



Andreas Krause

Hedging with options

Option types

Option types

- ▶ Options give the purchaser the **right** to buy or sell the underlying asset

Option types

- ▶ Options give the purchaser the right (**but not the obligation**) to buy or sell the underlying asset

Option types

- ▶ Options give the purchaser the right (but not the obligation) to buy or sell the underlying asset **in the future**

Option types

- ▶ Options give the purchaser the right (but not the obligation) to buy or sell the underlying asset in the future at a **given price**

Option types

- ▶ Options give the purchaser the right (but not the obligation) to buy or sell the underlying asset in the future at a given price (**strike price**)

Option types

- ▶ Options give the purchaser the right (but not the obligation) to buy or sell the underlying asset in the future at a given price (strike price)
- ▶ The seller of the option has to sell or buy the underlying asset **on demand of the purchaser**

Option types

- ▶ Options give the purchaser the right (but not the obligation) to buy or sell the underlying asset in the future at a given price (strike price)
- ▶ The seller of the option has to sell or buy the underlying asset on demand of the purchaser
- ▶ **Call options** give the right to buy the underlying asset

Option types

- ▶ Options give the purchaser the right (but not the obligation) to buy or sell the underlying asset in the future at a given price (strike price)
- ▶ The seller of the option has to sell or buy the underlying asset on demand of the purchaser
- ▶ Call options give the right to buy the underlying asset
- ▶ **Put options** give the right to sell the underlying asset

Option types

- ▶ Options give the purchaser the right (but not the obligation) to buy or sell the underlying asset in the future at a given price (strike price)
- ▶ The seller of the option has to sell or buy the underlying asset on demand of the purchaser
- ▶ Call options give the right to buy the underlying asset
- ▶ Put options give the right to sell the underlying asset
- ▶ **European options** give the right to exercise the option at maturity only

Option types

- ▶ Options give the purchaser the right (but not the obligation) to buy or sell the underlying asset in the future at a given price (strike price)
- ▶ The seller of the option has to sell or buy the underlying asset on demand of the purchaser
- ▶ Call options give the right to buy the underlying asset
- ▶ Put options give the right to sell the underlying asset
- ▶ European options give the right to exercise the option at maturity only
- ▶ **American options** give the right to exercise the option at any time until maturity

Option types

- ▶ Options give the purchaser the right (but not the obligation) to buy or sell the underlying asset in the future at a given price (strike price)
- ▶ The seller of the option has to sell or buy the underlying asset on demand of the purchaser
- ▶ Call options give the right to buy the underlying asset
- ▶ Put options give the right to sell the underlying asset
- ▶ European options give the right to exercise the option at maturity only
- ▶ American options give the right to exercise the option at any time until maturity

European call option payments at maturity

European call option payments at maturity

- ▶ If at maturity the underlying asset is worth less then the strike price, the option will **not be exercised**

European call option payments at maturity

- ▶ If at maturity the underlying asset is worth less than the strike price, the option will not be exercised
- ▶ Exercising the option would result in **buying** the asset at a price **above its value**

European call option payments at maturity

- ▶ If at maturity the underlying asset is worth less then the strike price, the option will not be exercised
- ▶ Exercising the option would result in buying the asset at a price above its value
- ▶ If at maturity the underlying asset is worth more then the strike price, the option will be **exercised**

European call option payments at maturity

- ▶ If at maturity the underlying asset is worth less then the strike price, the option will not be exercised
- ▶ Exercising the option would result in buying the asset at a price above its value
- ▶ If at maturity the underlying asset is worth more then the strike price, the option will be exercised
- ▶ Exercising the option would result in **buying** the asset **below its value**

European call option payments at maturity

- ▶ If at maturity the underlying asset is worth less then the strike price, the option will not be exercised
- ▶ Exercising the option would result in buying the asset at a price above its value
- ▶ If at maturity the underlying asset is worth more then the strike price, the option will be exercised
- ▶ Exercising the option would result in buying the asset below its value
- ▶ In this case the profits made by the purchaser are the difference between the **asset value** and the **strike price**

⇒ $\Pi_T = S - K$

European call option payments at maturity

- ▶ If at maturity the underlying asset is worth less then the strike price, the option will not be exercised
- ▶ Exercising the option would result in buying the asset at a price above its value
- ▶ If at maturity the underlying asset is worth more then the strike price, the option will be exercised
- ▶ Exercising the option would result in buying the asset below its value
- ▶ In this case the profits made by the purchaser are the difference between the **asset value** and the **strike price**, provided it is **positive**

⇒ $\Pi_T = \max \{0; S - K\}$

European call option payments at maturity

- ▶ If at maturity the underlying asset is worth less then the strike price, the option will not be exercised
- ▶ Exercising the option would result in buying the asset at a price above its value
- ▶ If at maturity the underlying asset is worth more then the strike price, the option will be exercised
- ▶ Exercising the option would result in buying the asset below its value
- ▶ In this case the profits made by the purchaser are the difference between the **asset value** and the **strike price**, provided it is **positive**, less the **option premium** paid

⇒ $\Pi_T = \max \{0; S - K\} - C$

European call option payments at maturity

- ▶ If at maturity the underlying asset is worth less then the strike price, the option will not be exercised
- ▶ Exercising the option would result in buying the asset at a price above its value
- ▶ If at maturity the underlying asset is worth more then the strike price, the option will be exercised
- ▶ Exercising the option would result in buying the asset below its value
- ▶ In this case the profits made by the purchaser are the difference between the asset value and the strike price, provided it is positive, less the option premium paid

