CORPORATE FINANCE

Financial and Real Options

F. MICHAUX

2020

GENERAL AGENDA

Futures contract

- Long position, Short position
- Example
- Future Valuation

Financial and Real Options

- Calls, Puts and Shares
- Financial Alchemy with Options
- What Determines Option Value
- Option Valuation

TOPICS COVERED

- Calls, Puts and Shares
- Financial Alchemy with Options
- What Determines Option Value
- Option Valuation

FUTURE OBLIGATIONS

	Buyer	Seller
Long position	Obligation to buy asset	Obligation to sell asset
Short position	Obligation to sell asset	Obligation to buy asset

FUTURE TERMINOLGY

Long Position

Obligation to buy an asset at a specified exercise on or before the exercise date.

Short Option

Obligation to sell an asset at a specified exercise on or before the exercise date.

FUTURES CONTRACT VALUE

The value of future at expiration is a function of the asset price and the exercise price.

FUTURE VALUE

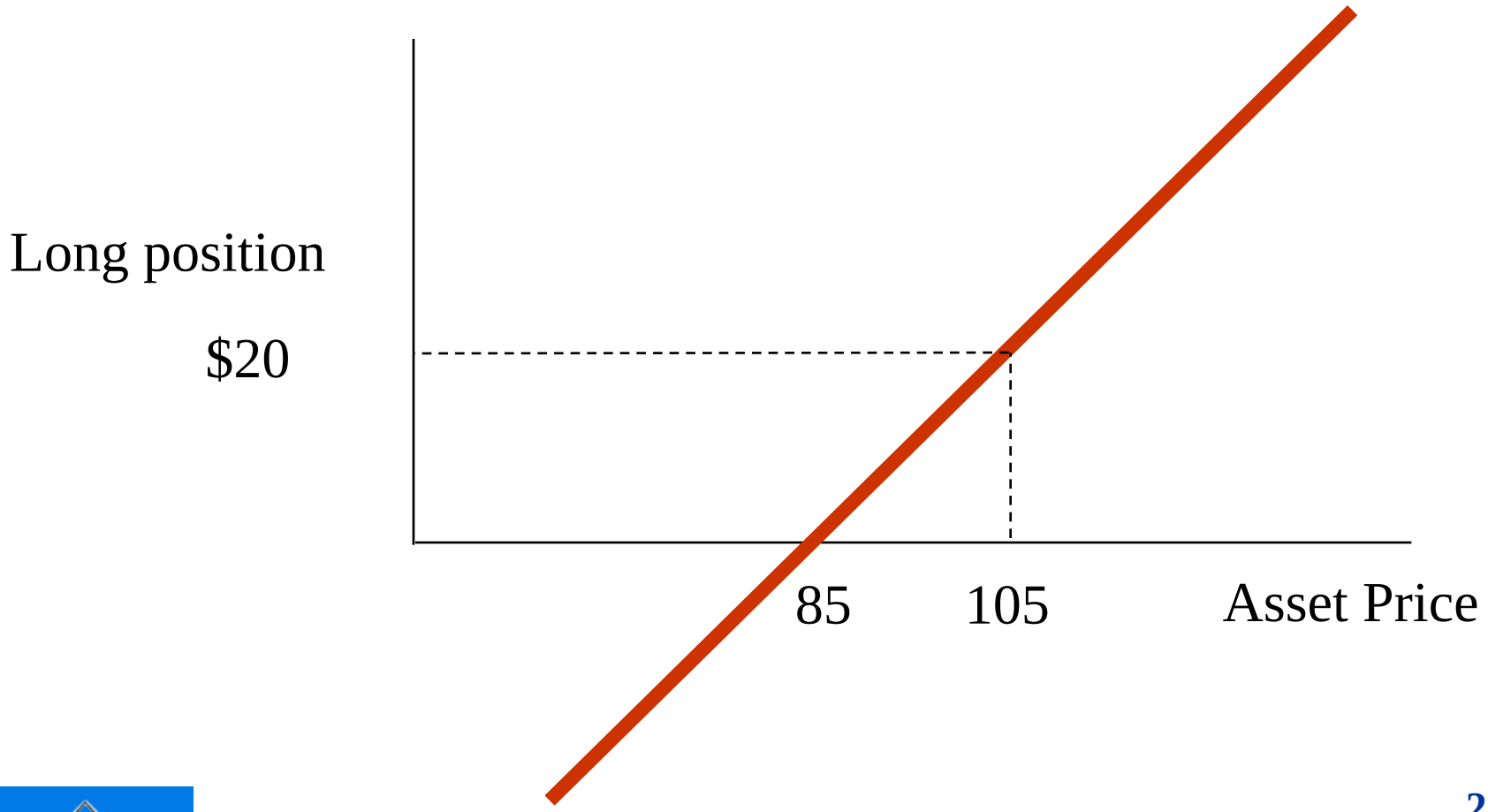
- **The value of a Future at expiration is a function of the asset price and the exercise price.**

Example - Future values given a exercise price of $85

Asset price	$60	70	80	90	100	110
Long Position Value	-25	-15	-5	5	15	25
Short Position	25	15	5	-5	-10	-15

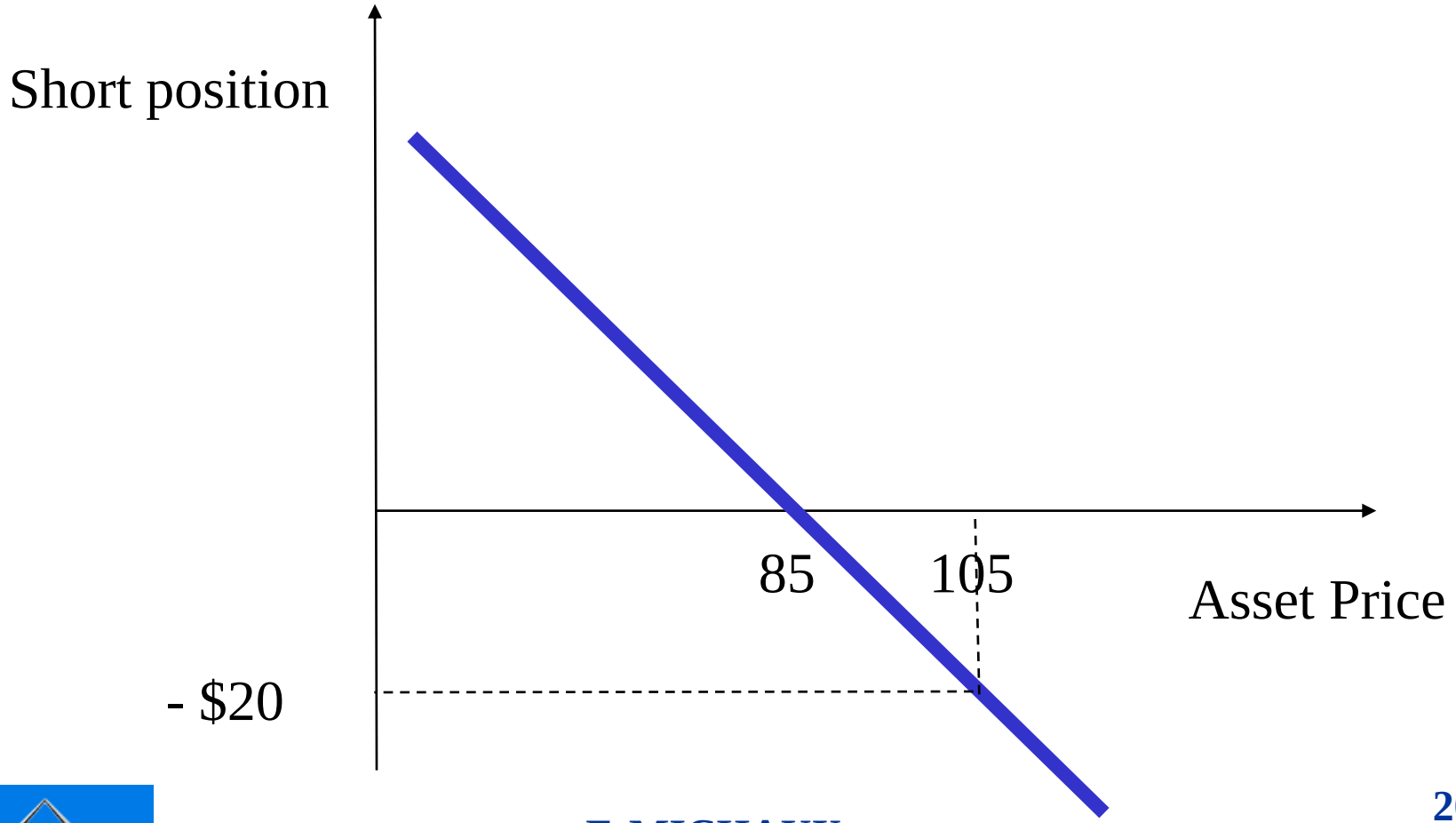
Future Contract Value

Long position value (graphic a given a $85 exercise price.



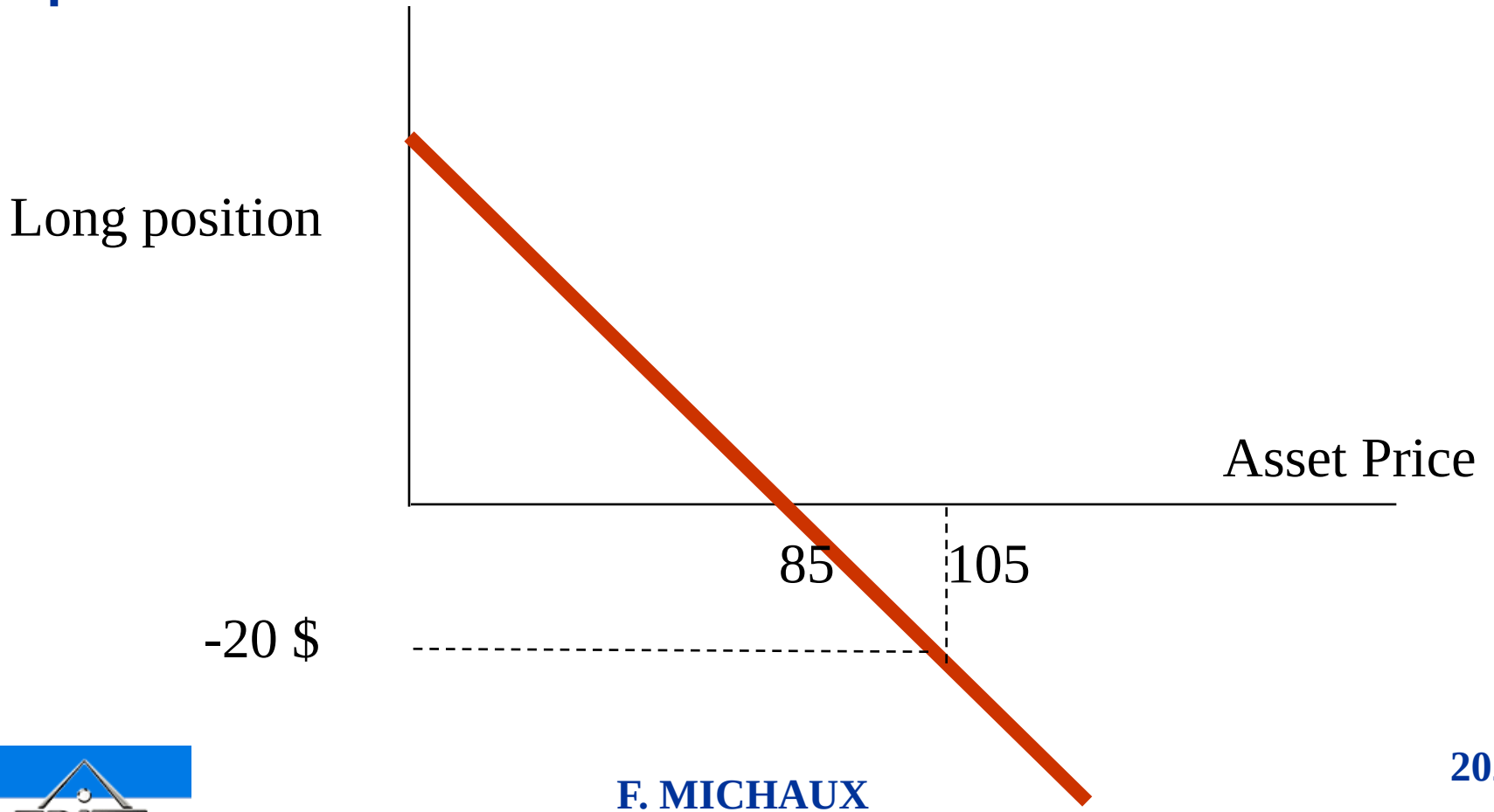
Future Contract Value

Short position value (graphic) given a $85 exercise price.



