

## Trend Analysis as a Useful Tool for Monetary Policy in the Real Estate Market

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### Abstract

**Purpose of article:** The primary purpose of this study consists in the research that focuses on developing various scenarios for central bank interest rate regulation and its impact on property prices. Partial areas include the specification of individual factors and the description of relationships between individual scenarios. Since the study is based on real data and purely numerical calculations and simple statistical methods might not cover the whole issue, the trend analysis was used. After determining the main factors, a model containing a series of scenarios will be built. Based on these scenarios and the individual relationships between them, the oriented transitional graph will be generated. The eight-dimensional model serves as an example to determine transitions between scenarios and to understand the resulting scenario map as a whole. Using this study, we can monitor current market developments and behaviour both in the past, present and predict a possible sequence of events in the future. This study builds on the already explored issues and extends the state of scientific knowledge in order to build more advanced models in the future with current factors and new conclusions valid for the continuous progress in the property market.

**Methodology/methods:** Solving with using statistical methods, correlation matrix, trend analysis.

**Scientific aim:** It is to find the correlation that proves the possibility of finding ways to lower house prices through central bank rates.

**Findings:** The central bank interest rate has a direct impact on the real estate market which can be observed in the onset of scenarios in the transition graph.

**Conclusions:** The real estate bubble represented as the housing price index can be affected by the central bank interest rates with the impact on other significant variables on the market.

**Keywords:** forecast, monetary policy, real estate, trend, qualitative, transition

**JEL Classification:** E4, E7, G21

## Introduction

A number of factors influence the current issue of housing prices. One of these factors is the central bank's two-week repo rate. For a very long time, it was set at the very bottom, but in recent years it has increased (Czech Republic economy, 2018).

Based on the current state of scientific knowledge, it can be assumed that a change in the interest rates by the central bank will have a direct impact on housing prices.

Based on a study evaluating the primary and secondary housing market in Poland, it can be stated that the interest rates have an impact on the price of real property. Mortgages are a significant asset in banks' balance sheets and are therefore very sensitive to changes in the interest rates by the central bank (Leszczyński, Olszewski, 2017).

Using the transitional graphs, it is possible to model a number of scenarios documenting changes in housing prices concerning the level of interest rates set by the central bank.

The next part is to summarize the current state of scientific knowledge in the field. According to researchers Virtanen *et al.* (2018), who dealt with the theme of banking crisis forecasts, it can be said that when forecasting banking crises, we consider the effectiveness of unit root pressure tests. This is based on a sample of 15 EU countries over the last three decades. Variables based on credit and debt services are identified as better predictors than variables in the housing market, which in turn outweigh the market share variables. The results confirm the existing literature showing that the financial crisis is usually preceded by leverage bubbles, more specifically that after initial signs of a sharp rise in credit and asset prices, debt servicing costs are reduced as the financial crisis approaches. The risk of the financial crisis reaches its peak shortly after the bubble burst. Our results show that enthusiasm tests that can be used to predict the crisis in a similar way to conventional early warning models which

can easily be integrated into the financial stability supervision toolkit.

In another article by the authors Čirjevskis, Tatevosjans (2015), even small housing bubbles can cause that many projects can suffer uncertainty in further development. As expressed above, it will definitely affect our selected variables. The main focus of the article was about the real option price theory (ROV) to investigate investment in the energy, oil, gas and pharmaceutical industries, but few studies have empirically examined the ROV theory to investigate real property investment in EU countries, which have gone through a severe economic crisis and are now recovering from the crisis. This paper aims to empirically test the use of the ROVs in a development project with considerable price and cost volatility and strict legal constraints. The article illustrates the empirical testing of the ROV applications for the Sun Village investment project developed by ABC Project Ltd in Latvia in 2014. We use three ROV methods: an optional Tomato Garden space matrix, a Black-Scholes option pricing model, and a Black-Scholes option pricing model, as well as the binomial option pricing model prior to submitting the final test result. The ROV block diagram in the development projects presented in our research can serve as a "map" for many similar EU projects that suffer from housing bubbles and are uncertain.

