The Double Play: Simultaneous Speculative Attacks on Currency and Equity Markets[1]

Sujit Chakravorti
Federal Reserve Bank of Chicago

Subir Lall
International Monetary Fund

December 2000

Abstract

This paper investigates the potential for foreign speculators to profit from simultaneously taking short positions in foreign exchange and equity markets under a fixed exchange rate regime, in what has been termed as the "double play." Such a strategy is considered when the monetary authority is faced with two conflicting objectives—exchange rate stability and low interest rates. While the monetary authority may not be able to directly intervene to stabilize interest rates under the fixed exchange rate regime, it may consider intervention in equity markets to head off speculative pressure on interest rates. The model determines market conditions where speculators may find the double play strategy profitable and the impact of government intervention on speculative short equity positions and the interest rate, concluding that intervention can never simultaneously reduce speculation in the equity and the money markets. In the case where country fundamentals are strong, intervention while reducing short positions in equity markets actually increases short positions in the money market and induces higher interest rates. The paper concludes by discussing the Hong Kong Monetary Authority's intervention in the Hong Kong equity market within the context of this model.

Key Words: equity market intervention, speculative attacks, exchange rates, market manipulation

JEL Classification: E58, E44, F31, G15

Authors' E-mail Addresses: sujit.chakravorti@chi.frb.org and slall@imf.org

[1] This paper was written in part when Chakravorti was a Visiting Scholar at the IMF Research Department. We benefited from comments received on earlier drafts from Vivek Arora, Lucia Dettori, Burkhard Drees, Robert Flood, Anna Ilyina, Anthony Richards, Raymond Robertson, and presentations at the 2000 Western Economic Association International Annual Conference, the 2000 Financial Management Association Conference, the 2000 Australasian Finance and Banking Conference, the Federal Reserve Bank of Chicago and the International Monetary Fund. The views in this paper are our own and not necessarily those of the Federal Reserve Bank of Chicago, the Federal Reserve System, or the International Monetary Fund.

I. INTRODUCTION

The 1997-99 crises in emerging markets has again focused attention on fixed exchange rate regimes and the techniques used by authorities to defend the regime. The dramatic collapse of several Asian currencies, followed by the devaluation of the Brazilian *real* in 1999, has highlighted the difficult policy choices that authorities face when their currencies are under strong speculative pressures.

Innovations in financial markets and the accompanying proliferation of instruments have increased the channels through which investors can take positions on expected asset price movements in emerging markets. In times of crisis, a high degree of volatility has often been transmitted through various markets, posing a dilemma for national authorities in pursuing their policy objectives, which have typically included exchange rate and financial market stability, as well as broader macroeconomic objectives such as growth and price stability.

While the classic speculative attack takes place through on-balance sheet sales of domestic currency and other domestic assets converted into foreign exchange, alternative positions can be taken in markets for other assets such as domestic stocks and bonds, international stocks and bonds, as well as a variety of derivatives such as currency forwards and futures, equity and bond futures, options and total rate of return swaps. While the typical defense of a speculative attack has meant a combination of spot foreign exchange intervention and an interest rate defense, when strong pressures have been felt in markets and instruments other than domestic credit, national authorities have in some cases been tempted to intervene through unorthodox methods to counter speculative pressures.

Some of these interventions have involved alternate uses of foreign exchange reserves such as to buy equity or to buy back outstanding debt, or impositions of restrictions on the mobility of capital. Since the beginning of the Asian crisis in mid-1997, several countries have adopted such unorthodox interventions, raising questions about the implications of such intervention for the behavior of market participants and asset prices in the future (see International Monetary Fund 1999). The line distinguishing orthodox from unorthodox interventions is by definition elastic.

This paper focuses on one such unorthodox intervention. Specifically, the rationale for intervention by a central bank in its stock market under a strict fixed exchange regime is investigated. A notable case of such intervention was by the Hong Kong Monetary Authority in August 1998.[2] The model presented allows speculators to take both long and short positions in equity and money markets subject to a constraint on their access to credit needed for emplacing such positions. Conditions under which a "double play" i.e. a simultaneous shorting of equity and currency/money markets may be a potentially profitable strategy are considered. Speculators attempt to influence interest rates by demanding domestic currency credit to profit from the potential negative effect the consequent interest rate rise would have on equity markets, having already established short equity positions beforehand.

The monetary authority is an entity whose primary objective is the maintenance of the exchange rate regime, but it also has a distaste for interest rate increases and losses from equity market intervention. The model determines what the optimal equity market intervention of the central bank would be under such circumstances, and what the resultant speculative positions are in the stock and money markets, as well as equilibrium interest rates. The model predicts that government intervention in the equity market is only effective in lowering interest rates if the fundamentals are weak to begin with. Furthermore, government intervention increases short positions in the equity markets under such a scenario. Alternatively, if the fundamentals are relatively strong, government intervention into equity markets does not lower interest rates.

This paper is organized as follows. In the next section, we briefly discuss the speculative attack literature. In section 3, we construct a two-period model that incorporates intervention in the equity market. In section 4, we discuss policy implications of such a policy. In section 5, we analyze the Hong Kong Monetary Authority's August 1998 intervention in their equity markets within the context of our model. Finally, in section 6, we conclude.

II. The Speculative Attack Literature

The initial speculative attack literature considered a small country with limited foreign reserves and predicted the timing of collapse of the exchange rate regime (see Krugman (1979) and Flood and Garber (1984)). This literature has been developed in several different directions, including the possibility of self-fulfilling attacks (the so-called Type II models) and central banks with preference functions.

