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COVERED INTEREST ARBITRAGE UNDER THE LINKED EXCHANGE RATE: DOES IT EXIST? AN EVIDENCE FROM THE HONG KONG FOREIGN EXCHANGE MARKET*

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ABSTRACT

Empirical studies of covered interest arbitrage suggest that the interest rate parity condtion is not always met and thus arbitrage profit apportunities do exist. As an international financial centre in the Asian Pacific region, the evidence on the validity of the relationship in the Hong Kong foregin exchange market is overwhelming. Allowing for transaction costs, we attempt to examine whether there exist unexploited profit opportunities in the Hong Kong foreign exchange market under the Hong Kong linked exchange rate system.

I INTRODUCTION

Arbitrageurs who are not willing to assume exchange rate risks but still wish to take advantage of interest rate differentials can move funds from place to place and through recourse to the forward market. Thus, on the assumption of smooth and efficient global capital mobility, the covered interest arbitrage activity will exploit any profit opportunities. The interest rate parity will finally be achieved.

However, empirical studies of covered interest arbitrage suggest that the interest rate parity condition is not always held. The relationship holds well between some countries and/or during some periods of time. Thus arbitrage profit opportunities do exist from place to place and/or from time to time. In consideration of the existence of transaction costs, political risk, speculative sentiments and capital market imperfections, many studies analysed the underlying factors that lead to the persisting deviations from the interest rate parity. Stoll (1968) believed that persistent speculative sentiment over time could explain the deviations. Branson (1969) and Frenkel & Levich (1975, 1977) asserted that deviations from the parity were caused by transaction costs. Aliber (1973) believed that political risk was one of the key factors causing the deviations. McCormick (1979) suggested that the deviations might be produced by capital control. In Hong Kong, Mak (1983) examined the covered interest rate parity hypothesis under the flexible exchange rate system, and found that the deviations might be due to persistent speculative sentiment over time and the limited arbitrage funds.

Since the introduction of the linked exchange rate system in Hong Kong in October 1983, the Hong Kong dollar has been linked to a fixed parity (HK$7.8 per US$1). In theory, the spot and forward rate of the HK$ against US$1 will be close to the parity. However, speculation on the revaluation or devaluation of the Hong Kong dollar makes it deviate from the parity. The maintenance of the parity partially relies upon the covered interest arbitrage between the spot and the forward market. If there still exist persistent unexploited profit opportunities between the spot market and the forward market, then obviously, the effect of the covered interest arbitrage will not be as large and/or as influential as the Hong Kong government expects it to be. In that case, some measures need to be implemented.

The purpose of this paper is to examine the covered interest arbitrage under the linked exchange rate system, allowing for transaction costs. In section II, we briefly summarise the Hong Kong linked exchange rate system. Section III dwells on the theorem of the covered interest arbitrage with and without transaction costs, particularly with reference to US and HK market. Section IV illustrates the daa. Section V presents the empirical findings. Lastly, the conclusion is given in Section VI.

II   HONG KONG LINKED EXCHANGE RATE SYSTEM

In the period of 82-83, in the shadow of a series of the political squabbles on the Hong Kong's future (1997 problem) between China and the United Kingdom, there were substantial slumps in the trade-weigted exchange rate index of the Hong Kong dollar (about 17.3% drop in September 1982 - August 1983, 7.4% decrease in a single month, September 1983).[1] To rescue and stabilise the exchange rate of the Hong Kong dollar, the Hong Kong Government in October 1983 introduced the linked exchange rate system. Since them, the Hong Kong currency has been pegged with the US dollar at the parity of HK$7.8/US$1.0.

The linked exchange rate regime in Hong Kong is quite special and different from the traditional fixed exchange rate system which is mainly dependent on the central bank's intervention. Without any central bank in Hong Kong, the Hong Kong Government relies on the operation of a fund called exchange fund[2] to maintain the official parity (fixed rate) with commercial banks. At the same time, a free foreign exchange market where there are no restraints on private trading in foreign exchange is maintained. Any divergence of the free market rate from the parity will attract banks and speculators to aribtrage and thus the linked exchange rate is maintained. In other words, the maintenance of the linked parity relies mainly upon arbitrage force undertaken by financial institutions in Hong Kong, especially the commercial banks. In fact, this is one of the features of the Hong Kong linked exchange rate system — the reliance upon the arbitrage from the private sector to maintain its stability, rather

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[1]   These figures are calculated from the relevant index obtainable from the Hong Kong Monthly Digest of Statistics, January 1984.

[2]   The Exchange Fund was established by the Currency Ordinance of 1935. The establishment of the Exchange Fund was to ensure that every dollar of Hong Kong currency had been adequately backed. The Exchange Fund is managed by the Monetary Affairs Branch under the direction of the Financial Secretary. The fund's assets are held in bank deposits in Hong Kong dollars and in certain foreign currencies, and in various interest-bearing instruments in foreign currencies.

than dependence upon the official intervention like the case of fixed exchange rate system. In theory, there exists the following feedback relation: the deviations of the market HK dollar rate from the official parity will lead to arbitrrage activities which in return would reduce or eliminate the devitions. Thus the market rate will remain around and close to the parity.

There are two types of arbitrage operations under the linked exchange rate system in Hong Kong — Cash arbitrage and interest arbitrage.

