Jordan Journal of Economic Sciences, Volume **2**, No.**1** 2015

The Accumulator as a Toxic Option Strategy – Poland Case

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ABSTRACT

The paper is on toxic foreign exchange options problem which occurred in many emerging markets directly prior to - and just after the outbreak of the recent crisis. The article concentrates exclusively on so called *accumulators*. These portfolios of exotic options were nicknamed "*I will kill you later"* in the Southern Asia countries. However, they were offered also in Poland by local banks to their customers. Similarly to Asian countries, *accumulators* contributed to significant losses for the banks' clients. The paper explains a mechanism of the contract as well as presents the explanatory case study of an authentic transaction. Because of accumulators' complexity, banks succeeded in selling these unfair transactions thus, making profits. The correct pricing procedure reveals the unfairness of these options, as it is demonstrated in the article.

Keywords: Exotic foreign exchange options; toxic options; accumulators; barrier option pricing; option strategies.

INTRODUCTION

The issue of 'toxic' FX options in Poland

(The 'toxic FX options' of 2008–2009 dealt a heavy blow to Polish enterprises, dragging some of them under). FX options were concluded between banks operating in Poland and Polish exporters, which settled their sales in hard currencies – the US dollar or Euro. These enterprises had been losing their competitive advantage on foreign markets on the back of the strengthening Polish zloty in relation to the main currencies, which has continued since 2004. The businesses put such options in place primarily to hedge against currency risk. However, it was not plain vanilla (standard) options that were used to close the currency positions. The banks offered non-standard options (combination strategies) to virtually all customers. They were usually zero-cost and multiple instruments (involving pay-offs, for example, every month for a year). Long positions in options were financed by opening short positions in the appropriate options. Another feature characteristic for the products offered by banks was installing the mechanism of 'deactivating' structures, for example after exceeding the relevant threshold by the exchange rate or after effecting pay-offs to the entrepreneur for the specified total amount. This significantly reduced the losses which could be potentially suffered by the bank as a result of further strengthening of the Polish zloty.

In addition to option contracts, in a similar period Polish companies also concluded transactions known as CIRS (Cross Currency Interest Rate Swap). These transactions, similarly to currency options, are categorised as derivative financial instruments, and pay-offs thereunder depend both on the developments of exchange rates as well as the interest rates related to the

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Received on 6/4/2014 and Accepted for Publication on 8/5/2014.

selected currencies. The financial leverage mechanism also applies to CIRS. Transactions offered by banks as "zero-cost" in 2008–2009 required enterprises to make very large payments to banks – the other party to the transaction. Their scale was beyond the financial capabilities of the enterprises.

No estimates of losses suffered by Polish companies in 2007–2009 as a result of the derivative transactions, involving derivatives and interest rates, were officially produced in Poland. Although the Main Statistical Office attempted to quantify the changes in the value of the derivative instruments (see Table 1) using surveys, in my opinion the presented estimates (profits and losses amounting to billions of euro) are unrealistically high. However, many of these option losses-liabilities were either transferred to third parties or conversed (e.g. into credit liability or equity (Liberadzki, 2011)). Although the media quoted estimates reaching EUR 10 billion, no official calculation based on credible statements of financial institutions has been published.

Table 1. Aggregate result on derivative instruments (PLN million)

Type	2007	2008	2009
TOTAL	129,230.0	94,771.1	-341,674.4
Forward contracts	134,791.9	161,280.5	-246,410.9
Futures contracts	-49.7	70.6	57.0
Options, including:	1,720.6	-6,976.2	-93,526.0
asymmetric combination currency options	1,558.5	-18,222.1	-69,756.8
Swap contracts, including:	-7,232.9	-59,603.8	-1,794.5
CIRS	236.5	8,879.6	2,241.4

Source: (Main Statistical Office, 2010).

The result on derivative instruments is based on data provided in 2007 by 238 respondents (175 in capital groups and 100 standalone), 2008 data was provided by 322 enterprises (222 in capital groups and 100 standalone) and 2009 data was provided by 362 entities (242 in capital groups and 120 standalone). Data shows positive or negative valuations of derivatives, which is why they should not be analysed in combination with the performance of the portfolio of financial instruments, complied on the basis of data collected from fewer enterprises (respectively: 251, 287, 307), or the bottom-line result.

