SUBPRIME MORTGAGE CRISIS IN THE UNITED STATES IN 2007–2008: CAUSES AND CONSEQUENCES (PART II)

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Abstract. *This is the second part of the qualitative and quantitative research on the subprime mortgage crisis in the United States in 2007–2008. The main purpose of this research is to determine the factors and how they contributed to the subprime mortgage crisis, what their causal links and effects on the markets and the whole economy were, and to assess what actions could have been taken by the Federal Reserve and the Government in order to mitigate or prevent the consequences of the subprime mortgage crisis and the housing bubble. In order to obtain the results, the authors performed a qualitative analysis of the scientific literature on the course of events and their development that led to the subprime mortgage crisis and focused on insufficiently regulated home mortgage market expansion, the impact on subprime mortgage crisis of financial innovations and financial engineering, poorly evaluated systemic risks and policy undertaken by both the U.S. Government and the Federal Reserve before and after the crisis. The quantitative research focused on two main parts: firstly, the analysis of dependencies between the causes of subprime mortgage crisis and the consequences using the statistical and regression analysis; secondly, an alternative path the Government and the Federal Reserve could have taken in their policy actions, and the results they could have produced have been explored. The authors believe that the results of the research could give useful guidelines to the central bankers and government officials on how to make long-term decisions that can help in preparing for the financial distress, mitigating the consequences when the crisis strikes, accelerating the recovery and even preventing the crisis in the future.*

Key words: *banks, central bank, subprime mortgage crisis, mortgages*

I. Introduction

Since August 2007, global financial markets were shocked by catastrophic events and circumstances stemming from problems in the U.S. subprime mortgage segment. Financial institutions were forced to write down billions of losses in dollars, euro or Swiss franks. The main markets stagnated, their liquidity almost disappeared, and stock markets suffered a massive recession. Central banks originated hundreds of billions of loans making interventions not only to support the exchange rate, but also to preclude the collapse of separate institutions. The USA and European governments also intervened in the large-scale support to financial institutions. Huge losses forced the great majority of

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financial institutions to recapitalise, some of them were taken over by other financially stronger institutions, and others simply went bankrupt. In August 2008, the International Monetary Fund (IMF) expected total losses to reach almost USD 1 trillion, but in October its expectations were revised up to USD 1.4 trillion, so the cost of the global financial and credit crisis for the global economy was one of the highest throughout its history.

The effects of many previous large-scale financial crises had been more localised – affecting the economy and financial sector of one particular country. The recent crisis was unique – it was more complicated than any previous crisis (e.g., the Great Depression of 1929–1930, the USA Savings and Loan Crisis of the 1980s and the 1990s, the USA Long-term Capital Management Crisis of 1998 or the collapse of "dot-com" (IT) bubble of 2000–2001), while its damage is considerably more widespread among both the countries and financial institutions – banks, pension funds, investment banks, insurance undertakings, etc.

It is widely agreed that the subprime mortgage crisis was caused by the credit boom and the housing market bubble. However, it is not so clear why this combination of events has evolved into such a severe financial crisis, i.e. why the financial system suffered the freezing of capital markets and the widespread collapse of financial institutions, why the housing market and credit bubble was so inflated, and how and what factors on the part of the private and public sector had the essential impact. The subsequent systemic crisis reduced capital supply and availability to creditworthy institutions and individuals increasing the negative impact on the economy even more. The main hypothesis of this research is that the central bank, the government and the private sector have done not everything they could to control the formation, expansion, and consequences of the crisis and, moreover, they themselves have contributed to the subprime mortgage crisis.

II. Literature review. Lack of a thorough analysis of systemic risks

Over the last years, the analysis of causes of the subprime mortgage crisis in 2007–2008 has become the subject discussed by many economists and governments. The U.S. subprime mortgage and credit crisis was analysed in research and papers of Acharya et al. (2009), Isard (2009), Crotty (2009), Donnelly et al. (2010), Lim (2008), Jaffee (2008), Demiroglu et al. (2011), Purnanandam (2010), Crandall (2008), Schwarcz (2008), Simkovic (2011), Moran (2009), Taylor (2007), Carrillo (2008) and other researchers. Authors basically emphasised the relevance of the contribution of both the private sector and governmental organisations to the subprime mortgage crisis.

After the prolonged period of rapid expansion, the economic activity started receding in many countries of the world. The sharp turnaround was associated with the end of the house price boom in the United States. It is necessary to understand how short-sighted mortgage lending practices and financial engineering turned the global economy into a

house of cards, and why the U.S. authorities did little to curtail the outrageous lending practices and financial engineering (Isard, 2009).

The direct cause of the financial turmoil was the steep increase and subsequent sharp decline of housing prices, which, together with poor lending practices, led to large losses on mortgages and mortgage-related instruments in many financial institutions (Moran, 2009). Although the recent financial crisis was caused by the burst of mortgage market bubble when a massive default on obligations in the subprime mortgage market started, but the financial bubble of the housing market was the result of the development of financial innovations over the past three decades, which essentially is one of the main causes of the subprime mortgage crisis (Lim, 2008).

The subprime lending growth was boosted by more highly leveraged lending against the background of rapidly rising house prices. The strong investor appetite for higher-yielding securities contributed to looser loan granting and mortgaging standards. However, safeguards ensuring prudent lending were weakened by the combination of remunerations and bonuses at each stage of the securitization process and the dispersion of credit risk, which weakened loan monitoring and control incentives. Hence, intermediaries were remunerated primarily by generating loan volume rather than quality (Kiff et al., 2007).

As long as housing prices kept climbing, fuelled by ever-increasing levels of debt and leveraging, all these problems remained hidden. The rising house prices provided the borrowers in financial trouble with an incentive to sell their homes and pay off their mortgages prematurely. In 2006, when prices peaked and began to fall, things started to unravel. After several years of unsustainable housing pricing appreciation and imprudent lending practices, a housing market correction – the bursting of the bubble – was both inevitable and even necessary. As interest rates rose and house prices flattened with loan value and then turned negative in a number of regions, many stretched borrowers were left with no choice but to default as prepayment and refinancing options were not feasible with little or no housing equity (Kiff et al., 2007). This subprime mortgage crisis, marked by home foreclosures of enormous scale and illiquid mortgage-related securities which have created huge capital holes on the balance sheets of banks and financial institutions, has spilled over into the global economy, causing a global credit crisis and fuelling a deep, long, and painful recession (Moran, 2009).

While discussing the causes of the subprime mortgage crisis, different researchers and economists have pointed out and distinguished different factors contributing to the crisis. Different researchers have expressed different views as to the relative importance of the contributing factors and how the blame should be shared (Isard, 2009). This paper introduces three groups of the root causes of the U.S. subprime mortgage crisis considered to be the main by the authors: 1) problems directly and specifically related to the

subprime mortgage lending practices; 2) causes related to the subprime mortgage securitizations; 3) causes related to the ability of financial institutions and public authorities to assess the systemic risks.

As the first part of the paper essentially dealt with the first two groups of causes, the theoretical aspects of the origin of the U.S. subprime mortgage crisis analysed in it helped to determine that income and growth were excessively highlighted with too little attention devoted to the risks and risk volumes on the part of both the private and the public sectors. The concentration of banks on growth was motivated by competition and investments in the markets of mortgages and securities comprising them. Seeing a too wide competitive gap in the sphere of fixed-income securities, the majority of banks focused their resources towards growing markets of asset-backed securities, mortgage securities, and adjustable-rate mortgages, which were considered to offer huge possibilities for income growth.

Nobody has in general cared too much about analysing in detail such essentially erroneous strategy of banks and its risks. Overreliance of risk management and control on credit ratings assigned by rating agencies prevented from predicting and analysing the credit risk of mortgage securities. Furthermore, the casual attitude of the financial market participants was also facilitated by the fact that financial institutions relied too much on the quantitative methods of analysis, stress tests and statistical risk assessment models based on data of the last few years. At the same time, the correlation between the risk of securitization and the risk of securities held on balance sheets of banks was ignored.

The first part of the paper also discloses the insufficient attention of the financial market participants to the systemic risks, such as reduction of liquidity in certain markets or a drop of housing prices. Due to that, the new information about the growing default rates or dependence of results of the mortgage securities market on the entire housing market of the U.S. has not been taken into account.

Finally, even the peculiarities of the system of incentives of financial institutions were inadequate: higher-yielding investments in riskier securities or other financial instruments were stimulated by huge bonuses and payments, disregarding the long-term impact of taken risks; the change of a more effective and expensive risk insurance scheme by a cheaper and less effective one was generously rewarded.

In the first part of the paper, less attention has been devoted to the role and significance of the public authorities and regulators with respect to influencing the independent variables of the regression equation; therefore, this part elaborates more on the impact of the Central Bank of the U.S. and of the system of regulatory financial institutions on the housing market bubble, as well as on the possible alternative actions of such public authorities, by which it would be possible to mitigate or avoid the great majority of the negative consequences of the crisis. Having assessed and considered this properly, the paper presents the preventive measures for housing market bubbles, regulatory proposals

for institutions as well as alternatives and long-term political and Government decisions that would help to better prepare for, or even prevent, financial shocks in the future and accelerate the economic recovery.

Government practices: unjustified housing acquisition incentives and insufficient control

Considering that homeownership is beneficial for individuals, families and districts the Government has encouraged the homeownership for a long time. However, at the same time the tendency of granting risky mortgages was enhanced. Moran (2009) in his work proves that the homeownership was mainly encouraged by issuing a number of laws and legislative acts the purpose of which and their impact on the markets are shown in Table 1.

TABLE 1**. U.S. law and acts that contributed to the housing bubble inflation**

Year	Law/act	Purpose and impact on the economy and the markets
1975	Home Mortgage Disclosure Act/ Equal Credit Opportunity Act	In pursuit of a social goal – universal home ownership – banks either lowered credit standards and granted mortgages or faced fines and business penalties for the Home Mortgage Disclosure Act (HMDA) or Equal Credit Opportunity Act (ECOA) violations.
1977	Community Reinvestment Act	Encouraged banks to lend to mortgage customers formerly considered ineligible for loans. The act committed the Federal regulators to stimulate financial institutions that fall under their regulations to meet the credit demand of the public and to keep the credit standards safe and reliable at the same time. Regulators periodically observed how banks complied with this act and made decisions based on compliance regarding the new establishments of affiliates, mergers and acquisitions of the banks.
1986	Tax Reform Act	Encouraged and fostered increased home lending as residential mortgages have become the sole consumer loans in which the interest paid is tax deductible.
1995	National Homeownership strategy	Promoted homeownership as both patriotic and an easy win for all, so the HUD alleviated many mortgage anxieties for first-time home buyers and fueled the mortgage engine: insured billions of dollars in loans, changed existing regulations so that families no longer had to prove that their incomes would remain stable for five years, allowed lenders to hire their own appraisers, which often resulted in inflated house valuations, and no longer required lenders to interview most government-insured borrowers in person or maintain physical branch offices.
1997	Taxpayer Relief Act	Exempted most home sales from the capital gains tax, therefore giving people greater incentive to plow even more money into real estate. At the same time, the Department of Housing and Urban Development (HUD) loosened mortgage restrictions so that first-time buyers could qualify for loans they could not get before.
2003	American Dream Downpayment Act	Authorized subsidies to 40,000 low-income households per year to cover down payments and closing costs. To accomplish this homeownership objective, new policies encouraging homeownership were advocated, like the "zero-down-payment initiative" (in 2007 alone, twenty nine percent of mortgages were originated with no down payment), including ones only requiring the payment of interest for the first two years of the mortgage loan term or option ARMs where the borrower chooses how much he or she wants to pay.

Prepared by authors based on Moran, 2009.

One part of mortgages extended with the Government's blessing fell into the clutches of speculators and the other part into the hands of borrowers, who were able to acquire homes due to the increased availability of credits. Thus, as noted by Moran (2009), starting from individuals who obtained credits for homes appreciating in value and ending with banks that collected huge taxes, there were few of those who would have liked that to end.

Although banks are still being blamed for too loose standards of lending to low-income communities, Crandall (2008) emphasises that all these governmental laws, acts, programmes or strategies, directly or indirectly, encouraged such lending behaviour.

