

## THE ISSUES OF MONETARY POLICY RESPONSE TO ASSET PRICE BUBBLES IN MODELS WITH ASSUMPTION OF THE FINANCIAL ACCELERATOR

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financial crisis

*Introduction.* There are a lot of papers in the academic literature which study the effects of asset bubbles on different parts of the real economy. However, the ways how asset price volatility affects real macro-variables are not trivial and need to be studied. First of all, referring to the role of bubbles in the redistribution of capital in the economy, it is worth noting that the unreasonable growth expectations of the latter in some sectors of the economy can lead to inefficient distribution of resources in the economy. Financial resources can be used for capital investment in industries where growth opportunities are greatly exaggerated. Existing bubbles in some stock prices encourage firms to issue more shares, and the derived growth expectations are forcing investors to divert money to those industries. Such a process is very important, as some directions of the flow of these new financial resources may affect the opportunities for further development of the economy and the unemployment rate as well. In this sense, misallocation of capital can have a long-term effect on economic growth. The impact of asset price bubbles on the real economy is becoming larger in scale due to the imperfections in the financial markets and financial frictions. In this context, the problem was examined by Bernanke and Gertler [Bernanke, Gertler 1999, p. 20]. In their paper, the authors consider the so-called "balance sheet channel" as the main quantitative explanation for the interrelationship between asset price bubbles and real macro-economic variables, the essence of which is as follows: based on the assumption of the existence of financial frictions and consequently information asymmetries in the credit markets, financial intermediaries, as a response to certain costs of overcoming these asymmetries, prefer lending to companies with stronger financial position, as the latter may have a higher level of collateral, which will compensate the considered costs. In such a situation, the decrease in asset prices leads to an increase in the leverage ratio of the firm, constrains the credit access, which in turn leads to a decrease in capital investment and, consequently, to a decrease in output. Thus, in the described circumstances, it can be said that the fall in asset prices affects both "aggregate demand" and "aggregate supply". The amplification and propagation of economic shocks with the presence of financial frictions, which follows the logic of the influence of information asymmetries in lending processes described above, have been examined by Bernanke, Gertler, and Gilchrist and have been called "financial accelerator" [Bernanke, Gertler, Gilchrist, 1998].

**Methodology.** The models used by regulators in different countries, to respond to asset price bubbles are considered as a scientific basis for the paper. In order to address this issue in the context of the financial accelerator model, the applications of the dynamic stochastic general equilibrium (DSGE) models have been considered.

In order to test for bubbles in the RA real estate market, we use statistical tests and Monte Carlo simulations. Within the framework of the policy analysis conducted by the Central Bank of the Republic of Armenia, the legal orders and decisions of the Central Bank of the Republic of Armenia were used as a basis.

**Literature review.** The observations discussed above lead to the following question: If fluctuations in asset prices could lead to real macroeconomic and financial instability, how should regulators respond to them?

Bernanke and Gertler [Bernanke, Gertler, 1999] raise the question of how central banks should respond to asset price bubbles in the context of a monetary policy interest rate rule strategy. Even though monetary policy is not the main tool used to respond to asset price spikes in the economy, history shows that collapses of asset price bubbles caused the economies the greatest damages at times when central banks have shown irresponsibility or, conversely, have adopted a policy of prematurely responding to the rise in asset prices. As a result, the question arises: what policy should the central bank adopt? Is it necessary to respond to asset price bubbles in the monetary policy rule? If so, how to distinguish the growth of asset prices due to the fundamentals of the economy from a bubble? At what stage should the regulator respond?

The authors present a dynamic general equilibrium model in their work, which includes the concept of financial accelerator and exogenous bubbles in asset prices (it is the extension of BGG [Bernanke, Gertler, Gilchrist, 1998] model with the assumption of asset bubbles). To introduce the idea of asset price bubble, the fundamental value of capital is defined as a sum of discounted dividends, the deviation from which will be considered as a bubble. Given by the following equation [Bernanke, Gertler, 1999, p.24]:

$$Q_t = E_t \sum_{i=0}^{\infty} [(1 - \delta)^i D_{t+1+i} / \prod_{j=0}^i R_{t+1+j}^q] = E_t \{ [D_{t+1} + (1 - \delta)Q_{t+1}] / R_{t+1}^q \}$$

Where  $E_t$  indicates expectation,  $\delta$  is the physical depreciation rate of capital,  $D_{t+i}$  are dividends and  $R_{t+1}^q$  is the discount rate.

