FINANCIAL MANAGEMENT

RELATIVE FINANCIAL BENEFITS OF SWISS FRANC AND EURO-DENOMINATED MORTGAGE LOANS IN POLAND

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ABSTRACT: This paper evaluates financial benefits obtained by private clients of banks in Poland resulting from Swiss Franc- and Euro-denominated mortgage loans against Polish zloty mortgages. As fx mortgage loans were commonly used in period 2005-2009 and quickly dominated Polish banking sector (as well as sectors in many other CEE countries), they became a fundamental element of banks’ assets and a source of risk for borrowers. The main goal of the paper is to evaluate if fx mortgage loans, are more cost-efficient, than loans taken in domestic currency (PLN). To assess the financial benefits, the author proposed mathematical model of repayment of mortgage loans taken in the period 12.2004-12.2012 based on variable interest rates and actual exchange rates. Upon the data obtained from the model, the author used eight ratios for assessments of benefits. The analysis of benefits of fx borrowers was conducted per borrower, per period (month) as well as in form of cumulated benefits for all borrowers and all months of crediting. Upon the research one may find that since 2005 most beneficial in Poland are mortgage loans denominated in Euro. They are generally more cost-effective than loans denominated in Polish zloty and most popular in period 2005-2009 fx loans in Swiss Franc. The investigation of relative benefits showed also that the most commonly used fx loans denominated in Swiss currency are globally more expensive for borrowers than domestic currency loans. The exception are 30-years loans taken in 2009 and 2011.

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Introduction

Swiss Franc- and Euro-denominated mortgage loans are crucial forms of financing of real estate in Poland. Despite their low availability on Polish market since 2013, with the exception of loans granted to borrowers obtaining incomes in Swiss Franc and Euro currency, their development in period 2006-2012 made them predominant in Poland. At the end of 2014 their value amounted to 163 bln PLN and their volume reached 654 thousand contracts. Such value concentrated about 47% of value of all mortgage loans in Poland and 35% of their volume. Nonetheless, in 2008 the fx mortgage loans reached even 70% of total value of mortgages, what reflected strong development of such form of financing (mostly in Swiss Franc - CHF) instead of domestic currency. Such phenomenon called as "francisation" exposed borrowers as well as banks onto significant financial risks.
foreign exchange (fx) risk. A similar development of foreign currency loans for housing purposes was observed also in many other CEE countries (e.g. Hungary, Serbia, Croatia, Romania), where Swiss Franc or Euro due to substantially lower interest rates were replacing local currencies in purchasing real estates. Until outbreak of subprime crisis Swiss Franc and Euro-denominated loans were perceived as safe, stable and beneficial. Borrowers took profits due to disparity of interest rates, which in Poland reached approx. 6 p.p. (in Hungary more than 10 p.p.). Vital factor for Polish borrowers was also long-term depreciation of foreign currencies in years 2004-2008. Since September 2008, due to a high volatility and strong revaluation of Swiss Franc and Euro versus Polish currency, fx borrowers had to repay quickly elevating installments. CHF-denominated loans become in particular under consideration as they were dominant amongst all of fx borrowings and their disbursement peak period occurred around the historical minimum rate of Swiss Franc (CHF/PLN = 1,96 in July 2008). The mentioned period was the most unfavorable from the point of view of borrowers in Poland for taking fx loans, however during that time the highest volume and value of new loans was noted. The problem of fx risk was in particular influencing CHF-borrowers altogether with strong appreciation of Swiss currency versus PLN to the rate CHF/PLN = 3,32 in February 2009, 3,96 in August 2011, and 4,32 in January 2015. To the lesser extent this problem touched euro-borrowers, as in majority they took loans at elevated valuation of EUR. The strong long-term appreciation of Swiss currency as well as dominance of loans taken around minimal valuation of Franc started to question the benefits of fx loans which were expected by the borrowers when taking the decision about choosing the currency of loan. Fx loans during 3-4 years of development started to create a systemic risk in Polish financial sector, and simultaneously turned out to be less beneficial for borrowers than PLN-denominated mortgages. Moreover they had been exposing borrowers onto significant bankruptcy risk.

