Common Knowledge and the Value of Defending a Fixed Exchange Rate

Louise Allsopp

December 2000
CENTRE FOR INTERNATIONAL ECONOMIC STUDIES

The Centre was established in 1989 by the Economics Department of the Adelaide University to strengthen teaching and research in the field of international economics and closely related disciplines. Its specific objectives are:

- to promote individual and group research by scholars within and outside the Adelaide University
- to strengthen undergraduate and post-graduate education in this field
- to provide shorter training programs in Australia and elsewhere
- to conduct seminars, workshops and conferences for academics and for the wider community
- to publish and promote research results
- to provide specialised consulting services
- to improve public understanding of international economic issues, especially among policy makers and shapers

Both theoretical and empirical, policy-oriented studies are emphasised, with a particular focus on developments within, or of relevance to, the Asia-Pacific region. The Centre’s Director is Professor Kym Anderson (Email kym.anderson@adelaide.edu.au) and Deputy Director, Dr Randy Stringer (Email randy.stringer@adelaide.edu.au)

Further details and a list of publications are available from:

Executive Assistant
CIES
School of Economics
Adelaide University
SA 5005 AUSTRALIA
Telephone: (+61 8) 8303 5672
Facsimile: (+61 8) 8223 1460
Email: cies@adelaide.edu.au

Common Knowledge and the Value of Defending
a Fixed Exchange Rate

Louise Allsopp

School of Economics
Adelaide University, Australia 5005

louise.allsopp@adelaide.edu.au

December 2000

I am particularly indebted to Alan Sutherland, University of St Andrews, UK, and also to two anonymous referees for helpful comments and suggestions. The usual disclaimer applies.
ABSTRACT

Common Knowledge and the Value of Defending a Fixed Exchange Rate

Louise Allsopp

Based on a framework originally developed by Morris and Shin (1995), this model shows how a currency crisis may be triggered by a lack of common knowledge regarding government type. Speculators receive noisy differential information concerning the value a government places on maintaining an exchange rate parity. When this value falls in a particular region, the government will abandon the peg if a sufficient number of speculators sell their currency. However, it will maintain the peg if no attack is launched. This paper shows that, in this region, it is always optimal for the speculators to attack the currency thereby forcing a devaluation.

Keywords: Common Knowledge, Currency Crises

JEL codes: D82, F41

Contact author:
Louise Allsopp
School of Economics
Adelaide University
Australia 5005.
Phone No. (+61 8) 8303 4930
Fax No. (+61 8) 8223 1460
Email: louise.allsopp@adelaide.edu.au
1 Introduction

This paper illustrates how informational events can trigger currency crises using a model based on that of Morris and Shin (1995, 1998). They show how a self fulfilling speculative attack can be launched on a currency when there is a lack of common knowledge among speculators over the state of the economy. This model extends their analysis to consider the case where the fundamentals are known by each investor. Instead it is the value placed by the government on defending a fixed exchange rate which is viewed with a degree of uncertainty. Arguably, this is a more realistic scenario since figures relating to the state of the economy are widely available. However, the government’s degree of commitment to a fixed exchange rate regime is often the cause for debate. This has been seen in terms of the European exchange rate mechanism in 1992 and more recently for the East Asian economies in 1997. In each case, speculators have faced uncertainty regarding the extent to which the national government will intervene in defence of its currency.

This adaptation of the Morris and Shin model assumes that the value placed by the government on maintaining an exchange rate parity is viewed by speculators with an error. It is shown that while the value may only be observed with the smallest degree of error, it can nevertheless culminate in a self fulfilling attack on the currency. Furthermore, this framework raises the issue of capital controls. In particular, the Tobin tax is shown to be effective under particular circumstances in acting as a deterrent to a speculative attack.

The paper is organised as follows. Section 2 provides an overview of
the framework while section 3 outlines the mathematics of the basic model. Section 4 considers the role of information in the model. It is set up to show what would happen if all information were observed without error and then extended to consider the scenario with noisy differential information. The results of the model are discussed in section 5 with particular emphasis given to the implications of a Tobin tax and also to the choice of distribution in the framework. The final section contains concluding remarks.