Even if successful, the defense of a pegged exchange rate has its costs, most notably high domestic interest rates. Bensaid and Jeanne (1994) suggest that defending the peg is costly for the monetary authority and this cost alone may provide incentives to abandon the peg. Since speculators are aware of these incentives to abandon the peg, they continue to attack the currency. Bensaid and Jeanne use their model to explain some features of the 1992-93 EMS crisis.

---

[2] Numerous country authorities have at various points in time intervened in equity markets to support policy
continued

Furthermore, the literature had emphasized intervention in the spot foreign exchange market but more recently, Lall (1997) considered intervention by monetary authorities in the forward foreign exchange market and studied the impact of such an intervention on the domestic interest rate. He modeled a central bank that was averse to interest rate squeezes, and also was constrained by the losses it could take on its capital through its intervention in spot and forward markets. Obstfeld (1996), Ozkan and Sutherland (1995), and Drazen and Masson (1994) have also constructed models where a monetary authority's loss function is minimized.

III. The Model

We model the attack on the exchange rate and equity markets as an interaction between the monetary authority and speculators. **Speculators** are profit-maximizing entities that intend to maximize their profits from taking positions in one or more of the money- and equity markets. The **monetary authority** operates the exchange rate arrangement. Its primary goal is to fix the exchange rate, but it also has a distaste for deviations of the interest rate from a target interest rate. Thus, while doing all it can to maintain the exchange rate, within this broad bound it may choose to undertake other policy actions such as equirty market intervention to minimize the interest rate squeezes that may be needed to defend the exchange rate. While one could consider a strict currency board arrangement as one where the monetary authority has no control on interest rates i.e. it is an endogenous variable, that framework is somewhat compatible with a monetary authority that has a distaste for interest rates volatility, because a currency board has to be agnostic to interest rate movements.

objectives through such vehicles e.g. Taiwan Province of China's market stabilization fund.

Speculators who can foresee that the authority will follow a policy that produces a sharp interest rate response, because of the primary objective of defending the exchange rate, may want to trigger such an automatic response, to profit from price movements that the interest rate volatility generates on other asset markets—specifically the equity market. What then can a monetary authority do to maintain the exchange rate regime while limiting interest rate volatility? It may try to reduce the profitability of speculating in the equity market through directly intervening there, and therefore taking pressure away from interest rates, as speculators in a perfect foresight world would find such equity market speculation unprofitable. The basic question then becomes: does such intervention in the equity market reduce (a) rises in interest rates; and (b) speculation i.e. short selling, in equity and money markets.

For analytical tractability, we rely on an exogenous random event to drive the ultimate demise of the exchange rate regime and set up the model in a way that separates and isolates the various phenomena that occur in the very short term money and asset markets during a speculative attack. Under normal circumstances, given the monetary authority's preference, it will do all it can to maintain the exchange rate, i.e. raise interest rates as high as needed, intervene using its reserves, and borrow unlimited amounts to intervene. It is clear that a combination of any two of the above three can be used to defend an exchange rate indefinitely, and the regime would not have to collapse at the time of the attack. In other words, the central bank will not willingly give up the exchange rate regime.

To analyze the question at the heart of this paper, i.e. what will the central banks do *within* that broad policy constraint to minimize the pain of an interest rate squeeze, we allow for the possibility that regardless of the central bank's motives, the exchange rate may nevertheless collapse. A practical way of introducing this notion is to introduce a third terminal end-of-day period wherein a random shock to domestic credit can occur as in Lall (1997) (this could be the imminent collapse of (a) large domestic bank(s) that would then need an extension of credit to keep it afloat, which is a channel to introduce uncertainty in the path of domestic credit as in Flood and Garber (1984)), and where the central bank's access to lines of credit is limited at that point. One interpretation of such a framework is that while the central bank has access to lines of credit to defend its currency against an attack by speculators, it will not have access to such lines to bail out a domestic financial entity whose collapse may be imminent.

A. Speculators' objective function

Speculators are profit-maximizing agents, whose profits are given by the sum of the gains from their capital invested in the equity market and that invested in the money markets. Under this model's framework we want to analyze the attacks on equity markets in the case where no one expects the currency to collapse due to their actions, i.e. the existing institutional mechanisms will allow the central bank to defend the exchange rate against speculation, and the central bank's behavior is predictable. This model does not consider the case where the central bank considers a surprise **one-off** nonstandard response to speculation. Both the central bank and speculators know that the collapse of the exchange rate is going to be dependent solely on the exogenous credit shock, and speculators are trying to manipulate the equity market given everyone's (identical) expectations on the credit shock and hence the expected future exchange rate, to profit from their equity positions.

The individual speculator's optimization problem is the following:

$$\text{Max} \quad \prod_{t+1} = x\left[\left(\frac{e_t}{e_{t+1}}\frac{S_{t+1}}{S_t}\right)-1\right]+y\left[\frac{e_t}{e_{t+1}}(1+r)-1\right], \qquad (1)$$

subject to:

$$|x| + |y| \leq C,$$

where:

$e_t \equiv$ the exchange rate at time t (local currency/\$),
$S_t \equiv$ the value of a stock or an equity index at time t,
$x \equiv$ the quantity of capital invested in the equity market,
$y \equiv$ the quantity of capital invested in the currency market,
$r \equiv$ the domestic one - period interest rate,
$C \equiv$ the total amount of capital available to the speculator.

The profit on an equity position is given by the first part of equation (1) and the profit on a fixed income (i.e. local currency credit) position is given by the second part. The capital constraint limits the overall value of the speculator's position. C can also be interpreted as the limit on access to credit that the speculator has, that can be a multiple of its capital in the case where the speculator is employing leverage.