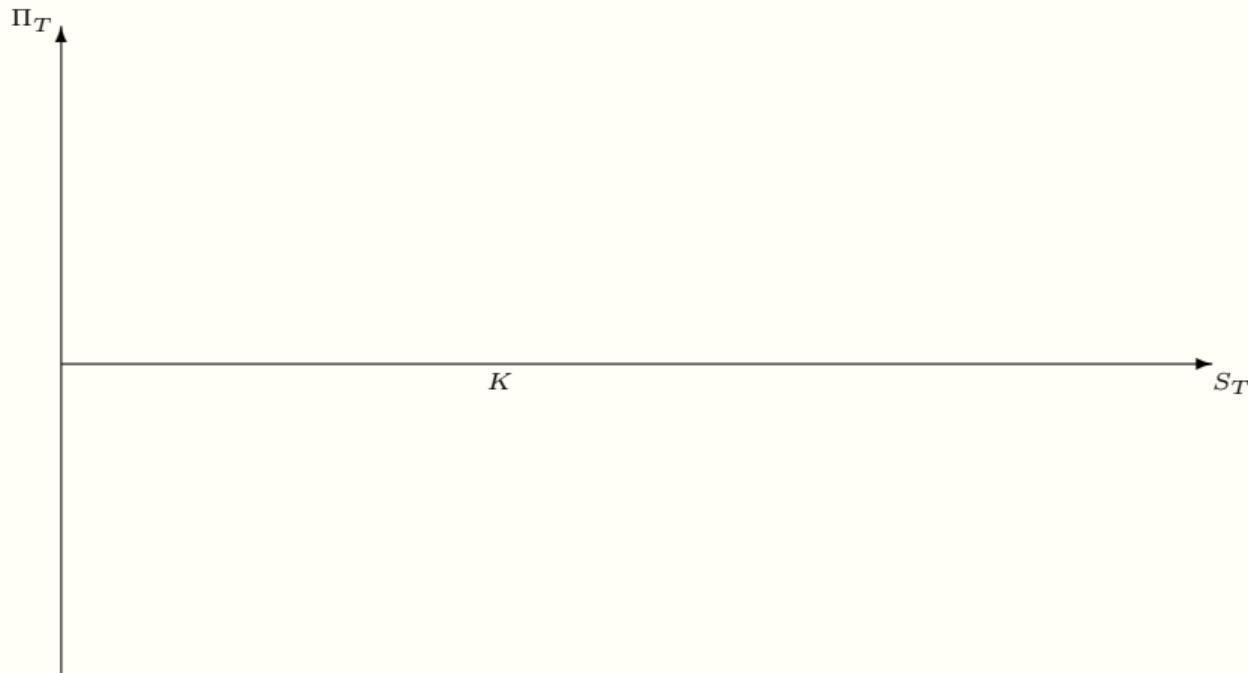
⇒ $\Pi_T = \max \{0; S - K\} - C$

Call option payoffs

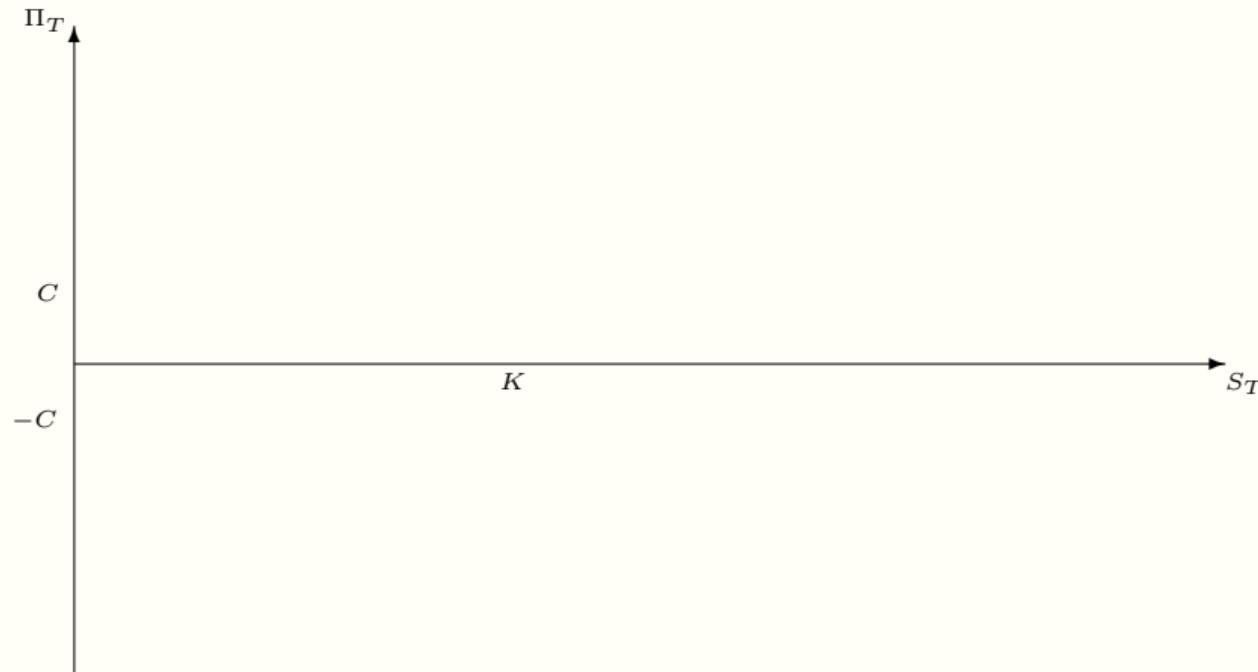
Call option payoffs



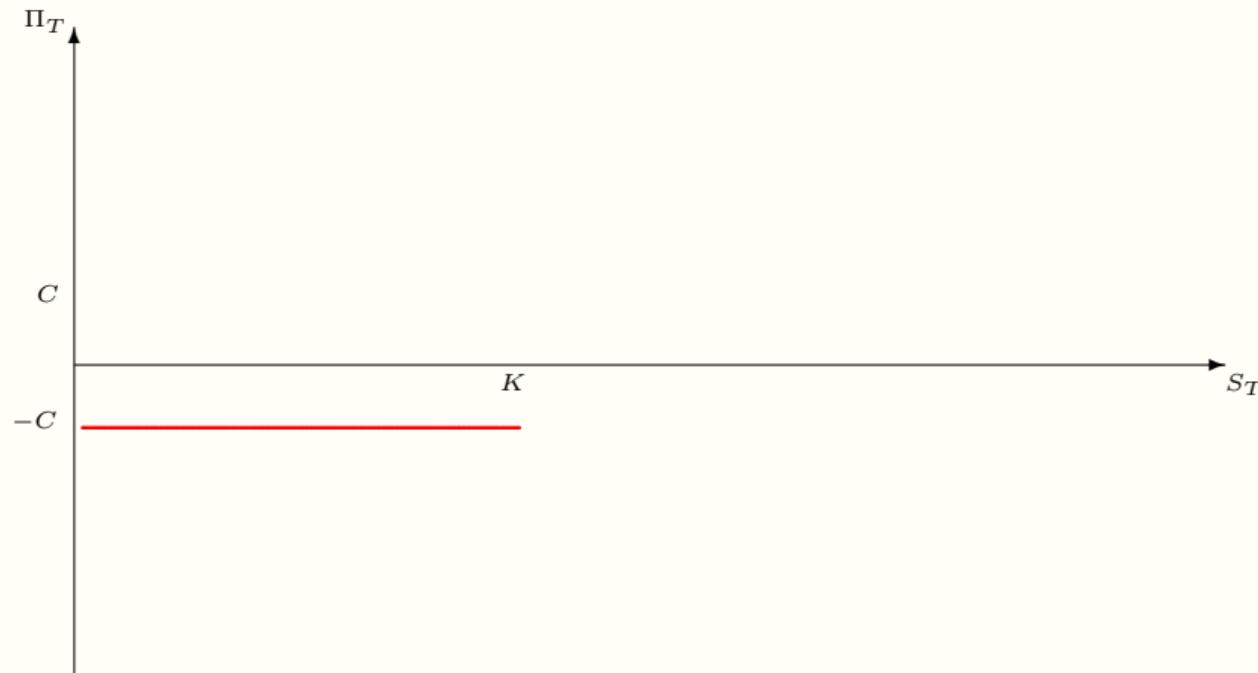
Call option payoffs



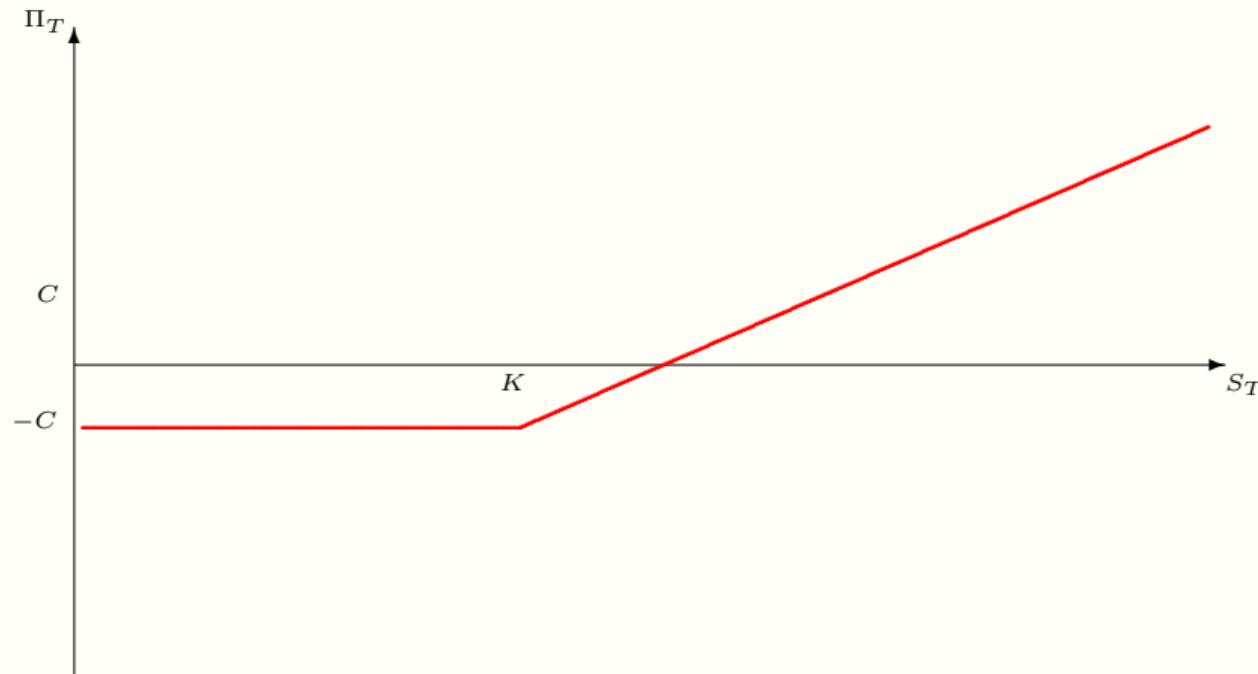
Call option payoffs



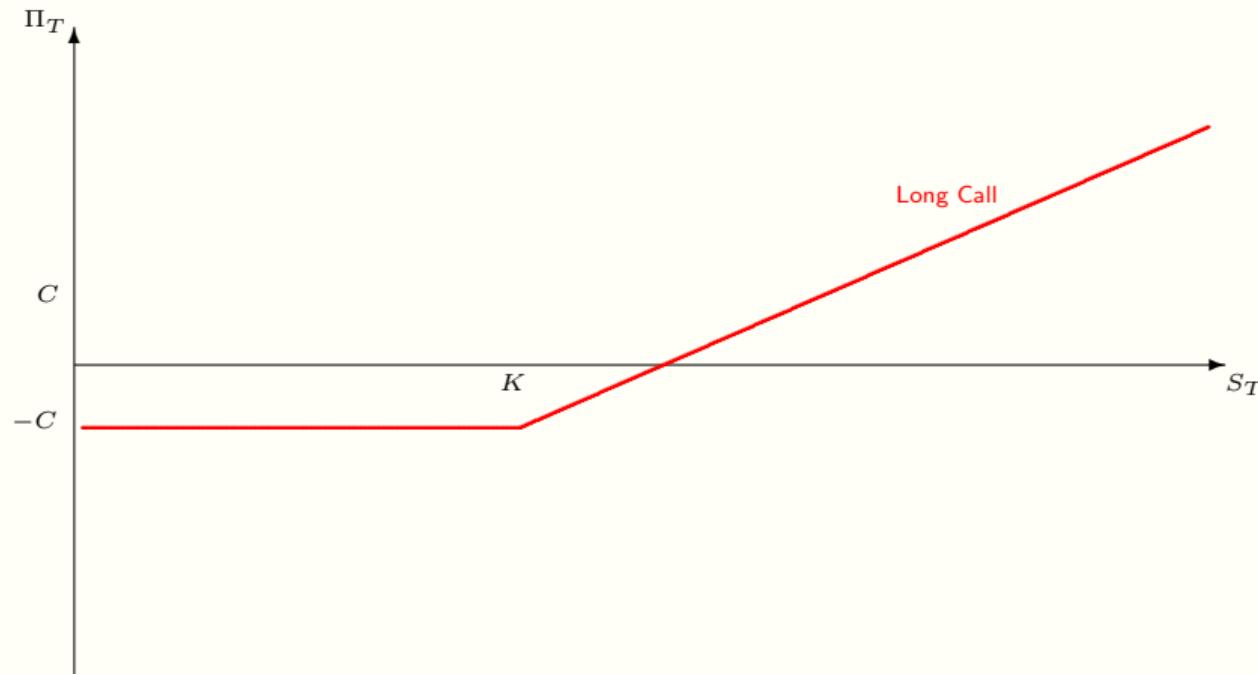
Call option payoffs



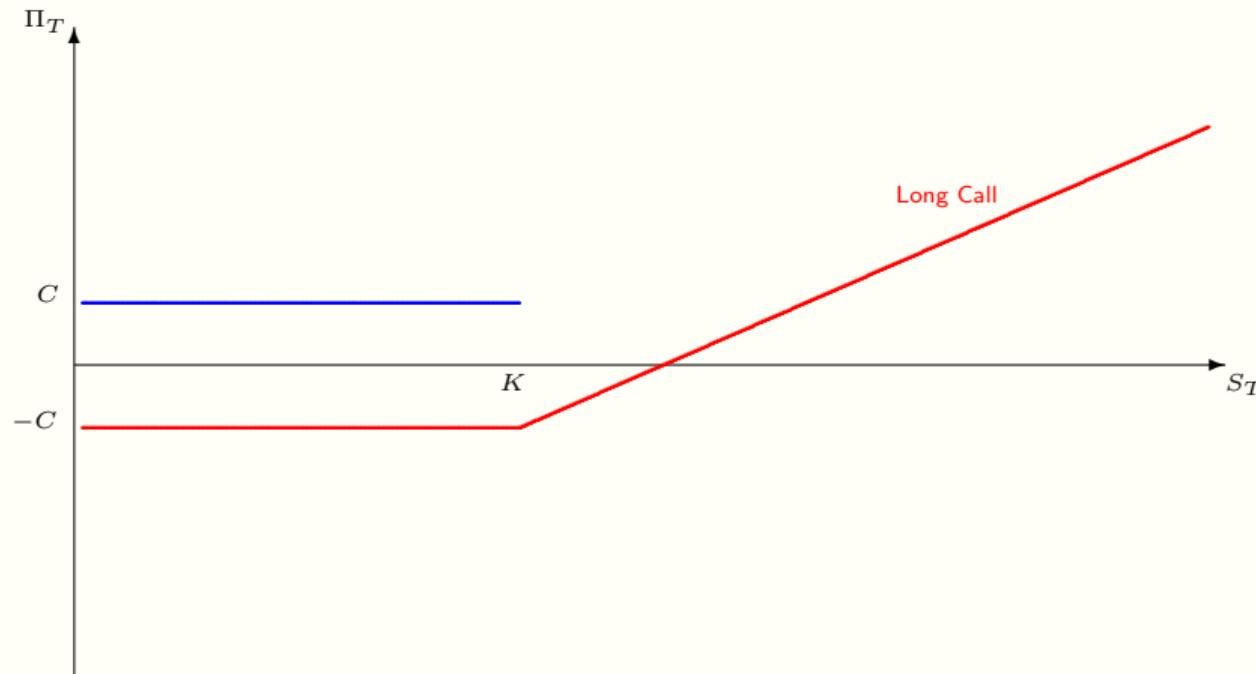
Call option payoffs



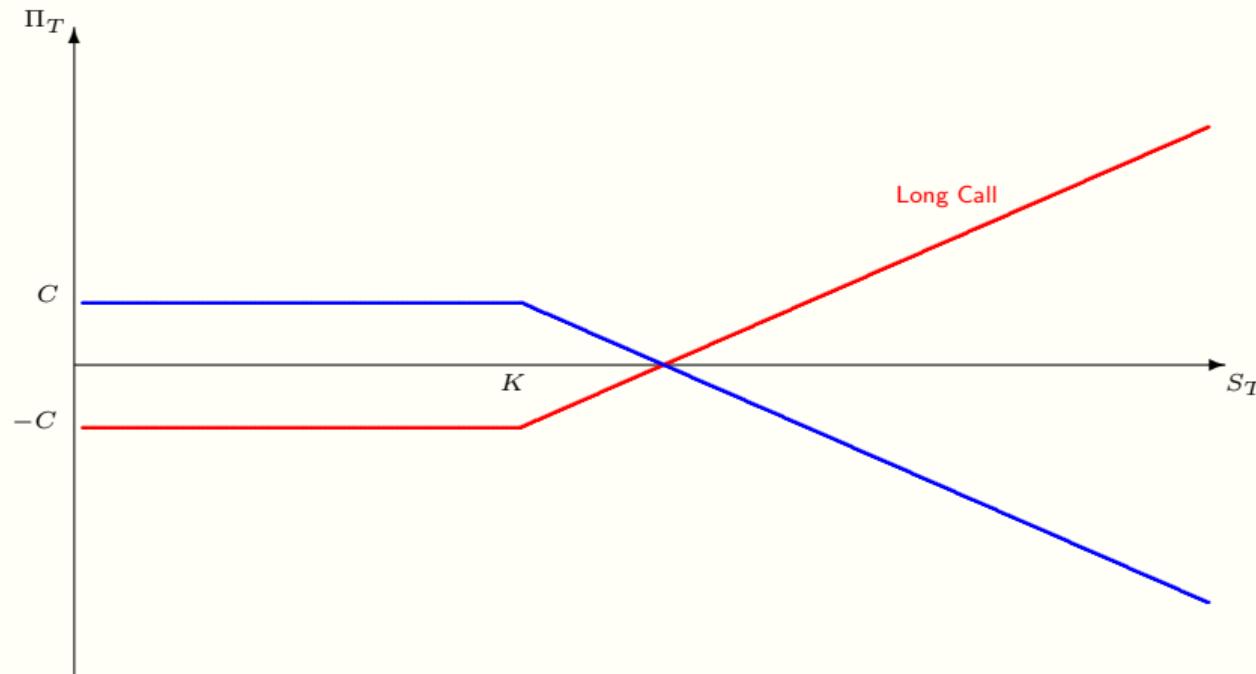
Call option payoffs



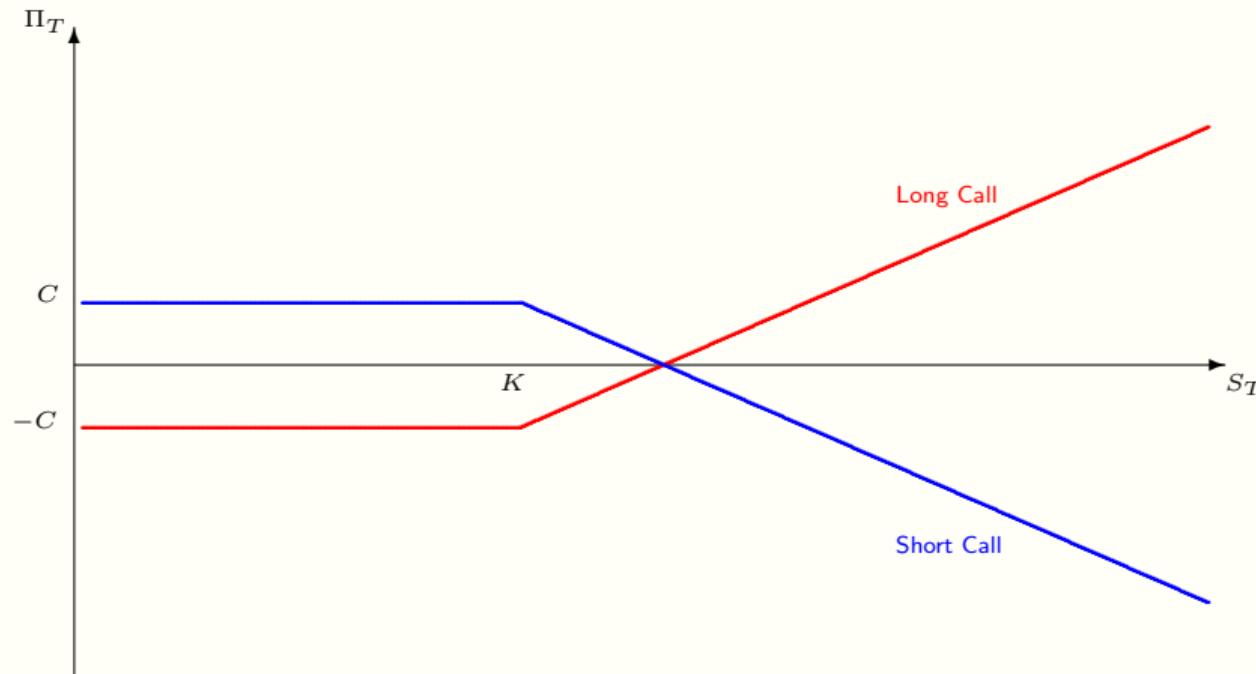
Call option payoffs



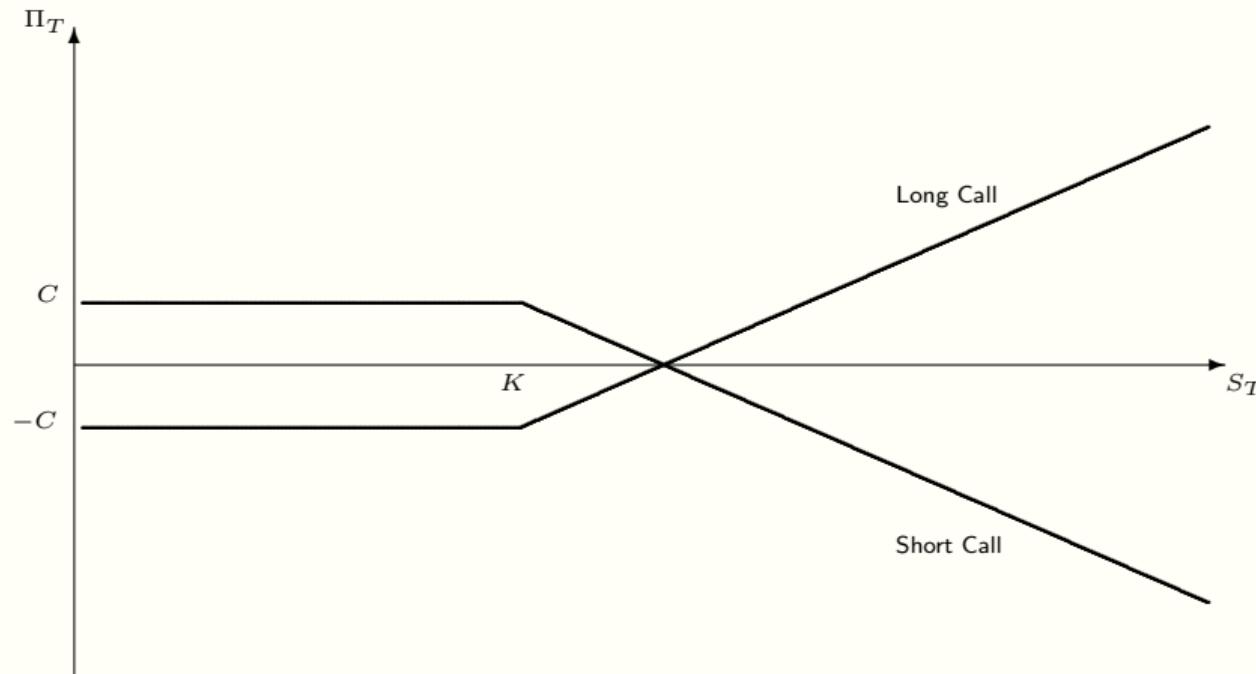
Call option payoffs



Call option payoffs



Call option payoffs



European put option payments at maturity

European put option payments at maturity

- ▶ If at maturity the underlying asset is worth more then the strike price, the option will **not be exercised**

European put option payments at maturity

- ▶ If at maturity the underlying asset is worth more than the strike price, the option will not be exercised
- ▶ Exercising the option would result in **selling** the asset at a price **below its value**

European put option payments at maturity

- ▶ If at maturity the underlying asset is worth more than the strike price, the option will not be exercised
- ▶ Exercising the option would result in selling the asset at a price below its value
- ▶ If at maturity the underlying asset is worth less than the strike price, the option will be **exercised**

European put option payments at maturity

- ▶ If at maturity the underlying asset is worth more than the strike price, the option will not be exercised
- ▶ Exercising the option would result in selling the asset at a price below its value
- ▶ If at maturity the underlying asset is worth less than the strike price, the option will be exercised
- ▶ Exercising the option would result in **selling the asset above its value**

European put option payments at maturity

- ▶ If at maturity the underlying asset is worth more than the strike price, the option will not be exercised
- ▶ Exercising the option would result in selling the asset at a price below its value
