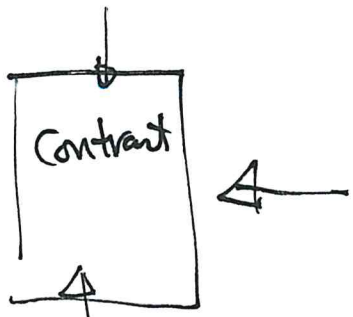
Chapter 1 ~~Be~~ Financial Derivatives ?? 6-Sep-2018



Value depends on ("?")

Stock.

Commodity

T°

∴ "Financial derivative Contract"

(1) Short Selling (賣空)

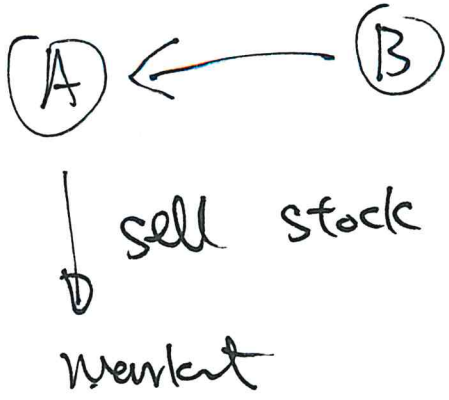
Today: (A) borrows "stock" from (B)

↳ sell stock to the ~~market~~ market

Later

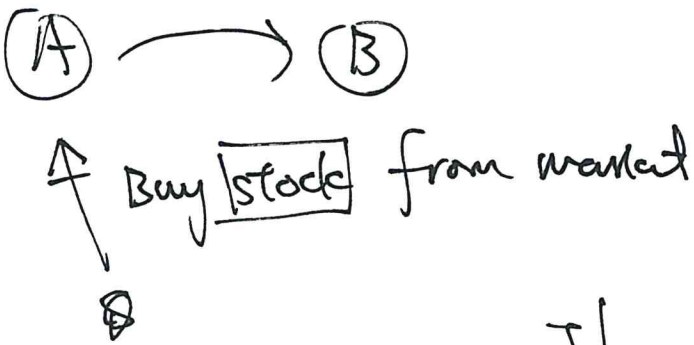
Short selling

$t=0$:



Cash inflow of (A) = ($)

$t=T$:



Cash inflow of (A) = − ($$)

If ($$) < ($), (A) profit

($$) > ($), (A) loss

Profit @ day t_0

= Cash inflow $[0, \text{day } t_0]$ − Cash outflow $[0, \text{day } t_0]$

= $S_0 - [S_{t_0} + D]$

= $S_0 - S_{t_0} - D$??

Consider time value of money. (PV : present value)
(FV : future value)

~~$= S_{t_0} - FV(S_{t_0})$~~

$= FV(S_0) - [S_{t_0} + FV(D)] = \underbrace{FV(S_0)}_{S_0 e^{rT}} - S_{t_0} - \underbrace{FV(D)}_{D e^{r(T-t_D)}}$

Why short selling?

(1) speculate price of stock ↓

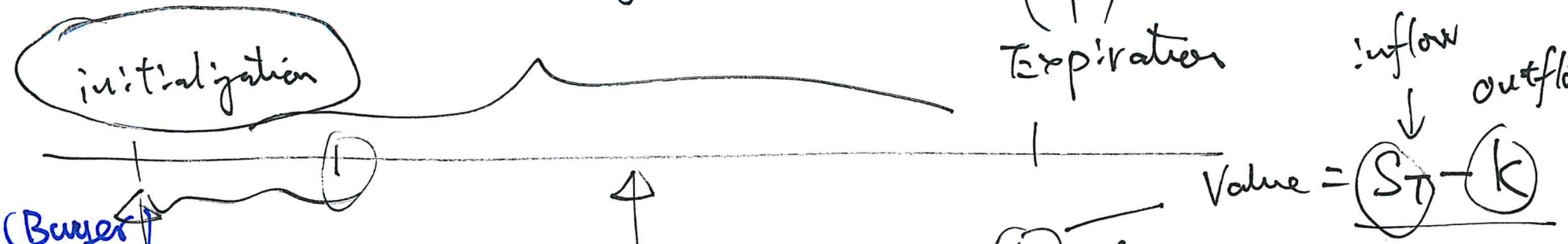
(2) ~~Financing~~. Financing

(3) hedging

" credit risk "

Forward contract (underlying asset / (oil)
Nothing happen

(5)

