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The Risk of Hypothecary Credit Indexed to Swiss Franc

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Abstract

The idea of crediting and credit repayment is based on an assumption that each payment of the principal reduces the debt balance. This tendency is not followed in case of the hypothecary credit allowed and paid out in PLN and indexed to Swiss franc. Here, the balance of principal repaid in PLN is a function of currency exchange rate fluctuations. The situation denies then the idea of credit, according to which "you pay back as much as borrowed". The cost of credit, calculated as a total of the LIBOR - credit in CHF (WIBOR - credit in PLN) rate and the bank's margin specified in the contract. The purpose of the paper is to prove that a banking product like this does not meet the standards of crediting, the principal balance being dependent on the unforeseeable direction of changes. The purpose of the paper is to design a model of risk of the hypothecary credit indexed to Swiss franc, to enable the measurement of the loan payment risk. The model design methodology assumes control variables of the risk monitoring process to be included in the model structure. The estimated loan payment risk measures have revealed an upturn in the loan payment risk related to higher PLN/CHF rates and the resultant higher cost of credit accompanied by the loan principal growth. The risk dynamics estimations for the years 2006 – 2012 support the research thesis – the banking product analysed does not show the characteristics of a loan. Under growing PLN/CHF rates, the loan principal indexation translates into the debt balance escalation.

Keywords: hypothecary credit, credit indexed to Swiss franc, credit risk of indexed to Swiss franc, risk measurement

JEL classification: G21

Introduction

The hypothecary credit market had been offering loans indexed to Swiss franc – CHF – in Poland since the year 2000.¹ They were granted and paid out in the domestic currency, but the lending bank recorded the credit in the currency of indexation, applying the rate of exchange as of the date of release. The product seemed advantageous to borrowers, considering that high domestic currency base lending rates and the relatively low LIBOR translated into a low cost of credit.

The period between 2004 and 2014 saw the materialization of risk involved in the product which had been expected to solve the housing problem of many people in Poland.² In the years 2004 – 2008, the PLN/CHF rate of exchange was showing a downward tendency. Over this period, the credit risk measured by the credit cost level was tending to decline.

¹Such products were also offered by banks in France, Peru, Turkey, Australia, Austria, UK, Montenegro, Island, Norway, Denmark, Spain, Hungary, and Croatia. Indexation was applied to USD and EUR as well.

²About 700 thousand such loans were allowed in Poland, their total amount close to PLN 160 billion.

The crisis faced by financial markets in mid-2008 changed this positive trend. With the growing PLN/CHF rate, the cost of loan servicing was increasing, while the new situation revealed a significant disadvantage of indexed credits, which was not known to borrowers at the time when the PLN/CHF had been falling, namely that the credit principal value was also indexed by the growing rate of exchange. As a result, the loan balance kept growing despite regular payments (Table 1).