The main goal of this paper is to evaluate relative financial benefits obtained by private borrowers taking fx mortgage (housing) loans against mortgages in Polish zloty. The benefits would be defined as a difference of total costs of repayment of installments (ordinary annuities) of PLN- and fx mortgage loans, per borrower, per period and in total. To reach the goal, the author elaborated mathematical model to calculate periodically variable actual installments and then total value of repayment of CHF-, EUR- and PLN-denominated loans. Upon the value of repayment, the author proposed nine ratios (measures) to assess the benefits as on the end of 2014. Taking into consideration the goal presented above the author put forward a hypothesis, that fx mortgage loans despite exposing Polish borrowers onto fx and foreign interest rate risk are more beneficial for them (more cost-effective) than loans in domestic currency.

Literature review

The problem of using foreign currency, especially US dollar, on domestic markets known as "dollarization" was quite commonly described in the past years. The reason was that the considered currency was quite often used by many countries as public and private credit. Less commonly one may find results of investigation of using CHF or EUR as credit currencies in CEE countries. Most papers were written in years 2010-2013 as a consequence of dominance of those currencies in mortgage lending and their post crisis negative influence on banks, financial systems as well as whole economies of CEE region. The papers mostly focus on macro aspects. E.g. Brzoza-Brzezina et al. (2010) prove that development of market for fx loans hampers central bank’s monetary policy. The authors find that monetary tightening leads to a decrease in domestic currency lending and
accelerates spreading of foreign currency denominated loans. Brzoza-Brzezina et al. (2015) show that foreign currency loans impair the transmission of monetary policy but do not affect strongly the effectiveness of macroprudential policy. They also find that such loans increase welfare when domestic interest rate shocks are strong and decrease it when exchange rate shocks dominate. Dübel, Walley (2010) investigate markets, effects and regulation of foreign currency mortgage loans in Poland, Hungary, Latvia, Ukraine and Austria. They claim that in high-inflation economies, foreign currency mortgages are likely to be an essential element of the product set, or even the only feasible product option. According to them there is a necessity for retaining foreign currency mortgages under a strict regulatory and support regime. The authors indicate that in low-inflation economies, the social case for foreign currency loans is largely absent, but they advocate for limiting the products to specific cases or banning it. Yesin (2013) analyses the problem of foreign currency loans in different countries in Europe with the special focus onto systemic risk. The author finds that systemic risk due to foreign currency loans is substantial in the non-euro area, while it is rather low in the eurozone countries. According to the author CHF-denominated loans are not the main source of the high systemic risk but rather loans denominated in other foreign currencies. The author finds out that banks in Europe have continuously held more foreign-currency denominated assets than liabilities, what is a confirmation of their awareness of the fx loans credit risk. An influence of foreign currency loans on banking sectors was also investigated by Pann et al. (2010). Their paper was examining the stability and risks of Austrian banks due to foreign currency loans given in CEE and the CIS countries. As Austrian banks played a major role in foreign currency lending in Eastern Europe, their analysis was particularly interesting by giving some outlook from the perspective of crediting institutions. The authors of the paper underline sharp increase of fx lending of Austrian banks in period 2005-2009. They found that quick depreciations of some of the local currencies in the region led to the occurrence of indirect credit risks inherent in foreign currency lending by Austrian banks. Nonetheless, they indicated that loan loss provisions of Austrian banks’ subsidiaries until 2010 could not be linked directly with credit risk in the foreign currency loan portfolio in CEE and CIS countries. They noted that evidence on country level showed nonlinear relationship between the occurrence of indirect credit risk from foreign currency lending and local currency depreciation. Authors also revealed that the funding risks inherent in a foreign currency loan portfolio was not adequately matched by foreign currency deposits. Bethlendi (2011) investigated policies toward foreign currency lending and their efficiency in CEE countries. The author stated that foreign currency lending phenomenon in CEE countries was a result of macroeconomic imbalances. He found that macroeconomic policies mostly turned out to be inefficient against such lending, except the administrative measures which were found most effective only in the short-term due to the high degree of financial liberalisation. The author also indicated that regulatory measures toward fx lending were less efficient, while frequently used supervisory actions, as well as financial education, moral persuasion, or market development measures had just minor effect, if any. Brown and De Haas (2012) investigated relationship between bank ownership, bank funding and foreign currency lending across emerging Europe. They found that foreign currency lending by banks is determined by the macroeconomic environment but not the ownership structure. The authors did not find evidence that foreign banks were preferring foreign currency lending because of an easier access to wholesale funding in foreign currency. Brawn et al. (2010) examined demand-side and supply-side determinants of fx lending in CEE countries. They found out that foreign currency borrowings in CEE countries were driven not only by borrowers trying to get benefits from lower interest rates but also by banks that hesitated to lend...
for a long-term in local currencies and banks eager to match the currency structure of assets and liabilities. Basso et al. (2011) investigated the relationship between an access to foreign funds, interest rate differentials and credit dollarization. They found that increasing access to foreign funds leaded to a higher credit dollarization, while it decreased deposit dollarization. The authors stated that interest rate differentials mattered for the dollarization of both loans and deposits. Fidmuc (2013) analysed determinants of foreign currency loans of households, using data related to the behaviour of households in CEE countries. The authors found that foreign currency loans were driven by households’ lack of trust in the stability of the local currency and in domestic financial institutions. They also claimed that special factors including remittances and expectations of Euro adoption played an important role in CEE countries.