- ▶ If at maturity the underlying asset is worth less than the strike price, the option will be exercised
- ▶ Exercising the option would result in selling the asset above its value
- ▶ In this case the profits made by the purchaser are the difference between the **asset value** and the **strike price**

⇒ $\Pi_T = K - S$

European put option payments at maturity

- ▶ If at maturity the underlying asset is worth more than the strike price, the option will not be exercised
- ▶ Exercising the option would result in selling the asset at a price below its value
- ▶ If at maturity the underlying asset is worth less than the strike price, the option will be exercised
- ▶ Exercising the option would result in selling the asset above its value
- ▶ In this case the profits made by the purchaser are the difference between the **asset value** and the **strike price**, provided it is **positive**

⇒ $\Pi_T = \max \{0; K - S\}$

European put option payments at maturity

- ▶ If at maturity the underlying asset is worth more than the strike price, the option will not be exercised
- ▶ Exercising the option would result in selling the asset at a price below its value
- ▶ If at maturity the underlying asset is worth less than the strike price, the option will be exercised
- ▶ Exercising the option would result in selling the asset above its value
- ▶ In this case the profits made by the purchaser are the difference between the **asset value** and the **strike price**, provided it is **positive**, less the **option premium** paid

⇒ $\Pi_T = \max \{0; K - S\} - P$

European put option payments at maturity

- ▶ If at maturity the underlying asset is worth more than the strike price, the option will not be exercised
- ▶ Exercising the option would result in selling the asset at a price below its value
- ▶ If at maturity the underlying asset is worth less than the strike price, the option will be exercised
- ▶ Exercising the option would result in selling the asset above its value
- ▶ In this case the profits made by the purchaser are the difference between the asset value and the strike price, provided it is positive, less the option premium paid