2 Overview of the Framework

This paper adapts the Morris and Shin framework so as to allow the state of the economy to be known to all players. However, the value placed by the government in retaining a fixed exchange rate is observed by each of the speculators with a degree of error. It is assumed that a tough government places a large value on sustaining the regime whereas a weak government places a small value on maintaining the parity.

There are three possible regions for the value of maintaining an exchange rate. In the stable region, a fixed rate regime will be maintained even if all speculators sell their holdings of the currency since the cost of intervention falls short of the value of sustaining the regime. In the unstable region, the cost of maintaining the regime exceeds the benefit irrespective of the actions of the speculators. In the ‘ripe for attack’ region, the decision to sustain a fixed rate regime depends crucially on the behaviour of the speculators. If they all sell, it is optimal for the government to abandon the regime. However, if they all retain their holdings of the currency, it is then optimal
to maintain the fixed rate regime. In the ‘ripe for attack’ region each investor will sell his holdings of the currency if there is a lack of common knowledge among the speculators concerning the value placed by the government on maintaining a fixed rate.

When each speculator receives differential information concerning the value of an exchange rate, the outcome will be sensitive to this differential information. This is because the value is no longer common knowledge. Even if the degree of noise in the signal is very small, it is never common knowledge that the exchange rate parity will be maintained. Each speculator knows that his payoff depends on the actions of the others. In turn, their actions are determined by their beliefs. It follows that the speculator will be concerned about the beliefs of his counterparts. Despite receiving a message which rules out certain values, he may still have to consider these values since they may contain information about his opponents’ beliefs. His opponents face the same problem. It follows that although every player knows that the exchange rate can be maintained at its current parity, they must take into consideration what would happen if this parity was unsustainable because the actions of other speculators may make it unsustainable.

Within the framework, selling the domestic currency yields a fixed, known payoff. However, holding on to the currency is risky. The returns are high if the speculators agree not to attack but low if the currency collapses. Unless these speculators can agree on how to interpret their news, remaining in the currency is not optimal. Therefore, when each speculator receives a signal, independently and uniformly distributed around the true value placed on the exchange rate, the target rate collapses in both the unstable and ‘ripe
for attack’ regions.

3 Model Outline

Firstly, it is assumed that there are a large number of speculators to ensure that each one is small in relation to the total population. The model uses a flow demand and supply for foreign exchange and hence demand for the currency determined through the foreign exchange market is denoted by:

\[ D(e) \]  \hspace{1cm} (1)

where \( e \) is the exchange rate and \( D(e) \) is a flow concept. A large value of \( e \) implies a strong domestic currency. It follows that demand for domestic currency is decreasing in \( e \). At the start of the game, each speculator holds domestic currency. In total, these holdings have been normalised to 1. The aggregate sale of the currency is denoted by \( s \). It is assumed that even under a floating regime there is some degree of government intervention denoted by \( I(v) \) where \( v \) is the value that the government places on maintaining the parity. A tough government will intervene to a greater degree under a floating regime than will a weaker government.

If the currency is allowed to float, the exchange rate will be determined by the intersection of the supply and demand schedules. The point of equilibrium is denoted by:

\[ f(v, s) \]  \hspace{1cm} (2)
which is that value of the exchange rate at which demand for the currency equals supply so that:

\[ I(v) + D(e) = s \]  

(3)

\( f(v, s) \) is decreasing in \( s \) and increasing in \( v \).

It is further assumed that the government has an exchange rate target of \( e^* \). This represents the fixed rate which, it is assumed, exceeds the floating rate. This implies that intervention to support the target is necessary if the fixed rate regime is to be maintained. The government can achieve this through purchasing domestic currency and thereby incur a cost of \( c(x) \) where \( x \) denotes the quantity of currency to be bought. It is assumed that, firstly, this cost increases in \( x \) and that it is a one off cost. Secondly, the government will undertake some level of intervention. The value placed on maintaining the target denoted by \( v \) is drawn from a uniform distribution on the interval \([0, 1]\). If it is at its lowest point, 0, the cost of intervention exceeds the benefit from maintaining the exchange rate parity.