Apart from macroeconomic, systemic risk, and banking sector analysis the problem of fx lending in CEE countries was to the lesser extent investigated from the micro point of view, i.e. financial benefits of borrowers. The reason of it is that in most CEE countries such type of financing clearly turned out to be not beneficial neither to banks not to borrowers due to appreciation of foreign currencies, increased cost of refinancing and increased credit risk. As in Poland most of the existing fx mortgage loans are indexed with floating exchange rate and variable LIBOR or EURIBOR interbank interest rate, the borrowers may compensate the risk of strong appreciation of CHF and EUR with the very deep reduction of interest rates. The evaluation of cost-efficiency, profitability and risk of fx loans in Poland is then more complex than in many other countries of CEE. Up to date there were published just few papers related to evaluation of benefits of borrowers. The preliminary evaluation of cost-efficiency and risks conducted Buszko (2013). The author underlined the problem of high volatility of Swiss currency as well as uncertainty of the future valuation of the Swiss currency and hence loans denominated in francs. According to the author, the major problem of CHF-denominated loans is unfavorable exchange rate at which most of the loans were taken. Such rate would determine from the beginning losses on fx loans. An investigation of CHF appreciation and its risk onto Polish borrowers and banking sector was conducted also by Polish Financial Supervision Authority (2015). The Authority presented rather positive outlook on fx loans repayment against PLN-denominated loans. PFSA considered data confirming very good quality of fx loans, reflected in a very low percentage of non-performing mortgages. Due to that reason, the Authority did not recommend any special support for CHF borrowers, as it would be unjust from the point of view of all borrowers in Poland. According to PFSA any systemic support to CHF-borrowers would be an example of uneven treatment of foreign and domestic currency borrowers.

Macroeconomic background of fx mortgage loans

The fx mortgage loans started to develop intensively in Poland in 2005 as a consequence of interest rate disparity (shock) and intensive promotion by banks, which searched for additional profits. Altogether with very advantageous conditions of Polish economy, i.e. growing GDP with good perspectives for future, decreasing unemployment rate, good views for business development and increase of salaries, banks were able to liberalize their credit policies. They also significantly reduced their credit spreads. At the same time, the optimistic forecasts of personal finance, change in VAT tax rate on building materials after entering EU in 2004 and unmet demand on real property led to significant increase of the real property market. As a consequence, one could note in Poland quick increase of the number of issued building permits, the number of flats whose
construction started as well as number of flats commissioned for use (Report, 2013). Such conditions were interacting with extraordinary development of mortgage loans market and rise of prices of real estates. As the increased economic development in Poland was reflected in elevated inflation rate, hence the National Bank of Poland was implementing monetary policy instruments to maintain the mid-term inflation level at 2.5% with possible adjustments of +/- 1 p.p. As Poland represent an emerging market economy, the target level of inflation is assumed to be higher than in the Western countries. This policy should reduce a difference in the economic development level between Poland and well-developed countries. Since 2002 the interest rates in Poland were structurally significantly higher than in eurozone and Switzerland (Figure 1).

**Figure 1. Interest rates of NBP, ECB and SNB (%)**

[Graph showing interest rates over time]

Source: Own work.

