

The historical cost principle and the fair value concept: The basic measures of the value of synthetic financial instruments

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Abstract: The contemporary global financial market is characterized by the fact that most financial instruments can be replicated. The replication procedures involve the construction of a new financial instrument through combining other financial instruments, so that the effect of the combination is identical to the properties of the existing instrument. New financial instruments, referred to as synthetic instruments, are constructed on the basis of both primary and derivative instruments. A synthetic instrument is a financial structure based on an appropriate combination of primary and derivative instruments—their substitutes. It provides the possibility of constructing any type of a financial instrument.

The paper presents a concept for designing synthetic instruments on the basis of the call/ put parity. The call/ put parity can be a basis for designing a synthetic share, a call option and a put option, and a risk-free investment. The concepts were used to develop two strategies (strangle and straddle) based on synthetic instruments. The balance sheet valuation of strangle and straddle spread strategies was based on a mixed valuation model, making use of two basic measures of valuation—historical costs and fair value.

Key words: accounting, financial instruments, historical cost, fair value

1. Introduction

Creating new financial instruments, being part of contemporary financial engineering, reflects various strategies adopted by investors in financial markets. These strategies are applied by investors to achieve specific market objectives, and they combine primary and derivative instruments. Investor activities, or investor market behaviours, are commonly divided into three categories:

- speculation,
- arbitrage,
- hedging.

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Strategies (speculative, arbitrage and hedging) based on primary, synthetic or mixed instruments (synthetic-primary) are portfolios of financial instruments designed to achieve specific levels of risk profile or rates of return. Practically, indefinite numbers of strategies can be developed on the basis of financial instruments. New strategies are continuously designed, adjusted to the specific economic and investment needs (tailor-made solutions). Frequently, having designed and sold new strategies, financial engineers offer their products to other entities in financial markets. As a result, in the course of time, innovative investment strategies are adopted by investors and businesses as standard products.

The article presents a concept for designing synthetic instruments on the basis of the call/put parity. The call/put parity can be a basis for designing a synthetic share, a call option and a put option, and a risk-free investment. The concepts were used to develop two strategies (strangle and straddle) based on synthetic instruments. The balance sheet valuation of strangle and straddle spread strategies was based on a mixed valuation model, making use of two basic measures of valuation—historical costs and fair value.

2. The concepts of designing synthetic instruments

Literatures offer various concepts as to what base instruments are needed to design a given financial instrument (Marshall and Bansal, 1992), (Kolb, 1997), (Luenberger, 2003), (Kolb and Overdahl, 2006). It is commonly believed that the basic financial instruments used to design synthetic instruments include the following:

- shares (or futures contract),
- risk-free investments (e.g. bonds),
- call option,
- put option.

The alternation of shares and futures contracts results from the fact that the profit of a buyer of shares (*long share*) is the same as in the case of a buyer of a futures contract (*long futures*). The same relation occurs in the case of short shares and short futures.

Therefore, if these instruments are regarded to be base instruments for designing synthetic instruments, the process of designing synthetic instruments originates from the put/call parity relationship. The parity concept is based on combining a risk-free investment with the purchase of a share, the purchase of a put option and the sale of a call option for the same share (Stoll, 1969), (Merton, 1973). Holding such a portfolio in an open position (i.e. the purchase of shares, the sale of call options, and the purchase of put options) results in a risk-free investment at expiry date. It implies that the value of the purchased portfolio is equal to the current price discounted by the risk-free rate of return. It can be demonstrated as follows:

$$S - C + P = \frac{E}{(1 + R_f)^T}$$

where:

S —price (value) of share,

E —the same exercise price for call and put option,

T —the same expiry date for call and put option,

R_f —risk-free rate of return,

C —price (value) of call option,

P —price (value) of put option.

The transformation of this equation leads to the formula of the value of a put option:

$$P = C - S + \frac{E}{(1 + R_f)^T}$$

This correlation indicates that a put option corresponds to the purchase of a call option, a short share and an investment which transfers the risk-free rate of return. A risk-free investment should yield the same profit as the price of exercising a call option and a put option. This is the way in which a synthetic put option can be designed.

