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# The impact of inflation on the cost of adjustable-rate mortgages

**Tomasz MUSIAŁOWSKI**

**Wrocław University of Economics, Poland**

**Abstract:**

**Aim:** To assess how inflation affects the cost of adjustable-rate mortgage from the perspective of personal finances.

**Design / Research methods:** Adjustable-Rate Mortgage simulations were carried out, showing both the nominal and real costs of a mortgage loan. The behavior and the relationship between the inflation rate and WIBOR 3M rate were compared.

**Conclusions / findings:** The analysis shows that the real cost of mortgage decreases with an increase in inflation. During the period under review, inflation declined, reducing both the real and nominal cost of the loan. There was a strong positive correlation between the WIBOR 3M rate and the inflation rate. Equally strong, although a negative correlation was observed between the inflation rate and the real interest rate. With the decline in inflation, real mortgage rates increased, and vice versa. Particular attention was paid to the periods in which inflation was rising. WIBOR 3M rate reacted to this increase to a much lesser extent and with a lag compared to the inflation rate.

**Originality / value of the article:** Considering that forecasts presented by the National Bank of Poland predict inflation growth in the coming years, a thorough examination of the inflation impact on the mortgage costs is an important issue for risk management in households with mortgage.

*Key words: inflation, adjustable- rate mortgage, debt management, personal finance*
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## 1. Introduction

Inflation is a very complex phenomenon, affecting numerous and varied dimensions of economic life of all economic entities: from nations to enterprises, to every person who owns funds. Inflation is a sustained increase in prices whose consequence is a decrease in the purchasing power of currency. In other words,

Correspondence address: Tomasz Musiałowski, Wrocław University of Economics, Poland. E-mail: tomasz.musialowski@ue.wroc.pl
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inflation provides information on how the purchasing power of currency changes (Damodaran 2007: 509–13). Currency is a carrier of value and with the value falling a smaller number of goods and services can be purchased for the same amount of money.

The history of inflation dates back to the beginnings of economy with the level of inflation being strongly linked to the size of money supply. In the Middle Ages prices stayed at a relatively fixed level. The first global increase in prices came with the discovery of gold and silver sources in the New World and a sudden increase in the amount of money in the economy of that time. The second increase, and on a greater scale, began with the advent of the twentieth century and the abandonment of the gold standard (Samuelson, Nordhaus 2012: 619–22). The history of modern inflation begins with the introduction of fiduciary money and the possibility to print theoretically unlimited additional money.

High inflation is harmful for the entire economy, capable of slowing down economic growth and leading to irrational behavior of economic entities, which is the reason why the governments pursue monetary policy in a manner that seeks to keep inflation at a stable and low level, thereby stimulating a long-term economic growth (Musielak-Linkowska 2007: 13). In Poland, monetary policy is run by the Monetary Policy Council, a constitutional body of the National Bank of Poland (NBP), which has a variety of instruments for combating inflation, in particular, the interest rate (the Act on the National Bank of Poland of 1997 Article 12). The NBP's inflation target is at 2,5% with a possible fluctuation of 1 percentage point from the target. The NBP influences the level of inflation mainly by defining interest rates which determine the profitability of the monetary policy instruments (National Bank of Poland 2016). The two of those rates, deposit rate and Lombard rate, can have a considerable impact on the costs of mortgages in Poland.

The deposit rate is the interest rate on deposits of commercial banks charged by a central bank; Lombard rate is the interest rate on the central bank's loans granted against securities. These rates are linked to WIBOR rate, which defines the interest rates applied when commercial banks lend money to one another (ACI Polska 2016). The WIBOR level is between the levels of these two rates, since it would not be viable for a commercial bank to lend money to other banks more cheaply than to a

central bank whose default risk is smaller; or to borrow from other banks at a higher cost than that when borrowing from the National Bank of Poland.

The WIBOR rate, on the other hand, is the basis for the calculation of adjustable-rate mortgage in Poland. Banks determine the interest rates on those loans at the level of WIBOR rate plus a margin.

An excessive increase in inflation can be the reason for the Monetary Policy Council to raise the interest rates of the National Bank of Poland. This measure will lead to an increase in WIBOR rate, and thus an increase in the mortgage rates, thereby increasing the nominal amount of interest rates. On the other hand, however, inflation will reduce the real value of installments paid. In the existing literature the problem of the impact of inflation on the cost of adjustable-rate mortgage has not been solved.

The first section of the paper encompasses a review of literature which discusses the impact of inflation on the cost of credits and loans, in particular, mortgages. Personal finances do not represent a part of financial science that has been developed considerably in Poland, with very few Polish scholars addressing the subject of inflation from the point of view of an individual – that is why English language publications are predominant in the literature. A substantial number of papers focuses on the issue of choosing between a fixed-rate mortgage and adjustable-rate mortgage.