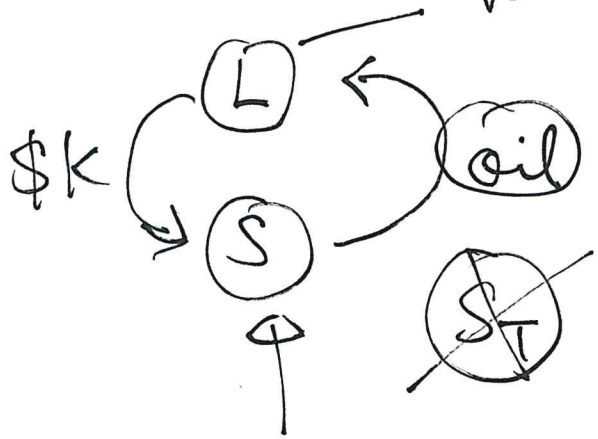


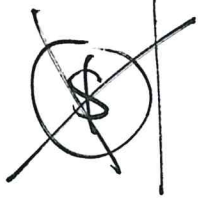
(Buyer)
(L)ong party
(Seller) (S)hort party

An agreement on price

Value of Forward $\neq 0$

$K ← Forward price





Value of Forward Contract = 0

Value = $K - S_T$

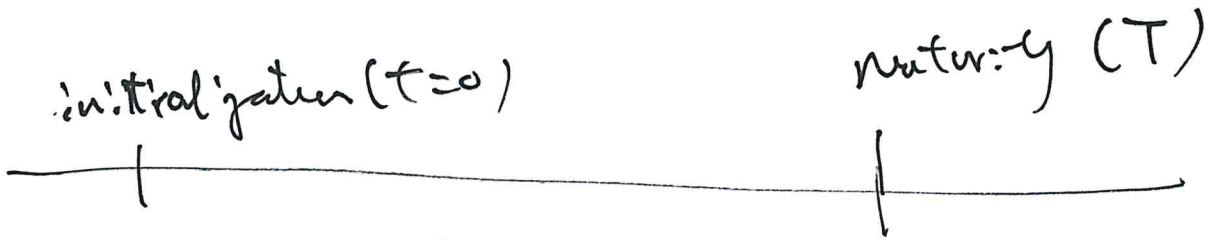
inflow outflow

Payoff = cashflow @ T

Long $= S_T - K$

Short $= K - S_T$

Zero-coupon bond (bond) (Face value = $K)



($P) ← price of the zero bond

pay $K to the buyer

Buy bond : lend the money

Sell bond : borrow the money

$P < K$

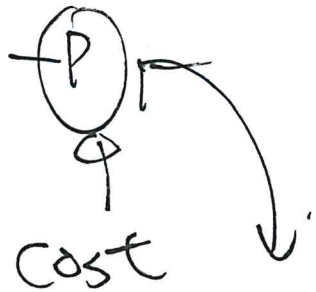
$P = PV(K) = K e^{-rT}$ (assume continuous compounding)

Portfolio $\Leftrightarrow$ hold a share of stock keep it to expiration

{ ① Long Forward
② Buy a zero-coupon bond with face value \$K

	t=0	t=T
Long forward	0	$S_T - K$
zero coupon bond	$-P$	K
total	$-P$	S_T

$\boxed{P = S_0}$

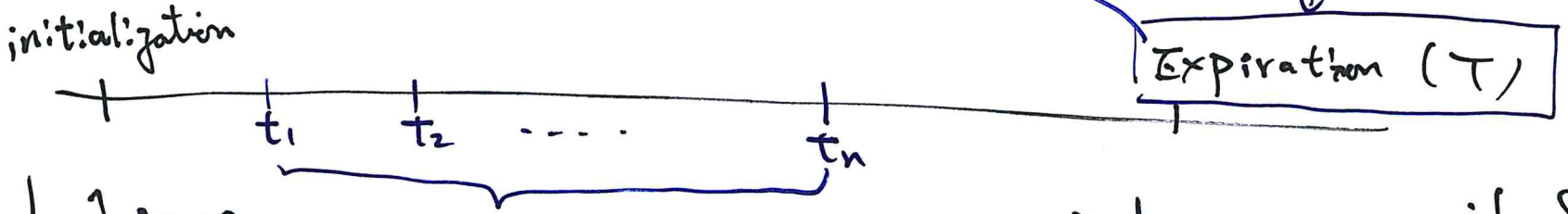


Portfolio ② : pay S_0 at t=0 and hold the stock.

