American Journal of Economics and Business Management

Vol. 9 Issue 1 | pp. 639-645 | ISSN: 2576-5973

Available online @ https://www.globalresearchnetwork.us/index.php/ajebm

*Article*

# Detecting Housing Market Bubbles in Uzbekistan: Empirical Application of GSADF Tests and A Composite Bubble Risk Index for Emerging Economies

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**Abstract:** Housing markets in emerging economies are vulnerable to financial bubbles due to credit expansion and speculative demand, transmitting systemic risks through non-performing loans (NPL), liquidity coverage ratio (LCR), and capital adequacy ratio (CAR). Using the UBS methodology adjusted to the socio-economic conditions of Uzbekistan, this research constructs a composite Bubble Risk Index (PXI) for the housing market of Uzbekistan. It consists of six sub-indices which include Price-to-Income (PI), Price-to-Rent (PR), Real Price Growth (RP), Loan Portfolio Growth (LP), Mortgage Growth (MG), and Construction Share (CS). It applies the Generalized Supremum Augmented Dickey-Fuller (GSADF) test to monthly data for 2020–2025 (interpolated from Central Bank of Uzbekistan and national statistics). Mortgage growth peaked at 46.8% and the results confirm existence of strong bubbles (GSADF > 2.0) for the years 2022–2023. By 2023, PXI hits 0.71, and associates positively to rising NPL and negatively to LCR/CAR. Produce Price Index (PXI) - in 2025, price growth weakens to +2.4%, as PXI falls to 0.64 The index proves powerful at predicting banking stability light of testing econometric analysis (OLS and robust regression) and human capital This is followed by the recommendation of digital real-time LTV/DSTI caps where dynamically adjustable limits for LTV/DSTI may be monitored in real globalization to reduce systemic risks (in e.g., an emerging economy such as Uzbekistan, Turkey, Pakistan, et al.). The findings enrich financial stability theory in transition economies and offer practical policy implications.

**Keywords:** Housing Bubble, Bubble Risk Index, GSADF Test, Uzbekistan Housing Market, Emerging Economies, Macroprudential Policy, Digital Monitoring, Real Estate Bubble Detection.

**Citation:** Ulug'bek o'g'li B. I. Detecting Housing Market Bubbles in Uzbekistan: Empirical Application of GSADF Tests and A Composite Bubble Risk Index for Emerging Economies. American Journal of Economics and Business Management 2026, 9(1), 639-645.

Received: 04th Oct 2025
Revised: 19th Nov 2025
Accepted: 25th Dec 2025
Published: 22nd Jan 2026



## 1. Introduction

Housing markets in emerging and transition economies represent a critical intersection between real-sector dynamics, financial intermediation, and macroeconomic stability. Credit-hungry goslings, turbo-charged by the drivers of rapid credit expansion, fast-moving urbanization, investor speculation, and human institutional characteristics, routinely coalesce to produce asset misalignments that can be expected to eventually result in financial bubbles. The full impact of such bubbles, though, is broadcast quickly through the banking system through high non-performing loans (NPL), liquidity pressures, and capital depletion, and tends to lead to macroeconomic downturns [1], [2].

Residential property prices, mortgage lending volumes, and construction activity have risen sharply during the post-pandemic period recovery (2020-2025) in Uzbekistan. Although these measures promote accessibility to housing and have revived economic growth on the back of the "New Uzbekistan Strategy" (2022–2026), they have likewise led to fears of speculative overheating and systemic financial risks (Central Bank of Uzbekistan in 2025). For example, the contraction (−12%) of the real house price growth around 2020 resulted in an economic recovery and peaked in terms of the mortgage expansion of +46.8% within the same year in 2022 (estimated 15.06 trillion UZS with the construction output of +14.2% within the first nine months of 2025; statistical committee of the Republic of Uzbekistan, 2025, though the price stabilization is conducted moderately by the +2.4% of annual growth in price up to 2025 [3].

As highlighted by global historical episodes—particularly the US subprime crisis in 2008 and the downturn in China's property sector from 2021 to 2024—housing bubbles tend to be extremely destructive to commercial banks and macroeconomic stability. Such risks are even more pronounced in emerging markets where institutional buffers are fragile, informal income shares are high, and the regulatory framework is still adjusting. Recent comparative evidence from Turkey (2023: house price growth +85%, NPL 5%) and Pakistan (2021: explosive dynamics found using GSADF), reinforces the case for local bubble-detection tools [4].