Some economists and researchers had also investigated the role of the Government Sponsored Enterprises (GSE) in the context of the subprime mortgage crisis. In his work, Moran (2009) mentions that such enterprises, the main of which were Fannie Mae and Freddie Mac, were profit-oriented, privately-owned mortgage finance companies with their shares traded on the New York Stock Exchange, and were two of the largest companies in the United States as measured by assets until they were placed into Government receivership. The principal purpose of Fannie Mae and Freddie Mac was to facilitate a liquid national market for residential mortgages as a means to foster homeownership. Thus, they operated in the secondary mortgage market by providing credit guarantees on mortgage-backed securities or directly investing in mortgages and mortgage-related securities through their retained mortgage portfolios. Consequently, in November 2008, Fannie Mae and Freddie Mac owned or guaranteed about 58% of all family mortgages. In principle, receiving a housing credit from HUD for purchasing mortgage-backed securities, Fannie Mae and Freddie Mac invested in subprime loans, encouraging banks, thrift institutions, and mortgage companies to make more loans to people with questionable credit ratings (Moran, 2009, p. 29). In 1998, 44% of the loans purchased by GSE were from low- and moderate-income borrowers, and in 2005 this share went up to 52%. The economists have different opinions about such behavior of these enterprises and its impact on the market of mortgages, however, there are two opinions worth distinguishing here: one of them is that the acts of GSE have considerably contributed to the over-expansion of the subprime mortgage market and risks, and the other – that the impact of the GSE on the subprime mortgage crisis was minor, and the acts of GSE were not the essential driver of the crisis.

The thoughts of the economists and scientists concerning the impact of the GSE on the crisis are summarised in Table 2: the left side of the Table presents the economists and scientists and their arguments why and how the acts of GSE influenced the subprime mortgage crisis, and the right side of the Table shows the economists and scientists and their arguments why the GSE acts had no decisive influence on the crisis.

TABLE 2. **Impact of GSE activity on the subprime mortgage crisis**

GSE activity considerably contributed to the subprime mortgage crisis	The influence of GSE activity on the subprime mortgage crisis was relatively moderate or indirect
Moran (2009) claims that the action from GSE, which is to operate in the secondary mortgage market by providing credit guarantees on mortgage-backed securities or directly investing in mortgages and mortgage-related securities through their retained mortgage portfolios, was designed to encourage those banks to extend home mortgages to individuals whose credit was generally not good enough to qualify for conventional loans. However, it condoned the practice of overly risky subprime mortgage lending.	Thomas et al. (2010) put stress on the fact that the subprime mortgage market expansion was not specific to GSE, because it mainly progressed through the non-traditional channels and was funded by issuing non-institutional securities.
Moran (2009) also emphasizes that due to increasing pressure from the Government to expand mortgage loans among low and moderate-income people and from the stockholders to maintain their phenomenal growth in profits, subprime mortgage loan originations surged by twenty five per cent per year between 1994 and 2003, resulting in a nearly tenfold increase in the volume of these loans in just nine years.	Moreover, as Thomas et al. (2010) note, although Fannie Mae and Freddie Mac were the main purchasers of the subprime mortgage backed securities, that they were simply complying with the goals set out by the regulators. Such purchases of securities met the requirements of HUD to promote loans to low-income borrowers.
Moran (2009) again indicates that the GSE activity provided banks and loan companies then with the opportunity to use the cash obtained from Freddie Mac and Fannie Mae to originate more mortgages. This constant cash flow kept the housing bubble inflated.	In addition, Thomas et al. (2010) argue that Fannie Mae and Freddie Mac did not cause the subprime boom and bust. They did have a role in buying senior pieces of structured deals, but these were the easy AAA parts that lots of investors wanted. They were not involved in the crucial CDO market or other vehicles for selling the important junior pieces of the deals.

Prepared by authors based on Moran, 2009; Thomas et al., 2010.

The acts of GSE were also analysed by Simkovic (2011) in his work "Competition and crisis in mortgage securitization". According to the author, both the underlying loan performance data and financial market prices for packaged securities suggest that the GSE maintained higher underwriting standards than most other secondary market participants. This is also confirmed by data shown in Fig. 1.

Therefore, summarising these attitudes and aspects, in can be concluded that Fannie Mae and Freddie Mac did not play the essential role in the subprime mortgage securities market. Moreover, the main reason for their collapse was the lack of capital for surviving the depreciation of assets which had started in about 2006, and the excessive risk taken by them when their market share started contracting, whereas the data show that the loan performance of GSE was better than of other institutions (Simkovic, 2011; Thomas et al., 2010).

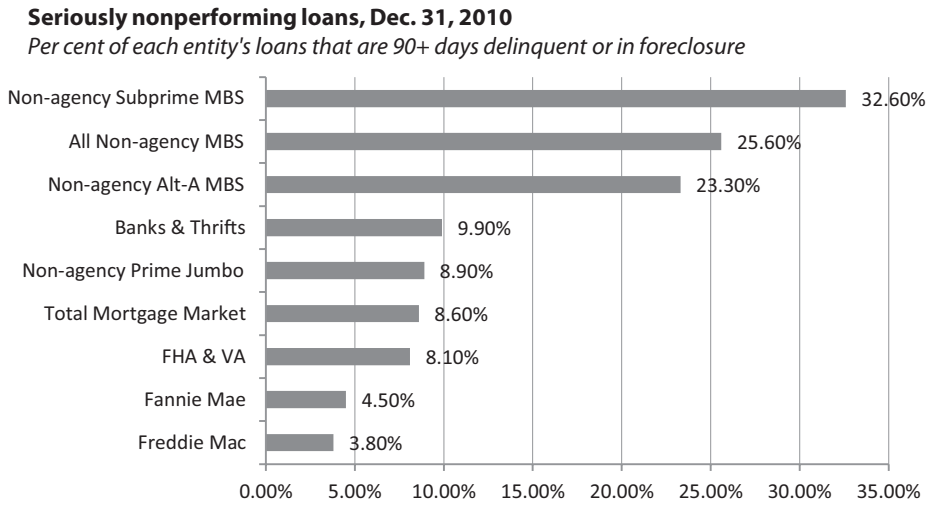

FIG. 1. **The share of seriously nonperforming loans in different markets and institutions**

Prepared by authors based on Simkovic, 2011.

In general, P. Isard (2009) is distinguished for the in-depth analysis of the matters of lending quality and risk control. In his opinion, the system of the U.S. political campaign financing generated incentives to do little to curtail subprime mortgage lending or dangerous financial engineering: therefore, the essentially prevailing political opinion was supportive of the growth of homeownership and resistant to regulation. This becomes even more obvious when analysing the actions, decisions, and policy of the U.S. Government already before the start of the subprime mortgage crisis. In general, all of them have contributed heavily to the dangerous expansion of subprime mortgage markets and securities comprising them, which became uncontrolled and brought about huge losses. The main acts and policies reducing control and regulation were as follows:

- In 2001, the predatory lending practices started drawing attention, but mortgage banking industry "bought" the political support >>>>> The plan of "curtailing secondary mortgages" was given up.
- By 2005, already the great majority of the Congress had admitted that the amounts of extended bad loans were too large >>>>> Efforts to legislate against such practices were blocked by the Congressional leadership (T. Delay).
- The Federal Reserve had the authority under the U.S. consumer protection legislation to set mortgage lending standards to be applied to all >>>>> The Federal Reserve also refused to exercise such authority.
- As early as in 2000, the Federal Reserve Governor N. Gramlich envisaged the increasing risk of subprime mortgages and tried to warn the federal regulators >>>>> The Federal Reserve Chairman A. Greenspan was of the opinion that market players

could decide better than the Government bureaucrats, and therefore the warnings were dismissed.

- The benefits of expansion of homeownership were considered to be worth the risks taken >>>>> Therefore, there was no sufficient and careful economic analysis assessing the systemic risk of housing depreciation.
- B. Born made strong efforts to regulate the rapidly growing market of financial derivatives >>>>> As the development of financial derivatives has been introduced as a symbol of the U.S. innovations and an advantage of deregulation, the efforts of regulation met stiff resistance from A. Greenspan and leaders of the Ministry of Finance.
- Shadow banking system companies became critical in the credit markets and in the financial system at large >>>>> However, they were not controlled and regulated in the same manner as commercial banks.
- In 2000, the market of credit default swaps was considered to be still very small and leaving no room for the possible existence of systemic risk >>>>> These transactions were left unregulated.
- The growing systemic risks were ignored and the regulatory tightening met with strong resistance >>>>> Regulators allowed the issuers of credit default swaps to operate without accumulating any reserves.
- The bankruptcy laws allowed borrowers to file a petition in bankruptcy after sale of a house for the default on obligations, when the amount was insufficient to cover all the debt, thus relieving borrowers from collection of the remaining debt >>>>> Loans were obtained and granted, relying too much on the continuously appreciating mortgages (homes) rather than on giving due consideration to the possibilities of their repayment and risks.
- Regulators allowed banks to keep risky securities with off-balance sheet companies, without the need to accumulate any capital reserves >>>>> Such regulatory system encouraged to shift as many assets as possible to the off-balance sheet companies.
- Regulators allowed giant banks to measure their risks and to establish capital requirements by themselves >>>>> Under the existing unjustified conditions this inevitably led to excessive exposures of banks (Isard, 2009; Moran, 2009; Geithner, 2008; Jacoby, 2008; Crotty, 2009).

The mid-September crisis of financial markets forced the Government and regulators to realise that, as a result of huge systemic risk, the global economy had become a "house of cards". Policy-makers have also started to realise that the global economy gradually developed into a vicious circle going downward in an accelerating spiral with financial stress and panic contributing to the weakening of economic activity and causing even greater panic and with linkages between financial markets and economic activity that could lead to a deep downturn of the global economy (Isard, 2009).

Imprudent acts and policies of the Federal Reserve

Figure 2 clearly reflects the acts of the Federal Reserve and its interest rate policy pursued before and during the crisis. As we can see, the Federal Reserve had been allowing the Federal funds rate to rise since early 2000, reaching a target rate of 6.5% percent in May of that year. In 2001, perceiving the rapidly accelerating weakness in the economy after the high-tech collapse, the Federal Open Market Committee (FOMC) initiated a loosening cycle, and by the end of August 2001 the target rate stood at 3.5%. Further sharp cuts followed the 9/11 attacks, however, and at the end of 2001 the rate stood at 1.75%. The rate was reduced further through 2002 and 2003, finally reaching a level of only 1% in June 2003. As argued by the Bank for International Settlements, the dollar's vehicle-currency role in the world economy makes it plausible that the U.S. monetary ease had an effect on global credit conditions more than proportionate to the U.S. economy's size (Obstfeld et al., 2010, p. 145).

Obstfeld et al. (2010) in his work emphasises that in early 2003 the concern over economic uncertainties related to the Iraq war played the dominant role in the FOMC's thinking, whereas in August the FOMC stated for the first time that "the risk of inflation becoming undesirably low is likely to be the predominant concern for the foreseeable future. In these circumstances, the Committee believes that policy accommodation can be maintained for a considerable period." Deflation was viewed as a real threat, especially in view of Japan's concurrent struggle with actual deflation, and the Fed intended to fight it by promising to maintain interest rates at low levels over a long period. The Federal Reserve kept its promise and did not increase its target rate until nearly a year later.

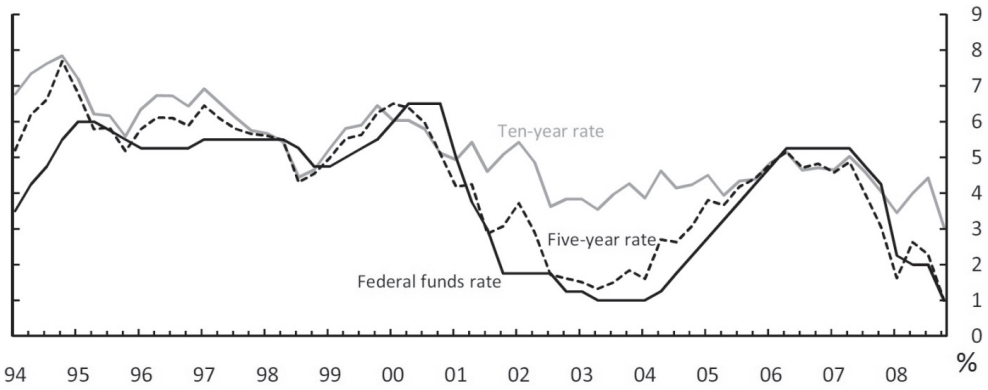

FIG. 2. **Various term interest rates in the US** (Obstfeld et al., 2010).

