Financial Derivatives and Risk Management
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Lecture 24: T-Bill Futures Applications

Some of the important applications of T-bill futures are now taken up:

Locking in a forward rate

Suppose an investor takes a long position in a T-bill future @ F_0 that matures for delivery at t=T and entails delivery of a T bill that matures for repayment at t=N. This means that:

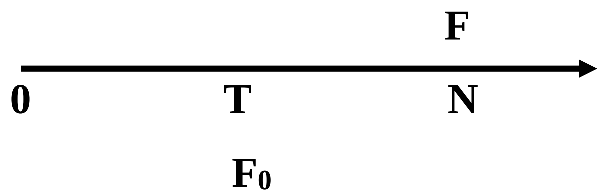
(i) At t=0, when the position is taken in the T-bill futures contract, the price F_0 at which the long party (L) will receive the bill on maturity of the futures is fixed at F_0. The maturity of the T-bill (say t=N) that forms the underlying of the futures is also clearly identified.

(ii) At t=T i.e. the maturity of the futures contract, the long party (L) will pay the price F_0 to the short party (S) and the short party shall deliver the T-bill against this payment. The T-bill now belongs to L.

(iii) At t=N, when the T-bill matures for payment, the issuer of the T-bill shall redeem the T-bill at its face value (F) to the party to whom it now belongs (L).

It is clear from the above that the cash flows of L at t=T (F_0) and t=N (F) are fully determined at t=0 (subject to MTM). Thus, the long party has effectively locked the forward rate for the period t=T and t=N i.e. f(0,T,N) because:

$$F = F_0\left[1 + f\left(0,T,N\right)\frac{\left(N-T\right)}{360}\right]$$ and both F_0 and F are known at t=0.



Locking a spot rate of different maturity

The logic is quite simple. Make a spot investment for (0,T). Also long a T-bill futures maturing for delivery of T-bill at t=T. Let the underlying T-bill delivered against the long futures mature at t=N. This strategy effectively locks the interest rate over (0,N) since your cashflow at t=0 is fixed, the two cashflows i.e. due to maturing of spot investment and the payment of futures price can be so aligned to neutralize each other and your cashflow received on maturity of the T-bill is equal to the face value of the bill and hence, known at t=0. We have:

$$F_0 = S_0\left[1+s_{0T}\left(\frac{T-0}{360}\right)\right] \; and \; F = F_0\left[1+f\left(0,T,N\right)\left(\frac{N-T}{360}\right)\right] \; so \; that$$
$$F = S_0\left[1+s_{0T}\left(\frac{T-0}{360}\right)\right]\times\left[1+f\left(0,T,N\right)\left(\frac{N-T}{360}\right)\right] = S_0\left[1+s_{0N}\left(\frac{N-0}{360}\right)\right] \; or$$
$$\left[1+s_{0T}\left(\frac{T-0}{360}\right)\right]\times\left[1+f\left(0,T,N\right)\left(\frac{N-T}{360}\right)\right] = \left[1+s_{0N}\left(\frac{N-0}{360}\right)\right]$$

Similarly, by making a spot investment for (0,N) and taking a short futures for (T,N), one can fix the spot rate for (0,T) where $0<T<N$. The procedure is:

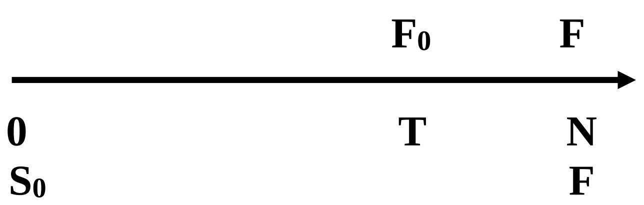
(i) Buy a T bill maturing at t=N@ P(N).

(ii) Since the redemption value is at face value and is known upfront, your return for (0, N) is fixed and fully determined at t=0 i.e. s_{0N} is fixed.

(iii) However, let us assume that your investment horizon is T where $0<T<N$. Then, clearly you are exposed to interest rate risk, due to uncertainty in the market price of the bill when it will be liquidated at t=T. Now, if you take a short position in a T bill future with delivery at t=T of a T bill maturing at t=N, you lock the forward rate F(T,N).