A necessary condition for profitable long positions in equities (i.e. when x>0) is:

$$\frac{S_{t+1}}{S_t} > \frac{e_{t+1}}{e_t},$$

i.e. the stock market has to rise (fall) by a factor greater (less) than any depreciation (appreciation) of the currency.

Conversely, a necessary condition for a profitable short position in equities (i.e. when x<0) is:

$$\frac{S_{t+1}}{S_t} < \frac{e_{t+1}}{e_t},$$

i.e. the proportionate fall (rise) in the stock index has to be greater (less) than the appreciation (depreciation) of the currency.

B. Market power and the ability to manipulate equity prices

An argument frequently made by market observers with regard to emerging markets is that the relatively small size of the market allows large leveraged international players to manipulate market prices and profit from this manipulation.[3] While the history of financial markets is replete with market corners and bear squeezes, the argument does not apply easily in the current context.[4] Price manipulation in and of itself stemming from having a large position can be profitable if the (or a group of) large player owns or controls the supply of the asset, and may have a claim on it. In a typical market corner, an entity that owns a large segment of the market in an asset, and then provides it to others for shortselling, can profit by raising the prices in that asset, while demanding delivery of the same asset it is owed, which is a typical bear squeeze.[5]

From the point of view of a large leveraged player in a small emerging market, the ability to manipulate prices for profit is not as easily apparent. For instance, while this player may be able to bid equity prices up as a result of being able to purchase a large chunk of the market's free float, the very act of closing out these positions in the absence of actions by other market

[3] This argument has generally been targeted at hedge funds and the proprietary desks of large commercial and investment banks.
[4] See Jarrow (1992) and Allen and Gale (1992) for discussion and examples of market manipulation by speculators.

players would, for the same reasons, drive prices back down, not allowing the speculator to profit from the ability to affect prices. Similarly, while short selling may drive prices down, the closing out of the short positions would move them symmetrically the other way i.e. back up, not allowing profits from short selling. The player could only profit if it can move prices a certain way, and then in addition convince others that prices should move even more in that direction, so that it can close out positions while other market participants are still moving in the opposite direction. As an example, a player may start buying a particular stock, and then convince others that its price will rise even more, and then close out its position by selling the stock at a higher price, while others are still buying.

While this is certainly a potentially profitable way to manipulate markets, it is not related to market power and size. In fact, it is trivial to see that this strategy of price manipulation is more profitable in large liquid markets rather than small illiquid ones, because the speculator would like to emplace its position without moving prices at all as profits are lower if it is acquiring positions while market prices are moving in response to its own position-taking. Being able to convince other market players to take positions to move prices in a direction while oneself taking the opposite position is not related to size of the player, but to possible informational inefficiencies in a market. In fact, any player large or small can exploit these inefficiencies and the smaller player would profit more than a larger player from this.

Since the size of market players is at best irrelevant in enabling them to profitably manipulate prices in a small and illiquid market—and more realistically puts them at a disadvantage—, speculators' market power and size is not a variable that can affect equity prices in this model.

[5] An oft quoted example of this is J.P. Morgan's squeeze of short sellers in the stock of U.S. Steel in 1907.

C. Affecting equity prices through the interest rate impact

The other remaining channel through which equity prices can be "manipulated" is through interest rates. Empirical evidence and a vast theoretical literature document the negative impact of interest rates on equity prices.[6] If there is any way that market participants can raise interest rates and maintain them at a high level, so that equity prices fall, then short selling may be a profitable strategy. However, for this channel to work, equity markets would again have to be deep and liquid, so that the closing out of positions would not move prices against the speculators.

There are two broad channels for raising interest rates by market participants in a currency board regime:

- A large spot sale of the currency would force an automatic contraction in the monetary base, bidding up interest rates.
- A squeeze in the interbank and/or money market would take liquidity out of the banking system and force interest rates up.

For purposes of this model, we assume that speculators have the ability to influence interest rates through demand for domestic credit that they can generate i.e. speculators can suddenly begin to demand huge amounts of credit from the money markets, which will then feed through to the

[6] It may be useful to note that it is rarely the overnight interest rate that has a strong impact on equity valuations. In the United States, market analysts typically focus on the 10-year US Treasury bond as the most important indicator. Furthermore, the impact of temporary shocks to the interest rate on equity prices is generally negligible. However, for purposes of investigating the double play strategy, we assume that even a temporary shock has some impact on the equity market. Otherwise, it is trivial to see the strategy would fail.

central bank. The size of this position in the money market will determine in equilibrium what the interest rates are.

D. The probability of an exchange rate collapse

To compute the probability of collapse of the exchange rate regime, and the exchange rate after the collapse, this paper uses the standard monetary model of the exchange rate. The system of equations is:

$$M_{t+1'} = M_{t+1} + e + \Delta R_{t+1},$$
$$\frac{M_{t+1'}}{P_{t+1'}} = a_0 - a_1 \bar{r},$$
$$e_{t+1'} = \frac{P_{t+1'}}{P*},$$

where:

$M_{t+1} \equiv$ the money supply at time $t+1$,
$e \equiv$ the domestic credit shock at the terminal period $t = 1'$,
$\Delta R_{t+1} \equiv$ the change in foreign exchange reserves at time $t+1$,
$P_{t+1} \equiv$ the level of domestic prices in period $t+1$,
$\bar{r} \equiv$ the target one-period interest rate,
$P* \equiv$ the world price level,

and a_0 and a_1 are constants and strictly positive.

The equations represent the fact that the change in money supply is the sum of changes in reserves and the shock to domestic credit; the equilibrium between real money demand and money supply, and the purchasing power parity assumption. If the exchange rate were to collapse at *t+1'*, the central bank would set the interest rate at the target level $\bar{r}$.