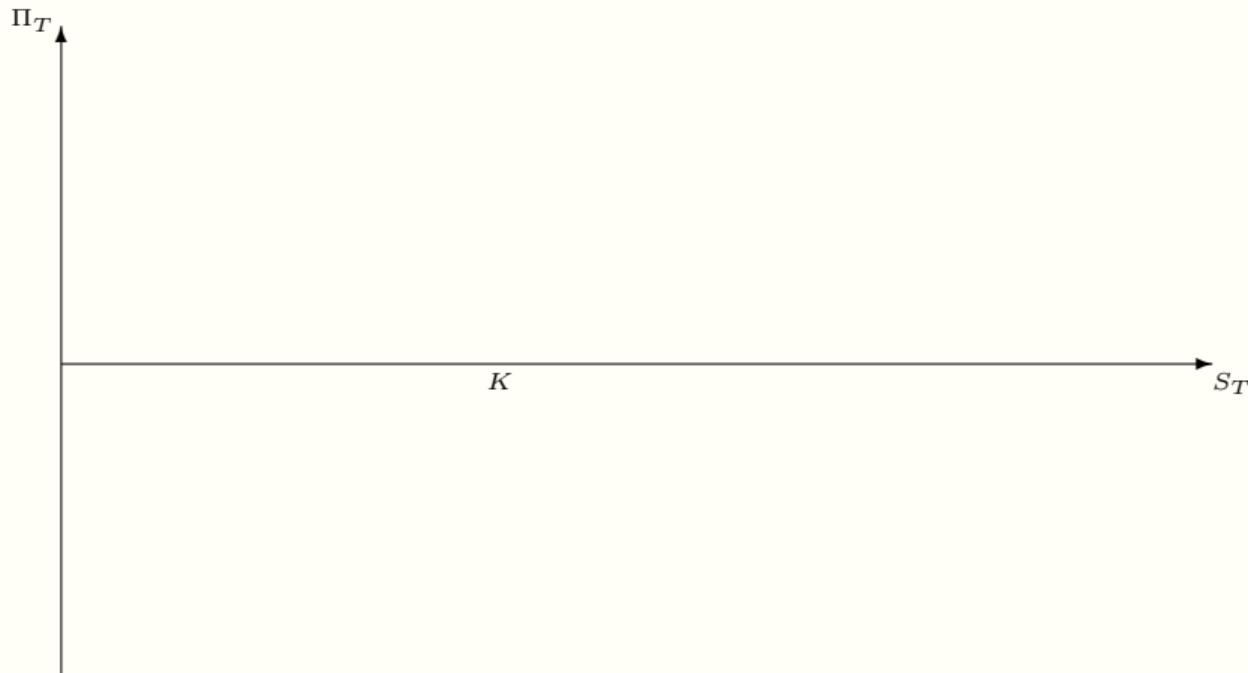
⇒ $\Pi_T = \max \{0; K - S\} - P$

Put option payoffs

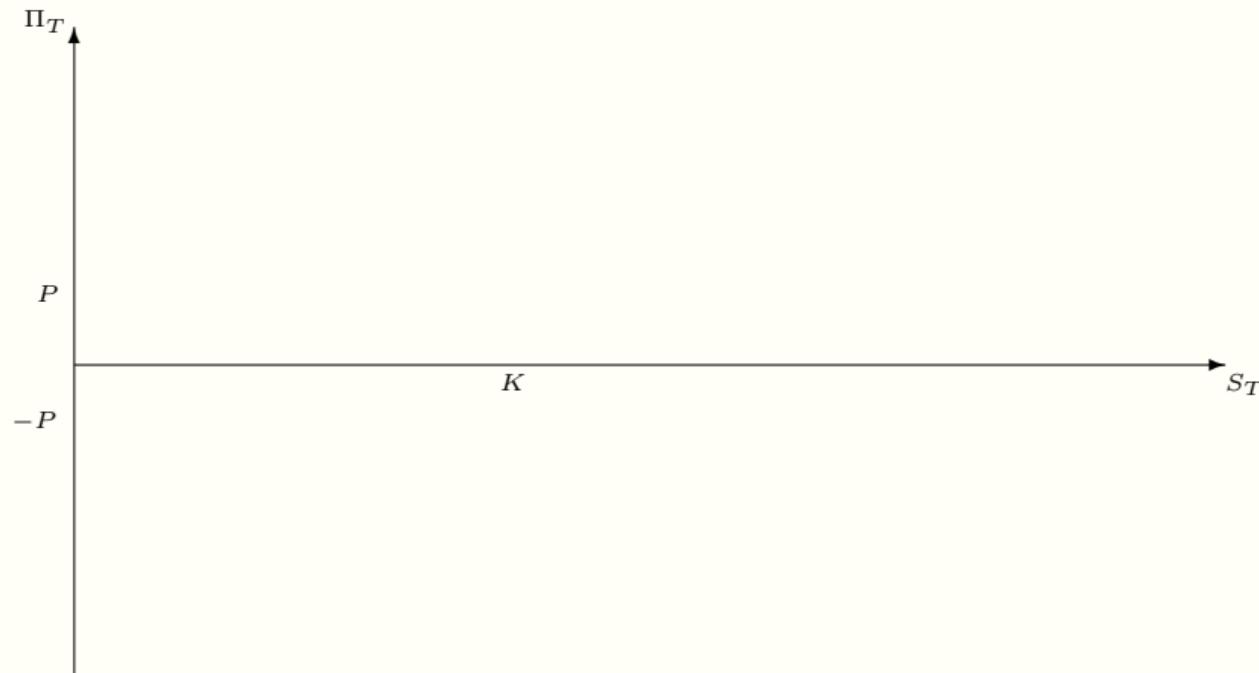
Put option payoffs



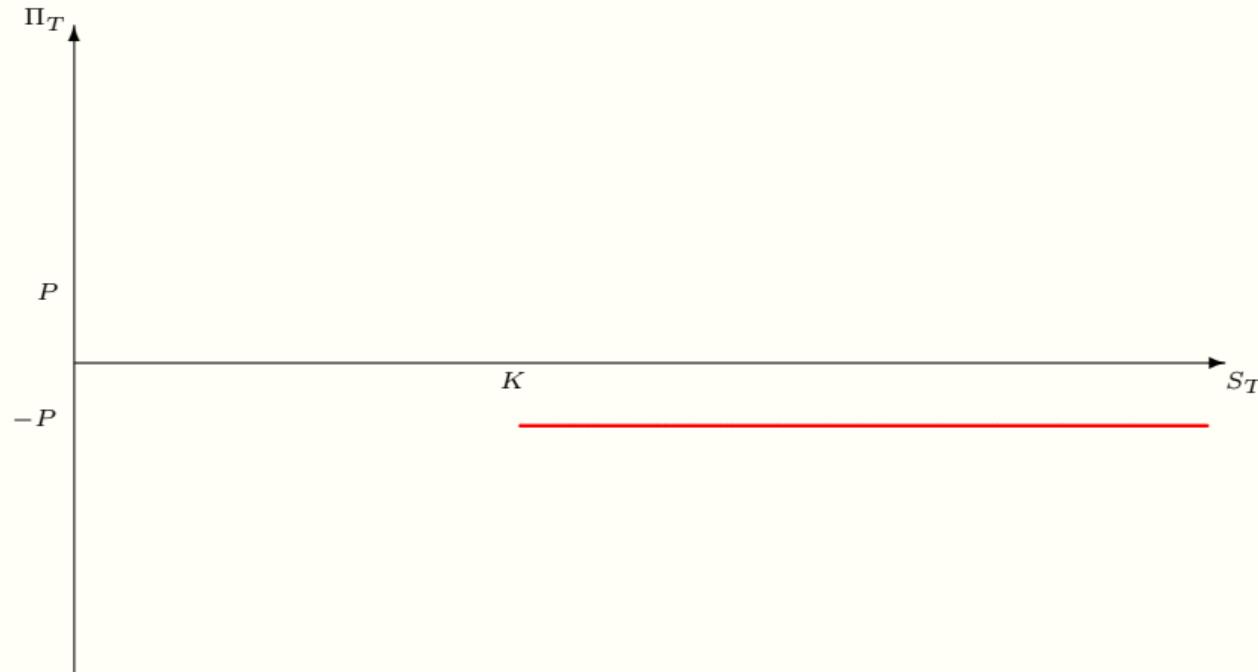
Put option payoffs



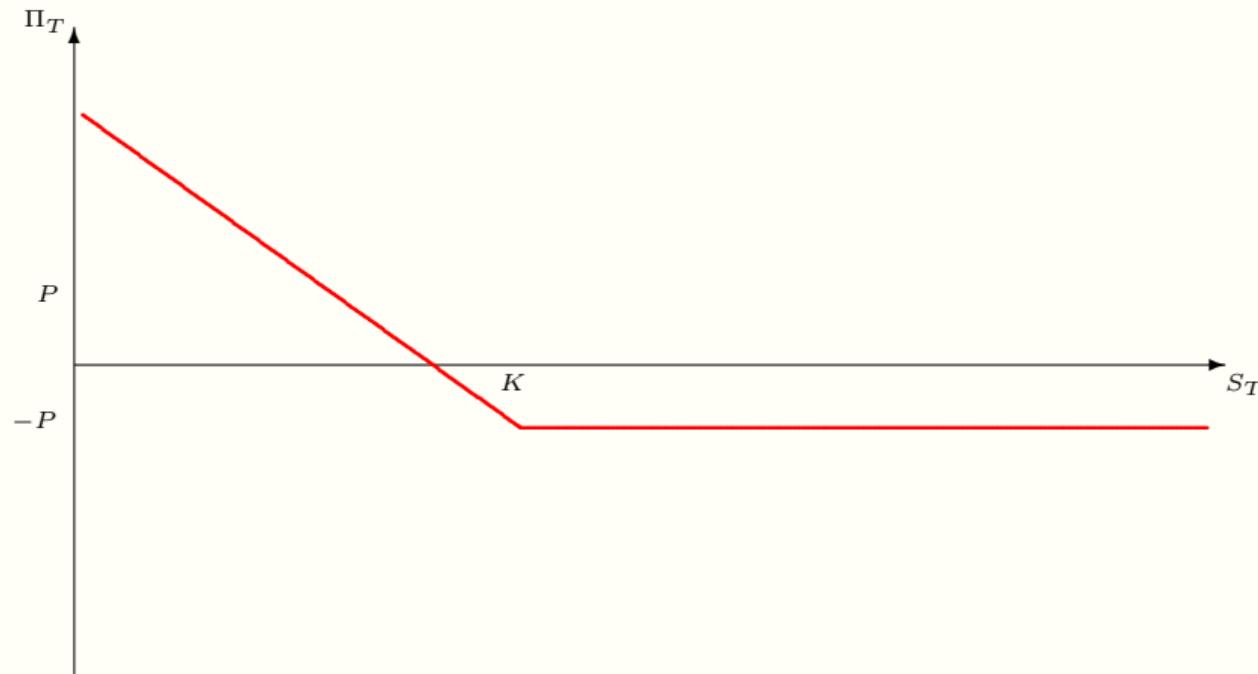
Put option payoffs



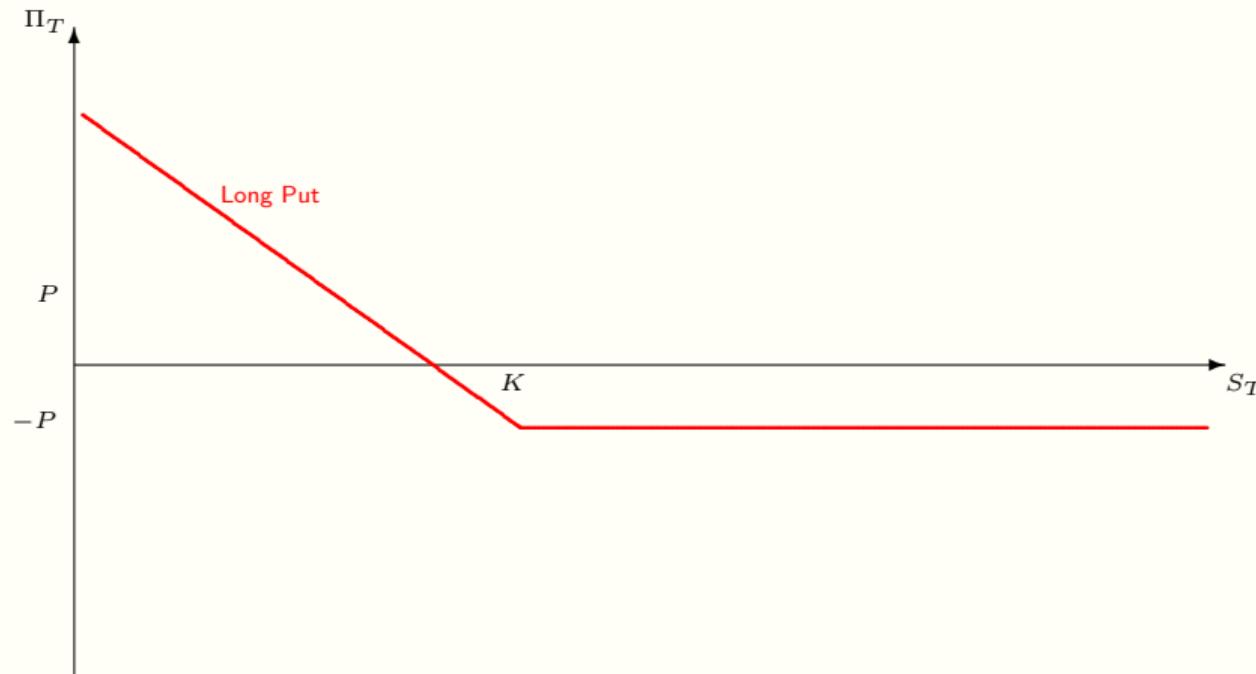
Put option payoffs



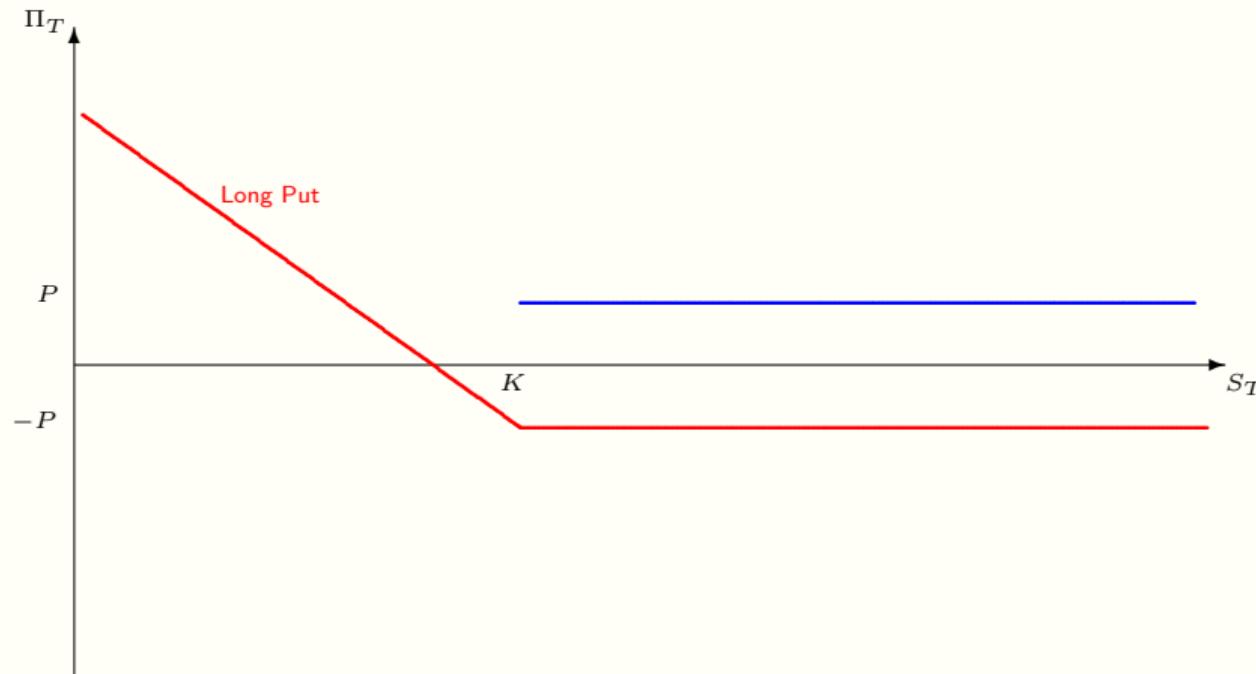
Put option payoffs



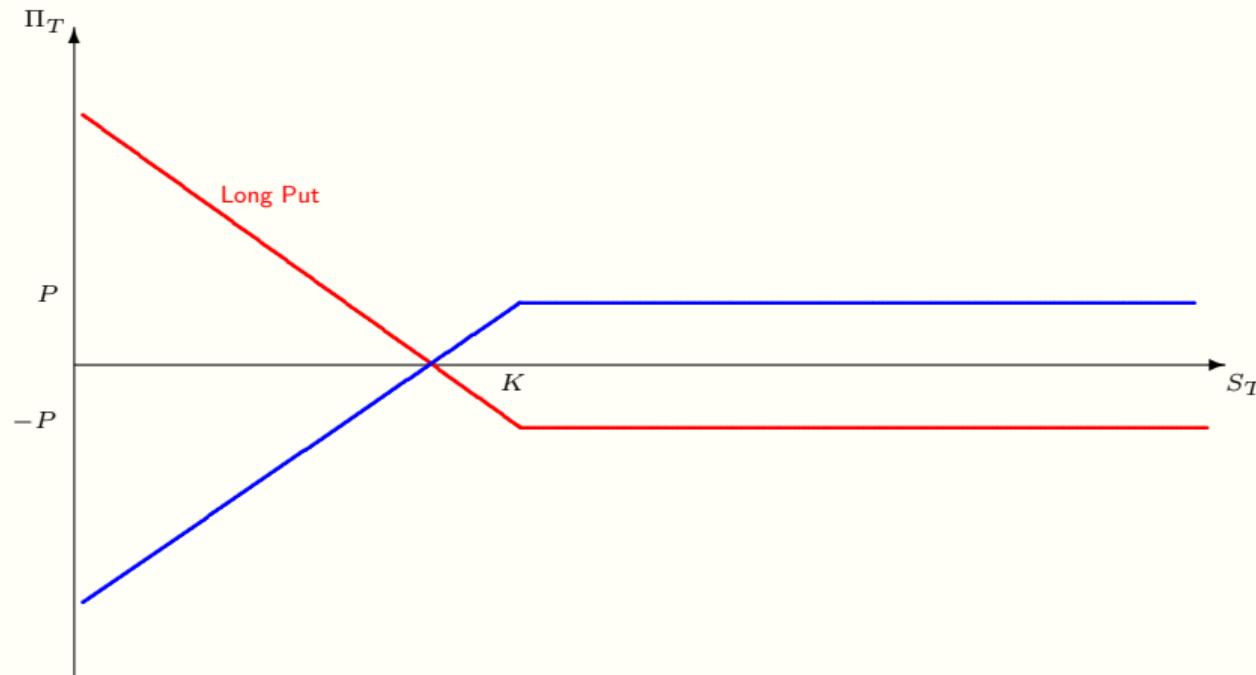
Put option payoffs



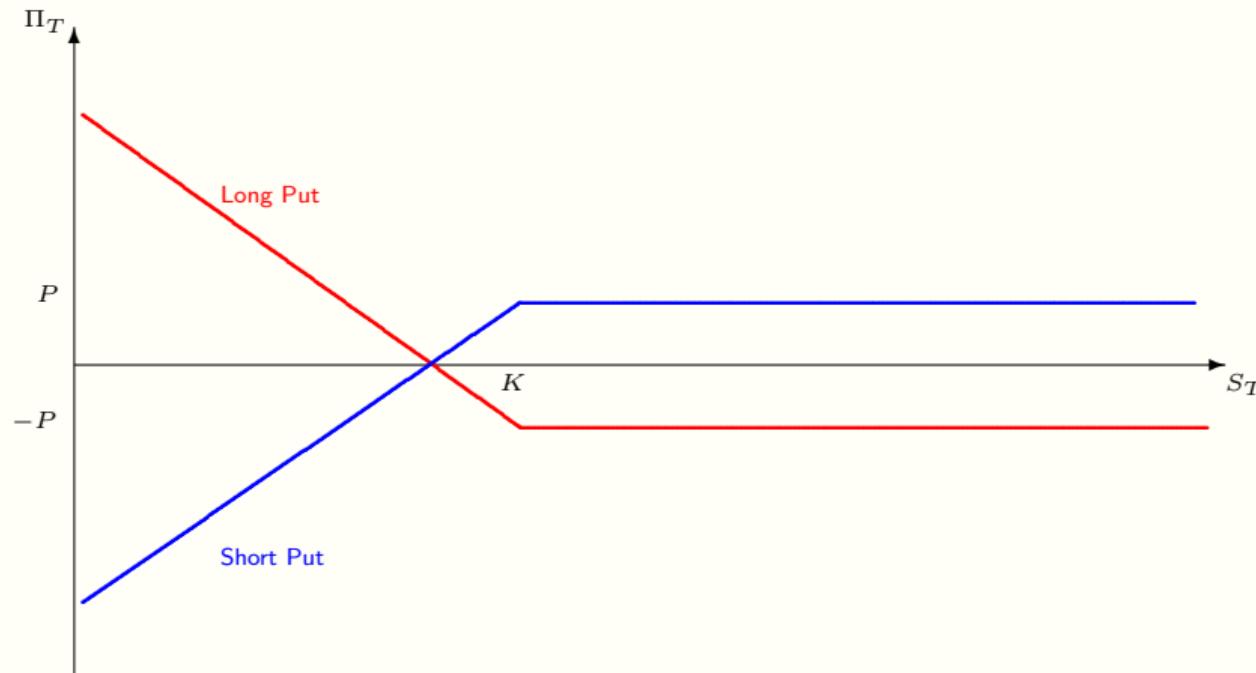
Put option payoffs



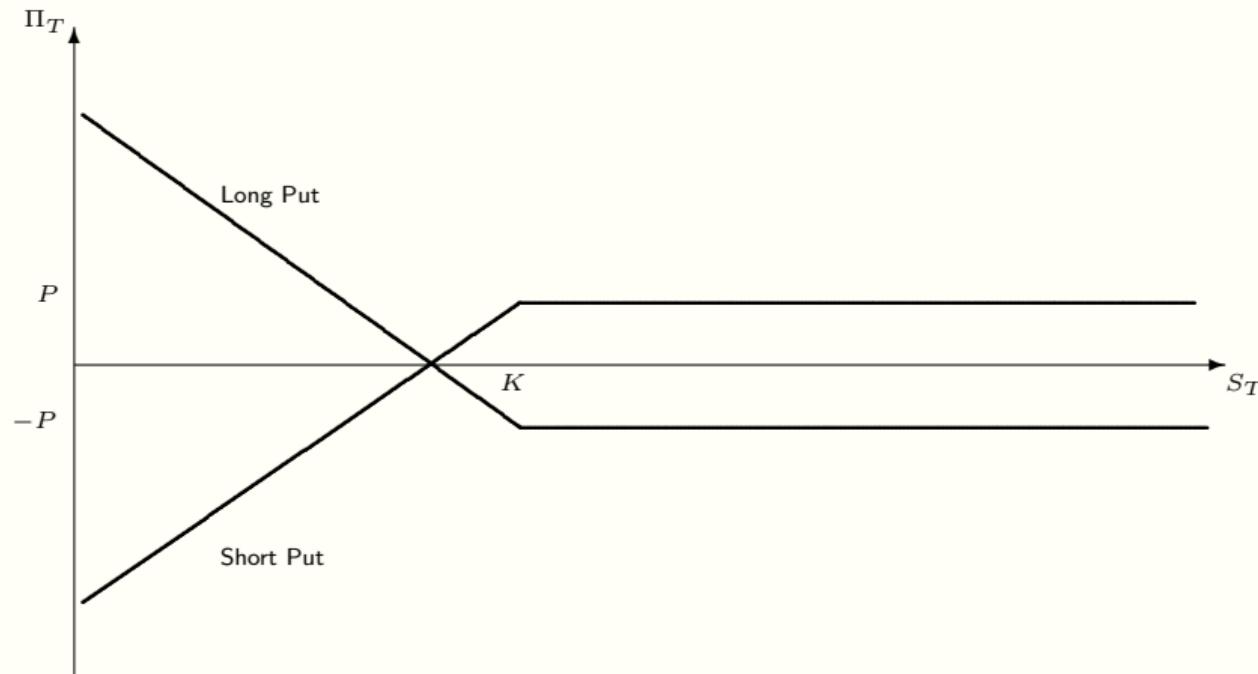
Put option payoffs



Put option payoffs



Put option payoffs



Eliminating risks

Eliminating risks

- ▶ Options can be used to **eliminate** losses from the underlying asset falling below the strike price (long position)

Eliminating risks

