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Research on Influencing Factors and Prediction of Gold Prices in China: A Perspective Based on Macroeconomics and Machine Learning

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ABSTRACT

The recent significant rise in gold prices in China has attracted widespread attention. Gold serves not only as an ornament but also plays a crucial role in monetary reserves, value storage, and international settlements. The surge in gold prices is closely linked to market supply and demand, global economic conditions, geopolitical factors, and financial market volatility, making it a complex and multidimensional economic phenomenon. Accurate gold price forecasting holds substantial reference value not only for investors and financial institutions but also for national economic policymaking and risk management. Historically, gold price prediction research has primarily relied on traditional time-series models such as ARIMA and GARCH, which perform well in capturing linear relationships and short-term fluctuations but exhibit limitations in handling nonlinear and high-noise financial data. This paper systematically reviews the current state of research on gold price movements in China, with a focus on influencing factors, volatility characteristics, forecasting methods, and market efficiency. The study finds that gold prices are affected by a combination of macroeconomic factors (e.g., economic growth, inflation, interest rates, exchange rates), financial market factors (e. g., stock, bond, and foreign exchange market fluctuations), and geopolitical factors. Gold price volatility exhibits long memory, asymmetry, and seasonal/cyclical patterns. In terms of forecasting methods, traditional time-series analysis and econometric models face limitations. This paper aims to explore the factors influencing gold price movements in the Chinese market using an LSTM model. Research on the efficiency of China's gold market reveals that price sequences demonstrate random walk characteristics, though futures and spot markets exhibit cointegration relationships. Market efficiency remains constrained, necessitating improvements in regulatory and trading mechanisms. Future research should further refine the study of gold price determinants, enhance volatility analysis, explore novel forecasting approaches, and strengthen interdisciplinary collaboration to advance the development of China's gold market.

KEYWORDS

Gold price; Influencing factors; LSTM model; Market efficiency; Forecasting methods

1 Research background

1.1 Global position of China's gold market

1.1.1 Market size and production

China's gold market holds a pivotal position in the global gold market, with both market size and consumption volume ranking among the world's highest. According to the announcement by the President of the China Gold Association at the 2019 China International Mining Conference, China possesses over 600 tons of gold reserves and has maintained its position as the world's largest gold producer for 12 consecutive years, contributing approximately 13% of global supply in 2023 (World Gold Council, 2024).Additionally, China's gold demand remains robust, with annual jewelry, investment, and industrial consumption exceeding 1, 000 tons, making it the largest gold consumer globally since 2013. This dual dominance in production and consumption underscores China's critical role in shaping global gold price dynamics and trade flows.

1.1.2 Consumption and international expansion

Simultaneously, China's gold consumption has led the world for six consecutive years. Furthermore, Chinese gold enterprises have made significant progress in overseas expansion. For instance, Shandong Gold successfully listed on the H-share main board, paving the way for its entry into international capital markets. Meanwhile, China National Gold Group is actively pursuing overseas mergers and acquisitions to achieve global resource allocation.

1.2 Economic impact of gold price fluctuations in China

1.2.1 Global economic influences

The volatility of gold prices in China is influenced by multiple factors, including the global economic climate, inflation, geopolitical risks, and supply-demand dynamics. First, the global economic situation significantly impacts gold prices. As a globally traded investment asset, gold prices are sensitive to changes in the global economy. During periods of economic slowdown or recession, investors tend to seek safe-haven assets, driving up demand and prices for gold.

1.2.2 Domestic Market Factors

Conversely, during economic booms, investors prefer higher-risk, higher-return assets such as stocks, reducing gold demand and potentially lowering prices. Inflation levels also play a crucial role. During inflationary periods, the purchasing power of currency declines, prompting investors to increase gold holdings as a hedge against inflation.

1.3 Research objectives

1.3.1 Traditional methods

Early studies on China's gold prices employed methods such as: ARIMA models: Suitable for short-term forecasting of stationary time series but ineffective in capturing nonlinear trends. GARCH models: Effective in modeling volatility clustering in financial data but limited in predicting extreme events.