The shadow post-collapse exchange rate based on the above system is given by:

$$e_{t+1'} = \frac{M_{t+1} + \boldsymbol{e} + \Delta R_{t+1}}{P^{*}[a_0 - a_1\overline{r}]}.$$

The probability of a collapse is the probability that the shadow exchange rate is greater than the fixed rate:

$$j(t) = \Pr\left[\frac{M_{t+1} + \boldsymbol{e} + \Delta R_{t+1}}{P^{*} \cdot [a_0 - a_1\overline{r}]} > \bar{e}\right].$$

This can be rewritten as:

$$j(t) = \Pr[\boldsymbol{e} > -\Delta R_t].$$

Thus, the probability of the collapse of the exchange rate is simply the probability that the random shock to domestic credit in the terminal period exhausts all the reserves of the monetary authority because *-DR(t+1)* which is the change in reserves from *t+1*, can never exceed the reserve stock of the country. The expectation at time *t* of the exchange rate at *t+1* will then be given by:

$$e_{t+1} = (1 - j(t))\bar{e} + j(t)e^{+}_{t+1}.$$

E. No Central Bank Equity Market Intervention

The benchmark case is one where the central bank is not concerned about interest rate volatility and simply reacts to changes in the demand for credit in an automatic fashion.

Determination of equity prices

The expected stock price in the next period is a function of:

$$S_{t+1} = f(F_{t+1}, r)$$

where: *F* is a set of exogenous fundamentals positively related to the level of the equity market (such as corporate earnings) while *r*, the interest rate, is negatively related.

We assume the following simple linear form:

$$S_{t+1} = f_2 F_{t+1} - f_3 r, \qquad (2)$$

where:

N_2 ≡ the weight of fundamentals on the future stock price,
N_3 ≡ the weight of the realized interest rate on the future stock price,

0 < N_2, N_3 # 1.

In a strict fixed exchange rate regime, if international price levels are constant, then domestic price levels can not change. One way to consider this if domestic money supply has to remain invariant, i.e. interest rates will move fully in response to shocks to money demand. These relationships can be expressed as:

$$M_t = M_{t+1},$$

and

$$a_0 - a_1 r - a_2 y = a_0 - a_1 \bar{r}.$$

Solving for *r*,

$$r = \bar{r} - \frac{a_2}{a_1} y \qquad (3)$$

Optimal speculative attack

We now solve for the optimal values of x and y. Substituting equations (2) and (3) into equation (1) yields:

$$\text{Max} \quad \prod_{t+1} = x\left[\left(\frac{e_t}{e_{t+1}}\left(\frac{f_2 F_{t+1} - f_3\left(\bar{r} - \frac{a_2}{a_1} y\right)}{S_t}\right)\right) - 1\right] + y\left[\frac{e_t}{e_{t+1}}\left(1 + \bar{r} - \frac{a_2}{a_1} y\right) - 1\right]. \tag{4}$$

subject to:

$|x| + |y| \leq C$

The maximum occurs at:[7]

$$y = \frac{-\frac{e_t}{e_{t+1}}\left[\frac{f_2 F_{t+1} - f_3 \bar{r}}{S_t} + C f_3 \frac{a_2}{a_1} - (1 + \bar{r})\right]}{2\frac{a_2}{a_1}\left(1 + \frac{e_t f_3}{e_{t+1} S_t}\right)}, \tag{5}$$

and

$$x = -C + \frac{\frac{e_t}{e_{t+1}}\left[\frac{f_2 F_{t+1} - f_3 \bar{r}}{S_t} + C f_3 \frac{a_2}{a_1} - (1 + \bar{r})\right]}{2\frac{a_2}{a_1}\left(1 + \frac{e_t f_3}{e_{t+1} S_t}\right)} \tag{6}$$

For y to be negative, the terms inside the bracket in the numerator must be positive. If y is negative, x has to be greater than $-C$. The double play in this formulation could be a trading strategy that players can implement to potentially profit from simultaneously shorting the equity

[7] For the solution to the optimization problem, see the mathematical appendix.

and currency markets. There are ranges within which it is profitable to short both the equity and money markets.

F. Central Bank Equity Market Intervention

Now, we consider a direct equity market intervention by the monetary authority. To limit the increase in the interest rate, the monetary authority intervenes in the equity market to prevent speculators from bidding up the interest rate and profiting from short positions in the equity markets. In addition to a distaste for deviations of the interest rate from its target interest rate, the central bank also has a distaste for expected losses on its capital from its intervention. The loss function can be written as:

$$L = Z(S_{t+1} - S^{+}) + b(r - \bar{r})^{2}, \qquad (7)$$

where:

Z ≡ the monetary authority's long position in the equity market,
S^{+} ≡ the expected value of a stock or an equity index at the time the monetary authority unwinds its position

This setup also assumes that the losses from intervention (in currency and equity markets) is always lower than the infinite cost of abandoning the regime. The central bank's optimal intervention will be derived from the minimization of this loss function.