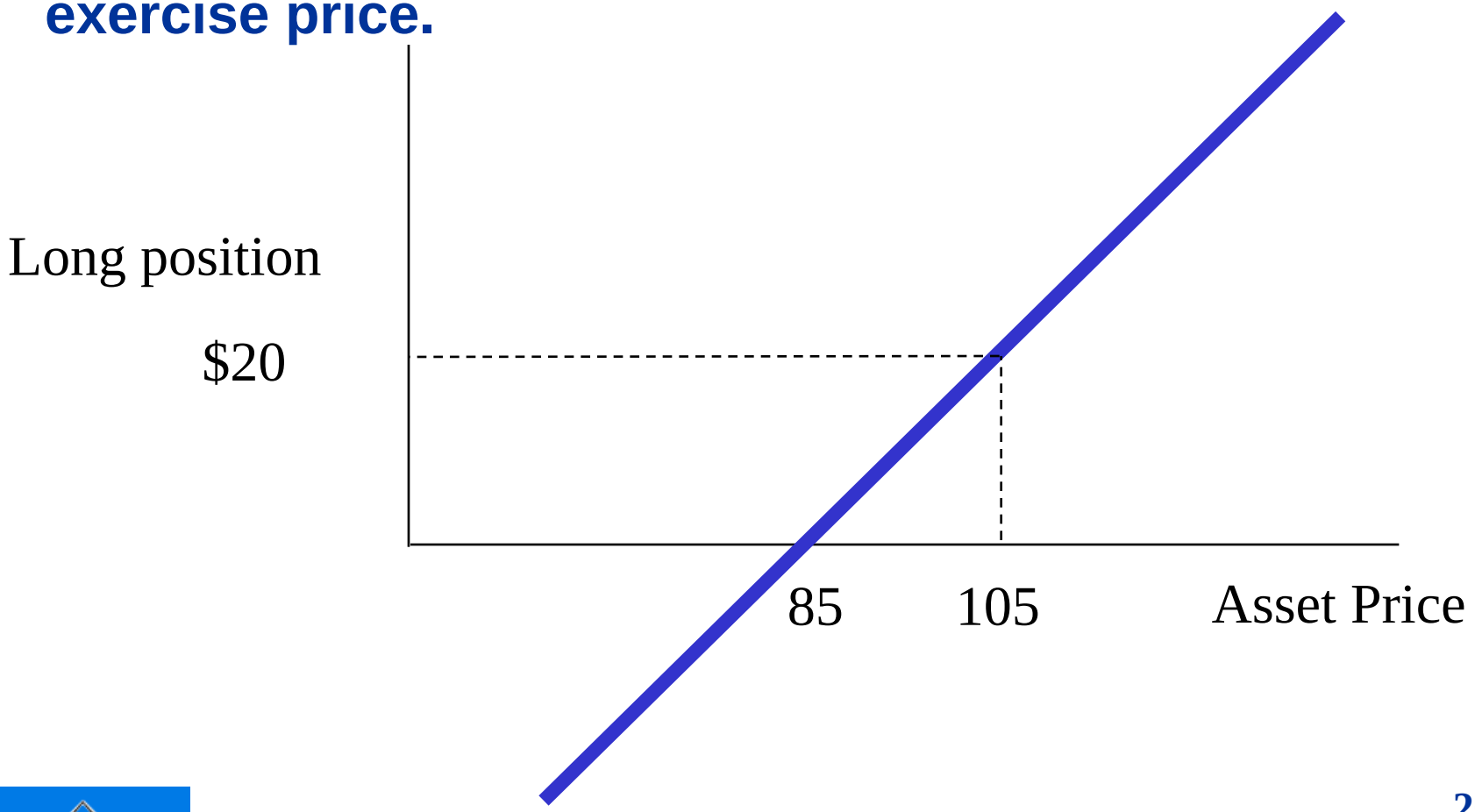
Future Contract Value

Long position value payoff (to seller) given a $85 exercise price.



Future Contract Value

Short position value pay off (to seller) a given a $85 exercise price.



Future Contract example

En avril, lors du semis et compte-tenu du contexte spécifique à son exploitation (niveau des charges, revenu souhaité, …), il estime qu'un prix de 210 €/t serait satisfaisant et lui permettrait de couvrir ses charges. Ces 210 €/t vont constituer son prix objectif. A la même période, la cotation des contrats de maïs à échéance Novembre indique un prix de 225 €/t. Notre agriculteur craint une baisse des prix d'ici la récolte. Il décide donc de vendre une partie de sa récolte sur le MAT pour se protéger contre une baisse des cours (cf slide suivant). Au moment de vendre sa récolte sur le marché physique, il va également déboucler sa position sur le MAT, c'est -à dire qu'il va prendre une position inverse à celle de départ. Il va donc racheter le même nombre de contrats que ceux qu'il a vendus.

A ce moment, deux cas de figure peuvent se présenter :

1. **les cours ont baissé. Il va donc obtenir un gain sur le MAT égal à la différence entre le prix de vente et le prix d'achat de ses contrats,**
2. **les cours ont monté. Il va donc obtenir une perte.**

Néanmoins comme le MAT et le marché physique sont corrélés, les pertes sur le MAT sont compensées par un gain sur le marché physique et inversement. Pour les éleveurs, les marchés à terme peuvent présenter un double intérêt. Ils peuvent se protéger contre une baisse des cours des céréales dans le cas où ils vendent leur production. Ils ont également la possibilité de se couvrir contre les hausses des cours des aliments. Tout dépend de leur stratégie de commercialisation. Dans le cas de la production porcine, les éleveurs peuvent même s'assurer une marge, en fixant un prix de vente des porcs et un prix d'achat d'aliment.

Future Contract example

Exemple d'application pour un producteur de maïs

En avril :		
Sur le marché à terme : Vente d'un contrat à terme à échéance novembre	225 €/t	
En novembre :	**Baisse des cours**	**Hausse des cours**
Sur le marché à terme : Achat d'un contrat identique à échéance novembre Gain/Perte (A)	205 €/t + 20 €/t	245 €/t - 20 €/t
Sur le marché physique		
Vente de la récolte (B)	190 €/t	230 €/t
L'agriculteur perçoit au total (A+B), soit son prix objectif	**210 €/t**	**210 €/t**

En avril, un agriculteur sème son maïs. Il se fixe un prix objectif de 210 €/t. Il craint une baisse des prix d'ici la récolte. Il décide donc de se positionner sur le marché à terme et effectue les opérations suivantes

Ainsi, que les prix montent ou chutent, la couverture sur le marché à terme a permis à l'agriculteur d'obtenir son prix objectif.

Future Contract example

La couverture du risque

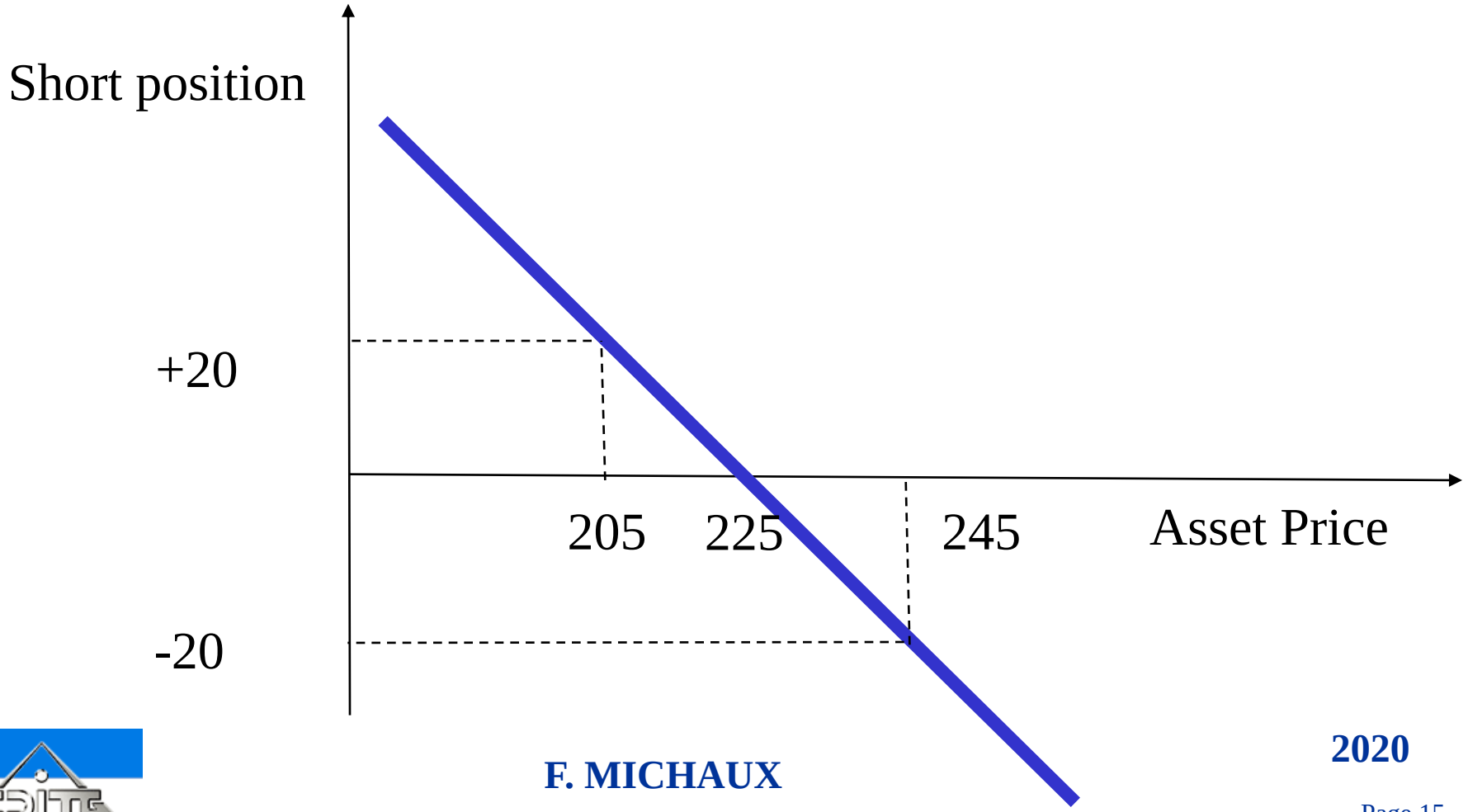
Position inverse

Type d'utilisateur	Risque sur le marché physique	Prise de position sur le MAT	Opération sur le MAT à échéance	Opération sur le physique
		Vente de contrat à terme à échéance A	Achat de contrat à terme à échéance A	Vente de la récolte
		Achat de contrat à terme à échéance A	Vente de contrat à terme à échéance A	Achat de matière première

Source : Chambre Régionale d'Agriculture de Bretagne

Future Contract Value

Short position value (graphic) given a $85 exercise price.



OPTION OBLIGATIONS

	Buyer	Seller
Call option	Right to buy asset	Obligation to sell asset
Put option	Right to sell asset	Obligation to buy asset

OPTION TERMINOLGY

Call Option

Right to buy an asset at a specified exercise price on or before the exercise date.

Put Option

Right to sell an asset at a specified exercise price on or before the exercise date.

OPTION VALUE

The value of an option at expiration is a function of the stock price and the exercise price.

OPTION VALUE

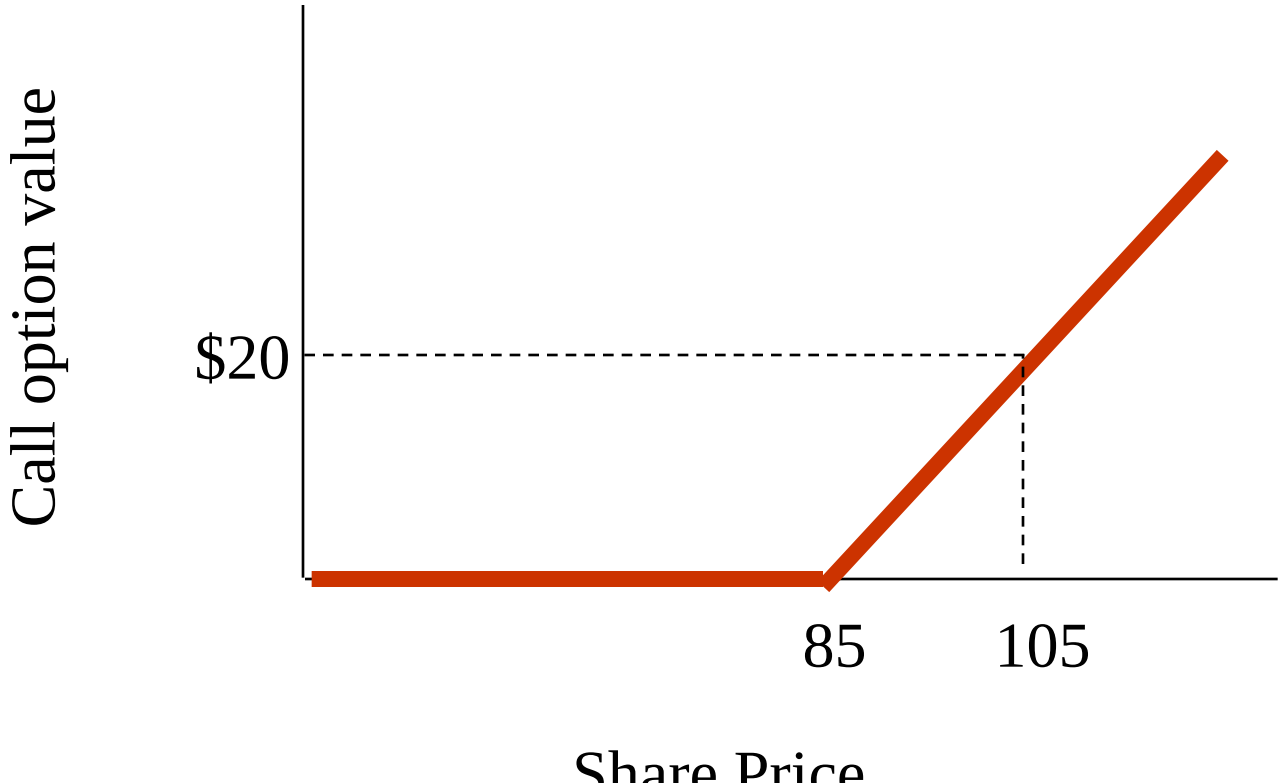
- **The value of an option at expiration is a function of the stock price and the exercise price.**