Table 1

CHF, PLN loan balance as per the CHF/PLN exchange rate; loan payable in PLN

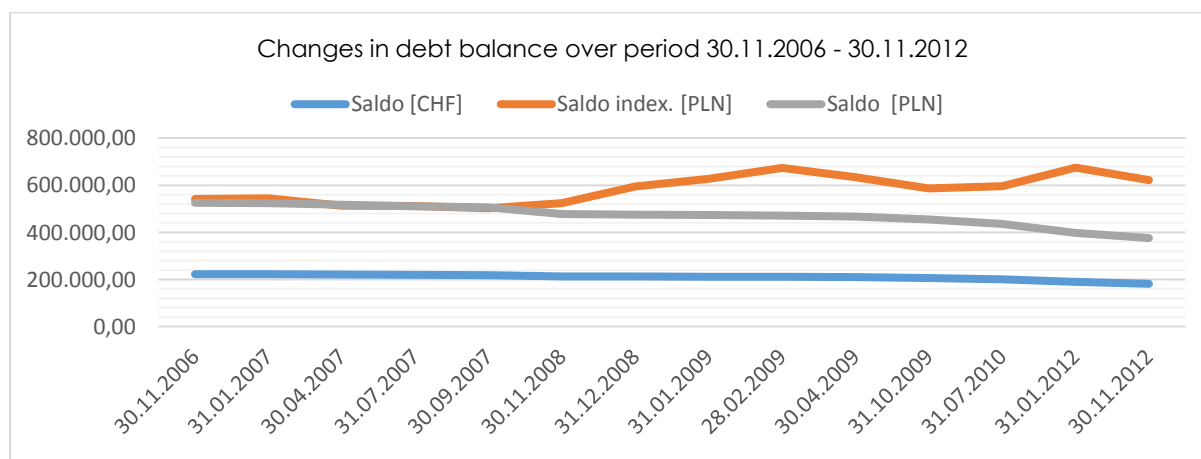
Due date	Buy rate [PLN/CHF]	Sell rate [PLN/CHF]	Debt balance, variable instalments [CHF]	Debt balance converted from [CHF] to [PLN], fixed instalments (principal + interest)	Debt balance, fixed instalments (principal + interest) [PLN] /bez indeksacji/
1	2	3	4	5	6
30.11.2006	2.3817	2.4299	222 671.00	541 068.26	527 389.53
31.01.2007	2.4039	2.4525	221 907.56	544 228.29	526 203.88
30.04.2007	2.2759	2.3219	220 778.06	512 624.58	524 382.44
31.07.2007	2.2864	2.3326	219 664.41	512 389.20	522 508.14
30.09.2007	2.2475	2.2929	218 938.10	502 003.17	521 228.48
30.11.2008	2.4149	2.4609	212 958.60	524 069.82	511 553.56
31.12.2008	2.7365	2.7962	212 487.68	594 158.05	510 811.80
31.01.2009	2.9547	2.9617	211 943.95	627 714.40	510 062.93
28.02.2009	3.1422	3.1843	211 373.09	673 075.33	509 306.88
30.04.2009	2.8994	3.0175	210 217.48	634 331.25	507 772.98
31.10.2009	2.7790	2.8372	206 664.54	586 348.63	502 991.76
31.07.2010	2.9276	2.9620	201 097.76	595 651.57	495 286.78
31.01.2012	3.4988	3.5694	189 197.23	675 320.59	477 743.11

Source: Author's analysis.

The analysis of changes in the debt balance occurring over the years 2004 – 2008 and until mid-2008 permits the definition of the product in question: the hypothecary credit indexed to a foreign currency – Swiss franc. This is a banking product, which does not have the main feature of a loan, since PLN/CHF rate fluctuations are reflected in the debt balance here, the monotonicity of variable depending on the direction in the currency exchange rate changes – see graphs: Figure 1.

Figure 1

Loan balance changes: a loan in CHF, converted from [CHF] to [PLN] and a loan in [PLN] over the period 30.11.2006 - 31.01.2012.



Source: Author's own analyses based on data from Table 1.

The loan balance is a function which is assumed to decrease over time. This property is independent on the scheme adopted for the payment of principal instalments. In the fixed principal instalment model, the debt balance decreases by the amount of the payment made. A similar tendency is observed in the annuity model, where payments are fixed, while the payment structure changes: the principal share grows, while the interest share decreases. Thesis: the balance of the hypothecary credit indexed to CHF and structured according to the annuity payment model, is a monotonically growing random variable, if the indexation currency rate grows.

The uncertainty of tendencies in the PLN/CHF changes exposes borrowers to the risk of losing their financial liquidity as a result of a significant growth of the exchange rate. To provide protection against the exchange rate variations, it is necessary to measure the uncertainty status. The design of instruments to be used for measuring the occurrence of such unfavourable scenarios within the term of the credit defines the purpose of the study.

Purpose of the study: design a risk model, define statistical measures of the borrower's risk over the term of the credit.

The structure adopted for the paper, consisting of the methodology, the results, the discussion and the conclusion allows to believe that the objective will be achieved and the research hypothesis – verified.

The choice of the reference literature has been determined by the methodology of the study. The approach chosen out the existing risk measurement models perceives risk as an effect of changes in the decision making environment. Hence, the research process was supported by the publications of the Author, where the risk model is a random vector and its components are symptomatic variables of the consequences of risk.

Methodology

Exchange rates fluctuations are determined by the situation on the financial markets, but also, as experience shows, are caused by currency speculations. Therefore, there is no doubt as to the qualification of the rate variability type: it is a scalable random variable, which means that the limits of the variability interval can be estimated.

Borrowers' choice to take the risk, despite being aware of the currency rates unpredictability, is merely a demonstration of their trust that if the exchange rate grows, the scale of growth will not exceed the level they regard as acceptable. The acceptable level of exchange rates is an essential element of the definition of risk involved in the payment of a loan under the currency rate growth.