Determination of equity prices

Equity prices are assumed to vary as:

$$S_{t+1} = f(F_{t+1}, r, Z)$$

The price appreciation of equity will depend upon the fundamentals and the interest rate that has prevailed in the period that the stock or index is being held in addition to the intervention impact:

$$S_{t+1} = f_1 Z + f_2 F_{t+1} - f_3 r \ . \tag{8}$$

Combining equations (7) and (8) yields:

$$L = Z(f_1 Z + f_2 F_{t+1} - f_3 r - S^+) + b\,(r - \bar{r})^2,$$

or

$$L = f_1 Z^2 + f_2 F_{t+1} Z - f_3 r Z - S^+ Z + b\,(r - \bar{r})^2 \, . \tag{9}$$

Substituting equation (3), the interest rate dynamics of the monetary model, into equation (9) yields:

$$L = f_1 Z^2 + f_2 F_{t+1} Z - f_3 \left(\bar{r} - \frac{a_2}{a_1} y \right) Z - S^+ Z + b \left(- \frac{a_2}{a_1} y \right)^2 .$$

The central bank will minimize the above loss function with respect to *Z*, yielding the following first order condition:

$$2Zf_1 + f_2 F_{t+1} - f_3 \left(\bar{r} - \frac{a_2}{a_1} y \right) - S^+ = 0 \, ,$$

resulting in the following optimal stock market intervention:

$$Z = \frac{1}{2f_1} \left[S^+ + f_3 \bar{r} - f_2 F_{t+1} - \frac{a_2 f_3}{a_1} y \right] . \tag{10}$$

Substituting equations (3) and (10) into equation (9) yields:

$$S_{t+1} = \frac{1}{2} \left[S^+ + f_2 F_{t+1} - f_3 \left(\bar{r} - \frac{a_2}{a_1} y \right) \right] . \tag{11}$$

Optimal speculative attack

Substituting equation (11) into the speculator's optimization problem yields:

$$\text{Max} \quad \prod_{t+1} = x\left[\left(\frac{e_t}{e_{t+1}}\left(\frac{S^{+} + f_2 F_{t+1} - f_3\left(\bar{r} - \frac{a_2}{a_1} y\right)}{2S_t}\right)\right) - 1\right] + y\left[\frac{e_t}{e_{t+1}}\left(1 + \left(\bar{r} - \frac{a_2}{a_1} y\right)\right) - 1\right]$$

subject to:

$$|x| + |y| \leq C \ .$$

The maximum occurs at:[8]

$$y = \frac{-\frac{e_t}{e_{t+1}}\left[\frac{S^{+} + f_2 F_{t+1} - f_3 \bar{r}}{2S_t} + C f_3 \frac{a_2}{a_1} - (1+\bar{r})\right]}{2\frac{a_2}{a_1}\left(1 + \frac{e_t f_3}{2e_{t+1} S_t}\right)} \tag{12}$$

and

$$x = -C + \frac{\frac{e_t}{e_{t+1}}\left[\frac{S^{+} + f_2 F_{t+1} - f_3 \bar{r}}{2S_t} + C f_3 \frac{a_2}{a_1} - (1+\bar{r})\right]}{2\frac{a_2}{a_1}\left(1 + \frac{e_t f_3}{2e_{t+1} S_t}\right)} \tag{13}$$

[8] For the solution to this optimization problem, see the mathematical appendix.

Define:

$$\tilde{F} \equiv \frac{1}{f_2}\left[\left(1+\frac{e_t f_3}{e_{t+1}}\right)S^+ + \left(1-\frac{e_t}{e_{t+1}}\right)f_3\,\bar{r} + \left(\frac{a_2 \bar{e}_t f_3^2}{a_1 e_{t+1}}\right)C\right]$$

Comparing equation (13) with equation (6) we find that the speculator shorts the equity market *less* with government intervention if:

$$F_{t+1} > \tilde{F} \qquad (14)$$

This suggests that *ceteris paribus* government intervention in equity markets will reduce short positions taken in equity markets when fundamentals are stronger to begin with. However, in such a case, the speculator will short the money market more. Such a result is intuitive given that if fundamentals are strong, investors would need to devote a greater proportion of their capital to pressuring the money market enough to get a bigger interest rate increase to get a comparable move on equity prices. Therefore for strong fundamentals, i.e. for $F_{t+1} > \tilde{F}$, and signifying positions at $\tilde{F}$ by $\tilde{x}$, $\tilde{y}$, and $\tilde{r}$, we find:

$x > \tilde{x}$ (less short positions in the equity market)

$y < \tilde{y}$ (greater short positions in the money market)

$r > \tilde{r}$ (higher interest rates)

If fundamentals are weak, on the other hand, resources are better spent in shorting the equity market relative to the money market, as it takes less of an interest rate rise to cause a comparable (expected) downward move in equity prices. The monetary authority faces a tradeoff between speculators either taking short positions in the equity markets or the money markets.

Therefore, interventions in the equity market produce several key outcomes: the monetary authority can never simultaneously reduce short positions in both equity and money markets, and hence can not mitigate speculation. If fundamental are strong, intervention reduces short equity market positions, but increase money market shorts and higher interest rates. If fundamentals are weak, intervention increases equity market short positions even more, but reduced money market short positions and interest rate spikes.

IV. Implications of Equity Market Intervention and the Double Play

We now analyze the implications of this simple model. Our model on the double-play strategy yields the following implications. First, the strategy of shorting the money and equity markets simultaneously may result from the expectation of speculators that the currency will depreciate and the economic fundamentals are weak. Although there may be instances under which speculators would short both markets absent these conditions, government intervention cannot simultaneously reduce shorting of both markets. In fact, only under certain conditions will government intervention in the equity market lead to lower interest rates. However, such a policy will also increase short positions in the equity markets.

Furthermore, such interventions may lead to undesirable long-run consequences. First, the unwinding of large equity positions by the government may lead to downward pressure on equity prices at a later date. Second, because governments may not be particularly good at predicting future equity prices, such a strategy is potentially associated with large financial losses if future equity prices fall. Third, government intervention may also lead to artificially high equity prices because of the artificial floor created by such intervention. Fourth, such policies may increase regulatory uncertainty that in turn may have the consequence of making foreign investment less attractive. As our model demonstrates, even the short-term benefits are questionable at best.