As in the original Morris and Shin framework, it is now possible to identify three regions for the value of \( v \). Firstly, there is \( v^* \). Beyond this point, even if all speculators sell their holdings of the currency, the cost of intervention falls short of the value of maintaining the parity. This is given by \( c \left[ -D(e^*) + 1 \right] = v^* \). Note that \(-D(e^*) + 1\) is the net supply of domestic currency which the government must purchase when all speculators sell their holdings of the currency. This is known as the stable region and is defined where \( v \in [v^*, 1] \). Here the exchange rate parity will be maintained and the actions of the
speculators do not affect the decision by the government to remain in the exchange rate regime.

The value $v_s$ solves $c \left[ -D (c^*) \right] = v_s$. Below this value of $v$, the cost of intervention is in excess of the benefit even if no speculator sells his currency. This is the unstable region defined for values of $v$ where $v \in [0, v_s]$. Once more, the actions of the speculators do not affect the decision by the government. This time it chooses not to maintain the exchange rate target.

For a value of $v$ in the interval, $v \in [v_s, v^*]$, the behaviour of the speculators determines the decision by the government to intervene. If all speculators choose to retain their holdings of the currency, then the cost of intervening is less than the value of maintaining the parity. However, if all speculators choose to sell their holdings, it is optimal for the government to abandon the target.

In this region, it follows that if more than a certain proportion of speculators sell their holdings of the currency, the government will be compelled to abandon the currency. This proportion of speculators required to trigger an exit from the system is called the trigger mass and is given by $\alpha (v)$. Notably, where $v$ is equal to $v_s$, $\alpha (v_s) = 0$ and for $v$ equal to $v^*$, $\alpha (v^*) = 1$. As in the Morris and Shin framework, a condition is imposed on the floating rate such that the stronger the government, the smaller will be the devaluation i.e. $f [v, \alpha (v)]$ is weakly increasing in $v$.

It is assumed that each speculator can sell all of his holdings or retain all his holdings. He does not sell a fraction of what he holds. In selling his share of currency, he bears a fixed cost, $t > 0$. This can represent a transactions cost or tax.
His payoff is dependent on the government’s decision to maintain or abandon the target. If the target is maintained and the speculator retains his holdings of domestic currency his payoff is normalised to 0. If the government abandons the target rate and the speculator does not switch out of the currency, his payoff will be the difference between the floating rate and the target:

\[ f - e^* \]  \hspace{1cm} (4)

If he sells his holdings of currency he can expect the fixed payoff of:

\[ -t \]  \hspace{1cm} (5)

which is unrelated to the value of maintaining the target rate.

4 Information in the Model

Having described the components of this model, it is important to investigate the role of information and common knowledge. In the first instance, it is assumed that the speculators can observe \( v \) without error. The value to be placed on sustaining the target rate, \( e^* \) is determined. The speculators view this perfectly and then decide whether to retain their holdings of domestic currency. This then decides the aggregate sale, \( s \). Having observed this, the government then chooses whether to intervene in support of the currency. This determines the exchange rate and hence the speculators receive their payoffs.
This is a very basic scenario in which the speculators have perfect information. They know that if \( v \) falls in the stable region, the government will sustain the target rate irrespective of speculative behaviour. Therefore, it is optimal to retain their holdings of currency. Conversely, if they observe a value of \( v \) in the unstable region, it is optimal to sell the currency since the government will not support the fixed rate even if all speculators retain their holdings.

Within the ripe for attack region, the actions of the government will depend on speculative behaviour. This is a situation of multiple equilibria since if all speculators co-ordinate their actions and retain their holdings, the government will find it optimal to defend the target. However, if they all sell their currency then the government will find that the costs of defending the target exceed the benefit. Hence, it will devalue the currency.

A similar result emerges even when it is assumed that \( v \) is observed with a degree of error. In this scenario, each speculator views a public signal. This is known to be observed with an error which lies within \( \epsilon \) of the true value, \( v \), so \( \epsilon \) represents a limit to the distribution. The speculators receive a message, \( m \), which is conditional on \( v \) and uniformly distributed over the interval, \( [v - \epsilon, v + \epsilon] \). The significance of this is that the message is still common knowledge. Although any decision by the speculators will now be determined by the message, \( m \), the three regions will still exist. The logic of this is as follows. Each speculator receives the same incorrect public signal within the interval. Therefore, there is no discrepancy in how to interpret the signal. It follows that each speculator will abandon the currency if the message tells him that the value is sufficiently small. Conversely, he will retain his
holdings if the message, \( m \), is large. However, if the speculator receives a message \( m \) such that a devaluation could occur if sufficient numbers attack the currency, he perceives the value as falling in a ripe for attack region. It follows that, multiple equilibria will still be a feature of the ripe for attack region. Therefore, the outcome is the same as in the perfect information case.