Exotic options, barrier options and accumulators

FX options were concluded between banks operating in Poland and Polish exporters, which settled their sales in hard currencies – the US dollar or Euro. These enterprises had been losing their competitive advantage on foreign markets on the back of the strengthening Polish zloty in relation to the main currencies, which has continued since 2004. The businesses put such options in place primarily to hedge against currency risk. However, it was not plain vanilla (standard) options that were used to close the currency positions. The banks offered non-standard options (combination strategies) to virtually all customers. They were zero-cost and usually multiple instruments (involving pay-offs, for example, every month for a year). Long positions in options were financed by opening short positions in the appropriate options.

There are four elementary trades in put and call options (Liberadzki and Liberadzki, 2012):

1. *Long call* (purchase of an option to buy)
2. *Short call* (writing an option to buy)

3. *Long put* (purchase of an option to sell)
4. *Short put* (writing an option to sell)

These trades can be used to develop various option strategies, constituting appropriate combinations thereof, by selecting the right price, strike and exercise.

Options with the so-called barrier have been used in Poland. Barrier options are the most popular exotic options presently used on FX markets (Jajuga, 2008). The barrier option is formed by adding the so-called barrier to a plain option. It specifies the price of the underlying instrument which must be passed in order for the option to be closed or to expire. A *knock-in* option is activated when the price of the underlying instrument reaches the barrier, at which point the barrier option becomes a plain one.

A *knock-out* option exists until the price of the underlying instrument reaches the barrier; the option subsequently expires worthless. If in the case of an American option the barrier is not reached before the expiry date, the option expires as a plain option. In the case of a European option, whether the barrier has been reached is determined only on the options expiry date. Single expiry of the barrier represented by the price of the underlying instrument determines the fate of the option.

In and *out* options come with an *up* or a *down* barrier. In the former case the barrier is set above the current price of the underlying instrument. To reach it, the spot exchange rate must increase before expiry of the option. In the latter case, the barrier is below the price of the underlying instrument, which is why the exchange rate needs to drop to close the option.

An accumulator is a type of a barrier option which is typically used in stock markets (Kwong *et al*, 2011). Accumulators are instruments with a double barrier, i.e. an *out* barrier set above the spot price of the underlying instrument and an *in* barrier set below the target price of the underlying asset; in this case the buyer of the accumulator should purchase double the amount of the underlying instrument. There are many types of accumulators: vanilla accumulators do not involve a double barrier and geared accumulators involve a double or even triple barrier. It is difficult to quote precise statistics concerning accumulators, as these instruments are not quoted on regulated markets and are concluded in private arrangements with qualified investors.

Accumulators – valuation

The accumulator mechanism can be explained by comparing it to making a long call with the strike price above the spot price and a short put with exercise price below the spot price. Therefore, the underlying instrument is available for purchase at the strike price if its price rises appropriately, and should its price drop, the investor will be forced to purchase the underlying instrument at a higher price, equal to the execution price of the written put options. Putting barriers in place makes the accumulator typically a combination of a long *up and out* call trade and a short *down and in* put. It is important to note that there are twice as many options written as there are purchased.

The valuation of an accumulator corresponds to the valuation of the portfolio of exotic options, being the sum of valuations of the particular options comprising the portfolio.

Barrier options can be broken down into more elementary structures, i.e. into a vanilla call, a reverse trade in a binary option and a vanilla put, for example:

long vanilla call up and out = long call +
short binary call + short vanilla put

A binary option, also called a digital option, is an option with a fixed pay-off, regardless of how far in-the-money the option is. The pay-off is usually quoted as a multiple of the price (DeRosa, 2011).

Valuation of European barrier options can be performed using the Monte Carlo (Weert, 2008) methodology as well as analytical models, such as the Reiner and Rubinstein model (Reiner and Rubinstein,

1991) extended by (Haug, 2007) or the more recent approach based on Vanna-Volga methodology (Clark, 2011).

In the case of the less frequent double-barrier options or American options, the Monte Carlo methodology is used, and the use of an appropriately specified trinomial with discrete time (Li *et al,* 1995) yields reliable results.