V. HKMA'S INTERVENTION IN THE EQUITY MARKETS

An example of intervention in the equity market is the Hong Kong Monetary Authority's (HKMA) purchase of stocks and futures. Between August 14 and 28, 1998, HKMA bought a total of some $15 billion in stocks and futures in the Hong Kong equity market, which constituted 7 percent of the capitalization and between 20 and 35 percent of the free float of the Hang Seng index.[9] This intervention in the equity market was at the time viewed by a wide variety of market participants as a significant departure from Hong Kong's traditional free market principles and clearly took the markets by surprise.[10]

---

[9] The portfolio is currently held by the Exchange Fund Investment Limited (EFIL), according to strict guidelines to avoid interference with the day-to-day commercial activities of the companies. The portfolio was worth some $26.7 billion following the Hong Kong market's 85 percent rise between September 1998 and end-June 1999.

[10] However, under severe pressures in 1987, the authorities had temporarily shut down the stock market altogether with adverse implications for market sentiment.

The Hong Kong authorities have explained their stock market intervention as being targeted at a specific group of speculators that were manipulating Hong Kong's equity and foreign exchange markets for profit in what was termed a “double play,” i.e. a simultaneous attack on equity and currency markets (see Tsang 1998). The authorities perceived certain players as selling Hong Kong dollars to drive up interest rates— taking advantage of the adjustment mechanism of Hong Kong's linked exchange rate arrangement— and depress stock prices, thus generating profits on previously established substantial short positions in the equity cash and futures markets.[11] Certain players were also said to have spread rumors in the market about a Chinese devaluation and its knock-on effect on Hong Kong, and about a collapse of the Hong Kong equity and property markets, to generate selling pressures on the Hong Kong dollar and the stock market. According to the authorities, the speculative attack “was a contrived game with clearly destructive goals in mind...[to] drive up interest rates, drive down share prices, make the local population panic and exert enough pressure on the linked exchange rate until it breaks” (Tsang 1998).

However, some market participants noted that at the time of the pressures, there were fundamental reasons to sell off Hong Kong equity holdings and the Hong Kong dollar. As of August 1998, the Hong Kong economy was heading into its deepest recession in 23 years with recently released figures showing first quarter GDP having shrunk 2.8 percent year-on-year. Other data released around that time showed unemployment at a 15-year high of 4.5 percent, a halving in property prices, and seven consecutive months of falls in retail sales year-on-year.

[11] According to the authorities, some of these sales of Hong Kong dollars may have been facilitated by “prefunding” in the swap market, that is, engaging in swaps to access Hong Kong dollars that multilateral organizations had raised through their bond issuances. Multilateral agencies, including inter alia the World Bank Group, the Asian Development Bank, the Inter-American Development Bank, and the European Bank for Reconstruction and Development, issued HK$36.6 billion (equivalent of US$4.7 billion) worth of bonds in the period January-August 1998.

Corporate earnings reports had also created a negative sentiment in markets. Reflecting these factors and the general speculative pressures in the region, by August 11 the Hang Seng Index (HSI) had slumped 36 percent in 1998, to its lowest level since January 1993.

Furthermore, Asian markets were close to their lowest levels since the onset of the Asian crisis in July 1997 and the outlook for the region was bleak. For example, the IFC Global index for Asia had declined in dollar terms by 60 percent over this period. Regional sentiment was very poor, the affected Asian countries were mired in a deep recession, and foreign investors were cutting back their exposures to emerging markets generally, and to Asian emerging markets in particular. Since Hong Kong SAR is one of the region's most liquid markets, a reduction in Asian regional exposure would trigger sales in Hong Kong's markets, as unwinding of positions in other less liquid markets would generate greater pressures on prices. In addition, the Japanese yen—which had been highly correlated with the HSI—was also at an eight-year low of 147 to the U.S. dollar, affecting sentiment towards Asia negatively. In this regard, the sell-off in Hong Kong was part of a general shift away from Asian emerging markets at a time of poor market sentiment.

Based on the market pressures and information on the positions and intentions of a few large players, the authorities took the unprecedented step of supporting the equity markets to maintain confidence in the economy and the financial system. The HKMA also subsequently made changes in the operation of the linked exchange rate system and the Liquidity Adjustment Facility to make interest rates less volatile to small shifts in the demand for credit, to strengthen the linked exchange rate arrangement. Since the intervention in August, markets have turned around remarkably. The HSI index rose 85 percent between September 1998 and June 1999. A number of factors have been responsible for this turnaround, including the interest rate cuts by the Federal Reserve and other central banks in the fall of 1998, the strength of the yen in the wake of the deleveraging following the near-collapse of LTCM, and improved sentiment and conditions in Hong Kong, and Asia more generally.

VI. Conclusion

This paper presents a simple linear model of a fixed exchange rate regime and an equity market, where speculators have the ability to influence stock market prices through manipulation of domestic interest rates, by sudden and large shifts in demand for domestic credit. Two regimes are considered: one in which the monetary authority is forbidden from intervening in equity markets, and the second where it can do so as was the case of Hong Kong in August 1998.

An important conclusion of this paper is that if government equity purchases reduce the interest rate under certain circumstances, equity prices face greater downward pressure. Furthermore, simultaneously shorting of the money and equity markets could result from an increase in the probability that the authorities may abandon the fixed exchange rate and poor economic fundamentals. Some market participants in Hong Kong claimed that this condition existed in Hong Kong during the summer of 1998. Thus, government intervention in the equity market may either reduce interest rate or reduce the downward price pressure in equity markets but not both.