However, before 2004, the low interest rate policy effects, which also included the threats of possible inflation and financial instability, had started rising concerns. Understanding the influence of such policy on the appreciation of prices, in June 2004,

the FOMC started the policy of the tightening cycle. Until November 2004, the target rate had already reached 2% and from this point started slowly rising to its peak of 5% reached in July 2006. As emphasised by Lim (2008) and Obstfeld et al. (2010) in their works, the entrenched expectations of housing appreciation interacted with low interest rates and financial innovation to push home prices up even more rapidly after 2003. Consequently, the market of mortgages and securities comprising them expanded rapidly, while at the same time the mortgage quality in the U.S. deteriorated.

The financial institutions and markets were subject to more serious controls and restrictions only in 2007 when the severity of the crisis became obvious, and until then the market of mortgages and securities comprising them had been prospering and growing at an accelerating rate. However, when the speculative U.S. housing bubble collapsed and housing prices started falling down to the actual demand – the level of supply, banks and financial institutions became exposed to defaults and the resulting loss of assets.

Thus, the Federal Reserve replaced the "dot-com" bubble by the housing bubble, increasing money supply and keeping low interest rates for a prolonged period, while residential housing schemes too actively encouraged lending to low-income individuals, which later resulted in higher mortgage delinquency rates and reduction of residential construction volumes and prices. Also, control from above was ineffective and allowed banks and other financial institutions to freely participate in the risky and growing subprime mortgage securities market, without accumulating sufficient capital reserves, whereas the control and level of risk of investment banks in the total balance and the general expansion of activities in the market of subprime mortgages were treated in perfunctory manner, and due to the fragmented structure of control such risk was not fully assessed or disputed.

III. Effects of alternative actions on the data table

The first part of the paper covered the authors' research of the causes and consequences of the subprime mortgage crisis in the United States of America in 2007–2008, in which the multiple regression equation and different statistical coefficients of significance and determination were calculated and assessed. The research results showed that the subprime mortgage crisis and the housing bubble were not isolated and independent phenomena. They were a result of the parallel functioning of several factors, the sources of which stretch not only to the risky activities of the private sector but also to the imprudent policy of the Federal Reserve Bank, actively pursued housing support policy, and inadequate control of financial institutions.

The number of new housing starts in the research has been chosen as the dependent variable – a factor, consequence or result of several independent variables or causes that have been influencing it for a prolonged time (see Table 3). The list of independent

variables for the research was compiled in observance of the possibilities to assess them in quantitative terms over the reference period and also having regard to their potential direct impact on the number of new housing starts. Although the number of causes analysed in the literature review was considerably larger, the research focuses on those factors and causes which could have been directly regulated or influenced by the central bank or government of the country.

TABLE 3. **Dependent variable and independent variables of the analysis**

Dependent variable (consequence, result)	Independent variables (causes)
Number of new housing starts	Federal funds rate
	Mortgage charge-off and delinquency rate
	Change in demand for mortgage loans
	Homeownership ratio
	Risk-weighted Tier I capital ratio
	Federal Housing Administration loans volume
	Change in mortgage lending standards

Prepared by authors based on Taylor, 2007; Avery, 2011.

Multiple regression analysis

An important aspect in producing the regression model is to determine the multicollinearity. The existence of multicollinearity in the model being produced in this case would mean a correlation between one or more independent variables of the model, i.e. one variable can be obtained linearly from other variables with a sufficiently high level of accuracy. In that case, any small changes in the model or data can bring about significant and variable changes in the calculated multiple regression coefficients, and the signs of the coefficients may be incompatible with the economic laws. The multicollinearity itself does not reduce the reliability and accuracy of the entire model, but it affects the calculation of its separate variables. It means that the multiple regression model with correlating variables can show with what accuracy and precision all independent variables predict the dependent variable, but the model cannot produce any particular results related to separate independent variables of the model or identify the variable which is insignificant. Given that the purpose of producing this multiple regression model is to assess the impact of separate factors and to calculate on its basis the results of alternative actions of the central bank and the government, the next step in this research paper is to verify whether the multicollinearity of the model exists, and if it by does exist – to eliminate it removing closely interrelated independent variables.

TABLE 4. **Paired correlation coefficients of regression variables**

	Number of new housing starts	Modified effective federal funds rate	Mortgage charge-off and delinquency rate	Net percentage share of respondent banks reporting higher demand for mortgage loans	Risk-weighted Tier I capital ratio	Home-ownership rate	Volume of loans insured by the Federal Housing Administration	Net percentage share of respondent banks, tightening mortgage underwriting standards
Number of new housing starts	1							
Modified effective federal funds rate	-0.545459998	1						
Mortgage charge-off and delinquency rate	-0.697422904	0.39153705	1					
Net percentage share of respondent banks, reporting higher demand for mortgage loans	0.581982172	-0.196919902	-0.328274809	1				
Risk-weighted Tier I capital ratio	-0.178378582	0.092095953	0.339578764	-0.272314915	1			
Homeownership rate	0.075420517	0.108840919	-0.079543376	0.232735079	-0.14947285	1		
Volume of loans insured by the Federal Housing Administration	-0.148920211	-0.189820144	0.293783563	0.131845193	0.295782417	-0.123086	1	
Net percentage share of respondent banks, tightening mortgage underwriting standards	-0.703381497	0.38325213	**0.713196585**	-0.384287973	0.244943833	-0.1932207	0.471929955	1

Prepared by authors based on New..., 2013; Selected..., 2013; Senior..., 2013; Seasonally..., 2013; Charge-off..., 2013; BHCPR..., 2013; FHA..., 2013.

For the purpose of assessing the multicollinearity, the table of paired correlation coefficients is used. Although quite often the "rule of thumb" is used according to which a model is considered to be multicollinear when the paired correlation coefficient module is greater than 0.8, however, in order to calculate the coefficients of the model with the maximum accuracy, in other stages this threshold is reduced to 0.7. The data of paired correlation coefficients are presented in Table 4. The grey column shows the correlation coefficients of the dependent variable and independent variables, thus it is not taken into account when assessing the multicollinearity of the model. As we can see, the coefficient is greater than 0.7 only in one case of paired correlation (marked in dark in the Table) – between the mortgage charge-off and delinquency rate and net percentage share of banks that have tightened mortgage lending terms. For the purpose of examining which of these factors should be eliminated, other correlation coefficients are considered. As the correlation of both factors with the dependent variable is essentially the same and the ratio of tightening mortgage lending terms is more related to the residual independent variables, this factor is eliminated from the model.

The multiple regression equation coefficients are calculated for all residual independent variables. The data table used for the calculations is presented in Appendix 2. As part of the factors has been eliminated, the residual ones are marked as follows:

Y – the number of new housing starts, percentage change compared to the last year's quarter (dependent variable);

X_1 – the modified effective federal funds rate (1.25 years time lag); X_2 – mortgage charge-off and delinquency rate of 100 largest banks, absolute change compared to the previous quarter; X_3 – the net percentage share of respondent banks reporting a higher demand for mortgage loans; X_4 – the risk-weighted Tier I capital ratio, percentage change compared to the previous quarter; X_5 – the homeownership ratio, percentage change compared to the previous quarter; X_6 – the volume of loans insured by the Federal Housing Administration, USD billion.

TABLE 5. **Regression equation calculation results**

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.861263309
R Square	0.741774487
Adjusted R Square	0.709496298
Standard Error	0.107316815
Observations	55

t-distribution value = 2.682204027

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	6	1.587996469	0.264666078	22.9806723	1.42067E-12
Residual	48	0.552811144	0.011516899		
Total	54	2.140807613			

	Coefficients	*Standard Error*	***t Stat***	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.18787908	0.044748829	**4.198525064**	0.000115628	0.097905531	0.27785263
Modified effective rate of Federal Funds. time lag of 5 quarters. %	-3.215419553	0.793464836	**-4.052378137**	0.00018464	-4.810787503	-1.620051604
Mortgage charge-off and delinquency rate of 100 largest banks, change compared to the previous quarter, %	-11.60068789	2.660261195	**-4.360732665**	6.82882E-05	-16.94950142	-6.251874363
Net percentage share of banks, reporting higher demand for mortgage loans, %	0.308060109	0.057033307	**5.401407065**	2.02911E-06	0.193386961	0.422733257
Risk-weighted Tier 1 capital ratio, change compared to the previous quarter, %	1.106674607	0.517499827	**2.138502373**	0.037593119	0.066171487	2.147177728
Homeownership rate, change compared to the previous quarter, %	-1.201308603	3.549283396	**-0.338465112**	0.736488804	-8.337621037	5.935003831
Volume of loans insured by Federal Housing Administration, bill. USD	-0.001824145	0.000762641	**-2.391879289**	0.020727712	-0.003357538	-0.000290753

Prepared by authors based on New..., 2013; Selected..., 2013; Charge-off..., 2013; Senior..., 2013.

In order to assess the impact of each independent variable on the dependent variable, the statistical significance of each factor is examined using *t* statistics (see Table 5) showing the independent variables of the model that should be included in the model at a particular confidence level. If |*t* calculated| > *t* notional and the null hypothesis is eliminated, the impact of the independent variable is statistically significant. As the model seeks the maximum accuracy, the confidence level chosen in this case is 99 % and the notional value *t* is 2.6822 (Table 5, upper highlighted boxes, using the TINV function). Having eliminated the homeownership ratio from the regression model, the same procedure is repeated until the *t* statistics of the modules of all residual factors become greater than the notional value *t* of the confidence level of 99 %. The risk-weighted Tier I capital ratio and the volume of loans insured by the FHA appeared to be statistically insignificant, which to a certain extent was also shown by the previous paired regression analysis.

TABLE 6. **Results of calculations of the final regression equation**

SUMMARY OUTPUT

Regression Statistics			
Multiple R	**0.835233692**		
R Square	**0.697615319**		
Adjusted R Square	0.679827985		
Standard Error	0.1126636	**F-distribution value =**	**4.190618788**
Observations	55		

ANOVA

	df	*SS*	*MS*	***F***	*Significance F*
Regression	3	1.493460187	0.497820062	**39.21977929**	2.76454E-13
Residual	51	0.647347426	0.012693087		
Total	54	2.140807613			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	**0.103011612**	0.025059616	4.110662092	0.000143479	0.052702335	0.153320889	0.052702	0.153321
Modified effective rate of Federal Funds, time lag of 5 quarters, %	**-2.698110366**	0.776807609	-3.473331536	0.001057084	-4.257616681	-1.13860405	-4.25762	-1.1386
Mortgage charge-off and delinquency rate of 100 largest banks, change compared to the previous quarter, %	**-13.0244469**	2.463088322	-5.287852158	2.60941E-06	-17.96930294	-8.079590863	-17.9693	-8.07959
Net percentage share of banks, reporting higher demand for mortgage loans, %	**0.249545473**	0.054659102	4.56548797	3.17442E-05	0.139812749	0.359278197	0.139813	0.359278

Prepared by authors based on New..., 2013; Selected..., 2013; Charge-off..., 2013; Senior..., 2013.

Therefore, having calculated and assessed the impact of separate three residual independent variables of regression on the dependent variable, the equation coefficients are obtained (column *Coefficients* in the lower part of Table 6). The final calculated regression equation is as follows:

$Y = –2.69811 \cdot X_1 – 13{,}02445 \cdot X_2 + 0{,}24955 \cdot X_3 + 0{,}10301$, where

Y – the number of new housing starts, percentage change compared to the last year's quarter (dependent variable);

X_1 – the modified effective Federal funds rate (1.25 years time lag);

X_2 – the mortgage charge-off and delinquency rate of 100 largest banks, absolute change compared to the previous quarter;

X_3 – the net percentage share of respondent banks reporting a higher demand for mortgage loans.

In other words, having systematised the available data and indicators, the model of the dependence of the number of new housing starts on the factors, which were directly and significantly affected by the Central Bank and the policy pursued by the Government, was produced. With the help of this model it was established that housing numbers in the model were influenced by the federal funds rate, the growing demand for mortgages and mortgage delinquency rate.

This part of the paper estimates the effects of alternative actions of the Government and the Central Bank on the number of new housing starts on the basis of the performed calculations, the regression equation, the relationship and impact indicators, and coefficients. The purpose of this estimate is to assess the alternative actions of the Federal Reserve and the Government and to forecast what would have been the result of the appropriate actions taken by the Federal Reserve and the Government at the respective time. Therefore, the independent variables that have been chosen are those which could have been monitored, regulated, changed or influenced by the selected policy actions of the Federal Reserve and the Government, predetermining in such a way the entire direction of the subprime mortgage market. As already mentioned above in the paper, the independent variables influenced by the Central Bank include the change of the effective federal funds rate, and two other variables remain within the sphere of influence of decisions of the country's government and legislators.