Definition. The risk of the indexed credit debt growth is a state which accompanies the debt payment indexed to the rate of currencies other than the credit currency, caused by the currency rate growth above the acceptable level.

The risk of the credit debt growth is caused by the growth of the domestic currency to Swiss franc exchange rate. Hence, how should one measure the risk of changes in the credit debt level?

The indexation currency exchange rate fluctuations are the control variable of risk, therefore the risk model is a random vector with a single component: the exchange rate.

The risk model enables the identification of risk measures – it is a random variable, hence these are the random vector statistic measures:

1. The probability of an event that the credit currency – PLN – rate of exchange to the indexation currency – CHF – takes a value from a certain interval $[a, b]$,

assuming that the probability density function of the risk vector is $f(x)$, equals:

$$P(a \leq x \leq b) = \int_a^b f(x) dx - \text{a definite integral defined on an interval } [a, b].$$

2. The random variable – rate of exchange – expected value: $E(X) = \int_{-\infty}^{+\infty} x f(x) dx$
3. The random variable – rate of exchange – variance: $Var(X) = \int_{-\infty}^{+\infty} (x - \mu)^2 f(x) dx$ - an integral defined on interval $[-\infty, +\infty]$.

Results

The idea of measuring risk, as well as its practical utility in risk analysis were verified on data of a real-life hypothecary credit contract indexed to CHF. The loan amounting to PLN 527 thousand, the loan payment period of 21 year, the interest rate: LIBOR CHF plus a 4.4% margin, fixed payments (principal + interest). Assumptions for the analysis:

1. The analysis covered a period from November 2006 to January 2012.
2. The CHF sell rate as of the date of the loan contract – PLN/CHF 2.4636 – was used as the reference point for measuring the currency rate variations.
3. Risk was estimated based on an assumption that the acceptable risk level is associated with a 15% exchange rate growth against the contract date rate, i.e. 2.8330 PLN/CHF. The acceptable risk level falls into the PLN/CHF rate interval [2,4636; 2,8330].
4. Risk was estimated based on currency rate quotations exceeding the acceptable level. Any quotations below this level were considered to represent an acceptable risk of the loan obligation payment.
5. Assumptions for the measurement of risk:

The distribution of the variable X probability distribution density follows normal distribution:

$$f(x) = \frac{1}{\sigma \sqrt{2\pi}} e^{-\frac{(x - \mu)^2}{2\sigma^2}}, \text{ with distribution parameters } \mu \text{ and } \sigma, \text{ this assumption}$$

enables statistical measures of risk to be defined:

- a. The probability that random variable X takes value from interval $[a, b]$:

$$P(a \leq x \leq b) = \frac{1}{\sigma \sqrt{2\pi}} \int_a^b e^{-\frac{(x - \mu)^2}{2\sigma^2}} dx.$$

- b. The expected value of random variable X:

$$E(X) = \frac{1}{\sigma \sqrt{2\pi}} \int_{-\infty}^{+\infty} x e^{-\frac{(x - \mu)^2}{2\sigma^2}} dx.$$

- c. The variance of random variable X:

$$Var(X) = \frac{1}{\sigma \sqrt{2\pi}} \int_{-\infty}^{+\infty} (x - \mu)^2 e^{-\frac{(x - \mu)^2}{2\sigma^2}} dx.$$

Based on the risk measurement assumptions defined in point 3 and 4, measures $\langle P(X), E(X), \sqrt{Var(X)} \rangle = \langle 0.5078; 2.4871; 0.0387 \rangle$ were estimated. They were taken as an acceptable level of the exchange rate risk. Risk measures of the analysed period

were estimated based on the Swiss franc – CHF – selling rate and point 5 of the risk measurement assumptions.

Table 2
Statistical measures of currency risk [PLN/CHF].