The strong demand on foreign exchange mortgage loans as well as their common sales started since 2005, i.e. during rising valuation of Polish currency. In the next years such trend was maintained and Polish zloty appreciating further, what allowed to achieve profits by all borrowers taking loans in foreign currencies. In July 2008 Polish currency noted historical maximum valuation toward Euro and Swiss Franc. At that time the trend of long-term appreciation of PLN against foreign currencies reverted and altogether with out bursting of the subprime crisis in September 2008 Polish zloty was quickly loosing value until February 2009 (Figure 2). In case of Swiss Franc, it was the first stage of its revaluation, what diminished benefits of fx mortgage loans taken up to that time. Euro become cheaper in the next years, what allowed to take benefits from EUR-denominated loans.

After starting subprime crisis commercial banks in Poland substantially limited granting CHF-denominated mortgage loans, replacing partially CHF with Euro. Such attitude was explained by a high volatility of Swiss currency, deteriorated conditions of interbank market refinancing in CHF, increased credit risk spreads as well as increasing credit risk of fx loans due to increase of CHF/PLN rate.

Table 1 and 2 present statistics of volatility of exchange rate CHF/PLN and EUR/PLN measured by daily return average, standard deviation, median, maximum and minimum daily return as well as annual range of change and annual change.
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FIGURE 2. VALUATION OF EUR AND CHF IN PLN

![Chart showing the valuation of EUR and CHF in PLN from Jan-05 to Jul-14.]

Source: Own work.
Note: Rate on 03.01.2005=100%.

### TABLE 1. VOLATILITY OF CHF/PLN 2005-2011

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average of daily change</td>
<td>-0.0234%</td>
<td>-0.0138%</td>
<td>-0.0376%</td>
<td>0.1103%</td>
<td>0.0079%</td>
<td>0.0643%</td>
<td>0.0621%</td>
</tr>
<tr>
<td>Average of absolute daily change</td>
<td>0.6148%</td>
<td>0.5739%</td>
<td>0.5192%</td>
<td>1.2830%</td>
<td>1.3500%</td>
<td>1.0388%</td>
<td>1.2021%</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>-0.0271%</td>
<td>-0.0249%</td>
<td>-0.0728%</td>
<td>-0.0024%</td>
<td>-0.0277%</td>
<td>-0.0056%</td>
<td>0.0362%</td>
</tr>
<tr>
<td>Median</td>
<td>2.2039%</td>
<td>2.0094%</td>
<td>1.6307%</td>
<td>5.8445%</td>
<td>3.7690%</td>
<td>3.5315%</td>
<td>3.9144%</td>
</tr>
<tr>
<td>Max daily change</td>
<td>-2.0196%</td>
<td>-1.7632%</td>
<td>-1.3715%</td>
<td>-3.5197%</td>
<td>-6.3136%</td>
<td>-5.0708%</td>
<td>-7.5056%</td>
</tr>
<tr>
<td>Annual range of change</td>
<td>12.9525%</td>
<td>10.8986%</td>
<td>14.2178%</td>
<td>42.9577%</td>
<td>26.9259%</td>
<td>20.4845%</td>
<td>33.4210%</td>
</tr>
<tr>
<td>Annual change</td>
<td>-6.1807%</td>
<td>-3.8164%</td>
<td>-9.3449%</td>
<td>29.6104%</td>
<td>-1.2601%</td>
<td>15.0091%</td>
<td>14.8361%</td>
</tr>
</tbody>
</table>

Source: Own work.