According to the authors Goodman, Bai (2017), who conducted research on mortgages, we can observe a number of market changes. This article identifies and analyses six effects on the mortgage market as a result of the end of the global decline in interest rates: (1) reduced mortgage volume, (2) lower initial returns and more industry consolidation, (3) increased insurance coverage, (4) higher prices, (5) low household repeats, and (6) access to other free markets. We have seen a considerable decline in global interest rates over the past 35 years. Mortgage rates peaked in 1981, reaching more than 18%,

and fell to 3.54% in autumn 2016. Mortgage rates have already started to increase, although it is not clear how high the rate cuts are.

The last but no less significant variable is the national bank rate, following the by Sirmans *et al.* (2015), which summarizes some of the last conclusions in this area and extensively connects them to the housing area. As you can see in the conclusion, ten-year government financial interest rates are seen as a critical factor for 30-year mortgage rates. The current 10-year LIBOR exchange rate is better suited to explain the current mortgage rate than the current one 10 year cash rate. This result seems to last for the most of the trial period, 1987–2011, using various statistical tests. Since in the long run, it is believed that mortgage rates can be better explained by the 10-year government funding rate, this document is an essential contribution in the literature showing that the exchange rate is higher.

### 1. Qualitative Models as used approach

According to the authors who deal with trend analysis and creation of trend models (Sen, 1994; Dočekalová, Kocmanová, 2016; Meluzín, Zinecker, 2016), a good description of the situation can be achieved. Most trend models are based on verbal descriptions using linguistic quantification. This is also the reason for using simple shapes. Figure 1 and Figure 2 are qualitative relations. Using these examples, you can see pairwise relations X and Y.

Six examples of quantifier-less pairwise trend relations are provided in Figure 1 and Figure 2.

For example, relation 22 indicates that:

- The relation  $Y=f(X)$  is increasing.
- There is a linear relationship between Y and X.
- If  $X=0$  then Y is positive.

There could be many possible options on

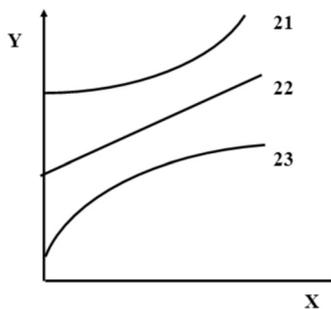


Figure 1. Examples of qualitative direct proportionality pairwise relations. Source: Authors.

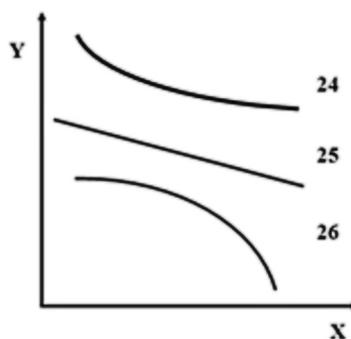


Figure 2. Examples of qualitative indirect proportionality pairwise relations. Source: Authors.

how to interpret trend concepts. The trend concepts as used in this paper are based on four values: see *e.g.* (Bredeweg *et al.*, 2007; Vicha, Dohnal, 2008):

The principal of qualitative modelling consists of the quantifiers as follows:

Positive	Zero	Negative	Any value	
+	0	-	* .	(1)

The following set of triplets describes a set  $S$  of  $m$ -qualitative  $n$ -dimensional scenarios lets:

$$S = [(X_1, DX_1, DDX_1), (X_2, DX_2, DDX_2), \dots, (X_n, DX_n, DDX_n)]_j, \tag{2}$$

where:

$X_i$   $i$ -th variable,

$DX_i$  first qualitative with respect to time,  
 $DDX_i$  second qualitative derivations with respect to time,  
 $j = 1, 2, \dots, m$ .

The triplet  $(X_j, DX_j, DDX_j)$  is based on the first and second derivatives. Housing development knowledge is relatively poor and therefore the third derivatives are unknown.

The further description of methods of evaluating relations among the variables is not the purpose of this paper, for further more insight, see e.g. (Dohnal, 2016; Poláček, Dohnal, 2017). The provided information is sufficient for the basic understanding of how the model evaluates variables.

### 1.1 Transcription through transitional graphs

The trend analysis provides a lot of useful data. It is possible to generate a transition

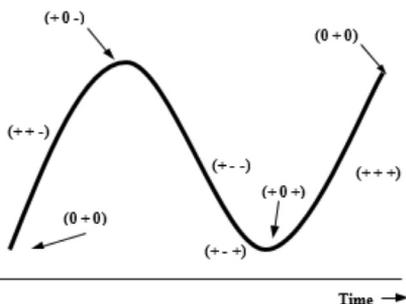


Figure 3. A trend description of a quantitative oscillation. Source: Authors.