The essence of research of the alternative independent variables is to replace each independent variable on the basis of tightened rules of the regulation of financial institutions and markets, newly adopted legislative acts and regulations, by the higher federal funds rate, and on the basis of the modified data and calculated regression equation to arrive at the result of alternative actions – the number of new housing starts under the alternative and tightened market conditions.

Thus, the next phase of the research is the modification of data series of each independent variable under more stringent conditions and on the basis of the relevant assumptions.

Modified effective federal funds rate

The question what would have happened if the alternative path of the federal funds rate would have been chosen is answered using the rule proposed in 1993 by the economist J. B. Taylor – a model describing how the monetary policy (or, to be more precise, the federal funds rate) should respond to the economic situation of the country. The rule in itself is quite straightforward and accentuates the overall price level of the country and the net output (the difference between the actual and the potential GDP). Although there is no common agreement on the values of the coefficients that should be used in this rule, this paper uses the coefficient of 0.5 for the inflation and 0.5 for the net output, which were selected by the author when introducing this model for the first time. The mathematical expression of the rule is presented below:

$$i = r + \pi^* + 0.5 \cdot (\pi - \pi^*) + 0.5 \cdot y, \tag{1}$$

where:

i – the nominal federal funds rate;

r – the equilibrium real interest rate;

π – the current annual inflation rate;

π^* – the target inflation rate of the Federal Reserve;

y – the percentage deviation of real GDP from the potential GDP (Taylor, 1993).

To put it otherwise,

$$y = \frac{100 \cdot (Y - Y^*)}{Y^*}, \tag{2}$$

where

Y – the real, actual GDP;

Y^* – the potential GDP.

In simple terms, the rule of Taylor mechanically links the federal funds rates with the deviation of inflation from the target and with the net output. This rule of the interest rate fixing policy has a distinguishing feature, i.e. the federal funds rate increases when the inflation rises above the target rate or when the real GDP exceeds the potential GDP level.

For the calculation of the federal funds rates of the period of 2000–2013 under consideration according to the rule of Taylor, the coefficient of 0.5, existing at the inflation factor, is used on the basis of the classical modification of this rule, but there are many of

them, and they are quite different. The net output coefficient is also 0.5, so the response of the Federal Reserve to the inflationary pressure is the same as the response to the excessive economic potential. For the purpose of simple calculations, in the research it is considered that the target inflation rate of the Federal Reserve is the officially announced value of 2%. As shown by Alexis et al. (2005), the real equilibrium interest rate that represents the real rate of return required to keep the economy's output equal to the potential output is time-variant, highly persistent and affected by real shocks. But on the basis of real-time information that could have been used in reaching a policy decision, complexity and difficulties in precisely estimating the equilibrium interest rate, it is kept constant. Therefore, in favor of the simplicity of the model, the real equilibrium interest rate is also considered to be 2%, because such interest rate was originally proposed by J. B. Taylor in his model and also applied in their works both by Poole (2007) and Taylor (2007).

The current inflation rate is measured as a change in the consumer price index over the last four quarters. The calculations are based on all the urban consumer price indices provided by the Labor Statistics Bureau. Given that the data provided by the Bureau are only monthly, semi-annual or annual, for the purpose of calculations it is necessary to recalculate the data and convert them into quarterly data. This is done using the quarterly indices' calculation methodology of the Statistics Lithuania: in order to estimate the changes in quarterly consumer price indices compared to the relevant quarter of the previous year, a 3-month average of the consumer price indices is determined, and then the percentage change over four quarters is calculated.

The percentage deviation of the real GDP from the potential GDP is calculated using the official quarterly estimates of the potential GDP provided by the Congressional Budget Office and the official quarterly estimates of the real GDP provided by the Bureau of Economic Analysis. The percentage change, which is necessary for the subsequent assessment of the nominal federal funds rate according to the rule of Taylor, is calculated using formula (2). More detailed steps of calculating the deviation of the actual GDP from the potential GDP are also provided in Appendix 1. Appendix 3 systematises all available and calculated indicators which are inserted in formula (1) to arrive at the federal funds rate according to the Taylor rule. Given that the obtained numbers do not correspond to the 0.25 percentage point multiples' increase/decrease of the policy pursued by the Central Bank, the data of the federal funds rate calculated according to the rule are rounded to the nearest multiple of 0.25 percentage points, assuming that the effective interest rate is approaching the nominal rate. Formula (1) presents the instant outcome of the economic situation, without taking into account the previous interest rates, inflation and other economic indicators or any future forecasts and economic perspectives; therefore, during the period under consideration, the difference between the results of interest rates calculated according to the rule of Taylor and the actual data of the federal

funds rate is obvious. Furthermore, the research is continued disregarding the fact that the values of interest rates calculated applying the rule of Taylor would differently affect all actual economic indicators according to which the further interest rate data are calculated, because it is difficult to measure the deviation of inflation required for the calculations and of the actual GDP from the potential GDP due to the indefinitely large number of variables influencing them and the complicated relationships among them. Thus, the calculated values of interest rates, in principle, represent a notional estimate of a particular quarter based on the information of economic indicators available at that time. The regression model calculations were carried out using the interest rate fixed by the Federal Reserve with a time lag of 1.25 years; therefore, analogously, the further simulation of the situations also uses the data of interest rates calculated according to the rule of Taylor with a time lag of 1.25 years (see Appendix 3).

The same Appendix 3 presents the data of interest rates used for the further simulation of the model. The model was simulated under three different assumptions: 1) the federal funds rate completely follows Taylor's formula, i.e. the interest rate is fixed in strict compliance with this rule; 2) the federal funds rate follows Taylor's formula only to a certain extent, without letting it fall to 1%, and later again returns back to the level of the actual federal funds rate, i.e. follows the rule of Taylor only from the third quarter of 2002 until the third quarter of 2007. Thus, at the main stage of inflating the bubble, the federal funds rate stays higher and inhibits the formation of the bubble as soon as the first signs of the overheating of economy and of the formation of the housing market bubble emerge; 3) the federal funds rate follows its actual path and falls to 1%, but later, in compliance with the rule of Taylor, it raises faster and, at a certain point, again reaches the actual values, i.e. from the first quarter of 2005 until the third quarter of 2007. In this case, when the bubble starts inflating, the federal funds rate rapidly falls, but a sudden increase of the interest rate prevents the bubble from getting significantly inflated. In other words, although such actions are rather delayed, they still allow taking the measures to regulate the economy.

It should be noted that the data series in column 8 is used for the simulation of the case when the rule of Taylor is completely followed, in column 9 – when the interest rate is not allowed to reach 1%, and in column 10 when the interest rate is allowed to reach 1%, but later is elevated quicker. Furthermore, all calculations are provided with a time lag of 1.25 years, therefore, in order to obtain a certain interest rate effective from the third quarter of 2002, it should be determined five quarters before, i.e. in the second quarter of 2001, etc. Detailed calculations of different scenarios in the research are presented after modification of all data of independent variables (Appendix 4 and Appendix 5).

Mortgage charge-off and delinquency rate of 100 largest banks

The exceptional numbers of new housing starts over the analysed period are linked with the subprime mortgage market problems. While low interest rates increased the supply of funds to the mortgage market, the high housing inflation along with the increasing demand for mortgages resulting from the housing market promotion policies had led to a significant reduction in mortgage charge-off and delinquency rates because of various subprime mortgage incentives offered to homebuyers. However, when the period of incentives ended, the prices started falling and the market participants' expectations worsened, the relatively low mortgage charge-off and delinquency rates reversed. Under the housing promotion policies, many subprime mortgages were extended to low-rated borrowers, i.e. large numbers of loans were of poor quality. Although, for a certain period of time, they were concealed by rising prices and market optimism, as soon as the first signs of economic disturbances manifested themselves the poor-quality loans became delinquent or simply defaulted. However, before the reversal of the mortgage charge-off and delinquency rate, many mortgages and mortgage-backed securities had been issued with credit ratings reflecting unusually low delinquency rates, which increased only later. Automatic underwriting programmes, which look at the risks of mortgages and securities, mortgage charge-off and delinquency rates underestimated the effects of the price change on subprime mortgages. Hence, people purchased securities comprising such mortgages without knowing the risk that they entailed (Taylor, 2007). Although it is difficult to adjust the rate in the right direction over a short period, because it partially reflects the result of mortgages issued in the past, nevertheless, it is a perfect reflection of the longer-term policy direction of the Central Bank and the Government. Given that the years of 2001–2004 were noted for the improving conditions, the numbers of poor quality mortgages issued during that period were the largest, the negative outcomes of which started manifesting themselves in 2006–2007 when the first larger mortgage repayment amounts appeared, which the borrowers were unable to repay. The falling mortgage charge-off and delinquency rates positively predisposed the creditors as regards the future economic situation, so the standards loosened, and the growing demand for homes boosted their prices and concurrently the housing demand. However, the higher mortgage charge-off and delinquency rates, in their turn, showed a negative example to the markets and worsened the market participants' expectations, which also caused a sharp decline in the numbers of new housing starts. If the Central Bank and the Government would not have encouraged so actively the expansion of the housing market, the standards of mortgages would have probably remained almost the same as in 2001–2002, and the mortgage charge-off and delinquency rate would not have increased as much as they actually did. Thus, the actual data of this rate are modified relying on the assumption that if the incentives of the Central Bank and the Government would have been smaller and the mortgage standards and conditions would not have changed to

such a great extent, the mortgage charge-off and delinquency rate would also have been retained. Accordingly, the actual data are calculated assessing them according to the moving central average of the rates that existed 2 years on either sides of the respective point in time, because, in addition to allowing the smoothing of changing data and obtaining the trend equation, such a period also eliminates high fluctuations caused by price changes.

Net percentage share of respondent banks reporting a higher demand for mortgage loans

The Government incentives were directed not only towards creating the supply on the creditors' part, but also towards encouraging the demand on the debtors' part. Lower-income individuals were offered different mortgage incentives, such as loans guaranteed by FHA available for a low down payment, reducing credit scores for individuals eligible to apply for mortgages, as well as lower interest rates and insurance premiums, different legislative acts imposing obligations on creditors to extend subprime mortgages, penalties for the failure to extend mortgages, etc. Such a loosening Government policy predetermined the increase in the demand for mortgages in a great number of banks during the pre-crisis period. However, before and during the crisis, the expectations of the existing and potential borrowers and creditors have changed essentially, leading to restrictions and tightening of lending schemes, which, in turn, downgraded the general demand for mortgages. The reducing demand automatically resulted in a more complicated survival of the housing bubble collapse and recovery. Thus, the mortgage demand increase factor in the research is simulated under the assumption that the pro-cyclical behavior of institutions with respect to lending standards and incentive schemes is replaced by a smoother and less fluctuating data series which could have been achieved without attempting to artificially inflate the mortgage supply and demand straining both the offered schemes, lending standards and borrowers to achieve the required level. To put it otherwise, the upward and downward jumps of the mortgage demand are more reflected by the data trend series using the same moving central average of the rates that existed 2 years on either side of the respective point in time, which partially eliminates the volatility of this indicator and equalises the upward and downward phases over the period under consideration.

Therefore, these two independent variables – the net percentage share of respondent banks reporting the increase in the demand for mortgage loans and the mortgage charge-off and delinquency rate of 100 largest banks – represent the second group of variables that was mostly influenced by the Government decisions to provide active support to the housing market and to design different homeownership support programmes. This case (likewise the case of the Federal funds rate) also covers the simulation of three scenarios:

1) modifying the data over the entire period under consideration, assuming that such active Government policies artificially promoting and inflating the housing market in 2000–2013 were ineffective and unrealisable;

2) modifying the data only from the third quarter of 2002 together with the federal funds rate and up to the first quarter of 2013, assuming that the measures for the stabilisation and regulation of the economy are taken as soon as the first signs of the economic overheating and of the housing market bubble appear;
3) modifying the data only from the first quarter of 2005 together with the federal funds rate and up to the third quarter of 2013, assuming that even when the first problems in the economy and housing market appear, the adoption of decisions on the tightening of control is delayed until the interest rates reach the level of 1% – only then the measures for the stabilisation and regulation of the economy are taken.