- ▶ Options can be used to eliminate losses from the underlying asset falling below the strike price (long position)
- ▶ Options can be used to **eliminate** losses from the underlying asset rising above the strike price (short position)

Eliminating risks

- ▶ Options can be used to eliminate losses from the underlying asset falling below the strike price (long position)
- ▶ Options can be used to eliminate losses from the underlying asset rising above the strike price (short position)
- ▶ With options, the risk of losses is eliminated, but the possibility of gains is **preserved**

Eliminating risks

- ▶ Options can be used to eliminate losses from the underlying asset falling below the strike price (long position)
- ▶ Options can be used to eliminate losses from the underlying asset rising above the strike price (short position)
- ▶ With options, the risk of losses is eliminated, but the possibility of gains is preserved
- ▶ Such protection is not free, an **option premium** has to be paid

Eliminating risks

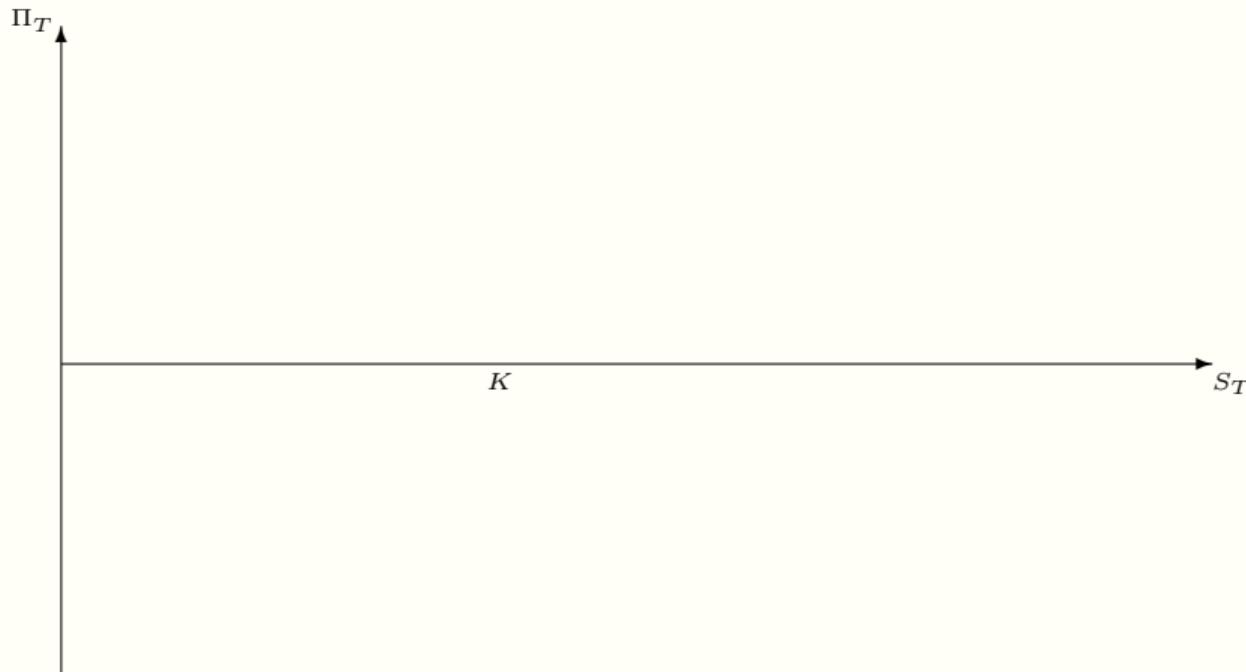
- ▶ Options can be used to eliminate losses from the underlying asset falling below the strike price (long position)
- ▶ Options can be used to eliminate losses from the underlying asset rising above the strike price (short position)
- ▶ With options, the risk of losses is eliminated, but the possibility of gains is preserved
- ▶ Such protection is not free, an option premium has to be paid

Hedging a long position in the underlying asset

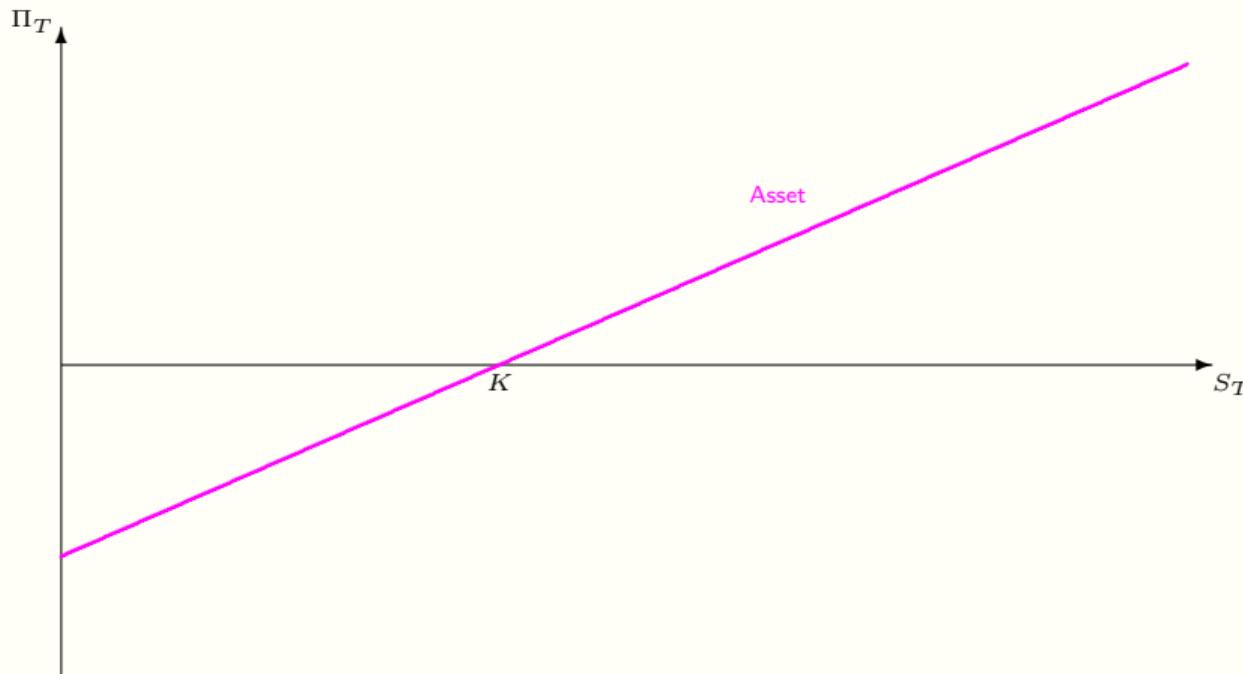
Hedging a long position in the underlying asset



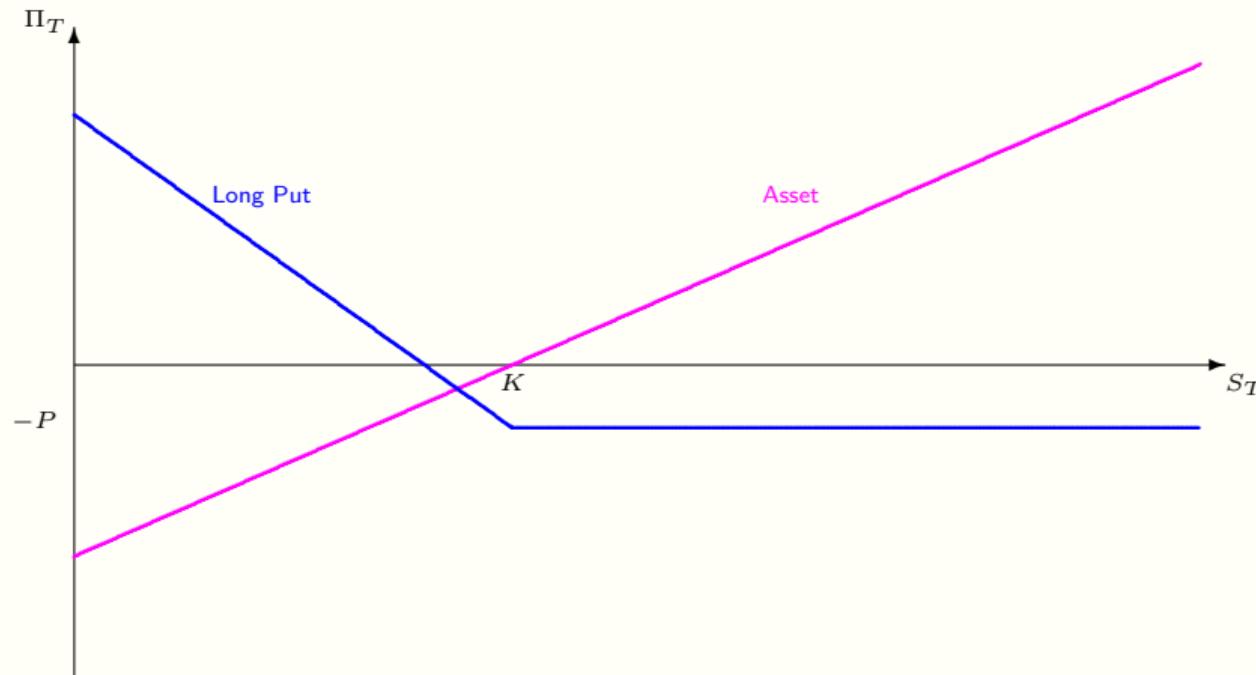
Hedging a long position in the underlying asset