In order to examine how inflation impacted the real mortgage cost in Poland, a study was conducted which will be outlined in the second section of this paper. The study consists of two mortgage simulations: one for a mortgage loan taken out on 1 January 2001 for 15 years and the second for the loan taken out on 1 January 2006 for the term of 10 years. The choice of such timeframes was linked to high WIBOR rates in the years 2001 and 2002, which were the legacy of the hyperinflation of the 1990'.

The aim of the paper is to determine the effects of inflation, mainly from the perspective of the science concerned with personal finances. Making decisions on taking mortgage, many people do not take into consideration inflation; while making decisions to on a long term debt obligation, even as long as 30 years, for a relatively substantial amount of money in relation to income on the basis of nominal values,

people fail to take into account the risk involved in the change of the level of interest rates or the time value of money.

## 2. Literature review

Inflation is a phenomenon inextricably linked to money. The first attempts to address the subject of inflation date as early as the Middle Ages. The Czech chronicler Kosmas writes the following: ”it is certain that no disaster, no plague nor death could do more harm to the people of God than the frequent change and treacherous deterioration of monies (Kosmas 1968: 165).”

Spoiling money, that is, melting down coins into new ones, smaller and of lesser purity was a frequent procedure among Medieval rulers. In the fourteenth century Oresmes (Nicolas Oresme), a lecturer at Sorbonne and Bishop of Lisieux in his *Treatise on the origin, nature, law, and alterations of monies* voiced his view against the nominalist concept of money. He maintains that money should have autonomous value as noble metal and in spoiling it one leads to its decline in trade and a decline of better money in circulation (good coinage is driven out of circulation by bad). Moreover, in the sixteenth century, of the same view was Nicolaus Copernicus in *Treatise on Money* and Thomas Gresham in *Information Touching the Fall of Exchange* (sometimes knows as Copernicus-Gresham law) (Morawski 2002: 48–49).

E. Henry Phelps-Brown and Sheila V. Hopkins studied inflation based on the available data from England (since the 17$^{th}$ century, Great Britain) over the period of seven centuries until the present times. They observe that a clear increase in inflation has been linked to an increase in money supply (Phelps-Brown, Hopkins 1956). Such events occurred during the conquest of Scotland and Wales in the 13$^{th}$ century, at the time of immense colonial acquisitions at the turn of the 17$^{th}$ century and the North American gold rush in the 18$^{th}$ century. The events which had a ruining effect on the English (and British) economy – Hundred Years' War, Wars of the Roses, the English Civil War, Napoleonic Wars and Revolutions of 1848 – caused deflation.

The turning point leading to the change in the nature of inflation came with the Great War. Its participants suspended the possibility of exchanging money for precious metal, fearing that the hostile nations would use it to their advantage; that

the situation will return to normal after the end of the war was a widely held expectation. The war was financed largely by an inflation policy while the 1920' saw the attempts made to return to the situation before 1914. This, however, proved unrealistic with one of the effects of these attempts being deflation, which in the following decade would lead to the Great Depression (Morawski 2002: 130–44) in 1929, whose end in the 1930' marked the departure from the gold standard (Morawski 2002: 162–64).

With money becoming fiduciary, the governments could theoretically issue it with no limitations turning the inflation phenomenon into an important issue for growing economic sciences.

The first landmark theory pertaining to inflation was formulated by Irving Fisher, who asserts that prices change along with the amount of money in circulation, while taking into account the speed at which money circulates and the total volume of transactions in which this money has been used (Fisher 1914). After the Second World War, the leading macroeconomic theory was Keynesian economics created by John M. Keynes, which consists in a strong intervention on the part of state governments. In the 1960' the theory yielded good results; however, the following decade saw inflation grow with economies becoming inured to interventionist stimulations (Morawski 2002: 153–54). Keynesian economics was superseded by monetarism, which stood in opposition to Keynes's theory, with Milton Friedman being its most prominent figure. Friedman expanded the Fisher's quantity theory of money: money is neutral, which means that it does not influence the development of real economic values, being capable of affecting only nominal values. Monetarists advocated to keep inflation at a level of approximately 3-4% annually, commensurate to the natural growth of the economy's supply potential (Morawski 2002: 198–200).

Since Fisher's times, inflation has been one of the topics addressed rather frequently in finances. However, the focus has been mostly on the macroeconomic side with much less attention being paid to examining inflation from the perspective of an enterprise, and with even fewer studies concerned with inflation from the point of view of a household or an individual.

In the 1970s Donald R. Lessard and Franco Modigliani (1975) formulated the

phenomenon of mortgage tilt: countering inflation brings about an increase in mortgage interest rates – investors compensate in this way the loss of purchasing power of their receivables, which in turn leads to increased annual payments needed to purchase a house at a particular value. However, when mortgage rates grow only to such a degree as to protect the value of the money made available, the increased payments, despite the increased nominal amount, fail to increase the real value of costs borne by the borrower for purchasing a house, since this money continues to be its equivalent.

