

INNOVATIONS IN THE FINANCIAL SECTOR - THE CASE OF EXOTIC FOREIGN EXCHANGE OPTIONS ON THE POLISH MARKET*

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This article discusses a problem of 'toxic' derivative financial instruments (TDIs) which occurred in Poland in 2007/2008 between Polish banks and some exporters, with the structure of a typical derivative instrument (call/put options) being firstly described. Many of them were 'exotic', i.e. previously unknown to Polish companies. Nevertheless, banks offered these instruments as products of advanced financial engineering innovations. Limited knowledge about such instruments was the main factor in causing further enterprises' problems. Many companies declared bankruptcy in the effect of changes on the foreign exchange market or suffered from serious financial problems. General losses of Polish companies from 'toxic' financial instruments are estimated at EUR 1.5 to as much as 20 billion. This article discusses character of relations between banks and enterprises, arising from the derivative transactions. The article analyzes two main issues: (a) asymmetry of the option structure hedging exporters against a foreign currency risk for a narrow corridor of an exchange rate level and (b) lack of knowledge about consequences of a contracted derivative transaction presented by the exporters. A case of a transaction carried out by a major Polish company and a leading bank on the Polish market is described and analyzed. Analysis of this case

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confirms the hypotheses that structure of options transactions produce unequal distribution of risk between enterprises and banks.

1. INTRODUCTION

The accession of Poland to the European Union began a period of stabilization and improvement of the *Polish zloty* in relation to the world's main currencies. During the period of 2004 – 2008, the euro rate fell from more than 4.5 to 3.2 in Polish zlotys. The many-year downswing of the EU currency caused an increased interest of Polish entities in a possibility of securing themselves against any further disadvantageous rate changes. Exporters, especially, became open to opportunities offered by contemporary financial engineering and the market of hedging instruments, first of all to derivatives.



Figure 1. Euro/Polish zloty exchange rate

Source: www.money.pl

As an effect of these tendencies, there was an increased number of protection transactions between the Polish exporters and financial institutions – mainly banks¹. They were especially popular in 2007 and 2008. It can be easily noticed that the trend of the euro/zloty exchange rate reversed in September - October 2008. From that moment on, many Polish enterprises began to suffer from serious problems arisen from their earlier transactions of the purchase/sale

¹ Banks strictly connected with international financial groups (BRE Bank SA, ING Bank SA and BPH SA) were leading in such transactions. These banks prepared the derivatives' distributing system on their own. Other Polish banks participated in transactions as representatives of foreign financial institutions.

of derivatives, mainly currency options. Soon it turned out that many firms had to bear considerable financial costs resulting from the service of these contracts. The fact that their problems only started was an additional piece of “bad luck” because their contracts had long-term negative consequences².

It is difficult to estimate the full scale financial effects of these transactions for non-financial entities because of the lack of reliable official data. Estimates are extremely varied: the Polish financial supervision estimated consequences of a phenomenon defined as *toxic derivative instruments*³ at approximately 15 - 17 billion Polish zlotys, while some experts believed it to be several dozen billion Polish zlotys. However, even if the lowest estimates are true, it is impossible to ignore the consequences of using these “toxic instruments” for Polish business. In many cases, the matured instruments were being rolled up into other options with a prolonged date of maturity⁴. Thus, the problem was not solved, but only postponed in time.

The options in question were completely new and innovative instruments for those Polish entities which took part in the derivative transactions. This article discusses the nature of those derivative contracts and points out elements of unnoticed risks responsible for the losses of non-financial entities. The author also wants to explain why decision makers in many major business entities failed to notice the dangers of those derivative instrument transactions.

2. EXCHANGE RATE AND PROBLEMS OF POLISH EXPORTERS

The exchange rate tendencies observed from 2004 - 2008 created a threat for Polish exporters. The decline of the euro rate negatively influenced their income from those export sales which were denominated in the domestic currency. This situation encouraged exporters to protect themselves against a negative impact of changes in the exchange rates.

² In some cases analyzed by the author, there was a two-year span from the contracting to the maturity of a transaction.

³ The term „*toxic derivative instruments*” was originally used as a description of the American CDO’s connected with mortgage loans. Many Polish specialists used the same name for derivatives transactions contracted in Poland during 2007 and 2008, especially for the barrier option transactions. The similarity between the American and Polish TDI’s arises from an unrecognized risk of both instruments.

⁴ According to The Polish Financial Authority report: “*Podstawowe wnioski z analizy zaangażowania przedsiębiorstw w walutowe instrumenty pochodne*”, issued in March 2009). This report comments on the effects of foreign exchange option transactions in Poland. PFA estimated general losses of Polish exporters at 4-7 billion zlotys. See: http://www.knf.gov.pl/opracowania/sektor_bankowy/raporty_i_opracowania

The exporters had many available solutions which could be used to protect companies against a decline of the foreign currency rate - e.g. forward or futures contracts, currency swaps or exchange rate options. In reference to the last ones, the simplest strategy was using the plain vanilla currency put option. When buying a put option based on an agreed exchange rate, its buyer has a guarantee of receiving at least the incomes exchanged at the execution rate established in the contract, even in case of the plexus of unfavourable conditions on the currency market. This kind of option also gives an opportunity to resign from this currency exchange transaction if it was disadvantageous for its owner. Thus, the settlement of payments at the maturity for such options can be defined as: *"The buyer will obtain income no smaller than..."*.

However, if exporters wanted to protect themselves by opening a long position in a put option, they should pay an option premium, which would influence the efficiency of this protection. Let's assume that for an option worth EUR 1 million and the execution rate of 3.50 Polish zloty per euro, the put premium amounts to 50 000 zlotys. An exporter executing this option can have an effective exchange rate of 3.45 zloty per euro.