The model of the scenario of alternative actions

The data series of independent variables modified using the above-described ways and methods are systematised in one data table, on the basis of which the quantitative change of the new housing starts is estimated. The model is formed by varying the scenarios of the modification of data of both groups of variables and observing which combination is best suited for limiting the inflation of the housing bubble forming during the period under consideration and for neutralising the negative consequences of its collapse. The tables and calculations of combinations of these different data modifications are presented in Appendix 4. The further analysis in the paper is limited only to the best combination of different scenarios, as shown in Appendix 5.

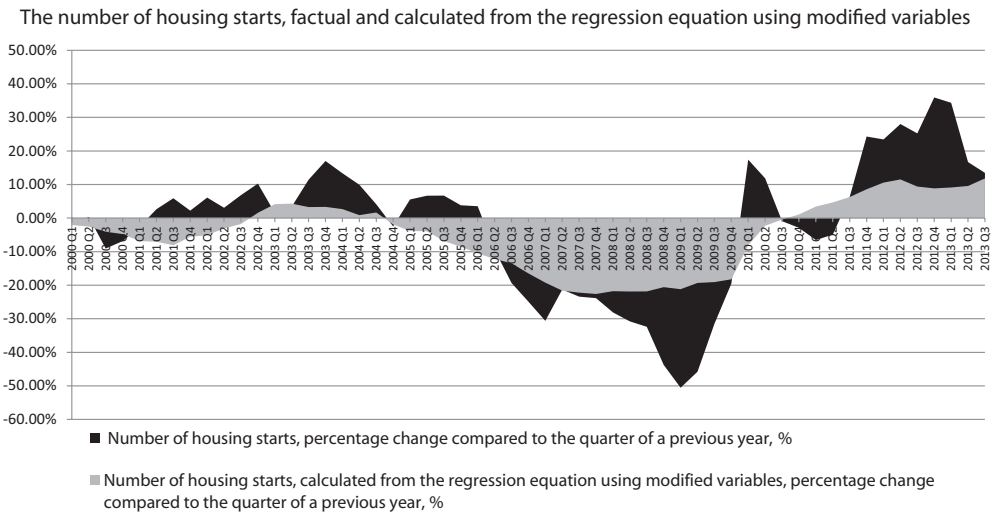

FIG. 3. **The change of factual housing starts and housing starts calculated from the regression equation using the first modification scenario for variables in 2000–2013**

Prepared by authors based on New..., 2013.

As we can see, the modification of the data series of all three independent variables provided the best control of the formation and consequences of the housing bubble. It means that the interest rate adjustment according to the Taylor rule over the reference period was the most effective when it was applied from the third quarter of 2002 and returned to the actual rate in the fourth quarter of 2007. The application of the rule of Taylor to the entire reference period proved to be less effective, because actually the interest rate calculated according to the rule over the entire pre-crisis period was slightly above the actual rate. Due to that, the recovery from the "dot-com" bubble collapse and 9/11 attacks would have lasted longer. Furthermore, the rule of Taylor appeared to be quite short-sighted for the future forecasts, so if its application is continued after 2007, the interest rate would be kept at a high level for a prolonged period, and due to that the estimated number of new housing starts would fall even below the actual number, causing even more painful consequences and recovery after the subprime mortgage crisis. The application of the Taylor rule from the first quarter of 2005 also appeared to be quite effective, but over the same period of 2002–2005 the housing market bubble inflated considerably more and the market collapse would generate larger negative consequences.

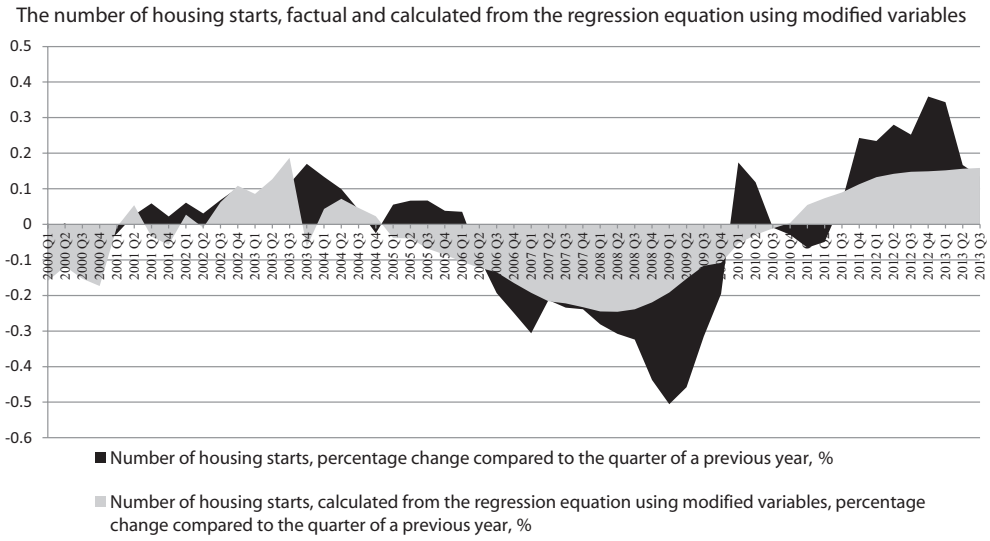

FIG. 4. **The change of factual housing starts and housing starts calculated from the regression equation using the third modification scenario for variables in 2000–2013**

Prepared by authors based on New..., 2013.

The modification of decisive factors of the Government programmes and policies supporting homeownership in the model also relies on the second scenario. Although the results produced by the first scenario (modifying the data over the entire period), as shown in Fig. 3, do not differ considerably, still the second scenario is more logically

and economically sound – the support programmes as such are not bad or dangerous, and therefore in this case they would be treated more strictly only upon the emergence of the first disturbances in the economy and the housing market and in parallel with the change of the federal funds rate. The third scenario has already been essentially given up, because the greatest rise in the mortgage charge-off and delinquency rates and in the demand for mortgages was in 2003–2006 (see Fig. 4). Therefore, due to artificially promoted and deteriorating quality mortgages over this period, the numbers of new housing starts obviously jumped up towards the actual values. Consequently, the subsequent decline of this number would have caused more painful circumstances than in the case of the second scenario.

On the basis of the regression equation calculated in the first part of the paper, the values of the numbers of new housing starts are calculated from the available data modified according to the second scenario and compared with the actual values to assess whether the developed model and simulated scenarios actually generate the real effect. The differences between the actual and the simulated (in the case of alternative decisions and actions of the Central Bank and the Government) values of the numbers of new housing starts are shown in Fig. 5.

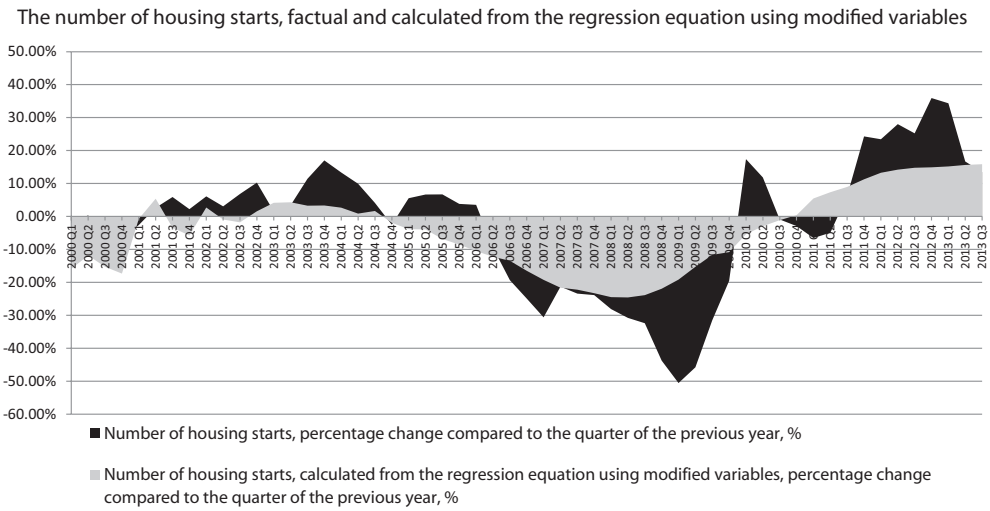

FIG. 5. **The change of factual housing starts and housing starts calculated from the regression equation using the second modification scenario for variables in 2000–2013**

Prepared by authors based on New..., 2013.

The number of the modified factors of new housing starts, calculated according to the regression equation before the third quarter of 2002, when more stringent decisions regulating the financial market, banks and housing market were introduced, is basically similar to the index of the calculated unmodified factors, because the data during that period, due

to the selected second scenario of actions, are not modified and therefore close to the actual data. The number of the new housing starts calculated over this period, albeit being quite volatile due to the fluctuations in the values of the independent variables affecting it, in principle stayed below the actual values exceeding them only over one quarter.

The subsequent implementation of the plan of alternative actions obviously distinguishes the curve of actual values from the curve of values calculated by the model. The actual values continued growing and the housing market bubble kept inflating – almost four years in a row (2002–2006) the average annual increase in the number of the new housing starts was almost 10%, while the curve calculated according to the model during the reference period remained more or less stable, staying at the level of 4–5% until 2005 and declining to a slightly higher 6–7% rate reduction when the first signs of the subprime mortgage crisis appeared. Thus, the curve of the model testifies to the effectiveness of the selected alternative actions – they prevent the housing market bubble from inflating to such a great extent, and the rate of their change is more stable, lower and better forecasted. The increase in the case of the actual data lasts until the first quarter of 2006, and in the case of the calculated data – until the fourth quarter of 2004 when there is a shift, and the trend of growth in the number of actual rates prevailing for a considerable period of time is replaced by the reducing growth rates until the beginning of 2006 when both the actual and the calculated values reverse to the negative side and the new housing start numbers start declining. It is worth noting that the change in the calculated values was again considerably lower – from end–2003 until the beginning of 2009, i.e. over five years, the actual values of change in the numbers of the new housing starts dropped from 17.00% to –50.56%, resulting in almost 70% of absolute difference. While the calculated values were far more stable – from their peak of 4.31% in the second quarter of 2003 until the lowest level of – 24.58% in the second quarter of 2008, resulting, therefore, in a more than twice smaller jump and a fall of the number as compared to the actual value. Although a sudden jump and fall of the number of the new housing starts in itself is not inferior, for example, to the extended and long-lasting decline of the number, we can see from the graph that essentially the change in both the actual and the calculated values over time was very similar – the maximum and minimum points of curves occur in the close quarters, and the points at which both the curves cross the zero axis are similar. Thus, the main difference is the angle of curves, the slope which shows how significantly the number of the new housing starts fluctuated over the reference period, i.e. how strongly the bubble got inflated and what was the extent of the consequences of its collapse. Apparently, the curve of the actual values testifies to both the considerably more inflated bubble and to more painful consequences for the housing market after its collapse, because the quantitative reduction of the new housing starts over the same period was noticeably greater than the curve of calculated values reflects.

The last period of 2010–2013, visible in Fig. 3, looks rather controversial – the actual values really stay above the calculated ones. This, however, is explained by the fact that the developed model and the modification of data were aimed at, and concentrated on, controlling the housing market bubble rather than on stimulating the economy and recovery programmes; therefore, even during the post-crisis period, the model focuses on the as stable and moderate as possible change in the numbers of the new housing starts.

Therefore, under the rapid appreciation of housing prices, the charge-off and delinquency rates of the secondary mortgage reduced, leading to more favorable credit ratings than it was possible to maintain. When the short-term interest rates returned to the normal level, the housing demand rapidly declined, concurrently reducing the housing and construction volumes and at the same time even more negatively affecting the inflation of prices. At that time, mortgage delinquency and foreclosure rates considerably increased, finally leading to the decline in the subprime mortgage market and in all financial instruments and securities.

Although the actions of the Federal Reserve in the developed alternative model might seem to be over-zealous and slowing down the economy and growth, however, in the given case and under the given circumstances, subject to the assumptions made, they would have helped avoid such a great rapid inflation of the housing market bubble and the negative consequences of its collapse. Certainly, in the case of the free market economy, the regulation should be reduced to the minimum – then theoretically the best functioning of the economy can be achieved. However, due to the excessively grown weight and significance of financial institutions in the national economies, leaving the governments and central banks responsible for their rescue in critical situations, the great majority of them use their "immunity" and the "too-big-to-fail" tag. Thus, the inadequately measured and priced risk brought about huge losses to both financial institutions as the private sector and to the national economy, followed by new assistance packages issued one after another trying to protect against such losses.

It follows from the above that a financial institution which applies for the state support in the cases of economic difficulties should also contribute by submitting itself to a more stringent control and accumulate an additional reserve from its own funds rather than from the taxpayers' money.

