

Domestic credit is assumed to be expanding continuously at a constant, exogenously given rate μ, i.e.

$$\dot{D}_t = \mu \qquad (9)$$

This growth in domestic credit is the ultimate cause of the breakdown of the fixed rate regime.

Consider the implications of this growth under, alternatively, fixed and flexible exchange rates.

Fixed Exchange Rate

We know that the money supply is constant when the exchange rate is fixed, and is given by (7), i.e. $m_t = \overline{e}$. Hence $\dot{m}_t = 0$ implying from (8):

$$\gamma \dot{D}_t = +(1-\gamma)\dot{R}_t = 0$$

or (using $\dot{D}_t = \mu$):

$$\dot{R}_t = \frac{-\gamma}{(1-\gamma)}\mu \qquad (10)$$

i.e. foreign exchange reserves fall continuously at the rate $\frac{\gamma}{(1-\gamma)}\mu$

Clearly, whatever the initial stock of reserves, at some point they will be exhausted and the fixed rate will have to be abandoned, even without a speculative attack.

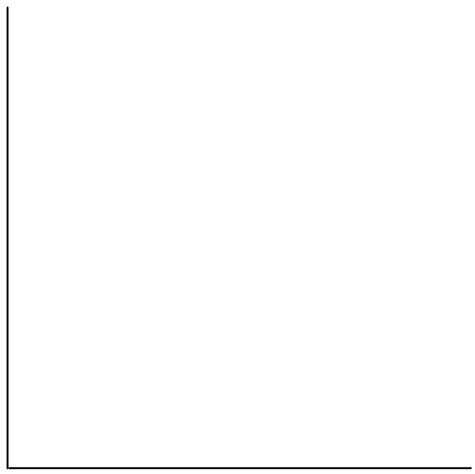
The economy under the fixed rate regime

$$m_t = \overline{e} \qquad (7)$$

$$\dot{D}_t = \mu \qquad (9)$$

$$\dot{R}_t = \frac{-\gamma\mu}{(1-\gamma)} \qquad (10)$$

Paths of D, R, M and e in absence of speculative attack



D_0 = initial stock of domestic credit
R_0 = initial stock of foreign reserves

Continuous depletion of foreign reserves implies that they would eventually be exhausted even in the absence of a speculative attack. At this point the fixed rate would have to be abandoned.

Represent this point in time by t_N - the point of 'natural collapse' of the regime.

Flexible Exchange Rate

Now there is no foreign exchange market intervention and the rate of monetary growth reflects purely changes in domestic credit.

From (8) with $\dot{R}_t = 0$ and $\dot{D}_t = \mu$

$$\dot{m}_t = \gamma\mu \qquad (11)$$

With *m* increasing continuously, domestic prices will be increasing continuously at the same rate. PPP then requires an identical rate of depreciation of the domestic currency, i.e.:

$$\dot{e}_t = \dot{p}_t = \dot{m}_t = \gamma\mu$$

Substituting for $\dot{e}_t$ in (6′)

$$e_t = m_t + \lambda\gamma\mu \qquad (12)$$

Note (12) indicates that e_t is higher at each instant than the value which would prevail if the rate of growth of the money supply were zero, i.e. if μ was zero then $e_t = m_t$

Explanation
$\mu > 0 \Rightarrow \dot{p} > 0 \Rightarrow \dot{e} > 0 \Rightarrow r > r^*$. With $r > r^*$ the demand for money is lower, requiring for any value of *m* a higher value of *p*, implying a higher value of *e*

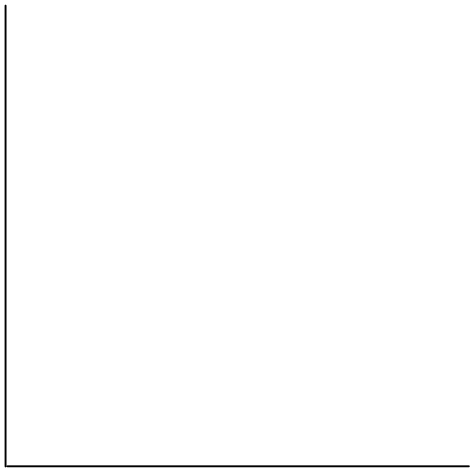
Collapse of the fixed rate regime and the transition to a floating rate in the absence of a speculative attack

We consider what would happen in the absence of a speculative attack and show that this is inconsistent with expected profit maximisation on the part of international investors. This identifies why a speculative attack occurs.