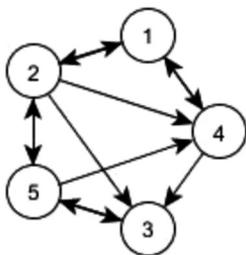


Figure 4. Example transitional graph based on the set of 5 scenarios. Source: Authors.

between scenarios so that the resulting set of scenarios (2) is the not only available result.

Figure 3 of the above option shows the extensive spectrum of variable oscillations to occur, such as irregular oscillations, dumping oscillations with random or deterministic varying frequencies or amplitudes.

The more complex transitional graph shown in Figure 4 may serve to illustrate the more complex situation. The transitional graph in Figure 4 shows the unstable behaviour of the more complex model. There are 5 scenarios.

The transitional graph shows all possible trend histories to choose from and all possible trend forecasts. If the forecaster proves that the model is valid and accepts it, then it can be said that the transitional graph is a generator for trend-based forecasts.

The following scenario No. 4 can be considered the root of the forecast. The following forecast is formulated in two steps.

$$\begin{aligned} S_4 &\rightarrow S_3 \rightarrow S_5, \\ S_4 &\rightarrow S_1 \rightarrow S_2. \end{aligned} \tag{3}$$

No other solutions are possible.

The set  $X$  of variables:

$$\begin{aligned} X &= X_1, X_2, \dots, X_n = (V \cup G \cup O), \\ V \cap O &= \emptyset, \\ V \cap G &= \emptyset, \\ O \cap G &= \emptyset, \\ V &= (V_1, \dots, V_v) = (X_1, \dots, X_v), \\ G &= (G_1, \dots, G_t) = (X_{v+1}, \dots, X_t), \\ O &= (O_1, \dots, O_w) = (X_{t+1}, \dots, X_n), \\ n &= v + w + t. \end{aligned} \tag{4}$$

It is chosen as relevant. Any forecasting/decision-making will be based on an  $n$ -dimensional model  $M(X)$ . A set  $X$  of  $n$  variables is a union of Decision variables  $V$ , Goals variables  $G$  and Off-control variables  $O$  (4).

The variables marked with  $O$  are not in the decision-making power of the decision-maker. If the model author were a company

manager or government, the set of variables labelled  $O$  would be different. It is, therefore, essential to always correctly interpret the set of variables labelled  $X$ . (5) (Renigier-Bilozor, Bilozor, 2015).

Possible variables from a Central bank perspective can be:

<i>Central bank interest rate</i>	$V$	
<i>Housing prizes</i>	$G$	
<i>Gross domestic product</i>	$O$	(5)

The variable  $V$  is controlled by the monetary policy, more precisely by the central bank.

## 2. Theoretical hypotheses

The selected variables must be linked to the purpose for which the simulation calculations are performed. The theoretical analysis, methodology, and results of various conditions are presented. The presented methodology of calculating different types of scenarios based on the sensitivity analysis follows the statistical analysis. These tools are important

for establishing relevant research models.

A successful culmination of the modelled situation using the sensitivity analysis for all market factors used that has been included in the trend analysis will be the development of a possible scenario that will lead to a reduction in housing prices without causing a serious deterioration of all other factors.

According to the article dealing with the issue of bubbles in the housing market, these crises can be beneficial. This was claimed, for example, by the author Glaeser (2016).

All data was collected from publicly available national-level databases. Based on statistical methods and observations, we can successfully claim that the factors we propose have a potential for correlation. The used model is built on relations among variables and its correlations and its right order is based on correlation coefficient. The aim is to demonstrate the relationship of the central bank in whose power it is to change the central interest rate to actively affect housing prices.