For a bubble to exist, the  $S_t$  market value of capital may differ from the fundamental value  $Q_t$ . If there exists a bubble at time t, it persists with probability p and the growth equation is as follows:

$$S_{t+1} - Q_{t+1} = \frac{\alpha}{p} (S_t - Q_t) R_{t+1}^q$$

where  $p < \alpha < 1$ : If the bubble bursts with probability  $1-p$ , then

$$S_{t+1} - Q_{t+1} = 0$$

In the extended model, the presence of bubbles affects the real economy through the income channel and through the impact that market values of assets have on companies' balance sheets. The authors view the response of central banks to asset price bubbles in the context of the monetary rule, in one case considering the simple version of the rule, when the interest rate is determined based on inflation expectations, and in the other case allowing the latter to respond also to the lag value of stock price fluctuations. Exogenous shock by one percentage point to the fundamental value of stock prices is considered a bubble in asset prices. In this case, authors consider the options of response and non-response to asset prices in the interest rate regulation by the central banks with 2 types of policies: accommodative ( $\beta=1.01$ ) and aggressive ( $\beta=2$ ) inflation targeting.

The results obtained by the authors show that if the monetary rule adopted by the central bank does not respond to asset price bubbles, then in the case of aggressive inflation targeting policy, the effect of the bubble (assumed to last for 5 periods) is mitigated. Despite the assumption that monetary policy does not respond directly to asset price bubbles, in the case of aggressive policies, there is awareness in the society that interest rates are quite sensitive to inflationary pressures arising from the increase in the asset prices (remember that flexible inflation targeting assumes high-level transparency from central banks), which leads to a reduction of asset price and inflation fluctuations.

If in the monetary policy rule interest rate responds to the asset price bubbles, then the policy, in this case, is also divided as accommodative -aggressive depending on the coefficient of response to the inflation expectations. The coefficient of response to asset price bubbles is considered constant 0.1. The results show that in the case of an accommodative policy, in the presence of a bubble, the expected increase in interest rates leads to a decrease in the fundamental value of assets, which, together with the expectations of future interest rate increases, counteracts the increase in the market prices of the assets, resulting in a decline in real output. The authors interpret this result as targeting incorrect variables by the central banks based on asset prices and not on the fundamentals of the economy. In the case of aggressive inflation targeting, the monetary rule reacts more to the expected inflation, specifying the inverse effect of the asset price response. As a result, it can be argued that in the case of a monetary rule, responding to asset prices, the expected inflation response should be aggressive rather than accommodative. Aggressive inflation targeting will only provoke a response to interest rates if the increasing prices lead to inflationary expectations, thus refraining central banks from the difficult question of distinguishing fundamentally rational growth in asset prices from a bubble. One of the advantages is the central bank's more transparent policy which, along

with rising asset prices, will create public expectations that interest rates will rise, which by itself can be a tool to calm the public exuberance or, conversely, a way to curb panic.

The accelerator model of responding to asset price bubbles was a turning point in the modeling of the economy with financial rigidities. However, the model was modeled on the US economy, and the assessment of the reliability of the results for small open economies still needed to be examined. The mentioned problem considers Martha Lopez in the paper [Lopez, 2014]. The work considers the extension of the theory suggested by Bernanke and Gertler, with the assumption of a small open economy. The main purpose of the work is to find out whether the results of the model built with the assumption of a closed economy [Bernanke, Gertler, 1999] are still reliable in the case of a small open economy, as well as to perform a comparative analysis of impacts between the two types of economies. In addition to the discussions above, the author views the policy pursued by central banks in the context of responding to asset prices, taking into account both capital inflows and real exchange rate appreciation, which comes from the assumption of a small open economy.

The results of the open economy model show that the results obtained by Bernanke and Gertler in the closed economy model, were still relevant. In particular, the paper reaffirms the view that central banks should respond to inflation expectations, and should not respond to asset price bubbles, even more, in the small open economy model, if central banks respond to asset price bubbles with an accommodative monetary policy rule, then in the presence of an asset price bubble, real output declines more than in a closed economy model, which is since there are public expectations that the central bank will respond to rising asset prices, rising interest rates, which will lead to a bubble burst. Thus, the fundamental value of assets decreases, which together with the decrease in the real exchange rate leads to a lower market value of assets, hence due to the credit channel of accelerator mechanism, the subsequent decline in real output at a higher rate than in the case of an open economy. The obtained results allowed arguing that business cycles in small, open economies are deeper.