(iv) Since, both s_{0N} and f(0,T,N) are locked, s_{0T} gets locked by no arbitrage.

$$We \; have: F = S_0\left[1+s_{0N}\left(\frac{N-0}{360}\right)\right] \; and \; F = F_0\left[1+f\left(0,T,N\right)\left(\frac{N-T}{360}\right)\right] \; so \; that$$
$$If \; F_0 = S_0\left[1+s_{0T}\left(\frac{T-0}{360}\right)\right], \; then$$
$$\left[1+s_{0T}\left(\frac{T-0}{360}\right)\right] = \left[1+f\left(0,T,N\right)\left(\frac{N-T}{360}\right)\right]^{-1}\times\left[1+s_{0N}\left(\frac{N-0}{360}\right)\right]$$



Hedging with T-bill futures

Let us take an example. Say at t=0, an investor takes a long position in a T-bill futures at a certain price, say, P_f. It means that on the date of maturity of the futures i.e. t=T, he will receive a 90-day T-bill i.e. a T-bill that will mature 90 days after that date of delivery (i.e. the date of maturity of the futures) for payment. The investor in the futures will pay the price P_f at t=T but will receive the maturity proceeds of the T-bill 90 days later i.e. at t=T+90. Obviously, P_f is determined at t=0.

Thus, the contract is negotiated at t=0, Price at which the futures will be settled i.e. at which the T-bill will be received by the long futures is agreed at t=0.

The contract is settled at t=T, the maturity date of the futures by the short delivering a 90-day T-bill to the long and the long paying the price P_f.

The T-bill now belongs to the party who was long in the futures. He will receive the proceeds (face value) of the T-bill when it matures at the end of 90 days from delivery i.e. at t=T+90.

The important thing is that the price that the investor paid at t=T to get the 90-day T-bill would normally be the market price of the bill at that date. However, because he has taken a long futures on the bill, this price if prefixed at t=0.

Secondly, what the long futures holder receives is a 90-day T-bill which will be redeemed by the issuer of the bill after 90 days. In other words, after 90 days the long futures party will receive the face value of the T-Bill.

Now, if during the period (0,T) there is a downward shift in interest rates, the price of the bill in the cash market will, obviously, appreciate since price and interest rates are inversely related. It is likely that the futures price of the bill will also rise.

But the long futures holder is already assured of getting this bill at a prefixed price. A price which is fixed beforehand, before this interest change occurred. The price has now increased. Therefore, the value of the long futures position will rise. because that position holder will be getting the bill at a lesser price compared to the updated futures price. Thus, the long futures holder makes a profit on his long futures in the event of an unanticipated decline in interest rates.

Thus, If the investor’s portfolio is such that a downward shift at interest rate will result in a loss, and he desires to protect his portfolio against such an eventuality, he can, by taking up long T-bill futures create a hedge. The hedge would so operate that if the interest rates move downwards, his long T-bill futures would generate profits that would compensate his losses on the portfolio. Of the converse will also hold.

Some examples of interest rate hedging

(i) You hold $10 m 91-day T-bills which you will sell in one month's time because you need to pay your creditors. **SHORT**

(ii) You will receive $10m in 6 months' time which you want to invest in a Eurodollar bank deposit for 90 days. **LONG**

(iii) You hope to issue $10m of 180-day commercial paper in 3-month time (i.e. to borrow money). **SHORT**

In case (i), you would need to hedge against a price fall of the T-bills at the point of exiting the investment i.e. your hedge should operate against a rise in interest rates. In other words, the hedge should generate a profit on the rise in interest rates. This implies that you should hedge by taking a short position in the T-bill futures. In case the spot interest rates rise, it is likely that the futures interest rates will also rise. This would be expected to be accompanied by a fall in the T-bill futures prices whence your short hedge will generate profits.

T-bills hedging: number of contracts

Hedging an existing portfolio

Consider an investor having a portfolio of T-bills of the face value of F_s. Let H be the holding period of the investor and T the maturity of the T-bills. Let d_{s0} be the discount yields on T-bills at t=0 and let d_{sH} be its corresponding value at t=H. Then, the value of the portfolio at t=0, $V_{0,s}$ and t=H, $V_{H,s}$ will respectively be:

$$V_{0,s} = F_s\left(1 - d_{s0}\frac{T-0}{360}\right);\ V_{H,s} = F_s\left[1 - d_{sH}\left(\frac{T-H}{360}\right)\right]$$

$$Change\ in\ value\ of\ \ portfolio\ dV_s = V_{H,s} - V_{0,s} = F_s\left[d_{s0}\frac{T}{360} - d_{sH}\left(\frac{T-H}{360}\right)\right]$$

$$= F_s\left[d_{s0}\left(\frac{T-H}{360}\right) - d_{sH}\left(\frac{T-H}{360}\right) + d_{s0}\left(\frac{H}{360}\right)\right] = F_s\left[-\Delta d_s\left(\frac{T-H}{360}\right) + d_{s0}\left(\frac{H}{360}\right)\right]$$

