Eg: 5m F = ₹82.3050/$

S = ?

5m interest rate (annually compounded)

₹ = 9%

$ = 5% (B.C.)

EAR → Tone : $(1+r)^t$

Soln:- $\frac{F}{S} = \frac{(1+r_{₹})^t}{(1+r_{\$})^t}$

$\frac{82.3050}{S} = \left[\frac{1.09}{1.05}\right]^{5/12}$

$\therefore S = \frac{82.3050}{1.0157} = ₹81.0328/\$$

% premium on $ = $\frac{F-S}{S} \times 100 \times \frac{12}{n}$

$= \frac{82.3050 - 81.0328}{81.0328} \times 100 \times \frac{12}{5}$

$= 3.7677 \quad (\equiv 4\% = 9-5)$

Eg: Spot = $1.3620/£

3m F = ?

3m interest rates ⇒ $ = 7%

(p.a. compd daily) £ = 11%

Soln:- Daily compounding → CAR → Tone : e^{rt}

$$\frac{F}{S} = e^{(r_\$ - r_₹) \times t} = e^{(0.07 - 0.11) \times 3/12}$$

$$F = 1.3620 \times e^{-0.01}$$

$$F = \$1.3484/₹$$

Eg: $S = ₹72.3450/€$

6m F = ?

6m interest rates p.a. (continuously compounded) ⇒ ₹ = 12%, € = 6%

Soln:- $$\frac{F}{S} = e^{(r_₹ - r_€) \times t} = e^{(0.12 - 0.06) \times 6/12}$$

$$F = 72.3450 \times e^{0.03}$$

$$F = ₹74.5482/€$$

Covered Interest Arbitrage :-

- Why IRP must hold good?

To prevent covered interest arbitrage.
(money market + currency market)

- Covered Interest Arbitrage -

Step 1: Borrow one currency, say ₹ (8000 @ 9%)
Calculate ₹ outflow on maturity. (₹8720)

Step 2: Convert the borrowed amount at spot into another currency, say $ $\left[\frac{₹8000}{₹80/\$} = \$100\right]$

Step 3: Invest this amount ($100 @ 4%)
Calculate amount receivable on maturity ($104)

Step 4: Cover yourself i.e. sell receivable forward.
($104 × ₹86/$)

Calculate ₹ inflow on maturity (₹8944)

Arbitrage profit = Inflow in step 4 - Outflow in step 1
(= 8944 - 8720 = ₹224)

Steps 1 to 4 involve money market & currency market.
(borrow & invest) (buy & cover)

⚠ So which currency should we borrow in step 1?
The one which has lower interest rate or
The one which loses its value?

		①	②
ICAI :	Difference b/w interest rates (Money Market)	= say 5%	say 7%
	Forward premium % (Currency Market)	= say 7.5%	say 4.5%

① High Gap → currency market
∴ Enjoy in currency market
& suffer in money market. → borrow at higher rate of interest.

② High Gap → Money Market
∴ Suffer in currency market
& Enjoy in Money Market → borrow at lower rate of interest.

Types of Sums :-

- Type 1 :-

Show Covered Interest Arbitrage -

1) Annualised forward premium / discount on base currency
$= \frac{F-S}{S} \times 100 \times \frac{12}{n}$ → % - currency gap

2) Difference of Interest Rate → % - money market gap

Date:

If % CM > MM → Suffer in Money Market i.e. borrow @ higher interest rate currency

If % MM > CM → Enjoy in Money Market i.e. borrow @ lower interest rate currency

- Type 2 -

1) Calculate should be 'F' as per IRP
2) Actual 'F' ≠ should be 'F'

Show Covered Interest Arbitrage.... Type 1 jaisa....

⚠ How much to borrow ?

Icai is inconsistent

Either given in Q. or assume & give note....

Part-2

Q.50	PG
CW.20	

Type 2 sum.