However, the result is different if the speculators observe differential information which is noisy. It is assumed that each speculator receives a message, \( m \), from the interval, \([v - \epsilon, v + \epsilon]\). These messages are assumed to be independent across speculators and are uniformly distributed over the interval, \([v - \epsilon, v + \epsilon]\). As in the Morris and Shin framework, this paper considers the equilibria determined by a \( k \) trigger strategy. The speculator sells his holding of domestic currency if he receives a message which is less than \( k \). If the message, \( m \), is in excess of \( k \), then he retains his currency. If each speculator behaves according to this decision rule then an equilibrium is known as a \( k \) trigger equilibrium.

Payoffs for the speculators are as before. They receive \(-t\) if they sell their holdings and \(0\) if they retain the currency and, subsequently, the target is maintained. If the target is abandoned by the government and the speculators are holding domestic currency, the payoff is \( f - e^* \). The aggregate sale will depend upon the number of speculators who have received news less than \( k \). The sale of currency is denoted by:

\[
s(v, k) \tag{6}
\]
This is the aggregate sale when the value of sustaining the target rate is 
v and all speculators employ the k trigger strategy. When the true v lies 
below k - \epsilon, all speculators will have received a message that falls short of k.
Therefore, they will all choose to sell their currency holdings. Conversely, if 
the true value of v exceeds k + \epsilon, all speculators will have received a message 
greater than k. Therefore, none of them will choose to sell their currency. 
However, when v falls between k + \epsilon and k - \epsilon, aggregate sales will be \frac{k + \epsilon - v}{2\epsilon}.
The reason is that speculators receive a message between v + \epsilon and v - \epsilon i.e. 
within a 2\epsilon interval. If they adopt a k trigger strategy then aggregate sales 
will be determined by those speculators receiving a message smaller than k. 
It follows that s(v, k) is given by:

\[
s(v, k) = \begin{cases} 
0 & : v \geq k + \epsilon \\
1 & : v \leq k - \epsilon \\
\frac{k + \epsilon - v}{2\epsilon} & : k - \epsilon < v < k + \epsilon 
\end{cases}
\] (7)

This is best illustrated graphically using figure 1. The horizontal axis 
measures the aggregate sale of the currency. This falls between 0 and 1. 
The value placed by the government in maintaining the fixed exchange rate 
is plotted on the vertical axis. Note that the distance between 0 and v_s 
represents the unstable region, the area between v^* and 1 represents the 
stable region and the area between v_s and v^* is the ripe for attack region.

**Insert Figure 1 Here**

The upward sloping line represents the cost of intervention. This inter-
sects the vertical axis at v_s since this value solves c (-D (v^*)) = v_s. Con-
versely, the value, v^* solves c (-D (v^*) + 1) = v^* and occurs when sale of
the currency equals 1. The sale of the currency is given by $s(v, k)$. This is downward sloping since the larger the value placed by the government on maintaining the exchange rate, the smaller the aggregate sale of the currency. This intersects the vertical axis where $v$ equals $k + \epsilon$. At this point, sales of the currency equal zero since if all speculators employ the $k$ trigger strategy, then this will imply that no one sells their holdings of the currency. Conversely, where $v$ equals $k - \epsilon$, all speculators will choose to sell their holdings of the currency and so sale of sterling equals 1. The intersection point of these two schedules occurs where the cost of maintaining the parity given the aggregate sale of the currency is just equal to the value, $v$.

The floating exchange rate is increasing in $v$, while $s(v, k)$ is decreasing in $v$. It follows that the function, $f[v, s(v, k)]$ is increasing in $v$.

When the speculators decide on whether to sell their currency, they take into account the likelihood of government intervention. As in the Morris and Shin framework, it is now possible to assign a number:

\[ d(k) \]

for any value of $k \in (v^* + \epsilon, v^* - \epsilon)$ which denotes the value of $v$ at which the government is indifferent between sustaining the target rate and devaluing the currency. It is, therefore, the value of $v$ which solves

\[ c \left[ s(v, k) - D(e^*) \right] = v \]

(9)

and also
\[ s(v, k) = \alpha(v) \]  

(10)

This is known as the *devaluation point* for a \( k \) trigger strategy. Again this can be seen using figure 1.