The details of case arbitrage will not be discussed here.[3] For interest arbitrage, the Hong Kong Government, through the help of the Hong Kong Association of Banks,[4] can artificially adjust HK dollar deposit rates in response to a large variation of the Hong Kong dollar market exchange rate from the parity. This will also considerably affect the local interbank markets, specifically the interbank liquidity.

Against the background of smooth and efficient global capital mobility, changes in HK dollar interest rates, particularly interbank rates, relative to interest rates of other foreign currencies can always generate large movements of profit-seeking funds between hong Kong and foreign countries.

III   COVERED INTEREST ARBITRAGE

Against the background of smooth and efficient global capital mobility, arbitrageurs, who are risk averse and do not want to face exchange rate risks but still wish to take advantage of interest rate differentials can move funds from one country to another by selling the foreign currency proceeds from the investment.

(a)   Covered Interest Arbitrage With No Transaction Cost

Assuming there exist no transaction costs, an arbitrageur borrowing in Hong Kong and simultaneously investing in the US for n periods will result in profits if

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[3]   For details, please refer to [4].
[4]   The Hong Kong Association of Banks was established in January, 1981. All banks in Hong Kong should join as members. The Assocition sets the maximum rates of interest payable on deposits with licensed banks and has the statutory obligation to consult the government on these interest rates.

$$n*(r_{HK} - r_{US}) < \left\{ \left[\frac{F_n \frac{HK\$}{US\$}}{S \frac{HK\$}{US\$}} \right] - 1 \right\} *(1 + n*r_{US}) \tag{1}$$

where: S = Spot rate

F = Forward rate

r_{US} = US dollar interest rate

r_{HK} = HK dollar interest rate

n = Maturity period of forward conract on a yearly basis.

The reverse activity, borrowing in the U.S.A. and simultaneously investing in Hong Kong will be profitable if the reverse inequality holds. As long as either inequality holds, it pays to borrow in one market and invest in the other because the investment proceeds are more than enought to cover the loan.

The interest arbitrage will continue until there no longer exist any profit opportunities between the Hong Kong and the US market. The following interest parity will finally be achieved.

$$n*(r_{HK} - r_{US}) = \left\{ \left[\frac{F_n \frac{HK\$}{US\$}}{S \frac{HK\$}{US\$}} \right] - 1 \right\} *(1 + n*r_{US}) \tag{2}$$

In reality, transaction costs do exist and the covered interest arbitrage will be affected. Transaction costs are brokerage fees on securities purchased and / or sales, and information costs for small investors, thus cause the net yields of doing the arbitrage to be lower. For covered interest arbitrage to occur, the net yield must be greater so as to cover the transaction costs involved.[5]

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[5]   For details, refer to M. Levi (1983), pp: 163-181.

The transaction costs for covered interest arbitrage include the brokerage costs of buying and selling spot and forward foreign exchanges and commission costs of interbank borrowing and lending HK dollars and US dollars. As at February 1, 1990, the standard costs charged by brokerage firms in Hong Kong are shown in Table 1 (see Appendix).

Admittedly, direct dealings between traders may save brokerage commission fees and may avoid any time lag due to liaison between brokerage firms and traders. This is especially true when the dealing amount is very substantial. However, as an intermediary, a broker has wide relationship with many traders. It can gather more efficient market infomation for buyers and sellers. Consequently, rates quoted by the brokers usually more genuinely reflect the market prices. Therefore, even though a buyer or seller needs to pay commission fees to a broker, they still prefer to have indirect dealings through the broker as this may eliminate searching costs.

(b) Covered Interest Arbitrage with Transaction Costs

For covered interest arbitrage with transaction costs and for simplicity, we assume that an arbitrageur, say, a commercial bank in Hong Kong, faces two investment alternatives: (1) borrowing in HK$ and investing in US$ money market and (2) borrowing in US$ and investing in HK$ money market.

By taking the transaction costs and the number of days within investment duration periods into consideration, the interest parity relation becomes:

Case I: Borrowing HK$ Fund and Lending US$ Fund

An arbitrageur who borrows HK$ fund and lends US$ fund will have covered interest advantage whenever

$$\left\{ [R_{(HKO)i} + c_1] * \frac{N_i}{365} \right\} - \left\{ [R_{(USB)i} + c_2] * \frac{N_i}{360} \right\} < \left[\frac{(F_{bi} - M_i)}{(S_s + c_s) - 1} \right] *$$

$$\left\{ [1 + [R_{(USB)i} - c_2] * \frac{N_i}{360} \right\} \tag{2}$$

where $i = 1, 3$ and 6 months

$R_{(HKO)}$ = KH$ offered interbank rate for months i

$R_{(USB)}$ = US$ bid interbank rate for months i

c_1 = HK$ borrowing commission fees

c_2 = US$ lending commission fees

c_s = Spot transaction commission fees

M_i = Forward transaction commission fees for months i

N_i = No. of days to delivery date for months i

S_s = Spot selling rate of US$ versus HK$ (HK$/US$)

F_{bi} = Forward buying rate of US$ versus HK$ (HK$/US$) for months i

That is to say, borrowing in Hong Kong and simultaneously investing in US will result in a profit if the number of HK dollars received from the US investment exceeds the repayment on the Hong Kong loan.

Case II : Borrowing US$ Funds and Lending HK$ funds.