Based on the defined variables and data mined from publicly accessible databases, using correlation matrices in Figure 5 and

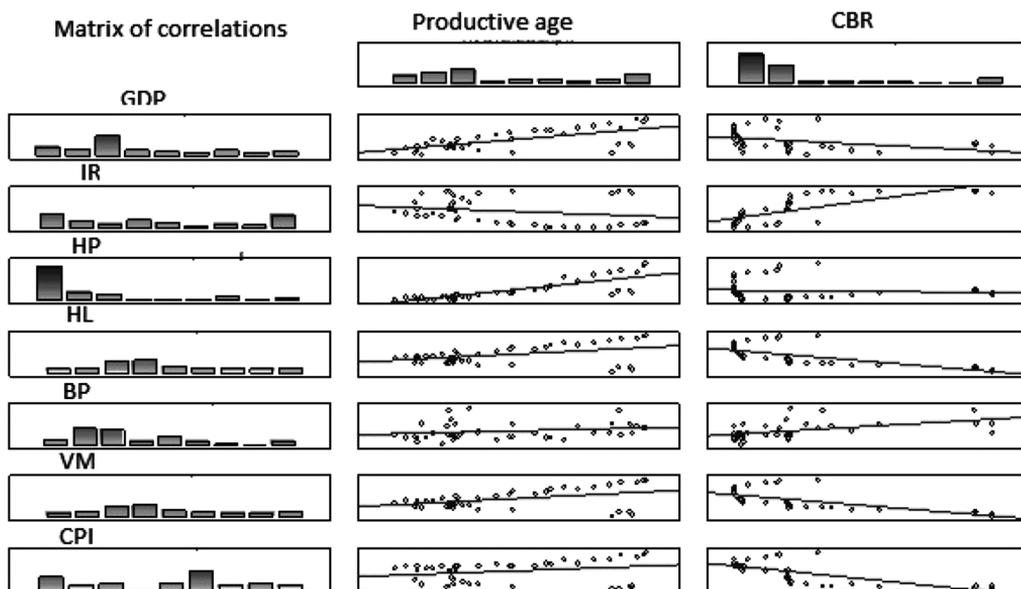


Figure 5. Matrix of correlations among the used variables Source: Authors.

#	PA O	GDP O	HP G	CPI O	VM O	IR O	HL O	CBR V	BP O
1	+++	+++	+++	+++	+++	+—	+++	+—	+—
2	+++	++0	+++	+++	+++	+—0	++0	+—0	+—0
3	+++	++—	+++	+++	+++	+—+	++—	+—+	+—+
4	+++	++—	+++	+++	++0	+—+	++—	+—+	+—+
5	+++	++—	+++	+++	++—	+—+	++—	+—+	+—+
6	+++	++—	+++	++0	+++	+—+	++—	+—+	+—+
7	+++	++—	+++	++0	++0	+—+	++—	+—+	+—+
8	+++	++—	+++	++0	++—	+—+	++—	+—+	+—+
9	+++	++—	+++	++—	+++	+—+	++—	+—+	+—+
10	+++	++—	+++	++—	++0	+—+	++—	+—+	+—+
11	+++	++—	+++	++—	++—	+—+	++—	+—+	+—+
12	++0	++—	++0	+++	++—	+—+	++—	+—+	+—+
13	++0	++—	++0	++0	++—	+—+	++—	+—+	+—+
14	++0	++—	++0	++—	++—	+—+	++—	+—+	+—+
15	++—	++—	++—	+++	++—	+—+	++—	+—+	+—+
16	++—	++—	++—	++0	++—	+—+	++—	+—+	+—+
17	++—	++—	++—	++—	++—	+—+	++—	+—+	+—+
18	+0+	+0+	+0+	+0+	+0+	+0—	+0+	+0—	+0—
19	+00	+00	+00	+00	+00	+00	+00	+00	+00
20	+0—	+0—	+0—	+0—	+0—	+0+	+0—	+0+	+0+
21	+—+	+—+	+—+	+—+	+—+	++—	+—+	++—	++—
22	+—+	+—0	+—+	+—+	+—+	++0	+—0	++0	++0
23	+—+	+—	+—+	+—+	+—+	+++	+—	+++	+++
24	+—+	+—	+—+	+—+	+—0	+++	+—	+++	+++
25	+—+	+—	+—+	+—+	+—	+++	+—	+++	+++
26	+—+	+—	+—+	+—0	+—+	+++	+—	+++	+++
27	+—+	+—	+—+	+—0	+—0	+++	+—	+++	+++
28	+—+	+—	+—+	+—0	+—	+++	+—	+++	+++
29	+—+	+—	+—+	+—	+—+	+++	+—	+++	+++
30	+—+	+—	+—+	+—	+—0	+++	+—	+++	+++
31	+—+	+—	+—+	+—	+—	+++	+—	+++	+++
32	+—0	+—	+—0	+—+	+—	+++	+—	+++	+++
33	+—0	+—	+—0	+—0	+—	+++	+—	+++	+++
34	+—0	+—	+—0	+—	+—	+++	+—	+++	+++
35	+—	+—	+—	+—+	+—	+++	+—	+++	+++
36	+—	+—	+—	+—0	+—	+++	+—	+++	+++
37	+—	+—	+—	+—	+—	+++	+—	+++	+++

(6)

Table 1. Table of used variables in the model situation.

