short selling

short selling

4-Sep-2019

①

A B C

borrow
tencent
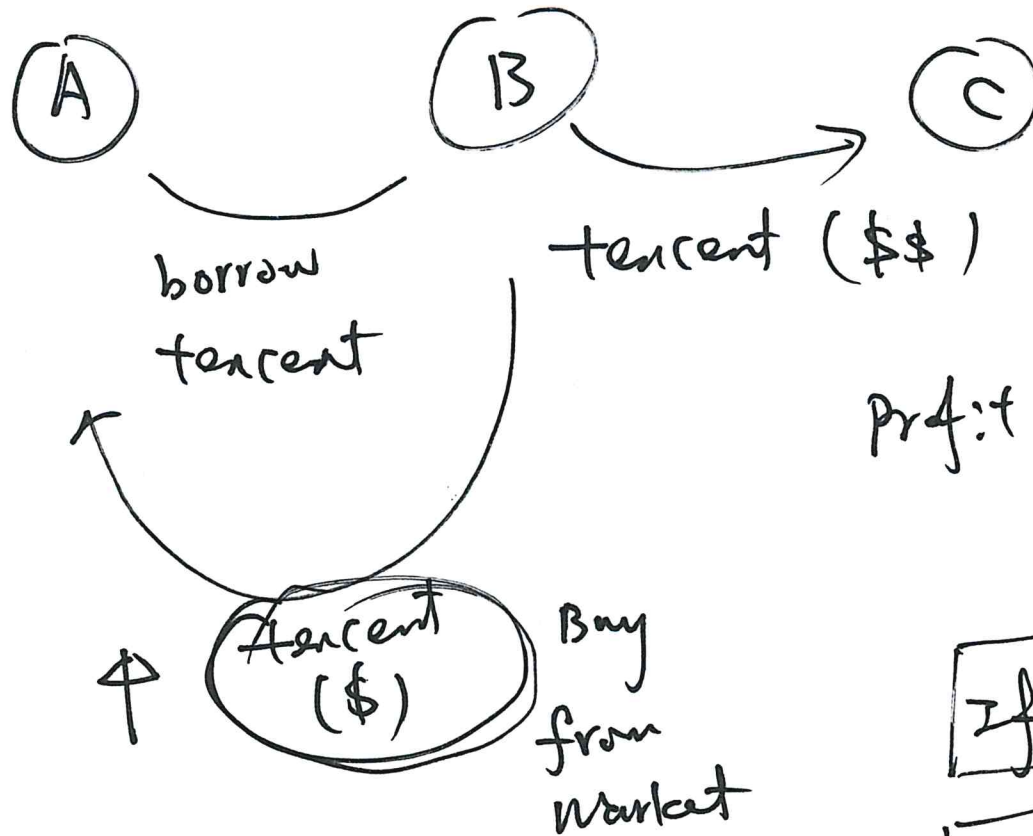
tencent ($$)

tencent
($)

Buy
from
market

Profit of B = cash inflow ($$)

      — cash outflow ($)

If $$$ > $$ B: profit $\in$

If $$$ < $$ ⬆ ,   B: loss

$$\text{Profit} = S_0 - PV(D) - PV(S_{p0})$$

②

underlying asset : Tencent

Cashflow ✓

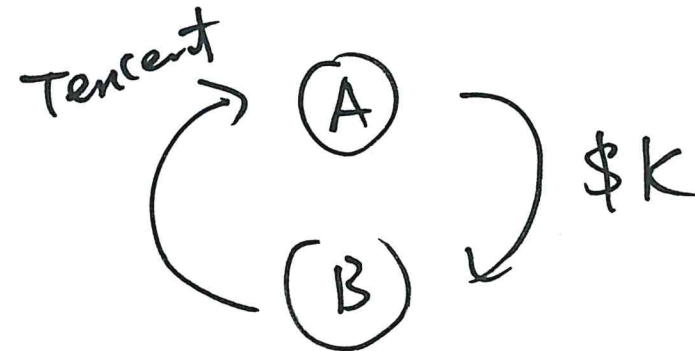———————|——————————————————|———————

today   T (future time)

(No cashflow)
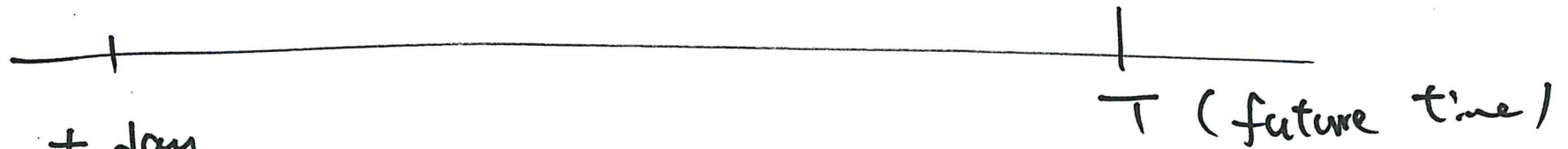
Ⓐ   agree

Ⓑ   ① a fixed price   K (Forward price)