An arbitrageur who borrows US$ funds and lends HK$ funds will have covered interest advantage whenever

$$\left\{ [R_{(HKB)i} - c_3] * \frac{N_i}{365} \right\} - \left\{ [R_{(USO)i} + c_4] * \frac{N_i}{360} \right\} > \left[\frac{(F_{si} - M_i)}{(S_b + c_s) - 1} \right] *$$

$$\left\{ [1 + [R_{(USO)i} + c_4] * \frac{N_i}{360} \right\} \tag{3}$$

where $R_{(HKB)}$ = KH$ offered interbank rate for months i

$R_{(USO)}$ = US$ offered interbank rate for months i

c_3 = HK$ lending commission fees

c_4 = US$ borrowing commission fees

S_b = Spot buying rate of US$ versus HK$ (HK$/US$)

F_{si} = Forward selling rate of US$ versus HK$ (HK$/US$) for months i

In other words, borrowing in the US and similtaneously investing in Honk Kong will result in a profit because the number of US dollars recieved from the HK investment exceeds the repayment on the US loan.

In fact, the left hand side of inequalities (2) and (3) are the interest differential between the Hong Kong and US market adjusted for the transaction cost, while that of the right hand side are forward premium/discount between the Hong Kong and US dollar, also adjusted for the transaction costs.

For convenience, we will use the following symbols to denote the above two inequalities.

ID_{1i} = Interest Differential as stated in inequality (2)
(left-hand side of the inequality)

ID_{2i} = Interest Differential as stated in inequality (3)
(left-hand side of the inequality)

FP_{1i} = Forward premium/discount as stated in inequality (2)
(right-hand side of the inequality)

FP_{2i} = Forward premium/discount as stated in inequality (3)
(right-hand side of the inequality)

To summarise, unexploited profit opportunities exist between the Hong Kong and US market whenever the interest differential is smaller than the forward premium/discount in those two markets, i.e.

$$ID_{1i} < FP_{1i}$$
<div align="right">Inequality (2)</div>

The unexploited profit opportunity would enduce borrowing HK$ funds and lending US$ funds. This would have the following effects. The borrowing of HK$ funds to profit from the arbitrage opportunity will put upward pressure on HK$ interest rates. If the borrowing is

through selling securities, this would reduce their prices and raise r_{HK}. Since interest arbitrage requires the spot sale of the Hong Kong dollars for US dollars. This will help bid up for the spot price of the US dollar. That is, S_s will increase. Then the US dollars that are purchased will be invested in a US security. If there are enough extra buyers, the price of the security will increase, and the yield will decrease. That is, r_{US} will fall. Lastly covering the funds moved to US, which involves the forward sale of US dollars, will lower F_{bi}. We can observe that all these steps of the arbitage will work together and the movement is back toward the interest parity line.

Similarly, when the interest differential in Hong Kong and the US market is larger than the forward premium/discount in those two markets, that is,

$$ID_{2i} > FP_{2i} \hspace{4cm} \text{Inequality (3)}$$

Interest arbitrageurs will wish to borrow in the US money market and invest in the Hong Kong market. As before, there will be borrowing in the US and hence an increase in r_{US}; spot purchases of Hong Kong dollars, which will lower S_b; investment in Hong Kong, which lower r_{HK}; and forward sales of Hong Kong dollars, which will raise F_{si}. Again all these steps works simultaneously and the movement is back towards the parity line.

The arbitrage will stop when every
$$ID_{1i} \geq FP_{1i} \text{ and } ID_{2i} \leq F_{2i}.$$

There exist no unexploited opportunities because allowing for the transaction costs, the number of US/HK dollars received from the UK/US investment cannot cover the repayment on the US/HK loan.

To see whether there exist persistent unexploited profits, we examine inequalities (2) and (3) by plotting the relation between interest differentials and forward premium/discount.

IV   DATA

This paper confines an analysis to the period of January 1990 to April 1990. During this period, Hong Kong financial markets were not subjected to any speculative pressure. Daily spot and forward US$ rates (versus HK$) as well as interbank rates for HK and US dollars with respect to maturity of 1, 3 and 6 months were recorded simultaneously during the time period between 10:45 and 11:15 a.m[6] of each reference day. Rates quotation of these were obtained from Tokyo Forex & Tullett and Hua Chiao Commercial Bank Limited.

V   EMPIRICAL FINDINGS

Figure 1 and Figure 2 show the interest parity diagrams for one month to maturity under case I and II situations. Since $ID_{11} > FP_{11}$, allowing for transaction costs, the loss in interest differential is greater than the gain in forward premium. There exsists no profit incentive to borrow HK$ funds and lend US$ funds. Meanwhile, $ID_{21} < FP_{21}$, the gain in interest differential is less than the loss in forward premium. There exists no profit incentive to borrow US$ funds and lend HK$ funds. In other words the forward exchange market for one-month forward contract adjusts rapidly to the state of eqilibrium. No covered arbitrage advantage can can be exploited.

Figure 3 and Figure 4 show the interest parity diagrams for three months to maturity under case I and II situations. We find two inequalities : $ID_{13} > FP_{13}$ and $ID_{23} < FP_{23}$. The first inequality shows that as arbitrageurs borrow HK$ funds and lend US$ funds, the loss in interest differential is greater than the gain in forward premium. There exsists no profit incentive to abritage. Meanwhile, the second inequality shows that as arbitageurs borrows US$ funds and lend HK$ funds the gain in interest differential is less than the loss in forward premium. There also exsists no arbitrage incentive. No covered arbitrage advantage can be exploited.

