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PURCHASING PRICE AND FAIR VALUE AS THE BASIC MEASURES OF THE VALUE OF SYNTHETIC FINANCIAL INSTRUMENTS

The paper presents the concept for developing synthetic instruments on the basis of the put/call parity and the cost of carry model. The put/call parity can be the framework for designing a synthetic share, a put and call 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 strategies was based on a mixed valuation model, making use of two basic measures of valuation – historical costs and fair value.

Keywords: *financial instruments; synthetic instruments; historical cost; fair value; put and call options.*

Павєл Бєлявські

ЦІНА ПРИДБАННЯ ТА СПРАВЕДЛИВА ЦІНА ЯК БАЗОВІ ХАРАКТЕРИСТИКИ ВАРТОСТІ СИНТЕТИЧНИХ ФІНАНСОВИХ ІНСТРУМЕНТІВ

У статті описано концепцію формування синтетичних інструментів на основі паритету пут-кол та вартості моделі кері-трейд. Доведено, що паритет пут-кол може бути основою для формування синтетичних акцій, опціонів колл та пут, а також безризикових інвестицій. Представлено дві розроблені стратегії одночасного придбання (т.зв. стренгл та стредл) на основі синтетичних інструментів. Оцінювання балансових показників даних стратегій проведено на основі двох основних показників – історичної та справедливої вартості.

Ключові слова: *фінансові інструменти; синтетичні інструменти; історична вартість; справедлива ціна; пут- і кол-опціони.*

Форм. 9. Рис. 4. Табл. 8. Літ. 17.

Павел Белявски

ЦЕНА ПРИОБРЕТЕНИЯ И СПРАВЕДЛИВАЯ ЦЕНА КАК БАЗОВЫЕ ХАРАКТЕРИСТИКИ СТОИМОСТИ СИНТЕТИЧЕСКИХ ФИНАНСОВЫХ ИНСТРУМЕНТОВ

В статье описана концепция формирования синтетических инструментов на основе паритета пут-колл и стоимости модели кэрри-трейд. Показано, что паритет пут-колл может быть основой для формирования синтетических акций, опционов колл и пут и безрисковых инвестиций. Представлены две разработанные стратегии одновременной покупки (т.наз. стрэнгл и стрэдл) на основе синтетических инструментов. Оценка балансовых показателей для данных стратегий проведена на основе двух основных показателей – исторической и справедливой стоимостей.

Ключевые слова: *финансовые инструменты; синтетические инструменты; историческая стоимость; справедливая цена; пут- и колл-опционы.*

Introduction. The contemporary global financial market is characterised by the fact that most financial instruments can be replicated. 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

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and derivative instruments – their substitutes. It provides the possibility of constructing any type of a financial instrument.

Creating new financial instruments, being part of contemporary financial engineering, reflects various strategies adopted by investors at 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 behaviors, are commonly divided into three categories: speculation, arbitrage, hedging.

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 return rates. Practically, indefinite numbers of strategies can be developed on the basis of financial instruments. New strategies are continuously designed, adjusted to specific economic and investment needs (tailor-made solutions). Frequently, having designed and sold new strategies, financial engineers offer their products to other entities at financial markets. As a result, in the course of time, innovative investment strategies are adopted by investors and businesses as standard products.

The concepts of designing synthetic instruments. Literature offers various concepts as to what base instruments are needed to design a given financial instrument (Marshall and Bansal, 1992; Kolb, 1997; Jajuga and Jajuga, 1998; Luenberger, 2003; Kolb and Overdahl, 2006). It is commonly believed that basic financial instruments used to design synthetic instruments include the following:

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

The alternation of shares and futures contracts results from the fact that profit of buyer of shares (*long share*) is the same as in the case of the 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 the 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 free risk investment at the 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:

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

where S – price (value) of share; E – the same exercise price for put and call option; T – the same expiry date for put and call option; R_f – risk-free rate of return; C – price (value) of call option; P – price (value) of put option

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

$$P = C - S + \frac{E}{(1+R_f)^T}. \tag{2}$$

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 put and call option. This is the way in which a synthetic put option can be designed.

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

$$S = C - P + \frac{E}{(1+R_f)^T}. \quad (3)$$

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 free-risk 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 put and call option.