Example - Option values given a exercise price of $85

Stock Price	$60	70	80	90	100	110
Call Value	0	0	0	5	15	25
Put Value	25	15	5	0	0	0

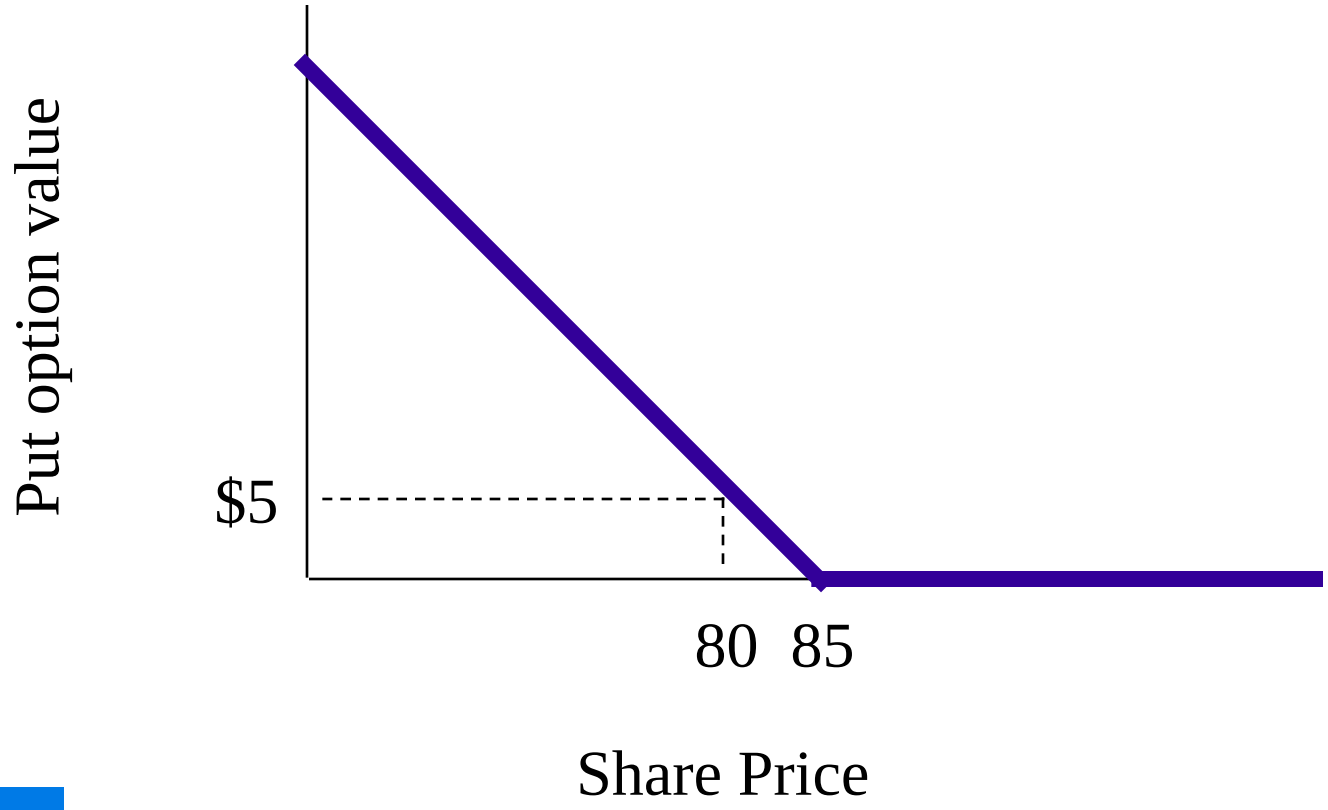
OPTION VALUE

Call option value (graphic) given a $85 exercise price.



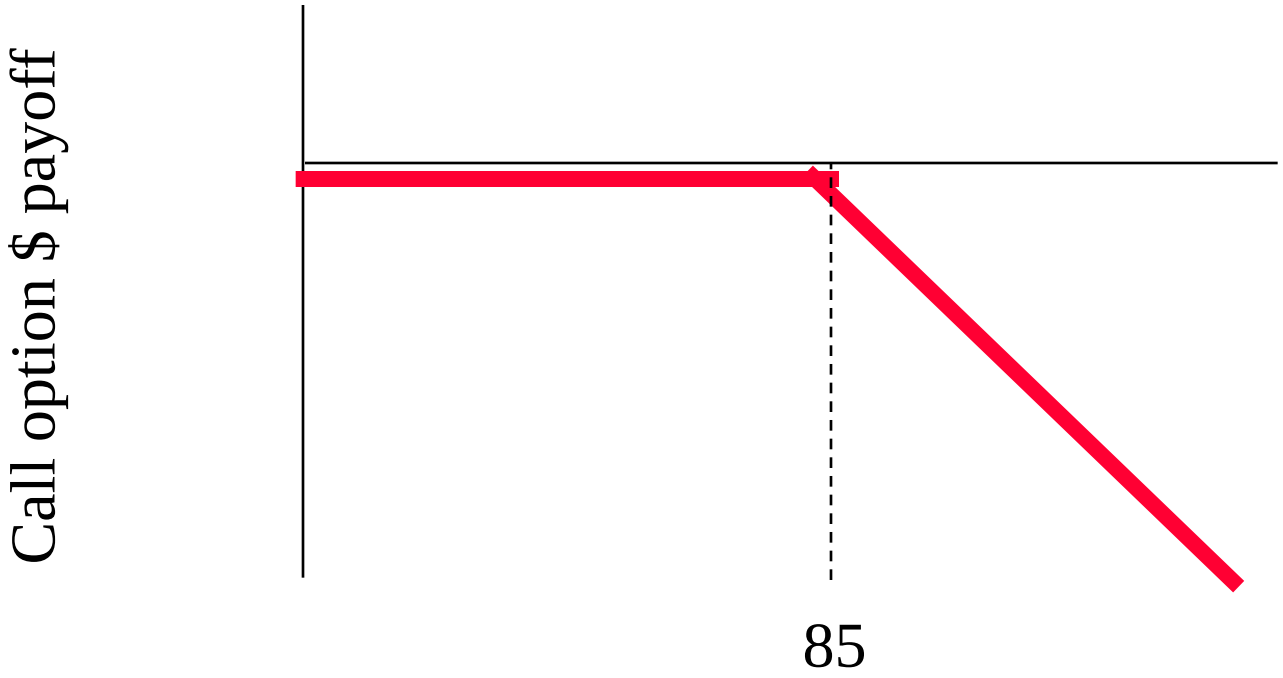
OPTION VALUE

Put option value (graphic) given a $85 exercise price.



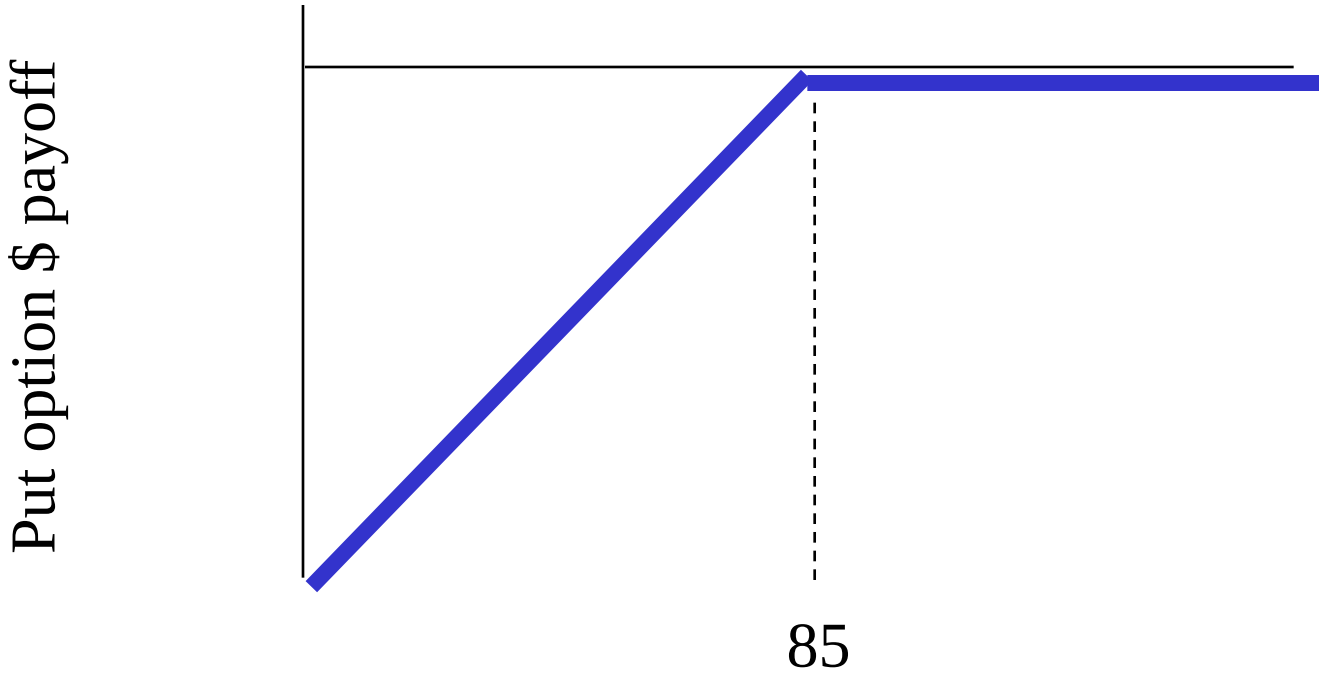
OPTION VALUE

Call option payoff (to seller) given a $85 exercise price.



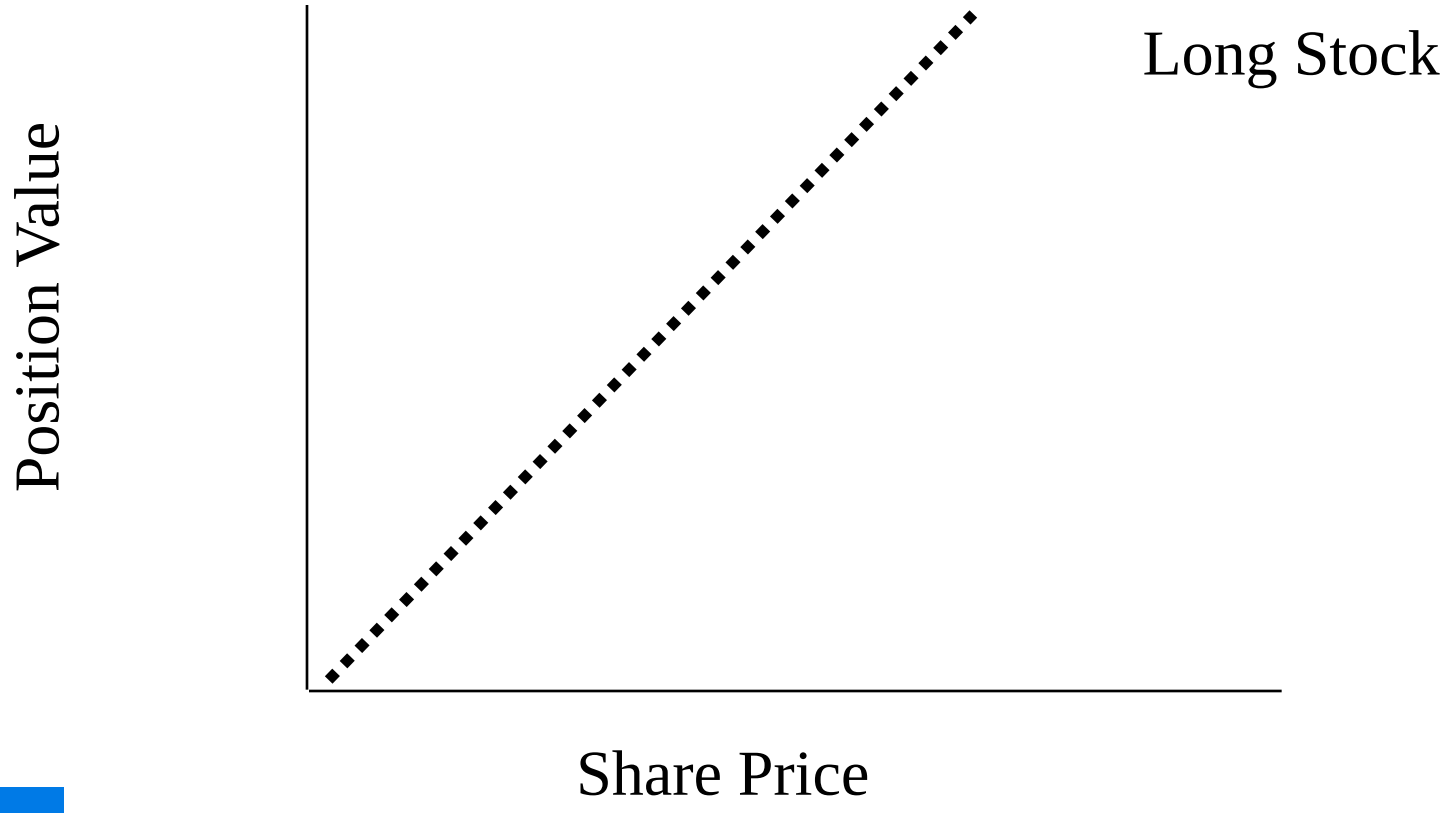
OPTION VALUE

Put option payoff (to seller) given a $85 exercise price.



