Chapter 8

Currency Options (1): Concepts and Uses

Overview

Introduction
- Puts and Calls
- Some Jargon: IV, I-A-OTM, TV
- Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage
- Lower Bounds
- (European) Put-Call Parity

Using Options (2): hedging
- Advantages

Using Options (3): Speculation

What have we learned?
- Summary
- Are Options too Expensive?

Overview

Introduction
- Puts and Calls
- Some Jargon: IV, I-A-OTM, TV
- Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage
- Lower Bounds
- (European) Put-Call Parity

Using Options (2): hedging
- Advantages

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- Summary
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Overview

Introduction
- Puts and Calls
- Some Jargon: IV, I-A-OTM, TV
- Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage
- Lower Bounds
- (European) Put-Call Parity

Using Options (2): hedging
- Advantages

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What have we learned?
- Summary
- Are Options too Expensive?

Overview

Introduction
- Puts and Calls
- Some Jargon: IV, I-A-OTM, TV
- Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage
- Lower Bounds
- (European) Put-Call Parity

Using Options (2): hedging
- Advantages

Using Options (3): Speculation

What have we learned?
- Summary
- Are Options too Expensive?

Overview

Introduction
- Puts and Calls
- Some Jargon: IV, I-A-OTM, TV
- Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage
- Lower Bounds
- (European) Put-Call Parity

Using Options (2): hedging
- Advantages

Using Options (3): Speculation

What have we learned?
- Summary
- Are Options too Expensive?

Overview

Introduction
- Puts and Calls
- Some Jargon: IV, I-A-OTM, TV
- Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage
- Lower Bounds
- (European) Put-Call Parity

Using Options (2): hedging
- Advantages

Using Options (3): Speculation

What have we learned?
- Summary
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Outline

Introduction
Puts and Calls
Some Jargon
Rational Exercising
Institutional Aspects
Using Options (1): Arbitrage
Using Options (2): hedging
Using Options (3): Speculation
What have we learned?

Introduction
Puts and Calls
Some Jargon: IV, I-A-OTM, TV
Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage
Lower Bounds
(European) Put-Call Parity

Using Options (2): hedging
Advantages

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What have we learned?
Summary
Are Options too Expensive?

A Young person's Guide to FX Options

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Puts and Calls

Some Jargon

Rational Exercising

Institutional Aspects

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Using Options (2): hedging

Using Options (3): Speculation

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  $\begin{cases} \text{at} & \text{(European-style option)} \\ \text{up until} & \text{(American style option)} \end{cases}$ an agreed-upon expiry moment T, an agreed-upon quantity of a specied asset ("underlying") at an agreed-upon price (strike or exercise price), from/to the writer of the option.

- Exercising (killing) the option: using the right, that is, buying (or selling) at the strike, at T or (for an American-style:) possibly also early, i.e. before T

- Premium: the price paid (by the holder, to writer) for the option, irrespective of exercising.

  Usually paid upfront, rarely at T (forward-style), sometimes partly via mark2market and partly final (futures-style).

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Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Puts and Calls

Some Jargon

Rational Exercising

Institutional Aspects

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Using Options (2): hedging

Using Options (3): Speculation

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Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Puts and Calls

Some Jargon

Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Using Options (3): Speculation

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A Young person's Guide to FX Options

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Puts and Calls

Some Jargon

Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Using Options (3): Speculation

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A Young person's Guide to FX Options

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Puts and Calls

Some Jargon

Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Using Options (3): Speculation

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A Young person's Guide to FX Options

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Puts and Calls

Some Jargon

Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Using Options (3): Speculation

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A Young person's Guide to FX Options

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Puts and Calls

Some Jargon

Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Using Options (3): Speculation

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A Young person's Guide to FX Options (2)

- Intrinsic value or value dead: what the option would be worth if the exercise decision would have to be taken now.
- In / at /out of the money (ITM, ATM, OTM): the strike relative to the current price is such that immediate exercise would yield a positive / zero / negative cashflow.

  ITM means the intrinsic value is positive.
- Time value := premium - intrinsic value. Positive if the market thinks that it's better to postpone exercising.

  An ATM/OTM option's premium is pure time value.

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Exercise Rules

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction
- Puts and Calls
- Some Jargon
- Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Using Options (3): Speculation