As a result of the disadvantage in premium payments, Polish banks proposed other, more complicated option transactions. These transactions usually included a composition of two options - put and call - contracted simultaneously. Thus, a non-financial entity "bought" a put option and "sold" a call option. As an effect of such a structured transaction, the exporter was obliged to pay the put option premium, but was entitled to receiving the call option premium. Consequently, mutual obligations and charges between a bank and a non-financial entity led to the common compensation of payments. Banks called these transactions **non-cost options or zero-cost options**. The reason for such transactions can be explained using a quotation by a representative of the Polish Financial Supervision Authority: *"How can we cut exchange rate security costs by purchasing a put option? By issuing a corresponding call option. If the firm believes that the future exchange rate of the euro will not rise above a certain level, then it accepts that the realization of such a call option is also unlikely. However, this option's price is lower than the put option's, so in order to refinance the full protection provided by the put option, it is necessary to issue multiple call options..."*⁵. An example of a similar transaction and a settlement of its payment is presented below:

⁵ An interview with Stopczynski A., the Head of the PFA Banking Supervisory, presented in the journal: *"Gazeta Parkiet"*, Warszawa, 10.06.2010.

If an exporter does not have sufficient liquidity to pay the premium for a put option, he or she could accept the bank proposal so that instead of the payment for the option, he or she would issue a currency call option in the interest of the bank. In such a situation, it was acknowledged that a premium of the put option (payable by the non-financial entity) and the call option (payable by the bank) were equal and would cancel themselves out. Accepting that a rate of the execution of the put option is equal to 3.50 zlotys for 1 euro, the execution rate of the call option is 3.80, and the spot currency rate at the moment of contracting these transactions amounts 3.65 - the settlement of both options will depend on the euro rate at the moment of both options' execution (the same execution term)⁶.

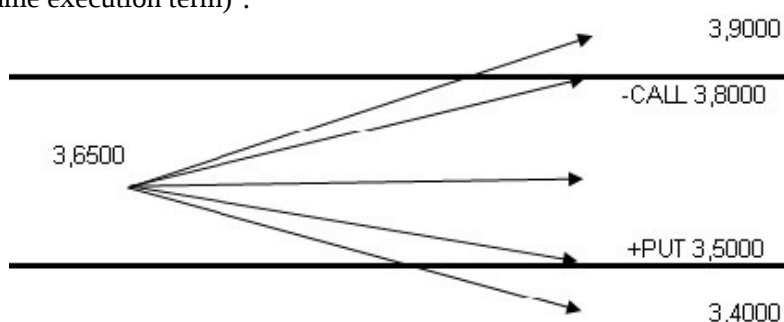


Figure 2. Purchase of the put option and the sale of the call option by the exporter

Source: http://www.alphafs.com.pl/php/dokumenty/baza_plikow_71.pdf

If the exchange rate gets below 3.50, then the put option will be activated and the exporter will have the right to sell the currency for an execution rate warranted beforehand. At a rate of above 3.80, the call option will be activated, which will cause the obligation of the non-financial subject to sell the currency at that rate at its maturity term. In the area between 3.50 and 3.80, none of the options will be executed. The schema described above is an illustration of a security which uses a rate-corridor in the presented borders. Such a corridor strategy seems safe and attractive for exporters – they acquire protection against the fall of exchange rates. Additionally, a purchase of these put options entails no initial expenses. However, a more detailed analysis of this scenario reveals a few of its less obvious traits:

⁶ Based on discussion in the following source: http://www.alphafs.com.pl/php/dokumenty/baza_plikow_71.pdf

- **Equivalency of the transaction** – both in the example and in practice, call and put options were selected in order to assure the compensation of payments between both sides of the transaction. This means that a premium of put should be equal to a premium of call. However, there are many factors which may affect the final value of these premiums (the spot rate, the execution rate, their date of completion, the variability of the exchange rate, changes of the variability, interest rates of local and foreign currencies, and many others). As a result, the price equality of both premiums is not certain. This inequality can be additionally deepened by the fact that, in practice, denominations of put and call were usually different in favour of the latter.
- **The certainty of export incomes** - exporters treated option deals as a protection of expected export incomes. In many cases, those incomes were never received, so options served as a speculative no hedging instrument. Such a situation was often the result of the general economic crisis and the decline in the international trade volume. However, partly, it was also an effect of the construction of the option transactions, mainly a long period of their duration. There were many cases when such transactions spanned a period of about two years. It is virtually impossible to foresee either long-term export earnings or future changes in exchange rates.
- **Obscurity of the character of transaction** - non-financial entities were not prepared for estimating the possible results of these transactions. This was caused by many factors, but the confidence in banks and in products offered by them was crucial. Banks, however, did not make much effort to reliably inform customers about possible threats related to the offered products (Karkowski, 2009, pp.168-170). The aims of the exporters and the banks in the option transactions were therefore different because the banks were interested in maximizing their gains on transactions and commissions in the increase of sale volume and in attracting new customers by offering them seemingly “attractive” products. Many specialists indicated also a lack of proper care for preserving individual relations as described by the Good Bank Customs' rules (Karkowski 2009, p.167-168). This negligence appeared also in the pseudo-professionalism of the bank personnel, offering toxic products.

3. BARRIER OPTIONS - A NEW ELEMENT ON THE POLISH MARKET OF DERIVATIVES

The case of the protection against the exchange risk by using “plain vanilla” options was quite rarely applied in real-life transactions made from 2007 - 2008. In those deals, banks often used *derivative exotic options*, mainly barrier options. These instruments are more complicated, not so much with respect to their construction, as with respect to their valuation, as well as the estimation of risk resulting from these transactions.