The issue of regulators' response to asset price bubbles has been addressed in the work by Robert Tetlow [Tetlow, 2005], who sought to extend Bernanke and Gertler's results by incorporating into the model adjustment costs in investments, consumption habits, and the impact of asset price fluctuations on entrepreneurs' investment decisions.

The results largely reaffirmed Bernanke and Gertler's assertion that the central banks' response to asset price bubbles should be based solely on inflation expectations; no separate asset price response is required. At the same time, given the uncertainties in measuring the fundamental value of asset prices, the authors suggest using a non-linear

interest rate rule to enable regulators to respond to large asset price bubbles, the existence of which is not uncertain.

The suggestions made by Tetlow can be seen in the paper of Alexei Vasilenko from the Central Bank of Russia [Vasilenko, 2018], which, based on the work already presented by Bernanke and Gertler, presents a model based on the financial accelerator, which the author combined with a model of agent-based financial markets, allowing bubbles to exist in asset prices. The interest rate decisions of central banks are guided by Taylor's rule, which assumes that interest rates respond to asset price bubbles in a non-linear manner. Particularly, it is assumed that the central bank changes the interest rate to prevent a bubble when the ratio of the market value of capital to its fundamental value exceeds a predetermined threshold, which is considered as a parameter in the model. Otherwise, the standard Taylor rule is in use. The existence of a response threshold allows regulators to avoid tightening monetary policy during small fluctuations in asset prices, which may lead to a reduction in the real output level. On the other hand, the threshold refrains regulators from the recognition of the asset price bubble, as the monetary response occurs in case of sufficient deviation of asset prices from the fundamental value when the bubble is already visible.

The paper then looks at the behavior of the economy in the event of a shock to asset prices, in one case when the central bank raises interest rates in response to a bubble, in the other case not. The results show that the response of the central bank to the bubble reduces the level of output, inflation, as well as the level of fluctuations in social wealth in the context of the policy pursued by the Central Bank (as social wealth the authors consider the ratio of the difference between the actual and steady-state levels of the household utility function and the level of consumption at steady state). It is worth noting that the resulting model also includes an effective communication policy conducted by the central bank, which implies transparency, a clear public perception of the policy pursued by the policymaker. In the absence of an adequate level of communication policy, the central bank's policy effectiveness of responding to asset price bubbles suffers.

Eddie Gerba [Gerba, 2011] also considers the model of the influence of asset prices on entrepreneurs' investment decisions in his work. Based on the accelerator mechanism, the work re-examines the monetary policy with the assumption of asset price bubbles. In addition to previous research in which exogenous fluctuations in asset prices, affect the net worth of the entrepreneur, in the presented model entrepreneurs make investments based not on the fundamental value of capital, rather than the market value, which leads to the above-mentioned exogenous fluctuations' influence on entrepreneurs' investment decisions. To assess the effectiveness of monetary policy to asset price bubbles, the author examined welfare changes (measured by a change in the loss function that the government wants to minimize) when the monetary rule does not res-

pond to asset bubbles but the bubble exists (type 1 error), and when the regulator recognizes a bubble and responds with the monetary rule, but it does not exist (type 2 error). The obtained results are compared with the case when the regulator recognizes and responds to the bubble when it exists. The results showed that the monetary rule, which responds to asset prices, is preferable to one that ignores them.

Simon Gilchrist and Masashi Saito [Gilchrist, Saito, 2006] consider the problem of central banks' response to asset price bubbles by discussing the accuracy of the information that have the government and the society. To this end, the authors assume that asset prices in the economy reflect the growth rate of technology. In this case, the authors assume that asset prices influence entrepreneurs' investment decisions. The private sector and the government have uncertainties about the growth rate of technology, which they assimilate over time.