The economy with a floating rate

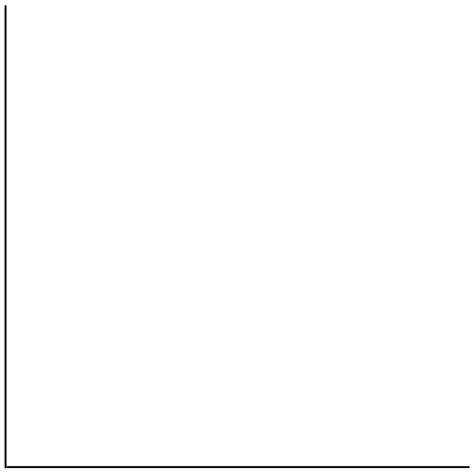
$$\dot{m}_t = \gamma\mu$$

$$e_t = m_t + \lambda\gamma\mu$$



What does this imply about the path of the exchange rate?

In fact, at the instant the fixed rate regime collapses and the domestic currency begins to depreciate gradually at the rate $\gamma\mu$, the domestic currency must undergo a discrete jump depreciation of value $\lambda\gamma\mu$ (since $e_t = m_t + \lambda\gamma\mu$)



But this jump in the exchange rate would be foreseen by agents with rational expectations.

This will lead them to sell the domestic currency in advance of the time of natural collapse. i.e. it will lead to a speculative attack and the collapse of the fixed rate regime before reserves are exhausted.

The Timing of the Speculative Attack

The timing of the speculative attack (and its size) is determined by the requirement that the exchange rate does not 'jump' at the instant the regime collapses.

Let t_c represent the instant when the speculative attack occurs and the fixed rate regime collapses. Then the 'no jump' requirement implies:

$$e_{t_c} = \bar{e} \qquad \text{(A)}$$

Let $m_{t_{\bar{c}}}$ be the value of the money supply immediately before the speculative attack.

m_{t_c} be the value of the money supply at the point the regime collapses. Then

$$m_{t_{\bar{c}}} = \bar{e} \qquad \text{(B)}$$

$$e_{t_c} = m_{t_c} + \lambda\gamma\mu \qquad \text{(C)}$$

Substituting (B) and (C) into (A):

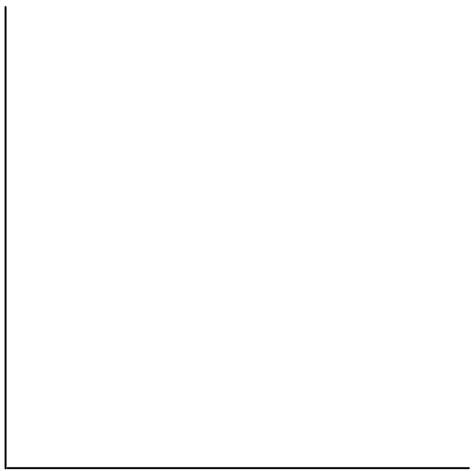
$$m_{t_c} + \lambda\gamma\mu = m_{t_{\bar{c}}}$$

or

$$m_{t_c} = m_{t_{\bar{c}}} - \lambda\gamma\mu$$

This equation tells us that the attack causes a fall in the money stock, through a fall in reserves, of $\lambda\gamma\mu$.