It.	Sell rate [PLN/CHF]	$P(a \leq x \leq b)$	$E(X)$	$Var(X)$	Standard deviation	Due date
1	2	3	4	5	6	7
1	2.4299	0.5085	2.4468	0.0006	0.0238	30.11.2006
2	2.4525	0.2183	2.4487	0.0003	0.0172	31.01.2007
3	2.3219	0.6928	2.4170	0.0042	0.0649	30.04.2007
4	2.3326	0.6656	2.4001	0.0046	0.0677	31.07.2007
5	2.2929	0.7453	2.3822	0.0056	0.0747	30.09.2007
6	2.4609	0.0095	2.3935	0.0055	0.0744	30.11.2008
7	2.7962	0.4373	2.4438	0.0250	0.1582	31.12.2008
8	2.9617	0.5446	2.5014	0.0517	0.2274	31.01.2009
9	3.1843	0.6146	2.5697	0.0926	0.3043	28.02.2009
10	3.0175	0.5767	2.6104	0.1016	0.3187	30.04.2009
11	2.8372	0.4513	2.6293	0.0966	0.3108	31.10.2009
12	2.9620	0.5682	2.6549	0.0971	0.3116	31.07.2010
13	3.5694	0.7326	2.7202	0.1494	0.3865	31.01.2012

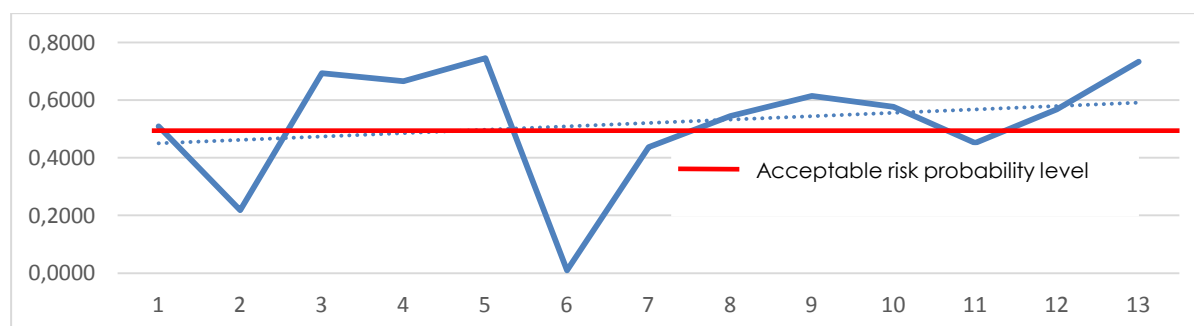
Source: Author's analyses based on PLN/CHF exchange rate data published on the Narodowy Bank Polski (Polish National Bank) website.

The currency risk measures estimated for the period from November 2006 to January 2012 [Table 2] have a significant informative value as regards the role of exchange rate risk in the financial liquidity management in respect of credit payment.

The probability of the currency rate growth showed a growing tendency in the analysed period. The exchange rate risk measure deviated unfavourably from the acceptable probability level. This level was defined in points 3 and 4 of the assumptions accepted for the risk measurement procedure in this study.

Figure 2

The probability of events that the PLN/CHF exchange rate will take values from the interval determined by the PLN/CHF selling rate as of the day of the credit release against the PLN/CHF rate as of the loan instalment payment.

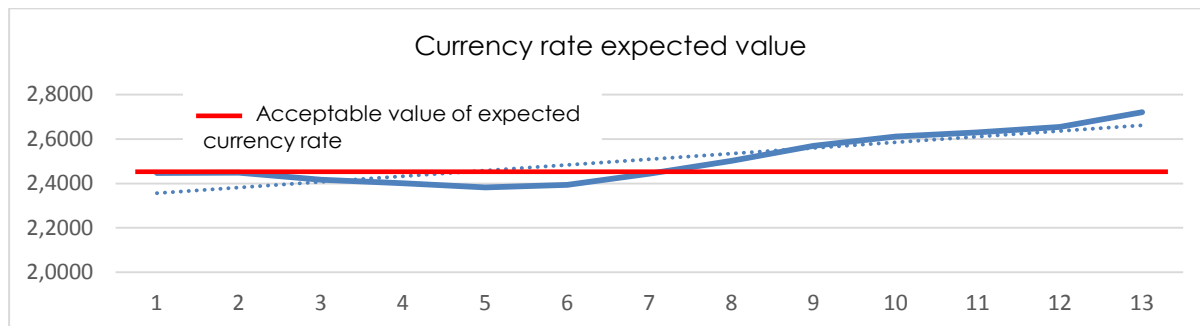


Source: Author's own analyses based on data from Table 2.

The PLN to CHF rate "entered the path of growth" in QIV 2008 and this tendency has been observed for more than five years now. Over this period, the probability of

events resulting in the currency rate to “take” a position above the acceptable level (Figure 2) increased significantly.