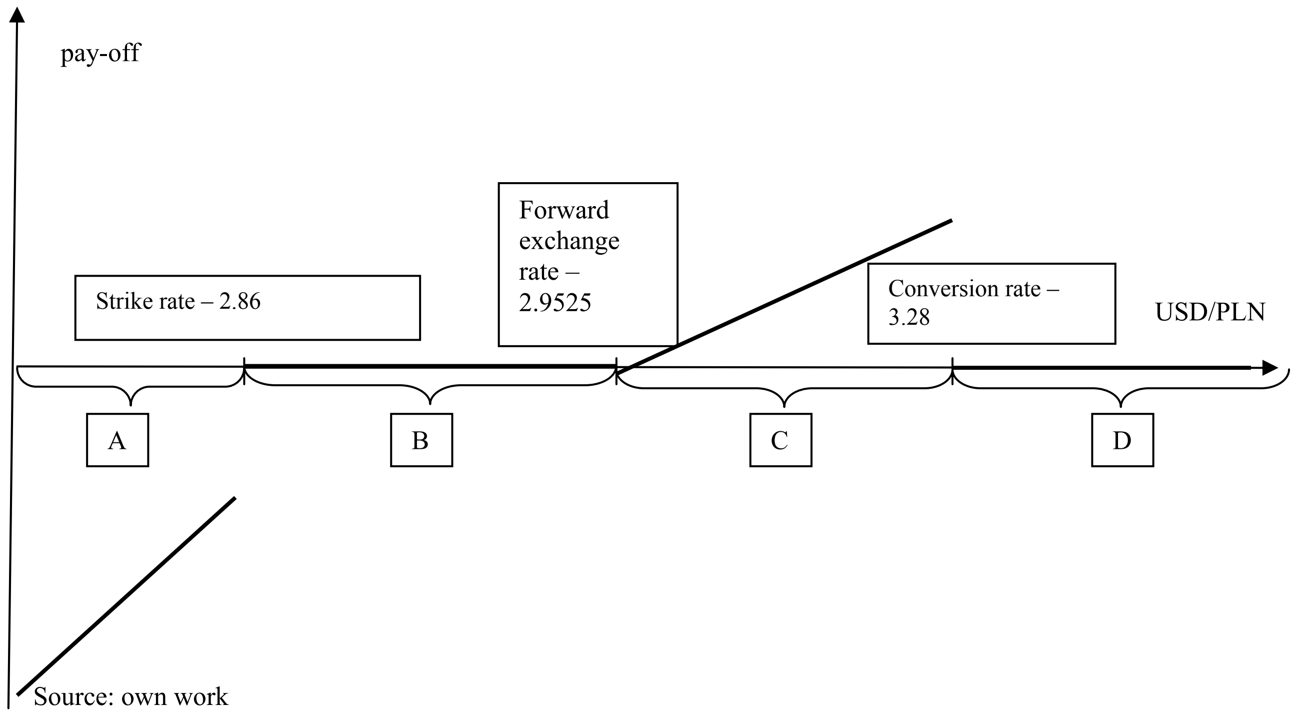
Controversies around accumulators and a case study

The use of accumulators, which first entered the stock markets in 2002, resulted in major losses suffered by investors, particularly in emerging stock markets. For example, accumulators appeared in Hong Kong in 2006, and already in 2008 the value of open positions was estimated to amount to approximately USD 40–60 billion. The sudden collapse of stock market indices triggered massive losses. In Hong Kong, losses suffered by single investors often reached 15 million dollars (Kwong *et al*, 2011). The accumulators were nicknamed *"I will kill you later"*.

Accumulators gained similarly negative publicity in Poland. This time the underlying instruments were currencies – mainly euro and the US dollar. I decided to illustrate the loss mechanism with the example of a transaction concluded and settled by a Polish company (the customer) with a major local bank.

An accumulator transaction based on the US dollar was concluded in February 2007, which we will call Transaction 1. This was a cascading transaction, which means that it involved periodical settlements – in this case on a monthly basis over 20 months. The pay-off function in each settlement period, presented to the bank's customer, was as in Figure 1:

Figure 1. Accumulator pay-off profile – Transaction 1



Source: own work

This was a zero-cost transaction, which means that on the date of its conclusion none of the parties made any payments thereunder.