As per IRP : $\frac{F}{S} = \left[\frac{1+r\$}{1+r€}\right]^{t}$

$$\frac{F}{1.665} = \left[\frac{1.015}{1.020}\right]^{6/12}$$

$$\therefore F = 1.665 \times 0.9975$$

$$\therefore F = \$1.6609/€$$

Currency Market Gap → $\frac{F-S}{S} \times 100 \times \frac{12}{n}$

$$\frac{1.664 - 1.665}{1.665} \times 100 \times \frac{12}{6} = -0.12\%$$

(ignore negative sign)

Money Market Gap → 1.5 - 2.0 = -0.5%

∴ Enjoy MM by borrowing $ (MM > CM)

Annualized forward discount < Interest rate differencial

(CM) (MM)

Let us assume amount of borrowing to be $100000

Step 1 : Borrow $100000 @ 1.5% for 6 months
∴ Amount of outflow after 6 months
$= 100000\ (1.015)^{6/12}$ EAR
$= \underline{\$\ 100747.21}$

Step 2 : Convert $100000 spot @ $1.665/€ getting
$\frac{\$100000}{\$1.665/€} = €60060.06$

Step 3 : Invest €60060.06 @ 2% for 6 months
Amount receivable after 6 months
$= 60060.06 \times (1.02)^{6/12}$
$= €\ 60657.68$

Step 4 : Sell €60657.68 one month forward @ $1.664/€
getting €60657.68 × $1.667/€ = $\underline{\$\ 100934.39}$

∴ Arbitrage profit = 100934.39 − 100747.21 = $\underline{\$\ 187.18}$

Note : The profit calculated above is based on the assumption of amount borrowed $100000. If we take another amount, there will be another amount of profit but the process will remain same

Q.51	pg
cw.20	

Type 2 sum

$\frac{F}{S} = e^{(r_£ - r_\$)\times t} = e^{(0.05-0.08)\times 2}$

$F = 0.75\ e^{-0.06}$

$F = 0.75 \times 0.9413$

∴ $F = £\ 0.7060/\$$

IRP is totally violated → even direction-wise.
khelo jor se → Both money & currency market.
So we will borrow £.

Let us assume that amount borrowed is £100000

Step 1 : Borrow £100000 @ 5% p.a. for 2 years
Outflow after 2 years = $100000\, e^{0.05\times 2}$

$= \frac{100000}{e^{-0.1}} = £110485.03$

Step 2 : Sell £100000 spot @ £0.75/$ getting
$\frac{100000}{0.75} = \$133333.33$

Step 3 : Invest $ @ 8% p.a. for 2 years.
$133333.33 \times e^{0.08\times 2} = 133333.33 \times e^{0.16}$
$= 133333.33 \times 1.1735 = \$156466.67$

Step 4 : Sell $156466.67, 2 year forward @ £0.85/$
getting $156466.67 \times 0.85 = £132996.67$

∴ Arbitrage Profit = 132996.67 − 110485.03 = £22511.64

Self practice : Extra Q.1] HW. Soln. pg. 69

Part-3

Q.52	pg
CW. 20	

(i) Equation for IRP :

$$\frac{F}{S} = \frac{(1+r_{CAD}\times t)}{(1+r_{DEM}\times t)}$$

$$\frac{0.780}{0.775} = \frac{(1+0.09\times 3/12)}{(1+0.07\times 3/12)}$$

$1.0064 \neq 1.0049$
IRP does not hold good.

(ii) There is a scope for arbitrage.
Interest Rate Differential (Money Market Gap)

= 9 - 7 = 2% p.a.

Annualized forward premium (currency market gap)

$$= \frac{F-S}{S} \times 100 \times \frac{12}{n} = \frac{0.780-0.775}{0.775} \times 100 \times \frac{12}{3} = 2.56\%$$

∴ Enjoy in currency market & suffer in MM as CM > MM

Borrow CAD 1 million from @ 9% for 3 months for CIA.

Step 1 : Borrow CAD 1 million @ 9% p.a. for 3 months

∴ Outflow for 3 months = $100000 \times (1 + 0.09 \times 3/12)$

= CAD 1022500

Step 2 : Convert CAD 1000000 into DEM @ spot rate of CAD 0.775 / DEM.