And here the question of what – large or small institutions, or none at all – should be regulated by the national supervisory authorities arises as the principal one. At this point, it should be admitted that the impact of large financial institutions on the market is too great to allow them operate in the economy uncontrolled, and, at the same time, the price of seeking short-term profits at all costs, which is one of the essential features of the private sector, both for the financial institutions and taxpayers is considerably higher than the assumed risk is worth.

IV. Conclusions and proposals

Having summed up the thoughts, theories, arguments, facts and considerations of the economists and researchers about the causes and factors of the subprime mortgage crisis in the U.S. in 2007–2008, the following conclusions were drawn:

1. The analysis of theoretical aspects of the role of public authorities has shown that control from above was ineffective and allowed banks and other financial institutions to freely participate in the risky and growing subprime mortgage securities market, without accumulating sufficient capital reserves, whereas the control and level of risk of investment banks in the total balance and the general expansion of activities in the market of subprime mortgages were treated in a perfunctory manner, and due to the fragmented structure of control such risk was not fully assessed and supervised.
2. The analysis of literature and regression has shown that the Federal Reserve has deliberately replaced the "dot-com" bubble by the housing bubble, by increasing money supply and keeping low interest rates for a prolonged period and ignoring the Taylor rule, which indicated the economic overheating and the formation of the bubble. Furthermore, until 2007, the housing schemes had been too actively encouraging lending to low-income individuals, which later resulted in higher mortgage delinquency rates and in the reduction of residential construction volumes and prices.

Having systematised the authors' research of the causes and factors of the subprime mortgage crisis in the U.S. in 2007–2008, the following conclusions were drawn:

1. Having summed-up the results of the regression equation obtained in the first part of the paper, the model of the impact of the alternative actions of the Federal Reserve and the Government on the number of the new housing starts has been developed, which uses the modified data of independent variables. Having examined several different situations of the model, it was established that the following policies of the Central Bank and the Government in controlling the housing bubble would have been most effective:
   a) adjusting the interest rates according to the rule of Taylor over the analysed period and starting to apply it from the third quarter of 2002 and returning to the actual rate in the fourth quarter of 2007, which would have helped in avoiding the greater part of the housing market bubble.
   b) if such active Government support programmes would not have been applied from the third quarter of 2002 and until the end of the period under consideration, the number of the new housing starts would not have first increased and

later reduced to such a great extent under the influence of factors resulting from such programmes.

2. The quantitative change of the new housing starts calculated using the regression equation on the basis of the modified data of independent variables obviously differs from the curve of actual values. The actual values kept increasing and inflating the housing market bubble, while the curve calculated according to the model, i.e. upon implementation of the plan of alternative actions over the respective period, has remained more or less stable. Thus, the curve of the model testifies to the effectiveness of the selected alternative actions – they would prevent the housing market bubble from inflating to such a great extent, and the rate of quantitative change of the new housing starts would be more stable and lower in absolute terms.

On the basis of analysis of the literature and the developed model of alternative policy actions of the Central Bank and the Government, the following proposals for the prevention of the housing bubble formation and subprime mortgage crisis are provided:

a) to pursue a more rules-based monetary policy and the fixing of interest rates that are time-tested and effective, rather than implement a discretionary monetary policy which calls for the particular prudence. In other words, the interest rate should be fixed with due regard to the macroeconomic development in the inflation and real GDP indicators, and the fixing of the interest rate, which is based on other factors, should be well thought-out and estimated;
b) to give up the active and aggressive promotion policies in housing development that have put creditors under abnormal pressures, encouraged excessive lending to low-income individuals and artificially inflated mortgage demand and supply. This would mean tighter requirements for individuals applying for a FHA guaranteed mortgage loan, larger amounts of down–payments, and more prudent goals and volumes of GSE mortgage purchases adopted with due regard to the systemic risk, as well as a more responsible and better assessed lending by private creditors;
c) to introduce a tighter capital adequacy framework based on the Basel III guidelines. The framework should comprise not only the increase of the Tier I capital ratio, which is most important for covering the losses, and also additional capital buffers. Furthermore, regular performance of stress tests, the tightening of liquidity ratios, capital planning resolutions, improvement and reconsideration of the entire system of risk weightings calculating the capital ratios are also a critical factor;
d) to increase the transparency and clarity of financial derivative instruments while monitoring and analysing the mortgage-backed securities' transactions between

the counterparties. The supervision of sellers of the credit default swaps (CDS) should also be considerably enhanced. Moreover, subprime loans should not be extended to individuals eligible to a prime loan, and highly concessional loans should be banned completely. Commissions and various bonus incentives paid for the contracting of high-interest rate loans should be limited, and the use of credit rating systems should be subjected to a very careful review, at the same time demanding the higher transparency between banks and credit rating agencies, what would allow achieving a better rating of mortgage-backed securities and reduce the asymmetry of information. The risk management should be changed by improving the risk assessment systems and providing risk managers with a higher influence within the components related to financial derivatives;

e) to implement a tighter direct and indirect control of the shadow banking. The indirect control should cover the banking and insurance sector regulation defining and controlling the shadow banking related potential risks of financial institutions and deter financial institutions from circumventing the capital adequacy and other requirements. The direct controls of the shadow banking activities should include the monitoring of the liquidity risk and requirements of the liquidity risk management system as well as the requirements for the use of the system of leverages and improvement of reporting and transparency that would facilitate the identification of the risks taken and the monitoring of shadow banking activities.

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APPENDICES

APPENDIX 1**. Calculation of potential and real GDP percentage change**

Quarters	Potential GDP, bill. USD	Real GDP, bill. USD	Percentage change	Quarters	Potential GDP, bill. USD	Real GDP, bill. USD	Percentage change	Quarters	Potential GDP, bill. USD	Real GDP, bill. USD	Percentage change
1998 Q1	11237.98	11309.00	0.63%	2003 Q2	13411.43	13151.80	-1.94%	2008 Q3	15163.83	14895.10	-1.77%
1998 Q2	11333.93	11418.70	0.75%	2003 Q3	13496.61	13374.00	-0.91%	2008 Q4	15243.10	14574.60	-4.39%
1998 Q3	11431.67	11568.10	1.19%	2003 Q4	13578.98	13525.70	-0.39%	2009 Q1	15290.43	14372.10	-6.01%
1998 Q8	11530.98	11757.90	1.97%	2004 Q1	13687.85	13606.60	-0.59%	2009 Q2	15356.59	14356.90	-6.51%
1999 Q1	11633.89	11867.80	2.01%	2004 Q2	13765.35	13710.70	-0.40%	2009 Q3	15418.82	14402.50	-6.59%
1999 Q2	11735.90	11967.70	1.98%	2004 Q3	13841.95	13831.00	-0.08%	2009 Q4	15477.81	14540.20	-6.06%
1999 Q3	11839.37	12120.10	2.37%	2004 Q4	13918.44	13947.70	0.21%	2010 Q1	15480.88	14597.70	-5.70%
1999 Q4	11944.41	12329.80	3.23%	2005 Q1	14037.47	14100.20	0.45%	2010 Q2	15535.20	14738.00	-5.13%
2000 Q1	12045.40	12365.20	2.65%	2005 Q2	14116.99	14177.20	0.43%	2010 Q3	15589.53	14839.30	-4.81%
2000 Q2	12155.31	12598.70	3.65%	2005 Q3	14197.30	14292.90	0.67%	2010 Q4	15645.09	14942.40	-4.49%
2000 Q3	12266.24	12614.80	2.84%	2005 Q4	14278.74	14372.00	0.65%	2011 Q1	15780.64	14894.00	-5.62%
2000 Q4	12377.72	12682.00	2.46%	2006 Q1	14360.77	14546.40	1.29%	2011 Q2	15844.98	15011.30	-5.26%
2001 Q1	12473.02	12645.70	1.38%	2006 Q2	14445.80	14591.60	1.01%	2011 Q3	15911.22	15062.10	-5.34%
2001 Q2	12583.12	12712.80	1.03%	2006 Q3	14532.08	14604.40	0.50%	2011 Q4	15979.04	15242.10	-4.61%
2001 Q3	12691.89	12674.10	-0.14%	2006 Q4	14619.37	14718.40	0.68%	2012 Q1	16047.97	15381.60	-4.15%
2001 Q4	12798.64	12705.20	-0.73%	2007 Q1	14685.06	14728.10	0.29%	2012 Q2	16117.35	15427.70	-4.28%
2002 Q1	12896.40	12824.60	-0.56%	2007 Q2	14774.69	14841.50	0.45%	2012 Q3	16187.52	15534.00	-4.04%
2002 Q2	12997.42	12894.70	-0.79%	2007 Q3	14864.20	14941.50	0.52%	2012 Q4	16258.69	15539.60	-4.42%
2002 Q3	13095.86	12956.70	-1.06%	2007 Q4	14952.82	14996.10	0.29%	2013 Q1	16329.87	15583.90	-4.57%
2002 Q4	13191.40	12962.90	-1.73%	2008 Q1	14995.63	14895.40	-0.67%	2013 Q2	16401.94	15679.70	-4.40%
2003 Q1	13323.35	13028.60	-2.21%	2008 Q2	15081.07	14969.20	-0.74%	2013 Q3	16475.47	15839.30	-3.86%

Prepared by authors based on Real..., 2013; Potential..., 2013.