There are two factors of exotic option market development. As in the case of classical derivatives, the development of exotic instruments was caused by creating theoretical models allowing to value some exotic options. In 1973, Merton presented a model of the valuation of barrier put options with an exit down barrier. This model was developed for the valuation of other barrier options. Yet, in the 1970s, there also appeared some other valuation models:

- the composed options (the Geske model),
- the backward options (the Goldman, Sosin and Gatto model),
- the conversion options (the Margrabe model).

In the '80s of the last century, other models were also built; among others, the Stulz model (the valuation for the option founded on the maximum or the minimum of two basic instruments) and the Ingersoll model (the first model for the valuation of Asiatic options).

The second factor which favoured the dissemination of exotic options was a quick implementation of such instruments by financial institutions. Practitioners soon adopted models of the theoretical valuation of exotic options and it became an impulse for the creation of similar products and offering them at the financial market. Their popularity was further increased by the fact that such instruments provided individual investors with greater flexibility, as they could be easily adapted to any individual investor's needs (Napiorkowski 2001, pp.6-12). The market of exotic instruments had been developing dynamically since the '80s of the last century. The slowdown in the exotic instruments market started only in the middle of the '90s after several spectacular bankruptcies of significant financial institutions were caused by the use of derivatives. However, as Napiorkowski wrote, “... today it's Asiatic options, barrier options, basket options, binary options and rainbow-hued options which are important. Goods, exchange rates, shares, share indexes, indebted securities, and interest rates – they are all used as basic instruments on the exotic options market.” (Napiorkowski, 2001, pp.44-45).

Defining exotic options is not easy, mainly because of a wide variety of their conditions. Generally, an accepted definition is the opposite of the classical options – exotic ones are contracts warranting a different function of their payment from standard put/call options (Kuzmierkiewicz, 1999).

In Polish financial practice, many transactions were based on a group of exotic barrier options. Barrier options are different from the classical instrument because of a single additional condition: an activation or deactivation barrier. The barrier is a level of the basic instrument price which, if crossed, decides of either the expiration of an option before its maturity or its activation. A level of this barrier is an additional component of the contract defined at the moment of its signing. The value of a barrier option depends on the price of its basic instrument during the whole life-time of the option, not only at its maturity. The appearance of the condition in the form of crossing the barrier “switches on” (knock-in option) or “switches off” (knock-down option) the possibility of the execution of this option contract at its maturity.

There are two basic types of barriers. An option of the *knock-in* type can be executed if its basic instrument reaches the barrier during its life period (from contracting to maturity). A barrier option becomes a standard option after reaching the barrier level and if it terminates in-the-money, its possessor receives a payment agreed-upon in the option contract.

A *knock-out* option deactivates if during the duration of its contract, the value of its basic instrument reaches the level set as a barrier. If the barrier is reached, the option deactivates just like a classical put/call one. It is not important whether during the contract's duration the basic instrument reaches or crosses the level set as the barrier. If the exit barrier is reached, the option deactivates regardless of what will happen to the price of the basic instrument in the future (Napiorkowski, 2001, pp. 44-45).

Additionally, the barriers can be divided into barriers of the *down* type (*activation* or *deactivation* of the option happens when the price of the basic instrument crosses the mark barriers) or the *in* type (the *activation* or *deactivation* of the option happens when the price of the basic instrument reaches the levels above the set barrier). According to the above-mentioned divisions, one can present the typology of barrier options presented in Table 1.

This division can be broadened by including put and call options. Thus, the basic classification of barrier options includes eight types of these instruments, depending on their kind of barriers and options.

Table 1. General types of barrier options

Type of barrier	Deactivated option (knock-out)		Activated option (knock-in)	
	Type of option	Characteristic	Type of option	Characteristic
Down out/in barrier	Deactivation down&out	Barrier is below the basic instrument spot price. At the beginning of its life, the option is in-the-money. Option is deactivated if the basic instrument price crosses the barrier.	Activation down&in	Barrier is below the basic instrument spot price. At the beginning of its life, the option is out-of-the-money; Option is activated if the basic instrument price crosses the barrier.
Up out/in barrier	Deactivation up&out	Barrier is up the basic instrument spot price. At the beginning of its life, the option is in-the-money. Option is deactivated if the basic instrument price crosses the barrier.	Activation up&in	Barrier is up the basic instrument spot price. At the beginning of its life, the option is out-of-the-money; Option is activated if the basic instrument price crosses the barrier.

Source: Chriss (1997, p. 437).

4. PROTECTION OF EXPORTS EARNINGS BY ZERO-COST BARRIER OPTIONS

An analysis of protecting transactions against the risk of exchange rates on the Polish market indicates that since the beginning, exporters have been using forward contracts. Over time, banks started to offer more complicated products (options, swaps, option pairs), including barrier options. First, put options with a down & out barrier were offered to exporters. The argument was that there was only a small chance of the exchange rate in question to reach their barriers. However, such options were still treated as a method of protection against the fall of foreign currencies' exchange rates, and the cost of such a barrier option was lower than the cost of a standard put option. Below, the author presents an example of how such options could be used as a hedging instrument.

If the spot exchange rate is 3.85 zlotys for 1 euro, an exporter can protect against a fall of the euro rate by purchasing a plain vanilla put option with the execution rate of 3.70 or alternatively - a barrier put option with the execution rate at the same level and the knock-out barrier of 3.60. For the denomination for both options, being, e.g. EUR 1 million, the premium for plain vanilla is 50 000 zlotys. However, a barrier option premium is 30 000 zlotys⁷. A function of exercising the settlement of these contracts is presented by the following figure.