The authors argue that in the absence of financial rigidities, even in a situation where the private sector is unaware of the true rate of technological progress, monetary policy rule, that responds only to the expected inflation is sufficient. In the presence of financial rigidities, inflation targeting somewhat inhibits the impact of asset price volatility on real macroeconomic variables, however, real output deviations from potential are still observed in the economy. The authors, on the other hand, argue that the ability of central banks to respond to asset prices depends on the level of public and regulator's awareness of the real technological growth rate. The paper concludes that the response of the interest rate rule to asset prices is most effective when the private sector is uncertain about the real rate of technological progress and the regulator, on the contrary, is fully aware of it.

The study of bubbles observed in asset prices, in particular, in the real estate market, gained special importance after the financial crisis of 2007-2009. A large number of economists cited the unprecedented rise in prices in the US real estate market in the early 2000s as the cause of the crisis, which can already be called a bubble, which later exploded. At the same time, at the root of the crisis one can see the liberalization of the US financial sector, the gaps in securitization control mechanisms, as well as the many factors of public panic behavior that can be summarized as imperfections in financial and credit markets.

There are many academic and non-academic types of research about the reasons behind the crisis. Ben Bernanke, in his article (Bernanke, 2018) tries to answer the question about the reasons for the crisis that follow the imperfections of the credit markets. Don't we underestimate the effects of the crisis on the real sector? The author puts forward a theory that, despite the negative impact of the crisis on households, it would not be so profound if the financial sector had shown greater stability, and panic behavior would not have prevailed in the decisions made by individuals. Not ignoring the role of

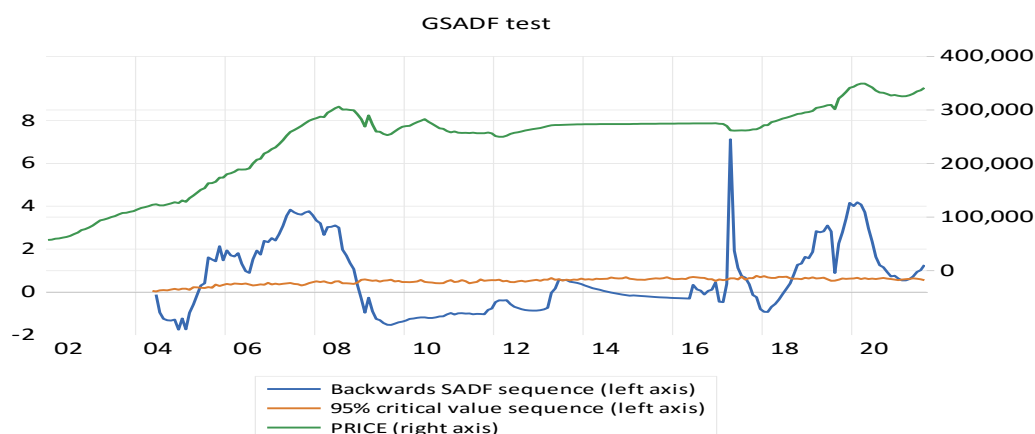
aggressive financial lending in the pre-crisis period (which led to a sharp rise in the households' balance sheets leverage ratio and a decline in their solvency in times of crisis); the study, nevertheless, claims that the financial crisis got an irreversible volume because of the panic in the financial markets, which led to a reduction in credit supply, and further, with the financial accelerator effect, amplified and propagated the volume of negative shocks. However, the results of Bernanke's paper were not accepted unequivocally. In particular, Paul Krugman disagreed with the results, who in turn published a critical article [Krugman, 2018], in which he expressed the view that the main motive of the financial crisis of 2008 was the explosion of a bubble in the real estate market. The same reason stands for the long-term decline in real macroeconomic indicators, which lasted longer than the instability of the financial sector. Expressing distrust of Bernanke's VAR analysis, Krugman claims that he does not see the "transmission mechanism" by which financial sector imperfections will have such long-term effects on real macro-variables. Bernanke, in turn, published an analysis [Bernanke, 2018] in which, in response to Krugman's view, he presents the analysis of time series of macro variables, the chronology of which, according to the author, suggests that variables related to the real estate market accurately describe the state of the economy. However, after 2007, variables that characterize financial panic, such as non-mortgage credit yields, have become more explanatory. On the other hand, the author notes that only a decline in the real estate market a reduction in credit supply would naturally have an impact on credit-sensitive spending, but in the case of self-financing firms, which do not need lending to run their business properly, the behavior is explained more accurately by the panic in the financial market. The author states that he does not underestimate the role of the real estate price bubble in the financial crisis, even more, he considers it as a part of the financial accelerator mechanism, which led to the deterioration of household balance sheets. However, the worst effect of the bubble was the panic in the financial sector. Absence of panic combined with a higher level of stability of the financial sector would not have allowed the crisis to deepen so much.