Similarly, from Figure 5 and Figure 6, we find two inequalities for six months to maturity : $ID_{16} > FP_{16}$ and $ID_{26} < FP_{26}$. As arbitrageurs borrow HK$ funds and lend US$

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[6]   During this time period, trading transactions are most active and the spread of rates may acutally reflect the real demand and supply situation and foreign exchange at that particular moment.

funds, the loss in interest differential is greater than the gain in forward premium. There exsists no profit incentive to arbitrage. Meanwhile, as arbitrageurs borrow US$ funds and lend HK$ funds the gain in interest differential is less than the loss in forward premium. Therefore, no covered arbitrage can be exploited.

Table 2 summarises all the findings and implications. They unanimously show that investors do not conduct covered arbitrage operations because there exists no exploited profit opportunities during the study period.

VI   CONCLUSIONS

Empirical studies of covered interest arbitrage suggest that the interest rate parity condition is not always held and it holds well between some countries and/or during some periods of time. Arbitrage profit opportunities do exsist from place to place and from time to time. In this paper, allowing for transaction costs, we have found that there exsists no persistant unexploited profit opportunities between the spot market and the forward market in Hong Kong during the study period. In other words, during this period, the spot and forward rates of the Hong Kong dollar were not subject to any speculative pressure.

In this paper, it has been shown that interest rate differentials still take a significant part in explaining in relation between forward and spot exchange rates in the case of US$ and HK$. Since the maintenance of the linked parity partially relies upon the covered interest arbitage between the spot and forward market. Based on the findings on this paper, the Hong Kong Government can reinforce the covered interest arbitage through carefull manipulation of Hong Kong dollar interest rates with a view to maintaining the linked rate.

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APPENDIX

Table 1   *Transaction Costs in Covered Interest Artibtrage*

Types of Transactions		*Commission Fees*
Spot FX		HK$175 per million US$
Forward FX	1 Month	HK$160 per million US$
	3 Month	HK$200 per million US$
	6 Month	HK$200 per million US$
HK$ Interbank Market	Lending	NIL
	Borrowing	0.025% p.a. on transaction amount for duration of borrowing period calculated at 365 days basis
US$ Interbank Market	Lending	0.025% p.a. on transaction amount for duration of lending period calculated at 360 days basis
	Borrowing	0.025% p.a. on transaction amount for duration of borrowing period calculated at 360 days basis

Figure 1 : The Interest Parity Diagram

Case I, 1 Month to Maturity
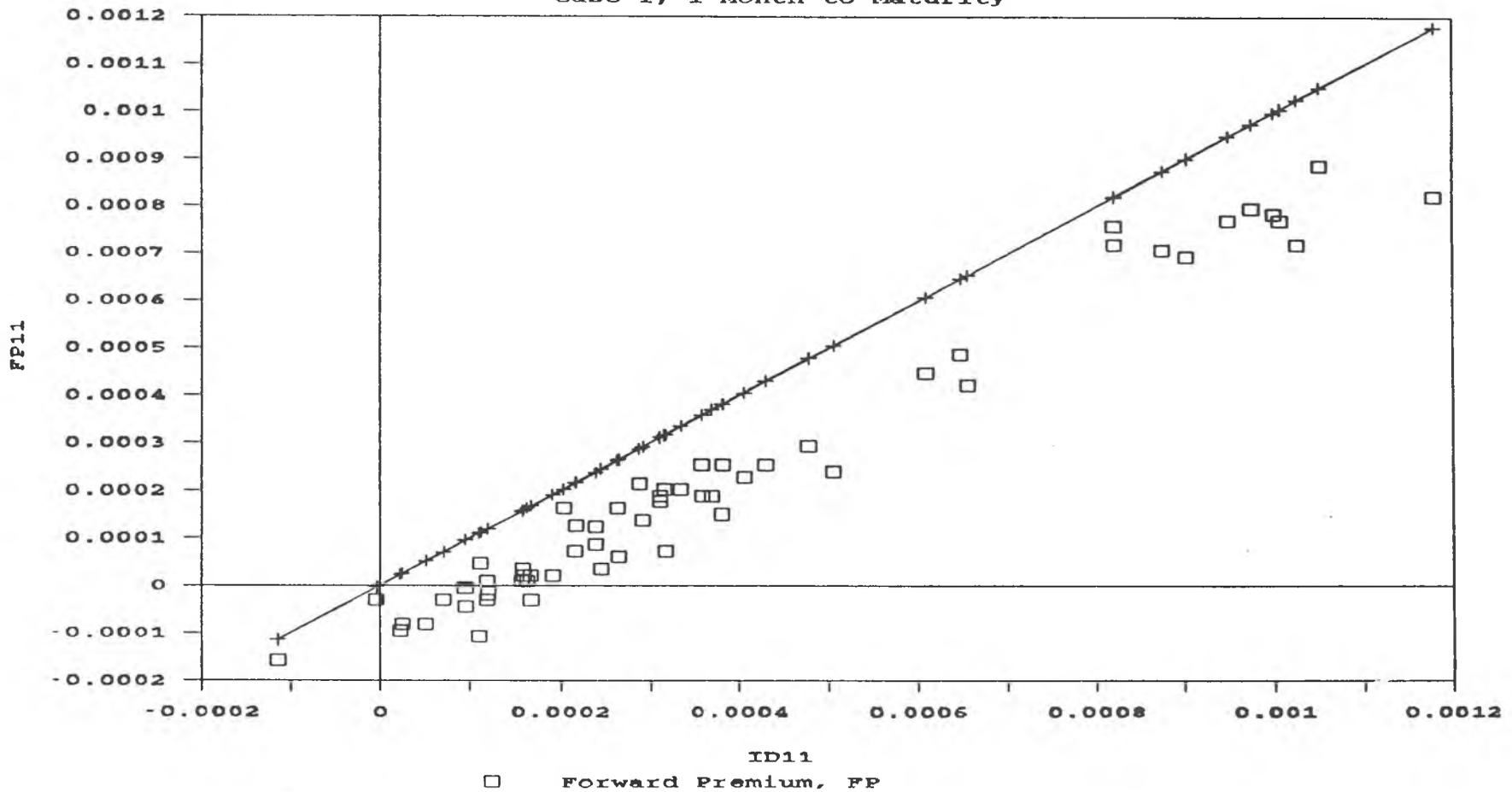
Figure 2 : The Interest Parity Diagram