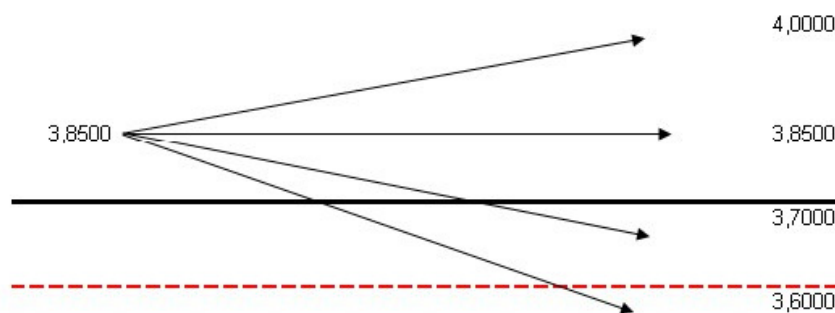


Figure 3. Purchase of the put option with the down & out barrier

Source: http://www.alphafs.com.pl/php/dokumenty/baza_plikow_71.pdf

If on the execution date a spot exchange rate was below 3.60, the barrier option would not be activated. In the same situation, the plain vanilla option would give the right to sell 1 euro for 3.70 zloty. Between 3.60 and 3.70 zloty

⁷ Based on discussion in the following source: http://www.alphafs.com.pl/php/dokumenty/baza_plikow_71.pdf

per euro, the barrier option is more effective - e.g. for the rate of 3.65, the effective selling exchange rate of the currency would be 3.62 for the barrier option and 3.60 for the plain vanilla option. If the execution rate was above 3.70, then both options would generate no payment for the exporter - he would lose the option rights. Despite that, using the barrier option for protection against exchange rate risk is sometimes unsafe.

As an illustration of this thesis, the following comment can be quoted: *“This strategy of using the down & out option is completely senseless and useless from the point-of-view of any exporter. Such a strategy does not provide protection against risk, but only raises it even more. The exporter defends himself against the strengthening of the domestic currency – therefore, why would he have to agree on the condition that if the domestic currency strengthens considerably, he loses all the protection?! This is a typical SPECULATIVE transaction and no exporter should accept such transactions for hedging!”*⁸.

A *down & out* put option could be used as a hedging instrument only if we assume a very small variability of an exchange rate. Such an assumption could not be made for the period of 2007/2008 in Poland, when the historic variability of the euro on the currency market fluctuated between 0.17 and 0.21 zloty; thus, options with similar parameters and a *down & in* barrier or plain vanilla options would be a better solution for most exporters. However, according to the results of the transaction analyses, this solution has not been applied.

Instead of that, banks frequently proposed a compound strategy of two barrier options - a purchase of a put option with a *down & out* barrier and a sale of a call option with an *up & in* barrier, which turned out to be a very risky solution. The use of this compound strategy causes the protection against the fall of the exchange rate to be limited only to a narrow change corridor. Out of this corridor, such a put option is deactivated and it does not protect against any exchange risk. What is more, an activation of the call option causes a theoretically unlimited risk for an exporter. The previous example can be broadened, with the assumption that, at the same time, the exporter buys a barrier put option and sells a call option with the execution price of 4.00 zlotys, and an *up & in* barrier at the level of 4.10 zlotys per euro⁹.

⁸ Source: Zajac, D. (2008): *Artykuł edukacyjny - Ściągawka dla eksportera (opcje barierowe)*, http://www.alphafs.com.pl/php/dokumenty/baza_plikow_71.pdf

⁹ Based on discussion in the same source.

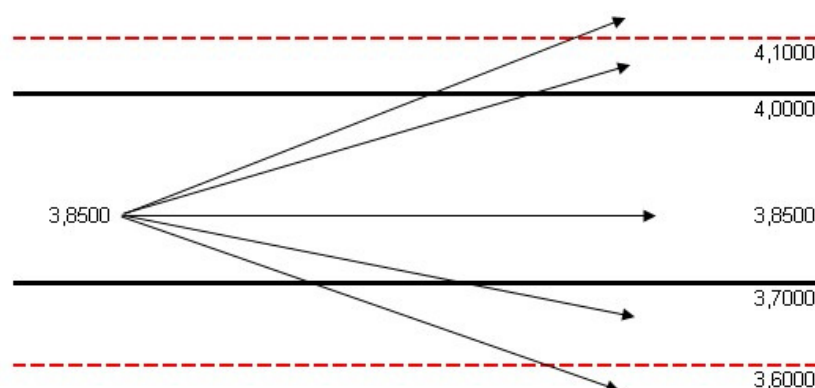


Figure 4. Purchase of a barrier put option and sale of a barrier call option

Source: http://www.alphafs.com.pl/php/dokumenty/baza_plikow_71.pdf

If the exchange rate at maturity is lower than 3.60 zloty per euro, the exporter loses the protection as the result of reaching the exit barrier. Between 3.60 and 3.70, the put option can be executed and the non-financial entity can sell the euro currency at 3.70 zloty per euro. Between 3.70 and 4.10, both options work. However, if the exchange rate is above 4.10, the exporter is open to the exchange risk because he/she must sell the currency below the market price at 4.00 zloty per unit.