### TABLE 2. VOLATILITY OF EUR/PLN 2005-2011

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average of daily change</td>
<td>-0.0202%</td>
<td>-0.0016%</td>
<td>-0.0260%</td>
<td>0.0642%</td>
<td>0.0053%</td>
<td>-0.0075%</td>
<td>0.0448%</td>
</tr>
<tr>
<td>Average of absolute daily change</td>
<td>0.1569%</td>
<td>0.0207%</td>
<td>0.0235%</td>
<td>0.4170%</td>
<td>1.3998%</td>
<td>0.3624%</td>
<td>0.4770%</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>-0.0089%</td>
<td>0.0074%</td>
<td>-0.0392%</td>
<td>-0.0299%</td>
<td>-0.0338%</td>
<td>-0.0864%</td>
<td>0.0189%</td>
</tr>
<tr>
<td>Median</td>
<td>1.9839%</td>
<td>1.9019%</td>
<td>1.2482%</td>
<td>4.0602%</td>
<td>3.8317%</td>
<td>2.4452%</td>
<td>2.2566%</td>
</tr>
<tr>
<td>Max daily change</td>
<td>-1.7963%</td>
<td>-1.5842%</td>
<td>-0.7884%</td>
<td>-2.9967%</td>
<td>-4.4858%</td>
<td>-4.2423%</td>
<td>-1.7528%</td>
</tr>
<tr>
<td>Annual range of change</td>
<td>11.8594%</td>
<td>9.3172%</td>
<td>10.3252%</td>
<td>30.6688%</td>
<td>25.0932%</td>
<td>8.9098%</td>
<td>18.8501%</td>
</tr>
<tr>
<td>Annual change</td>
<td>-5.3739%</td>
<td>-0.7410%</td>
<td>-6.5045%</td>
<td>16.4824%</td>
<td>-1.5387%</td>
<td>-3.2279%</td>
<td>11.5269%</td>
</tr>
</tbody>
</table>

Source: Own work.
The fx risk, the difficulties with refinancing mortgage loans as well as legal solutions provided by Polish Financial Supervision Authority (Rekomendacja T, 2011; Rekomendacja S, 2013) inclined banks to cease granting fx loans mostly since 2012, except of clients of private banking and borrowers receiving incomes in foreign currencies.

Methodology

To investigate if Polish borrowers obtained or are still obtaining financial benefits due to use of fx mortgage loans the author proposed mathematical model of loan repayment for credits in Swiss Franc, Euro and Polish zloty. The model was used to simulate actual conditions of repayment of credits by Polish borrowers. The author assumed principal value of a loan 100.000 zł or equivalent in Swiss Franc and Euro (approx. 25.000 CHF and 24.000 EUR). Loans had been taken between 12.2005 and 12.2012 and repaid between 01.2006 and 12.2014. Such periods reflect their most intensive development (approx. 90% of all currency mortgage loans value and 75% of volume). The model includes actual WIBOR 3M, LIBOR CHF 3M, EURIBOR 3M interest rates which were adjusted with credit spread respectively 1,5% (PLN), 2,0% (CHF) and 2,25% p.a. (EUR). The indexed interest rates with added credit spread are most common practice used by banks in to calculate interest and installments of mortgage loans in Poland. In general, the value of credit spreads reflects availability of currency, volatility risk and a level of bank competition in granting loans. It also represents a minimal interest rate spread obtainable by the borrowers in all of the periods of analysis. The author used foreign average exchange rates CHF/PLN and EUR/PLN taken from quotations of National Bank of Poland. The rates were adjusted with bid-offer spread to convert the value of installments of fx loans into Polish zloty. The analysis was conducted for mortgage loans with maturity of 20 and 30 years, which are repaid from January 2006 in form of ordinary annuities. All the benefits have been calculated as on 31.12.2014.

The model of analysis of relative benefits of loans in CHF and EUR required calculation of a value of installments, which were repaid until 12.2014 due to PLN- and fx-denominated loans. The equations for calculation of installments are as follows:

\[ I_{PLN}(rt) = \frac{D_{PLN}(rt) \cdot r_{PLN}(rt)}{1 - (1 + r_{PLN}(rt))^{-p}}, \]  
\[ I_{FX}(rt) = \frac{D_{FX}(rt) \cdot r_{FX}(rt)}{1 - (1 + r_{FX}(rt))^{-p}} \cdot c_t, \]

Where, \( D \) - principal to repay, \( rt \) - recalculation period (March, June, September, December), \( r \) - monthly interest rate, \( c_t \) - exchange rate, \( p \) - number of installments to repay.

All the installments of loans were recalculated every quarter reflecting change of WIBOR 3M, LIBOR CHF 3M and EURIBOR 3M interest rate and the value of principal of a
loan remaining to repay. On disbursement day the principal of foreign currency loan as well as all installments in the repayment period were exchanged into PLN at the average rate from the first six days of each month. Such rate was reflecting the timing of payment of installments, which in majority take place at the beginning of each month. To simulate actual conditions of fx-denominated loans repayment the author used ±3,5% bid-offer spread on the average value.