\

$$But\ F_s d_{s0}\left(\frac{H}{360}\right)\ is\ the\ change\ in\ value\ of\ the\ portfolio\ even\ is\ yield\ is\ unchanged.$$

$$Hence, change\ in\ value\ of\ \exp osure\ due\ to\ yield\ change\ dS = -F_s \Delta d_s \left(\frac{T-H}{360}\right)$$

$$Now,\ futures\ price\ per\ contract\ at\ t=0\ is: P_{0,f} = F_f^*\left(1-0.25d_{f0}\right);$$

$$and\ at\ t=H\ is: P_{H,f} = F_f^*\left[1-0.25d_{fH}\right]\ where\ F_f^* = Face\ value\ per\ futures\ contract$$

$$Change\ in\ value\ of\ N_f\ futures\ contracts: dF = -0.25 N_f F_f^* \Delta d_f$$

$$For\ the\ hedge\ to\ be\ optimal\ with\ \min\ \mathrm{var}iance\ N_f = \frac{(T-H)F_s}{360\times 0.25\times F_f^*}\beta_{\Delta d_s,\Delta d_f}$$

Now, Now, $F_s d_{s0}\left(\frac{H}{360}\right)$ is nothing but the erosion in value of the portfolio due to passage of time at the original yield rate and does not carry any impact of the changed yield. If the original yield did not change, even then this change would have occurred. This change in value would have occurred because this change is due to the time value of money at the original rate. Hence, we not concerned with it in the context of hedging as hedging relates to the protection of portfolio's value against changes in yields.

Observations

(i) The entire stochasticity of yields is captured by the regression coefficient β (hedge ratio).

(ii) If we assume parallel shifts of the spot and futures yield curves, then $\beta_{\Delta ys, \Delta yf}$ being the slope of the regression line between Δy_s, Δy_f is unity because interest rates for all maturities shall change with the same amount and so the change in Δy_f will be accompanied by an equal change in Δy_s and vice versa.

(iii) The value of the futures position is proportional to the remaining lifespan of the hedged T-bills (T-H) after the completion of the hedge period. This is so because any yield shift will impact the value of the T bill over this span. Hence, greater the lifespan, greater will be the price change of the T bill for a given yield shift. If there is a change in yield, then it will impact the T-bill price with reference to the remaining lifespan of the bill.

(iv) The beta term arises in the usual manner if we write the expression for the variance of the hedged portfolio and then optimize it by minimizing the variance.

It is generally the case that we assume the yield shifts in the spot market to be parallel. In other words, the changes in yields are equal in so far as the entire spectrum of yields is concerned. This implies that the change in futures yields also occur by the same amount so that beta approximates unity.

$$e^{2S_{02}} = e^{S_{01}} e^{f_{12}} = e^{S_{01}+f_{12}};\ f_{12} = 2S_{02} - 1S_{01}$$
$$f_{12}^{*} = 2\left(S_{02}+\Delta\right) - 1\left(S_{01}+\Delta\right) = 2S_{02} - S_{01} + \Delta = f_{12} + \Delta$$

Whether it really happens or not impacts the effectiveness of the hedges as we will see later.

EXAMPLE

Today is t=0. XYZ Ltd is holding 12-month T-Bills (FV of $10m) with a maturity of t=12 months. Its investment horizon is upto t=2 months. The company decides to hedge through 3-month T-Bill futures with delivery at t=5 months. The hedge will be lifted at t=2 months by the closing of the futures contracts.

The IMM index quotes at t=0 and t=2 months of the 3-month T-Bill futures turn out to be 88.00 and 86.00 respectively. Spot discount yields on T-bills at t=0 and t=2 months are 9% and 11% respectively. Work out the extent to which the hedge has operated successfully. Assume yield shifts to be parallel.