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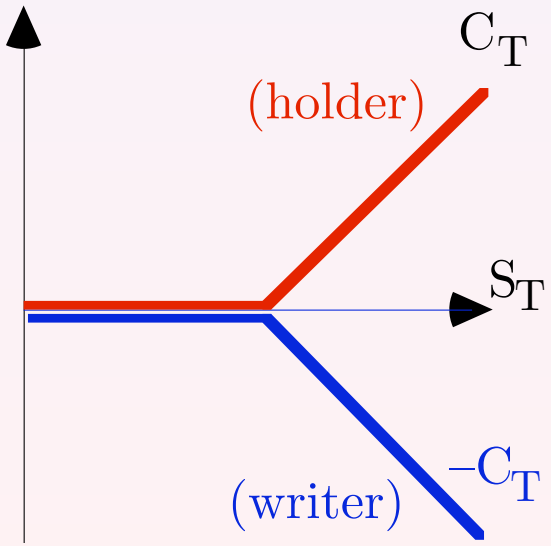
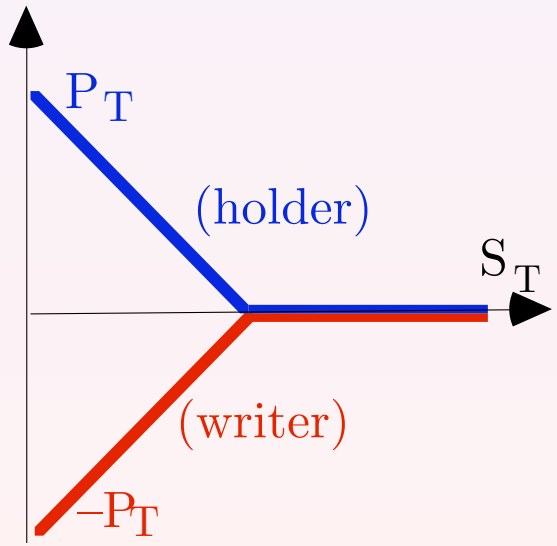
(style)	call	put
European	$S_T > X$	$X > S_T$
American	$\begin{cases} S_t > X \\ C_t^{am} = S_t - X (> 0) \end{cases}$	$\begin{cases} X > S_t \\ P_t^{am} = X - S_t (> 0) \end{cases}$

European: – what's what part of what forward contract?





Outline

Introduction
Institutional Aspects
Using Options (1): Arbitrage
Using Options (2): hedging
Using Options (3): Speculation
What have we learned?

Introduction
- Puts and Calls
- Some Jargon: IV, I-A-OTM, TV
- Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage
- Lower Bounds
- (European) Put-Call Parity

Using Options (2): hedging
- Advantages

Using Options (3): Speculation

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- Are Options too Expensive?

Institutional stuff

Traded v OTC

- Traded: Exchanges copied after futures: margin (for writer), clearing
- OTC: professionals

Option on futures contract

- Call: if you exercise, you become long side of a contract with historic price X,never marked to market.
- Triggers MtM flow of $f_{t,T_f} - X$.
- Exercise rules: Eur:
  Am:

Futures-style options

- initial margin; daily MtM; final payment
- useful for speculators
- price is [price of regular option]$\times(1 + r_{t,T})$
- if on futures: convenient for put-call arbitrage

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Traded options: contract info (LIFFE)

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Using Options (3): Speculation

What have we learned?

US DOLLAR / EURO OPTIONS

Underlying :

Codes and classification			
Mnemo	DEX	MEP	AMS
Exercise type	European	Unit	€

US Dollar / Euro Options

Unit of trading	100
Contract size	USD 10.000
Expiry months	1) Initial lifetime: 1, 2, and 3 months Cycle: all months 2) Initial lifetime: 6, 9 and 12 months Cycle: March, June, September and December 3) Initial lifetime: 3 years Cycle: September
Quotation	Euros per USD 100
Minimum price movement (tick size and value)	EUR 0.01 (= EUR 1 per contract)
Last trading day	Trading in expiring currency derivatives have the EuroFX rate as their settlement basis and ends at 13.00 Amsterdam time on the third Friday of the expiry month, provided this is a business day. If it is not, the previous business day will be the last day of trading.
Settlement	EuroFX rate contracts: Cash settlement, based on the value of the Euro / US Dollar rate set by EuroFX at 13.00 Amsterdam time. For DEX, the inverse value of the EuroFX Euro / US Dollar rate is used and rounded off to four decimal places.
Trading hours	9.00 – 17.25 Amsterdam time
Clearing	LCH.Clearnet S.A.
Option style	European style. Holders of long positions are not entitled to exercise their options before the exercise date.
Exercise	European
Last update	21/12/04

- **Trading Platform:** LIFFE CONNECT®
- **Wholesale Service:** Prof Trade Facility

Traded options: price info (Neue Zürcher Zeitung)

Options (1): Concepts and Uses

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Introduction

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Using Options (3): Speculation

What have we learned?