Given the role of the real estate market in the global financial crisis, economists give a special significance to real estate prices and the proper ways for responding to them. A paper published by the economists of the Central Bank of the Netherland [Hessel, Peeters, 2011] also addresses the issue of regulators' response to the real estate bubbles. The authors, studying the real estate market developments in the economies of the Organization for Economic Cooperation and Development (OECD) and their impact on macroeconomic and financial variables, essentially share the view that monetary policy should not be considered as a primary tool for cyclical fluctuations in asset prices, giving priority to macroprudential policy. Macroprudential instruments, such as restrictions on the LTV ratios, have a more targeted effect on the problem, while a change in interest rates may have an impact on the wider economy, leading to undesirable conse-

quences. Giving priority to macroprudential policy, the authors, however, acknowledge that without the support of appropriate monetary policy, macroprudential policy is not sufficient to ensure financial stability in the country.

**Testing for bubbles in the real estate market with the help of statistical tests.** As we have already noted, for the central banks to respond accurately to the asset price bubbles, it is first necessary to recognize the bubble and separate it from the rational growth derived from the fundamentals.

The issue of recognizing bubbles has been in the focus of economists for many years, especially after the 2008 crisis. However, at the theoretical level, the problem of recognition is very difficult. First, it is difficult to determine the price of an asset derived from the fundamentals of the economy. Another way to identify bubbles is to use statistical tests. An example of such a test is the extended version of the right-tail unit root tests developed by Phillips, Wu, Yu [Phillips, Wu, Yu, 2012], which tests the non-stationary hypothesis of a time series of asset prices as being an explosive process. In addition to testing the hypothesis of the presence of a bubble component in the time series, these tests also estimate Monte Carlo simulations to generate critical values of test statistics, which are used to detect the beginning and end periods of the bubble. These tests have been widely used for the recognition of bubble periods in stock price indices [Phillips, Shi, Yu, 2013], as well as for the recognition of bubbles in the real estate market for the RA [Avetisyan, 2017](the analysis in the paper has been done as of 2017). In this paper, a more comprehensive version of the analysis is presented, covering the data period 2002-2021.



**Graph 1.** Real estate price bubble periods estimated for apartments located in Yerevan, GSADF test

Testing for asset price bubbles is primarily concerned with limiting companies' access to financial resources through the corporate balance sheet channel in the accelerator mechanism. Real estate, on the other hand, in the accelerator concept, acts as col-



lateral for financial intermediaries for providing financial resources to firms, which creates potential risks to the stability of the financial system in the event of a bubble. Graph 1 presents the analysis based on GSADF statistics for the recognition of bubble periods in housing prices in Yerevan. The values of the SADF statistics are compared with the critical values of the 95% confidence level of the SADF statistics, which were obtained with the help of Monte Carlo simulations with 100 replications.

We may conclude that the test recognized the period of the global crisis of 2008 (06 / 2005-11 / 2008) as the period of bubble, and the short period of 2017 (04 / 2017-08 / 2017). After 09/2018, the value of SADF statistics exceeds the critical value, returning to its critical value level in 11/2020, shortly after 06/2021, exceeding the critical value again. The letter may be due to the demand shock by the society, mainly conditioned by government decision about the gradual repeal of the law that allows mortgage borrowers to direct income tax amounts to repay mortgage interest. Thus, according to the GSADF method, the housing market in Yerevan was in the bubble period as of 08/2021.

Regarding the monetary rule applied by the Central Bank of Armenia, it should be noted that, according to the provided information [Central Bank, 2010], it does not contain a component that responds to asset prices. However, in 2021, the Central Bank began to use macroprudential instruments [Central Bank, 2021] (in particular, for the loans up to 300,000 drams were imposed restrictions on consumer credit scores and for the ratio of monthly payment/income). The restrictions mentioned above were aimed at controlling the risks conditioned by the growth of loan portfolios as of 2019.