Nevertheless, this increase has a significant impact on the distribution of cash flow over time. High mortgage rates which are to compensate for the future decline in purchasing power of money have the effect that initial installments can be a considerable burden for borrowers when set beside their income. Over time the purchasing power of money is reduced, which is coupled with the reduced burden of household budgets, and yet the initial high installments are a factor which restricts the demand for home loans among those who may be interested in borrowing money to purchase a property, and yet they cannot afford it over a long-term. The higher the inflation, and thus higher initial installments, the more people have to abandon home purchase plans (Lessard, Modigliani 1975: 13–20).

Another problem which they have observed was the uncertainty as regards future inflation. For loans with a fixed interest rate, which have been the most popular type of mortgages in the United States, the rates are dependent on the inflation recorded at the moment of signing a mortgage contract. The level of inflation, however, is characterized by high volatility and therefore granting loans at a low level of inflation involves some risk for lenders, while with high inflation the risk is on the side of borrowers. Such a situation leads to considerable market imbalances: with low inflation loan demand is high, but supply is low; with high inflation, on the other hand, the situation is reverse – supply is incomparably higher than demand (Lessard, Modigliani 1975: 21). The uncertainty related to future inflation represents a substantial cost in business operations for enterprises which sign long-term agreements – and banks providing mortgages are certainly that (Fischer, Modigliani 1978: 828–29).

Lessard and Modigliani have demonstrated several possible solutions to the

above problems, which could consist in a varying rate depending on the level of a specific reference rate (ARM – Adjustable-Rate Mortgage) or price level adjusted mortgage (PLAM). This would solve the problem linked to the lender's risk and the imbalance on the part of supply, albeit the interest rate risk would be shifted entirely onto the borrower. This would not solve the problems relating to demand – with high inflation, mortgages would still be available to households which could afford them in a situation of fixed monetary value. This problem could be partially managed in that the interest rates would be based on the level of prices of goods and services; however, such a construction could undermine the stability of the US financial system (Lessard, Modigliani 1975: 27–37).

These observation have been confirmed by empirical studies conducted by James R. Kearl, who emphasizes that inflation in its own right as well as the measures designed to counter it exert influence on both mortgage supply and demand, and simultaneously the demand on the property market (Kearl 1979). James R. Follain estimated, based on an econometric model, that an increase in inflation by 1% caused a decline in demand for housing at a level ranging from 4 to 5% (Follain 1982).

In 1991 Jeffrey Telgarsky and Katherine Mark (1991) compared various forms of loan interest using as their example data from Turkey, where over the years 1970-1990 inflation was high and showing high volatility: from 1970 to 1977 it ranged between 10 and 20%, with inflation turning into hyperinflation at a level of over 110% and not falling below 40% until 1990. The authors compared a mortgage with fixed rates, different types of adjustable-rate mortgage and interest rates adjusted according to inflation rate. In the case of the fixed rate mortgage, creditworthiness proved to be very low owing to the significant burden of the first installment, which is a considerable drawback from the borrower's point of view. Moreover, the lender's internal rate of return after the payment period of 15 years was negative because of fixed-rate installments and the rapidly decreasing value of money: e.g. the real value of the loan paid back which was granted in the amount of 26 249 lira was only 16 763 lira.

The interest of the borrower would have been secured if the mechanism of adjusting payments according to the inflation rate had been applied; however, the analysis showed a substantial risk being borne by the borrower: when in 1988 real

wages fell, the borrower's burden would have amounted to as many as 40% of his salary (instead of the predicted 20%). Adjustable rate is an indirect solution: it transfers the risk arising from price volatility onto borrower, but not to such a degree as PLAM: when inflation increases, the rates increase, but the principle value stays at the nominal level, allowing a bank to recover its receivables together with some of the interest rates (internal rate of return is positive, but lower than in the case of PLAM). A drawback of ARM is reduced loan availability, since the first payment is only slightly lower than is the case for fixed rates.

The author notes that in countries with interest rates based on price level adjusted mortgage the consumers' pressure (e.g. Brasil, Chile and Israel) forced banks or regulators to change the form of interest rates in such a way as to make it less risky for borrowers (Telgarsky, Mark 1991). The research conducted by Telgarsky and Mark was theoretical in its nature, whereas James D. Shilling, Upinder S. Dhillon and C. F. Sirmans carried out an empirical study on micro-data on loans taken out in the USA. They find that households with a more stable income and those which considered the possibility of moving into next property tended to choose loans with adjustable rather than fixed rates (Dhillon et al. 1987). John Y. Campbell and João F. Cocco address the problem of the choice of mortgage rates focusing on risk management and not economic costs. They argue that households with a lower ratio of property value to income, a more stable income, lower risk aversion and a higher probability of moving house should choose adjustable-rate mortgage. However, the authors caution that their recommendation arises from the fact that they do not accept loan terms under which the lender were to suffer a loss (Campbell, Cocco 2003).