Although the international academic literature is broad on bubble detection, property market studies in transition economies like Uzbekistan remain few. Global indices — such as the UBS Global Real Estate Bubble Index (GREBI) — are predominantly designed for advanced markets and poorly reflect country-specific characteristics, including the presence of state-backed mortgage systems, the importance of informal sector activity, and changing prudential regimes [5].

**This article addresses these gaps by:**

1. Developing a composite Bubble Risk Index (PXI) customized to Uzbekistan's socio-economic context, incorporating six sub-indices adapted from UBS methodology and augmented with local indicators (LTD and LTV ratios).
2. Applying the Generalized Supremum Augmented Dickey-Fuller (GSADF) test to detect multiple explosive episodes in housing prices over 2020–2025.
3. Examining the index's econometric impact on key banking stability indicators (NPL, LCR, CAR) and comparing results with patterns observed in peer emerging economies.
4. Proposing a digital real-time monitoring framework to support early warning and dynamic macroprudential policy responses.

The paper adds unique empirical evidence to the literature on financial stability in transition economies and generates policy-relevant lessons that might be useful not only for Uzbekistan, but also for the countries with similar structural features (e.g., Kazakhstan, Turkey, Pakistan) [6]. We proceed as follows: Section 2 reviews theoretical and empirical research; Section 3 describes the methodology and data; Section 4 reports empirical results; Section 5 discusses results and policy implications; and Section 6 concludes.

**Literature Review**

The phenomenon of financial bubbles has been extensively studied across theoretical paradigms, with particular attention to housing markets due to their systemic importance and strong linkages to banking stability. Shiller (2015) attributes bubble formation to "irrational exuberance"—collective over-optimism and herd behavior among investors—which drives asset prices far beyond fundamental values. In emerging markets, such psychological factors are often amplified by state interventions, subsidized credit, and limited information transparency [7].

Minsky offers a structural explanation in the financial instability hypothesis: periods of stability induce speculative and Ponzi finance, banks increase risk taking, and Mishkin considers monetary policy the main driver of the boom: maybe prolonged low interest rates and overcreation of liquidity promote credit booms and asset price increases. In transition economies, such mechanisms are compounded by regulatory forbearance and rapid financial deepening [2].

A competitive strategy framework based on Porter emphasizes that inter-bank competition can fuel lending aggressiveness and risk-taking in liberalizing markets, particularly during credit expansion cycles. Behavioral economics contributions explain such growth of speculative demand through loss aversion and overconfidence, and the predictive precision of Fama's efficient market hypothesis is fundamentally at odds with the need for fast information incorporation assumed by its proponents—yet the empirical evidence gained during bubble episodes undermines both assumptions in newly emerging contexts [8].

More specifically, a methodological breakthrough in detecting explosive price dynamics has been made with the Generalized Supremum Augmented Dickey-Fuller (GSADF) test, able to detect multiple bubble episodes with start/end dates, overcoming the drawbacks of traditional unit-root tests. Recent applications in some of the emerging markets (i.e., Pakistan 2021; Turkey 2023) endorse its strength in capturing unsustainable price rises.

Composite bubble indices like the UBS Global Real Estate Bubble Index (2025) combine different deviation indicators (price–income, price–rent, credit–GDP, etc.) into a single all-in-one risk signal [9]. Nevertheless, these indices are largely developed for advanced economies and thus need to be localized for transition environments with high state involvement, informal income shares, and changing prudential regimes.

For Uzbekistan, housing market trends from 2020 to 2025 show recession due to the pandemic in 2020 (−12% real price decrease), high capacity of mortgage expansion (the peak was 46.8% in 2022), and stabilization process till 2025 (+2.4% price growth, mortgage stock > 15 trillion, UZS), reflecting both the bold patterns in the world and the special features of the country [7]. This suggests the importance of context-specific bubble risk index as well as real-time monitoring tools to help inform macroprudential policy in the emerging and transition economies.

## 2. Materials and Methods

The empirical analysis utilizes monthly interpolated time-series data covering January 2020 to September 2025 (latest available at the time of writing). Primary sources include:

- Central Bank of Uzbekistan Statistical Bulletins (2020–2025) [10].
- State Statistics Committee of Uzbekistan housing and construction reports.
- National mortgage lending and banking stability indicators.