DEVISENOPTIONEN

Strike	Call				Strike	Put			
	Sep	Dez	Mar	Jun		Sep	Dez	Mar	Jun
$/Fr.	Kassamittelkurs: **1.2235**					100,000 $; Rp/$			
1.2000	2.60	3.06	3.41	3.65	1.2000	0.62	2.23	3.56	4.71
1.2250	1.07	1.90	2.34	2.66	1.2250	1.59	3.53	4.97	6.18
1.2500	0.41	1.12	1.57	1.91	1.2250	3.42	5.23	6.67	7.89
1.2750	0.25	0.67	1.05	1.37	1.2750	5.57	7.27	8.62	9.80
~~€~~/Fr.	Kassamittelkurs: **1.5781**					100,000 ~~€~~; Rp/~~€~~			
1.5750	2.60	3.06	3.41	3.65	1.5750	0.62	2.23	3.56	4.71
1.6000	0.23	0.37	0.47	0.53	1.6000	2.62	3.39	4.10	4.74
1.6250	0.22	0.25	0.30	0.34	1.6250	5.09	5.75	6.41	7.01
1.6500	0.21	0.23	0.26	0.27	1.6500	7.85	8.22	8.84	9.41
~~€~~/$	Kassamittelkurs: **1.2917**					100,000 $; Cent/$			
1.2750	2.74	4.01	5.12	6.02	1.2750	0.58	1.49	2.08	2.55
1.3000	1.02	2.61	3.73	4.66	1.3000	3.52	1.03	4.48	4.85
1.3250	0.42	1.63	2.66	6.54	1.3250	3.52	4.03	4.48	4.85
1.3500	0.26	1.01	1.87	2.66	1.3500	5.84	5.87	6.11	6.36

Quelle: UBS

Outline

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

What have we learned?

Introduction
- Puts and Calls
- Some Jargon: IV, I-A-OTM, TV
- Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage
- Lower Bounds
- (European) Put-Call Parity

Using Options (2): hedging
- Advantages

Using Options (3): Speculation

What have we learned?
- Summary
- Are Options too Expensive?

Lower Bounds on Prices & Implications

Assume genuine uncertainty: 0 < prob(excse)<1.

- **Calls: lobos**
  - $C_t > \frac{S_t}{1+r^*_{t,T}} - \frac{X}{1+r_{t,T}}$ because ...
  - $C_t \to$[the above] if ...
  - $C_t > 0$ because ...
  - $C_t \to 0$ if ...
  - $C^{am}_t \geq C_t$ because ...
  - $C^{am}_t = C_t$ if
  - **Summary:** $C^{am}_t \geq C_t > \text{Max}\left(\frac{S_t}{1+r^*_{t,T}} - \frac{X}{1+r_{t,T}}, 0\right)$.
  - $C^{am}_t > \text{Max}(S_t - X, 0) = IV$ because ...

Note: if $r > r^* = 0$, the first bound subsumes the second one:

$$C^{am}_t > \text{Max}\left(S_t - \frac{X}{1+r_{t,T}}, 0\right) > \text{Max}(S_t - X, 0) = IV$$

$\Rightarrow$ when $r > r^* = 0$, early exercise is ...

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Options (1): Concepts and Uses

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Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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▷ $C^{am}_t > \text{Max}(S_t - X, 0) = IV$ because ...

Note: if $r > r^* = 0$, the first bound subsumes the second one:

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Lower Bounds on Prices & Implications

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

What have we learned?

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Lower Bounds on Prices & Implications

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Lower Bounds on Prices & Implications

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Lower Bounds on Prices & Implications

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Lower Bounds on Prices & Implications

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Lower Bounds on Prices & Implications

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Lower Bounds on Prices & Implications

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Lower Bounds on Prices & Implications

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Lower Bounds on Prices & Implications

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Lower Bounds on Prices & Implications

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Lower Bounds on Prices & Implications

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Put-Call Parity — European Options!

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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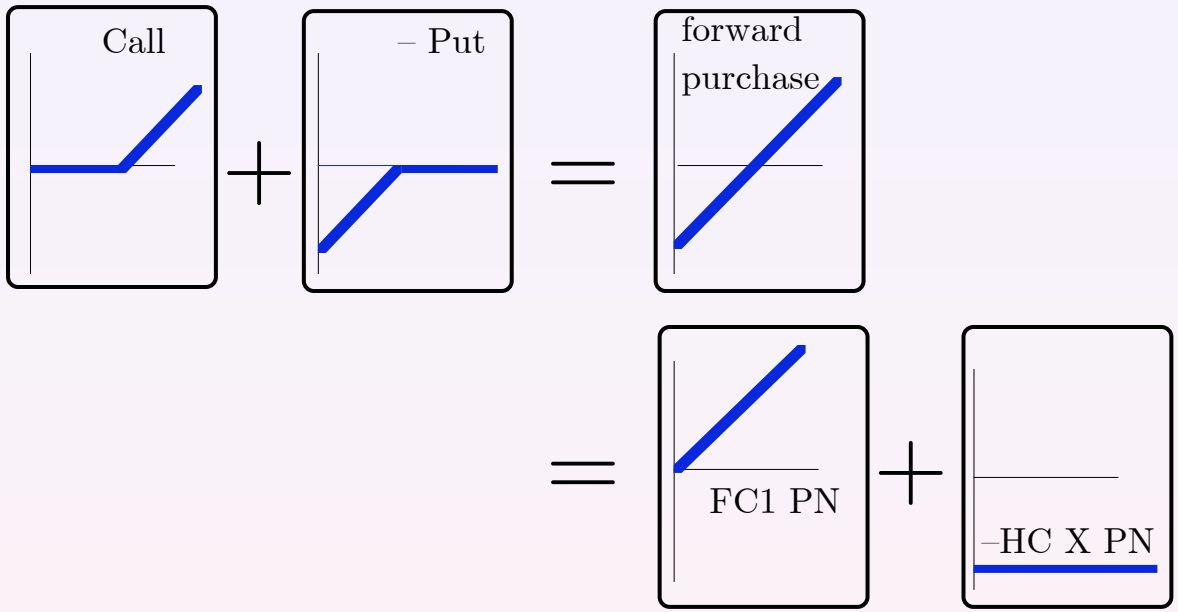
- Note the replication possibilities:



Applications

synth options	hedging (synth T-Bills)
$\tilde{S}_T - X + \tilde{P}_T = \tilde{C}_T \Rightarrow$ synth call	$\tilde{S}_T + \tilde{P}_T - \tilde{C}_T = X \Rightarrow$ synth HC PN
$X - \tilde{S}_T + \tilde{C}_T = \tilde{P}_T \Rightarrow$ synth put	$X - \tilde{P}_T + \tilde{C}_T = \tilde{S}_T \Rightarrow$ synth FC PN

Put-Call Parity

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

What have we learned?

- **A no-arb relation:** if at T: $C_T - P_T = S_T - X$, by arb there must be parity also at t:

$$C_t - P_t = \frac{F_{t,T} - X}{1 + r_{t,T}} = \frac{S_t}{1 + r^*_{t,T}} - \frac{X}{1 + r_{t,T}}$$

(Put-Call Parity—Eur. options only!)

- **Three implications**
  - At-the-forward (ATF): if $X = F_{t,T}$ then

$$C_t = P_t,$$

    i.e. ATF puts and calls have equal prices
  - At-the-money (ATM): if $X = S_t$ then

$$C_t - P_t = S_t \frac{r_{t,T} - r^* t, T}{(1 + r_{t,T})(1 + r^*_{t,T})} \begin{matrix} > \\ = \\ < \end{matrix} 0 \text{ if } r_{t,T} \begin{matrix} > \\ = \\ < \end{matrix} r^* t, T.$$

    i.e. ATM call (=upward potential) is more valuable than put (downward potential) if $F_{t,T} > S_t$ (i.e. FC "strong") & *vv*.
  - As soon as we have a Call option price model, PCParity implies the Put option pricing model.

Put-Call Parity

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Put-Call Parity

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Put-Call Parity

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Lower Bounds

(European) Put-Call Parity

Using Options (2): hedging

Using Options (3): Speculation

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Outline

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Advantages

Using Options (3): Speculation

What have we learned?

Introduction
- Puts and Calls
- Some Jargon: IV, I-A-OTM, TV
- Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage
- Lower Bounds
- (European) Put-Call Parity

Using Options (2): hedging
- Advantages

Using Options (3): Speculation

What have we learned?
- Summary
- Are Options too Expensive?