Inflation is the borrower's best friend, for it reduces the real value of debt – especially in the case of fixed interest rates when the value of housing, prices of other goods and services, and wages grow while the nominal amount of payment does not change. This is demonstrated by the late 1970' in the United States when the fast growing inflation reduced substantially borrowers' debts (Bodie et al. 2007: 17). It is also worth noting that assuming that the difference between the nominal rate and inflation rate is the same, higher inflation at higher interest rates over a long-term reduces the real cost of a loan more than is the case for lower inflation and lower interest rates (Debelle 2004: 55–56).

Personal finances are an interdisciplinary subject and as such its research issues often go beyond the traditional framework within which the science of finances is considered (Schuchardt et al. 2007). In dealing with people's finances one should bear in mind that *homo oeconomicus* does not really exist, as it is a simplified model of rational economic decisions (Thaler 1996: 227). An individual who makes financial decisions must remember about his flaws and human limitations – in this case mainly psychological constraints. One example of such limitations is the phenomenon of money illusion. Irving Fisher defines money illusion as a lack of discernment that a dollar or any other currency can gain or lose in value (Fisher 1928). Don Patinkin refers to money illusion as any departure from making decisions exclusively in real conditions: a person will feel money illusion if excessive demand on goods does not depend solely on relative prices and on real value (Patinkin 1965: 22). Moreover, Wassily Leontief argues that money illusion does not occur if demand and supply functions are homogeneous of degree zero (Leontief 1936).

Money illusion is strongly related to framing effect by which a different presentation of the same situation can lead to a completely different behavior (Tversky, Kahneman 1981). People's preferences largely depend on whether a problem is expressed in nominal units or in real units. The framing effect can be observed in the perception of time and risk tolerance. If a situation is presented in nominal conditions, people show a tendency to choose nominally less risky solutions, even if in real conditions this solution may prove to be more risky; likewise, if a problem is described in real conditions, people tend to choose a solution that is less risky in real conditions (Shafir et al. 1997).

The studies conducted by Robert J. Shiller suggest that people do not perceive inflation as a factor affecting an increase in wages (Shiller 1997a). Less than 1/3 of respondents knew that their nominal salary had increased over the last years because of inflation (Shiller 1997b). The findings of these observations can be transposed onto the way the mortgage costs are perceived, with the effect being that decisions as to the choice of mortgage are made on the basis of nominal data, while disregarding the influence of inflation. In addition, the effect of mental accounting is also present here in that people "enter in the books" gains and losses in separate "mental accounts", which in turn makes them fail to notice the links between them (Thaler

1980). In the case of mortgages they tend to ignore the fact that inflation affects the decline in the real value of their payments and of their salary because it is recognized (entered in the books) as an increase in prices.

Research shows that the key information when choosing mortgage is the current cost in relation to household's resources and abilities (Breslaw et al. 1996; Edwards 1997), or nominal interest rates (Leece 1995). The nominal mortgage rate is precisely what provides the basis for borrowers' choice of the cheapest offers, with the borrowers paying little attention (sometimes paying no attention at all) to the factors exerting a substantial influence on long-term costs. Borrowers who search for loans focus exclusively on mortgages, without considering any other additional products such as life insurance or repayment protection insurance. If these components are required by banks, they see them as mortgage costs (Skinner et al. 2000). In making their choice, consumers also pay attention to the reputation and trust which a particular institution enjoys (Rowlingson 2000), frequently discussing the issue with family and close friends (Skinner et al. 2000).

## 3. Description of the study

Making a decision on taking out a mortgage on the basis of the current financial situation, taking no account of inflation forecasts nor forecasts with respect to changes in income and household costs is vitiated by two serious hazards. The first one involves financial problems in case of increased inflation, and thus an increase in monthly payments, if household's income does not grow as well. The second is the risk of failing to choose the right moment for taking out a loan.

The study concerned with the scale of the first hazard was conducted based on mortgage simulations which were carried out using available national data. The study consisted of two mortgage simulations: one for a mortgage taken out on 1 January 2001 for a 15-year-term and the second one taken out on 1 January 2006 for 10-year-term. The choice of such timeframes was dictated by the attempt to select the longest possible mortgage horizon while being limited by high WIBOR rate in 2001 and 2002.

The 15-year-period contains high WIBOR rates (average for 2001 – 16.13%; average for 2002 – 8.99%) being the legacy of hyperinflation. The shorter period spanning 10 years started with the then lowest level of WIBOR rate (average for 2006 – 4.21%) and low inflation (1%). Adjustable-rate mortgage consists of a base rate which in Poland is usually represented by WIBOR 3M (sometimes WIBOR 6M) and a bank margin, which is fixed during the entire period of financing. In the simulation, the bank margin was determined at 1.5%. The level of the base rate is calculated as average of all observations for WIBOR 3M rate in a given calendar year (e.g. the base rate from 2002 is average of observations for WIBOR 3M throughout the entire 2002 and was at 8.99%).

