

## The Development of Mortgage Loans with Using Regression Analysis

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**Abstract:** After the financial crisis ended there was also a revival in the mortgage market. Since, 2013 there has been a growth in the number of contracts concluded and at the same time the amount of mortgage loans increase. The interest rates fell too and in July 2016 they recorded 1.88% their lowest historical value and according to, predictions they are supposed to decrease even further. In the last quarter of 2016 The Czech National Bank predicts a slow rise in interest rates. The study deals with the history and development of the mortgage market in The Czech Republic focusing on the current year 2016 and the analysis of development over the summer months compared with the previous years. This study aims to create a regression model for the amount of mortgage loans and interest rate including their analysis. Using correlation analysis to demonstrate the level of dependency of the amount (values) of loans in the year 2015-2016 on the interest rate.

**Key words:** Mortgage loans interest rate, regression analysis, prediction, current year, predictionsm, regression model

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### INTRODUCTION

As in most European Union countries, mortgage banking has a long history even in The Czech Republic. The first mortgage loans and the related mortgage bonds first appeared in the 18th century in territory of Silesia.

Mortgage loans have been granted in The Czech Republic, since, 1995. The initial period is characterised by a very small volume of mortgage loans while the main reasons were mainly relatively high interest burden on mortgage loans when the minimum rates on mortgage loans at individual banks ranged between 11 and 12% and lack of knowledge of the products associated with distrust. Since, 2000 there has been a significant reduction of interest rates and therefore, a more significant rise in demand for mortgage loans. The increase lasted until the end of 2008 when The Czech market was affected by the American mortgage crisis. After the crisis recovery takes hold again (Hatchondo *et al.*, 2015 Syrový, 2009; Kim, 2015; Soukal and Draessler, 2012; Rusnok, 2015; Stavebni, 2016).

A limited understanding of mortgage contracts and the risks involved may have contributed to the outbreak of the 2007-2008 financial crisis. Ooijen and Rooijn (2016) results demonstrate that homeowners appear to be well aware of mortgage risks. Institutions often offer a menu of

contracts to consumers in an attempt to create a separating equilibrium that reveals borrower types and provides better pricing (Agarwal *et al.*, 2017).

The goal of the study is to analyse the actual situation on The Czech mortgage market with the emphasis on development in the last year (2016) and the situation in the summer months when there is a regular decline in interest in these products.

### MATERIALS AND METHODS

This study is based on the analysis of the literature and study on housing. Important information is available on the official websites of each bank institution, The Czech National Bank, The Czech Statistical Office as well as of some financially oriented portals like Hypoindex, Golem Finance, etc.

Mortgage loans are a widely studied subject and there is an extensive literature dealing with mortgages on the Czech market which enables us to gain insight into the selected areas of mortgages from multiple sources which deepen or complement the issue. The development of mortgage loans in The Czech Republic is included in order to depict the situation on The Czech market (Hedvicakova and Pozdilkova, 2015; Allen and Paligorova, 2015).

This study aims to create a regression model for the amount of mortgage loans and interest rate including their analysis. Using correlation analysis demonstrates the level of dependency of the amount (values) of loans in the year 2015-2016 on the interest rate. Regression analysis is described in following chapters.

**Development of mortgage loans in The Czech Republic**

**The current situation in the mortgage market in The Czech Republic:** Interest rates in the Czech Republic in 2016 are reaching the lowest level ever but interest in mortgages has begun to decline. During July 2016, 7,615 people (Table 1) negotiated a mortgage in The Czech Republic which is the second lowest monthly amount this year after January. This means a decrease of 4,709 agreements, compared to June 2016. The analysis of the previous 7 years monitors a decline in the number of agreements concluded in July, compared to June but this year's drop is significant.

Compared to June 2016 the volume of mortgage loans in general are also lower. In July 2016, mortgage loans worth 15,225 billion Czech crowns were arranged (Table 2). The 2 years ago, this would have been a great result but in the current situation with the lowest ever interest rate, loan volume is not so positive. In contrast, the volume in comparison with the rest of the year

performed better than the calculations. With a value of 15,225 billion Czech crowns it is “only” the third lowest volume of the year.