$\frac{1000000}{0.775}$ = DEM 1290323

Agar is sum me CAD nahi balki DEM borrow krna hota toh -

1 million DEM ⊗

$\frac{\text{CAD 1 million}}{\text{CAD 0.775/DEM}}$ = DEM 1290323 borrow (spot pe convert)

Step 3 : Invest DEM 1290323 @ 7% for 3 months

DEM receivable = $1290323 \ (1 + 0.07 \times 3/12)$

= DEM 1312903

Step 4 : Sell DEM 1312903, 3 month forward @ CAD 0.780 / DEM

∴ Inflow = CAD 1024065

∴ Arbitrage Profit = 1024065 - 1022500

= CAD 1565

Suppose transaction costs are present

- FX Market - Bid / Ask
- Money Market - Bid / Ask

⇨ Conditions to prevent covered Interest Arbitrage -

1) $F_{ask} > F_{bid}$

2) $\frac{F_{ask}}{S_{bid}} \geq \frac{1 + r_{AI} \times t}{1 + r_{BB} \times t}$

3) $\frac{F_{bid}}{S_{ask}} \leq \frac{1 + r_{AB} \times t}{1 + r_{BI} \times t}$

r_{AI} : currency A ka investmt rate
r_{BB} : currency B ka borrowg rate
r_{AB} : currency A ka borrowg rate
r_{BI} : currency B ka investmt rate

This never came in exam

Eg: Spot (₹/$) 82.30 / 83.10
6m F (₹/$) 85.10 / 86.20
6m Interest rate (p.a.)
₹ 7% / 8%
$ 3% / 4%

Q.1] Check whether there is a CIA opportunity if you start by borrowing → a) ₹100000
b) $100000

Q.2) Find out the limits for 6m F rate to prevent CIA.

Soln :-

Q.1] (a) start by borrowing ₹100000 :-

Step 1 : Borrow ₹100000 @ 8% p.a. for 6m
Outflow after 6m = 100000 (1.04) = ₹104000

Step 2 : convert ₹100000 spot into $ @ ₹/$ 83.10
getting $\frac{₹100000}{₹83.10/\$}$ = $1203.37

Step 3 : Invest this amount @ 3% p.a. for 6m
$ receivable after 6m = 1203.37 × 1.015
= $1221.42

Step 4 : Sell $ 6m forward 85.10
₹ inflow after 6m = $1221.42 × ₹85.10/$
= ₹103943

since, ₹ Inflow < ₹ outflow, there is no CIA opportunity

Q.1] (b) start by borrowing $100000

Step 1 : Borrow $100000 @ 4% p.a. for 6 months
Outflow after 6m = 100000 (1.02) = $102000

Step 2 : Convert $100000 spot @ ₹82.30/$
getting 100000 × 82.30 = ₹8230000

Step 3 : Invest ₹8230000 @ 7% p.a. for 6m
₹ inflow after 6m = 8230000 (1.035) = ₹8518050

Step 4 : Sell ₹8518050 forward 6m @ ₹86.20/$
$\frac{₹8518050}{₹86.20/\$} = \$98817$

Since $ inflow < $ outflow, no CIA opportunity.

Q.2] 1) Fask ≥ Fbid

2) $\frac{Fask}{Sbid} \geq \frac{1 + r_{₹I} \times t}{1 + r_{\$B} \times t}$

$\frac{Fask}{82.30} \geq \frac{1 + 0.07 \times 6/12}{1 + 0.04 \times 6/12}$

$Fask \geq 82.30 \times \frac{1.035}{1.02}$

$\therefore Fask \geq 83.5103$

3) $\frac{Fbid}{Sask} \leq \frac{1 + r_{₹B} \times t}{1 + r_{\$I} \times t}$

$\frac{Fbid}{83.10} \leq \frac{1 + 0.08 \times 6/12}{1 + 0.03 \times 6/12}$

$Fbid \leq 83.10 \times \frac{1.04}{1.015}$

$Fbid \leq 85.1468$

Eg. For practice → Self practice - Extra Q.2] HW. soln pg. 70

spot ₹/£	89.40 / 90.30
3m F ₹/£	91.70 / 92.90
3m interest rate (p.a.) →	₹ 9% / 10%
	£ 3% / 4%

Q.1) CIA opportunity if u start borrowing
(a) ₹100000 (b) £100000

Q.2) Limits for 3 m forward rate to prevent CIA.

Soln :- Refer HW. soln. pg. 70

Self practice :- HW. Q. 33, 34, 35] pg. 14
HW. Q. 36, 37, 38] pg. 15