This locates precisely when the attack occurs

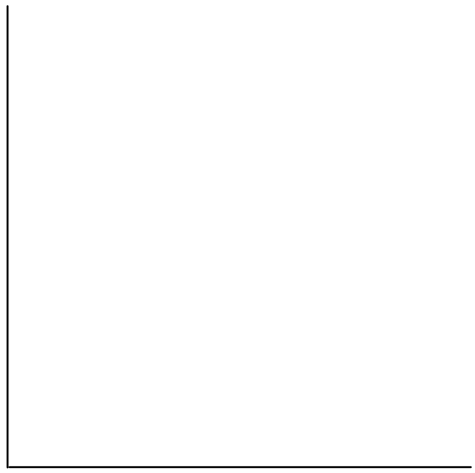


The speculative attack or capital outflow leads to foreign exchange market intervention in the form of purchases of domestic currency by the domestic central bank.

These purchases exhaust the country's reserves and force the abandonment of the fixed rate

The associated fall in the money supply is of precisely the correct magnitude to ensure money market equilibrium given the fall in the demand for money as the domestic currency begins to depreciate.

Hence there is no jump in e



Weakness of the model

The principal drawback of the model is that the prime cause of the collapse of the fixed exchange rate regime is domestic monetary policy, i.e. excessive domestic credit expansion, rather than the speculative attack itself.

The collapse would occur even in the absence of the attack; the attack merely leads to an earlier collapse than would otherwise occur.

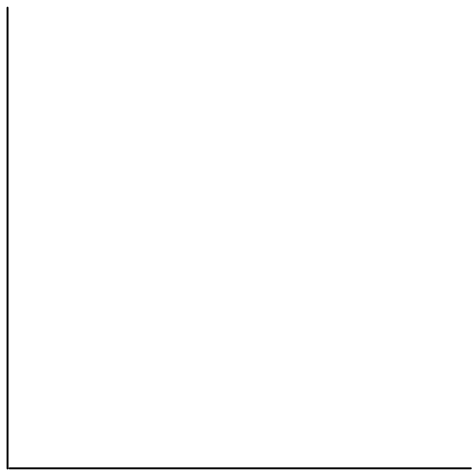
Nonetheless, the basic framework can be developed to examine speculative attacks as the source of collapse of a fixed rate regime.

2. KRUGMAN'S TARGET ZONE MODEL (QJE 1991)

Exchange rate target zones provide a possible means of limiting exchange rate movements. Their underlying intention is to prevent large changes in nominal exchange rates which potentially produce substantial misalignments of *real* exchange rates.

The use of target zones for this purpose has been advocated by Williamson (1985) and Miller and Williamson (1987), for example.

At the same time, the need for foreign exchange market intervention to defend a target zone is much-reduced compared to a fixed exchange rate, since such intervention is limited to preventing movements of the exchange rate outside the zone.



A target zone defines a band within which the exchange rate may be allowed to float freely.

However, intervention prevents movements of e outside the upper $(\overline{e})$ and lower $(\underline{e})$ limits of the zone.

A target zone which operates effectively will clearly influence exchange rate behaviour when the exchange rate is at the limits of the zone. If an event occurs which would otherwise take the exchange rate outside the boundaries of the zone, intervention takes place which keeps the exchange rate within the zone.