Although, the volume and numbers decreased in July, the average mortgage amount increased and approached 2 million crowns. On average, people borrowed 1,999,405 crowns which is the second highest amount during this year. In July, the average interest rate fell only slightly to 1.88% (Fig. 1).

Most banks start their actions on their products during autumn. For this reason, we can expect a slight recovery later this year.

In June 2016 the Chamber of Deputies approved the Act on Consumer Loans, Act No. 190/2004 Coll., (including Act No. 137/2014 Coll.). The Act will strengthen the position of consumers on the financial market and makes the credit market more transparent. The Act stipulates maximum penalties for late payments. Additionally, before selling a property that the creditor has pledged, it is required to provide 6 months to the consumer to pay the outstanding loan. People will be able to pay off the mortgage early without penalty while the banks will only charge reasonable costs. “The Ministry of Finance has taken the view that a loan repayment is not to be punished”, stated by the Minister of Finance and Rej Babis (MFCR., 2016) Table 3.

Table.1: The numbers of mortgage loans over the past five years

Year	2012	2013	2014	2015	2016
June-02	7062	10613	8938	10794	12324
July-05	5636	8770	8352	9574	7615

Fincentrum Hypoindex (Hrusova, 2016), own processing

Table.2: Mortgage loan volumes in the last five years (in million CZK\*)

Year	2012	2013	2014	2015	2016
June-02	11.629	17.266	15.205	19.747	23.776
July-05	9.143	14.078	14.120	17.513	15.225

Fincentrum Hypoindex (Hrusova, 2016), own processing (\*1Eur = 27 CZK)

Table.3: Summary data

Fixation time	All fixation
Fincentrum Hypoindex	1.88%
The change compared to the previous period (b.p.)	1
Number of new mortgages	7.615
Volume of new mortgages	15.225 million CZK
Average mortgage amount	1,999.405 CZK
Monthly payment 1 million for 20 years	5.001 CZK
Monthly payment 1 million for 15 years	6.379 CZK
Share of loans to purchase	63%
Share of loans for construction	18%
Share of other loans	19%

Fincentrum Hypoindex July 2016 (Hrusova, 2016), own processing



Fig. 1: The development of average interest rate in The Czech Republic (%); Own processing based on (GF., 2016; Hrusova, 2016)

**RESULTS AND DISCUSSION**

**Regression analysis:** Regression models are properly assembled, the quality of the model is verified based on the p-values for the parameter beta b (the parameter is statistically significant at a level of 0.05, p-value is less than the significance level), the quality of the entire regression model is satisfied (p-value 0.0000), determination index is less than the statistic Durbin-Watson it is not apparent regression. This applies to all models. Average mortgage amount is expected according to the regression model growing trend, average interest rate is expected conversely decreasing trend.

Regression coefficient indicates how much the variable changes when you increase the time unit by unit. A positive sign means that the value will increase with the growth of time units, negative-value of the variable will decrease with an increase in the time unit (Table 4).

**Correlation analysis:** The Spearman correlation coefficient was used and the negative correlation-0.6617647059 was found between the variables of the average interest rate-average mortgage amount. Therefore, the variables are mutually linearly dependent and it was shown that the average interest rate significantly affects the amount of the mortgage amount (Fig. 2).

**Regression model:** Average mortgage amount was chosen as an independent variable and average interest rate as the dependent variable. The linear model  $Y = A+Bx$  was used where  $A = Abs = 3027603.06$  and  $B$  is equal to the dependent variable of average interest rate, (Fig. 3).