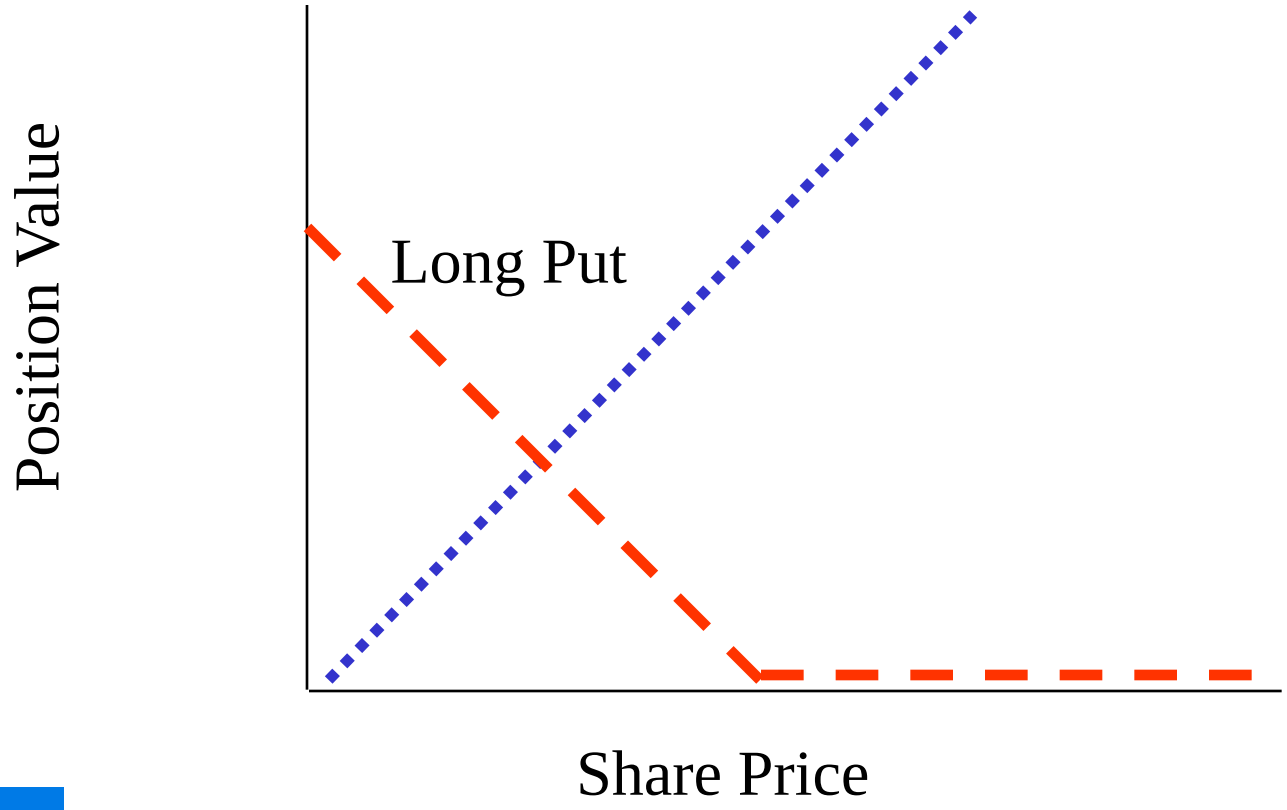
OPTION VALUE

Protective Put - Long stock and long put



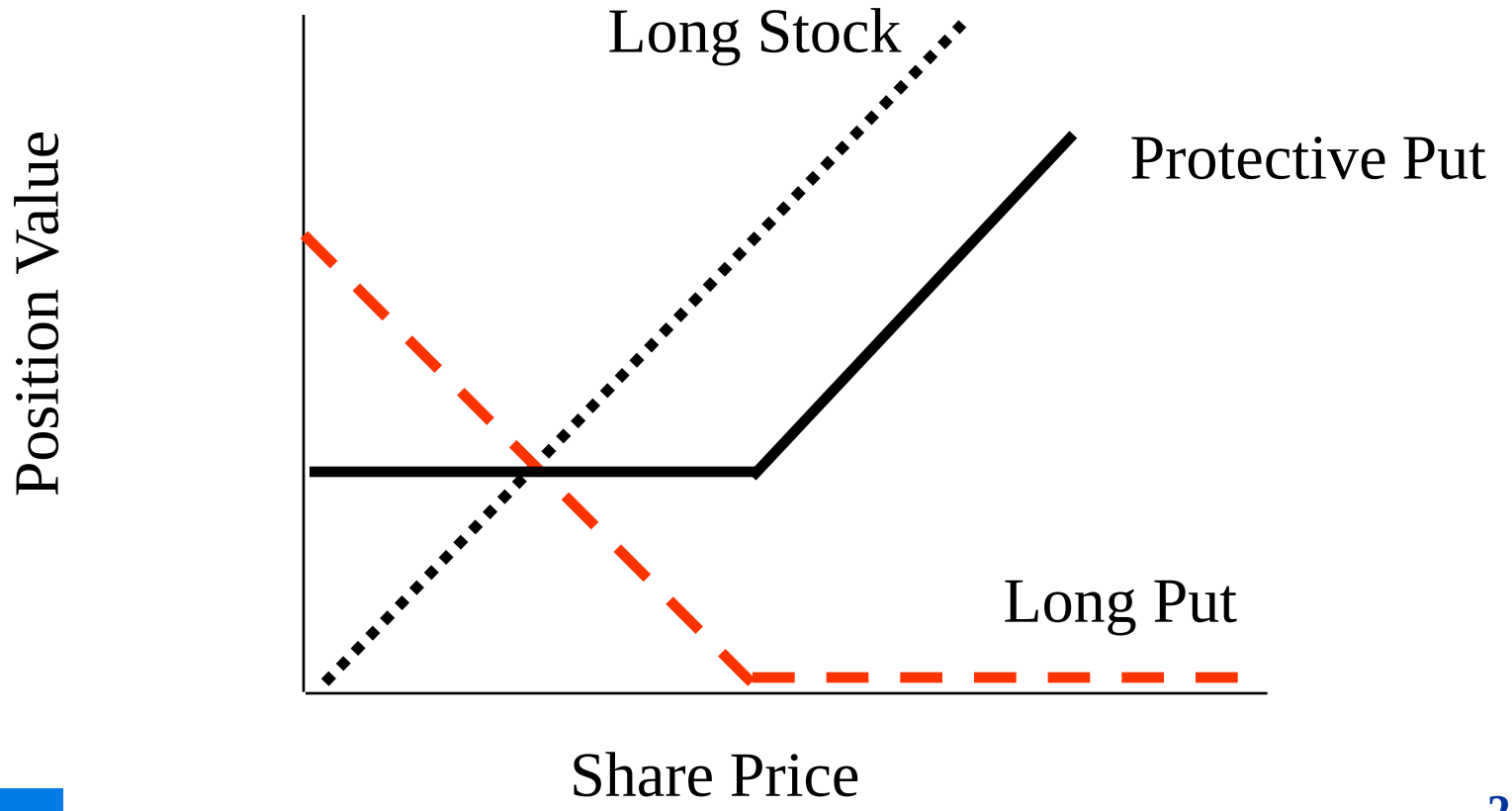
OPTION VALUE

Protective Put - Long stock and long put



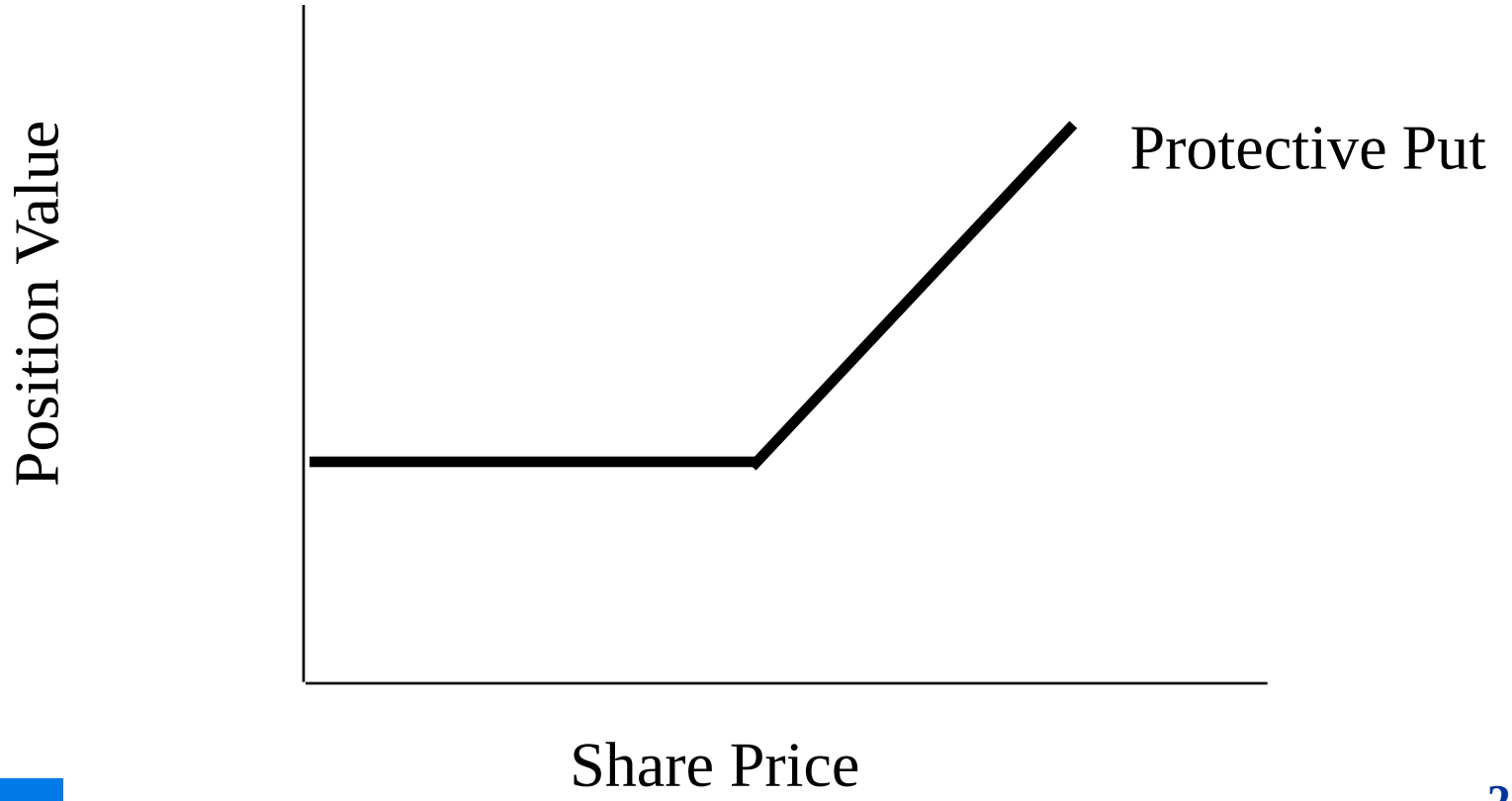
OPTION VALUE

Protective Put - Long stock and long put



OPTION VALUE

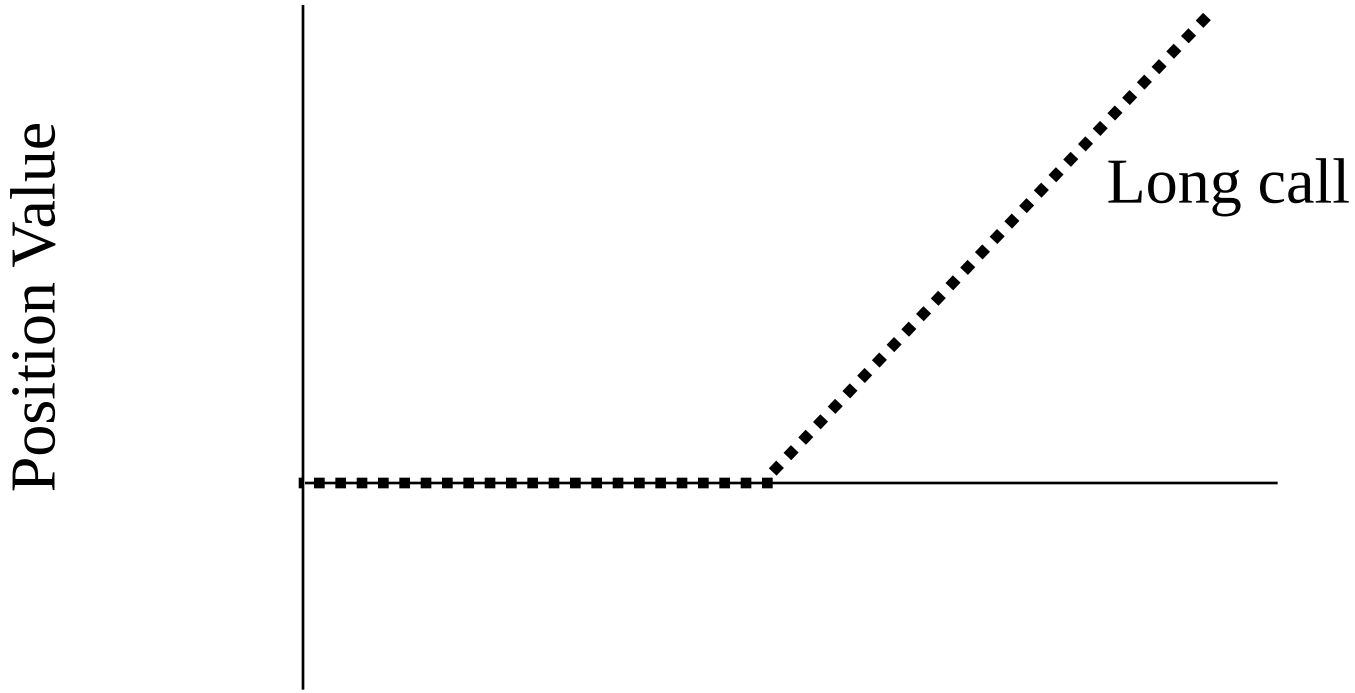
Protective Put - Long stock and long put



OPTION VALUE