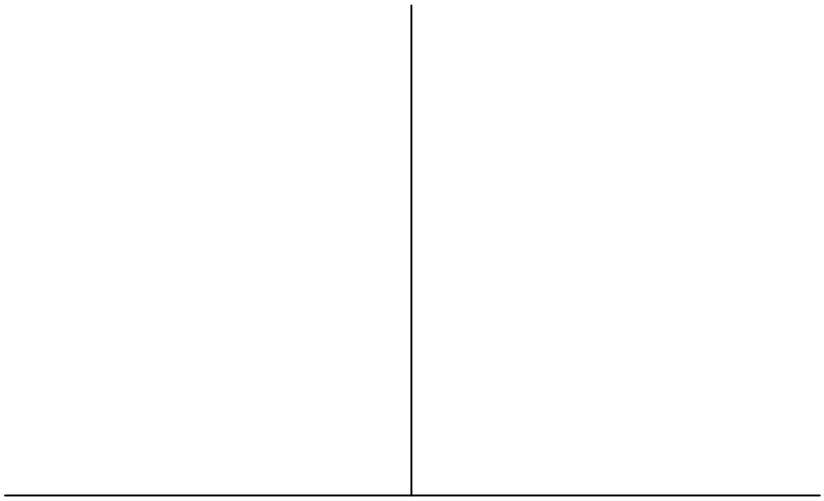
However, Krugman points out that the existence of a target zone, in affecting exchange rate behaviour at the boundaries of the zone, influences expectations of future movements in the exchange rate.

This effect on expectations implies that the existence of a target zone influences exchange rate behaviour *within* the boundaries of the zone.

Suppose exchange rate movements reflect shocks to 'fundamentals'.

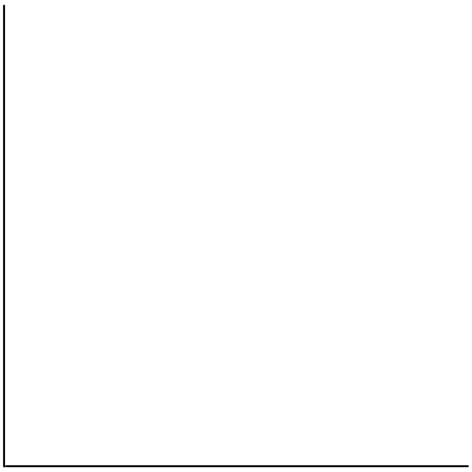
Assume the probability distribution of these shocks is symmetrical around zero, hence positive and negative shocks are equally likely.

In the absence of a target zone, the expected change in the exchange rate would be zero

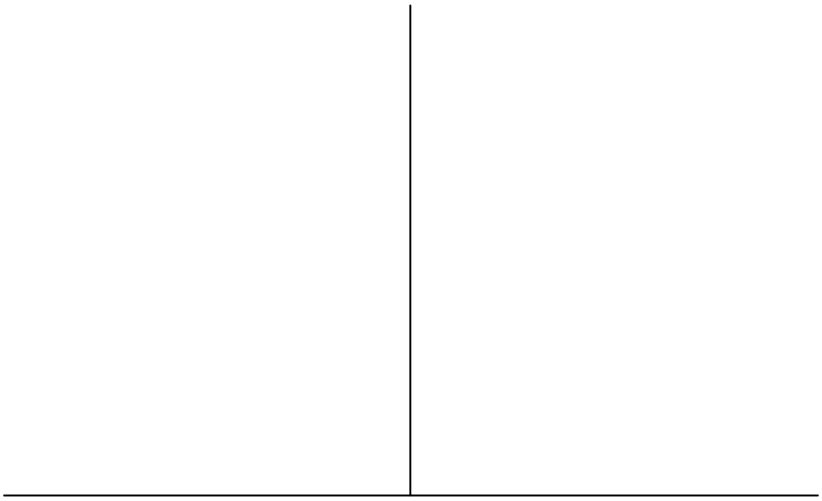


Probability distribution of future values of e

However, given the existence of a target zone, the expected change in the exchange rate depends on the current position of the exchange rate within the zone.