② a fixed future Ⓣ (maturity) time

Tencent → Ⓐ
Ⓐ ⤵ $K
Ⓑ ↺

Terminology :

Ⓐ : Long party (Buyer)

Ⓑ : Short party (seller)

Payoff : Cash inflow at a ~~particular moment~~ particular moment.
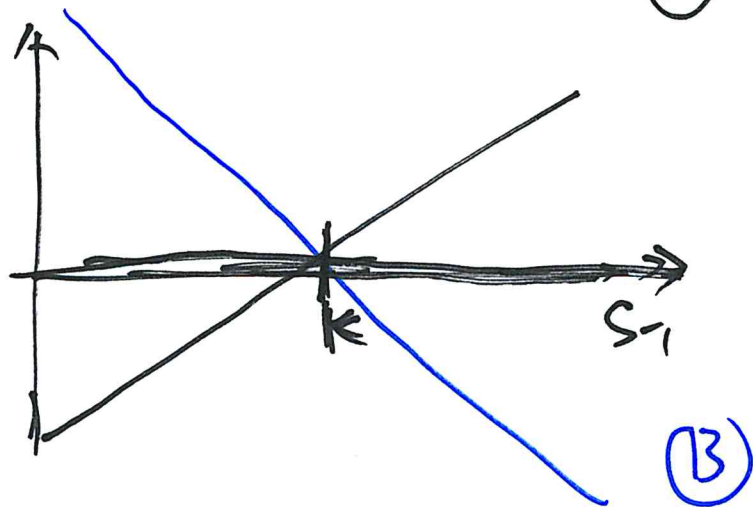
③

Payoff of the forward at T

Long : Ⓐ $= S_T - K$

Short : Ⓑ $= K - S_T$ + where S_T is the price of Tencent at T

$= 0$ (zero sum game)

Payoff diagram

Payoff

Ⓐ

Ⓑ

S_T

Zero coupon (bond)   Face value = K

$\$? = PV(K)$ $\$K \rightarrow$ Buyer

|——————————————————|——————————————
today T (maturity)

$$PV(K) = Ke^{-rT} \quad (r: \text{continuously compounded int rate})$$

$$= \frac{K}{(1+r)^T} \quad (r: \text{annually compounded int rate})$$

Price of zero coupon bond $= PV(K)$

Portfolio (A)   (5)

1) Long a forward   : forward price = K   } same
                                                   maturity
2) Buy a zero-coupon bond : face value = K   "T"

                                        Cost of (A) = cost of (B)

Payoff at T

$$= \boxed{S_T - K} + \boxed{K} = S_T \qquad (A)$$

   \quad forward \qquad Bond

Portfolio (B)   : Buy a share of asset at $t=0$.
                    and hold it until T.

                                    $\Rightarrow$ Payoff (A) = Payoff (B)

Payoff $= S_T$ (B)

Cost of (A) = Forward + Bond

$$= 0 + PV(K)$$

Cost of (B) = S_0

$$\Rightarrow \quad 0 + PV(K) = S_0$$

$$\cancel{K = FV(S_0)}$$

$$FV(PV(K)) = FV(S_0)$$

$$\boxed{K = FV(S_0)} = \begin{cases} S_0 e^{rT} \\ \\ S_0(1+r)^T \end{cases}$$

Call option

Tencent

A: Long (Buyer) ⑦

B: Short (Seller)

C: option premium

$(A) \xrightarrow{\$C} (B)$

——————————|——————————————————|——————

$t=0$ (today) $t=T$ (future time)

If $S_T > K$

(A) ① agree a fixed price K (Strike price)

Tencent $\to (A)$

$\overset{\curvearrowright}{(B)} \$K$

(A) use $\$K$ to buy Tencent
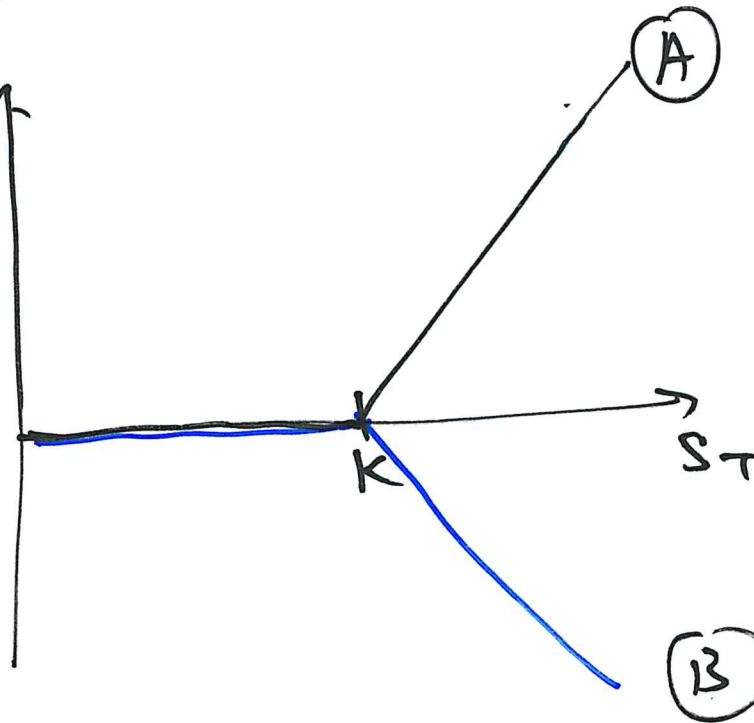
(B) ② agree a future date, T (maturity)