**Model quality evaluation:** Determination index = 0.3358014479 which is caused by a small range of input data. It also proved the correctness of the model and using the Wald test of autocorrelation it has been demonstrated that the autocorrelation of the data is insignificant (Table 5). With the sign test it was showed that the data do not show a trend component:

- Value of criteria Sg: 0.8379305816
- Quantile N (1-alpha/2): 1.959963999
- Probability: 0.402069692
- Conclusion: The residues do not have a trend

Using the Durbin-Watson autocorrelation test which calculated the value of 0.98, it has been proven that there is not an apparent regression between the data, since, the value of this parameter is greater than the determination

Table 4: The development of the average interest rate and mortgage amount

Date	Average interest rate	Average mortgage amount
4.16	1.94	1 886 765
3.16	1.97	1 909 937
2.16	2.02	1 878 013
1.16	2.06	2 138 995
12.15	2.06	1 913 396
11.15	2.09	1 843 878
10.15	2.12	1 866 517
9.15	2.11	1 852 485
8.15	2.11	1 841 182
7.15	2.08	1 832 976
6.15	2.05	1 829 483
5.15	2.05	1 816 423
4.15	2.11	1 783 330
3.15	2.16	1 751 311
2.15	2.27	1 731 248
1.15	2.34	1 725 728

Table 5: The model demonstrated statistical significance of the B parameter

Variable	Estimation	Deviation	Conclusion
Abs	3027603	443058	Significant
Average interest rate	-561716	21113	Significant

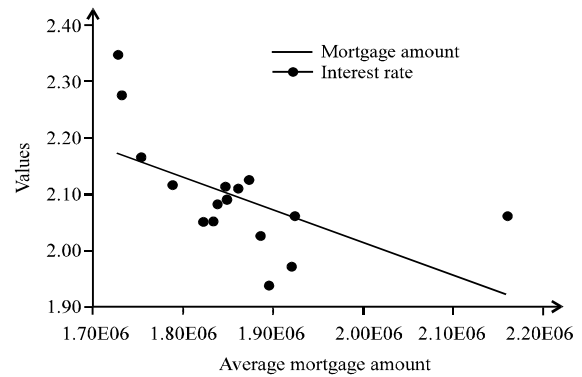


Fig. 2: Correlation

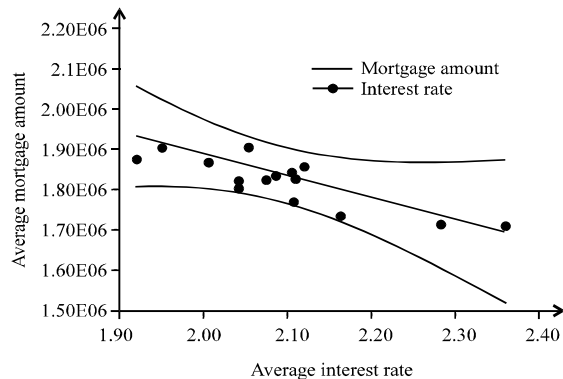


Fig. 3: Regression curve

index. The following Fig. 4 shows the possibility of using the model to predict the dependent variable for the next month.

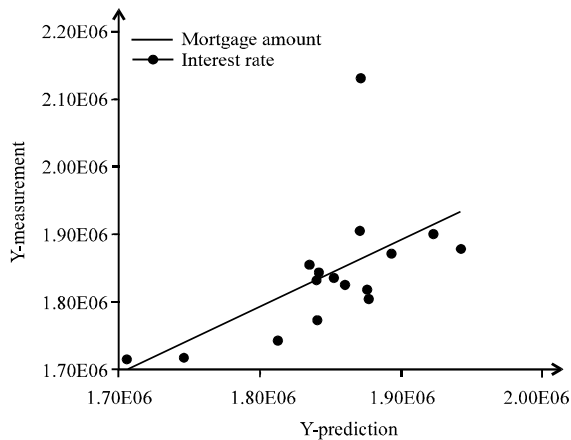


Fig. 4: Prediction

### CONCLUSION

In August 2016, the Bank Board of The Czech National Bank decided unanimously to keep interest rates unchanged at technical zero. The Bank Board decided to continue using the exchange rate as an additional instrument for easing the monetary conditions. It confirmed the CNB's commitment to intervene on the foreign exchange market if needed to weaken the koruna against the euro, so that, the exchange rate of CZK is kept close to CZK 27 to the euro.