The equation for the call/ put option parity can be transformed to separate the value of one financial instrument on its left side, with the values on the right side representing its substitute. For example, the following formula results from transforming the equation for the put/ call parity:

$$S = C - P + \frac{E}{(1 + R_f)^T}$$

The equation indicates that a financial instrument (a share) corresponds to the purchase of a call option, the writing of a put option or a risk-free investment. As a result, a synthetic share can be designed composed of the purchased call option, the written put option and a risk-free investment which equals the current trading price of the call and put option.

The transformation of the equation for the put/ call parity (C) leads to the following formula for the value of the call option:

$$C = P + S - \frac{E}{(1 + R_f)^T}$$

The formula indicates that the financial instrument (call option) corresponds to the purchase of a put option, a long position in a share and a short position in a risk-free investment. This is the way in which a synthetic call option can be designed.

The transformation of the equation for the put/ call parity, with regard to the risk-free investment, leads to the following formula:

$$\frac{E}{(1 + R_f)^T} = P + S - C$$

This transformation indicates that the financial instrument (risk-free investment) corresponds to the purchase of a put option, a long position in a share, and the writing of a call option. This is the way in which a synthetic risk-free treasury bond can be designed.

The put/ call parity can thus be a basis for designing a synthetic share, a put option and a call option, and a risk-free investment (Bielawski, 2007a, 2007b), (Bielawski, 2010a, 2010b).

3. The valuation of a strangle strategy at the purchasing price and at fair value

A strangle strategy combines a call option and a put option. To develop a strangle strategy it is necessary to enter into a call option and a put option on the same instrument, with

the same expiry date and the call option exercise price exceeding the put option exercise price. It can be assumed that the call option exercise price is PLN 110,000, and the put option exercise price is PLN 100,000. The call option's purchase price is $p =$ PLN 6,000, and the put option's price is $p =$ PLN 12,000. Call and put options are written for shares. A strangle strategy based on the above definition (primary financial instruments) is presented in Table 1.

Table 1. A strangle strategy based on options

Value of primary instrument after 1 year (at expiry date) in PLN	Put option (exercise price $E =$ PLN 100,000), purchase price PLN 12,000	Call option (exercise price $E =$ PLN 110,000), purchase price in PLN 6,000	Strangle
50,000	38,000	-6,000	32,000
60,000	28,000	-6,000	22,000
70,000	18,000	-6,000	12,000
80,000	8,000	-6,000	2,000
90,000	-2,000	-6,000	-8,000
100,000	-12,000	-6,000	-18,000
110,000	-12,000	-6,000	-18,000
120,000	-12,000	4,000	-8,000
130,000	-12,000	14,000	2,000
140,000	-12,000	24,000	12,000
150,000	-12,000	34,000	22,000

Source: Author's own elaboration.

A strangle strategy can be based on synthetic options. To develop a synthetic strangle strategy, it is necessary to purchase a call option and a put option, enter into a long and a short position on a share, and a long and a short position on a risk-free investment. The above financial instruments are the substitutes of a call option and a put option. A strangle based on synthetic financial instruments is presented in Tables: 2, 3, and 4.

Table 2. Synthetic strangle strategy—synthetic put strategy

Value of primary share after 1 year (at expiry date) in PLN	Call option (exercise price $E =$ PLN 100,000), purchase price PLN 6,000	Value of short position on share in PLN	State treasury bond (risk-free investment PLN 80,000 – 25%) in PLN	Synthetic put option in PLN
50,000	-6,000	-50,000	100,000	44,000
60,000	-6,000	-60,000	100,000	34,000
70,000	-6,000	-70,000	100,000	24,000
80,000	-6,000	-80,000	100,000	14,000
90,000	-6,000	-90,000	100,000	4,000

Value of primary share after 1 year (at expiry date) in PLN	Call option (exercise price $E = \text{PLN } 100,000$), purchase price PLN 6,000	Value of short position on share in PLN	State treasury bond (risk-free investment PLN 80,000 – 25%) in PLN	Synthetic put option in PLN
100,000	–6,000	–100,000	100,000	–6,000
110,000	4,000	–110,000	100,000	–6,000
120,000	14,000	–120,000	100,000	–6,000
130,000	24,000	–130,000	100,000	–6,000
140,000	34,000	–140,000	100,000	–6,000
150,000	44,000	–150,000	100,000	–6,000

Source: Author's own elaboration.