Despite these reservations, there were many transactions contracted on the Polish market which were compounded in different proportions of the down & out put options and up & in call options. The selection of options to such transactions was based on a non-cost (zero-cost) approach guaranteed by banks; in other words, the equivalency of put and call option premiums. The zero-cost approach often justified a slight differentiation in denominations of put and call options. The usually greater denomination of call options was explained as the result of the fact that a call option was cheaper than a put option of the same denomination. As Karkowski (2001, p. 75): writes: "... nobody paid anyone at the moment of contracting the structure. Necessary payments by a purchaser of the put option were balanced by the call option premium not paid to a bank, whereat, according to the bank, it was necessary that even a few call options were needed to balance a single put option payment. Therefore, we need to acknowledge that because of this - rather unimportant - reason (from 0.01 to 0.10 zlotys) of the rate of improvement, the customer was forced (because of the alleged inaccessibility of other instruments) and in some cases, unknowingly accepted the incommensurateness of possible final settlements resulting from

'toxic derivatives', and accepted the contracting of a very dangerous call option."

The option structure gave a completely new schedule of the payment at its maturity. The schedule of the payment at maturity means the final settlement of the option contract at the maturity. The following figure shows an example of a settlement for the options discussed in the previous example. Both are denominated at EUR 1 000 000.

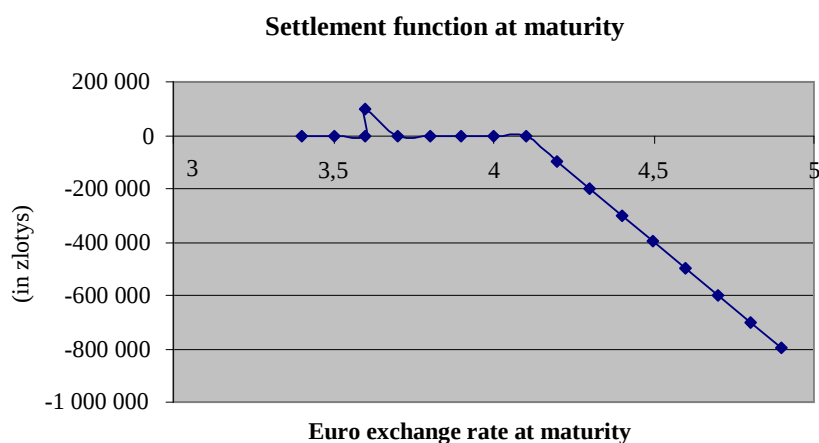


Figure 5. Schedule of the payment of the put option (bought) and call option (sold)

Source: Based on own research.

It is worth noticing an asymmetry of this settlement, disadvantageous for an exporter. If the inequality in denominations of put and call was taken into account, the asymmetry would be even bigger. Many specialists pointed out that banks avoided presenting the payment function during the negotiations about the option structure transactions. Many bank clients would probably become warier and withdraw from the transaction if they knew its detailed conditions and all the contract's consequences.

It is also interesting how banks pressed their clients to take part in such zero-cost option transactions. The zero-cost transactions were also offered to those entities which were able to pay the put option premium. What is more, in 2007 and 2008, banks ceased to issue other, non-compound derivatives for foreign exchange currency hedging. A tendency of using zero-cost derivatives is

also strange in the situation of serious difficulties concerning the compounding of such transactions.

5. OPTION STRUCTURES - *TABULA RASA* FOR CUSTOMERS

The majority of the contracted option transactions included the compound of put and call, mainly barrier options. The buyers of put were mostly exporters, as banks purchased call options. However, many derivative transactions held from 2007 - 2008 in Poland did not only have an occasional or individual character. Those option transactions were often arranged in series. It means that an exporter and a bank could contract a series of the put options with different maturity and a series of the call options at the same time. Of course, all of them were based on the zero-cost approach. For example, the author investigated the case of the put/call option transactions maturing every week for a two-year period. The deal included 104 down & out put options and 104 up & in call options.

Such transactions were more complicated for evaluation than any individual put/call transaction. If somebody wanted to calculate the zero-cost condition for the whole transaction, he/she would have to estimate all premiums for all 208 options at the contracting date. No bank customer had any chance to make such an analysis unless he/she was a well-versed financial engineering professional. Thus, the bank customer "had to" accept the version of the bank officer, who was trying to convince him/her that the presented transaction was zero-cost and that it was equally profitable for both sides. What is more, many officers were unfamiliar with derivative valuation methods, mostly because they were traders and not specialists in derivative construction. It is clear today that many of those transactions did not fulfill the zero-cost condition. Difficulties with estimating the premium were similar to the difficulties of risk connected with such a derivative structure. It was crucial to estimate the probability of net payment for a bank or for an exporter. This task is complicated even for a professional and virtually impossible for a person who does not usually deal with complicated financial instruments and usually lacks the necessary computer software. Thus, many clients chose to believe banks which advertised those transactions as low-risk ones.

It is true that the better part of the so-called zero-cost option structures did not fulfil this criterion. All the more, banks used only a single parameter of the transaction for achieving the equilibrium between the premiums of both options. It was the relation between the put and call option denominations – one time it

was 1 to 2, another time 1 to 10. However, they ignored additional factors influencing the premium level.

The opinion above will be confirmed in the next part of the article, which discusses a real-life case of such a transaction. The further confirmation of this opinion can also be found in existing elaborations of this subject. Based on the research carried out by Karkowski (2009), results of the valuations of three plain vanilla options, issued by a Polish bank in August 2008, can be quoted.

Table 2. Premiums from the put and call options

	Premiums on 25. Feb. 2009
Purchasing by exporter put option (EUR 100.000 per 3.41 zlotys)	- 7 000
Selling by exporter call option (EUR 100.000 per 3.34 zlotys)	4 000
Selling by exporter call option (EUR 200.000 per 3.41 zlotys)	12 000
Premium settlement for exporter	9 000

Source: Karkowski (2009, p. 78).

The estimation was made taking into account both a historical estimation of the variability of the exchange market and the level of interest rates at the day of contracting the transaction. There is no reason to believe that assumptions made by a bank differed significantly from these used by Karkowski (2009). Thus, it could be expected that the bank should have known that the transactions did not meet the equivalency criterion. As a result, they could hardly be called “zero-cost”.