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

$$C = P + S - \frac{E}{(1+R_f)^T}. \quad (4)$$

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 in the way in which a synthetic call option can be designed.

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

$$\frac{E}{(1+R_f)^T} = P + S - C. \quad (5)$$

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 and call option, and a risk-free investment (Bielawski, 2007a, 2007b; Bielawski, 2010a, 2006b; Bielawski, 2011).

Synthetic futures contracts can be designed on the basis of the relation between the put/call parity and the cost of carry model (Kolb and Overdahl, 2006). The price of futures contracts is in most cases consistent with the cost of carry model. The cost of carry model almost always works in futures markets – index, interest rate and FX contracts, while it has a limited ability to explain price correlations at the markets of non-financial assets (commodity futures contracts).

In all financial futures contracts the costs of storage, insurance and transport are equal to zero. Financial costs are the only carrying costs in financial futures contracts. Most participants of futures contracts incur financial costs which are equal to the return rate on repo contracts. On the effective market the current rate of repo contracts must be equal to the implied repo rate (Hull, 1997). The implied repo rate is defined by the following formula:

$$r_r = C = \frac{FP_{o,t}}{SP_o} - 1, \tag{6}$$

where $FP_{0,t}$ – futures price in the period $t = 0$ for delivery in period t; SP_0 – spot price in period $t = 0$; C – financial costs equal implied repo rate; r_r – implied repo rate.

When the implied repo rate exceeds the level of financial costs, an arbitrage strategy should be used (cash and carry). On the other hand, when the implied repo rate is lower than financial costs, a reverse cash and carry strategy should be adopted.

Therefore, it can be assumed that the implied repo rate has a value close to the risk-free rate of return ($r_r \approx R_f$). Taking into account this assumption, the futures price of an asset can be presented in the following way:

$$F = S(1 + R_f), \tag{7}$$

where F – futures price; S – spot price; R_f – free-risk rate of return (according to the assumptions, it equals to carrying costs).

In this approach the cost of carry model presents a futures price as a spot price increased by the sum of a unit and the free-risk rate of return which, as assumed, equals the implied repo rate. The value of a futures contract is determined by the spot price and a constant value – the free-risk rate of return equal to carrying costs.

The presented generalised version of the cost of carry model can be now referred to the put/call parity relationship. The equation for the put/call parity should be transformed with regard to the difference of prices between put and call options. It can be presented by the following formula:

$$C - P = S - \frac{E}{(1 + R_f)^T}, \tag{8}$$

where S – price (value) of share; E – the same trading price of put and call option; T – the same expiry date for put and call option; R_f – risk-free rate of return; C – price (value) of call option; P – price (value) of put option.

The combination of the two above equations leads to the following formula:

$$C - P = \frac{F - E}{(1 + R_f)^T}. \tag{9}$$

The above equation indicates that the difference between the value of a call option and a put option is equal to the current value of the difference between futures price and the exercise price. In the specific case, when futures price equals to exercise price, the value of $F - E$ is equal to zero. It indicates that the value of $C - P$ is zero, which, in turn, leads to the conclusion that the value of the put and call option must be the same. When futures price is lower than the exercise price, the value of $F - E$ is negative. In this case the price of a put option is higher than that of a call option.

An analysis of the relations between primary instruments and options and futures (derivatives) leads to the conclusion that any of the above instruments can be replaced by an appropriate combination of the remaining ones. The valuation of strategies based on primary and synthetic instruments, as well as hybrid instruments, poses a great challenge to contemporary accounting systems and the presently adopted accounting standards (Bielawski, 2006a, b; Bielawski and Garlinska-Bielawska,

2008; Bielawski, 2009). The valuation of strategies based on synthetic instruments (as the portfolios of financial instruments) can be carried out with the use of a mixed valuation model based on historical cost and fair value. The mixed model can be applied for selected strategies, e.g. strangle and straddle strategies, based on synthetic financial instruments.