Table 3. Synthetic strangle strategy—synthetic call option

Value of primary share after 1 year (at expiry date) in PLN	Put option (exercise price $E = \text{PLN } 110,000$), purchase price PLN 12,000	Value of long position on share in PLN	Short position on state treasury bond (risk-free investment PLN 100,000 – 10%) in PLN	Synthetic call option in PLN
500	48,000	50,000	–110,000	–12,000
600	38,000	60,000	–110,000	–12,000
700	28,000	70,000	–110,000	–12,000
800	18,000	80,000	–110,000	–12,000
900	8,000	90,000	–110,000	–12,000
1,000	–2,000	100,000	–110,000	–12,000
1,100	–12,000	110,000	–110,000	–12,000
1,200	–12,000	120,000	–110,000	–2,000
1,300	–12,000	130,000	–110,000	8,000
1,400	–12,000	140,000	–110,000	18,000
1,500	–12,000	150,000	–110,000	28,000

Source: Author's own elaboration

Table 4. Result of synthetic strangle strategy—synthetic call and put option

Value of primary share after 1 year (at expiry date) in PLN	Synthetic call option in PLN	Synthetic put option in PLN	Synthetic strangle strategy
50,000	–12,000	44,000	32,000
60,000	–12,000	34,000	22,000
70,000	–12,000	24,000	12,000
80,000	–12,000	14,000	2,000

Value of primary share after 1 year (at expiry date) in PLN	Synthetic call option in PLN	Synthetic put option in PLN	Synthetic strangle strategy
90,000	-12,000	4,000	-8,000
100,000	-12,000	-6,000	-18,000
110,000	-12,000	-6,000	-18,000
120,000	-2,000	-6,000	-8,000
130,000	8,000	-6,000	2,000
140,000	18,000	-6,000	12,000
150,000	28,000	-6,000	22,000

Source: Author's own elaboration.

The valuation of a strangle strategy developed on the basis of synthetic instruments can be based on two methods—historical costs and fair value.

The valuation of a strangle strategy for synthetic instruments (Table: 2, 3, and 4) can be based on the following procedure:

T_0 —purchase of a call option for PLN 12,000, and a put option for PLN 6,000 on a stock exchange, price of shares PLN 100,000, price of bonds PLN 80,000, and PLN 100,000,

T_1 —value of the call option increased up to PLN 18,000, and the value of the put option decreased to PLN 0, value of shares PLN 140,000, the value of bonds increased up to PLN 90,000, and PLN 105,000,

T_2 —value of the call option increased up to PLN 28,000, value of the put option PLN 0, values of shares increased up to 150,000, value of bonds increased up to PLN 100,000, and PLN 111,000.

Call options		Put options		Profit and loss on strangle strategy	
SP X	12,000 (3)	SP X	6,000 (3)	(3) 6,000	16,000 (3)
(1) 12,000		(1) 6,000		(3) 50,000	50,000 (3)
				(3) 10,000	20,000 (3)
Investment account at brokerage office		Shares		Bonds	
SP X	198,000 (1)	SP X	100,000 (2)	SP X	100,000 (2)
(2) 200,000	266,000 (3)	(1) 100,000	100,000 (3)	(1) 80,000	80,000 (3)
(3) 284,000		(3) 100,000		(3) 100,000	

Figure 1. Valuation of synthetic strangle strategy based on purchase price (historical costs)

where:

- (1)—purchase of a call option and a put option, and long shares and long treasury bonds from investment account,
- (2)—sale of short shares and short bonds (transfer of funds into investment account at brokerage office),
- (3)—calculation of result of the call option (profit) and put option (loss), long shares (profit) and long bonds (profit), short shares (loss) and short bonds (loss), and settlement of profit on strategy in monetary terms.

Source: Author’s own elaboration.

