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Spot Speculation, Forward Speculation, and Arbitrage: Comment

By HOUSTON H. STOKES*

In his famous article in *Staff Papers*, S. C. Tsiang showed that the return to spot speculation was equal to the return to forward speculation plus the return to interest arbitrage. This note argues that this result is only strictly true in all cases if there is no government (central bank) intervention in the forward market. In some situations of government intervention, Tsiang's result will not hold. As a consequence there is a loss of generality of Tsiang's analysis unless other conditions are specified. In this paper I develop the conditions to tell whether there is government intervention and if such intervention is sufficient to invalidate Tsiang's analysis.

I. The Model

If F is the 90-day forward rate,¹ S is the spot exchange rate, S^e the expected spot rate in 90 days, and i^f and i^d the foreign and domestic 90-day interest rates, respectively, then interest parity² implies

$$(1) \quad F(1 + i^f) = S(1 + i^d)$$

If

$$(2) \quad F^* \equiv \frac{S(1 + i^d)}{(1 + i^f)}$$

there will be an outflow (inflow) of funds

* Assistant professor of economics, University of Illinois at Chicago Circle. I am indebted to Robert Mundell, Harry Johnson, and other members of the University of Chicago International Trade Workshop. Zoran Hodjera of the IMF made many helpful suggestions on an earlier draft. An anonymous referee also contributed. Any remaining errors are my responsibility.

¹ All exchange rates are quoted as the domestic currency price of one unit of the foreign currency. Time subscripts are ignored.

² This interest parity condition, the usual one, is a simplified version of the one Tsiang uses. If one thinks in Tsiang's terms one can "adjust" the interest rates for the subjective marginal convenience yield. This simplification does not affect the analysis.

from the domestic country if F is greater (less) than F^* . If C_{at} is defined as the desired stock of forward contracts held by arbitrageurs in period t , then³

$$(3) \quad C_{at} = \phi(F - F^*) \quad \text{where } \phi < 0$$

Forward speculators will sell (buy) the foreign currency forward if F is greater (less) than S^e . If C_{st} is the desired stock of forward contracts held by forward speculators in period t then

$$(4) \quad C_{st} = \Psi(F - S^e) \quad \text{where } \Psi < 0$$

Parity in the spot speculation market occurs when

$$(5) \quad S(1 + i^d) = S^e(1 + i^f)$$

From equations (5) and (2) we note that spot speculators will acquire the foreign (domestic) currency spot if S^e is greater (less) than F^* . If C_{st}^* is the desired stock of the domestic currency held by spot speculators in period t then

$$(6) \quad C_{st}^* = Z(S^e - F^*) \quad \text{where } Z < 0$$

We can plot equations (3) and (4) as the AA and SS curves where the intersection of SS and AA with the vertical axis is S^e and F^* , respectively. This has been done in Figures 1 and 2.⁴ In the absence of governmental intervention $F^* \geq F \geq S^e$ (Figure 1) or $S^e \geq F \geq F^*$ (Figure 2). Since the return to

³ If C_{at} is negative (positive) arbitrageurs have made an outflow (inflow).

⁴ The graphical treatment of the model is based on B. Reading's work. This model is a simplified version of Tsiang's; I have used it in my 1972 article. If $\phi = -\infty$ then there is perfect capital mobility and the AA curve is perfectly elastic. Here arbitrageurs determine the forward rate. If $\Psi = -\infty$ then the SS curve is perfectly elastic and speculators determine the forward exchange rate. It is impossible for $\phi = -\infty$ and $\Psi = -\infty$ at the same time except in the trivial case where $S^e = F^*$ or the SS curve lies on top of the AA curve.