The valuation of a strangle strategy. Strangle strategy combines a put and call option. To develop a strangle strategy it is necessary to enter into a put and call 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 1,100,000 PLN and the put option exercise price is 1,000,000 PLN. The call option's purchase price is p = 25,000 PLN and the put option's price is p = 50,000 PLN. put and call 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,** *author's own research*

Value of primary instrument after 1 year (at the expiry date), PLN	Put option (exercise price E = 1,000,000 PLN, purchase price 50,000 PLN)	Call option (exercise price E = 1,100,000 PLN, purchase price in 25,000 PLN)	Strangle
500,000	450,000	-25,000	425,000
600,000	350,000	-25,000	325,000
700,000	250,000	-25,000	225,000
800,000	150,000	-25,000	125,000
900,000	50,000	-25,000	25,000
1,000,000	-50,000	-25,000	-75,000
1,100,000	-50,000	-25,000	-75,000
1,200,000	-50,000	75,000	25,000
1,300,000	-50,000	175,000	125,000
1,400,000	-50,000	275,000	225,000
1,500,000	-50,000	375,000	325,000

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

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 (Tables 2–4) can be based on the following procedure:

T_0 – purchase of a call option for 25,000 PLN, and a put option for 50,000 PLN at stock exchange, price of shares 1,000,000 PLN, price of bonds 800,000 PLN and 1,000,000 PLN;

T_1 – value of the call option increased to 300,000 PLN, and the value of the put option decreased to 0 PLN, value of shares 1,400,000 PLN the value of bonds increased up to 900,000 PLN and 1,050,000 PLN;

T_2 – value of the call option increased up to 400,000 PLN, value of the put option 0 PLN, values of shares increased up to 1,500,000, value of bonds increased up to 1,000,000 PLN and 1,100,000 PLN.

Table 2. **Synthetic strangle strategy – synthetic put strategy,** *author's own research*

Value of primary share after 1 year (at expiry date), PLN	Call option (exercise price E = 1,000,000 PLN, purchase price 25,000 PLN)	Value of short position on share, PLN	State treasury bond (risk-free investment 800,000 PLN – 25%), PLN	Synthetic put option, PLN
500,000	-25,000	-500,000	1,000,000	475,000
600,000	-25,000	-600,000	1,000,000	375,000
700,000	-25,000	-700,000	1,000,000	275,000
800,000	-25,000	-800,000	1,000,000	175,000
900,000	-25,000	-900,000	1,000,000	75,000
1,000,000	-25,000	-1,000,000	1,000,000	-25,000
1,100,000	75,000	-1,100,000	1,000,000	-25,000
1,200,000	175,000	-1,200,000	1,000,000	-25,000
1,300,000	275,000	-1,300,000	1,000,000	-25,000
1,400,000	375,000	-1,400,000	1,000,000	-25,000
1,500,000	475,000	-1,500,000	1,000,000	-25,000

Table 3. **Synthetic strangle strategy – synthetic call option,** *author's own research*

Value of primary share after 1 year (at expiry date), PLN	Put option (exercise price E = 1,100,000 PLN, purchase price 50,000 PLN)	Value of long position on share, PLN	Short position on state treasury bond (risk-free investment 1,000,000 PLN – 10%), PLN	Synthetic call option, PLN
500,000	550,000	500,000	-1,100,000	-50,000
600,000	450,000	600,000	-1,100,000	-50,000
700,000	350,000	700,000	-1,100,000	-50,000
800,000	250,000	800,000	-1,100,000	-50,000
900,000	150,000	900,000	-1,100,000	-50,000
1,000,000	50,000	1,000,000	-1,100,000	-50,000
1,100,000	-50,000	1,100,000	-1,100,000	-50,000
1,200,000	-50,000	1,200,000	-1,100,000	50,000
1,300,000	-50,000	1,300,000	-1,100,000	150,000
1,400,000	-50,000	1,400,000	-1,100,000	250,000
1,500,000	-50,000	1,500,000	-1,100,000	350,000

Table 4. **Result of a synthetic strangle strategy – synthetic put and call option,** *author's own research*

Value of primary share after 1 year (at expiry date), PLN	Synthetic call option, PLN	Synthetic put option, PLN	Synthetic strangle strategy
500,000	-50,000	475,000	425,000
600,000	-50,000	375,000	325,000
700,000	-50,000	275,000	225,000
800,000	-50,000	175,000	125,000
900,000	-50,000	75,000	25,000
1,000,000	-50,000	-25,000	-75,000
1,100,000	-50,000	-25,000	-75,000
1,200,000	50,000	-25,000	25,000
1,300,000	150,000	-25,000	125,000
1,400,000	250,000	-25,000	225,000
1,500,000	350,000	-25,000	325,000

Call options		Put options		Profit and loss on strangle strategy	
SP X	25000 (3)	SP X	50000 (3)	(3) 50000	375000 (3)
(1) 25000		(1) 50000		(3) 500000	500000 (3)
				(3) 100000	200000 (3)

Investment account at brokerage office		Shares		Bonds	
SP X	1875000 (1)	SP X	1000000 (2)	SP X	1000000 (2)
(2) 2000000	2650000 (3)	(1) 1000000	1000000 (3)	(1) 800000	800000 (3)
(3) 2950000		(3) 1000000		(3) 1000000	

Legend: (1) – purchase of a call and 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.