Straddle - Long call and long put

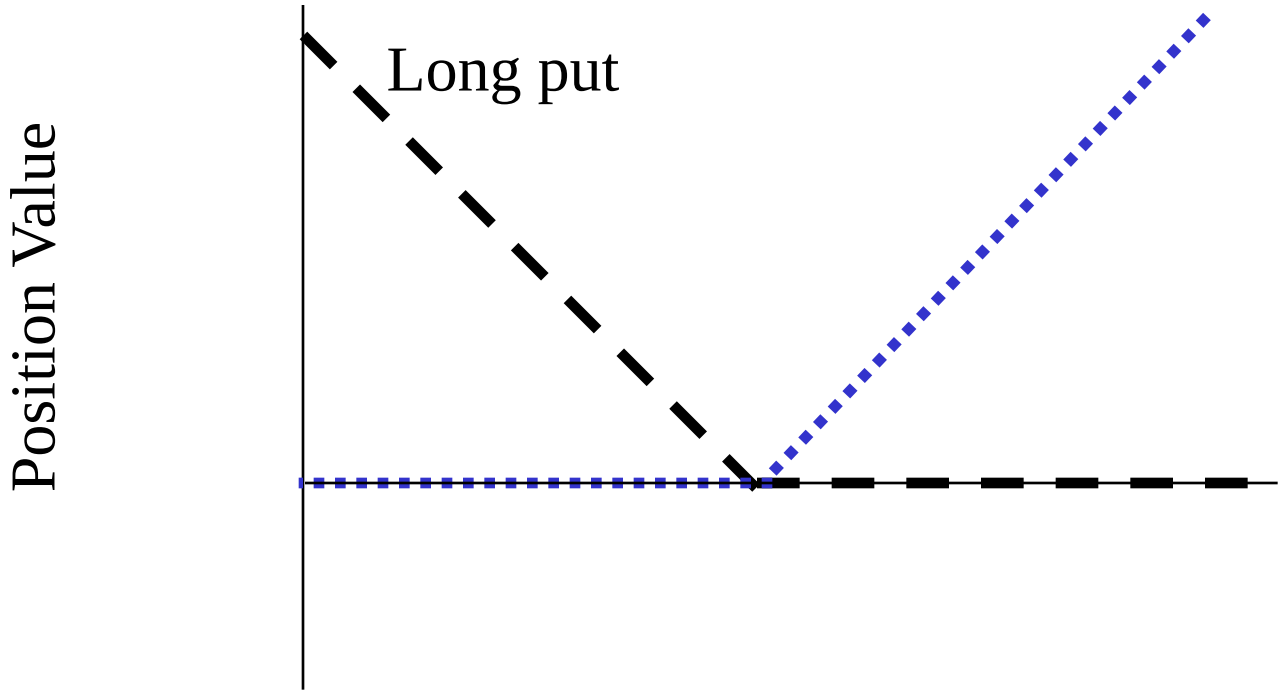
- Strategy for profiting from high volatility



OPTION VALUE

Straddle - Long call and long put

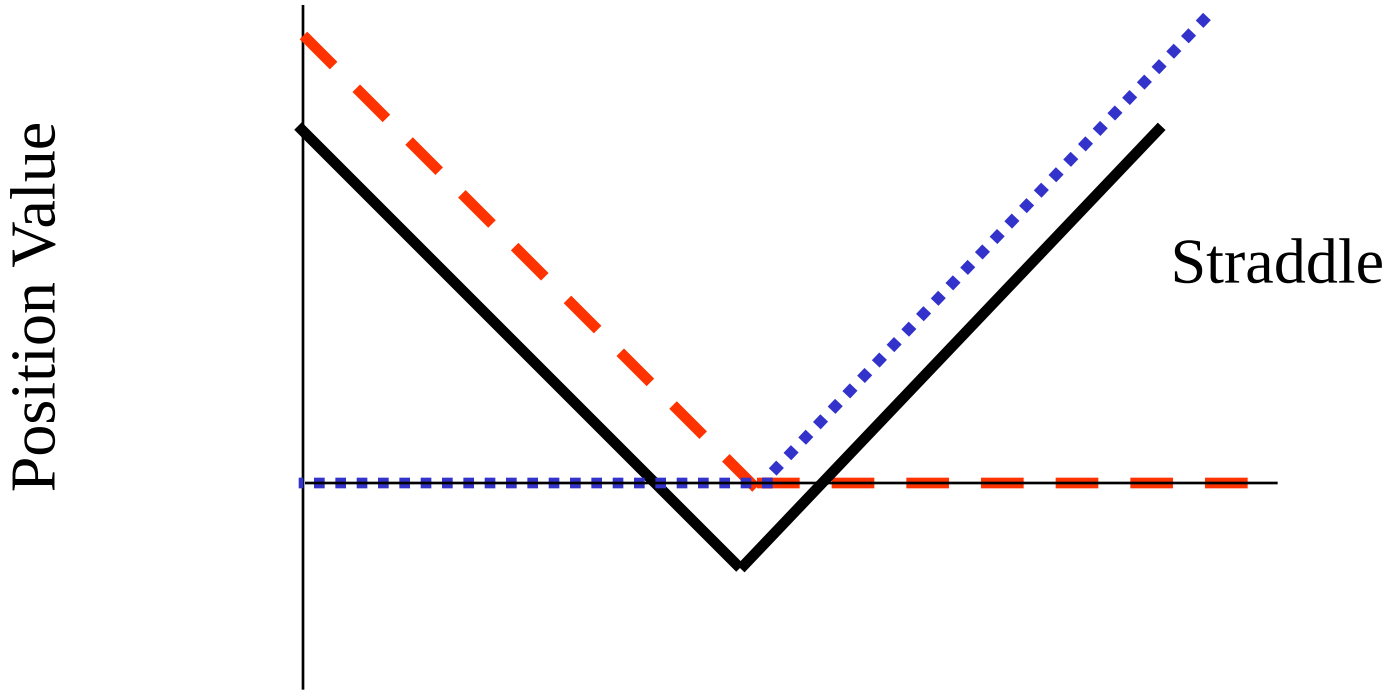
- Strategy for profiting from high volatility



OPTION VALUE

Straddle - Long call and long put

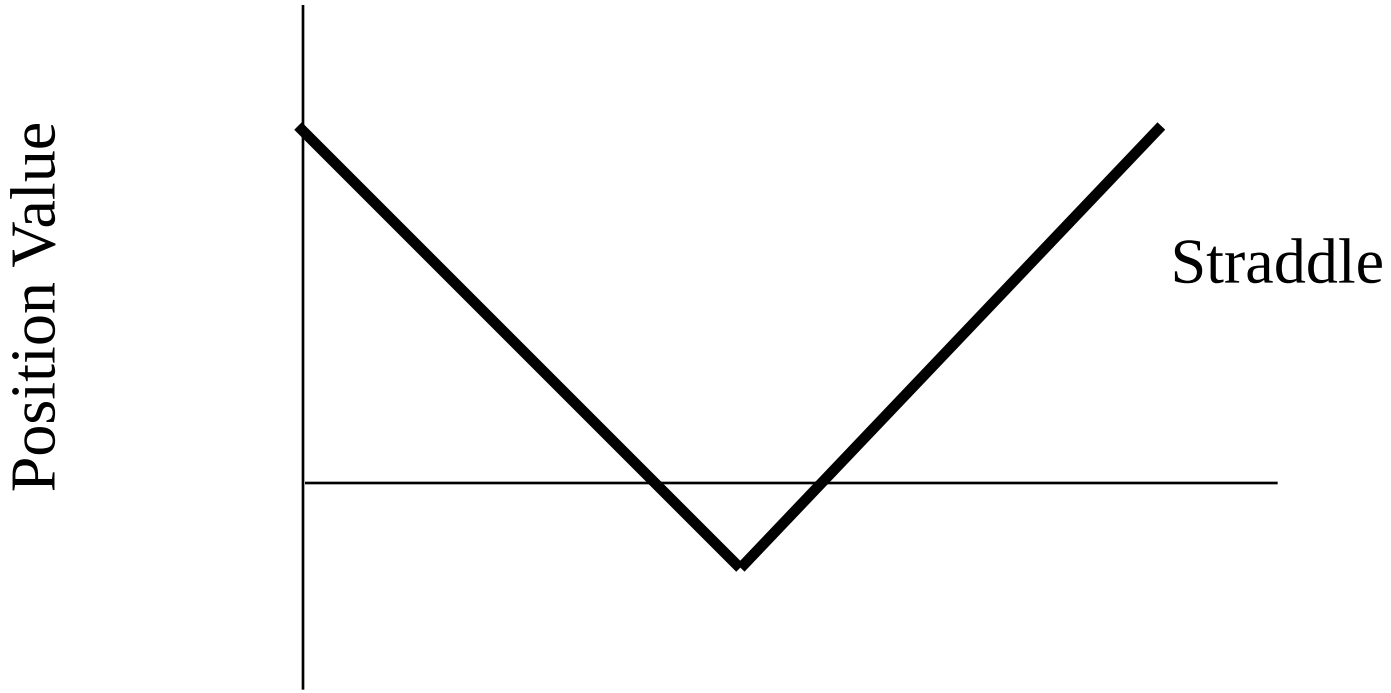
- Strategy for profiting from high volatility