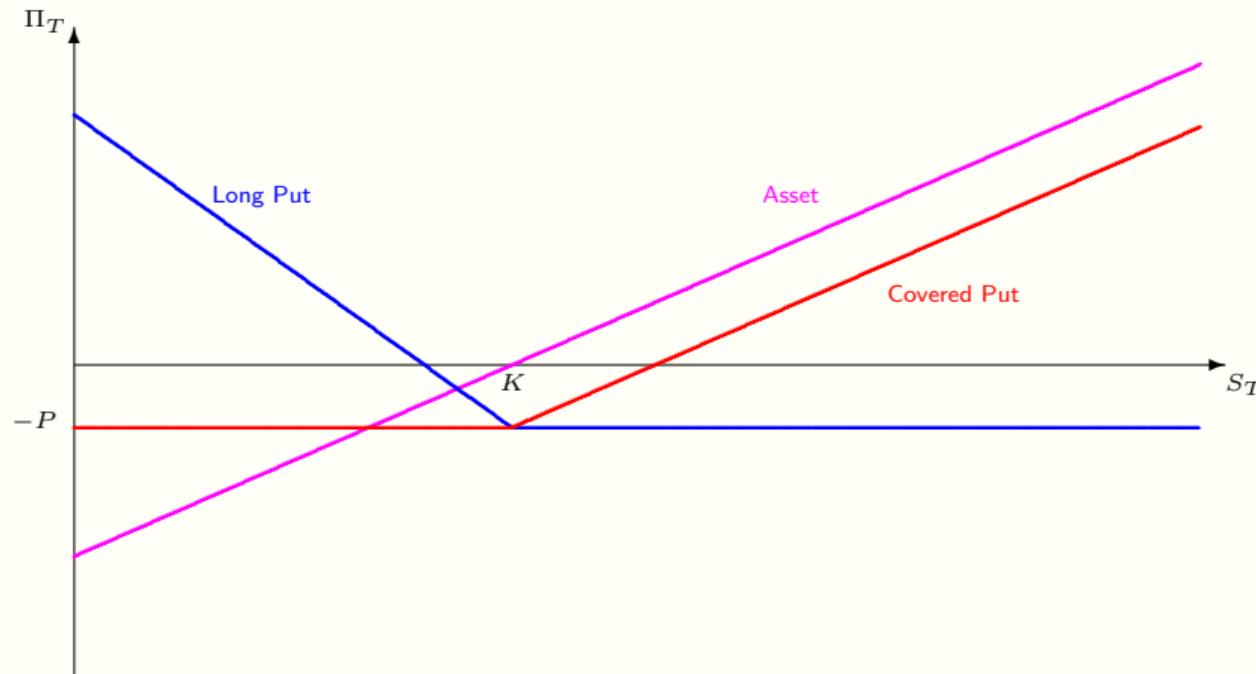
Hedging a long position in the underlying asset



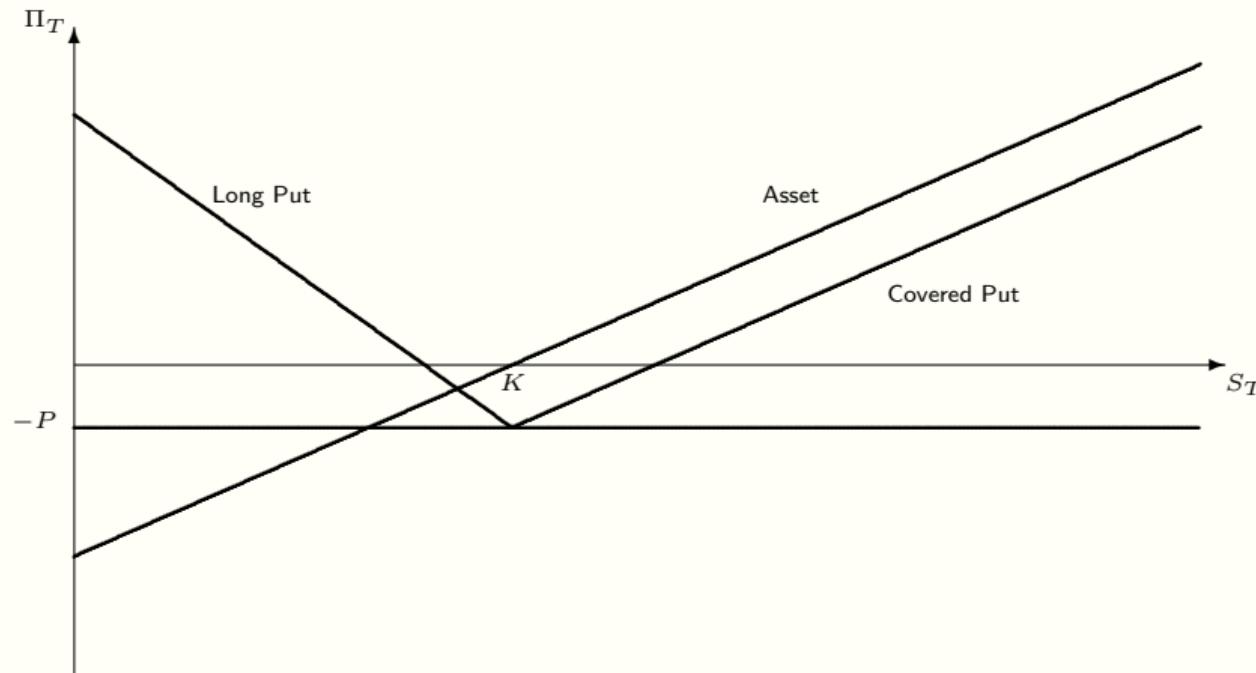
Hedging a long position in the underlying asset



Hedging a long position in the underlying asset



Hedging a long position in the underlying asset

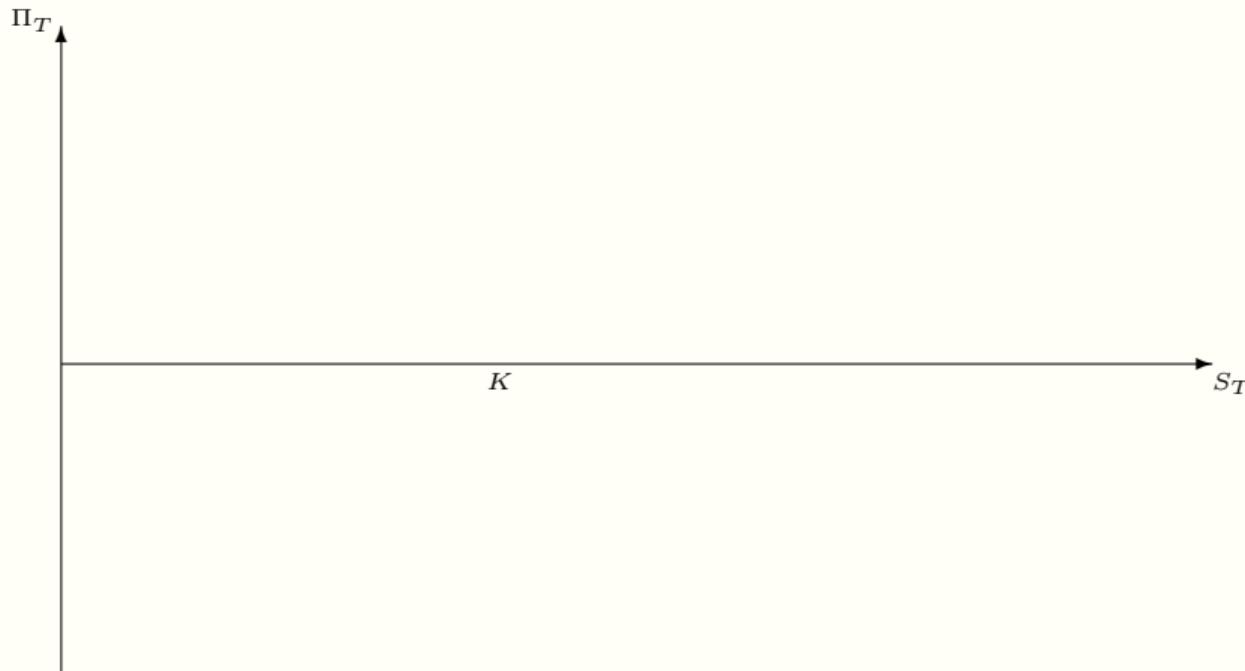


Hedging a short position in the underlying asset

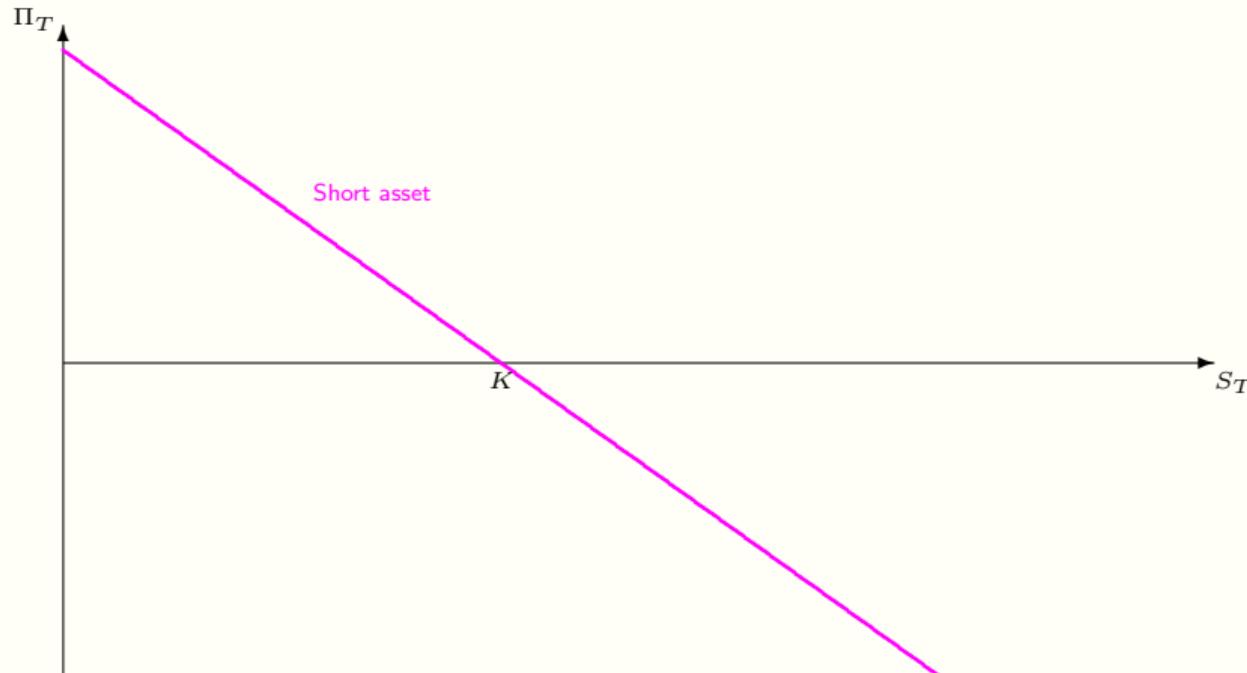
Hedging a short position in the underlying asset