The total intervention necessary to maintain the parity is given by \( s(v, k) - D(e^*) \). It follows that the cost of intervening is then \( c [s(v, k) - D(e^*)] \) which increases in \( s \). The trigger mass is that value of \( s \) which solves \( c [s(v, k) - D(e^*)] = v \) i.e. it is the intersection of the cost function with \( s(v, k) \). When \( v \) falls below this, the exchange rate at the end of the game i.e. the *post intervention exchange rate* will be the floating rate. If it exceeds this point, the target rate will prevail. This can be seen in the diagram by selecting a point for \( v \) and then examining the respective values of \( c [s(v, k) - D(e^*)] \) and \( s(v, k) \). The post intervention exchange rate is denoted by:

\[
\psi(v, k) = \begin{cases} 
  e^* & : \ v \geq d(k) \\
  f[v, s(v, k)] & : \ v < d(k) 
\end{cases}
\]  

(11)

where \( \psi(v, k) \) is non decreasing in \( v \). When \( v \) exceeds \( d(k) \), the exchange rate is defended and hence the payoff to the speculator holding the domestic currency is 0. If \( v \) is smaller than \( d(k) \), the peg collapses and hence the floating rate prevails. Here, the payoff to holding the currency is \( f(v, s(v, k)) - e^* \).
5 Model Solution

It can now be shown that for any \( k \) in the interval \( k \in (v_*, \epsilon, v^* - \epsilon) \), there is a tax rate \( t > 0 \) which makes the \( k \) trigger strategy a symmetric equilibrium strategy. A speculator receiving a message in the above interval will know that the true value of \( v \) falls in the ripe for attack region. The above statement says that for any message that tells him that \( v \) is in the ripe for attack region, there exists a unique tax rate for which this \( k \) is a trigger point. The above may be demonstrated in two steps.

Step 1 When all other speculators adopt a \( k \) trigger strategy, it is optimal for the \( i \)th speculator to do likewise. Consider the scenario where all but the \( i \)th speculator follow the \( k \) trigger strategy and speculator \( i \) receives the message, \( k^t \). Equation (12) shows the conditional expected payoff for the \( i \)th speculator in this case. In short, it shows the expected payoff for a speculator receiving message \( k^t \) when the remaining speculators use the \( k \) trigger strategy.

\[
\Pi(k^t, k) = \frac{1}{2\epsilon} \int_{k^t - \epsilon}^{k^t + \epsilon} \left[ \psi(v, k) - \epsilon^* \right] dv
\]

(12)

Note that speculator \( i \)'s conditional density over \( v \) given the message, \( k^t \) is uniform over \([k^t - \epsilon, k^t + \epsilon]\). It has already been noted that the post intervention exchange rate, \( \psi(v, k) \), is non decreasing in \( v \). Therefore, it follows that speculator \( i \)'s expected payoff is also non decreasing in \( v \) and is weakly increasing in \( k^t \).

Step 2 Now consider the expected payoff from holding the currency conditional on message \( k \) when all other speculators are adopting the \( k \) trigger strategy.
strategy. The payoff to a speculator who receives message $k$ when all other speculators are following a $k$ trigger strategy is:

$$
\Pi(k, k) = \frac{1}{2\epsilon} \int_{k-\epsilon}^{k+\epsilon} [\psi(v, k) - e^*] \, dv = \frac{1}{2\epsilon} \int_{k-\epsilon}^{d(k)} \left\{ f[v, s(v, k)] - e^* \right\} \, dv < 0
$$

(13)

The first half of (13) shows the payoff to holding the domestic currency for values of $v$ in the interval $[k + \epsilon, k - \epsilon]$. The second half of (13) follows from the fact that those values of $v$ in excess of $d(k)$ yield a payoff of 0 for the speculator since the peg is maintained. Below the devaluation point, $d(k)$, the post intervention rate, $\psi(v, k)$, is equal to the floating rate, $f[v, s(v, k)]$, since the peg is abandoned. The reason for the inequality at the end of (13) follows from the premise that for values of $v$ less than the devaluation point, the payoff from retaining domestic currency is negative. Since (12) is increasing in $kt$, it follows that a speculator receiving a message in excess of $k$ will prefer to retain his holdings while if he receives a message below $k$ he will want to sell the currency. Therefore, $k$ is the optimal trigger point. Furthermore, a tax rate set at the level, $t = -\Pi(k, k)$ will ensure that a speculator is indifferent between holding domestic currency and selling his share.