The contract was settled in PLN based on USD/PLN quotations. The pay-off function presented in Figure 1 is the following:

Area A:

CF_T^A= 80,000 * (Reference Rate – 2,9525)

Area C:

CF_T^c= 80,000 * (Reference Rate – 2,9525)

In the remaining areas of exchange rate development (Areas B and D):

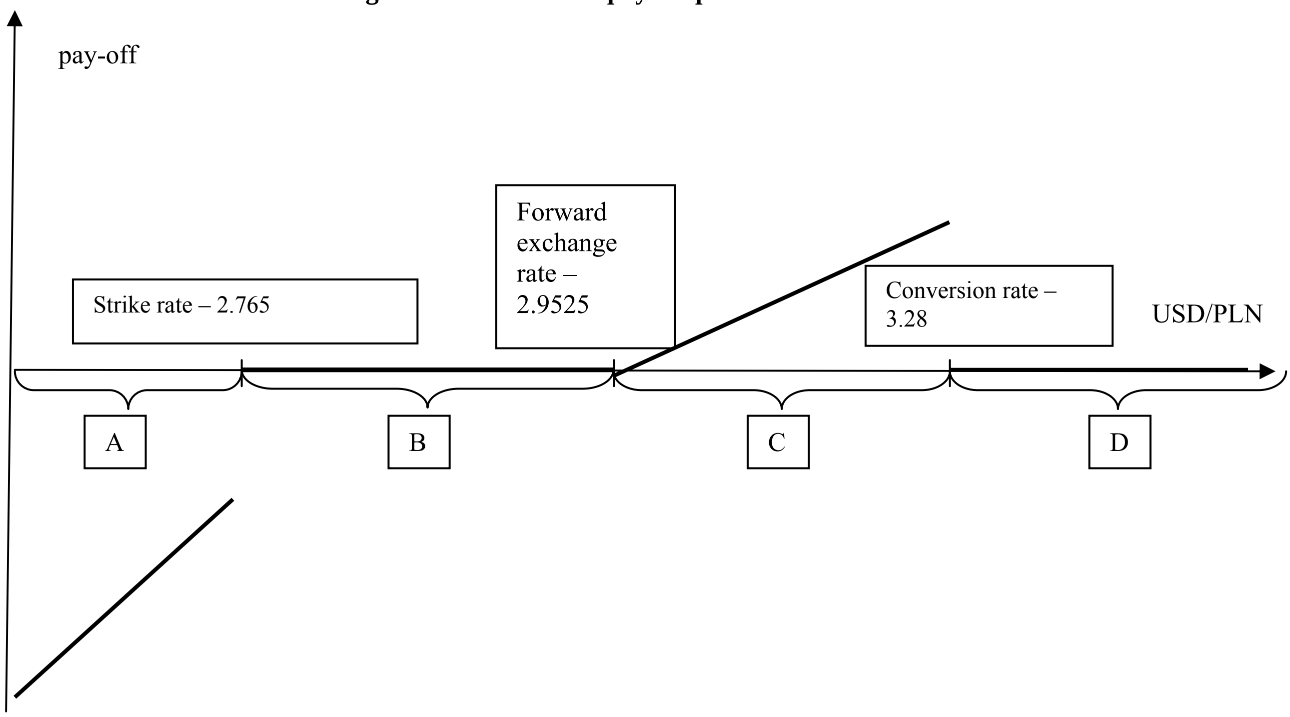
$CF_T^B = CF_T^C = 0$

where:

CF_T^i – settlement in PLN in the settlement month *T* in the *i-th* area of reference rate development.

After several settlements of Transaction 1, the bank's customer suffered a loss in the amount of PLN 8,960. Alarmed, the customer contacted the bank. Given the circumstances, the bank proposed to restructure the position in April 2007, namely to close Transaction 1 and conclude a new accumulator, which we will call Transaction 2 (Figure 2).

Figure 2. Accumulator pay-off profile – Transaction 2



Source: own work

The accumulator's pay-off function was the following:

Area A:

CF_T^A= 100,000 * (Reference Rate – 2,9525)

Area C:

CF_T^c= 50,000 * (Reference Rate – 2,9525)

In the remaining areas of exchange rate development (Areas B and D):

$CF_T^B = CF_T^C = 0$

As the dollar continued in a downward trend, the customer agreed for reduction of the Strike Rate at the price of increasing the nominal value of the transaction in the 'loss' area (from the previous PLN 80,000 to PLN 100,000). The accumulator was to be settled over 23 months. Transaction 2 was settled in full and the customer's loss totaled over PLN 670,000.

Given the loss, a question arises whether the accumulator was properly structured and was the game "fair"? In the presented example the total losses are low but the calculations were based on a low nominal value of the option.