APPENDIX 2. **Regression variables and their data, 2000–2013**

Quar-ters	Number of new housing starts, percentage change compared to the corresponding quarter of the previous year, %	Modified effective rate of Federal Funds, time lag of 5 quarters, %	Mortgage delinquency rate of 100 largest banks, absolute change compared to the previous quarter, %	Net percentage share of banks, reporting higher demand for mortgage loans, %	Risk-weighted Tier 1 capital ratio, percentage change compared to the previous quarter, %	Home-ownership rate, percentage change compared to the previous quarter, %	Volume of loans insured by Federal Housing Administration, bill. USD	Net percentage share of banks, tightening underwriting standards, %	Federal Funds effective rate, %
2000 Q1	-1.98%	4.75%	-0.19%	-63.5%	1.84%	0.30%	19.1	-1.9%	5.75%
2000 Q2	0.34%	4.75%	-0.10%	-42.6%	1.90%	0.15%	24.6	-5.6%	6.25%
2000 Q3	-9.08%	4.75%	0.22%	-39.7%	3.62%	0.74%	22.9	0.0%	6.50%
2000 Q4	-6.88%	5.00%	0.46%	-32.7%	0.00%	-0.30%	21.4	0.0%	6.50%
2001 Q1	-2.60%	5.25%	-0.24%	0.0%	-2.85%	0.00%	33.0	0.0%	5.50%
2001 Q2	2.63%	5.75%	0.07%	46.1%	1.90%	0.30%	42.5	3.8%	4.25%
2001 Q3	5.90%	6.25%	0.23%	24.5%	3.62%	0.59%	39.5	3.8%	3.50%
2001 Q4	2.21%	6.50%	-0.15%	-1.9%	0.00%	-0.15%	36.9	3.8%	2.25%
2002 Q1	6.10%	6.50%	-0.21%	28.9%	1.48%	-0.29%	30.4	1.9%	1.75%
2002 Q2	3.06%	5.50%	-0.17%	5.6%	1.56%	-0.29%	39.2	1.9%	1.75%
2002 Q3	6.83%	4.25%	-0.04%	27.5%	0.10%	0.59%	36.4	3.9%	1.75%
2002 Q4	10.26%	3.50%	0.00%	40.0%	-0.82%	0.44%	34.0	10.0%	1.50%
2003 Q1	1.54%	2.25%	-0.19%	7.4%	1.03%	-0.44%	36.0	11.1%	1.25%
2003 Q2	3.39%	1.75%	-0.22%	17.0%	0.82%	0.00%	46.0	5.7%	1.25%
2003 Q3	11.43%	1.75%	-0.12%	46.3%	0.10%	0.59%	43.0	1.9%	1.00%
2003 Q4	17.00%	1.75%	0.56%	-18.6%	1.93%	0.29%	28.0	0.0%	1.00%
2004 Q1	13.34%	1.50%	-0.59%	-38.5%	5.97%	0.00%	24.0	-1.9%	1.00%
2004 Q2	9.92%	1.25%	-0.13%	-5.8%	-6.95%	0.87%	25.0	-7.8%	1.00%
2004 Q3	4.11%	1.25%	0.03%	-7.7%	-0.50%	-0.29%	19.0	-5.8%	1.50%
2004 Q4	-2.50%	1.00%	-0.06%	-24.5%	1.83%	0.29%	16.0	1.9%	2.00%
2005 Q1	5.53%	1.00%	-0.14%	-27.5%	-1.89%	-0.14%	14.0	-7.8%	2.50%
2005 Q2	6.66%	1.00%	0.11%	-18.3%	0.41%	-0.72%	16.0	-2.1%	3.00%
2005 Q3	6.69%	1.00%	0.08%	20.4%	-2.73%	0.29%	15.0	0.0%	3.50%
2005 Q4	3.81%	1.50%	0.27%	-22.2%	0.10%	0.29%	12.0	-3.7%	4.00%
2006 Q1	3.53%	2.00%	-0.22%	-44.0%	-1.66%	-0.72%	13.0	0.0%	4.50%
2006 Q2	-9.46%	2.50%	-0.04%	-23.1%	1.48%	0.29%	16.0	-9.4%	5.00%
2006 Q3	-19.33%	3.00%	0.22%	-58.5%	-0.52%	0.44%	14.0	-9.3%	5.25%
2006 Q4	-24.92%	3.50%	0.46%	-60.4%	1.57%	-0.14%	13.0	1.9%	5.25%
2007 Q1	-30.63%	4.00%	-0.11%	-37.0%	-2.68%	-0.73%	12.0	16.4%	5.25%
2007 Q2	-21.31%	4.50%	0.22%	-15.9%	-0.74%	-0.29%	18.0	45.5%	5.25%
2007 Q3	-23.42%	5.00%	0.69%	-21.3%	-0.21%	0.00%	20.0	40.5%	5.00%
2007 Q4	-23.87%	5.25%	0.83%	-45.0%	-3.95%	-0.59%	27.0	60.0%	4.50%
2008 Q1	-28.11%	5.25%	0.89%	-69.2%	-1.56%	0.00%	38.0	84.6%	3.25%
2008 Q2	-30.79%	5.25%	0.95%	-29.7%	3.16%	0.44%	66.0	75.6%	2.00%
2008 Q3	-32.40%	5.25%	1.34%	-46.9%	-1.10%	-0.29%	73.0	84.4%	2.00%
2008 Q4	-43.75%	5.00%	2.41%	-72.4%	15.39%	-0.59%	67.0	89.7%	0.50%
2009 Q1	-50.56%	4.50%	1.25%	-64.0%	3.93%	-0.30%	78.0	48.0%	0.25%
2009 Q2	-45.79%	3.25%	0.97%	-12.0%	-1.29%	0.15%	100.0	64.0%	0.25%
2009 Q3	-31.52%	2.00%	1.51%	-16.7%	2.43%	0.30%	89.0	45.8%	0.25%
2009 Q4	-19.56%	2.00%	2.08%	-4.3%	4.57%	-0.59%	90.0	30.4%	0.00%
2010 Q1	17.40%	0.50%	0.06%	-35.3%	6.99%	-0.15%	56.0	29.4%	0.25%
2010 Q2	11.83%	0.25%	-1.09%	-33.3%	4.65%	-0.30%	78.0	4.8%	0.25%
2010 Q3	-0.92%	0.25%	-0.22%	0.0%	1.72%	0.00%	68.0	4.5%	0.25%
2010 Q4	-2.92%	0.25%	-0.31%	-9.5%	-0.54%	-0.60%	67.0	9.5%	0.25%
2011 Q1	-6.55%	0.00%	-0.28%	-13.0%	1.23%	-0.15%	47.0	13.0%	0.25%
2011 Q2	-4.94%	0.25%	-0.24%	-23.8%	1.07%	-0.75%	48.7	10.0%	0.00%
2011 Q3	6.28%	0.25%	-0.16%	-12.5%	-0.98%	0.61%	46.3	-4.2%	0.00%
2011 Q4	24.29%	0.25%	0.06%	4.5%	0.84%	-0.45%	46.1	0.0%	0.00%
2012 Q1	23.43%	0.25%	-0.01%	-4.3%	3.09%	-0.91%	47.0	4.3%	0.00%
2012 Q2	28.01%	0.25%	-0.29%	23.1%	-2.71%	0.15%	59.7	11.5%	0.25%
2012 Q3	25.22%	0.00%	1.07%	37.0%	-0.53%	0.00%	62.8	11.1%	0.25%
2012 Q4	35.93%	0.00%	-1.35%	12.5%	-2.72%	-0.15%	62.9	0.0%	0.25%
2013 Q1	34.34%	0.00%	-0.68%	0.0%	1.17%	-0.61%	58.3	2.9%	0.25%
2013 Q2	16.67%	0.00%	-0.78%	0.0%	0.38%	0.00%	62.0	0.0%	0.00%
2013 Q3	13.46%	0.25%	-0.95%	3.1%	1.07%	0.46%	45.0	-6.3%	0.00%

Prepared by authors based on New..., 2013; Selected..., 2013; Senior..., 2013; Seasonally..., 2013; Charge-off..., 2013; BHCPR..., 2013; FHA..., 2013.

APPENDIX 3. **Calculation of federal funds rate using the Taylor rule**

Quarters	Real equilibrium interest rate, %	Inflation target, %	Inflation level (CPI, change through 4 quarters), %	Percentage change between potential and factual GDP, %	Federal funds rate according to the Taylor rule, %	Rounded Federal funds rate according to the Taylor rule, %	Rounded Federal funds rate according to the Taylor rule (1.25 years time lag), %
1998 Q1	2.00%	2.00%	1.48%	0.63%	4.06%	4.00%	
1998 Q2	2.00%	2.00%	1.58%	0.75%	4.17%	4.25%	
1998 Q3	2.00%	2.00%	1.60%	1.19%	4.39%	4.50%	
1998 Q8	2.00%	2.00%	1.53%	1.97%	4.75%	4.75%	
1999 Q1	2.00%	2.00%	1.69%	2.01%	4.85%	4.75%	
1999 Q2	2.00%	2.00%	2.11%	1.98%	5.04%	5.00%	
1999 Q3	2.00%	2.00%	2.35%	2.37%	5.36%	5.25%	
1999 Q4	2.00%	2.00%	2.62%	3.23%	5.92%	6.00%	
2000 Q1	2.00%	2.00%	3.26%	2.65%	5.96%	6.00%	4.75%
2000 Q2	2.00%	2.00%	3.29%	3.65%	6.47%	6.50%	4.75%
2000 Q3	2.00%	2.00%	3.47%	2.84%	6.16%	6.25%	5.00%
2000 Q4	2.00%	2.00%	3.44%	2.46%	5.95%	6.00%	5.25%
2001 Q1	2.00%	2.00%	3.41%	1.38%	5.40%	5.50%	6.00%
2001 Q2	2.00%	2.00%	3.32%	1.03%	5.18%	5.25%	6.00%
2001 Q3	2.00%	2.00%	2.68%	-0.14%	4.27%	4.25%	6.50%
2001 Q4	2.00%	2.00%	1.87%	-0.73%	3.57%	3.50%	6.25%
2002 Q1	2.00%	2.00%	1.23%	-0.56%	3.34%	3.25%	6.00%
2002 Q2	2.00%	2.00%	1.32%	-0.79%	3.26%	3.25%	5.50%
2002 Q3	2.00%	2.00%	1.58%	-1.06%	3.26%	3.25%	5.25%
2002 Q4	2.00%	2.00%	2.25%	-1.73%	3.26%	3.25%	4.25%
2003 Q1	2.00%	2.00%	2.98%	-2.21%	3.38%	3.50%	3.50%
2003 Q2	2.00%	2.00%	2.01%	-1.94%	3.04%	3.00%	3.25%
2003 Q3	2.00%	2.00%	2.22%	-0.91%	3.65%	3.75%	3.25%
2003 Q4	2.00%	2.00%	2.00%	-0.39%	3.80%	3.75%	3.25%
2004 Q1	2.00%	2.00%	1.82%	-0.59%	3.61%	3.50%	3.25%
2004 Q2	2.00%	2.00%	2.79%	-0.40%	4.19%	4.25%	3.50%
2004 Q3	2.00%	2.00%	2.67%	-0.08%	4.30%	4.25%	3.00%
2004 Q4	2.00%	2.00%	3.38%	0.21%	4.80%	4.75%	3.75%
2005 Q1	2.00%	2.00%	3.04%	0.45%	4.74%	4.75%	3.75%
2005 Q2	2.00%	2.00%	2.92%	0.43%	4.67%	4.75%	3.50%
2005 Q3	2.00%	2.00%	3.82%	0.67%	5.25%	5.25%	4.25%
2005 Q4	2.00%	2.00%	3.67%	0.65%	5.16%	5.25%	4.25%
2006 Q1	2.00%	2.00%	3.69%	1.29%	5.49%	5.50%	4.75%
2006 Q2	2.00%	2.00%	3.92%	1.01%	5.47%	5.50%	4.75%
2006 Q3	2.00%	2.00%	3.34%	0.50%	4.92%	5.00%	4.75%
2006 Q4	2.00%	2.00%	1.97%	0.68%	4.32%	4.25%	5.25%
2007 Q1	2.00%	2.00%	2.43%	0.29%	4.36%	4.25%	5.25%
2007 Q2	2.00%	2.00%	2.67%	0.45%	4.56%	4.50%	5.50%
2007 Q3	2.00%	2.00%	2.35%	0.52%	4.43%	4.50%	5.50%
2007 Q4	2.00%	2.00%	4.03%	0.29%	5.16%	5.25%	5.00%
2008 Q1	2.00%	2.00%	4.14%	-0.67%	4.73%	4.75%	4.25%
2008 Q2	2.00%	2.00%	4.31%	-0.74%	4.78%	4.75%	4.25%
2008 Q3	2.00%	2.00%	5.25%	-1.77%	4.74%	4.75%	4.50%
2008 Q4	2.00%	2.00%	1.60%	-4.39%	1.61%	1.50%	4.50%
2009 Q1	2.00%	2.00%	-0.16%	-6.01%	0.00%	0.00%	5.25%
2009 Q2	2.00%	2.00%	-0.95%	-6.51%	0.00%	0.00%	4.75%
2009 Q3	2.00%	2.00%	-1.61%	-6.59%	0.00%	0.00%	4.75%
2009 Q4	2.00%	2.00%	1.48%	-6.06%	0.71%	0.75%	4.75%
2010 Q1	2.00%	2.00%	2.34%	-5.70%	1.32%	1.25%	1.50%
2010 Q2	2.00%	2.00%	1.78%	-5.13%	1.32%	1.25%	0.00%
2010 Q3	2.00%	2.00%	1.24%	-4.81%	1.21%	1.25%	0.00%
2010 Q4	2.00%	2.00%	1.22%	-4.49%	1.36%	1.25%	0.00%
2011 Q1	2.00%	2.00%	2.13%	-5.62%	1.25%	1.25%	0.75%
2011 Q2	2.00%	2.00%	3.35%	-5.26%	2.05%	2.00%	1.25%
2011 Q3	2.00%	2.00%	3.75%	-5.34%	2.21%	2.25%	1.25%
2011 Q4	2.00%	2.00%	3.34%	-4.61%	2.36%	2.25%	1.25%
2012 Q1	2.00%	2.00%	2.81%	-4.15%	2.33%	2.25%	1.25%
2012 Q2	2.00%	2.00%	1.90%	-4.28%	1.81%	1.75%	1.25%
2012 Q3	2.00%	2.00%	1.70%	-4.04%	1.83%	1.75%	2.00%
2012 Q4	2.00%	2.00%	1.90%	-4.42%	1.74%	1.75%	2.25%
2013 Q1	2.00%	2.00%	1.68%	-4.57%	1.56%	1.50%	2.25%
2013 Q2	2.00%	2.00%	1.42%	-4.40%	1.51%	1.50%	2.25%
2013 Q3	2.00%	2.00%	1.55%	-3.86%	1.84%	1.75%	1.75%

Prepared by authors based on Selected..., 2013; Real..., 2013; Potential..., 2013; Consumer..., 2013.