Call option

Exercise anytime [0,T] (American)

Exercise only at T (European)



$C

L / S — Agree to sell the underlying at $K at T

Option price (premium)

Strike price

Exercise only at $\{t_1, t_2, \ldots t_n\}$

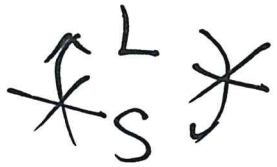
Bermudan

Asset: L / S — $K

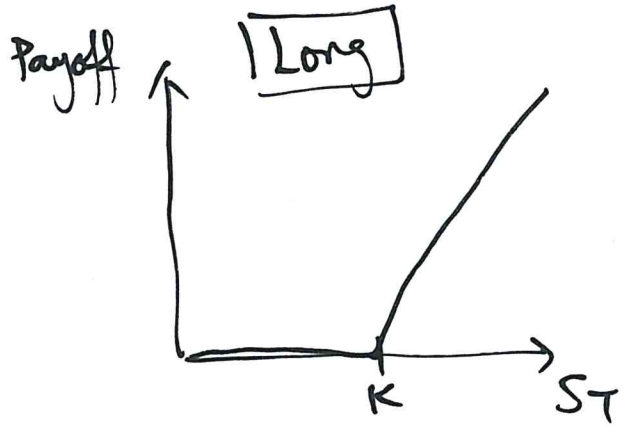
if $S_T > K$ (Exercise the option)

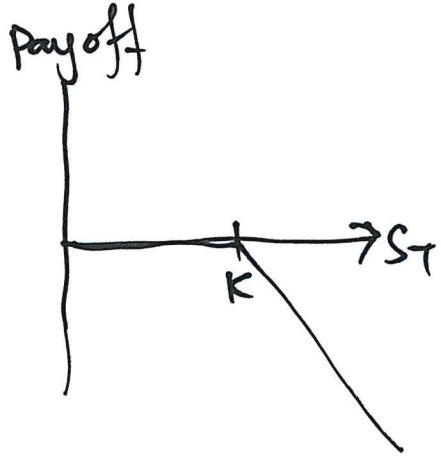
Nothing happen

if $S_T < K$



Long





Call option

① Payoff vs Profit @ T

= All cash inflow over $[0, T]$

= Payoff @ T − FV(C)

Call option vs forward

Right to buy

Obligation to buy

Long

Obligation to sell

Short

Obligation to sell

Call option

Forward

Payoff

$\max(0, S_T - K)$

$S_T - K$

Long

$-\max(0, S_T - K)$, $K - S_T$

Short

$\max(0, K - S_T)$

$-\max(0, S_T - K)$

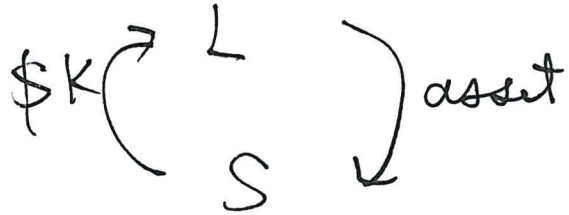
$S_T > K$

$= -(S_T - K) = K - S_T$

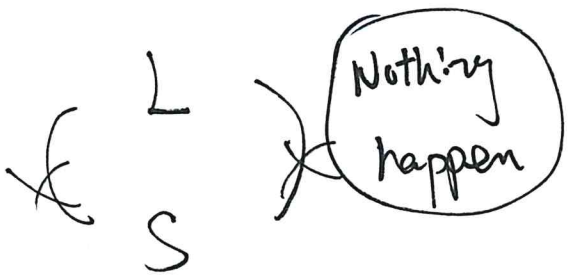
put option

Strike price = $K

option premium = $P



if $K > S_T$



if ~~$S_T < K$~~ $K < S_T$

Payoff Long: $\max(0, K - S_T)$

Short: ~~fixed~~ $- \max(0, K - S_T)$

Profit = Payoff − FV(option premium)

Call option on Tencent

Tencent price = HK$ 350 today

3-mth Call option $K = \$340 < \$350$

$K = \$380 > \$350$

$K = \$350 = \$350$

$\max((S_T - K), 0)$

~~out of~~ In the money.

out-of-money

At the money.

3-mth put option $K = \$340 < \$350$

$K = \$380$

$K = \$350$ 350

$\max(0, (K - S_T))$

out-of money

in-the-money

At-the money.