Using Options 2: hedging

Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

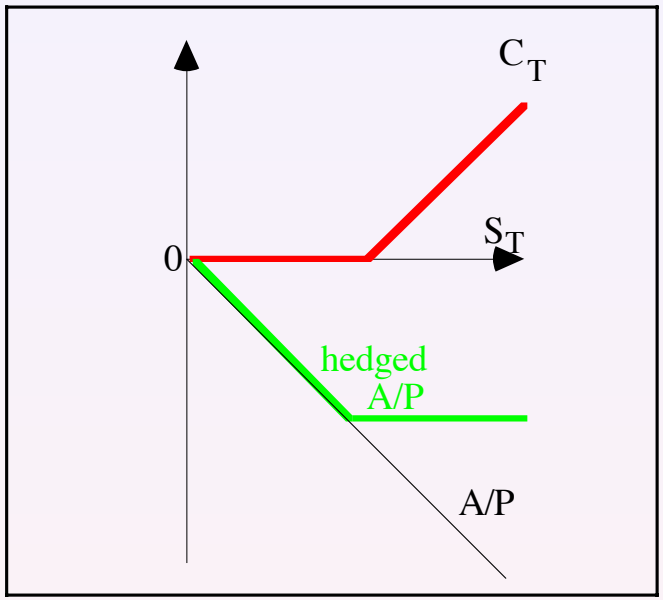
Using Options (2): hedging

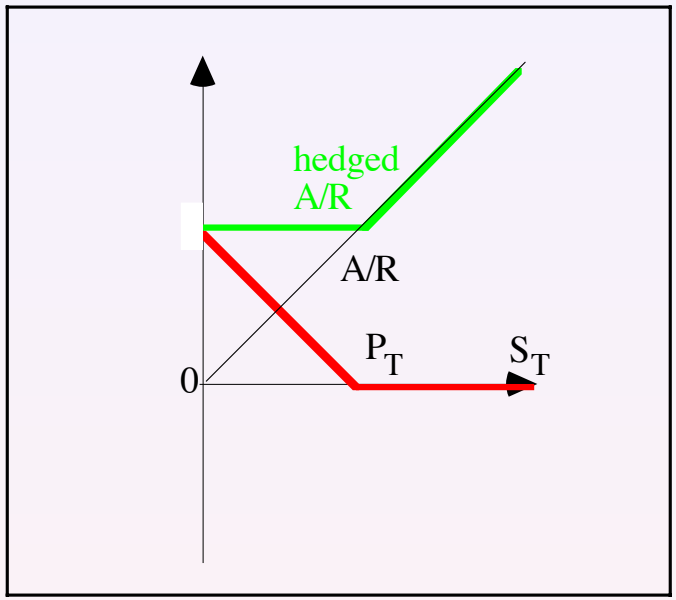
Advantages

Using Options (3): Speculation

What have we learned?

◇ One-edged hedging of contractual exposure





◇ "Hedging exposures with big quantity risks"

- ▷ Examples: Int tender, risky A/R etc, risky stock investments, reinsurance,
- ▷ "Advantage": no risk of two bad tidings—losing on the exposed position *and* on the hedge: OTM option not exercised
- ▷ Dubious argument: option's added flexibility is still 100% tied to Xrisk, not to quantity risk

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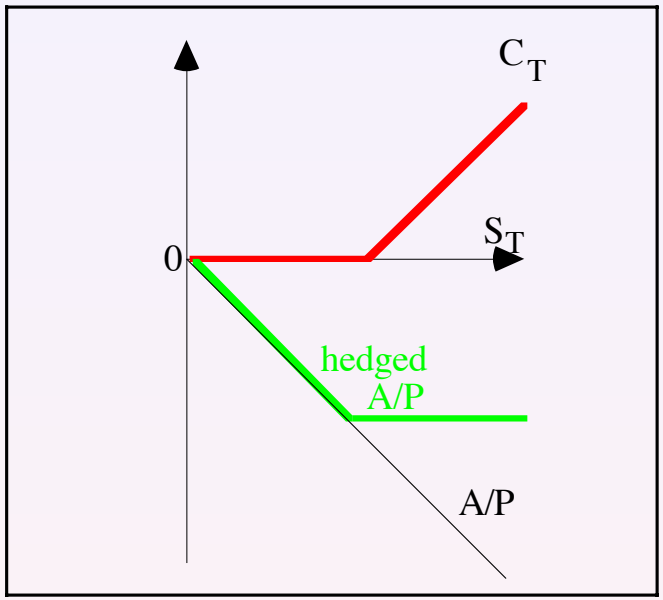

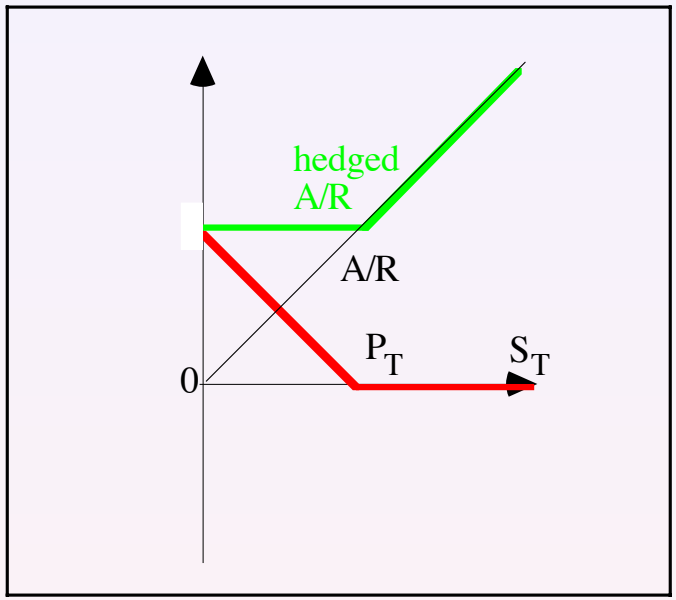

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Introduction

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Advantages

Using Options (3): Speculation

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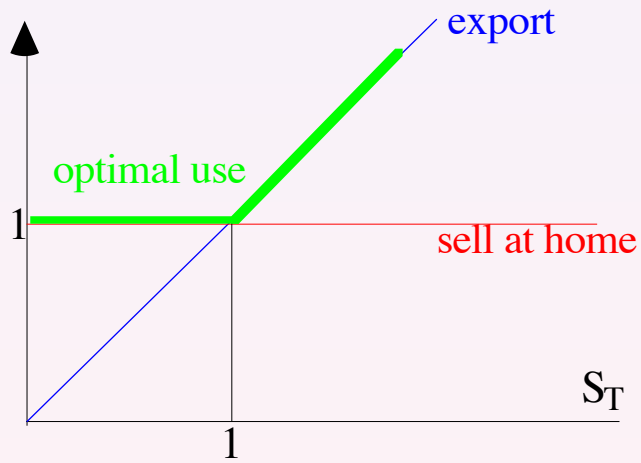
◇ Hedging nonlinear exposure

Example: exports as an option

- your perifraxes can be sold either at home at EUR 1, or exported at USD 1 net (price takership).
- Thus—see graph—$V_T = 1 + \text{Max}(\tilde{S}_T - 1, 0)$, quite option-like



- Selling an option replaces this *potential* extra income by its (PV'd) CEQ, the premium income.
- Naive forward hedging (USD 1 per perifrax) cannot remove the exposure at all.