The relative benefits/losses of fx loans were calculated as a rule as a difference between total installments repaid on loans in PLN and total installments repaid on loans in foreign currencies. The PLN-denominated loans were generally used as a benchmark for evaluation of benefits as the borrowers naturally seek for credits in their national currency, in which they receive regular income. The author used totally 8 ratios to calculate relative financial benefits of fx-denominated loans.

The first ratio $R_1$ (3) presents the total value of a difference between PLN and fx loans installments repaid from disbursement period until 31.12.2014.

$$R_1 = \sum_{t=1}^{n} (I_{PLN}(t) - I_{FX}(t)),$$  \hspace{1cm} (3)

Where: $t$ - number of month (from disbursement until 31.12.2014)

The second ratio $R_2$ (4) presents benefits per installment (average monthly benefits).

$$R_2 = \frac{\sum_{t=1}^{n} (I_{PLN}(t) - I_{FX}(t))}{n},$$ \hspace{1cm} (4)

The third ratio $R_3$ (5) presents benefits per amount of repaid principal of fx-loans, what is in practice a rate of return on fx loan.

$$R_3 = \frac{\sum_{t=1}^{n} (I_{PLN}(t) - I_{FX}(t))}{\sum_{t=1}^{n} I_{FX}(t)},$$ \hspace{1cm} (5)

Apart from total benefits, average monthly benefits and return on fx loan obtained by an average borrower taking a loan in each month until 12.2012, the author evaluated also average benefits obtained by all of the fx borrowers in a given period. Due to lack of availability of sufficient monthly data, in this calculation the author assumed that the benefits/losses of borrowers are not weighted with volume or value of loans (month).

The ratio $R_4$ (6) presents average benefits obtained by borrowers in a given period.
Where: \( i \) - number of borrowers repaying loans in a given month

The ratio \( R_5 \) (7) shows the benefits obtained by all of the borrowers in a given period in relation to the amount of already repaid installments, what is in fact a rate of return on fx loans.

\[
R_5 = \frac{\sum_{i=1}^{m}(I_{PLN}(i) - I_{FX}(i))}{\sum_{i=1}^{m}I_{FX}(i)},
\]  

(7)

The author proposes also calculation of relative financial benefits as function of the benefits obtained from all installments, which were repaid until the given period by all of the borrowers.

The ratio \( R_6 \) (8) presents total benefits obtained by all borrowers taking loans in a given currency until the period of repayment:

\[
R_6 = \frac{\sum_{i=1}^{n}\left(\sum_{t=1}^{T}(I_{PLN}(i) - I_{FX}(i))\right)}{\sum_{t=1}^{n}t},
\]  

(8)

Ratio \( R_7 \) (9) shows total benefits obtained by all borrowers due to repayment fx loans in relation to the amount repaid.

\[
R_7 = \frac{\sum_{i=1}^{n}\left(\sum_{t=1}^{T}(I_{PLN}(i) - I_{FX}(i))\right)}{\sum_{i=1}^{n}\left(\sum_{t=1}^{T}I_{FX}(i)\right)},
\]  

(9)

The analysis of relative benefits was supplemented also by the ratio \( R_8 \) (10) presenting relation between LtV ratio of PLN- and fx-denominated. Such measure is to indicate the problem of risk of fx loans in relation to PLN-denominated debt.
The findings of research

The analysis of benefits due to taking fx mortgage loans in Poland shows that the level of benefits is variable with highest volatility between 08.2008 and 03.2009 (Figures 3. and 4.).

$$R_8 = \frac{LV_{PLN}(t)}{LV_{FX}(t)},$$  \hspace{1cm} (10)