**Conclusion.** The paper presented the channels, through which asset price bubbles have their influence on real macroeconomic variables, as well as their role in the context of amplifying macroeconomic shocks. The paper discusses the experience of different authors and central banks in responding to asset price bubbles. The mentioned results show that there is no unequivocal agreement on expediency and methods in response of bubbles by different regulators. However, models for responding to already visible balloons that exceed a certain threshold value are more widely used. Our analysis is a part of the financial sector impact assessment study on real macroeconomic variables in the context of the financial accelerator mechanism. The results of the analysis of Yerevan's real estate market during 2002-2021 show that the statistical tests in different periods, including 08/2021, are recognized as bubble periods.

### **References**

1. A. Vasilenko, Bank of Russia, Research and Forecasting Department, "Should Central Banks Prick Asset Price Bubbles? An Analysis Based on a Financial Accelerator Model with an Agent-Based Financial Market", Working Paper series N35, 2018
2. B. Bernanke, "The housing bubble, the credit crunch, and the Great Recession: A reply to Paul Krugman", Brookings, 2018
3. B. Bernanke, "The Real Effects of the Financial Crisis", BPEA Conference Drafts, September 13-14, 2018

4. B. Bernanke, M. Gertler, "Monetary Policy and Asset Price Volatility", Federal Reserve Bank of Kansas City's Symposium, 1999
5. B. Bernanke, M. Gertler, S. Gilchrist, "The Financial Accelerator in a Quantitative Business Cycle Framework", National Bureau of Economic Research, Cambridge, 1998
6. E. Gerba, "Monetary policy, the Financial Accelerator model and Asset price bubbles", University of Kent, 2011
7. J. Hessel, J. Peeters, "Housing bubbles, the leverage cycle and the role of central banking", De Nederlandsche Bank, 2011
8. M. Lopez, "Asset price bubbles and monetary policy in a small open economy", Central bank of Colombia, 2014
9. P. Krugman, "The Credit Crunch and the Great Recession", The New York Times, 2018
10. P. Phillips, S. Shi, J. Yu, "Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P500", Yale University, 2013
11. P. Phillips, Y. Wu, J. Yu, "Explosive behavior in the 1990s NASDAQ: When did exuberance escalate asset values?", 2012
12. R. Tetlow, "Monetary policy, Asset Prices, and Misspecification: the robust approach to bubbles with model uncertainty", Conference Proceedings, Bank of Canada, 2005
13. S. Gilchrist, M. Saito, "Expectations, Asset Prices, and Monetary Policy: The Role of Learning", National Bureau of Economic Research, 2006
14. A. Avetisyan, "Preconditions for the emergence of asset price bubbles and their influence on the macroeconomic environment", Finance and Economics, 2017, 7-8 (203-204), p. 138-146
15. «Hayastani Hanrapetowt'yan Kentronakan banki kanxatesman & Qaghaqakanowt'yan verlowc'owt'yan Hamakargy'», HH Kentronakan bank, 2010
16. HH KB Oroshowm «Ereq haryouw hazar dramy' Chgerazancogh sparoghakan kreditner tramadrman y'nt'acqowm spar'oghmeri varkow nakow t' yan gnahatman kanonneri v eraberyal» kargy' hastatelow masin», 2021, Er&an)

#### **Ara AVETISYAN**

##### **The issues of monetary policy response to asset price bubbles in models with assumption of the financial accelerator**

*Key words: monetary policy, financial accelerator, transmission mechanism, asset bubbles, financial crisis*

In economic modeling problems, asset prices are considered endogenous variables. Meanwhile, there are times when they do not reflect the true nature of the economy, that is, pricing is not based on the fundamentals. It is worth noting that such fluctuations in asset prices are not only the result of deviations from the fundamentals of the economy; but also have an impact on the economy, causing real economic instability. Such fluctuations in asset prices can be attributed to both the irrational (or so-called behavioral) characteristics of investors and the liberal policies pursued by regulators, which are characterized by increased access to credit and can lead to asset overvaluation. The paper aims to present possible ways in which asset price bubbles affect real macroeconomic variables, as well as the models used by regulators to respond to bubbles, emphasizing those based on the concept of a financial accelerator. The paper expands the results of the statistical test for the presence of bubbles in the real estate market in Yerevan and the approaches used by the Central Bank of RA to respond to asset price fluctuations.