It can now be shown that for any message, $m \in (v_* + \epsilon, v^* - \epsilon)$, there is a tax level, $t_0 > 0$ below which all speculators will want to sell their holdings of the currency given $m$. This is an important result since it suggests that when differential information is noisy, a low tax rate induces a speculator to sell his currency if he knows $v$ falls in the ripe for attack region. This can
be shown using the following steps. The relevance of each of the findings in Steps 1-3 will become clear when the conditional expected payoff is examined in (16).

**Step 1** When the value of maintaining the target \( v = d(k) \), the sale of domestic currency, \( s(v, k) = \alpha(v) \). Note that \( s(v, k) \) decreases in \( v \) but \( \alpha(v) \) increases in \( v \). As \( v \) increases, it takes a larger proportion of speculators attacking the currency to force a devaluation. Conversely, as \( v \) gets larger, the aggregate sale of the currency will decrease. This means that:

\[
f[v, s(v, k)] \leq f[v, \alpha(v)]
\]  

(14)

When \( v \) is such that the function, \( f[v, s(v, k)] \), equals \( f[v, \alpha(v)] \), the quantity of currency sold coincides with the trigger mass. In figure 1, this is the point of intersection of the two schedules. However, when \( v \leq d(k) \), the result is (14). Here the quantity of currency sold exceeds the trigger mass and hence a devaluation will occur.

**Step 2** When \( k \in (v^*_s + \epsilon, v^* - \epsilon) \), it can be shown that \( k - \epsilon < d(k) < k + \epsilon \). This says that when the value of \( k \) falls within the ripe for attack region, the devaluation point falls within \( \epsilon \) of \( k \). The fact that it falls within this interval is important in the context of the speculator’s expected payoff. Equation (7) shows that when \( v \) falls in the interval \( (k - \epsilon, k + \epsilon) \), the aggregate sale of the currency will be given by \( \frac{k + \epsilon - v}{2\epsilon} \). A devaluation will occur at this point if the trigger mass, \( \alpha(v) = \frac{k + \epsilon - v}{2\epsilon} \). Rearranging this gives the value of \( v \) at which a devaluation will occur i.e. it is the value of \( v \) which solves:
\[ v = k + \epsilon \left[ 1 - 2\alpha(v) \right] \]  

where \( 0 < \alpha(v) < 1 \). It follows that this value of \( v \) must lie in the ripe for attack region since \( k \in (v_s + \epsilon, v^* - \epsilon) \).

Step 3 It can also be shown that within the interval \((v_s + \epsilon, v^* - \epsilon)\), \( d(k) \) is invertible and increasing in \( k \) and \( d(k) - k \) is decreasing in \( k \). In figure 1 this is apparent since an increase in \( k \) within this interval leads to corresponding shifts in the cost function and \( s(v, k) \). Algebraically, this can be seen by examining \( k = v - \epsilon \left[ 1 - 2\alpha(v) \right] \). Since \( \alpha \) depends on \( v \), so too does \( k \). It is apparent that \( d(k) \) is increasing in \( k \) since its inverse is increasing in \( v \) over the interval \((v_s, v^*)\). In considering \( d(k) - k \), note that it is decreasing in \( k \) since \( \alpha \) and \( d^{-1} \) are increasing functions in \( d(k) - k = \epsilon \{1 - 2\alpha [d^{-1}(k)]\} \).