Figure 3
Changes in the currency rate expected value.



Source: Author's own analyses based on data from Table 2.

The standard deviation, representing the measure of the PLN to CHF rate deviations from the estimated mean values of the rate is showing exactly the same tendency. As far as the exchange rate expected value and deviation, the exchange rate risk measures are characterized by the same moment of the estimated measures "transition" over the level defined as acceptable.

Discussion

A hypothecary credit indexed to CHF might be an excellent banking product, but it is subject to certain essential determinants. It would be competitive against loans in domestic currencies, but only provided a stable exchange rate throughout the payment term and a high national base lending rate. Meeting these conditions has been, is and most probably will be impossible. What threats will the indexation involve, considering the risk of the currency growth? This aspect has been referred to in the research thesis of the study and it is the right moment now to prove it.

Let K_0 stand for the loan principal, R – for the fixed payment under the annuity scheme, where payments, by definition, consist of a principal component and the interest on the loan principal balance to be paid: $R = k_n + p_n (K_0 - \sum_{i=1}^{n-1} k_i)$, where p_n is the loan interest rate in the n -th period of the loan payment, p_n is the currency rate function, and $k_i, i = 1, 2, \dots, n$ is the principal payment. Let us designate respective principal payments in periods $(n, n-1)$ as:

$$k_{n-1} = R - p_{n-1} (K_0 - \sum_{i=1}^{n-2} k_i),$$

$$k_n = R - p_n (K_0 - \sum_{i=1}^{n-1} k_i), \quad p_n = p_{n-1} + \Delta p \wedge \Delta p > 0,$$

The principal balance at moment n equals: $SK_n = SK_{n-1} - K_n$,

$$SK_n = SK_{n-1} - (R - (p_{n-1} + \Delta p)(K_0 - \sum_{i=1}^{n-1} k_i)),$$

$$SK_n = SK_{n-1} - (R - p_{n-1}(K_0 - \sum_{i=1}^{n-2} K_i)) + p_{n-1}k_{n-1} + \Delta p(K_0 - \sum_{i=1}^{n-1} k_i),$$

$$\Delta SK_n = p_{n-1}k_{n-1} + \Delta p(K_0 - \sum_{i=1}^{n-1} k_i).$$

The balance of debt growth caused by the loan interest rate growth as a result of the currency rate increase by Δp is measured by component ΔSK_n dependent on Δp of the estimated principal balance $SK_n > 0$, which proves that the principal balance has grown.

The uncertainty of future scenarios of the currency rate growth inclines one to provide an effective instrument for measuring the state of uncertainty, which would enable the continual measurement of the risk of exceeding the acceptable currency rate level. Is this information essential?

An average borrower does not know how to interpret statistical measures of a random vector. The measurement instrument designed here is useful for financial analysts, as they know how to read the estimated risk measures and how to use them creatively in the process of forecasting changes in currency rates, as well as to indicate safeguards against the loan payment consequences.

Conclusion

The research hypothesis of the study has been positively verified. The domestic currency (PLN) loan indexation has been proved to lead to an unacceptable situation: the debt grows as a result of the currency rate increase, even though principal payments were made. The debt balance change is a random variable, the principal balance being unpredictable in case of the currency rate variations.

The findings here answer the question about the analysed banking product quality – it does not meet the criteria of a loan. This answer is one aspect of the study. The other one – a positive context – opens an area for further studies on the rolling forecasting methodology applied to risk, with the risk vector components taken into consideration.

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Jerzy Zemke graduated at the Nicolaus Copernicus University in Torun - Poland, where he completed his Master Thesis in Mathematics. He obtained his Ph.D. degree in Economics at University of Gdansk. He lectures at the Faculty of Management of The University Of Gdansk in mathematics, econometrics, operation research and risk in economic organizations. During the period 2005 – 2008 his research interests focused on enterprises management under risk and especially on the formalization of the risk space definition, risk itself and risk measurement methods. He is an author of 40 articles on the subject of risk published in Poland and USA. The results have been published in the monograph "Risk in the Business Organization Management" (edited by the University of Gdańsk, April 2009). Additionally to his academic assignments, he collaborates with financial institutions, banks and insurance companies. He is a licensed Insurance Broker. uthor can be contacted at jerzy.zemke@ug.edu.pl