Face Value of the portfolio (F_s): 10,000,000

Life of T-bills (T): 12-months

Hedge Period (H):2 months

Face Value of T-bills underlying one futures (F^{*}_{f}): 1,000,000

$$No\ of\ \ futures: N_f = \frac{\left(T-H\right)F_s}{360\times 0.25\times F_f^{*}}\beta_{\Delta d_s,\Delta d_f} = \frac{\left(360-60\right)\times 10,000,000}{360\times 0.25\times 1,000,000}\times 1 = 33\left(r.o\right)$$

PERFORMANCE OF HEDGE	**0**	**2**
FUTURES QUOTES	**88**	**86**
DISCOUNT YIELD	**0.12**	**0.14**
FUTURES PRICE	**970000**	**965000**
PROFIT PER CONTRACT		**5000**
PROFIT ON FUTURES POSITION		**165000**
CASH POSITION		
DISCOUNT YIELD	**0.09**	**0.11**
REMAINING MATURITY	**1**	**0.833333333**
PRICE	**910000**	**908333.3333**
PRICE AT ORIGINAL YIELD		**925000**
LOSS DUE TO CHANGE IN YIELD		**16666.66667**
TOTAL LOSS DUE TO CHANGE IN YIELD ON 10 BILLS		**166666.6667**
HENCE CHANGE IN VALUE OF HEDGED POSITION		**-1,666.67**

The company decides to hedge using 3-month T-bill futures for delivery at t=5 months. This means the 3-month T-bills will be delivered at t=5 months. The T-bills themselves will mature at t=8 months when they will be redeemed by the issuer. However, the hedger will lift the hedge at t=2 months by reversing the futures trade in the market at that time when he closes the hedge. Now please note that when we talk about hedging with T-bill futures, there are four time points:

(i) One is the time point at which the hedge is created i.e. the position in futures market is taken up by the hedger (t=0).

(ii) Second is the time point at which the hedge is lifted by reversing the original trade in the futures market (t=H) and thereby closing the futures position and the hedge.

(ii) The third point is when the futures themselves mature for delivery i.e. when the long position holder gets delivery of the underlying T-bills (t=T).

(iv) The fourth point is when the underlying T-bills mature for payment and the issuer of the bills redeemed the bill (t=N).

Now, the time span between when the futures themselves are notified for trading and when they mature for delivery of underlying need not necessarily be three months although it will be specified by the exchange. However, the time between delivery of the T-bill and its maturity for payment by the issuer will be three months for a 3-month T-bill futures.

Now, futures quote at t=0 and t=2 months are 88 and 86. The corresponding discount yields are 12% and 14% respectively whence the traded price of futures is 970,000 and

965,000 per 1,000,000 face value of underlying. Because the position is a short position, this difference of 5,000 will be a profit on the futures per 1,000,000 face value. Since the hedger has shorted 33 contracts, the total profit on futures is 165,000.

Let us now look at the cash position. The spot yield at t=0 is given at 9%. Applying this to the face value of the investment of 10,000,000 with a maturity of one year, we get the value of the investment at t=0 as 10,000,000x(1-0.09x1) = 910,000. Similarly, the yield at t=2 months is 11%. However, the time to maturity of the investment is now 10 months. Hence, its value is 10,000,000x(1-0.11x0.83333) = 9,083,333. The value of the investment if the yield had not changed from 9% to 11% would have been 10,000,000x(1-0.09x0.83333) = 9,250,000. Thus, the loss due to the change in yield is 9,083,333-9,250,000=166,667.

Hence, the net loss on the hedged portfolio is 1,667. This loss comes from the fact that the number of contracts have been rounded off from 33.33 to 33. Had 33.33 futures been shorted, one would have ended up with a nil loss.

Hedging of a future investment: Prefixed redemption value

Let the amount to be invested V_{sH} *at time H*

$$\text{Then, we have } V_{sH} = F_s\left(1 - d_{s0}\frac{T-H}{360}\right)$$

Let the actual yield at time be d_{sH}

$$\text{Actual investment } V_{sH}^{*} = F_s\left(1 - d_{sH}\frac{T-H}{360}\right)$$

$$\text{Change in investment } V_{sH}^{*} - V_{sH} = -F_s\left(d_{sH} - d_{s0}\right)\left(\frac{T-H}{360}\right) = -F_s\Delta d_s\left(\frac{T-H}{360}\right)$$

Hence, change in value of exposure due to yield change

$$dS = -F_s\Delta d_s\left(\frac{T-H}{360}\right)$$

$$\text{For each futures, } P_{0,f} = F_f^{*}\left(1 - 0.25d_{f0}\right);\ P_{H,f} = F_f^{*}\left[1 - 0.25d_{fH}\right]$$

$$\text{Change in value of } N_f \text{ futures } dF = -0.25N_fF_f^{*}\Delta d_f$$

$$N_f = \frac{\left(T-H\right)F_s}{360*0.25\times F_f^{*}}\beta_{\Delta d_s,\Delta d_f}$$