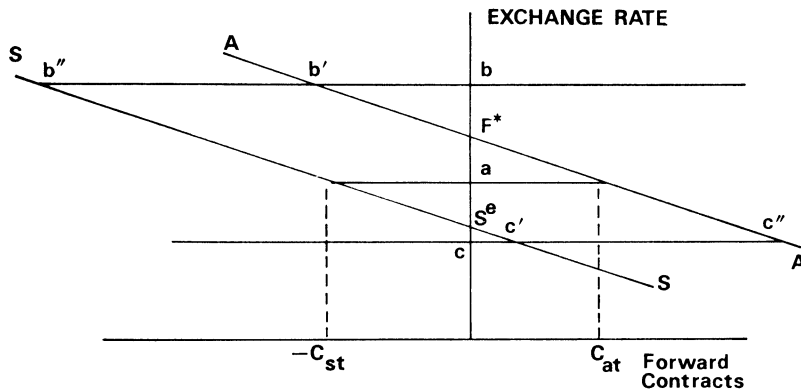


FIGURE 1. NOTE: a=NONINTERVENTION LEVEL OF F

forward speculation is $(|S^e - F|)$, the return to interest arbitrage is $(|F^* - F|)$ and the return to spot speculation is $(|S^e - F^*|)$ it clearly follows that in the absence of governmental intervention in the forward exchange market, Tsiang is correct; the return to spot speculation is equal to the return to forward speculation plus the return to interest arbitrage. This reduces to

$$(7) \quad |S^e - F^*| = |S^e - F| + |F - F^*|$$

We note that in this case

$$(8) \quad |C_{st}| = |C_{at}|$$

If the government intervenes in the forward market it is possible to have⁵ any of the following cases.

⁵ In my 1972 paper, I developed conditions concerning the effectiveness of forward intervention. By differentiating (3) and (6) with respect to F we can derive an expression for the net flow of money to the domestic country (dM_d) due to forward intervention. This reduces to

$$dM_d = dF \left[\frac{\partial S^e}{\partial F} Z + \phi \right] \quad \text{where } \phi \neq -\infty$$

and

$$dM_d = dI \left[\frac{\partial S^e}{\partial F} Z + 1 \right] \quad \text{where } \phi = -\infty$$

and I = the dollar amount of forward contracts of the foreign currency sold by the central bank. This analysis builds on the effect of forward intervention on the position of the AA and SS schedules mentioned briefly by Tsiang but not worked out.

$$(9) \quad F \geq F^* \geq S^e$$

$$(10) \quad F^* \geq S^e \geq F$$

$$(11) \quad F \geq S^e \geq F^*$$

$$(12) \quad S^e \geq F^* \geq F$$

In all these cases, Tsiang's result does not hold. Equation (9) represents the government bidding the forward rate up to b starting from an initial situation represented by point a in Figure 1. The government has bought $bb' + bb''$ forward contracts from the arbitrageurs and forward speculators, respectively. Since F is now no longer between F^* and S^e , Tsiang's statement that the return to spot speculation $|S^e - F^*|$ is equal to the return to forward speculation $|S^e - F|$ plus the return to arbitrage $|F - F^*|$ is not correct. In this situation the return to forward speculation $|F - S^e|$ is equal to the return on arbitrage $|F - F^*|$ plus the return to spot speculation $|S^e - F^*|$.

In equation (10) the government starting from initial equilibrium in Figure 1 has sold contracts to the arbitrageurs and forward speculators driving the forward rate to c . Total government sales of forward contracts are equal to $cc' + cc''$. Here again Tsiang's proof does not hold. In this situation the return to arbitrage $|F - F^*|$ is equal to the return to spot speculation $|S^e - F^*|$ plus the return to forward speculation $|S^e - F|$.