Analysing the accumulator, one should view it as a portfolio of exotic options. As evidenced by the concluded agreements, discussed with and approved by the customer, the bank enters into vanilla, barrier and binary option contracts:

*Transaction 1 comprised **80** options **in groups of 4 with 20** maturity dates (Forward Transaction Execution Dates).*

*Transaction 2 comprised **46** options **in groups of 2 with 23** maturity dates (Forward Transaction Execution Dates).*

In both strategies the following transactions are closed on each maturity date:

2 vanilla options (plain), 1 barrier option and 1 binary option, the two latter being exotic options. Among these options only one (the vanilla one) is purchased by the customer, and as many as 3 are written by the bank's customer (1 vanilla option and 2 exotic ones).

Overall, the customer's trades on each maturity date in Transaction 1 are the following:

Long USD call PLN put; exchange rate – 2.9525; nominal amount – USD 40,000 – the customer's long trade in the vanilla option

Short USD call PLN put; exchange rate – 3.28; nominal amount – USD 40,000 – the customer's short trade in the vanilla option

Short USD call PLN put; exchange rate – 3.28; pay-off – USD 13,100 – the customer's short trade in the binary option

Short USD put PLN call; exchange rate – 2.86; nominal amount – USD 80,000 – the customer's short trade in the down & in *binary option with a barrier at 2.86*

The customer's trades on each maturity date in Transaction 2 are the following:

Long USD call PLN put; exchange rate – 2.9525; nominal amount – USD 50,000 – the customer's long trade in the up & out *barrier option with a barrier at 3.28*

Short USD put PLN call; exchange rate – 2.9525; nominal amount – USD 100,000 – the customer's short trade in the down & in *barrier option.*

To assess the 'fairness' of the contract, in the economic sense, the transaction needs to be reliably valuated. Transactions 1 and 2 were concluded as zero-cost, as long trades were financed in full with short positions in options. In the case of Transaction 1, only 25% of the options (1 out of 4 options on each maturity date) are long positions and protect their buyer only within the stipulated range (2.9525–3.2800) and only for the nominal amount of USD 40,000. 75% of the options (3 out of 4 options on each maturity date are written by the customer to the bank) expose the company to losses. Both in Hong Kong as well as in Poland the same risk involved in using the accumulator was noted – concluding transactions with the bank, the investor needed to write significantly more options than were purchased. Even more so given that the long trade (generating risk for the bank) concerns an *out* barrier option, which significantly reduces the bank's potential losses. The options written by the customer are *in* barrier options – in the case of unfavourable developments, the investor is exposed to unlimited losses.

In accordance with the calculations made by (Jajuga, 2010), Transaction 1 presented above had a positive valuation at PLN 58 173 from the bank's perspective (resulting from the difference between the premiums of the *put* and *call* options). This means that upon opening its position, the customer should receive compensation on account of the risk, whose amount should be determined using market-based methods. The bank agreed to restructure the customer's positions by closing Transaction 1 and substituting it with Transaction 2. Quoting the above-referenced source, Transaction 2 upon conclusion with the customer was favorable for the bank, the positive difference being PLN 156 716. These valuations reveal the true nature of the accumulator: the bank's customer writes more options than are purchased, not being adequately compensated in the form of a premium for excessive risk.

Conclusions

The accumulator is an option strategy involving barrier options, which is usually zero-cost as long trades in options under the strategy are financed with short positions. Little is known about accumulators in the market, as such instruments are offered under bilateral agreements between banks and qualified customers. As in the case of certain countries from the Southeast Asia region, in 2007–2009 in Poland accumulators were currency option strategies which brought major losses to non-financial companies.

Losses and the resulting controversies around accumulators result from their specific construction: in a typical case, from the perspective of the bank's customers, long trades in the *out* barrier options were financed with short trades involving *in* barrier options, while the nominal amount of the written options was usually twice the amount of the purchased ones. The contract is risky beyond any doubt. To make things worse, it was difficult for the customers to perform reliable valuations of the strategies on their own. In many cases the accumulators proved ill-valuated, which only inflated the losses and deprived the customers of any form of compensation for being exposed to risk.