Now we consider the hedging of a future investment. An investor wants to make an investment in the future (say at t=H) and he is worried about the change in the investment amount due to a change in interest rates between t=0 and t=H. At today's yield rates, the investment amount V_{sH} at t=H for a redemption amount of F_s on maturity at t=T is given by $V_{sH}= F_s\{1-d_{s0}[(T-H)/360]\}$. Suppose the yield rates change at t=H to d_{sH}, then the actual investment to be made for the redemption proceeds of the face value of F_s at t=T will be $V^*_{sH} = F_s\{1-d_{sH}[(T-H)/360]\}$. Thus, the change in investment amount due to yield shift is $dS=- F\Delta_s d_s[(T-H)/360]$.

Using the notation as earlier the change in value of a hedge consisting of N_f futures is: $dF=-0.25N_fF^*_f\ \Delta d_f$. Using these expressions, we can set up the expression for the variance of the hedged portfolio. Thereafter on minimizing the variance, we get the number of contracts as:

$$N_f = \frac{(T-H)F_s}{360 * 0.25 \times F_f^*}\beta_{\Delta d_s,\Delta d_f}$$

This is the number of contracts. F^*_f is the face value of underlying per futures contract.

EXAMPLE

It is t=0 and the treasurer of company X expects to make an investment of $1m redemption value in 6-month T-bills at t=3 months until t=9 months. The treasurer fears a fall in interest rates, which would imply that his investment beginning in t=3 months will earn less interest. The treasurer buys (goes long) 3-month T-bill futures today (t=0) with maturity in t=4 months.

The IMM index quotes at t=0 and t=3 of the T-Bill futures turn out to be 89.2 and 90.3 respectively. Spot investment rates at t=0 and t=3 months are 11% and 9.6% respectively. Work out the extent to which the hedge has operated successfully. Assume spot yield shifts to be parallel.

Redemption (Face) Value of the portfolio (F_s): 1,000,000

Maturity of T-bills from now (T): 9-months

Timing of investment (Hedge Period) (H): 3-months

Face Value of T-bills underlying one futures (F^*_f): 1,000,000

$$No\ of\ futures: N_f = \frac{(T-H)F_s}{360 \times 0.25 \times F_f^*}\beta_{\Delta d_s,\Delta d_f} = \frac{(270-90)\times 1,000,000}{360\times 0.25\times 1,000,000}\times 1 = 2$$

PERFORMANCE OF HEDGE	0	3
FUTURES QUOTES	89.2	90.3
DISCOUNT YIELD	0.108	0.097
FUTURES PRICE	973000	975750
PROFIT PER CONTRACT		2750
PROFIT ON FUTURES POSITION		5500
CASH POSITION		
INTEREST RATE	0.11	0.096
MATURITY	0.5	0.5
INTEREST INCOME	52132.7	45801.52672
LOSS DUE TO CHANGE IN INTT RATE		-6331.174704
NET LOSS		-831.1747042

In the above example, today is t=0. An investor desires to make an investment three months from now i.e. at t=3 months in 6-month T-bills of the face (redemption) value of 1,000,000. The investor fears a fall in interest rate. If interest rates fall between now and 3 months, the price of T-bills will increase and he will have to make a higher investment to obtain the same redemption value at the end of the investment.

Now, if he goes long in T-bill futures, since any fall in spot rates will be mirrored by a fall in futures rates and a rise in futures prices of T-bill thereby generating profits on his long position. Thus, if the interest rates fall, the loss that he will make on the cash position on the investment will be compensated by the profit that he makes on the futures position.

The futures quote at t=0 and t=3 months are 89.2 and 90.3 respectively. Corresponding futures prices are 973,000 and 975,750 yielding a profit of 2,750 per contract. Since we have longed two contracts, profit on the hedge is 5,500. This profit arises at t= 3months when the hedge is lifted.