Figure 1. **Valuation of a synthetic strangle strategy based on historical purchase price,** *author's own research*

Call options		Put options		Profit and loss on strangle strategy	
SP X	400000 (14)	SP X	50000 (4)	(4) 50000	275000 (3)
(1) 25000		(1) 50000		(6) 400000	400000 (5)
(3) 275000				(8) 50000	100000 (7)
(9) 100000				(11) 100000	100000 (9)
				(13) 50000	100000 (10)
					100000 (12)

Investment account at brokerage office		Shares		Bonds	
SP X	1875000 (1)	SP X	1000000 (2)	SP X	1000000 (2)
(2) 2000000	2600000 (14)	(1) 1000000	400000 (6)	(1) 800000	50000 (8)
(14) 2900000		(5) 400000	100000 (11)	(7) 100000	50000 (13)
		(10) 100000	1500000 (14)	(12) 100000	1000000 (14)
		(14) 1500000		(14)1100000	

Legend: (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.

Figure 2. **Valuation of a synthetic strangle strategy at fair value,** *author's own research*

The valuation of a straddle strategy. Straddle strategy is a combination of a put and call option for the same instrument (e.g., a share). To develop a straddle strategy, it is necessary to buy a put and call option at the same expiration and exercise price. It can be assumed that the exercise price of both options is 1,000,000 PLN. The call option's purchase price is p = 20,000 PLN, and the put option's price p = 40,000 PLN. A strategy defined in this way (primary financial instruments) is presented in Table 5.

Table 5. **A straddle strategy based on options,** *author's own research*

Value of primary share after 1 year (at option's expiry date), PLN	Put option (exercise price E = 1,000,000 PLN, purchase price 40,000 PLN)	Call option (exercise price E = 1,000,000 PLN, purchase price 20,000 PLN)	Straddle
500,000	460,000	-20,000	440,000
600,000	360,000	-20,000	340,000
700,000	260,000	-20,000	240,000
800,000	160,000	-20,000	140,000
900,000	60,000	-20,000	40,000
1,000,000	-40,000	-20,000	-60,000
1,100,000	-40,000	80,000	40,000
1,200,000	-40,000	180,000	140,000
1,300,000	-40,000	280,000	240,000
1,400,000	-40,000	380,000	340,000
1,500,000	-40,000	480,000	440,000

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

Table 6. **Synthetic straddle – synthetic put option,** *author's own research*

Value of primary shares after 1 year (at option's expiry date), PLN	Call option (exercise price E = 1,000,000 PLN, purchase price 20,000 PLN)	Value of short shares, PLN	State treasury bonds (risk-free investment – 800,000 PLN – 25%)	Synthetic put option, PLN
500,000	-20,000	-500,000	1,000,000	480,000
600,000	-20,000	-600,000	1,000,000	380,000
700,000	-20,000	-700,000	1,000,000	280,000
800,000	-20,000	-800,000	1,000,000	180,000
900,000	-20,000	-900,000	1,000,000	80,0000
1,000,000	-20,000	-1,000,000	1,000,000	-20,000
1,100,000	80,000	-1,100,000	1,000,000	-20,000
1,200,000	180,000	-1,200,000	1,000,000	-20,000
1,300,000	280,000	-1,300,000	1,000,000	-20,000
1,400,000	380,000	-1,400,000	1,000,000	-20,000
1,500,000	480,000	-1,500,000	1,000,000	-20,000

The above presented straddle strategy based on synthetic instruments can be valuated with the use of historical costs and at fair value.