6. ANALYSIS OF A CASE OF THE ZERO-COST OPTION STRUCTURE

Using the data provided by a Polish enterprise, it was possible to estimate the consequences of using the put/call option structure. All transactions were made with a bank in the summer of 2008 and included a series of 104 settlements of option contracts, dropping every week. The entity acquired a series of 104 put options, denominated at EUR 500 000, with the execution rate of 3.70 zloty per euro for options maturing in 2008, and with the execution rate of 3.35 for options maturing in 2009 and 2010. The options included a *down & out* barrier at 3.20 for all options.

The bank acquired (and the non-financial subject issued) 104 call options denominated at EUR 1,000,000 with the execution rate of 3.70 zlotys for

options maturing in 2008, and the execution rate of 3.35 for options maturing in 2009 and 2010. The call options included the down & out barrier at the level of 3.20 zloty per euro. At the moment of contracting the transaction, the spot exchange rate was 3.26 zloty per euro.

The presented option structure seems to be symmetrical, because mutual charges and obligations of the transaction sides will be terminated, if the rate falls below 3.20 (by about 0.06 zloty). However, it did not happen in spite of the rate almost rubbing elbows with the barrier (3.2026). After analyzing the changes of the exchange rate in 2008 – 2009, it can be noticed that the bank customer noted a profit from the structure up to November 2008. From 10. November 2008, the exchange rate exceeded the 3.70 level, which meant the execution of the call option, thus the bank became the beneficiary of the transaction.

Such an analysis can be made ex-post when changes on the foreign currency market are measured and known. In fact, the increase of the euro-zloty exchange rates at the end of 2008 and 2009 were unexpected and no professional predicted such a strong reversal of rate trends. However, it is worth asking two questions:

- *Did bank customers have to be completely helpless and could they not show some greater caution concerning the protection of their currency transactions?*
- *Could the tendency of the exchange rate, shown by Figure 1, have been predicted? Could losses from the total option structure have been avoided?*

Of course, the answer to these questions is strictly related to the in-depth knowledge of the international currency market. Pursuing this kind of knowledge, however, is not a subject of this article. Its purpose is to use the analysis of derivatives to explain the consequences of transactions contracted between exporters and banks. A starting point of the analysis is the assumption that initial prices of the options (premiums) were in some way related to their final value at the maturity of options. Such an assumption is nothing new - most of the models used for option valuation are based on such premises - from the binominal model to more developed models based on complete algebraic formulas. This leads us to the conclusion that the analysis of the option structures can be carried out based on the valuation of individual options at their contracting days.

Any option valuation requires accepting certain parameters for individual instruments (maturity date, denomination) and some data from the currency market (the contracting spot exchange rate, the variability of exchange rates at this same moment, stability of the variability, interest rates for the domestic and foreign currencies). All necessary data were estimated using the market data from the moment of contracting. Several types of data were obtained using the historic analysis. As an instrument for the analysis, the author used a well-known version of the Black-Scholes model, known as the Garman-Kohlhagen model, which is considered very useful for valuating barrier options. (Derman & Kani, 1996; Kuzmierkiewicz, 1996; Weron & Weron, 1999).

The carried-out analysis concentrated on three issues:

- whether the contracted option structures fulfilled the zero-cost criteria,
- whether the temporary option premium schedule confirmed the reversal of settlements between the bank and the non-financial subject which really took place at the end of 2008,
- what the probability of suffering losses from the whole of the transaction was for the exporter, and what chance of losses the bank had.

In the previous part of the article, the reader could find the research by Karkowski which shows the existence of disequilibrium between premiums for the put and call options contracted in one transaction. This analysis is based on the plain vanilla option and confirms that the liabilities of the exporter are lower than receivables. If the settlement of a structure at the contracting date was based on a zero-cost approach, then a bank should pay the difference in premiums to an enterprise. In fact, the bank did not pay for it, because it treated the transaction as zero-cost. However, in this analysis, a slightly different methodology should be used. Due to the condition of equivalency, the transaction does not apply to each individual pair of put and call options dropping at the same moment, thus it is necessary to check the equality of all premiums for all the 104 put and call options series. The results of such an approach are presented by the Table 3.

Results concerning the option's value at the contracting date indicate the rise of the net payment from the bank to the exporter. The amount resulting from the difference between the put and call premiums is so huge, that even a slight correction of the assumed valuation parameters would not be enough to eliminate the discrepancy between payments of both sides.

Table 3. Value of the put and call zero-cost option structure premiums at the contracting date

Put premiums at contracting date	- 1.2 million zlotys
Call premiums at contracting date	13.8 million zlotys
Difference in settlements	12.6 million zlotys

Source: Based on own research.

Thus, the valuation of the total option structure confirmed a lack of the zero-cost character of the transaction in question. The bank had to know - in the author's opinion – about the inequality of payments. According to the accounting regulations, banks have to record the derivatives which require their proper valuation. It is also interesting that a very similar result of a payment difference is reached when examining other transactions of this customer with another bank, even though the parameters of options contracted there were considerably different.

The dynamic analysis of the net payments from contracted option premiums indicated that up to a certain moment, the bank customer had benefited from the deal, then the profit moved to the bank's side. Analysis based on the data from the contracting day confirmed the possibility of such a situation, which actually took place some months later. As an illustration of this thesis, the cumulative time distribution of the put and call premiums should be used. Their distribution is presented by Figure 6.