Result Each of the preceding three steps helps to explain the following result. If a speculator receives a message in the interval \( m \in (v_s + \epsilon, v^* - \epsilon) \), then where \( k \leq m \), the expected payoff produces the following:

\[
\Pi(k, k) = \frac{1}{2\epsilon} \int_{k-\epsilon}^{d(k)} \left\{ f \left[ v, s(v, k) \right] - e^* \right\} dv \leq \frac{1}{2\epsilon} \int_{k-\epsilon}^{d(k)} \left\{ f \left[ v, \alpha(v) \right] - e^* \right\} dv
\]

\[
\leq \frac{1}{2\epsilon} \int_{m-\epsilon}^{d(m)} \left\{ f \left[ v, \alpha(v) \right] - e^* \right\} dv < 0
\]

This is a similar result to that found by Morris and Shin. The first part of the equation follows from (13). This is the payoff to a speculator when all others are following the \( k \) trigger strategy. The first inequality arises since \( f \left[ v, s(v, k) \right] \) is bounded by \( f \left[ v, \alpha(v) \right] \). This was shown in (14). It was noted
that when \( v \leq d(k) \), the function, \( f[v, s(v, k)] \) was smaller than \( f[v, \alpha(v)] \). The second inequality follows from Step 3. Although \( f[v, \alpha(v)] \) increases in \( v \), it has been shown that \( d(m) - m \leq d(k) - k \). It follows that the final integral must be negative since, in the ripe for attack region, \( f[v, \alpha(v)] \) falls short of the target rate. The expected payoff for the speculator implies that, in the absence of capital controls, the optimal strategy is to sell the currency when \( v \) falls in the ripe for attack region. Hence, multiple equilibria do not appear in this scenario. The best response for a speculator receiving this information is to abandon the currency. This then triggers a devaluation.

However, consider now a tax level of:

\[
t_0 = -\frac{1}{2\epsilon} \int_{m-\epsilon}^{d(m)} [f(v, 0) - \epsilon^+] \, dv
\]  

(17)

If the value of \( v \) is such that the trigger mass is 0, a tax given by \( t_0 \) implies that the cost of leaving the currency will be equal to the expected payoff from retaining holdings. Any value of \( t \) which is smaller than this will imply an attack on the currency. In this instance it is never optimal to retain the currency for any value of \( k \leq m \) and it is not possible to find a trigger equilibrium. This gives the result that for any message in the ripe for attack region, there is a unique tax level below which all speculators will sell their currency.

5.1 Tobin Tax

The last decade has witnessed a series of currency crises worldwide and hence there is already an extensive literature on the relative merits of the Tobin
tax in deterring future crises. The arguments for and against such a proposal are given in ul-Haq, Kaul and Grunberg (1996). Capital controls have been considered in the light of the Mexican peso problem (Griffith-Jones, 1998) and for the member countries of the European exchange rate mechanism. Eichengreen, Tobin and Wyplosz (1995) argue that a small tax on foreign exchange would stabilise the European Monetary System. Jeanne (1996) shows that a Tobin tax of 0.1% would have had large stabilising effects on the French franc between 1991 and 1993. However, the advent of the East Asian crisis caused a renewed interest in the area. Krugman (1999) considered the large taxes imposed by Malaysia during this period and many other economists are now reconsidering the option of a Tobin tax (Bird and Rajan, 1999).

The existence of common knowledge in this model has important implications for a Tobin tax. In the first instance where investors observe a public signal which falls within $e$ of the true value, there is common knowledge in the content of the message. This implies a situation of multiple equilibria as in the case of perfect information. An attack need not occur in the ripe for attack region if investors agree on how to interpret the public signal. Imposing a large transactions tax may therefore be unnecessary when the value of retaining the exchange rate falls within this region.

In the absence of capital controls, a speculative attack becomes optimal not only in the unstable region but also in the ripe for attack region when there is noisy differential information. This is because the value placed on maintaining an exchange rate is not common knowledge among investors. However, it has been shown that when a message is received which falls in
this interval, there is a tax level above which it becomes optimal not to attack the currency. Here the cost of a speculative attack outweighs the benefit of holding the domestic currency. Thus if the monetary authorities apply the appropriate tax level within the ripe for attack region, it can deter a speculative attack. This is consistent with the findings of Heinemann (2000). It follows that the crucial element in this model is the lack of common knowledge when investors receive noisy differential information.

5.2 Choice of Distribution

This model is an adaptation of the framework used by Morris and Shin (1995, 1998). Therefore, it is not surprising that the results match their findings. However, it has subsequently been shown that the choice of distribution is crucial in this type of analysis. The Morris and Shin framework has become widely cited and used as the basis for further research into the area.