HP	Housing price	Index of housing prices, 100% of the price is related to 2010
IR	Interest rate	Current interest rates of commercial banks
HL	House loans	The total number of mortgages in one year
VM	Volume mortgages	The total number of funds allocated in mortgages
BP	Building permits	Number of building permits per year
CBR	Central bank rate	Central bank's two-week repo rate
PA	Productive age	The set of the economically active population aged 19–65
CPI	Consumer price index	Measures weighted average price of a basket consumer goods

Source: Authors.

Table 2. Used model based on correlation coefficients.

1	22	HP	PA
2	22	IR	CBR
3	24	CPI	CBR
4	21	GDP	PA
5	25	HL	CBR
6	24	VM	CBR
7	+	BP	CBR
8	21	HL	PA
9	21	VM	PA
10	–	GDP	CBR

Source: Authors.

obtained correlation coefficients, we created a model for calculating the trend analysis, see e.g. Table 2.

The banks' preference for convertible real property also explains why real property is often the source of the financial crisis. Real property bubbles can improve well-being if cities are too small due to the national economy or construction constraints (Fernández, Collado, 2017). Nevertheless, given the reasonable parameters, the enormous social security costs of any financial crisis are likely to outweigh the modest benefits of another building. Therefore, the central bank would be a potential opportunity to manage its financial impact better.

There are 37 scenarios;  $m=37$  (2), (6).

This graph shows us possible ways and combination to reach our target in its full length.

The set of scenarios is the broad set of all probable scenarios, which contain the

relations provided in the model see e.g. Table 2. For example, scenario No. 19 has the entire first and second derivatives zeros. It is, therefore, the qualitatively steady state.

The set of scenarios (6) can be used to answer the qualitative questions, for example:

Is it possible to:

$$\begin{aligned}
 &\text{Increase CBR AND } i.e. D(\text{CBR}) = + \\
 &\text{Increase IR AND } i.e. D(\text{IR}) = + \quad (7) \\
 &\text{Decrease HP AND } i.e. D(\text{HP}) = -
 \end{aligned}$$

The variables Table 1 are into two subsets of variables UN, OC.

If the studied query (7) is confronted with the set of scenarios (6), then it is clear that few scenarios could be the target ones. It means that the answer to the query (7) is YES.

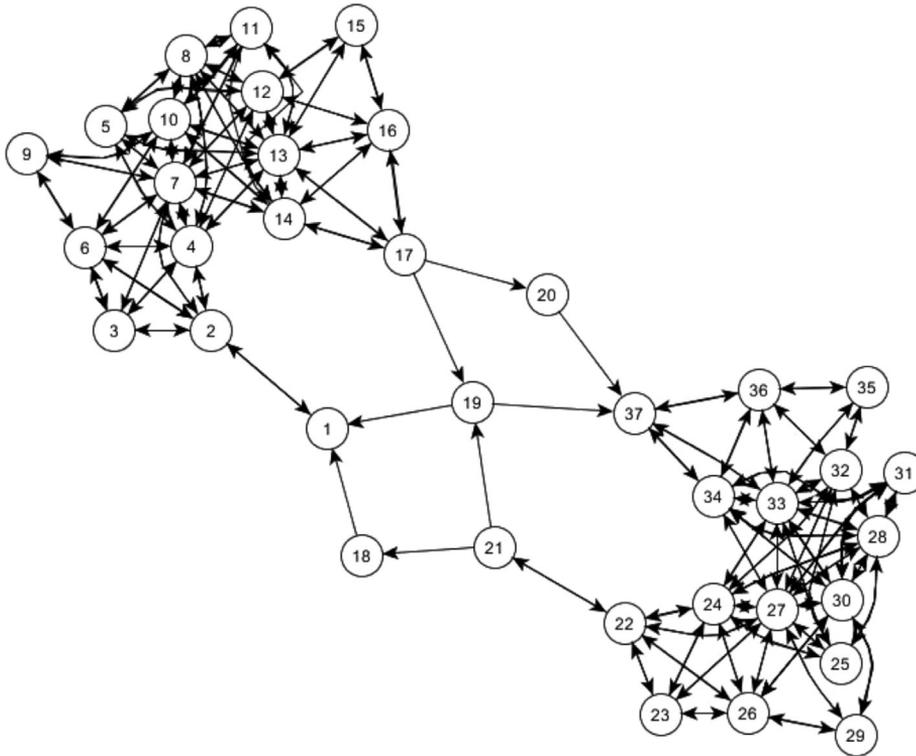


Figure 6. Transitional graph based on the set of 37 scenarios (6) Source: Authors.