Case II, 1 Month to Maturity
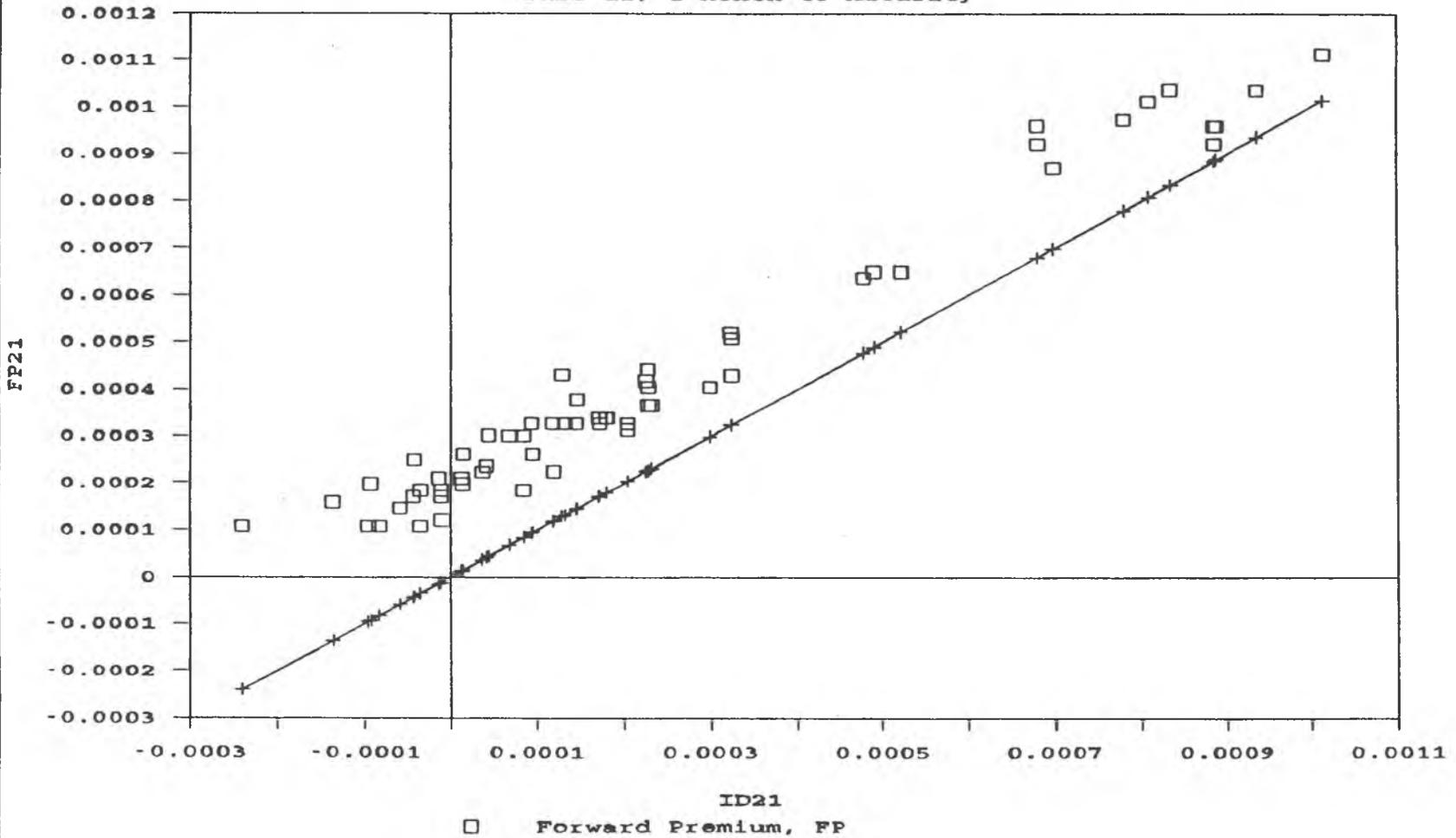
Figure 3 : The Interest Parity Diagram