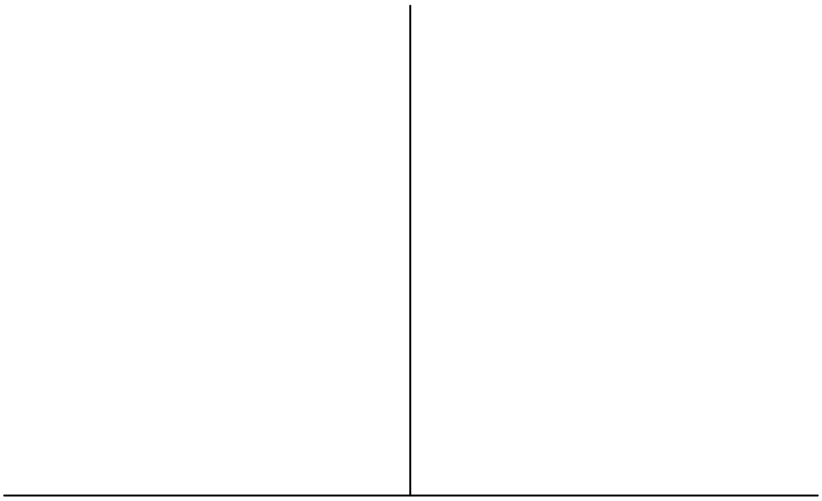


A: *At the centre of the zone*



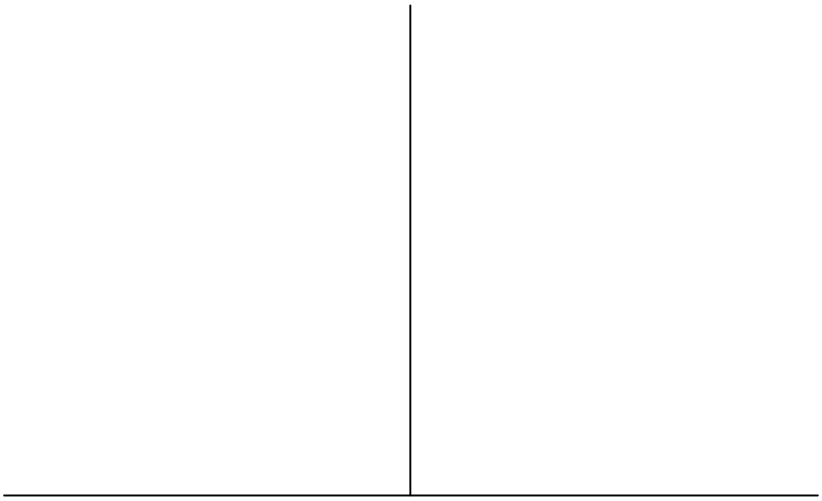
Expected change in exchange rate is zero

B: *Close to upper limit of the zone*



Domestic currency expected to appreciate

C: Close to lower limit of the zone



Domestic currency expected to depreciate

Summary

A. At the centre of the zone, the expected rate of change of e is zero: $E(de)/dt = 0$

B. If $e > e_0$ (the exchange rate is above the centre of the zone), the domestic currency is expected to appreciate: $E(de)/dt < 0$

The closer is e to $\overline{e}$, the greater the extent of the expected appreciation.

C. If $e < e_0$, the domestic currency is expected to depreciate: $E(de)/dt > 0$

The closer is e to $\underline{e}$, the greater the extent of the expected depreciation.

Underlying Model of Exchange Rate Determination

Krugman assumes the exchange rate to be determined according to:

$$e = m + v + \lambda E(de)/dt \qquad (1)$$

where

m = the money stock
v = velocity shock

$E(de)/dt$ = expected rate of depreciation
(equation can be viewed as based on the ERE monetary model - see Appendix)

v is assumed to follow a (continuous time) random walk, with variance σ^2. Consequently, changes in v are expected to be permanent and the expected value of v in the next instant is its current value.