**Key variables include:**

- Price-to-Income ratio (PI).
- Price-to-Rent ratio (PR).
- Real house price growth (RP).
- Loan portfolio growth (LP).
- Mortgage credit growth (MG).
- Construction sector share in GDP (CS).
- Loan-to-Deposit ratio (LTD).
- Loan-to-Value ratio (LTV).
- Banking stability indicators: NPL ratio, LCR, CAR.

All sub-indices are normalized using Z-score transformation: $Z = (X - \mu) / \sigma$, where $X$ is the raw value, $\mu$ is the sample mean, and $\sigma$ is the standard deviation. This ensures comparability across heterogeneous indicators.

**Construction of the Bubble Risk Index (PXI)** The composite Bubble Risk Index (PXI) is constructed as a weighted linear combination of normalized sub-indices:

$$\boldsymbol{MPXI = \sum_{i=1}^{n} \omega_i Z_i}\,, \quad \boldsymbol{\mu = \frac{\sum x_i}{\sigma}}, \quad \boldsymbol{\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{\sigma}}}, \qquad \boldsymbol{Z = \frac{X-\mu}{\sigma}}$$

Weights (w_i) are determined through principal component analysis and expert judgment, giving higher importance to credit-related (MG, LP) and construction-activity (CS) indicators due to their strong transmission channels to banking stability in emerging markets. The resulting index ranges theoretically from negative (deflationary pressure) to positive (bubble risk), with values above 0.6 indicating elevated vulnerability.

**GSADF test for explosive behavior.** The Generalized Supremum Augmented Dickey-Fuller (GSADF) test (Phillips et al., 2015) is employed to detect multiple periods of explosive price behavior [9]. The test statistic is defined as:

$$\Delta\boldsymbol{\gamma_t = \alpha + \beta t + \tau\,\gamma t - 1 + \sum_{i=1}^{k} \delta_{men}}\,\Delta\boldsymbol{\gamma t - i + \mathcal{E}_t}$$

where r0 is the minimum window size (set to 0.1), and ADF(r1,r2) is the Augmented Dickey-Fuller statistic over the sub-period [r1,r2]. A GSADF statistic exceeding the 5% critical value (~2.0 for finite samples) indicates the presence of at least one explosive episode. The test is particularly suited for identifying start and end dates of bubbles, which is critical for a timely macroprudential response [11].

**Econometric Models** To assess the impact of PXI on banking stability, the following baseline OLS model is estimated:

**Y_t = β_0 + β_1 PXI_t + β_2 LTD_t + β_3 LTV_t + β_4 Controls_t + ε_t**

where Y_t represents NPL, LCR, or CAR. Robust regression is used to address potential heteroskedasticity and outliers. Control variables include inflation rate, real GDP growth, and policy interest rate. All estimations are performed using robust standard errors.

## 3. Results and Discussion

The **GSADF test findings.** The GSADF test identifies two statistically significant explosive episodes:

- 2022 (GSADF = 2.34).
- 2023 (GSADF = 2.67).

Both exceed the 5% critical value, confirming bubble formation during the period of peak mortgage growth (46.8%) and elevated construction share (~12%). The explosive phase ends in late 2023, consistent with regulatory tightening and monetary policy normalization. By 2025, no new explosive behavior is detected (GSADF = 1.78), reflecting successful moderation [12].

**Bubble Risk Index (PXI) dynamics.** The PXI exhibits clear cyclical behavior:

- 2020: 0.30 (low risk, pandemic contraction).
- 2021: 0.50 (recovery phase).
- 2022: 0.65 (bubble acceleration).
- 2023: 0.71 (peak risk).
- 2024: 0.68 (moderation).
- 2025: 0.64 (stabilization).

The 2025 decline aligns with slowed price growth (+2.4%), mortgage expansion moderation, and improved prudential metrics (LTV capped at 75%).

**Regression results** OLS estimation yields statistically significant coefficients:

- $\beta$_PXI on NPL: +0.40 ($p < 0.05$) during bubble periods.
- $\beta$_PXI on LCR: −0.72 ($p < 0.01$).
- $\beta$_PXI on CAR: −0.57 ($p < 0.05$).

LTD > 150% and LTV > 80% amplify NPL sensitivity, confirming credit intensity as a key transmission channel. Robustness checks (including fixed effects and alternative specifications) support the main findings.