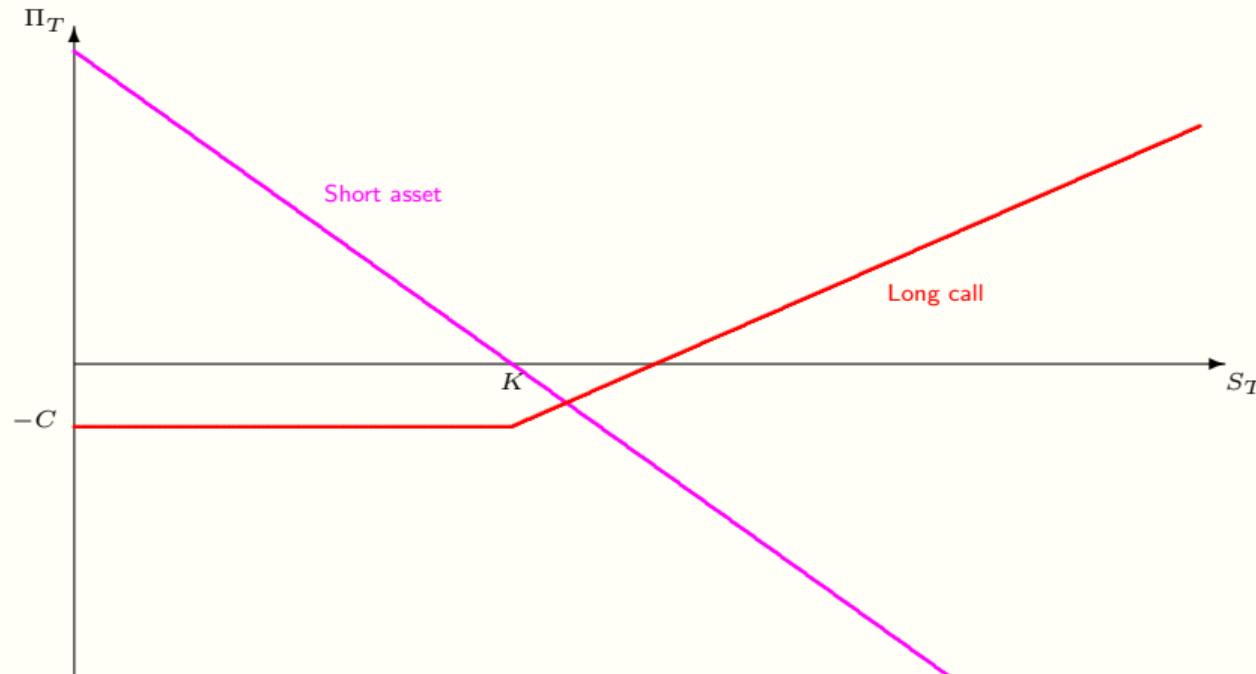
Hedging a short position in the underlying asset



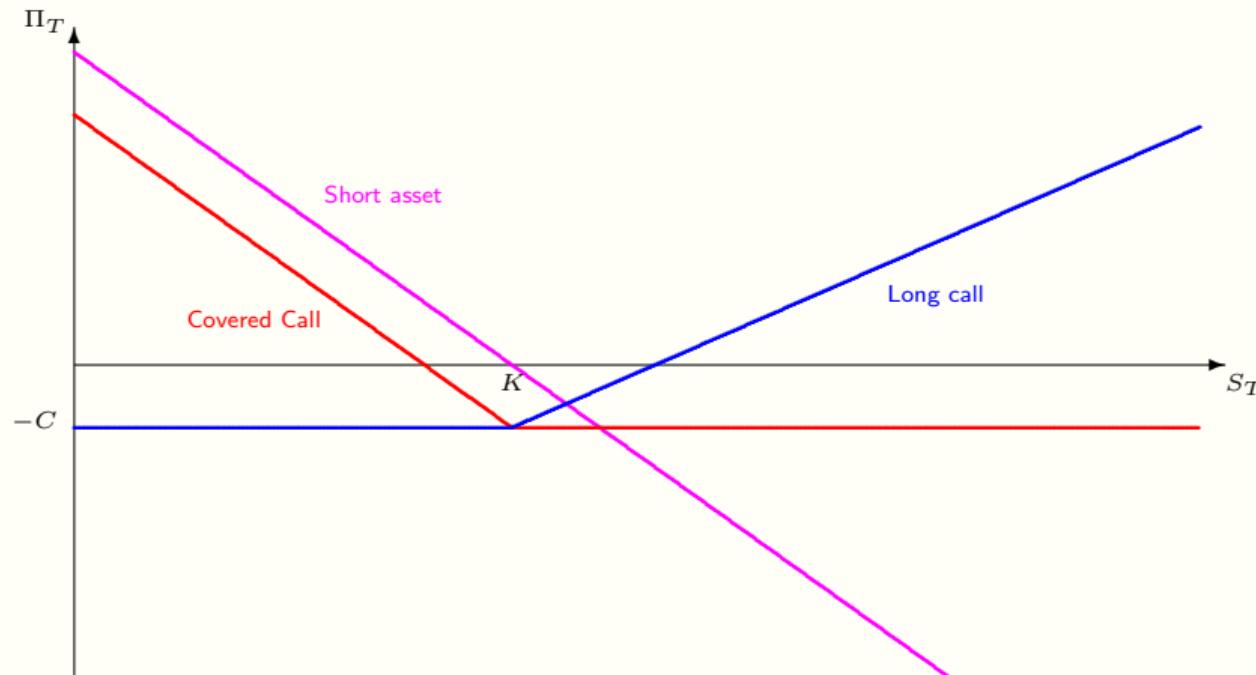
Hedging a short position in the underlying asset



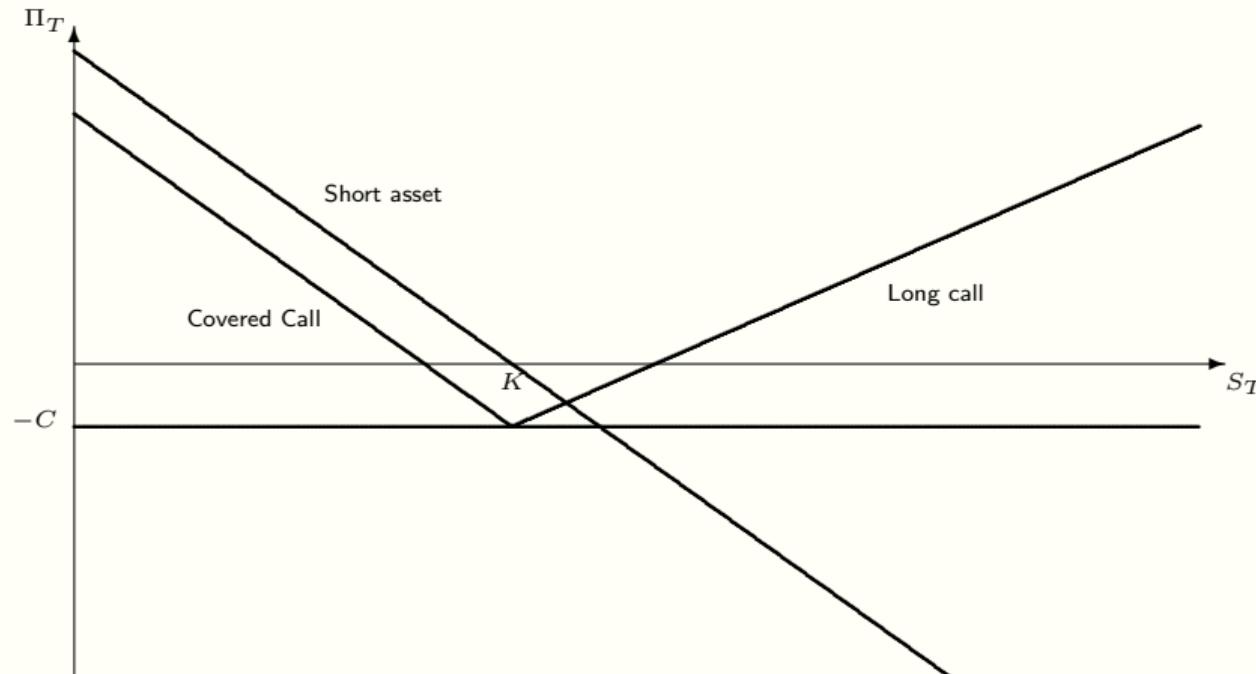
Hedging a short position in the underlying asset



Hedging a short position in the underlying asset



Hedging a short position in the underlying asset



Risk elimination only at maturity

Risk elimination only at maturity

- ▶ Purchasing an option that allows to sell or buy the position if it is loss-making, eliminates the risk of losses from the underlying asset **beyond the strike price**

Risk elimination only at maturity

- ▶ Purchasing an option that allows to sell or buy the position if it is loss-making, eliminates the risk of losses from the underlying asset beyond the strike price
- ▶ As an option premium is payable, losses are not fully eliminated but **cannot exceed the premium paid**

Risk elimination only at maturity

- ▶ Purchasing an option that allows to sell or buy the position if it is loss-making, eliminates the risk of losses from the underlying asset beyond the strike price
- ▶ As an option premium is payable, losses are not fully eliminated but cannot exceed the premium paid
- ▶ Risk is only eliminated at maturity of the option, the value of the portfolio can vary **prior to maturity**

Risk elimination only at maturity

- ▶ Purchasing an option that allows to sell or buy the position if it is loss-making, eliminates the risk of losses from the underlying asset beyond the strike price
- ▶ As an option premium is payable, losses are not fully eliminated but cannot exceed the premium paid
- ▶ Risk is only eliminated at maturity of the option, the value of the portfolio can vary prior to maturity



Copyright © by Andreas Krause

Picture credits:

Cover: Premier regard, Public domain, via Wikimedia Commons, [https://commons.wikimedia.org/wiki/File:DALL-E_2_Financial_markets_\(1\).jpg](https://commons.wikimedia.org/wiki/File:DALL-E_2_Financial_markets_(1).jpg)

Back: Rhododendrites, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0/>, via Wikimedia Commons, [https://upload.wikimedia.org/wikipedia/commons/0/04/Manhattan_at_night_south_of_Rockefeller_Center_panorama_\(11263p\).jpg](https://upload.wikimedia.org/wikipedia/commons/0/04/Manhattan_at_night_south_of_Rockefeller_Center_panorama_(11263p).jpg)

Andreas Krause
Department of Economics
University of Bath
Claverton Down
Bath BA2 7AY
United Kingdom

E-mail: mnsak@bath.ac.uk