\[\begin{align*}
\text{FIGURE 3. } & R_1 \text{ VALUE, 20Y LOANS (CHF, EUR)} \\
\text{FIGURE 4. } & R_1 \text{ VALUE, 30Y LOANS (CHF, EUR)} \\
\end{align*}\]
The $R_1$ and $R_2$ ratios show that in most cases of loans (with maturity of 20- and 30-years) and both major currencies (CHF and EUR) fx loans bring any benefits to the borrowers in some periods. 20Y CHF-denominated loans taken between October 2006 and December 2008 as well as July 2009 and April 2010 (for 30Y loans - in period October 2007-September 2008) are not bringing relative benefits. On 31.12.2014 borrowers taking CHF-denominated loans in July 2008 got highest losses (approx. -18.760 zł for 20Y loan and 7.974 zł for 30-Years loan). The highest benefits are noted for borrowers taking loans in CHF in February 2009. The results for 20- and 30-Years loans are +8.478 zł and +10.581 zł. Such results are confirming that the effectiveness of loans is strictly related to the minimal and maximal valuation of CHF observed in both periods (July 2008 and February 2009). In case of EUR-denominated loans borrowers were generating lower losses in the same periods (-8.896 zł for 20-Years loan and -2.591 zł for 30-Years loan in July 2008). The benefits obtained by borrowers taking EUR-denominated loans were higher than in CHF, i.e. +11.445 zł (for 20-Years loan) and +11.577 zł (for 30-Years loan). Both profits were brought by loans taken in February 2009.

Figures 5 and 6 present monthly benefits obtained by borrowers (per installment) and figures 5 and 6 show profitability ratio of borrowers.

**Figure 5. $R_2$ Value, 20Y Loans (CHF, EUR)**

![Figure 5](image)

**Figure 6. $R_2$ Value, 30Y Loans (CHF, EUR)**

![Figure 6](image)
The charts presented above confirm that many borrowers get benefits because of taking fx loans and the expenditures due to their repayment are lower comparing to borrowers taking loans in Polish zloty. In opposite to total benefits measured with $R_1$, the ratios $R_2$ and $R_3$ show that the highest benefits per installment as well as highest return on CHF-denominated loans have been observed for loans taken in August 2011. EUR-denominated loans brought the highest relative benefits (per installments and as a rate of return) when they were taken in February 2009.
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FIGURE 10. R4 VALUE, 30Y LOANS (CHF, EUR)

FIGURE 11. R5 VALUE, 20Y LOANS (CHF, EUR)

FIGURE 12. R5 VALUE, 30Y LOANS (CHF, EUR)

Source: Own work.
The analysis of relative benefits of fx loans with ratio $R_4$ and $R_5$, i.e. nominal benefits for average borrower in a given month and a rate of return of an average borrower confirm trend of systematic decreasing benefits of CHF-denominated loans in time and horizontal whether increasing trend of benefits obtained in case of loans in EUR.

**FIGURE 13. $R_6$ VALUE, 20Y LOANS (CHF, EUR)**

**FIGURE 14. $R_6$ VALUE, 30Y LOANS (CHF, EUR)**

**FIGURE 15. $R_7$ VALUE, 20Y LOANS (CHF, EUR)**
The ratios $R_6$ and $R_7$ indicate that all of the loans denominated in Swiss currency and taken between 12.2005 and 12.2012 are on 31.12.2014 as a whole less profitable (require more repayment) than loans denominated in Euro. 30-years loans in both currencies bring more profits than loans in PLN but 20-years loans in CHF are globally more expensive than in PLN and EUR.

**Figure 16.** $R_7$ Value, 30Y Loans (CHF, EUR)

Source: Own work.

**Figure 17.** $R_8$ Value, 20Y Loans (CHF, EUR)

Source: Own work.

**Figure 18.** $R_8$ Value, 30Y Loans (CHF, EUR)
Apart from the ratios presenting the difference in repayment of total installments, the author wanted to show the problem of valuation of the debt which is remaining to repay. Considering this problem one may use ratio $R_8$, which presents relation between LtV values of fx- and PLN denominated loans.

The ratio $R_8$ shows that fx loans are much more exposing borrowers to repayment risk due to a very high amount of debt exchanged into PLN at elevated price. Apart from short period of disbursement in 2009 and 2011 fx loans generally has higher amount of debt to repay than identical loans denominated in PLN ($R_8 > 1$). A very high disparity is visible in case of CHF-denominated loans (20Y and 30Y) taken in August 2008. Their LtV exceeds by approx. 75 and 73% value of LtV of PLN denominated loans.

**Conclusion**

Fx mortgage loans in Poland concentrate substantial share within total mortgage loans as well as within total assets of entire banking sector in Poland. The fx risk related to such loans and as a consequence systemic risk caused that since 2013 their availability is very low. Due to regulations of Polish Financial Supervision Authority and hardened credit policy of banks they are now available just to individuals receiving incomes in foreign currencies. Nonetheless, taking into account very long period of their repayment, their significance in Poland will remain high, especially thanks to loans given in period 2005-2008. Also, their profitability evaluation will be a complex task as Polish zloty is characterized by clear floating regime and in the nearest future will not be replaced by Euro.