APPENDIX 4. **Combinations of different data modifications**

Quarters	Number of housing starts, percentage change compared to the quarter of a previous year, %	Number of housing starts, calculated from the regression equation using modified variables, percentage change compared to the quarter of a previous year, %	Rounded Federal funds rate according to the Taylor rule (1.25 years time lag), %	Smoothed mortgage charge-off and delinquency rate of 100 largest banks, absolute change compared to the previous quarter, %	Smoothed net percentage share of banks, reporting higher demand for mortgage loans, %	Rounded Federal funds rate according to the Taylor rule (1.25 years time lag), %	Smoothed mortgage charge-off and delinquency rate of 100 largest banks, absolute change compared to the previous quarter, %	Smoothed net per-centage share of banks, reporting higher demand for mortgage loans, %
2000 Q1	-1.98%	-15.89%	4.75%	0.01%	2.38%	4.75%	-0.19%	-63.5%
2000 Q2	0.34%	-11.84%	4.75%	0.01%	0.58%	4.75%	-0.10%	-42.6%
2000 Q3	-9.08%	-15.29%	5.00%	0.01%	-3.04%	4.75%	0.22%	-39.7%
2000 Q4	-6.88%	-17.34%	5.25%	0.00%	-3.53%	5.00%	0.46%	-32.7%
2001 Q1	-2.60%	-0.74%	6.00%	0.00%	-3.97%	5.25%	-0.24%	0.0%
2001 Q2	2.63%	5.38%	6.00%	0.01%	-4.13%	5.75%	0.07%	46.1%
2001 Q3	5.90%	-3.44%	6.50%	0.00%	-3.63%	6.25%	0.23%	24.5%
2001 Q4	2.21%	-5.76%	6.25%	-0.05%	1.36%	6.50%	-0.15%	-1.9%
2002 Q1	6.10%	2.71%	6.00%	-0.01%	2.77%	6.50%	-0.21%	28.9%
2002 Q2	3.06%	-0.93%	5.50%	-0.03%	4.33%	5.50%	-0.17%	5.6%
2002 Q3	6.83%	6.22%	5.25%	-0.03%	6.63%	4.25%	-0.04%	27.5%
2002 Q4	10.26%	10.84%	4.25%	-0.04%	8.63%	3.50%	0.00%	40.0%
2003 Q1	1.54%	8.55%	3.50%	-0.08%	9.14%	2.25%	-0.19%	7.4%
2003 Q2	3.39%	12.69%	3.25%	-0.07%	7.43%	1.75%	-0.22%	17.0%
2003 Q3	11.43%	18.70%	3.25%	-0.07%	3.40%	1.75%	-0.12%	46.3%
2003 Q4	17.00%	-6.36%	3.25%	-0.08%	3.14%	1.75%	0.56%	-18.6%
2004 Q1	13.34%	4.33%	3.25%	-0.05%	1.88%	1.50%	-0.59%	-38.5%
2004 Q2	9.92%	7.17%	3.50%	-0.05%	-2.68%	1.25%	-0.13%	-5.8%
2004 Q3	4.11%	4.62%	3.00%	-0.04%	-4.48%	1.25%	0.03%	-7.7%
2004 Q4	-2.50%	2.27%	3.75%	-0.03%	-9.85%	1.00%	-0.06%	-24.5%
2005 Q1	5.53%	-3.86%	3.75%	0.00%	-16.13%	3.75%	0.00%	-16.13%
2005 Q2	6.66%	-3.94%	3.50%	0.01%	-18.90%	3.50%	0.01%	-18.90%
2005 Q3	6.69%	-6.83%	4.25%	0.03%	-20.96%	4.25%	0.03%	-20.96%
2005 Q4	3.81%	-8.55%	4.25%	0.08%	-25.18%	4.25%	0.08%	-25.18%
2006 Q1	3.53%	-10.53%	4.75%	0.10%	-26.83%	4.75%	0.10%	-26.83%
2006 Q2	-9.46%	-12.21%	4.75%	0.19%	-28.75%	4.75%	0.19%	-28.75%
2006 Q3	-19.33%	-13.46%	4.75%	0.26%	-30.24%	4.75%	0.26%	-30.24%
2006 Q4	-24.92%	-16.49%	5.25%	0.34%	-32.69%	5.25%	0.34%	-32.69%
2007 Q1	-30.63%	-19.25%	5.25%	0.50%	-35.69%	5.25%	0.50%	-35.69%
2007 Q2	-21.31%	-21.62%	5.50%	0.58%	-37.97%	5.50%	0.58%	-37.97%
2007 Q3	-23.42%	-22.23%	5.50%	0.64%	-37.58%	5.50%	0.64%	-37.58%
2007 Q4	-23.87%	-23.29%	5.00%	0.73%	-39.89%	5.25%	0.73%	-39.89%
2008 Q1	-28.11%	-24.49%	4.25%	0.84%	-38.78%	5.25%	0.84%	-38.78%
2008 Q2	-30.79%	-24.58%	4.25%	0.86%	-38.23%	5.25%	0.86%	-38.23%
2008 Q3	-32.40%	-23.89%	4.50%	0.79%	-38.87%	5.25%	0.79%	-38.87%
2008 Q4	-43.75%	-21.94%	4.50%	0.77%	-35.21%	5.00%	0.77%	-35.21%
2009 Q1	-50.56%	-19.17%	5.25%	0.72%	-32.03%	4.50%	0.72%	-32.03%
2009 Q2	-45.79%	-15.29%	4.75%	0.71%	-30.53%	3.25%	0.71%	-30.53%
2009 Q3	-31.52%	-11.66%	4.75%	0.68%	-31.03%	2.00%	0.68%	-31.03%
2009 Q4	-19.56%	-10.83%	4.75%	0.62%	-30.48%	2.00%	0.62%	-30.48%
2010 Q1	17.40%	-5.39%	1.50%	0.58%	-27.38%	0.50%	0.58%	-27.38%
2010 Q2	11.83%	-2.97%	0.00%	0.52%	-23.33%	0.25%	0.52%	-23.33%
2010 Q3	-0.92%	-1.13%	0.00%	0.44%	-20.03%	0.25%	0.44%	-20.03%
2010 Q4	-2.92%	0.39%	0.00%	0.43%	-14.78%	0.25%	0.43%	-14.78%
2011 Q1	-6.55%	5.45%	0.75%	0.19%	-9.48%	0.00%	0.19%	-9.48%
2011 Q2	-4.94%	7.35%	1.25%	0.07%	-5.48%	0.25%	0.07%	-5.48%
2011 Q3	6.28%	8.96%	1.25%	-0.04%	-4.73%	0.25%	-0.04%	-4.73%
2011 Q4	24.29%	11.27%	1.25%	-0.19%	-3.49%	0.25%	-0.19%	-3.49%
2012 Q1	23.43%	13.26%	1.25%	-0.34%	-3.43%	0.25%	-0.34%	-3.43%
2012 Q2	28.01%	14.20%	1.25%	-0.37%	-1.16%	0.25%	-0.37%	-1.16%
2012 Q3	25.22%	14.78%	2.00%	-0.32%	1.32%	0.00%	-0.32%	1.32%
2012 Q4	35.93%	14.91%	2.25%	-0.33%	1.43%	0.00%	-0.33%	1.43%
2013 Q1	34.34%	15.18%	2.25%	-0.33%	2.42%	0.00%	-0.33%	2.42%
2013 Q2	16.67%	15.63%	2.25%	-0.33%	3.96%	0.00%	-0.33%	3.96%
2013 Q3	13.46%	15.86%	1.75%	-0.34%	7.04%	0.25%	-0.34%	7.04%

Prepared by authors based on New..., 2013; Selected..., 2013; Senior..., 2013; Charge-off..., 2013; Real..., 2013; Potential..., 2013.

APPENDIX 5. **Choosing the most suitable alternative path of policies**

Quarters	Number of housing starts, percentage change compared to the quarter of a previous year, %	Number of housing starts, calculated from the regression equation using modified variables, percentage change compared to the quarter of a previous year, %	Rounded Federal funds rate according to the Taylor rule (1.25 years time lag), %	Smoothed mortgage charge-off and delinquency rate of 100 largest banks, absolute change compared to the previous quarter, %	Smoothed net percentage share of banks, reporting higher demand for mortgage loans, %
2000 Q1	-1.98%	-15.89%	4.75%	-0.19%	-63.5%
2000 Q2	0.34%	-11.84%	4.75%	-0.10%	-42.6%
2000 Q3	-9.08%	-15.29%	4.75%	0.22%	-39.7%
2000 Q4	-6.88%	-17.34%	5.00%	0.46%	-32.7%
2001 Q1	-2.60%	-0.74%	5.25%	-0.24%	0.0%
2001 Q2	2.63%	5.38%	5.75%	0.07%	46.1%
2001 Q3	5.90%	-3.44%	6.25%	0.23%	24.5%
2001 Q4	2.21%	-5.76%	6.50%	-0.15%	-1.9%
2002 Q1	6.10%	2.71%	6.50%	-0.21%	28.9%
2002 Q2	3.06%	-0.93%	5.50%	-0.17%	5.6%
2002 Q3	6.83%	-1.79%	5.25%	-0.03%	6.63%
2002 Q4	10.26%	1.57%	4.25%	-0.04%	8.63%
2003 Q1	1.54%	4.14%	3.50%	-0.08%	9.14%
2003 Q2	3.39%	4.31%	3.25%	-0.07%	7.43%
2003 Q3	11.43%	3.27%	3.25%	-0.07%	3.40%
2003 Q4	17.00%	3.33%	3.25%	-0.08%	3.14%
2004 Q1	13.34%	2.67%	3.25%	-0.05%	1.88%
2004 Q2	9.92%	0.86%	3.50%	-0.05%	-2.68%
2004 Q3	4.11%	1.66%	3.00%	-0.04%	-4.48%
2004 Q4	-2.50%	-1.92%	3.75%	-0.03%	-9.85%
2005 Q1	5.53%	-3.86%	3.75%	0.00%	-16.13%
2005 Q2	6.66%	-3.94%	3.50%	0.01%	-18.90%
2005 Q3	6.69%	-6.83%	4.25%	0.03%	-20.96%
2005 Q4	3.81%	-8.55%	4.25%	0.08%	-25.18%
2006 Q1	3.53%	-10.53%	4.75%	0.10%	-26.83%
2006 Q2	-9.46%	-12.21%	4.75%	0.19%	-28.75%
2006 Q3	-19.33%	-13.46%	4.75%	0.26%	-30.24%
2006 Q4	-24.92%	-16.49%	5.25%	0.34%	-32.69%
2007 Q1	-30.63%	-19.25%	5.25%	0.50%	-35.69%
2007 Q2	-21.31%	-21.62%	5.50%	0.58%	-37.97%
2007 Q3	-23.42%	-22.23%	5.50%	0.64%	-37.58%
2007 Q4	-23.87%	-23.29%	5.25%	0.73%	-39.89%
2008 Q1	-28.11%	-24.49%	5.25%	0.84%	-38.78%
2008 Q2	-30.79%	-24.58%	5.25%	0.86%	-38.23%
2008 Q3	-32.40%	-23.89%	5.25%	0.79%	-38.87%
2008 Q4	-43.75%	-21.94%	5.00%	0.77%	-35.21%
2009 Q1	-50.56%	-19.17%	4.50%	0.72%	-32.03%
2009 Q2	-45.79%	-15.29%	3.25%	0.71%	-30.53%
2009 Q3	-31.52%	-11.66%	2.00%	0.68%	-31.03%
2009 Q4	-19.56%	-10.83%	2.00%	0.62%	-30.48%
2010 Q1	17.40%	-5.39%	0.50%	0.58%	-27.38%
2010 Q2	11.83%	-2.97%	0.25%	0.52%	-23.33%
2010 Q3	-0.92%	-1.13%	0.25%	0.44%	-20.03%
2010 Q4	-2.92%	0.39%	0.25%	0.43%	-14.78%
2011 Q1	-6.55%	5.45%	0.00%	0.19%	-9.48%
2011 Q2	-4.94%	7.35%	0.25%	0.07%	-5.48%
2011 Q3	6.28%	8.96%	0.25%	-0.04%	-4.73%
2011 Q4	24.29%	11.27%	0.25%	-0.19%	-3.49%
2012 Q1	23.43%	13.26%	0.25%	-0.34%	-3.43%
2012 Q2	28.01%	14.20%	0.25%	-0.37%	-1.16%
2012 Q3	25.22%	14.78%	0.00%	-0.32%	1.32%
2012 Q4	35.93%	14.91%	0.00%	-0.33%	1.43%
2013 Q1	34.34%	15.18%	0.00%	-0.33%	2.42%
2013 Q2	16.67%	15.63%	0.00%	-0.33%	3.96%
2013 Q3	13.46%	15.86%	0.25%	-0.34%	7.04%

Prepared by authors based on New..., 2013; Selected..., 2013; Senior..., 2013; Charge-off..., 2013.