The simulation did not take into account any other additional fees such as commission for granting mortgage, a bridging insurance or fees for purchasing additional products. The mortgage was paid in declining installments for a loan amount equal to a 100 thousand zloty.

**Table 1. Inflation level in Poland over the period of 2001-2015**

| Year | Inflation level (r/r) | Year | Inflation level (r/r) | Year | Inflation level (r/r) |
|---|---|---|---|---|---|
| 2001 | 5.5% | 2002 | 1.9% | 2003 | 0.8% |
| 2004 | 3.5% | 2005 | 2.1% | 2006 | 1% |
| 2007 | 2.5% | 2008 | 4.2% | 2009 | 3.5% |
| 2010 | 2.6% | 2011 | 4.3% | 2012 | 3.7% |
| 2013 | 0.9% | 2014 | 0% | 2015 | -0.9% |

Source: Central Statistical Office, annual Consumer Price Index

Table 1 shows the annual values of Consumer Price Index in Poland over the period examined. In 2002 inflation was reduced to the level compliant with the strategic inflation target (3.5% until the end of 2003) and was at 1.9%. In 2003 the central bank with a view to strengthen the low inflation shifted from annual inflation targets to a continuous target. The Monetary Policy Council of the first term set it at 2.5% with permissible fluctuation band of +/-1 percentage point (National Bank of Poland 2001-2006 2007: 22-25). Inflation rising above the target corresponds to financial crises: the American housing market crisis at the turn of 2007/ 2008 and the

Greek debt crisis at the turn of 2010/2011. Since 2013 there was a clear decline in inflation, with 2014 seeing it at 0%, and in the following year there was deflation at 0.9%.

**Table 2. Average level of WIBOR 3M rate over the period of 2001-2015**

| Year | WIBOR 3M level | Year | WIBOR 3M level | Year | WIBOR 3M level |
|---|---|---|---|---|---|
| 2001 | 16.13% | 2002 | 8.99% | 2003 | 5.68% |
| 2004 | 6.21% | 2005 | 5.28% | 2006 | 4.21% |
| 2007 | 4.72% | 2008 | 6.36% | 2009 | 4.41% |
| 2010 | 3.93% | 2011 | 4.54% | 2012 | 4.91% |
| 2013 | 3.03% | 2014 | 2.52% | 2015 | 1.75% |

Source: calculated based on https://wibor.money.pl/

Table 2 presents the level of the average WIBOR 3M rate throughout the years 2001-2015. The values represent an arithmetic mean of all observations for WIBOR 3M rate in a given calendar year. The observation to be made is that there is a fairly strong positive correlation between inflation and WIBOR3M rate. The direction of changes with respect to inflation and the average WIBOR rate was the same in almost each year (except 2012 when inflation fell and WIBOR 3M rose); however, the level of those changes was different. One could say that WIBOR 3 responded to a smaller extent, and sometimes its reaction was lagged by one-period compared to inflation. Pearson correlation coefficient determined for inflation rate and WIBOR 3M rate over the period of 2001-2015 was at 0.6375; while in 2006-2015 it was at 0.8842.

**Table 3. Simulation of a mortgage taken out for 15 years – nominal values**

| Instalment no | total instalment | interest instalment | debt | year |
|---|---|---|---|---|
| 1 | 2 024.72 zł | 1 469.17 zł | 99 444.44 zł | 2001 |
| 13 | 1 371.44 zł | 815.89 zł | 92 777.78 zł | 2002 |
| 25 | 1 074.11 zł | 518.56 zł | 86 111.11 zł | 2003 |
| 37 | 1 069.56 zł | 514.00 zł | 79 444.44 zł | 2004 |
| 49 | 969.89 zł | 414.33 zł | 72 777.78 zł | 2005 |
| 61 | 872.78 zł | 317.22 zł | 66 111.11 zł | 2006 |
| 73 | 866.56 zł | 311.00 zł | 59 444.44 zł | 2007 |
| 85 | 904.89 zł | 349.33 zł | 52 777.78 zł | 2008 |
| 97 | 785.39 zł | 229.83 zł | 46 111.11 zł | 2009 |
| 109 | 736.56 zł | 181.00 zł | 39 444.44 zł | 2010 |
| 121 | 723.33 zł | 167.78 zł | 32 777.78 zł | 2011 |
| 133 | 698.00 zł | 142.44 zł | 26 111.11 zł | 2012 |
| 145 | 631.06 zł | 75.50 zł | 19 444.44 zł | 2013 |
| 157 | 600.22 zł | 44.67 zł | 12 777.78 zł | 2014 |
| 169 | 573.61 zł | 18.06 zł | 6 111.11 zł | 2015 |
| TOTAL | **163 611.81 zł** | **63 611.81 zł** | | |