Call options		Put options		Profit and loss on strangle strategy	
SP X	28,000 (14)	SP X	6,000 (4)	(4) 6,000	6,000 (3)
(1) 12,000		(1) 6,000		(6) 40,000	40,000 (5)
(3) 6,000				(8) 5,000	10,000 (7)
(9) 10,000				(11) 10,000	10,000 (9)
				(13) 5,000	10,000 (10)
					10,000 (12)

Investment account at brokerage office		Shares		Bonds	
SP X	198,000 (1)	SP X	100,000 (2)	SP X	100,000 (2)
(2) 200,000	260,000 (14)	(1) 100,000	40,000 (6)	(1) 80,000	5,000 (8)
(14) 278,000		(5) 40,000	10,000 (11)	(7) 10,000	5,000 (13)
		(10) 10,000	150,000 (14)	(12) 10,000	100,000 (14)
		(14) 150,000		(14) 110,000	

Figure 2. Valuation of synthetic strangle strategy at fair value

where:

- (1)—purchase of call and put option, and long shares and long bonds from investment account,
- (2)—sale of short shares and short bonds (transfer of funds into investment account at brokerage office),
- (3)—result of call option (profit) and adjustment of the fair value of call option to market value,
- (4)—result of put option (loss) and adjustment of the fair value of put option to market value,
- (5)—result of long shares (profit) and adjustment of the fair value of shares to market value,
- (6)—result of short shares (loss) and adjustment of the fair value of shares to market value,
- (7)—result of long bonds (profit) and adjustment of the fair value of bonds to market value,
- (8)—result of short bonds (loss) and adjustment of the fair value of bonds to market value,
- (9)—result of call option (profit) and adjustment of the fair value of call option to market value,
- (10)—result of long shares (profit) and adjustment of the fair value of shares to market value,
- (11)—result of short shares (loss) and adjustment of the fair value of shares to market value,
- (12)—result of long bonds (profit) and adjustment of the fair value of bonds to market value,
- (13)—result of short bonds (loss) and adjustment of the fair value of bonds to market value,
- (14)—result of call option (profit) and settlement of strategy in monetary terms.

Source: Author’s own elaboration.

4. The valuation of a straddle strategy at the strike price and at fair value

A straddle strategy is a combination of a put option and a call option for the same instrument (e.g. a share). To develop a straddle strategy, it is necessary to buy a call option and a put option at the same expiration and exercise price. It can be assumed that the exercise price of both options is PLN 100,000. The call option's purchase price is $p = \text{PLN } 8,000$, and the put option's price $p = \text{PLN } 16,000$. A strategy defined in this way (primary financial instruments) is presented in Table 5.

Table 5. A straddle strategy based on options

Value of primary share after 1 year (at option's expiry date) in PLN	Put option (exercise price $E = \text{PLN } 100,000$), purchase price PLN 16,000	Call option (exercise price $E = \text{PLN } 100,000$), purchase price PLN 8,000	Straddle
50,000	34,000	-8,000	26,000
60,000	24,000	-8,000	16,000
70,000	14,000	-8,000	6,000
80,000	4,000	-8,000	-4,000
90,000	-6,000	-8,000	-1,400
100,000	-16,000	-8,000	-24,000
110,000	-16,000	2,000	-14,000
120,000	-16,000	12,000	-4,000
130,000	-16,000	22,000	6,000
140,000	-16,000	32,000	16,000
150,000	-16,000	42,000	26,000

Source: Author's own elaboration.

A straddle strategy can be based on synthetic options. A synthetic straddle is based on the purchase of a put option and a call option, long and short shares, and long and short positions in a risk-free investment. The above financial instruments substitute call and put options. A straddle strategy based on synthetic financial instruments is presented in Tables: 6, 7, and 8.

Table 6. Synthetic straddle—synthetic put option

Value of primary share after 1 year (at option's expiry date) in PLN	Call option (exercise price $E = \text{PLN } 100,000$), purchase price PLN 16,000)	Value of short shares in PLN	State treasury bonds (risk-free investment: PLN 800 – 25%) in PLN	Synthetic put option in PLN
50,000	-16,000	-50,000	100,000	34,000
60,000	-16,000	-60,000	100,000	24,000
70,000	-16,000	-70,000	100,000	14,000
80,000	-16,000	-80,000	100,000	4,000
90,000	-16,000	-90,000	100,000	-6,000

Value of primary share after 1 year (at option's expiry date) in PLN	Call option (exercise price E = PLN 100,000), purchase price PLN 16,000)	Value of short shares in PLN	State treasury bonds (risk-free investment: PLN 800 – 25%) in PLN	Synthetic put option in PLN
100,000	-16,000	-100,000	100,000	-16,000
110,000	-6,000	-110,000	100,000	-16,000
120,000	4,000	-120,000	100,000	-16,000
130,000	14,000	-130,000	100,000	-16,000
140,000	24,000	-140,000	100,000	-16,000
150,000	34,000	-150,000	100,000	-16,000

Source: Author's own elaboration.