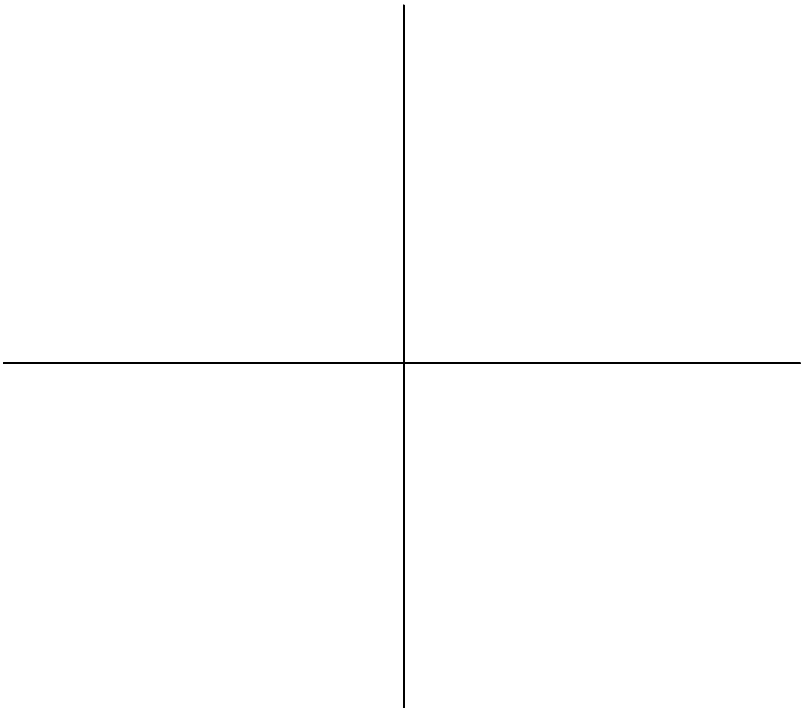
m is changed only to prevent e moving outside the target zone as a result of velocity shocks.

e.g. suppose e is close to $\overline{e}$ and a positive velocity shock occurs which would take e outside the zone

Then the monetary authority intervenes, reducing m to keep e inside the zone.

Exchange Rate Behaviour in the Absence of a Target Zone

With m constant, changes in e reflect velocity shocks, i.e. changes in v. Moreover, with v following a random walk, the expected change in the exchange rate is zero: $E(de)/dt = 0$



Relationship between e and v for m=0

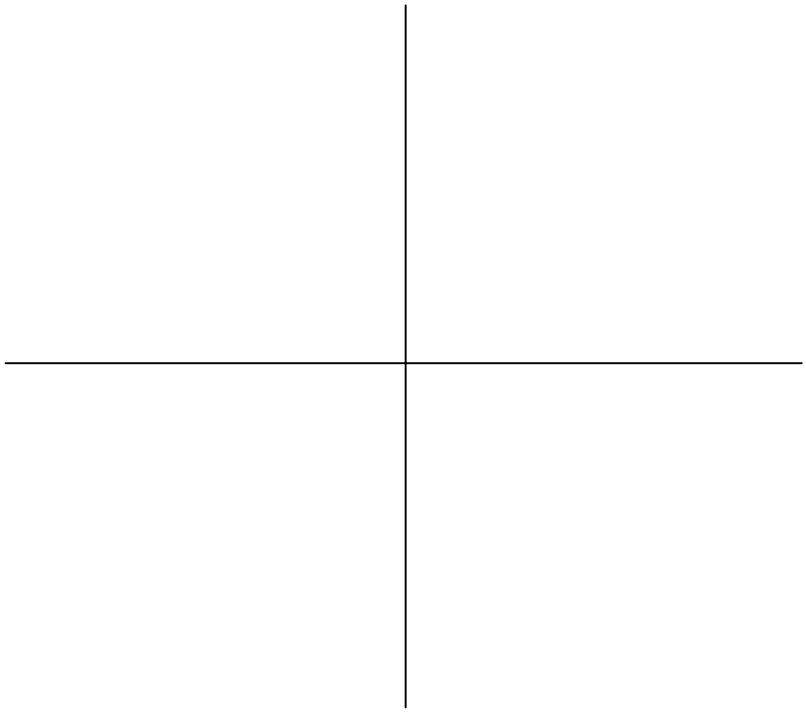
With m=0 and $E(de)/dt = 0$, (1) implies $e = v$

A naïve view of exchange rate behaviour within a target zone

For convenience, let the centre of the target zone be $e_0 = 0$. Hence $\underline{e} = -\overline{e}$

A naïve view of the influence of the zone on exchange rate behaviour would be that its effects are confined to preventing movements of e outside the zone.