UN (Under control of a decision-maker): CBR.  
 OC (Outside control): PA, GDP, CPI, VM, IR, HL, BP. (8)

This variable splitting (8) represents a point of view and is done on an ad hoc basis. It means that different decision-makers can choose different UN and OC subsets.

For the purposes of the implementation of using the decision method in practice, it is necessary to find the current situation of housing developing project on our generated list of scenarios (6). Using the above-mentioned

list (6), we can describe the current position by each used variable with their definition on the first and second derivations (2). The current situation of the working project is best described by the scenario No. 6. This scenario will serve as the starting position for our goal, which will be determined by the targeting the state of the first and second derivation of the “goal variable”.

After determination of our situation through the description of the scenario, it is easier to plan decision-making using the cut out from the main transitional graph; see Figure 6 and Figure 7.



Figure 7. A reachable subgraph of the complete transitional graph see Figure. 6. Source: Authors. This is also a narrowed transition graph showing the chosen approach.

### 3. Results of estimation and discussion of findings

The shortest path is the path leading from the worst scenario  $S_6$  to the target scenario  $S_{37}$ ; see *e.g.* Figure 7:

$$S_6 \rightarrow S_7 \rightarrow S_{14} \rightarrow S_{17} \rightarrow S_{20} \rightarrow S_{37}. \quad (9)$$

The sequence of scenarios is, see (9):

#	PA	GDP	HP	CPI	VM	IR	HL	CBR	BP
	O	O	G	O	O	O	O	V	O
6	+++	++-	+++	++0	+++	+--+	++-	+--+	+--+
7	+++	++-	+++	++0	++0	+--+	++-	+--+	+--+
14	++0	++-	++0	++-	++-	+--+	++-	+--+	+--+
17	++-	++-	++-	++-	++-	+--+	++-	+--+	+--+
20	+0-	+0-	+0-	+0-	+0-	+0+	+0-	+0+	+0+
37	+--	+--	+--	+--	+--	+++	+--	+++	+++

(10)

the OC as out of control (8). It means that any forecast is partially based on available descriptions of OC variables.

### 4. Conclusions

The monetary policy is part and one of an instrument of the economic policy. It is a set of measures and principles designed to promote the fulfilment of monetary objectives through monetary instruments. Direct instruments of the monetary policy are rarely used in advanced economic systems and their use is indicative of a failure of the indirect application. For the model used, it was decided to influence the discount instruments, represented by the interest rates and other credit conditions that the central bank provides to commercial banks in the domestic currency – this has a significant impact on the credit capacity of commercial banks. As mentioned in the text above, the two-week repo rates were selected as the indirect instrument variable.

The scenario No. 6 represents the worst possible situation for enlarging the real property bubble. The scenario No. 37 is the best variant from the central bank’s point of view. The path (10) leads from the very problematic situation to the optimal one.

A decision-maker has no free choice to change the variables, see *e.g.* Table 1. Some variables are not under his/her control (8). Therefore, there are variables selected by

The presented methodology of calculating different types of scenarios based on the sensitivity analysis follows the statistical analysis. The result of the study consists in a successfully modelled situation using the sensitivity analysis for all defined market factors that have been included in the used trend analysis. The authoris identified the development of a possible scenario leading to a reduction in housing prices without causing severe deterioration of all other factors. It is a possibility to set the trend of real property bubbles or we can observe the sensitivity changes in major quantities.

Despite the set of scenarios considering different options, we finally came to one of the possible solutions. However, it is very interesting that a comparison of the empirical findings which we have made in the course of our research and a comparison of the current situation on the market. Although the central bank of the Czech Republic issued a recommendation not to offer 100% mortgages, the interest rate is still decreasing. It is a unique market paradox that offers further

challenges and provides a huge area for further mapping.

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