Table 7. Synthetic straddle—synthetic call option

Value of primary share after 1 year (at expiry date) in PLN	Put option (exercise price E = PLN 100,000), purchase price PLN 8,000	Value of long shares in PLN	Short treasury bonds (risk-free investment PLN 80 – 25%) in PLN	Synthetic call option in PLN
50,000	42,000	50,000	-100,000	-8,000
60,000	32,000	60,000	-100,000	-8,000
70,000	22,000	70,000	-100,000	-8,000
80,000	12,000	80,000	-100,000	-8,000
90,000	2,000	90,000	-100,000	-8,000
100,000	-8,000	100,000	-100,000	-8,000
110,000	-8,000	110,000	-100,000	2,000
120,000	-8,000	120,000	-100,000	12,000
130,000	-8,000	130,000	-100,000	22,000
140,000	-8,000	140,000	-100,000	32,000
150,000	-8,000	150,000	-100,000	42,000

Source: Author's own elaboration.

Table 8. Result of a straddle—synthetic call and put option

Value of primary shares after 1 year (at expiry date) in PLN	Synthetic call option	Synthetic put option	Synthetic straddle
50,000	-8,000	34,000	26,000
60,000	-8,000	24,000	16,000
70,000	-8,000	14,000	6,000
80,000	-8,000	4,000	-4,000
90,000	-8,000	-6,000	-1,400
100,000	-8,000	-16,000	-24,000

Value of primary shares after 1 year (at expiry date) in PLN	Synthetic call option	Synthetic put option	Synthetic straddle
110,000	2,000	-16,000	-14,000
120,000	12,000	-16,000	-4,000
130,000	22,000	-16,000	6,000
140,000	32,000	-16,000	16,000
150,000	42,000	-16,000	26,000

Source: Author's own elaboration.

The above presented straddle strategy based on synthetic instruments can be valued with the use of historical costs and at fair value. The valuation of a synthetic straddle strategy (Tables: 6, 7, and 8) can be based on the following scenario:

T_0 —purchase of a call option for PLN 16,000 and a put option for PLN 8,000 on a stock exchange, price of shares PLN 100,000, price of bonds PLN 80,000,

T_1 —value of the call option increased up to PLN 20,000, value of the put option decreased to PLN 0, value of shares PLN 120,000, value of bonds increased up to PLN 90,000,

T_2 —value of the call option increased up to PLN 24,000, value of the put option PLN 0, value of shares increased up to PLN 140,000, value of bonds increased up to 100,000.

Call option		Put option		Profit and loss on a straddle	
SP X	16,000 (3)	SP X	8,000 (3)	(3) 8,000	8,000 (3)
(1) 16,000		(1) 8,000		(3) 40,000	40,000 (3)
				(3) 20,000	20,000 (3)
Investment account at brokerage office		Shares		Bonds	
SP X	204,000 (1)	SP X	100,000 (2)	SP X	80,000 (2)
(2) 180,000	248,000 (3)	(1) 100,000	100,000 (3)	(1) 80,000	80,000 (3)
(3) 272,000		(3) 100,000		(3) 80,000	

Figure 3. Valuation of a synthetic straddle strategy based on purchase price (historical costs) where:

- (1)—purchase of a call option and a put option, long shares and long treasury bonds from investment account,
- (2)—sale of short shares and short bonds (transfer of funds into investment account at brokerage office),
- (3)—result of call option (profit) and put option (loss), long shares (profit) and long bonds (profit), short shares (loss) and short bonds (loss) and calculation of strategy's profit in monetary terms.

Source: Author's own elaboration.