Within the zone the exchange rate behaves as in the absence of a target zone.



However, this view is incorrect.

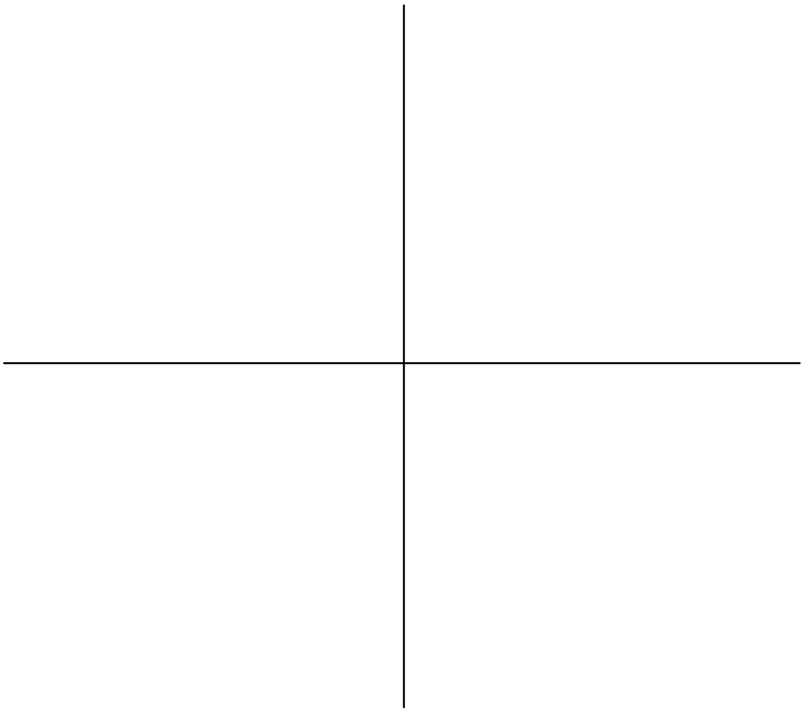
Only if *e* is at the centre of the zone is the expected rate of change of *e* zero.

Effect of the zone on exchange rate behaviour within the zone

If *e* is above the centre of the zone, the expected rate of change of *e* is negative, i.e. $E(de)/dt < 0$. This lowers *e* relative to its free float value.

If *e* is below the centre of the zone, the expected rate of change of *e* is positive, i.e. $E(de)/dt > 0$. This increases *e* relative to its free float value.

The closer *e* lies to the upper or lower limit of the zone, the larger (in absolute terms) is the expected rate of change of the exchange rate and the greater the departure of *e* from its free float value



The relationship between e and v is described by an *S*-shaped curve, passing through the centre of the zone for v=0, and tangent to the limits of the zone.

Besides preventing movements of the exchange rate outside its boundaries, the zone also stabilises the exchange rate within the zone.

In the absence of the zone, non-zero realisations of v would move the exchange rate along the broken 45º line.

The existence of the zone implies less variation in the exchange rate as v takes different values.

Imperfect credibility of the zone

Suppose agents in the foreign exchange market are unsure whether the monetary authorities will defend the zone.

The probability they attach to the zone being defended is ϕ.

The probability attached to the zone not being defended is $1-\phi$.

What is the implied behaviour of the exchange rate in this case?

The relationship between e and v is now determined by considering what happens if the exchange rate reaches one of the boundaries of the zone.