The presented statement clearly indicates that the sum of the put premiums (the value of the exporter's rights at the moment of contracting the option structure) is clearly lower than the amount of liabilities (the value of all call option premiums purchased by the bank). The difference nominally amounts to exact zlotys (-12 600 000). To put it simply - it could be said that the bank should pay the exporter more than 12 million zlotys at the moment of the transaction, if it wishes to ensure the zero-cost of mutual settlements. Obviously, such a payment has never been made.

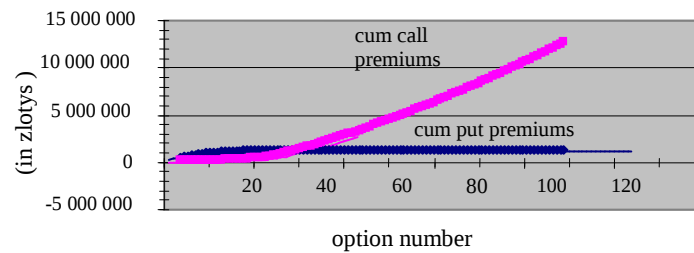


Figure 6. Time cumulative distribution of put and call premiums

Source: Based on own research.

It might be interesting to take a closer look at the moment of crossing the cumulative premiums of put series with the cumulative premiums of calls, which is demonstrated by the following figure.

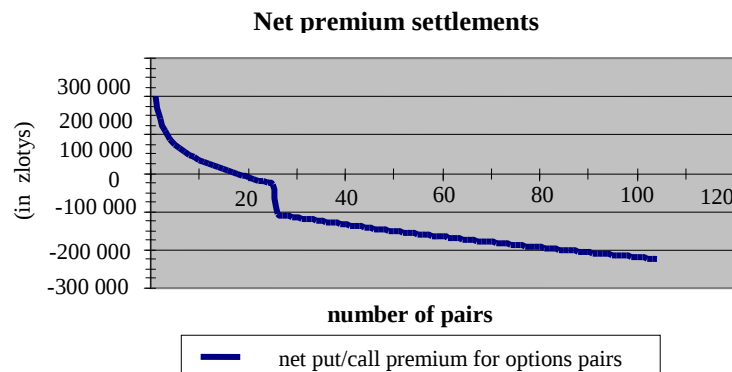


Figure 7. Net valuation of following pairs of put and call premiums

Source: Based on own research.

This distribution of the put and call pair net premium values shows that the premiums of call became higher than the put premiums after, approximately, the 20th series. The analysis indicates that after a period of a few months, when the exporter had been benefiting from the transaction, he would have entered into a period of losses. According to the analysis, the exporter should enter into negative settlements after four to five months from contracting the structure, which was confirmed in practice. It is surprising that the results of the theoretical analysis used in this article closely follow the trends of the exchange

rate at the end of 2008 and that it predicted the change of the exporter's settlement from positive to negative.

In real life, this shift happened in November 2008. The euro rate reached the level above 3.70 zlotys exactly on 10. November, precisely at the same moment which was suggested by the analysis performed using the data of five months earlier. The analytical framework presented above is not a typical instrument for making exchange rate predictions. However, the results of using it are satisfactory. All of the model's assumptions are realistic and based on the historical distribution of euro rates before July 2008. Even better, the conclusions drawn from the valuation were confirmed by the actual tendencies at the foreign currency market. These conclusions confirm a lack of equivalence in contracted structure option transactions. Therefore, all exporters participating in such transactions should be warned against the change of the direction in settlements with banks. As we could see, the lack of appropriate analytical tools caused many exporters to agree on option structure transactions which generated high losses and were later described as "toxic derivatives".

The matter of the risk assessment resulting from contracted transactions is another problem which could be investigated by using the model presented here. If it is assumed that the net settlements of the following put and call are a stochastic (random) variable, it is possible to analyze the distribution of a stochastic variable, by using parameters, such as the expected value or standard deviation. The net payment probability distribution function for analyzing such transactions is presented by the following figure.

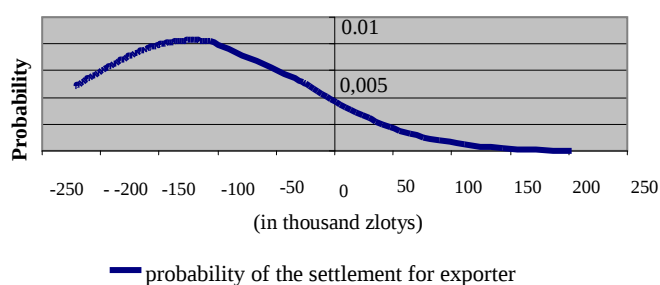


Figure 8. Probability distribution function of the net premium settlements

Source: Based on own research.

As it is shown above, a significant part of the net payment variability is located below zero, which suggests that the probability of a negative settlement for the exporter was higher than the probability of a positive settlement. The exact calculations are presented in the following table.

Table 4. Cumulative distribution function (CDF) for chosen levels of settlements

CDF	0	0.896677
CDF at put premium average	11 798	0.917015
CDF at call premium average	-133 504	0.451281

Source: Based on own research.

By using the statistical interpretation of the data, it can be said that the chances of an exporter suffering losses from the option structure transactions are about 89%. The probability of a positive settlement for the exporter is only at 11%. This suggests that the banks, arranging the option structure transactions could, with a very high probability, expect financially positive results. As mentioned above, the banks were probably acquainted with the risk distribution inequality, because of the obligation to record such transactions in the books.