Source: self-reported data

**Table 4. Simulation of a mortgage taken out for 10 years – nominal values**

| Instalment no | total instalment | interest instalment | debt | year |
|---|---|---|---|---|
| 1 | 1 309.17 zł | 475.83 zł | 99 166.67 zł | 2006 |
| 13 | 1 299.83 zł | 466.50 zł | 89 166.67 zł | 2007 |
| 25 | 1 357.33 zł | 524.00 zł | 79 166.67 zł | 2008 |
| 37 | 1 178.08 zł | 344.75 zł | 69 166.67 zł | 2009 |
| 49 | 1 104.83 zł | 271.50 zł | 59 166.67 zł | 2010 |
| 61 | 1 085.00 zł | 251.67 zł | 49 166.67 zł | 2011 |
| 73 | 1 047.00 zł | 213.67 zł | 39 166.67 zł | 2012 |
| 85 | 946.58 zł | 113.25 zł | 29 166.67 zł | 2013 |
| 97 | 900.33 zł | 67.00 zł | 19 166.67 zł | 2014 |
| 109 | 860.42 zł | 27.08 zł | 9 166.67 zł | 2015 |
| TOTAL | **130 524.75 zł** | **30 524.75 zł** | | |

Source: self-reported data

Tables 3 and 4 present the simulation of mortgages carried out according to the assumptions already given for the period of 15 and of 10 years. While paying back long-term loans, one should take into account inflation. Edward Smaga suggests that it can be done by raising the interest rate by the inflation rate or by discounting nominal values, with inflation rate being set as the discount rate (Smaga 1999: 162–63). For the calculation of the real loan cost by discounting nominal values, the base value which was adopted was the one from the moment of granting the loan. For the 15-year loan, the real value was set as the nominal value of PLN in 2000, and for the 10-year loan it was its nominal value in 2005.

**Table 5. Simulation of a mortgage taken out for 15 years – real values (2000 = 100%)**

| instalment no | total instalment | interest rate value | debt | year |
|---|---|---|---|---|
| 1 | 1 913.36 zł | 1 388.36 zł | 99 444.44 zł | 2001 |
| 13 | 1 271.33 zł | 756.33 zł | 92 777.78 zł | 2002 |
| 25 | 987.75 zł | 476.86 zł | 86 111.11 zł | 2003 |
| 37 | 949.12 zł | 456.12 zł | 79 444.44 zł | 2004 |
| 49 | 842.64 zł | 359.97 zł | 72 777.78 zł | 2005 |
| 61 | 750.69 zł | 272.85 zł | 66 111.11 zł | 2006 |
| 73 | 726.71 zł | 260.81 zł | 59 444.44 zł | 2007 |
| 85 | 726.98 zł | 280.65 zł | 52 777.78 zł | 2008 |
| 97 | 608.89 zł | 178.18 zł | 46 111.11 zł | 2009 |
| 109 | 556.19 zł | 136.68 zł | 39 444.44 zł | 2010 |
| 121 | 522.71 zł | 121.24 zł | 32 777.78 zł | 2011 |
| 133 | 485.74 zł | 99.13 zł | 26 111.11 zł | 2012 |
| 145 | 435.20 zł | 52.07 zł | 19 444.44 zł | 2013 |
| 157 | 413.94 zł | 30.80 zł | 12 777.78 zł | 2014 |
| 169 | 399.15 zł | 12.56 zł | 6 111.11 zł | 2015 |
| TOTAL | **136 401.43 zł** | **55 907.96 zł** | | |

Source: self-reported data

**Table 6. Simulation of a mortgage taken out for 10 years– real values (2005 = 100%)**

| instalment no | total instalment | interest rate value | debt | year |
|---|---|---|---|---|
| 1 | 1 296.08 zł | 471.08 zł | 99 166.67 zł | 2006 |
| 13 | 1 254.66 zł | 450.29 zł | 89 166.67 zł | 2007 |
| 25 | 1 255.14 zł | 484.55 zł | 79 166.67 zł | 2008 |
| 37 | 1 051.26 zł | 307.64 zł | 69 166.67 zł | 2009 |
| 49 | 960.26 zł | 235.97 zł | 59 166.67 zł | 2010 |
| 61 | 902.47 zł | 209.33 zł | 49 166.67 zł | 2011 |
| 73 | 838.64 zł | 171.15 zł | 39 166.67 zł | 2012 |
| 85 | 751.38 zł | 89.90 zł | 29 166.67 zł | 2013 |
| 97 | 714.67 zł | 53.18 zł | 19 166.67 zł | 2014 |
| 109 | 689.13 zł | 21.69 zł | 9 166.67 zł | 2015 |
| TOTAL | **114 342.99 zł** | **27 715.83 zł** | | |

Source: self-reported data

Over most of the period analyzed, inflation kept on falling, with its rise being recorded only in 2004, 2007, 2008 and 2011. Following the inflation decline the interest rates were reduced, which in turn also affected the fall in the level of WIBOR 3M rate. The fall in the reference rate led to the fall in the adjustable-rate mortgages, which had the effect that their nominal cost was reduced. The average inflation rate calculated according to GUS (Central Statistical Office) indicators in 2001-2015 was at 2.37%, and in 2006-2015 at 2.00%. Despite the falling inflation, it was still at a positive level, thus reducing the value of the installments paid. Eventually, the nominal cost of the mortgage taken out in 2000 was 62 611.81 zł, while that taken out in 2005 was equal to 30 524.75 zł; the real cost borne by borrowers was smaller by approximately a half: respectively 36 401.43 zł and 14 342.99 zł.