In addition to the limitations of equity market interventions in the very short run, policymakers should also consider the potentially detrimental long-term consequences. Most notably, such intervention distorts the price mechanism and may also decrease the flow of foreign funds because speculators may perceive greater regulatory uncertainty. As policymakers consider such unorthodox measures to alleviate pressure on financial markets during crises, full consideration should be given to short- and long-term effects.

References:

Allen, Franklin and Douglas Gale (1992), "Stock-Price Manipulation," *Review of Financial Studies*, **5**(3), 503-29

Bensaid, Bernard and Olivier Jeanne (1997), "The Instability of Fixed Exchange Rate Systems when Raising the Nominal Interest Rate Is Costly," *European Economic Review*, **41**, 1461-78

Drazen, Allan and Paul Masson (1994), "Credibility of Policies versus Credibility of Policymakers," *Quarterly Journal of Economics*, **109**, 735-54.

Flood, Robert P., and Peter M. Garber (1984), "Collapsing Exchange-rate Regimes: Some Linear Examples," *Journal of International Economics*, **17**, 1-13.

International Monetary Fund (1999), *International Capital Markets: Developments, Prospects and Key Policy Issues,* 92-101.

Jarrow, Robert A. (1992), "Market Manipulation, Bubbles, Corners, and Short Squeezes," *Journal of Financial and Quantitative Analysis*, **27**(3), 311-36.

Krugman, Paul (1979), "A Model of Balance-of-Payments Crises," *Journal of Money, Credit, and Banking*, **11**, 311-25.

Lall, Subir (1997), "Speculative Attacks, Forward Market Intervention, and the Classic Bear Squeeze," *IMF Working Paper* WP/97/164.

Obstfeld, Maurice (1996), "Models of Currency Crises with Self-fulfilling Features," *European Economic Review*, **40**, 1037-48.

Ozkan, F. Gulcin and Alan Sutherland (1995), "Policy Measures to Avoid a Currency Crisis," *Economic Journal*, **105**, 510-19.

Tsang, Donald (1998), speech at the Hong Kong Trade Development Council, Frankfurt, September 29.

Mathematical Appendix

In this appendix, we solve the speculator's optimization problem when there is no government intervention and when the government intervenes. The first optimization problem where there is no central bank intervention is:

$$\text{Max} \quad \prod_{t+1} = x\left[\left(\frac{e_t}{e_{t+1}}\left(\frac{f_2F_{t+1} - f_3\left(\bar{r} - \frac{a_2}{a_1}y\right)}{S_t}\right)\right) - 1\right] + y\left[\frac{e_t}{e_{t+1}}\left(1 + \bar{r} - \frac{a_2}{a_1}y\right) - 1\right]. \qquad (5)$$

subject to:

$$|x| + |y| \le C$$

The first order conditions with respect to x and y are:

$$\frac{e_t}{e_{t+1}S_t}\left(f_2F_{t+1} - f_3\left(\bar{r} - \frac{a_2}{a_1}y\right)\right) - 1 = 0,$$

and

$$\frac{xe_tf_3a_2}{e_{t+1}S_ta_1} + \frac{e_t}{e_{t+1}}(1+\bar{r}) - 1 - \frac{2e_ta_2}{e_{t+1}a_1}y = 0.$$

The first condition is satisfied when:

$$y = \frac{a_1}{a_2f_3}\left[\frac{S_te_{t+1}}{e_t} - f_2F_{t+1} + f_3\bar{r}\right].$$

Substituting this value of y into the second condition yields:

$$x = \frac{e_{t+1}}{e_t}\left[\left(\frac{S_ta_1}{f_3a_2} + \frac{2S_t^2}{f_3}\right) + \frac{S_ta_1}{f_3}\left(\frac{f_2F_{t+1}}{a_2} - (1+\bar{r}) - \frac{f_3\bar{r}}{a_2}\right)\right].$$

The second order conditions are:

$$\frac{\partial \Pi_{t+1}}{\partial x^2} = 0 \,,$$

$$\frac{-e_t a_2}{e_{t+1} a_1} < 0 \,,$$

and

$$0 < \left[\frac{x e_t f_3 a_2}{e_{t+1} S_t} \right]^2 .$$

Note that the first and third second order conditions do not satisfy the sufficient condition for a maximum. However, the critical point is a saddle point implying that there is no interior solution. The maximum lies at the boundary.

If we consider the conditions for a double play, namely values of x and y that are strictly negative, the optimization problem is bounded from the top by $-x \geq -C$ and $y = 0$, bounded to the right by $-y \geq -C$ and $x = 0$, and bounded from the bottom and to the left by $y = -x - c$. In the x and y plane, the boundary conditions form a triangle where the sides of the triangle are: on the x-axis from 0 to –C, on the y-axis from 0 to –C, and the diagonal line connecting (-C, 0) and (0, -C) for nonpositive x and y. To find the maximum point in this compact set, each leg of this triangle needs to be considered.