The forecast assumes that market interest rates will be flat at their current very low level and the exchange rate will be used as a monetary policy instrument until mid-2017. Consistent with the forecast is an increase in market interest rates thereafter.

In addition to the aforementioned Czech National Bank provisions the level of interest rates are also affected by the new Act on consumer loans. The question for discussion is the impact of this Act on consumer loans on the mortgage loan interest rates. According to Libor Ostatka, the director of the Golem Finance brokerage company: "The Act will bring the biggest regulatory change in the history of housing finance in general. In the case of mortgages, there is a highly competitive environment in the mortgage market which is a major obstacle to growth in prices. However, there are areas which can be affected by its implementation for example, it may concern some of the products including the impact on cost (Foreign currency mortgages, etc.)".

Although, it can be supposed that banks will want to compensate the shortfall in revenues for early repayment of loans for other fees or higher interest rates. Since, 2015, the continuously decreasing interest rates are considered the lowest, they have bottomed-out and it is predicted that they will start to increase. This

growth has not been confirmed yet and there is further slow decline up to the current limit of 1.88% in July 2016.

Average mortgage amount is expected according to the regression model growing trend, average interest rate is expected conversely decreasing trend using regression analysis. The final level of mortgage loan interest rates will be affected also by other indicators, e.g., Macro-economic indicators-particularly inflation development, competition of individual banks, the political situation in the country and the world, etc.

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### REFERENCES

- Agarwal, S., B.I. David and V. Yao, 2017. Systematic mistakes in the mortgage market and lack of financial sophistication. *J. Financial Econ.*, 123: 42-58.
- Allen, J. and T. Paligorova, 2015. Bank loans for private and public firms in a liquidity crunch. *J. Financial Stab.*, 18: 106-116.
- GF., 2016. Increases Act on loan mortgage rates?. Golem Finance, Prague, Czech Republic.
- Hatchondo, J.C., L. Martinez and J.M. Sanchez, 2015. Mortgage defaults. *J. Monetary Econ.*, 76: 173-190.
- Hedvicakova, M. and A. Pozdilkova, 2015. Analysis of business accounts in the Czech Republic. Proceedings of the 33rd International Conference on Mathematical Methods in Economics (MME), September 9-11, 2015, University of West Bohemia, Pilsen, Czech Republic, ISBN:978-80-261-0539-8, pp: 231-236.
- Hrusova, M., 2016. Fincentrum hypindex July 2016: The holidays interest mortgages dropped sharply. Czech Republic. <http://www.hypindex.cz/clanky/fincentrum-hypindex-cervenec-2016-o-prazdninach-zajem-o-hypoteky-rapidne-klesl/>.
- Kim, J., 2015. Households optimal mortgage and unsecured loan default decision. *J. Macroeconomics*, 45: 222-244.
- MF CR., 2016. MEPs approved the consumer credit act. Ministry of Finance of the Czech Republic, Czech Republic, Europe.
- Ooijen, V.R. and V.M.C. Rooij, 2016. Mortgage risks debt literacy and financial advice. *J. Banking Finance*, 72: 201-217.

- Rusnok, J., 2015. Monetární politika v menicím íf ekonomickém prostredí. Czech National Bank, Prague, Czech Republic.
- Soukal, I. and J. Draessler, 2012. Consumer desired price modeling-case study on the RCBS market. *Procedia Soc. Behav. Sci.*, 62: 916-920.
- Stavebni, S., 2016. Building savings on the rise again. Czech Republic. <http://www.hypindex.cz/rubrika/stavebni-sporeni/>.
- Syrový, P., 2009. Finance Private Housing. 5th Edn., Grada Publishing, Prague, Czech Republic, ISBN:978-80-247-2388-4, Pages: 144.