Upon the research conducted by the author of the paper one may draw conclusions as follows:

1. Despite substantial long-term appreciation of foreign currencies (especially CHF) fx mortgage loans bring relative financial profits (generate lower costs than PLN loans) for borrowers taking loans in years 2005-2006 and 2009-2012. In their case, the hypothesis put forward at the beginning of the paper was verified positively. Fx loans in Poland should not to be then considered and classified as systematically unprofitable.

2. The crucial factor that determines effectiveness (benefits) of loans is foreign exchange rate at which the loan was paid out to a borrower. Loans taken at depreciated valuation of CHF and EUR, especially in 2007 and 2008, are bringing substantial losses. Loans taken at inflated valuation of foreign currencies (in 2009 and 2011) are beneficial in Poland despite maintaining prolonged appreciation of Swiss currency and Euro toward Polish zloty.

3. As the level of benefits of fx loans is strongly determined by the disparity of interest rates, the historically lowest level of interest rates in Poland in period 2014-2016 has been reducing benefits of fx loans amongst Polish borrowers (especially those taking CHF loans).

4. As a rule 30-years mortgage loans bring more financial benefits to borrowers than 20-years loans. Such phenomenon is a consequence of appreciation of foreign currencies versus Polish zloty and decreasing their interest rates. In effect it reduces to a greater extent the amount of repayment of total installments and interest incorporated within those installments than in case of 20-years loans. The least beneficial fx loans are those taken in period November 2006-January 2009.
5. When assessing financial benefits of fx mortgage loans by taking into account the amount of debt remaining to repay (LtV ratio) the fx loans are less profitable than loans denominated in PLN. The lowest benefits (highest default risk) generate Swiss Franc loans. EUR-denominated loans are less risky than denominated in CHF but still less profitable than in PLN.

6. Evaluating loans on 31.12.2014 one may find that CHF-denominated mortgage loans are in total less beneficial than loans EUR. All the borrowers taking 20-years CHF loans repay more to the banks than borrowers taking loans in PLN. 20-years loans denominated in EUR as well as 30-years loans in both currencies (CHF, EUR) in total are more beneficial than loans in PLN.

7. Assuming that the valuation of Swiss currency and Euro will be stable in the next years, the relative benefits of the fx loans will be determined by the interest rate disparity. Under the low inflation conditions in Europe, the Polish interest rates might be reduced to the close to zero level. Minimization of the disparity will be reducing benefits on CHF and EUR-denominated loans, making all of such loans unprofitable for borrowers.

Summing up the conclusions one may find that despite financial benefits generated by fx loans for a large part of individual borrowers as well as in general (excluding 20-years loan in CHF), the loans under consideration cannot be unambiguously treated as more beneficial for borrowers than mortgages in PLN. Most benefits are generated by loans taken in some particular periods (i.e. at depreciated value of PLN). The critically negative period for taking CHF-denominated loans was between 10.2007-09.2008 and for EUR 05.2008-09.2008, i.e. when both currencies were priced at the historical low level. The benefits from such loans can be diminished in terms of extraordinary low interest rates in Europe, including Poland.

In opposite to Hungary, where fx mortgage loans were also commonly used, the formula of variable interest rate with added credit risk margin allowed Polish borrowers to trade-off costs related to increased financial market risk and elevated valuation of Swiss currency. As interest rates in Switzerland and eurozone were reduced down to the negative values, borrowers are paying lower interest on loans and hence the lower installments in foreign currency, what transmits into affordable amount of installments paid in Polish zloty. Moreover, the portfolio of fx mortgages represents the highest quality amongst all of the loans in Poland (2,7% of non-performing loans in total value of mortgage loans and 1,8% in their volume in 2014) what is contrary to Hungary.

Despite financial benefits obtainable by some part of Swiss Franc and most of Euro borrowers as well as very good quality of loans, the high LtV ratio exists in almost all of the CHF loans due to high valuation of Swiss Franc. The termination of the loan agreement before its maturity and the obligation of instant lump-sum repayment expose borrowers onto a high bankruptcy risk.

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