Case I, 3 Months to Maturity
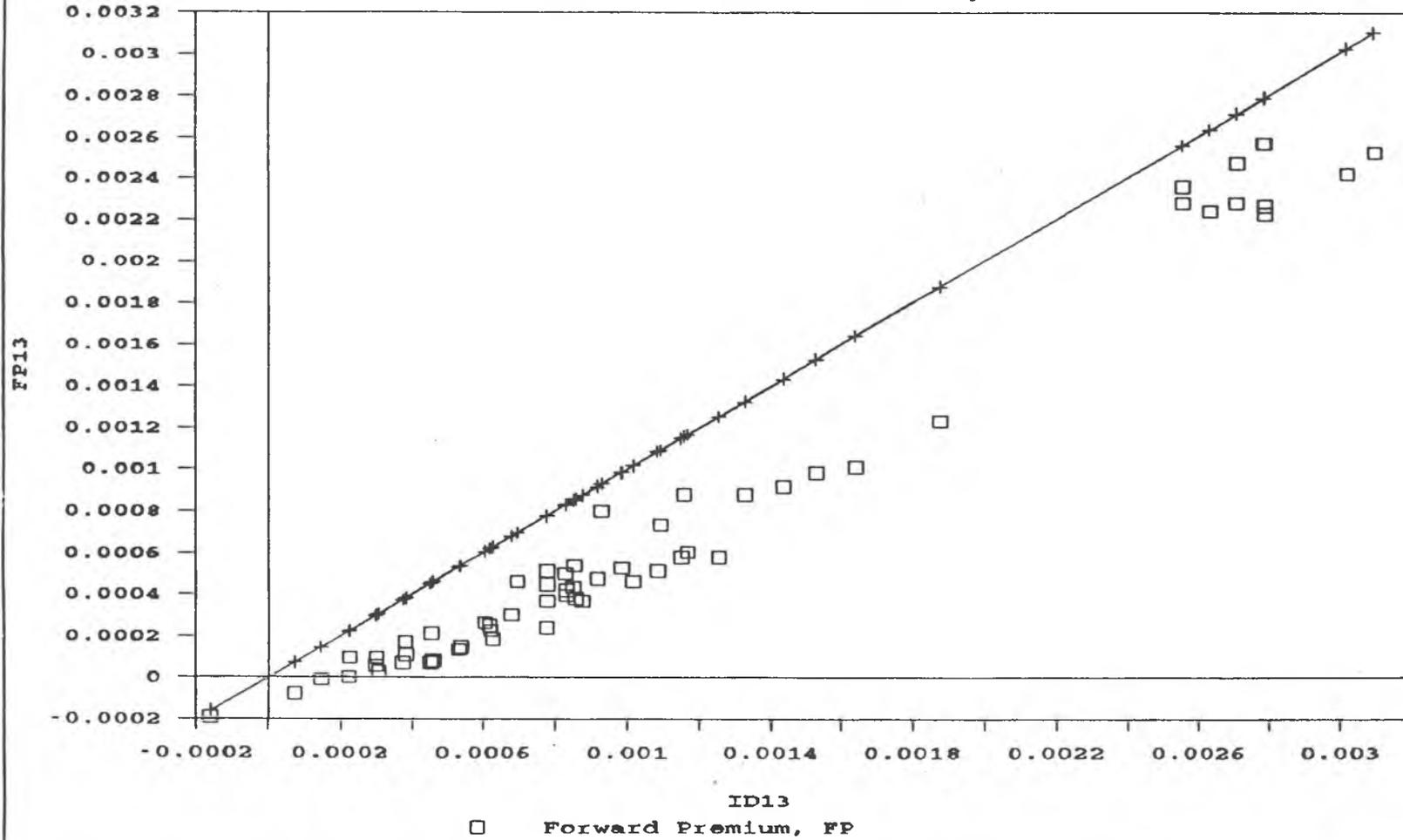
Figure 4 : The Interest Parity Diagram