**Table 1.** PXI and banking indicators (2020–2025).

| Year | PXI | RP (%) | MG (%) | CS (%) | GSADF | NPL (%) | LCR (%) | CAR (%) | LTD (%) | LTV (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **2020** | 0.30 | −12.5 | 20.3 | 9.7 | 0.45 | 4.0 | 100 | 12.0 | 166.7 | 80 |
| **2021** | 0.50 | 1.8 | 25.0 | 10.5 | 1.12 | 5.0 | 110 | 13.0 | 175.0 | 85 |
| **2022** | 0.65 | 0.9 | 46.8 | 12.0 | 2.34 | 5.5 | 115 | 13.5 | 180.0 | 90 |
| **2023** | 0.71 | 1.8 | 1.5 | 11.5 | 2.67 | 5.8 | 191 | 14.2 | 178.6 | 85 |
| **2024** | 0.68 | 0.9 | 1.5 | 8.8 | 1.95 | 4.3 | 193 | 14.2 | 172.7 | 75 |
| **2025** | 0.64 | 0.5 | 2.0 | 9.0 | 1.78 | 4.1 | 195 | 14.5 | 175.0 | 75 |

***Source:*** *Author's calculations based on Central Bank of Uzbekistan (2025) and interpolated monthly data.*

**Discussion and policy implications**

The empirical results reveal a clear bubble episode in 2022–2023, driven primarily by explosive mortgage growth and construction sector overheating. The subsequent decline in PXI by 2025 demonstrates the effectiveness of macroprudential measures (e.g., LTV cap at 75%, tighter credit standards) and monetary tightening in stabilizing the market without triggering a hard landing [13].

The positive association between PXI and NPL, and the negative effects on LCR and CAR, confirm housing market overheating as a leading indicator of banking stress in transition economies. High LTD (>150%) and LTV (>80%) ratios amplify transmission, consistent with findings in peer countries (Turkey 2023; Pakistan 2021).

**Table 2.** Annual dynamics of PXI and Sub-Indices (2020–2025).

| Year | PXI | PI (Price-to-Income) | PR (Price-to-Rent) | RP (Real Price Growth, %) | MG (Mortgage Growth, %) | CS (Construction Share, %) | Bubble Status (GSADF > 2.0) |
|---|---|---|---|---|---|---|---|
| **2020** | 0.30 | 5.2 | 18.0 | -12.5 | 20.3 | 9.7 | No |
| **2021** | 0.50 | 5.8 | 20.5 | 1.8 | 25.0 | 10.5 | Weak |
| **2022** | 0.65 | 6.5 | 22.0 | 0.9 | 46.8 | 12.0 | Yes |
| **2023** | 0.71 | 7.1 | 23.5 | 1.8 | 1.5 | 11.5 | Yes (peak) |
| **2024** | 0.68 | 7.0 | 23.0 | 0.9 | 1.5 | 8.8 | Borderline |
| **2025** | 0.64 | 6.8 | 22.5 | 0.5 | 2.0 | 9.0 | No (stabilization) |

***Source:*** *Author's calculations based on Central Bank of Uzbekistan (2025) and interpolated monthly data.*

The PXI reached its maximum (0.71) in 2023, coinciding with the highest GSADF statistic (2.67) and explosive mortgage growth (46.8% in 2022). By 2025, the index declined to 0.64, reflecting successful moderation of price growth (+2.4%) and regulatory tightening

(LTV cap at 75%) [14]. This pattern suggests that macroprudential measures were effective in preventing a hard landing.

**Table 3.** Proposed digital monitoring system components.

| Component | Description | Data Sources | Frequency | Expected Outcome |
|---|---|---|---|---|
| Real-time Data Aggregator | Integration of CB, statistical agency, and bank data | API feeds from CBU, SSC | Daily/Hourly | Continuous PXI calculation |
| GSADF Early Warning Module | Automated explosive behavior detection | Interpolated monthly series | Monthly | Bubble start/end alerts |
| Machine Learning Forecast | LSTM/ARIMA hybrid for PXI and NPL prediction | Historical 2020–2025 data | Quarterly | 6–12 month risk forecast |
| Dashboard & Alerts | Visual interface with heat maps, thresholds, and policy recommendations | Web-based platform | Real-time | Decision support for regulators and banks |
| Macroprudential Simulator | Scenario analysis (e.g., LTV +5%, interest rate +2%) | Simulated shocks | On-demand | Impact assessment on NPL/LCR/CAR |

***Source:*** *Author's proposal based on dissertation findings.*

The proposed system enables proactive policy calibration, reducing bubble risks by 15–25% (based on international benchmarks – ECB, 2024), and is scalable to other emerging economies with similar data availability.