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Options (1): Concepts and Uses

P. Sercu, *International Finance: Theory into Practice*

Introduction

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Advantages

Using Options (3): Speculation

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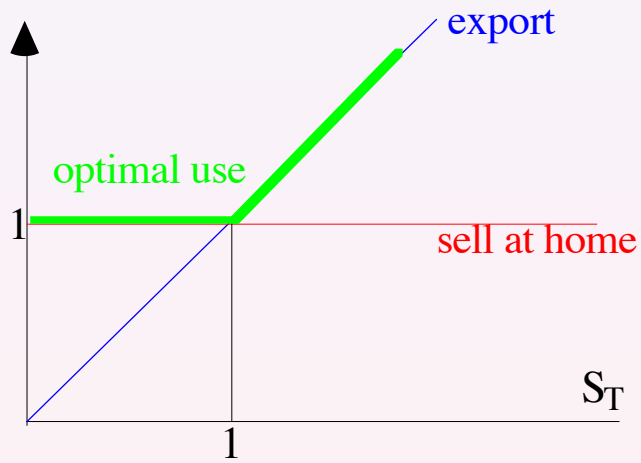

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Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Advantages

Using Options (3): Speculation

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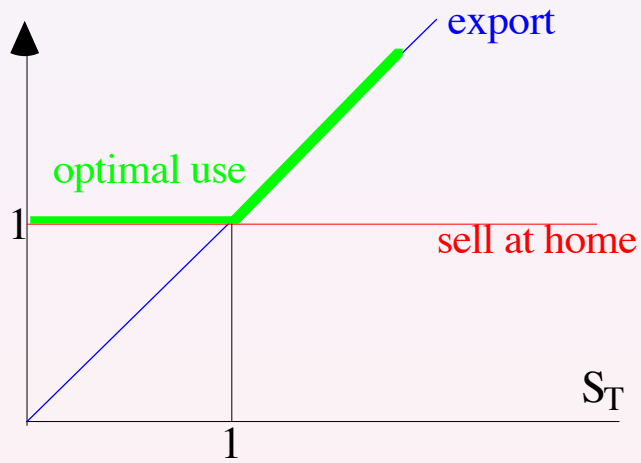

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Piecewise Linear Approximations & Options