Case II, 3 Months to Maturity
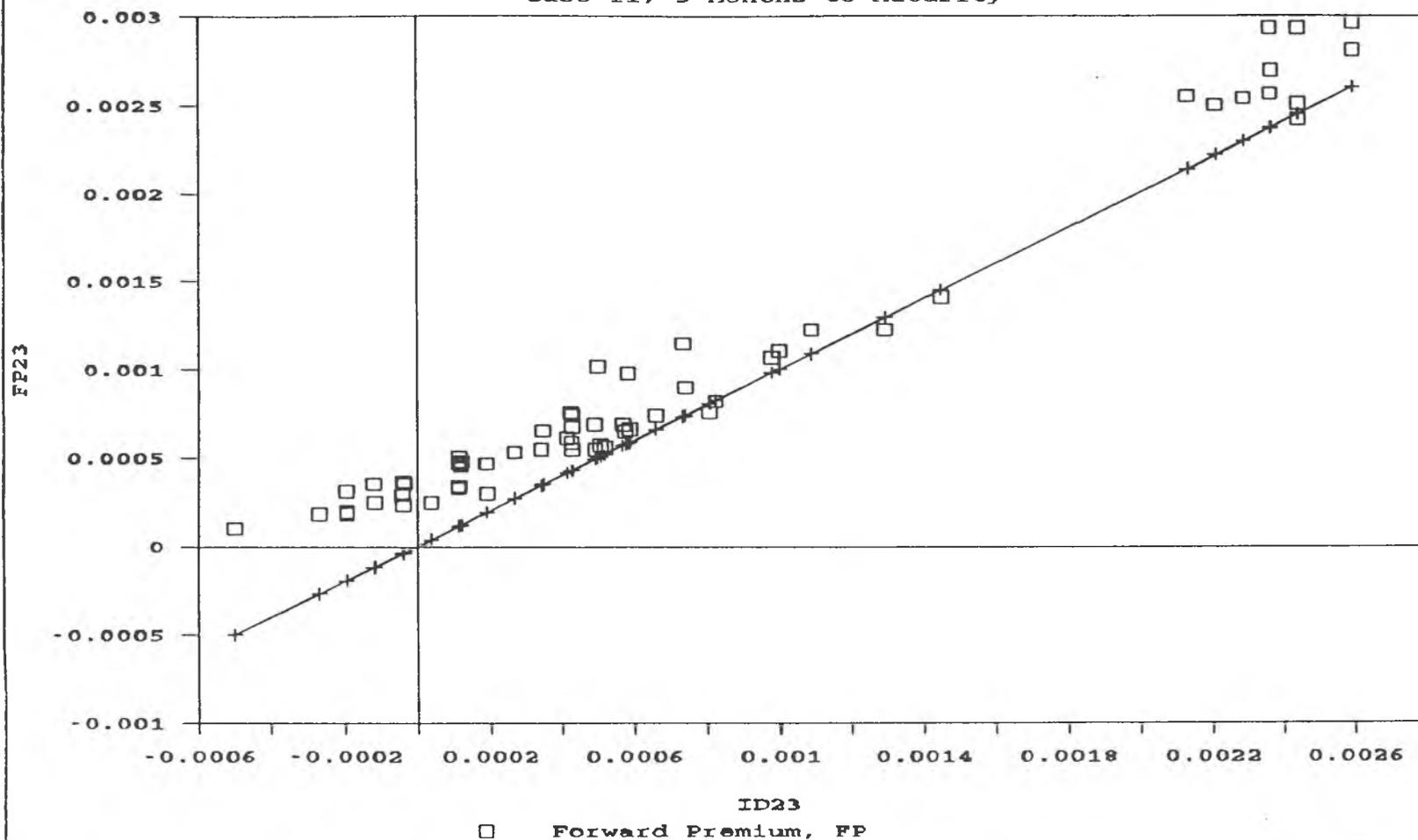
Figure 5 : The Interest Parity Diagram

Case I, 6 Months to Maturity

Forward Premium, FP
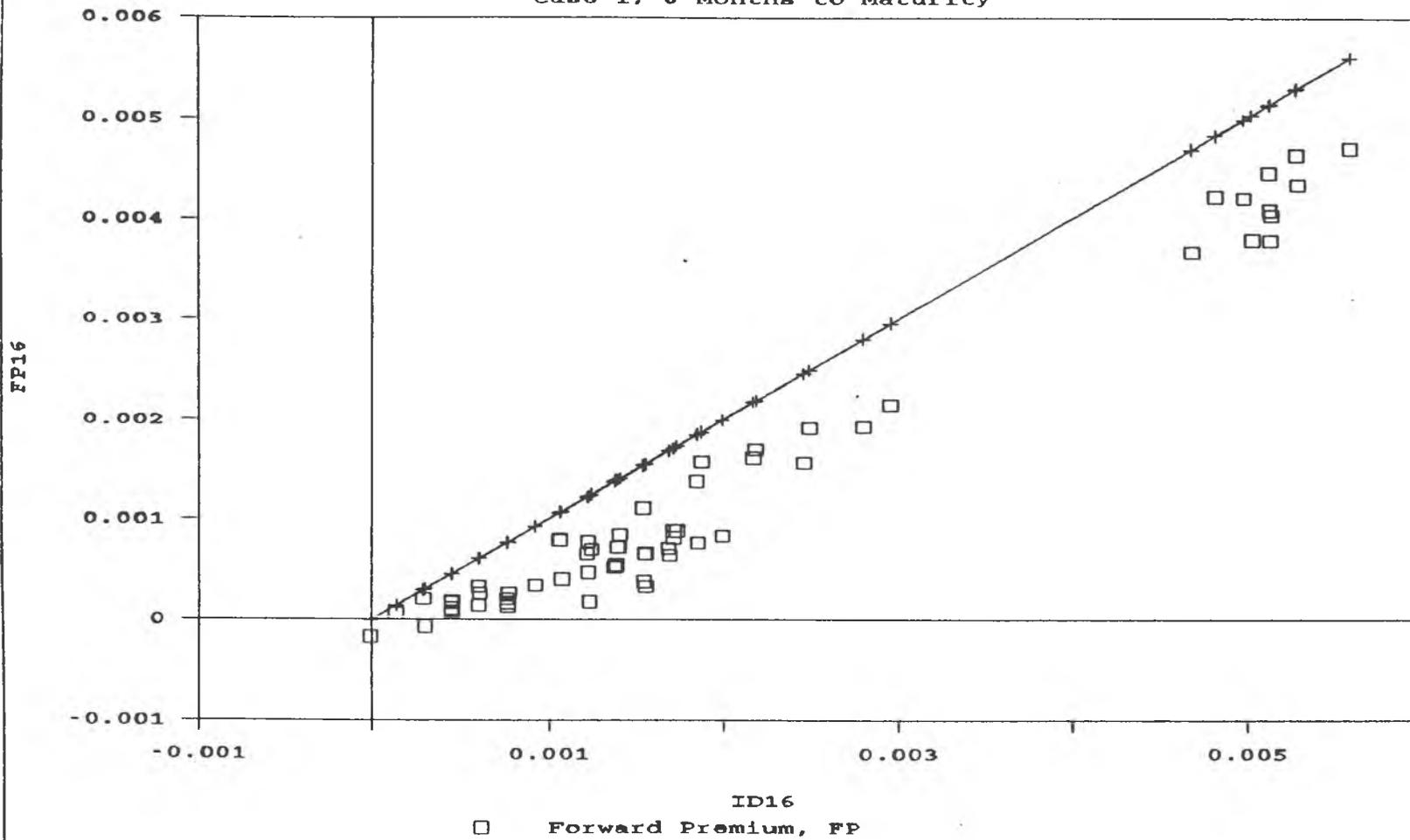
Figure 6 : The Interest Parity Diagram