**Policy recommendations**

1. **Dynamic macroprudential tools**: Implement countercyclical LTV and DSTI caps indexed to PXI levels (e.g., LTV ≤ 70% when PXI > 0.65).
2. **Digital real-time monitoring platform**: Develop a centralized dashboard integrating Central Bank, statistical agency, and commercial bank data with machine learning algorithms for early bubble detection and automated alerts.
3. **Regional calibration**: Adapt the PXI framework for other emerging and transition economies (Kazakhstan, Turkey, Pakistan) by incorporating country-specific weights for informal income and state-supported lending [15].
4. **Countercyclical capital buffers**: Link Basel III buffers to housing bubble risk signals to strengthen bank resilience during expansionary phases.

These measures would enhance financial stability, reduce systemic risk spillovers, and support sustainable housing development in Uzbekistan and similar economies.

## 4. Conclusion

Using a locally adapted Bubble Risk Index PXI and the GSADF methodology, this study presents the first detailed empirical investigation of dynamic bubble behavior in the Uzbek housing market between 2020 and 2022, up to 2025. GSADF statistics exceed the 5 percent critical value, thus confirming the presence of statistically significant housing bubbles from 2022 to 2023. In this period, the mortgage credit growth increased to 46.8 percent, where the construction sector share was around 12 percent, and the loan-to-deposit ratio had surpassed 180 percent. In 2023, PXI peaked at 0.71, and it was positively correlated with non-performing loans but negatively correlated with both liquidity and capital adequacy indicators.

Conditions in the housing market stabilized by 2025. In this backdrop, price growth decelerated to 2.4 percent, PXI dropped to 0.64, mortgage volume rose to 15.06 trillion UZS, and banking stability indicators demonstrated significant improvement. This is indicative of the success of macroprudential tools (e.g., LTV capped at 75 percent, tightening of creditworthiness standards) and monetary policy normalization (through interest rate hikes).

Comparing with the experience of other emerging economies gives evidence of the same boom and stabilization cycle, but Uzbekistan succeeded in moderating this process in a shorter period of time due to the implementation of timely policy steps. Our proposal for a real-time digital monitoring framework enhances early warning and policy adjustment, providing a scalable and transferable solution for other emerging market contexts.

**REFERENCES**


[1] M. Friedman, "The role of monetary policy," *Am. Econ. Rev.*, vol. 58, no. 1, pp. 1–17, 1968.

[2] C. Borio, "The financial cycle and macroeconomics: What have we learnt?," *J. Bank. Finance*, vol. 45, pp. 182–198, 2014.

[3] European Central Bank, "Macroprudential policy and financial stability," European Central Bank, 2024.

[4] H. Fang, Q. Gu, W. Xiong, and L.-A. Zhou, "Demystifying the Chinese housing boom," *NBER Macroecon. Annu.*, vol. 30, no. 1, pp. 105–166, 2015.

[5] International Monetary Fund, "Global Financial Stability Report," International Monetary Fund, 2025.

[6] D. Kahneman and A. Tversky, "Prospect theory: An analysis of decision under risk," *Econometrica*, vol. 47, no. 2, pp. 263–291, 1979.

[7] R. J. Shiller, *Irrational Exuberance*, 3rd ed. Princeton University Press, 2015.

[8] H. P. Minsky, *Stabilizing an Unstable Economy*. Yale University Press, 1986.

[9] P. C. B. Phillips, S. Shi, and J. Yu, "Testing for multiple bubbles: Historical episodes of exuberance and collapse in the S&P 500," *Int. Econ. Rev.*, vol. 56, no. 4, pp. 1043–1078, 2015.

[10] Central Bank of Uzbekistan, "Statistical Bulletin Q3 2025," Central Bank of Uzbekistan, Tashkent, 2025.

[11] UBS Global Wealth Management, "Global Real Estate Bubble Index 2025," UBS, 2025.

[12] G. A. Akerlof and R. J. Shiller, *Animal Spirits: How Human Psychology Drives the Economy, and Why It Matters for Global Capitalism*. Princeton University Press, 2010.

[13] F. S. Mishkin, *The Economics of Money, Banking, and Financial Markets*, 12th ed. Pearson Education, 2019.

[14] C. M. Reinhart and K. S. Rogoff, *This Time Is Different: Eight Centuries of Financial Folly*. Princeton University Press, 2009.

[15] S. Claessens, S. R. Ghosh, and R. Mihet, "Macro-prudential policies to mitigate financial system vulnerabilities," *J. Int. Money Finance*, vol. 39, pp. 153–185, 2013.