Call options		Put options		Profit and loss on a straddle	
SP X	24,000 (14)	SP X	8,000 (4)	(4) 8000	4,000 (3)
(1) 16,000		(1) 8,000		(6) 20000	20,000 (5)
(3) 4,000				(8) 10000	10,000 (7)
(9) 4,000				(11) 20000	4,000 (9)
				(13) 10000	20,000 (10)
					10,000 (12)
Investment account at brokerage office		Shares		Bonds	
SP X	204,000 (1)	SP X	100,000 (2)	SP X	80,000 (2)
(2) 180,000	240,000 (14)	(1) 100,000	20,000 (6)	(1) 80,000	10,000 (8)
(14) 264,000		(5) 20,000	20,000 (11)	(7) 10,000	10,000 (13)
		(10) 20,000	140,000 (14)	(12) 10,000	100,000 (14)
		(14) 140,000		(14) 100,000	

Figure 4. Valuation of a synthetic straddle at fair value

where:

- (1)—purchase of a call option and a put option, long shares and long bonds from investment account,
- (2)—sale of short shares and short bonds (transfer of funds into investment account at brokerage office),
- (3)—result of call option (profit) and adjustment of the fair value of call option to market value,
- (4)—result of put option (loss) and adjustment of the fair value of put option to market value,
- (5)—result of long shares (profit) and adjustment of the fair value of shares to market value,
- (6)—result of short shares (loss) and adjustment of the fair value of shares to market value,
- (7)—result of long bonds (profit) and adjustment of the fair value of bonds to market value,
- (8)—result of short bonds (loss) and adjustment of the fair value of bonds to market value,
- (9)—result of call option (profit) and adjustment of the fair value of call option to market value,
- (10)—result of long shares (profit) and adjustment of the fair value of shares to market value,
- (11)—result of short shares (loss) and adjustment of the fair value of shares to market value,
- (12)—result of long bonds (profit) and adjustment of the fair value of bonds to market value,
- (13)—result of short bonds (loss) and adjustment of the fair value of bonds to market value,
- (14)—result of call option (profit) and settlement of transactions in monetary terms.

Source: Author's own elaboration.

5. Conclusions

The paper presented a concept for designing synthetic instruments based on the call/ put option parity. The call/ put parity can be a basis for designing a synthetic share, a call option and a put option, and a risk-free investment. This concept was used to develop two strategies (strangle and straddle) based on synthetic instruments. The balance sheet valuation of strangle and straddle spread strategies was based on a mixed valuation model, making use of two basic measures of valuation—historical costs and fair value.

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Zasada kosztu historycznego i kategoria wartości godziwej jako podstawowe miary wartości syntetycznych instrumentów finansowych

Abstrakt: Specyficzną cechą współczesnego globalnego rynku finansowego jest to, iż większość instrumentów finansowych może być replikowana. Procedura replikacji oznacza, że można skonstruować nowy instrument finansowy poprzez złożenie innych instrumentów finansowych tak, aby efekt tego złożenia był identyczny jak w przypadku realnie istniejącego instrumentu. Do konstruowania nowych instrumentów finansowych, nazywanych instrumentami syntetycznymi (*synthetic instruments*), wykorzystuje się zarówno instrumenty podstawowe, jak i pochodne. Instrument syntetyczny jest strukturą finansową stworzoną na bazie odpowiedniej kombinacji instrumentów podstawowych i instrumentów pochodnych, będących jego substytutem.

Artykuł przedstawia koncepcje tworzenia instrumentów syntetycznych na bazie parytetu opcji kupna i opcji sprzedaży. Na podstawie parytetu opcji kupna i opcji sprzedaży można więc zbudować syntetyczną akcję, opcję kupna, opcję sprzedaży oraz inwestycję o stopie zwrotu wolnej od ryzyka. Koncepcje te zostały wykorzystane do skonstruowania dwóch strategii (*strangle* i *straddle*) na instrumentach syntetycznych. Do wyceny bilansowej strategii *strangle* i *straddle spread* zastosowano model mieszany wyceny, oparty na dwóch podstawowych miarach wartości instrumentów finansowych – zasadzie kosztu historycznego i kategorii wartości godziwej.

Słowa kluczowe: rachunkowość, instrumenty finansowe, koszt historyczny, wartość godziwa