The fall in inflation causes the fall in interest rates, and as such also in the nominal cost of mortgage. However, if this decline does not result in deflation, the real cost gets reduced even more than the nominal one. Moreover, a more complex issue is the impact of inflation rise on the real cost of mortgage.

The rise in inflation leads to an increase in interest rates, in the reference rate and

in interest – and thus to raising the nominal cost of mortgage. However, bigger inflation precipitates depreciation of money. The impact of rising inflation on the real mortgage cost will depend on which force is stronger – whether the increase in the nominal cost is substantial enough to raise the real cost as well. To examine this influence, observations were chosen for the years in which inflation grew and they are presented in Table 7.

**Table 7. Comparison between nominal and real installments of a 15-year mortgage throughout the periods of increased inflation**

| Year | Inflation | WIBOR 3M | Nominal instalment | Real instalment | Nominal difference | Real difference |
|---|---|---|---|---|---|---|
| 2003 | 0.8% | 5.68% | 1 074.11 zł | 987.75 zł | | |
| 2004 | 3.5% | 6.21% | 1 069.56 zł | 949.12 zł | -4.55 zł | -38.63 zł |
| 2006 | 1% | 4.21% | 872.78 zł | 750.69 zł | | |
| 2007 | 2.5% | 4.72% | 866.56 zł | 726.71 zł | -6.22 zł | -23.98 zł |
| 2008 | 4.2% | 6.36% | 904.89 zł | 726.98 zł | 38.33 zł | 0.27 zł |
| 2010 | 2.6% | 3.93% | 736.56 zł | 556.19 zł | | |
| 2011 | 4.3% | 4.54% | 723.33 zł | 522.71 zł | -13.23 zł | -33.48 zł |

Source: self-reported data

In 2004 inflation rose by 2.7 percentage points (from 0.8% in 2003 to 3.5% in 2004). Over the same period the average level of WIBOR 3M rate rose by 0.53 percentage point (from 5.68% in 2003 to 6.21% in 2004). According to the loan payment schedule, the declining installment should fall by 39.89 zł (with fixed interest rate). This demonstrates that there was a minor increase in the real mortgage cost in the year in which interests were raised. One can assume that if inflation was to remain at such a level for a longer period of time, interest rates should not change. Then the higher inflation would bring about a more rapid loss in the value of money, and of the payments made, which would ultimately lead to a situation where the real cost of mortgage would be substantially lower than its nominal cost.

A similar situation occurred in 2007, when inflation rose by 1.5 percentage points (from 1% in 2006 to 2.5% in 2007), while WIBOR 3M grew by 0.51 percentage point (from 4.21% to 4.72% ). An increase in inflation was also recorded

in the following year – by 1.7 percentage points, with WIBOR 3M rising only then to the extent which would allow it to have a considerable impact on the mortgage cost (by 1.64 percentage points) – the real cost of mortgage rose by 0.27 zł, instead of falling by 34.56 zł.

**Table 8. Comparison between inflation, average WIBOR 3M rate and real interest rate**

| Year | Inflation | WIBOR 3M | Real interest rate |
|---|---|---|---|
| 2001 | 5.5% | 16.13% | 11.02% |
| 2002 | 1.9% | 8.99% | 7.94% |
| 2003 | 0.8% | 5.68% | 5.83% |
| 2004 | 3.5% | 6.21% | 3.58% |
| 2005 | 2.1% | 5.28% | 4.09% |
| 2006 | 1% | 4.21% | 4.17% |
| 2007 | 2.5% | 4.72% | 3.14% |
| 2008 | 4.2% | 6.36% | 3.03% |
| 2009 | 3.5% | 4.41% | 1.85% |
| 2010 | 2.6% | 3.93% | 2.27% |
| 2011 | 4.3% | 4.54% | 1.19% |
| 2012 | 3.7% | 4.91% | 2.13% |
| 2013 | 0.9% | 3.03% | 3.10% |
| 2014 | 0% | 2.52% | 3.52% |
| 2015 | -0.9% | 1.75% | 3.68% |