The difference between the levels of the cumulative distribution function for the average of all put and call settlements - approximately 46% - can be interpreted as a degree of certainty for a bank. The degree of certainty explains the probability of achieving an average net premium settlement of 133 504 zloty from all the transactions in the option structure. It is certain that a bank which arranged such an option structure had carried out an estimation of the profitability and risks of the contracted derivatives. Probably, such an analysis was similar to the one presented in this article. Thus, it can be said that the disadvantage resulting from the absence of the equality of settlements and the high probability of the loss by the exporter were known to the bank, though unknown to the other party of the transaction - the non-financial subject.

7. CONCLUSIONS

The idea of a zero-cost option structure was based on purchasing barrier put option series, which can be treated as a protecting instrument, as well as on selling barrier call option series by exporters. The base instrument for the settlement of both options was the euro exchange rate and users could protect themselves against the foreign currency risk by buying the put options. The call options were issued to compensate premium payments between banks and their

clients. The barrier option structures caused very high losses for exporters and afterward they were called "toxic derivative instruments". There are two serious issues concerning these so-called "toxic options":

- The asymmetry of the option structure hedged the non-financial subject (the exporter) against a foreign currency risk for a narrow corridor of the exchange rate level. However, the structure also opened the exporter to the exchange risk due to the need of issuing the call options;
- The lack of knowledge about the consequences of a contracted derivatives transaction presented by the exporters was a reason of misinformation and poor decision-making. The banks did not provide appropriate information for their clients and failed to inform them about the risks resulting from buying and selling options.

The zero-cost option structures contracted at the Polish market did not fulfill their protection role and opened the exporters to the unnecessary currency risk. This was confirmed by the research results presented in this article. Some additional conclusions arising from the research are:

- lack of equivalency of the transaction which basically relied on the higher amount of premiums due for the non-financial subjects (exporters);
- the inevitability of the exchange rate trend reversal in the long period and as a consequence of the reversal to the settlements between the banks and exporters - from the initial profit to the final loss of the non-financial subject;
- the detailed statistical analysis of option structures showed that the probability of suffering the losses by exporters was close to 90%, which was also confirmed by the events on the Polish foreign currency market during 2008 and 2009.

REFERENCES

1. Chriss, N. A. (1997): *Black-Scholes and beyond: option pricing models*. McGraw-Hill Book Company, New York,
2. Carr, P., Chou, A.(1997): Breaking barriers: Static Hedging of Barrier Securities, *Risk*, October, New York,
3. Derman E., Kani I. (1996): The Ins and Outs of Barrier Options: Part 1, *Derivatives Quarterly*, Winter, New York,
4. Karkowski, P., (2009): *Toksyczne opcje. Od zaufania do bankructwa*, Green Capital, Warsaw,

5. Kuźmierkiewicz, M. (1999): Ewolucja rynku opcji ku pozagiełdowym opcjom egzotycznym i ich klasyfikacja, *Bank i Kredyt*, 3, Warsaw
6. Kuźmierkiewicz, M. (1999): Ogólna charakterystyka opcji egzotycznych, *Bank i Kredyt*, 4, Warsaw,
7. Kuźmierkiewicz, M. (1999): Opcje uwarunkowane, *Bank i Kredyt*, 6, Warsaw
8. Napiórkowski A. (2001) *Charakterystyka, wycena i zastosowanie wybranych opcji egzotycznych*, National Bank of Poland, Warsaw
9. Nelken, I. (1995): *Handbook of Exotic Options*, Probus, Chicago Il.,
10. The PFA report (2009): Podstawowe wnioski z analizy zaangażowania przedsiębiorstw w walutowe instrumenty pochodne, 11. March, <http://www.knf.gov.pl>
11. Sopoćko, A. (2005): *Rynkowe instrumenty finansowe*, PWN Warsaw
12. Weron, A., Weron, R. (1999): *Inżynieria finansowa. Wycena instrumentów pochodnych, symulacje komputerowe, statystyka rynku*. Wydawnictwo Naukowo-Techniczne, Warsaw,
13. Zhang, P. (1996): *Exotic Options: A Guide to the Second Generation Option*, World Scientific, New York

INOVACIJE U FINANCIJSKOM SEKTORU: SLUČAJ "EGZOTIČNIH" OPCIJA DEVIZNOG TEČAJA NA POLJSKOM TRŽIŠTU

Sažetak

U ovom se radu raspravlja o problemu "toksičnih" deriviranih financijskih instrumenata, kreiranih u Poljskoj, 2007. i 2008. godine, ugovorima između poljskih banaka i nekih izvoznih poduzeća. Prvo se opisuje struktura tipičnih deriviranih instrumenata (call/put opcija). Mnoge su od njih "egzotične", odnosno prethodno nepoznate poljskim poduzećima. Banke su ih, pak, nudile kao rezultat naprednih financijskih inovacija. Ograničeno poznavanje ovih instrumenata je bilo glavnim čimbenikom u stvaranju daljnjih problema poduzeća. Mnoga od njih su bankrotirala zbog posljedica promjena na deviznom tržištu, ili su imala velikih financijskih problema. Ukupni troškovi poljskih poduzeća od "toksičnih" financijskih instrumenata procjenjuju se od 1,5 pa do čak 20 milijardi EUR. U ovom se radu raspravlja o karakteru odnosa između banaka i poduzeća, a koji proizlazi iz deriviranih transakcija. Pritom se analiziraju dva temeljna pitanja: (a) asimetrija opcijske strukture kojim su izvoznici pokušali smanjiti svoj rizik promjene deviznog tečaja u vrlo uskom području te (b) nedostatak znanja o posljedicama ugovornih deriviranih transakcija, ponuđenim izvoznicima. Opisuje se i analizira slučaj jednog od velikih poljskih poduzeća i vodeće poljske banke, pri čemu se potvrđuje hipoteza da struktura opcijskih transakcija stvara nejednaku distribuciju rizika između poduzeća i banaka.