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Introduction

Institutional Aspects

Using Options (1): Arbitrage

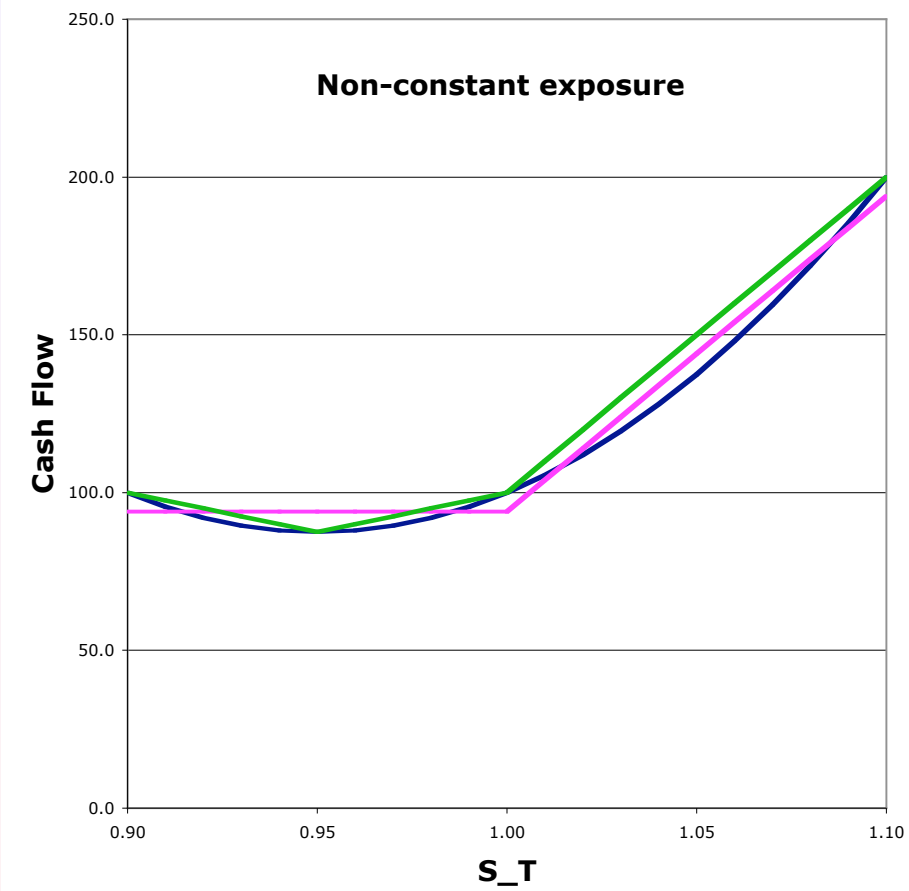
Using Options (2): hedging

Advantages

Using Options (3): Speculation

What have we learned?

S_T	Cash Flow	Approx1	Approx2
0.90	100.0	94.0	100.0
0.91	95.5	94.0	97.5
0.92	92.0	94.0	95.0
0.93	89.5	94.0	92.5
0.94	88.0	94.0	90.0
0.95	87.5	94.0	87.5
0.96	88.0	94.0	90.0
0.97	89.5	94.0	92.5
0.98	92.0	94.0	95.0
0.99	95.5	94.0	97.5
1.00	100.0	94.0	100.0
1.01	105.5	104.0	110.0
1.02	112.0	114.0	120.0
1.03	119.5	124.0	130.0
1.04	128.0	134.0	140.0
1.05	137.5	144.0	150.0
1.06	148.0	154.0	160.0
1.07	159.5	164.0	170.0
1.08	172.0	174.0	180.0
1.09	185.5	184.0	190.0
1.10	200.0	194.0	200.0



Outline

Introduction
Institutional Aspects
Using Options (1): Arbitrage
Using Options (2): hedging
Using Options (3): Speculation
What have we learned?

Introduction
- Puts and Calls
- Some Jargon: IV, I-A-OTM, TV
- Rational Exercising

Institutional Aspects

Using Options (1): Arbitrage
- Lower Bounds
- (European) Put-Call Parity

Using Options (2): hedging
- Advantages

Using Options (3): Speculation

What have we learned?
- Summary
- Are Options too Expensive?

Speculating on S or on σ_S

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Introduction

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

Using Options (3): Speculation

What have we learned?

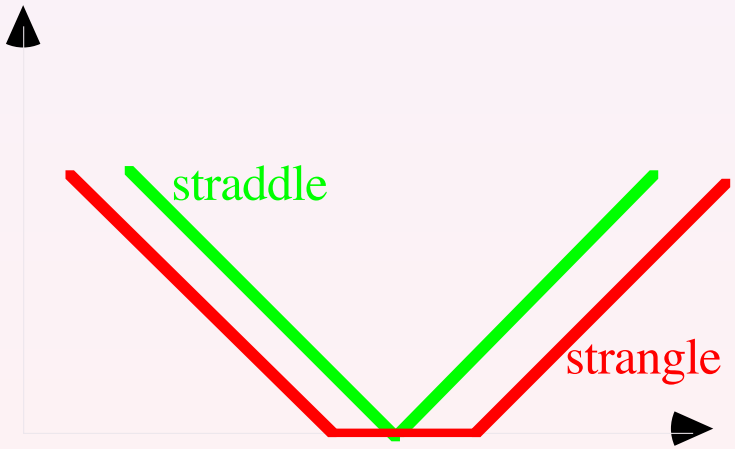
◇ Speculation on S

- ▷ Bulls buy calls or sell puts, Bears buy puts or sell calls
- ▷ Buying options limits your risk to the premium

  ... but the chance of losing all is usually big (≈50%, ATM)
- ▷ Selling options is risky

◇ Speculating on volatility

- ▷ Wait till T and cash in big-time—or so you hope



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Institutional Aspects

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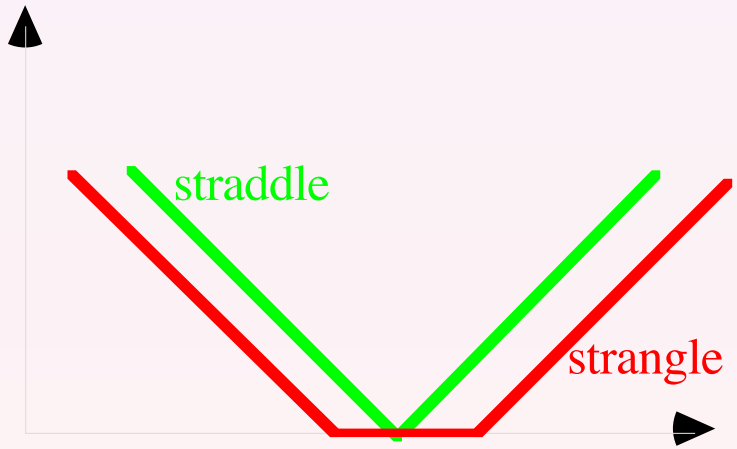