OPTION VALUE

Straddle - Long call and long put

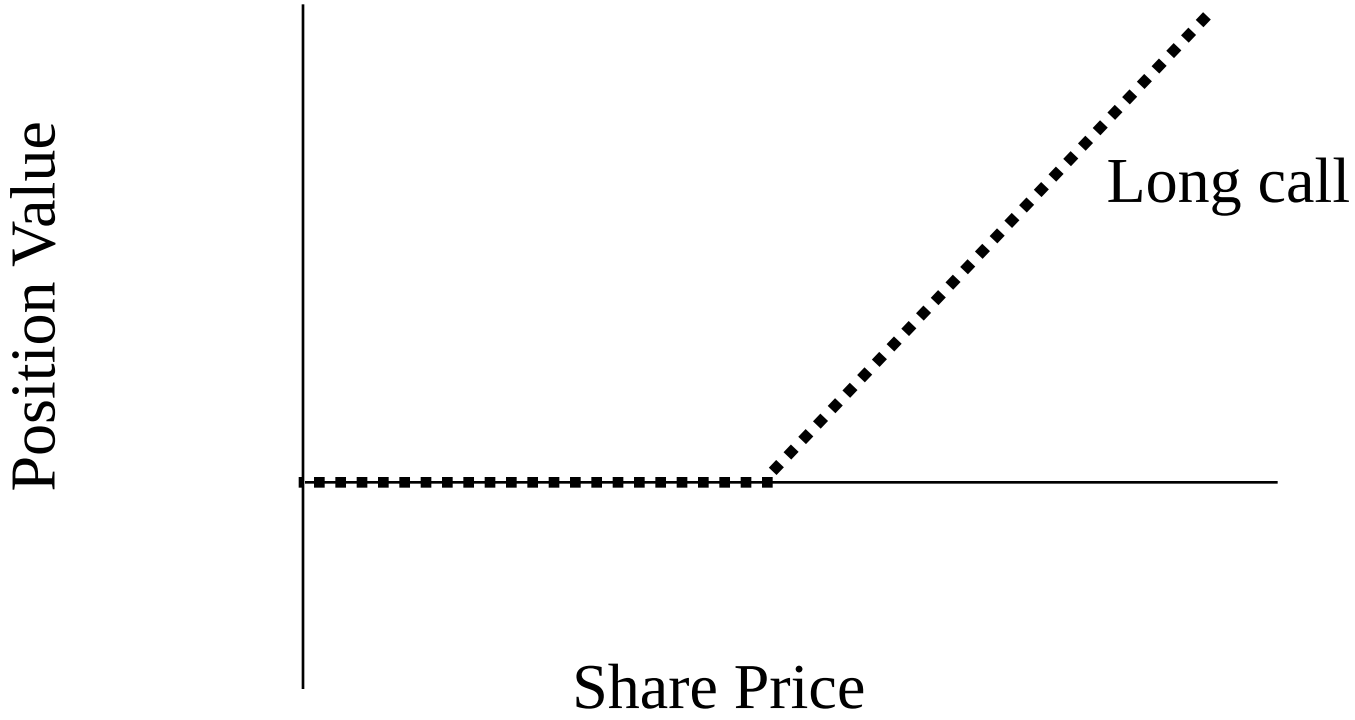
- Strategy for profiting from high volatility



OPTION VALUE

Strip – 1 Long call and 2 long put

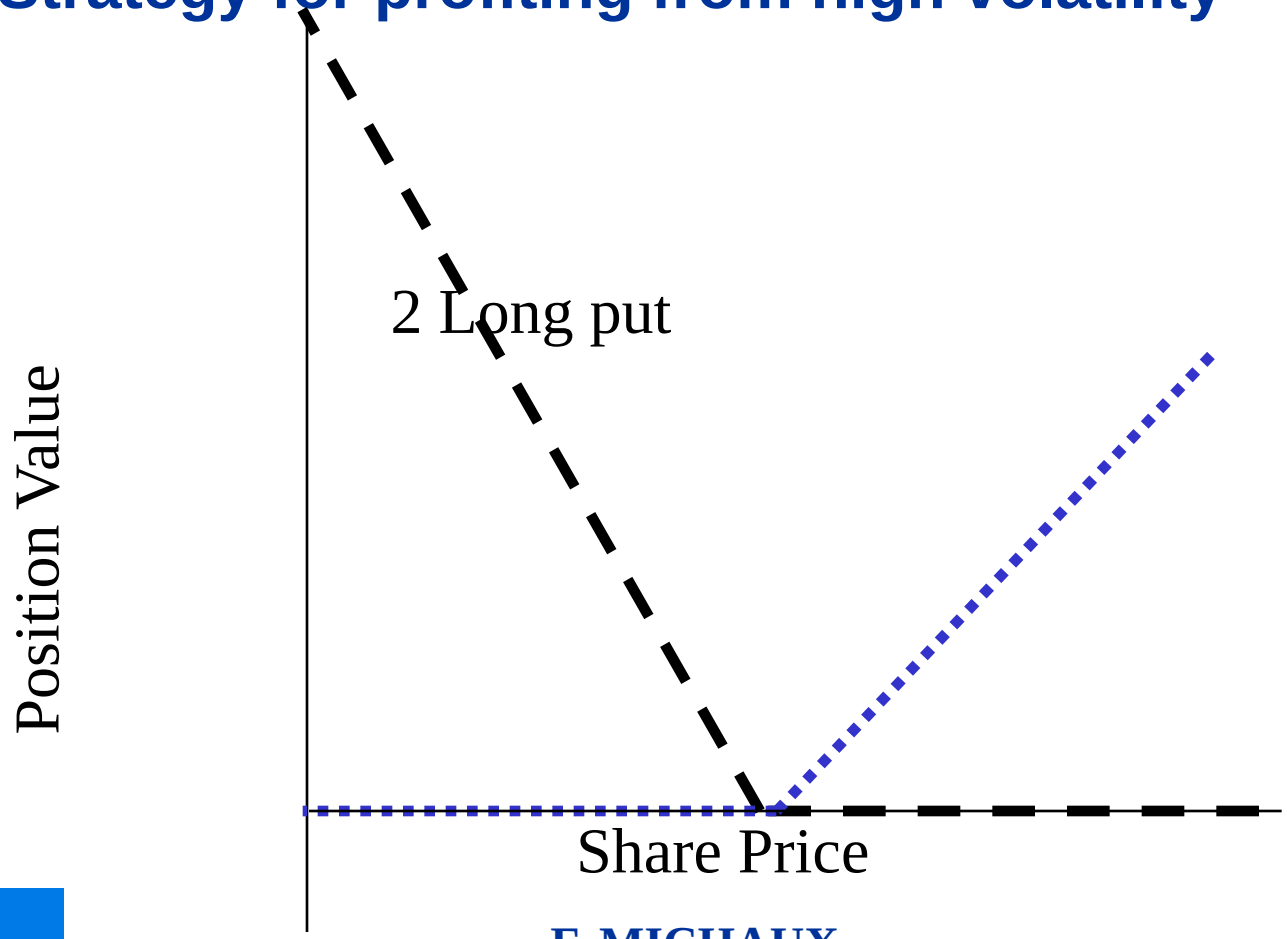
- Strategy for profiting from high volatility



OPTION VALUE

Strip – 1 Long call and 2 long put

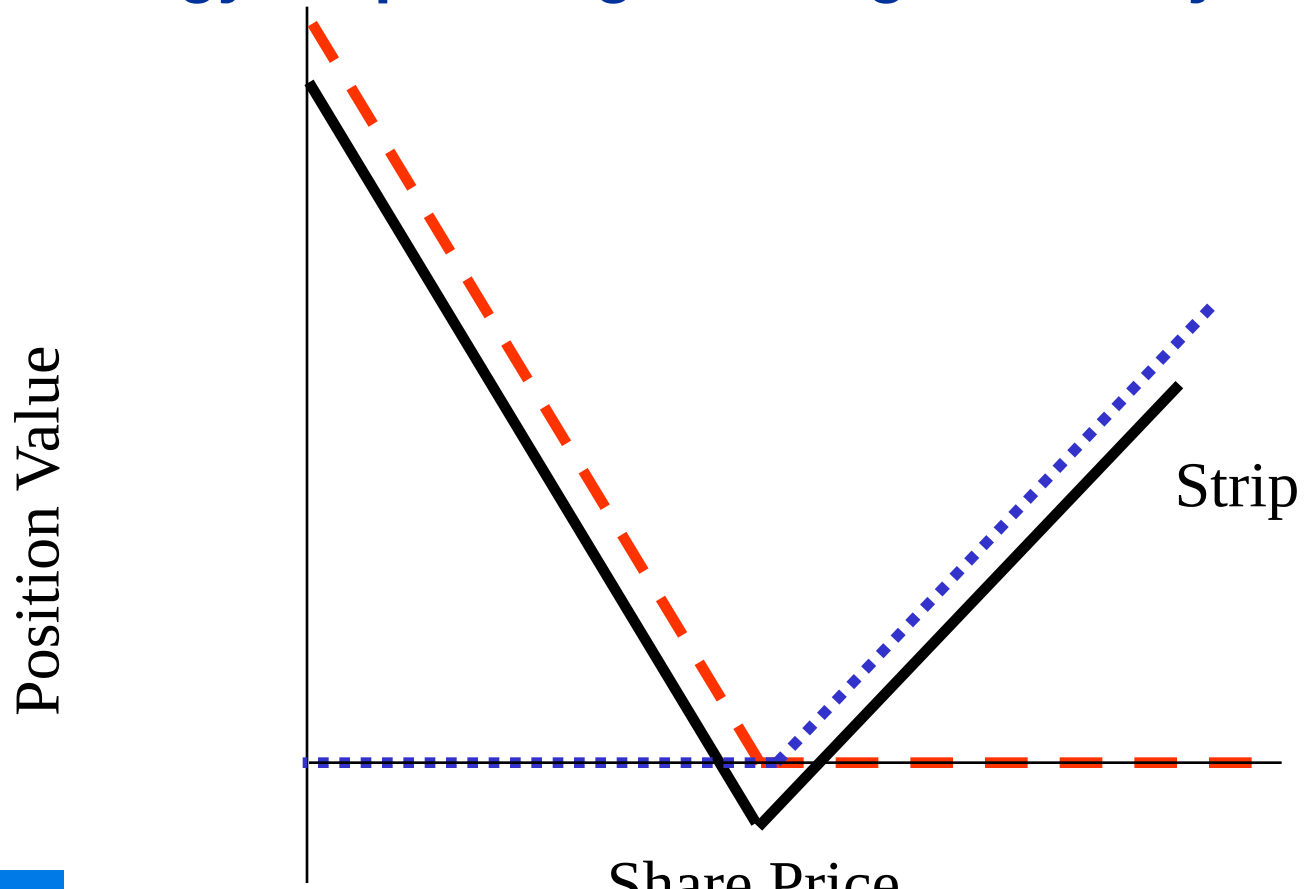
- Strategy for profiting from high volatility



OPTION VALUE

Strip – 1 Long call and 2 long put

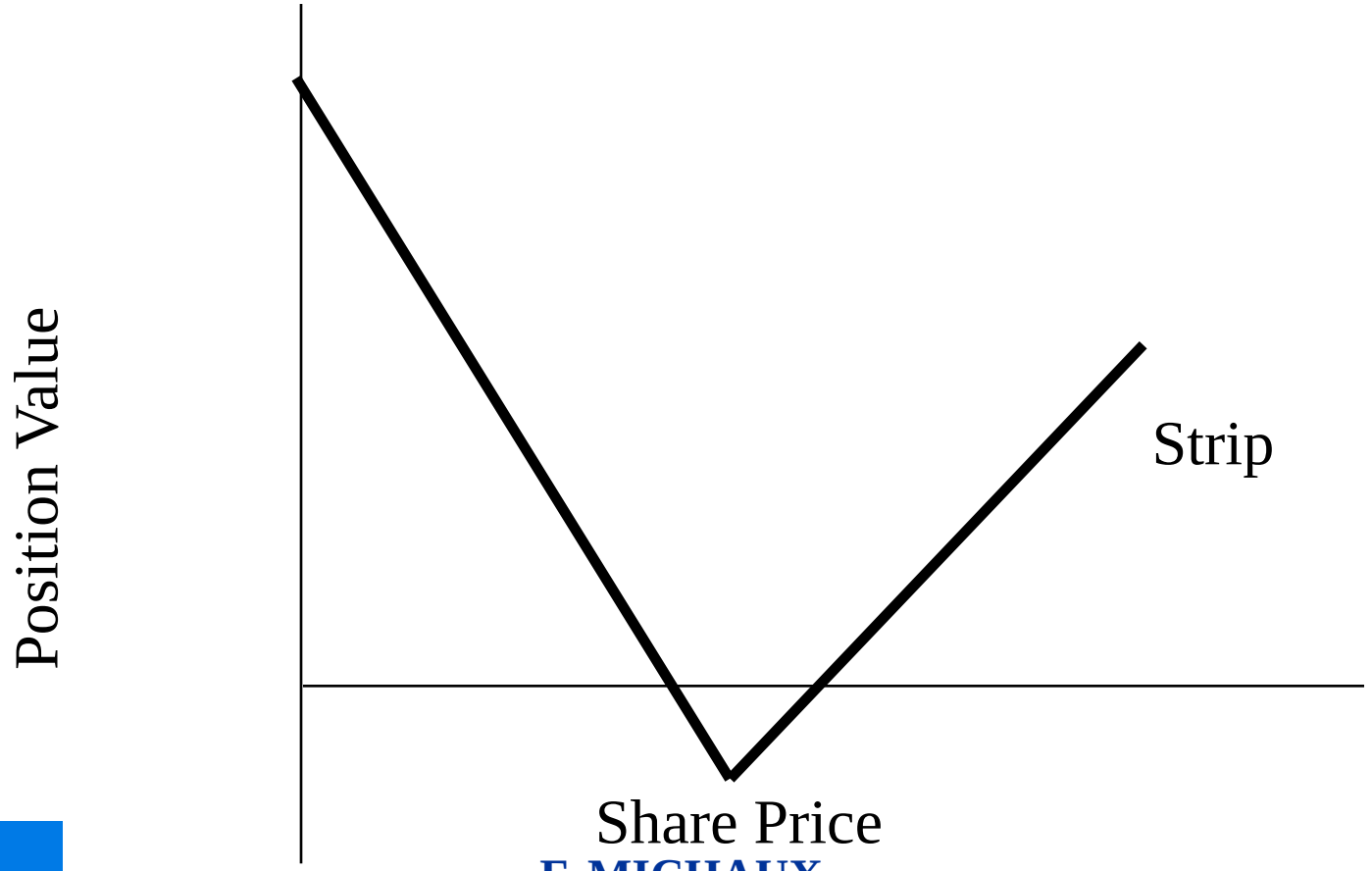
- Strategy for profiting from high volatility