Table 7. **Synthetic straddle – synthetic call option,** *author's own research*

Value of primary share after 1 year (at expiry date), PLN	Put option (exercise price E = 1,000 PLN, purchase price 40,000 PLN)	Value of long shares, PLN	Short treasury bonds (free-risk investment 80 PLN – 25%), PLN	Synthetic call option, PLN
500,000	460,000	500,000	-1,000,000	-40,000
600,000	360,000	600,000	-1,000,000	-40,000
700,000	260,000	700,000	-1,000,000	-40,000
800,000	160,000	800,000	-1,000,000	-40,000
900,000	60,000	900,000	-1,000,000	-40,000
1,000,000	-40,000	1,000,000	-1,000,000	-40,000
1,100,000	-40,000	1,100,000	-1,000,000	60,000
1,200,000	-40,000	1,200,000	-1,000,000	160,000
1,300,000	-40,000	1,300,000	-1,000,000	260,000
1,400,000	-40,000	1,400,000	-1,000,000	360,000
1,500,000	-40,000	1,500,000	-1,000,000	460,000

Table 8. **Result of a straddle strategy – synthetic put and call option,** *author's own research*

Value of primary shares after 1 year (at expiry date), PLN	Synthetic call option	Synthetic put option	Synthetic straddle
500,000	-40,000	480,000	440,000
600,000	-40,000	380,000	340,000
700,000	-40,000	280,000	240,000
800,000	-40,000	180,000	140,000
900,000	-40,000	80,0000	40,000
1,000,000	-40,000	-20,000	-60,000
1,100,000	60,000	-20,000	40,000
1,200,000	160,000	-20,000	140,000
1,300,000	260,000	-20,000	240,000
1,400,000	360,000	-20,000	340,000
1,500,000	460,000	-20,000	440,000

Call option		**Put option**		**Profit and loss on a straddle**	
SP X	20000 (3)	SP X	40000 (3)	(3) 40000	480000 (3)
(1) 20000		(1) 40000		(3) 500000	500000 (3)
				(3) 200000	200000 (3)

Investment account at brokerage office		**Shares**		**Bonds**	
SP X	1860000 (1)	SP X	1000000 (2)	SP X	800000 (2)
(2) 1800000	2540000 (3)	(1) 1000000	1000000 (3)	(1) 800000	800000 (3)
(3) 3040000		(3) 1000000		(3) 800000	

Legend: (1) – purchase of a call and 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.

Figure 3. **Valuation of a synthetic straddle strategy based on historical purchase price,** *author's own research*

Call options	
SP X	500000 (14)
(1) 20000	
(3) 380000	
(9) 100000	

Put options	
SP X	40000 (4)
(1) 40000	

Profit and loss on a straddle	
(4) 40000	380000 (3)
(6) 400000	400000 (5)
(8) 100000	100000 (7)
(11) 100000	100000 (9)
(13) 100000	100000 (10)
	100000 (12)

Investment account at brokerage office	
SP X	1860000 (1)
(2) 1800000	2500000 (14)
(14) 3000000	

Shares	
SP X	1000000 (2)
(1) 1000000	400000 (6)
(5) 400000	100000 (11)
(10) 100000	1500000 (14)
(14) 1500000	

Bonds	
SP X	800000 (2)
(1) 800000	100000 (8)
(7) 100000	100000 (13)
(12) 100000	1000000 (14)
(14) 1000000	

Legend: (1) – purchase of a call and 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.

Figure 4. **Valuation of a synthetic straddle strategy at fair value,** *author's own research*

The valuation of a synthetic straddle strategy (Tables 6–8) can be based on the following scenario:

T_0 – purchase of a call option for 20,000 PLN and a put option for 40,000 PLN on a stock exchange, price of shares 1,000,000 PLN, price of bonds 800,000 PLN;

T_1 – value of the call option increased up to PLN 400,000, value of the put option decreased to 0 PLN, value of shares 1,400,000 PLN, value of bonds increased up to 900,0000 PLN;

T_2 – value of the call option increased up to 500,000 PLN, value of the put option 0 PLN, value of shares increased up to 1,500,000 PLN, value of bonds increased up to 1,000,000.

Concluding remarks. The paper presents a concept for designing synthetic instruments based on the put/call option parity and the cost of carry model. The put/call parity can be the basis for designing a synthetic share, a put and call option, and a free-risk investment. Also, futures contracts can be based on the cost of carry model and the put/call parity. 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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Стаття надійшла до редакції 28.04.2015.