In equation (11) the government starting

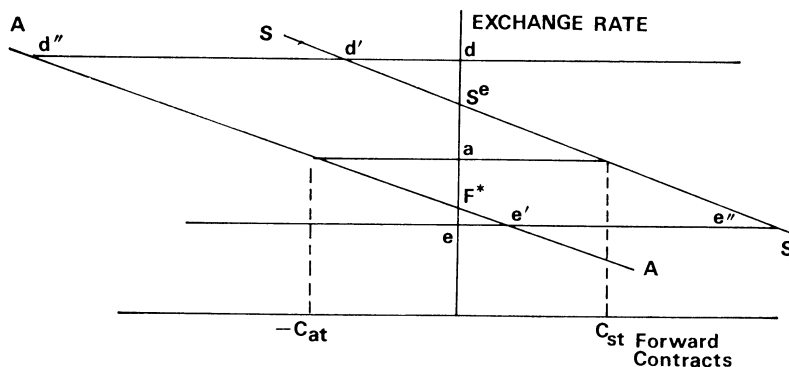


FIGURE 2. NOTE: a=NONINTERVENTION LEVEL OF F

from an initial equilibrium at point *a* in Figure 2 has bid the forward rate up to *d* by buying *dd'* from the forward speculators and *dd''* from the arbitrageurs. Tsiang's proof no longer holds. We find that the return to arbitrage $|F - F^*|$ is equal to the return to spot speculation $|S^e - F^*|$ plus the return to forward speculation $|S^e - F|$.

In equation (12) the government has intervened to disturb the initial equilibrium represented by Figure 2 to push the forward rate down to *e* by selling *ee'* to the arbitrageurs and *ee''* to the forward speculators. Here the return to forward speculation $|S^e - F|$ is equal to the return to spot speculation $|S^e - F^*|$ plus the return to arbitrage $|F - F^*|$.

Summarizing: In equations (9) and (12) instead of Tsiang's result, we find that the return to forward speculation is equal to the return to interest arbitrage plus the return to spot speculation. In equations (10) and (11), the return to interest arbitrage is equal to the return to spot speculation plus the return to forward speculation. These results are not surprising since if equation (9) represents the domestic country, equation (12) looks at the same situation from the point of view of the foreign country. Equations (10) and (11) are similarly related.

In short, only when

$$(13) \quad F^* \geq F \geq S^e$$

or

$$(14) \quad S^e \geq F \geq F^*$$

does Tsiang's result hold.

Equation (13) or (14) will hold if

$$(8) \quad |C_{at}| = |C_{st}|$$

and

$$(15) \quad C_{at} \neq C_{st}$$

If equation (8) and (15) do not hold we know there is government intervention.

Equation (13) and (14) can hold if $|C_{at}| \neq |C_{st}|$ if the government intervention has not driven the forward rate outside the band of spot speculation profitability, i.e., if C_{st} and C_{at} are not the same sign.⁶

The above findings are very important since Tsiang notes:

... a speculator who speculates on the spot exchange market may, in fact, be regarded as acting implicitly in the combined capacity of an interest arbitrageur and a forward exchange speculator ... the tentative assumption stated above that all speculation in foreign exchange is carried on in the forward market, does not impair the generality of our analysis as long as speculators who in effect speculate in the spot market are treated according to their dual capacity, namely, first as interest arbitrageurs and then as speculators in forward exchange.

[p. 92]

⁶ Equation (15) is necessary if we are to take into consideration the possibility of an intersection of the *AA* and *SS* curves. In such a situation intervention could drive the forward rate to a position where equation (8) holds but where neither equation (13) or (14) is satisfied.

My paper has questioned Tsiang's basic assumption. I have shown that although Tsiang's analysis holds in all cases of non-intervention it holds with intervention only if equation (13) or (14) are met. If intervention causes equations (9), (10), (11), or (12) to hold, Tsiang's results lose generality. The most likely possibility would be a situation such as equation (12) where the government in response to a rapidly rising expected spot rate is pushing the forward rate down. This appeared to be the case of the United Kingdom in 1967 where during the crisis prior to the devaluation, the interest arbitragers were coming to the United Kingdom while the speculators were leaving. In short, this analysis suggests that for empirical

work Tsiang's model must be used with caution since in the last decade prolonged periods of nonintervention have been the exception rather than the rule.

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