Case II, 6 Months to Maturity
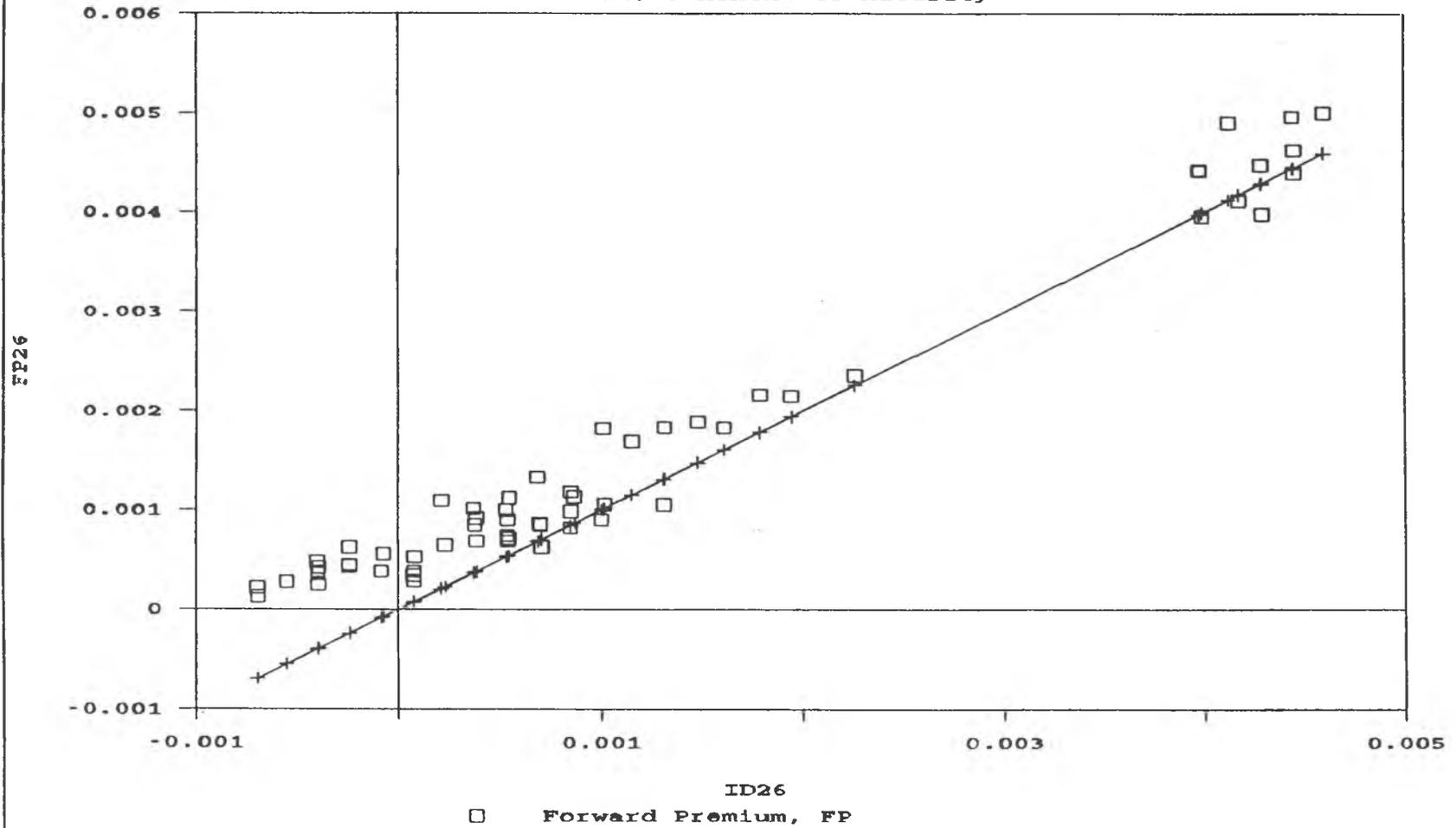
Table 2   *Findings & Implications of Interest Parity Diagrams*

Figure	Result	Implication
Figure 1	$ID_{11} > FP_{11}$	No Arbitrage
Figure 2	$ID_{21} < FP_{21}$	
Figure 3	$ID_{13} > FP_{13}$	No Arbitrage
Figure 4	$ID_{23} < FP_{23}$	
Figure 5	$ID_{16} > FP_{16}$	No Arbitrage
Figure 6	$ID_{26} < FP_{26}$	

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