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Institutional Aspects

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Using Options (3): Speculation

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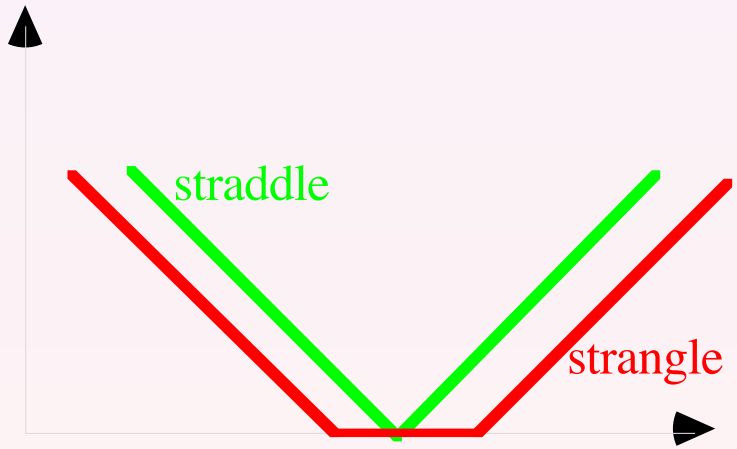

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Introduction

Institutional Aspects

Using Options (1): Arbitrage

Using Options (2): hedging

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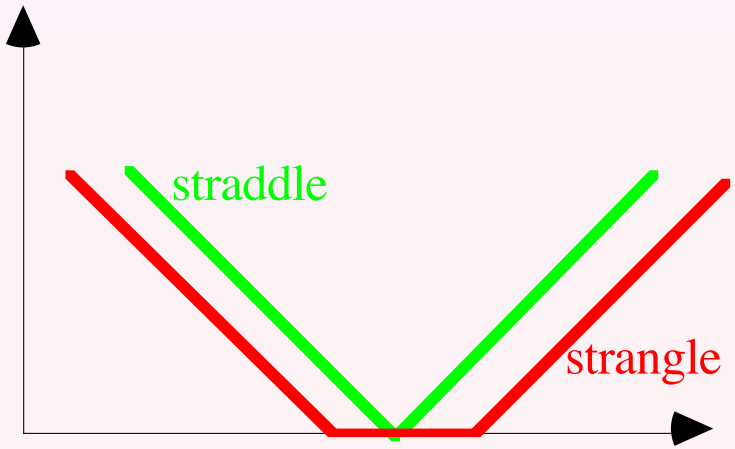

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Outline

Introduction
Institutional Aspects
Using Options (1): Arbitrage
Using Options (2): hedging
Using Options (3): Speculation
What have we learned?
Summary
Are Options too Expensive?

Introduction
- Puts and Calls
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Institutional Aspects

Using Options (1): Arbitrage
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What have we learned in this chapter?

◇ Chopped-up Forward Contracts

- ▷ European options provide the holder with the positive part of the payoff of the comparable forward contract—below X for the put, above X for the call. The writer gets the negative parts.
- ▷ Options being zero-sum games, the parties can agree only if the holder pays the writer a premium, which should be the risk-adjusted and discounted expected value.

◇ Lower Bounds on prices.

- ▷ As a European option provides the nice part of the comparable forwards, the value of the latter is a lower bound on the E option's price.
- ▷ Zero is another lower bound.
- ▷ American options are worth at least the E option, and also at least the intrinsic value.

  For some interest-rate combinations the latter bound can never be reached, or is unlikely to ever be reached.

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◇ Put-Call Parity

- ▷ As (European!) puts & calls are bits & pieces of forwards, one can replicate a forward from options, or one option from forwards and the other option; or one can hedge.
- ▷ Traders do this to balance their books or fill holes in the market.
- ▷ The resulting no-arb constraint is called Put-Call Parity.

◇ Using options

- ▷ Being broken-up forwards, options can be used for one-edged hedging, or hedging of non-constant exposures
- ▷ Because of its convexity an option can also be used to speculate on volatility, not just on the sign of ΔS.

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Are Options too Expensive?

◇ The most expensive option is cheap

- ▷ The most expensive option is a VeryDeep ITM one,
- ▷ and it is priced as a forward,
- ▷ which cannot be controversially expensive.

◇ Outrageous Bid-ask Spreads?

- ▷ Bid-Ask for options is easily 5% or more. but ...
- ▷ cannot be compared to spread on forwards, since the premium is a levered net value while the forward is the price of one leg

  Example: If $F_t = 100$ and $F_{t_0} = 98$ and $r \approx 0$ then the market value is 2; and a 0.10% spread on F would already be a 5% spread on 2.
- ▷ In addition, hedging the option is much more costly and risky, to the bank, than hedging a forward

◇ Lack of Understanding

- ▷ You need to read the next chapter

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