At this point, one of two things must happen:

either

1. The authorities defend the zone and intervene to keep the exchange rate within its boundaries.

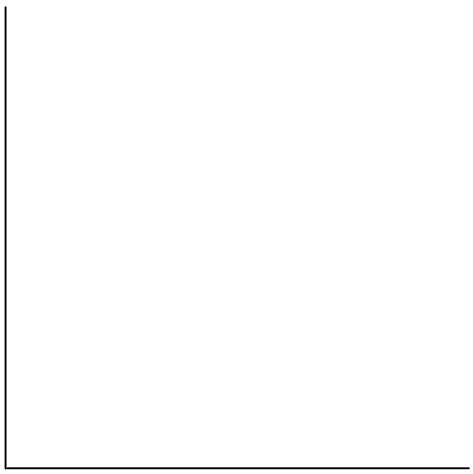
   This will give credibility to the zone and the exchange rate will jump to its "full-credibility locus" i.e. the *S*-shaped curve already derived.

or

2. The authorities do not defend the zone. In this case, the credibility of the zone is lost completely and the exchange rate jumps to its free float value.

The actual relationship between e and v is determined by the condition that, when the exchange rate reaches the boundary of the zone, the expected jump in the exchange rate is zero. If this were not the case potentially infinite capital gains could be made.

Consider the exchange rate reaching the upper boundary of the zone



The value of v at which the exchange rate reaches the boundary of the zone is determined by the requirement that the expected jump in the exchange rate when the boundary is reached is zero. Hence, if $\phi = ½$, then e must reach the boundary of the zone half-way between the full credibility and free-float loci $(v = \tilde{v}(\phi = .5))$.

Alternatively, if $\phi = ¾$, e must reach the zone's boundary at the point where the free float locus is three time the distance from $\overline{e}$ than is the full credibility locus $(v = \tilde{v}(\phi = .75))$

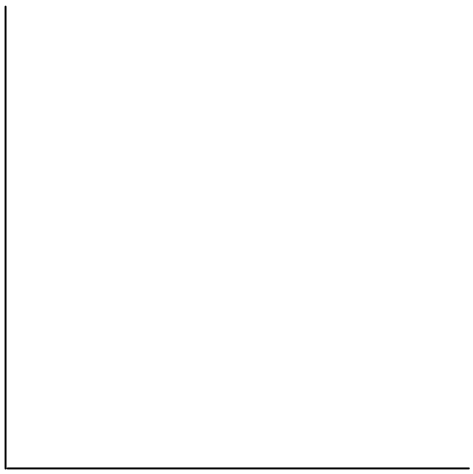
More precisely, letting $\tilde{v}$ be the value of v at which the boundary of the zone is reached, we require:

$$\phi\left[\underbrace{e_{FC}(\tilde{v}) - \overline{e}}_{\substack{\text{Jump if zone defended} \\ (e_{FC}(\tilde{v}) = \\ \text{value of } e \text{ on full credibility locus})}}\right] + (1-\phi)\left[\underbrace{m + \tilde{v} - \overline{e}}_{\substack{\text{Jump if zone not defended} \\ (m + \tilde{v} = \text{free} \\ \text{float value of } e)}}\right] = 0$$

or

$$\phi e_{FC}(\tilde{v}) + (1-\phi)(m+\tilde{v}) = \overline{e}$$

This final equation implicitly defines $\tilde{v}$



Within the zone the relationship between e and v lies between the free float and full credibility loci.

The more credible the commitment to defend the zone (the higher is ϕ) the closer the relationship between e and v lies to the full credibility locus.

The less credible the zone (the lower is ϕ) the closer the relationship between e and v lies to the free float locus.

Note that an imperfectly credible zone stabilises exchange rate movements within the zone by less than a fully credible zone, but still stabilises the exchange rate relative to a free float.

Appendix: Equilibrium Rational Expectations Monetary Model

$e = p - p^*$

$p = m - \phi y_F + \lambda r + v$

$r = r^* + E(de)/dt$

$\therefore e = m + v + \lambda E(de)/dt - \phi y_F + \lambda r^* - p^*$

Normalising by setting $-\phi y_F + \lambda r^* - p^* = 0$ yields (1)