Appendices

Appendix 1

Formula for european barier option pricing (Haug, 2007):

$$Z1 = \varphi e^{-R_f \tau}(\varphi x_1) - \varphi e^{-R_d} KN(\varphi x_1 - \varphi\sigma\sqrt{\tau}$$

$$Z2 = \varphi e^{-R_f \tau}(\varphi x_{12}) - \varphi e^{-R_d} KN(\varphi x_2 - \varphi\sigma\sqrt{\tau}$$

$$Z3 = \varphi e^{-R_f \tau} S\left(\frac{H}{S}\right)^{2(\mu+1)} N(\eta y_1) - \varphi e^{-R_d \tau} K\left(\frac{H}{S}\right)^{2\mu} N(\eta y_1 - \eta\sigma\sqrt{\tau})$$

$$Z4 = \varphi e^{-R_f \tau} S\left(\frac{H}{S}\right)^{2(\mu+1)} N(\eta y_2) - \varphi e^{-R_d \tau} K\left(\frac{H}{S}\right)^{2\mu} N(\eta y_2 - \eta\sigma\sqrt{\tau})$$

while:

$$\mu = \frac{R_d - R_f - \frac{1}{2}\sigma^2}{\sigma^2}$$

$$x_1 = \frac{ln\left(\frac{S}{K}\right)}{\sigma\sqrt{\tau}} + (1+\mu)\sigma\sqrt{\tau}$$

$$x_2 = \frac{ln\left(\frac{S}{H}\right)}{\sigma\sqrt{\tau}} + (1+\mu)\sigma\sqrt{\tau}$$

$$y_1 = \frac{ln\left(\frac{H^2}{SK}\right)}{\sigma\sqrt{\tau}} + (1+\mu)\sigma\sqrt{\tau}$$

$$y_2 = \frac{ln\left(\frac{H}{S}\right)}{\sigma\sqrt{\tau}} + (1+\mu)\sigma\sqrt{\tau}$$

where:

N(.) – normal cumulative distribution function;

K- strike price;

H- barrier;

S- spot price;

τ – expiry period (as a numer of years)

σ – exchange rate volatility (annual);

R_d, R_f – the interest rates for domestic and foreign currencies respectively

In case of Knock-Out Call (K>H) and Put (K<H) the variables η and φ are as follow:

$Call$: $C_{down\&out} = Z1 - Z3 \; while \; \eta = 1 \; and \; \varphi = 1$

Put: $P_{up\&out} = Z1 - Z3 \; while \; \eta = -1 \; and \; \varphi = -1$

Knock-In Call (K>H) and Put (K<H)

$Call$: $C_{down\&in} = Z3 \; while \; \eta = 1 \; and \; \varphi = 1$

Put: $P_{up\&in} = Z3 \; while \; \eta = -1 \; and \; \varphi = -1$

Appendix 2

Table 2. Implied volatilities taken for pricing the Transaction I (as of 22 February 2007) for the USD/PLN exchange rate

Maturity	Annual volatility (σ) in %
1 week	8,98
1 month	8,92
2 mths	9,11
3 mths	9,30
6 mths	9,32
1 year	9,58

Source: (Jajuga, 2010)

Table 3 Implied volatilities taken for pricing the Transaction II (as of 13 April 2007) for the USD/PLN exchange rate

Maturity	Annual volatility (σ) in %
1 week	6,95
1 month	7,48
2 mths	7,60
3 mths	7,70
6 mths	7,70
1 year	8,30

Source: See Table 2

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المُراكم بوصفه خيار استراتيجي سام – حالة بولندا

كاميل ليبراتسكي [1]

ملخص

يتناول البحث قضية خيارات العملات الأجنبية السامة التي وقعت في العديد من الأسواق الناشئة مباشرة قبل – وبعد اندلاع الأزمة الأخيرة. وتركز الدراسة حصراً على ما يُسمى المُراكم (نوع من المشتقات). ولقد لقبت خيارات العملات الأجنبية السامة بـ"سوف أقتلك في وقت لاحق" في بلدان جنوب آسيا، إلا أنها عرضت أيضا في بولندا من قبل البنوك المحلية لعملائها. وعلى غرار الدول الآسيوية، أسهم هذا النوع من المشتقات في وقوع خسائر كبيرة لعملاء البنوك. يشرح البحث آلية العقد وكذلك يقدم دراسة الحالة التفسيرية لمعاملة أصيلة. ونتيجة لتعقيد هذا النوع من الأوراق المالية، نجحت البنوك في بيع هذه المعاملات غير العادلة ومن ثمّ تحقيق الأرباح. ويكشف الإجراء التسعيري الصحيح عن عدم عدالة هذه الخيارات كما يتبين في البحث.

الكلمات الدالة: خيارات العملات الأجنبية السامة، الخيارات السامة، المُراكم، حاجز تسعير الخيارات، خطة عمل الخيارات.

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تاريخ استلام البحث 2014/4/6 وتاريخ قبوله 2014/5/8.