Spot investment rates at t=0 and t=3 months are 11% and 9.6% respectively. Thus, the original and revised investments at t=3 months for getting a redemption of 1,000,000 at t=9 months are:

$$V_{sH} = F_s \Big/ \left(1 + r_{s0}\frac{T - H}{360}\right) = 1{,}000{,}000 \Big/ \left(1 + 0.11 \times \frac{180}{360}\right) = 947{,}867$$

$$Actual\ investment\ V_{sH}^* = F_s \Big/ \left(1 + r_{sH}\frac{T - H}{360}\right) = 1{,}000{,}000 \Big/ \left(1 + 0.096 \times \frac{180}{360}\right) = 951{,}498$$

$$Change\ in\ investment\ V_{sH}^* - V_{sH} = 6{,}331$$

showing that the net loss on the hedged portfolio is 831.

Hedging of a future investment: Prefixed investment value

Here we consider a variant of the above case where the amount to be invested at a future date say t=H is prefixed and the impact of changes in interest rates is reflected in the changes in the redemption value of the investment at t=T. we have,

$$Let\ the\ amount\ to\ be\ invested\ be\ V_{sH}\ at\ time\ H$$

$$Then,\ we\ have\ redemption\ value\ on\ the\ basis\ of\ \text{int}erest\ rates\ at\ t = 0:$$

$$F_s = V_{sH}\left(1 + r_{s0}\frac{T - H}{360}\right)$$

$$Let\ the\ actual\ \text{int}erest\ rate\ at\ the\ date\ of\ investment\ i.e.\ at\ time\ t = H\ be\ r_{sH}$$

$$Actual\ redemption\ value\ F_s^* = V_{sH}\left(1 + r_{sH}\frac{T - H}{360}\right)$$

$$Change\ in\ iredemption\ proceeds\ dF = F_{sH}^* - F_{sH}$$

$$= V_{sH}\left(r_{sH} - r_{s0}\right)\left(\frac{T - H}{360}\right) = V_{sH}\Delta r_s\left(\frac{T - H}{360}\right)$$

$$Hence, change\ in\ value\ of\ \text{exp}osure\ due\ to\ yield\ change$$

$$dF = V_{sH}\Delta r_s\left(\frac{T - H}{360}\right)$$

$$For\ each\ futures, P_{0,f} = F_f^*\left(1 - 0.25d_{f0}\right);\ P_{H,f} = F_f^*\left[1 - 0.25d_{fH}\right]$$

$$Change\ in\ value\ of\ N_f\ futures\ dF = -0.25N_f F_f^*\Delta d_f$$

$$N_f = \frac{(T - H)V_{sH}}{360 * 0.25 \times F_f^*}\beta_{\Delta r_s, \Delta d_f}$$

EXAMPLE

It is t=0 and the treasurer of company X expects to receive $1m in t=3 months, and wishes to invest this in a 6-month T-bill until t=9 months. The treasurer fears a fall in interest rates, which would imply that his investment beginning in t=3 months will earn less interest. The treasurer buys (goes long) 3-month T-bill futures today (t=0) with maturity in t=4 months (since t=3 maturity T-Bill futures are not trading).

The IMM index quotes at t=0 and t=3 of the T-Bill futures turn out to be 89.2 and 90.3 respectively. Spot investment rates at t=0 and t=3 months are 11% and 9.6%

respectively. Work out the extent to which the hedge has operated successfully. Assume spot and future yield shifts to be parallel.

Value of investment (V_{sH}): 1,000,000

Maturity of T-bills from now (T): 9-months

Timing of investment (Hedge Period) (H): 3-months

Face Value of T-bills underlying one futures (F^*_f): 1,000,000

$$No\ of\ \ futures: N_f\ =\ \frac{(T - H)V_{sH}}{360\times 0.25\times F_f^*}\beta_{\Delta d_s,\Delta r_f}\ =\frac{(270 - 90)\times 1,000,000}{360\times 0.25\times 1,000,000}\times 1 = 2$$

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PROFIT PER CONTRACT		2750
PROFIT ON FUTURES POSITION		5500
CASH POSITION		
INTEREST RATE	0.11	0.096
MATURITY	0.5	0.5
INTEREST INCOME	55000	48000
LOSS DUE TO CHANGE IN INTT RATE		-7000
PV OF THE LOSS		-6686.406299
NET LOSS		-1186.406299

One point needs emphasis. The profit from the futures hedge arises at t=3 months when the hedge is lifted by the investor by liquidating his futures position. However, the loss on account of interest due to the fall in spot rates occurs at the end of the investment period i.e. at the end of 9 months. When the investment is liquidated. Therefore, there is a clear timing mismatch between the loss on the hedged asset and the profit on the hedge. Hence, we need to bring them to a common point in time before calculating the net profit/loss on the total hedges.