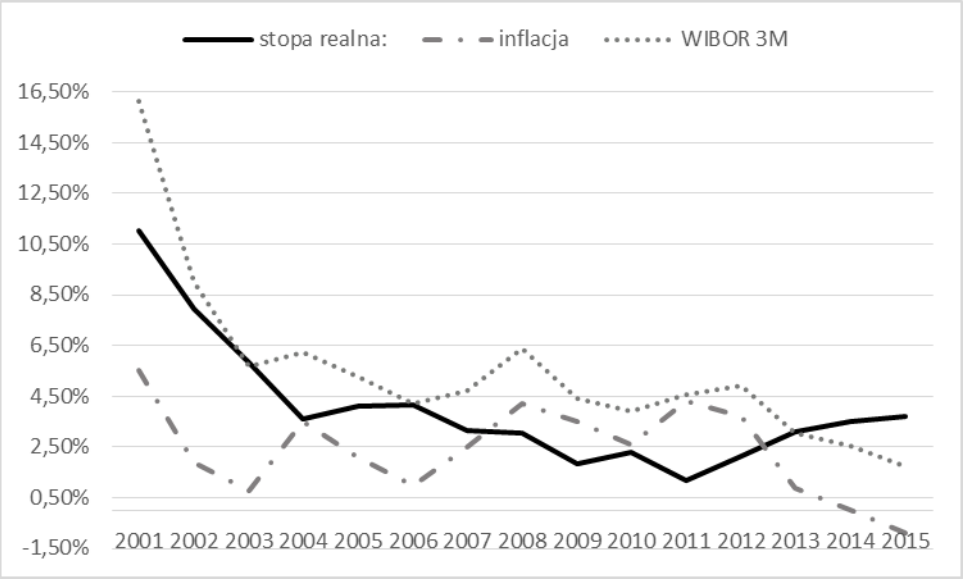
Source: self-reported data

Table 8 shows the comparison between inflation, the average WIBOR 3M rate and real interest rate. The real interest rate was calculated according to the assumptions included in the mortgage simulations prepared earlier. As many as 11 out of 14 observations of the real interest rate had an opposite direction (rise/fall) than the direction of inflation change. The analysis of correlations for the data from 2003-2015 also showed a strong negative correlation (Pearson correlation coefficient was equal to -0.617). The graphic analysis of the chart confirms these results.

One can see on the chart the relationships relating to certain time shifts. It is

possible to discern the lag in changes between the level of interest rates and the level of inflation. The phenomenon of hysteresis can be explained in that interest rates, as an instrument of price stabilization, are dependent on the level of inflation.

**Chart 1. Comparison between inflation, average WIBOR 3M rate and the real interest rate**




Source: self-reported data

This implies that when inflation grows, real mortgage rates fall, and with inflation falling, real mortgage rates increase. On the basis of the data collected for the Polish market, after excluding 2001 and 2003, one can say that when inflation was low, real mortgage rates were high, and when inflation grew, real mortgage rates decreased.

## 4. Conclusion

The study shows that the real cost of mortgage decreases with an increase in inflation. However, this issue requires a more in-depth investigation of other

markets, mainly in developed countries, considering that the Polish history of stable inflation is quite short. It was only in 2003 that the NBP completed price stabilization following the period of a two- digit inflation rate.

Throughout the period examined inflation kept falling, thereby decreasing the real as well as the nominal cost of mortgages. A relatively strong positive correlation could be observed between WIBOR 3M rate and inflation. Moreover, an equally strong but negative correlation was observed between the inflation rate and the real interest rate: with falling inflation, real mortgage rates increased, while with growing inflation, real mortgage rates fell. Inflation (apart from 2014-2015) remained at a positive level, which additionally reduced the real value of installments paid.

A decrease in the real cost of mortgage in the situation of falling inflation (albeit, still inflation) is obvious – when inflation falls, interest rates are lowered as well, and thus mortgage rates and the nominal mortgage cost are lowered. A more problematic issue presents a growing inflation, and for this reason, a particular attention should be paid to the periods in which inflation grew. Interest rates reacted towards this increase to a much lesser extent and with a lag. Each such increase in interest rates brought about a substantial increase in nominal mortgage installments; however, in 2007/2008 what also increased significantly was their real value.

Considering the forecasts of the National Bank of Poland suggesting that the upcoming years will see an increase in inflation, a thorough examination of its influence on the mortgage cost is a valid issue. It is important not only from the perspective of risk management in households with an adjustable-rate mortgage and from perspective of the optimization of mortgage costs over the long-term but also from the standpoint of the banking sector and the entire economy. Good decisions made with respect to mortgages will improve the quality of banks' portfolios, will enhance stabilization of this sector and will reduce costs related to servicing irregular repayments of mortgages. Moreover, individuals capable of managing their finances well are more prone to consumption in the long-term, which is crucial for economic development.

The subject concerned with the influence of inflation on personal finances is very broad and largely unexplored. The most important topics relating to the impact of inflation on the borrower's situation which need to be further explored include the

following: the influence of inflation on the change in banks' margins, the volume of loans granted or the level of negative decisions.

The margin is an extremely important component of mortgage interest rates because it does not change for the entire mortgage term. The answer to the question how margins behave depending on inflation will allow households to construct better long-term plans. The changes in volumes of granted mortgages and the percentage of negative decisions can help find the answer whether or not the changes in inflation affect mortgage availability.

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