OPTION VALUE

Strip – 1 Long call and 2 long put

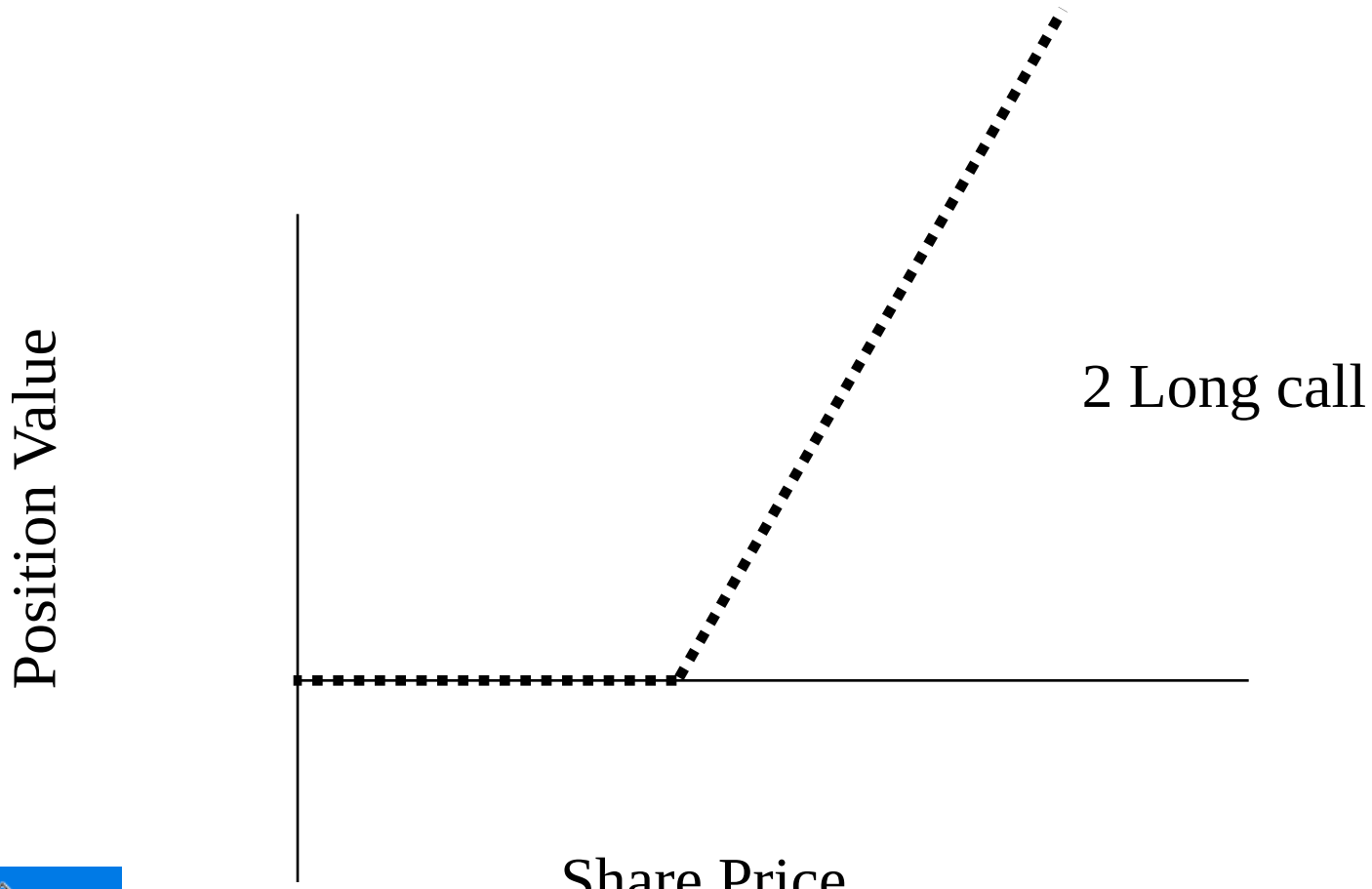
- Strategy for profiting from high volatility



OPTION VALUE

Strap – 2 Long call and 1 long put

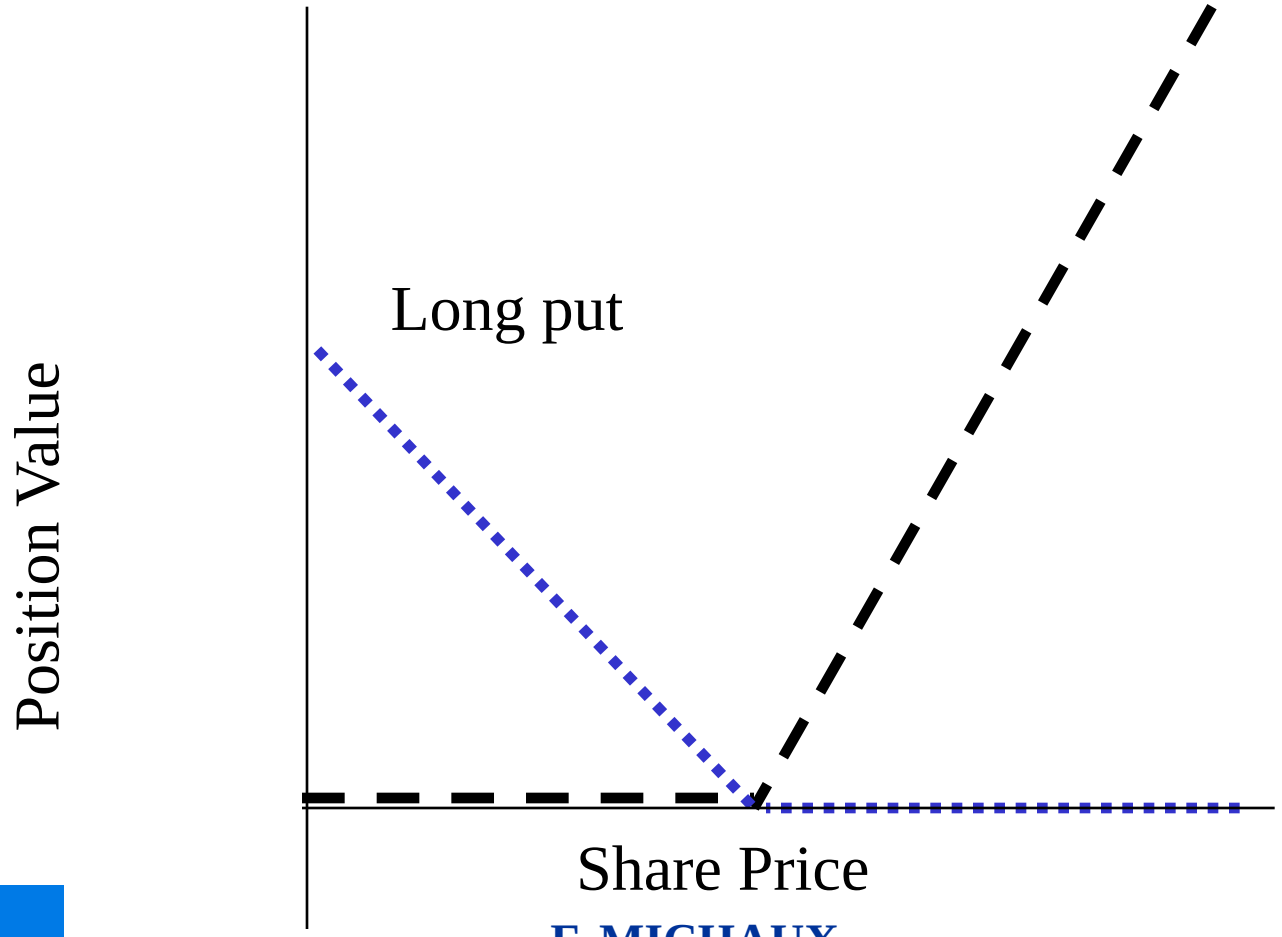
- Strategy for profiting from high volatility



OPTION VALUE

Strap – 2 Long call and 1 long put

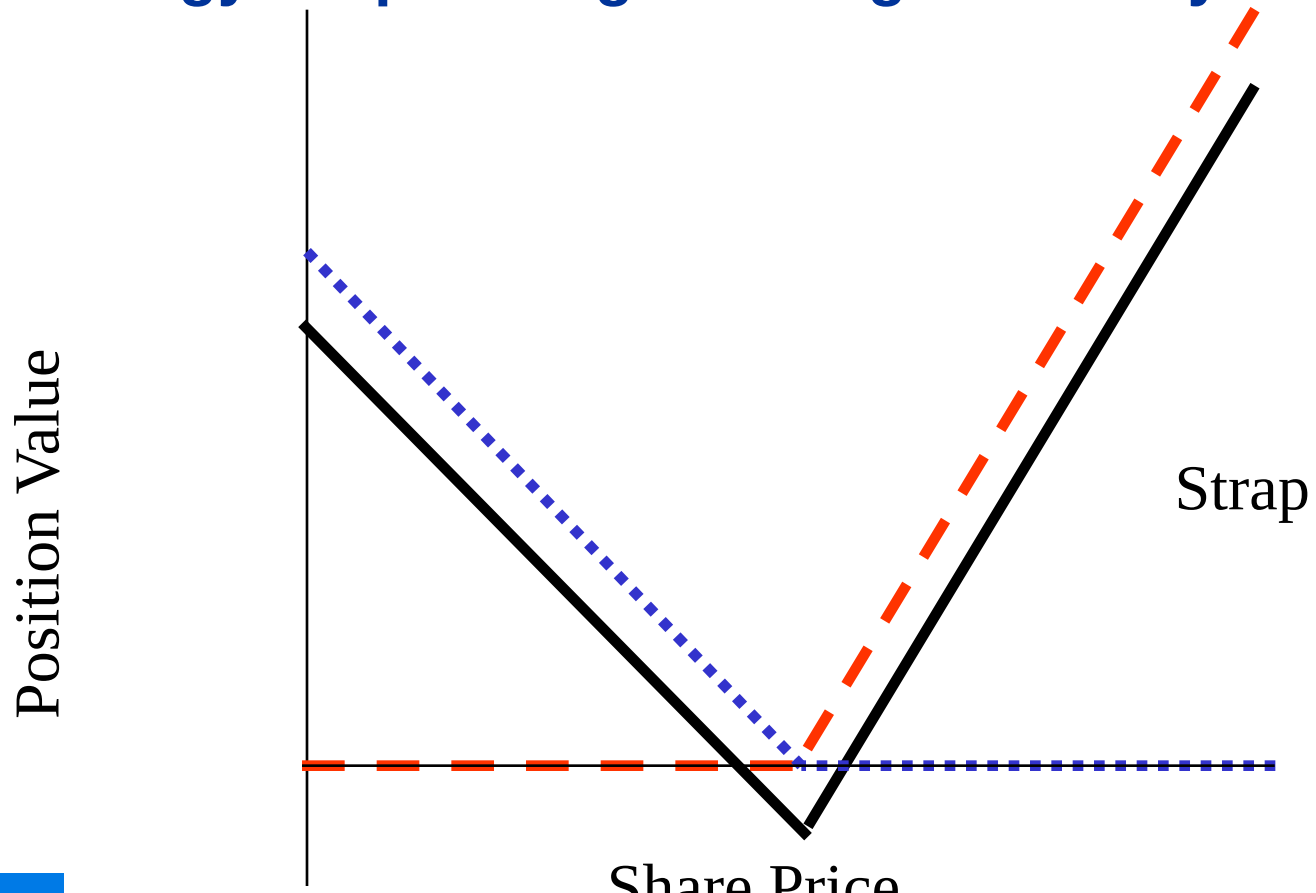
- Strategy for profiting from high volatility