If $S_T \leq K$

Nothing happend

$$\text{Payoff of } (A) = \begin{cases} S_T - K & \text{if } S_T > K \\ 0 & \text{if } S_T \leq K \end{cases} \quad (A)$$

$Max(S_T - K, 0)$

$$\text{Payoff of } (B) = \begin{cases} K - S_T & \text{if } S_T > K \\ 0 & \text{if } S_T \leq K \end{cases} \quad (B)$$

$- Max(S_T - K, 0)$

Payoff diagram

Payoff vs Profit

⑧

Profit of Ⓐ at T over [0, T] = Payoff at Ⓣ $-$ FV(C)

Profit $\neq$ Payoff   (option)

Profit of Ⓑ at T over [0, T] = Payoff at Ⓣ $+$ FV(C)

Put option

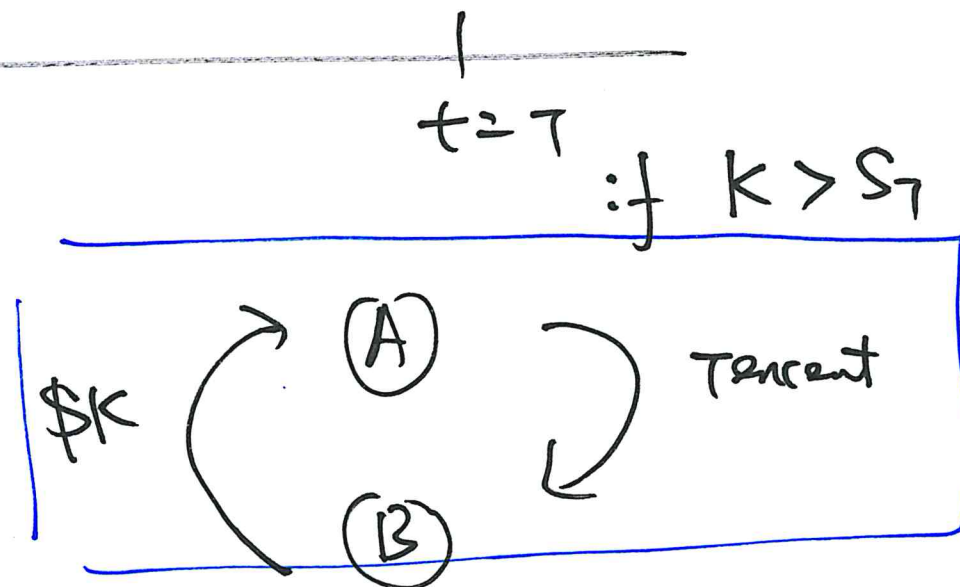(A) $\xrightarrow{\$P}$ (B) P: option premium

———————————————————————— $t = T$

$t = 0$

$\qquad\qquad\qquad\qquad\qquad\qquad$ if $K > S_T$

(A) agree K (strike)

(B) agree T

$\$K$ (A) $\quad$ Tencent

$\qquad\qquad\qquad\qquad\qquad$ (B)

if $K > S_T$

(A) sells Tencent

to (B) at $\$K$

if $K \leq S_T$

(A)

Nothing

(B) happend

Payoff

(A) $= \text{Max}(K - S_T, 0)$

(B) $= -\text{Max}(K - S_T, 0)$

Profit of $\boxed{\text{at } T}$

(A) $= \text{Max}(K - S_T, 0) \; \ominus \; FV(P)$

(B) $= -\text{Max}(K - S_T, 0) \; \oplus \; FV(P)$

Call option   K = $100

underlying : Tencent

Moneyness

$S_0 = \$90$

$S_u = \$100$

$S_u = \cancel{\$70} \$110$

$S_0 < K$ out-of-money

At the money

in the money

Put option :   K = $100 $(K - S_0)$

moneyness.

~~in money~~ in the money (

$S_0 = \$90$

$S_0 = \$100$ at the money

$S_0 = \$110$ out-of-money.