Chan and Chiu (2000) show that under a more general specification, the existence of noisy private observations will not be enough to prevent multiple equilibria in the framework. They retain the assumption that each speculator receives a private signal which will differ from that of his counterparts. However, in contrast to the Morris and Shin framework (and also this paper), their model implies that a greater degree of transparency of information will lead to more crises. In short, Chan and Chiu show that transparency may trigger crises even when fundamentals are healthy.

A similar argument has been made by Sbracia and Zaghini (2000). In their model, all speculators observe the same public information concerning
the fundamentals. They also note that lack of common knowledge will not be sufficient to eliminate multiple equilibria.

However, the results of Heinemann and Illing (2000) add support to the original Morris and Shin framework. As in the aforementioned models, the Morris and Shin framework is adapted to consider a broader class of probability distribution. The authors use the technique of iterated elimination of dominated strategies to show that uniqueness will still prevail. While Chan and Chiu (2000) note that this is a weaker solution concept than the Nash equilibria obtained in their framework, it is nevertheless, a useful result.

The reason for outlining these papers is to stress the role of the probability distribution within this model. The results which have been obtained are consistent with those of Morris and Shin and also Heinemann (2000). However, it is important to qualify these results by noting that they rely on the distribution itself as well as the nature of the solution concept.

6 Conclusion

This paper illustrates how Morris and Shin’s model of currency crises may be extended to consider the case where speculators have differential information regarding government type. When there is a lack of common knowledge of the value a government places on maintaining a target rate, it becomes optimal for each speculator to attack the currency when this value lies in the ‘ripe for attack’ region. Conversely, when differential information is observed with an error in the form of a public signal, an attack need not take place in this region. This is because the news received is common knowledge and hence,
speculators can agree on how to interpret it. It is only when this differential information becomes noisy that it becomes optimal for each speculator to attack in the ripe for attack region.

If \( v \) lies in this region, the government can avoid a crisis by imposing a Tobin tax which ensures that no attack will be optimal. It follows that, in the context of this model, there is a specific role for the Tobin tax in deterring a speculative attack.

However, it has been noted that these results are dependent on the choice of probability distribution as well as the solution concept. In future research, it would be worthwhile investigating the impact of government type given a broader class of distribution. Nevertheless, it is hoped that this paper represents a positive contribution to the growing literature in the area.
Figure 1: The Decision to Abandon or Maintain the Currency
References


The CIES Discussion Paper series provides a means of circulating promptly papers of interest to the research and policy communities and written by staff and visitors associated with the Centre for International Economic Studies (CIES) at the Adelaide University. Its purpose is to stimulate discussion of issues of contemporary policy relevance among non-economists as well as economists. To that end the papers are non-technical in nature and more widely accessible than papers published in specialist academic journals and books. (Prior to April 1999 this was called the CIES Policy Discussion Paper series. Since then the former CIES Seminar Paper series has been merged with this series.)

Copies of CIES Policy Discussion Papers may be downloaded from our Web site at http://www.adelaide.edu.au/cies/ or are available by contacting the Executive Assistant, CIES, School of Economics, Adelaide University, SA 5005 AUSTRALIA. Tel: (+61 8) 8303 5672. Fax: (+61 8) 8223 1460. Email: cies@adelaide.edu.au. Single copies are free on request; the cost to institutions is US$5.00 overseas or A$5.50 (incl. GST) in Australia each including postage and handling.

For a full list of CIES publications, visit our Web site at http://www.adelaide.edu.au/cies/ or write, email or fax to the above address for our List of Publications by CIES Researchers, 1989 to 1999 plus updates.

0042 Rajan, Ramkishen S. and Rahul Sen, "Hong Kong, Singapore and the East Asian Crisis: How Important were Trade Spillovers?", November 2000.
0041 Li Lin, Chang and Ramkishen S. Rajan, "Regional Versus Multilateral Solutions to Transboundary Environmental Problems: Insights from the Southeast Asian Haze", October 2000. (Forthcoming in The World Economy, 2000.)


0026 Alston, Julian M., John W Freebairn, and Jennifer James, "Beggar-thy-Neighbour Advertising: Theory and Application to Generic Commodity Promotion Programs", May 2000.


0023 Peng, Chao Yang, "Integrating Local, Regional and Global Assessment in China's Air Pollution Control Policy", May 2000.