First, consider the maximum for $-x \geq -C$ and $y = 0$. Substituting $y = 0$ into equation (5) yields:

$$\prod_{t+1} = x \left[\frac{e_t}{e_{t+1}} \left(\frac{f_2 F_{t+1} - f_3 \bar{r}}{S_t} \right) - 1 \right].$$

Note that x is strictly negative if the term inside the brackets is negative. Hence, the following must hold to generate positive profits with short equity market positions:

$$F_{t+1} < \frac{1}{f_2}\left(\frac{e_{t+1}S_t}{e_t} + f_3\bar{r}\right) \text{ and } \frac{\partial \Pi_{t+1}}{\partial x} < 0 \tag{15}$$

If the above holds, the maximum on this frontier occurs at $x = -C$. The maximum profit is:

$$\prod_{t+1} = -C\left[\frac{e_t}{e_{t+1}}\left(\frac{f_2F_{t+1} - f_3\bar{r}}{S_t}\right) - 1\right].$$

To find the maximum at the boundary to the left, plug in $x = 0$ and $y = -C$ in equation (5):

$$\prod_{t+1} = y\left[\frac{e_t}{e_{t+1}}\left(1 + \bar{r} - \frac{a_2}{a_1}y\right) - 1\right].$$

To find the maximum value of y, differentiate the above with respect to y and set it equal to zero. The maximum y is:

$$y = \frac{a_1}{2a_2}\left[(1+\bar{r}) - \frac{e_{t+1}}{e_t}\right].$$

However, this condition is the one identical to the one where there is no profit to be made from the equity market and a double play is not a strategy under consideration. It can be seen that

$$\frac{\partial \Pi_{t+1}}{\partial y} < 0 \text{ when x=0}$$

Hence, the maximum on this frontier is $y = 0$ and $x = 0$.

Because the top frontier is continuous in x where $y = 0$, the maximum value of these two frontiers occurs at $x = -C$ and $y = 0$ when (15) above is met. Otherwise, profits are zero and no positions are taken, i.e. x=0 and y=0.

To determine the maximum value on the third frontier, the credit constraint is substituted into the speculator's profit function. If certain parameter values are satisfied as we will see below, the maximum on this edge occurs at:

$$y = \frac{-\frac{e_t}{e_{t+1}}\left[\frac{f_2 F_{t+1} - f_3 \bar{r}}{S_t} + C f_3 \frac{a_2}{a_1} - (1+\bar{r})\right]}{2\frac{a_2}{a_1}\left(1 + \frac{e_t f_3}{e_{t+1} S_t}\right)},$$

and

$$x = -C + \frac{\frac{e_t}{e_{t+1}}\left[\frac{f_2 F_{t+1} - f_3 \bar{r}}{S_t} + C f_3 \frac{a_2}{a_1} - (1+\bar{r})\right]}{2\frac{a_2}{a_1}\left(1 + \frac{e_t f_3}{e_{t+1} S_t}\right)}$$

For y to be negative, the terms inside the bracket in the numerator must be positive. If y is negative, x has to be greater than $-C$. Since this point is a maximum on this frontier and the maximum from the other two frontiers is also on this frontier, neither x nor y are zero.

The second optimization problem where the central bank intervenes in the equity market is:

$$\text{Max} \quad \prod_{t+1} = x\left[\left(\frac{e_t}{e_{t+1}}\left(\frac{S^+ + f_2 F_{t+1} - f_3\left(\bar{r} - \frac{a_2}{a_1} y\right)}{2S_t}\right)\right) - 1\right] + y\left[\frac{e_t}{e_{t+1}}\left(1 + \left(\bar{r} - \frac{a_2}{a_1} y\right)\right) - 1\right]$$

subject to:

$$|x| + |y| \le C .$$

The first order conditions are:

$$\left[\frac{e_t}{2e_{t+1}S_t}\left(S^+ + f_2F_{t+1} - f_3\left(\bar{r} - \frac{a_2}{a_1}y\right)\right) - 1\right] = 0 ,$$

and

$$\frac{xe_tf_3a_2}{2e_{t+1}S_ta_1} + \frac{e_t}{e_{t+1}}(1+\bar{r}) - 1 - \frac{2e_ta_2}{e_{t+1}a_1}y = 0 .$$

The first condition is satisfied when:

$$y = \frac{a_1}{a_2f_3}\left[\frac{2S_te_{t+1}}{e_t} - f_2F_{t+1} + f_3\bar{r} - S^+\right].$$

Substituting y into the second condition yields:

$$x = -\frac{S_ta_1}{f_3a_2}\left[1 + \bar{r} + \frac{e_{t+1}}{e_t} + \frac{a_1}{a_2f_3}\left(\frac{2S_te_{t+1}}{e_t} + f_2F_{t+1} + f_3\bar{r} - S^+\right)\right].$$

The second order conditions are:

$$\frac{\partial \Pi_{t+1}}{\partial x^2} = 0 ,$$

$$\frac{-e_ta_2}{e_{t+1}a_1} < 0 ,$$

and

$$0 < \left[\frac{e_tf_3a_2}{e_{t+1}S_ta_1}\right]^2 .$$

Similar to the no intervention case, the second order conditions are not satisfied. Neither the first or third condition satisfy the sufficient conditions necessary for maximum. However, this critical point is a saddle point. Thus, there are no interior solutions for this optimization problem.

Using similar means to determine the maximum profit at the boundaries yields:

$$y = \frac{-\frac{e_t}{e_{t+1}}\left[\frac{S^+ + f_2 F_{t+1} - f_3 \bar{r}}{2S_t} + C f_3 \frac{a_2}{a_1} - (1+\bar{r})\right]}{2\frac{a_2}{a_1}\left(1 + \frac{e_t f_3}{2e_{t+1}S_t}\right)},$$

and

$$x = -C + \frac{\frac{e_t}{e_{t+1}}\left[\frac{S^+ + f_2 F_{t+1} - f_3 \bar{r}}{2S_t} + C f_3 \frac{a_2}{a_1} - (1+\bar{r})\right]}{2\frac{a_2}{a_1}\left(1 + \frac{e_t f_3}{2e_{t+1}S_t}\right)}.$$