OPTION VALUE

Strap – 2 Long call and 1 long put

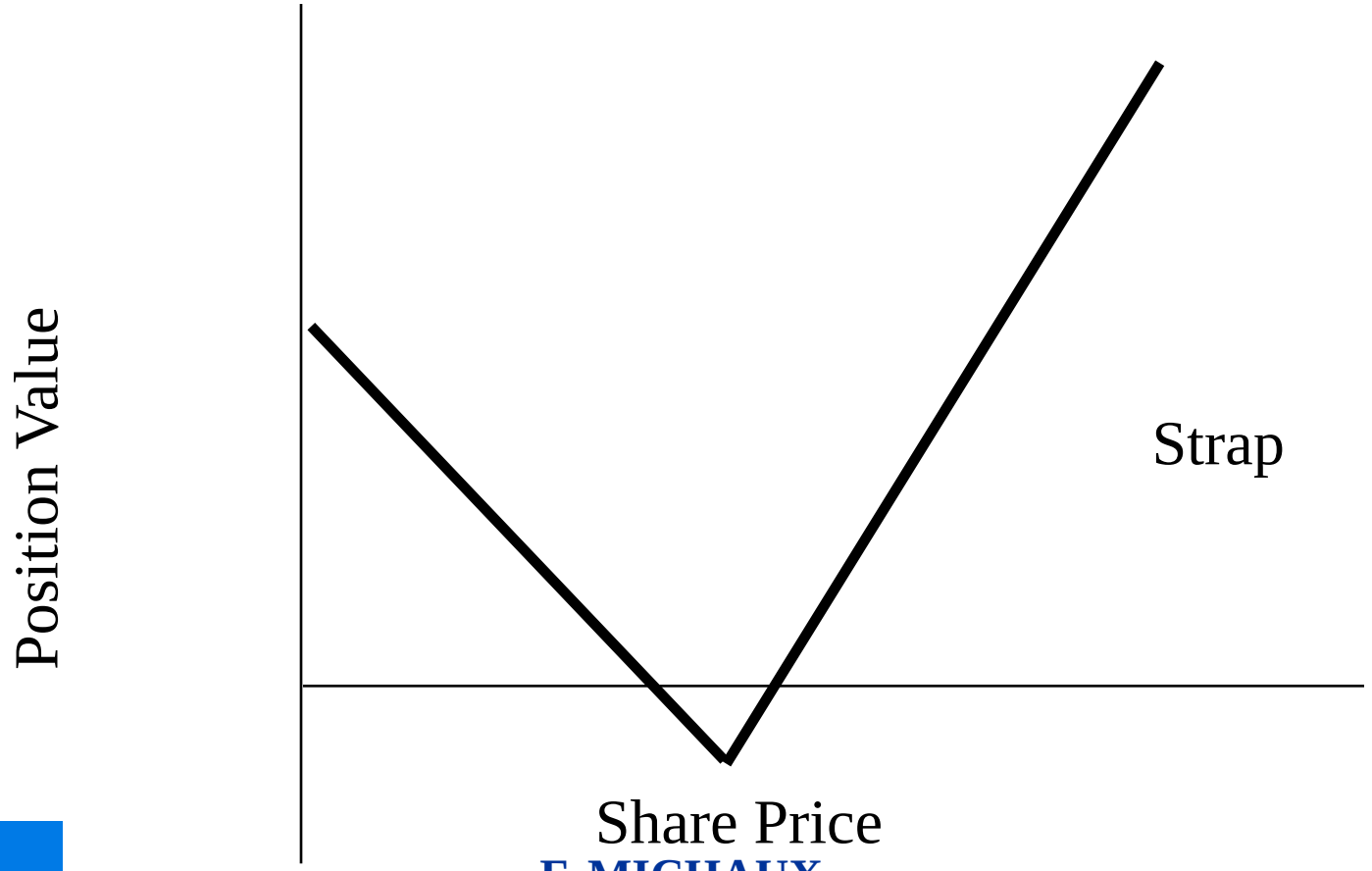
- Strategy for profiting from high volatility



OPTION VALUE

Strap – 2 Long call and 1 long put

- Strategy for profiting from high volatility



OPTION VALUE

Stock Price

Upper Limit

OPTION VALUE

Stock Price

Upper Limit

Lower Limit

(Stock price - exercise price) or 0
whichever is higher

OPTION VALUE

Components of the Option Price

1 - Underlying stock price

2 - Striking or Exercise price

3 - Volatility of the stock returns (standard deviation of annual returns)

4 - Time to option expiration

5 - Time value of money (discount rate)

OPTION VALUE

Black-Scholes Option Pricing Model

$$O_C = P_s[N(d_1)] - S[N(d_2)]e^{-rt}$$

Black-Scholes Option Pricing Model

$$O_C = P_s[N(d_1)] - S[N(d_2)]e^{-rt}$$

O_C- Call Option Price

P_s - Stock Price

$N(d_1)$ - Cumulative normal density function of (d_1)

Fonction de répartition $F_X(x) = \int_{-\infty}^{x} f_X(t)\,\mathrm{d}t.$

S - Strike or Exercise price

$N(d_2)$ - Cumulative normal density function of (d_2)

r - discount rate (90 day comm paper rate or risk free rate)

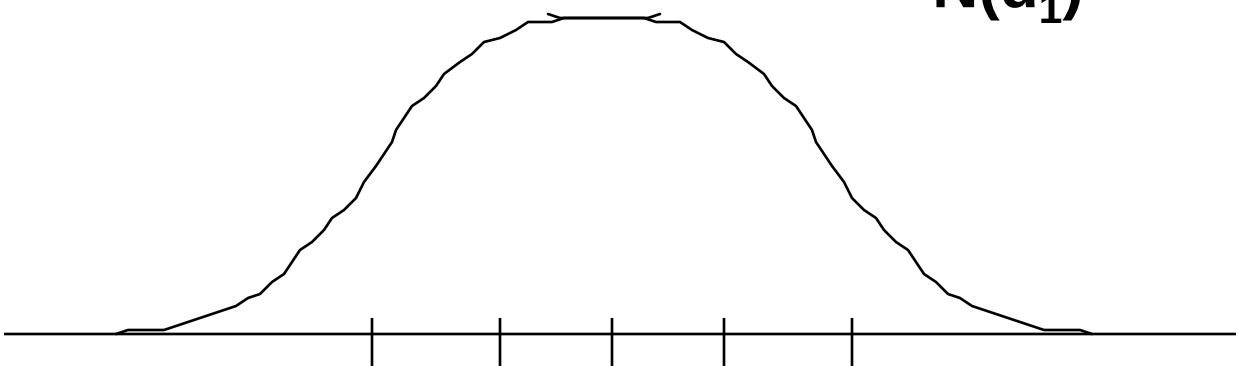
t - time to maturity of option (as % of year)

v - volatility - annualized standard deviation of daily returns

Black-Scholes Option Pricing Model

$$(d_1) = \frac{\ln \frac{P_s}{S} + \left(r + \frac{v^2}{2} \right) t}{v\sqrt{t}}$$

$N(d_1)=$



Cumulative Normal Density Function

$$(d_1) = \frac{\ln \frac{P_s}{S} + \left(r + \frac{v^2}{2} \right) t}{v\sqrt{t}}$$

$$(d_2) = d_1 - v\sqrt{t}$$

CALL OPTION

Example

What is the price of a call option given the following?

P = 36 r = 10% v = .40

S = 40 t = 90 days / 365

CALL OPTION

Example

What is the price of a call option given the following?

P = 36 **r = 10%** **v = .40**

S = 40 **t = 90 days / 365**

$$(d_1) = \frac{\ln \frac{P_s}{S} + \left(r + \frac{v^2}{2} \right) t}{v\sqrt{t}}$$

$(d_1) = -.3070$ $N(d_1) = 1 - .6206 = \underline{.3794}$

CALL OPTION

Example

What is the price of a call option given the following?

P = 36 **r = 10%** **v = .40**

S = 40 **t = 90 days / 365**

$$(d_2) = d_1 - v\sqrt{t}$$

$$(d_2) = -.5056$$

$$N(d_2) = 1 - .6935 = \underline{.3065}$$

CALL OPTION

Example

What is the price of a call option given the following?

P = 36 **r = 10%** **v = .40**

S = 40 **t = 90 days / 365**

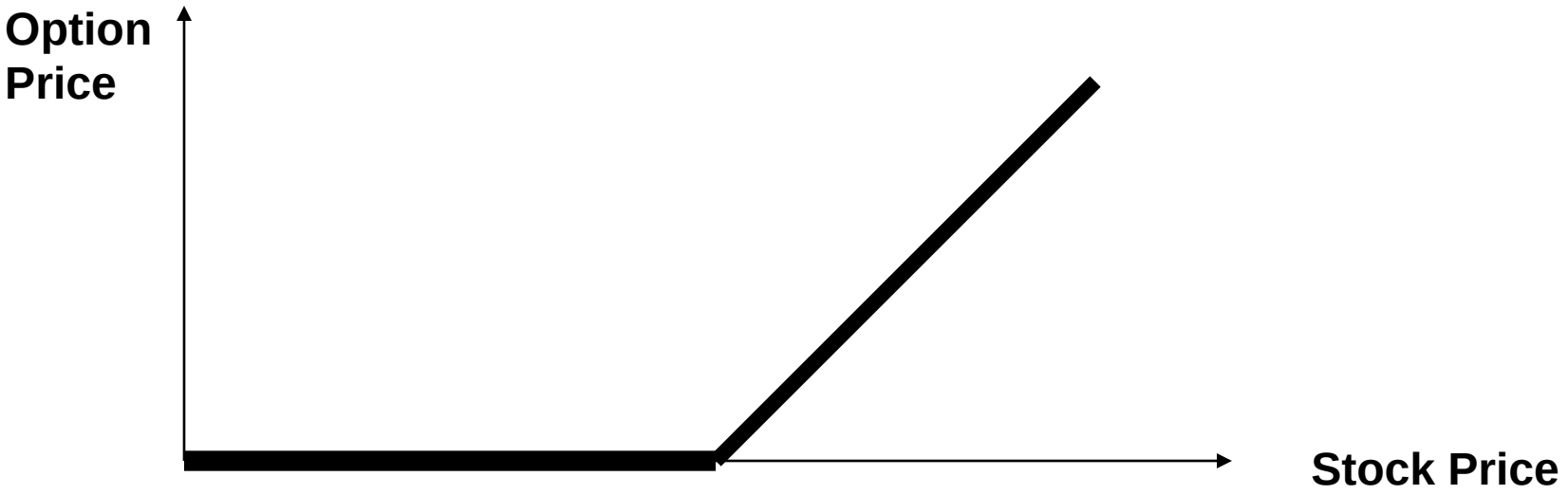
$$O_C = P_s[N(d_1)] - S[N(d_2)]e^{-rt}$$

$$O_C = 36[.3794] - 40[.3065]e^{-(.10)(.2466)}$$

$$O_C = \$\ 1.70$$

OPTION TO WAIT

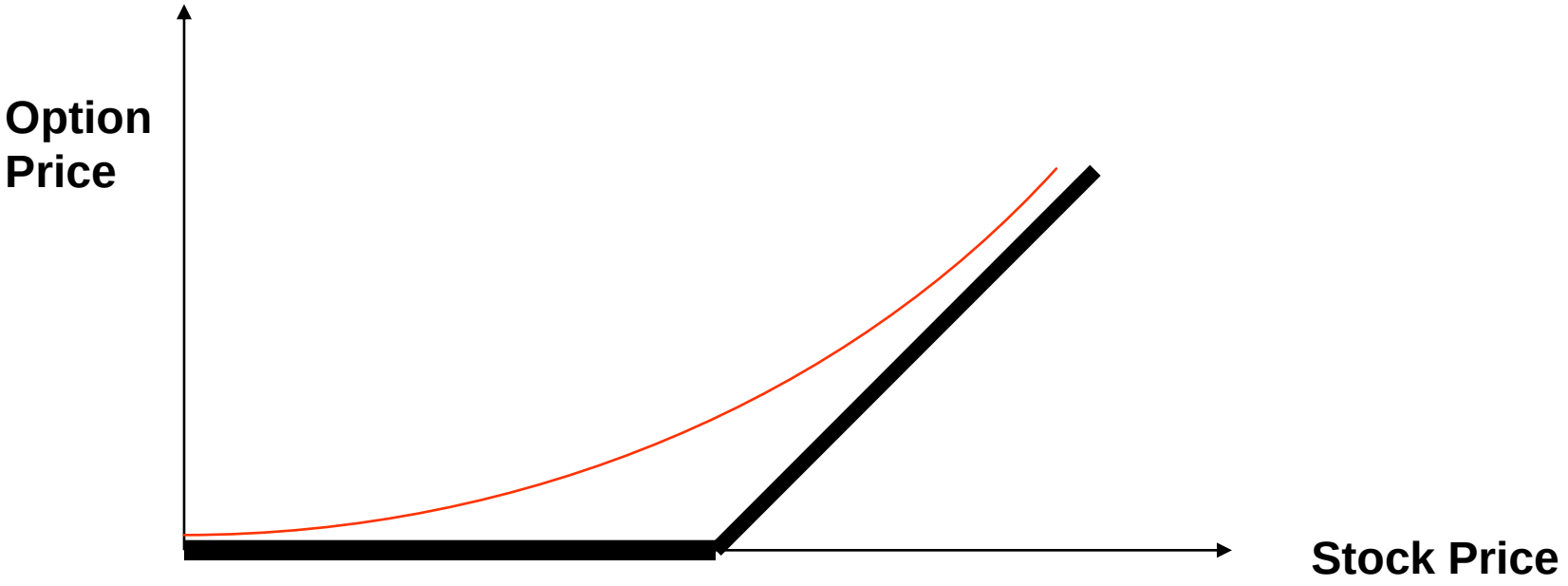
Intrinsic Value



OPTION TO WAIT

Intrinsic Value + Time Premium = Option Value

Time Premium = Vale of being able to wait



OPTION TO WAIT

More time = More value