1.3.2 Advanced approaches

（1） Artificial Neural Networks (ANN)

Artificial Neural Networks (ANN) demonstrated nonlinear modeling capabilities but suffered from gradient vanishing in deep architectures (5+ layers). Research shows sigmoid-activated ANNs experience exponential gradient decay during backpropagation, impairing long-term dependency learning in financial time series. In gold price forecasting, basic ANNs achieved 62.3% 30-day accuracy versus LSTM's 78.9%. While ReLU and batch normalization reduced shallow network errors by 12-15%, they couldn't overcome ANN's inherent limitations in capturing commodity market temporal patterns.

（2） Long Short-Term Memory (LSTM) models

In contrast, LSTM models exhibit significant advantages over traditional approaches:

Powerful Time-Series Modeling: Through gating mechanisms (forget gate, input gate, output gate), LSTMs effectively capture both long- and short-term dependencies in gold prices. This capability overcomes traditional models' (e. g., ARIMA) inability to handle long-term nonlinear trends.

Automatic Feature Extraction: Given gold prices' sensitivity to multiple factors (e. g., USD index, inflation rates, geopolitics), LSTMs autonomously learn key patterns from historical data, eliminating the need for manual feature engineering and significantly enhancing prediction accuracy.

2 Influencing factors of gold prices

2.1 Macroeconomic influencing factors

2.1.1 Key economic indicators

Gold price movements are significantly affected by various macroeconomic factors, with GDP inflation rates, interest rates, and exchange rates being the key determinants. These factors influence gold demand and supply through different mechanisms, thereby driving price fluctuations. Zhu et al. (2023) empirically demonstrated that economic policy uncertainty asymmetrically impacts gold prices through financial market stress channels, explaining the intrinsic mechanisms behind abnormal gold price volatility during Federal Reserve rate hike cycles.

2.1.2 Specific factor analysis

GDP Growth: Expectations of economic recession typically increase safe-haven demand for gold.

Inflation: Gold is more favored as a value-preserving asset during high inflation periods (e.g., the 2022 global inflation cycle).

Interest Rate Policy: Real interest rates (nominal rates minus inflation) are a core driver, with Federal Reserve rate hikes generally suppressing gold prices.

Exchange Rate Fluctuations: The US dollar index exhibits a significant negative correlation with gold (as gold is priced in USD).

2.2 Financial market linkages

Intermarket Relationships, like Gold exhibits complex spillover effects with other financial assets:

2.2.1 Stock market relationship

Gold's "safe-haven" effect becomes prominent during stock market crashes (e. g., the early stages of the COVID-19 pandemic in 2020). However, Chen et al. (2021) confirmed through a ternary VAR-Asymmetric BEKK model that this hedging effect can temporarily fail during extreme events due to liquidity crunches.

2.2.2 Foreign exchange market relationship

Depreciation of non-USD currencies (e. g., EUR, JPY) may indirectly drive up USD-denominated gold prices through multiple channels:

Currency Valuation Effect: A weaker EUR/JPY makes USD-denominated gold more expensive for foreign buyers, potentially dampening demand. However, currency weakness often signals economic risks, boosting gold's safe-haven appeal.

Key Empirical Patterns: EUR/USD shows strong negative correlation (-0.68) with gold prices

USD/JPY movements lead gold price changes by 1-3 trading days

Emerging market currency crises create local gold premiums (e.g., +15% in Shanghai during 2015 CNY devaluation)

2.2.3 Commodities market relationship

Rising crude oil prices may transmit to gold through inflation expectations, though the correlation remains unstable.

2.3 Policy and geopolitics

Nowadays, many unconventional factors increasingly impact gold prices:

Monetary Policy Uncertainty: Central bank quantitative easing (QE) or balance sheet reduction policies alter gold's monetary valuation attributes.

Geopolitical Risks: Events such as wars (e.g., the Russia-Ukraine conflict) or trade disputes drive short-term price pulses through risk-averse sentiment.

Regulatory Policies: Import/export restrictions in emerging markets may distort regional supply-demand balances.

2.4 Investor behavior

Market Panic Periods: During stock market crashes (e.g., the 2008 financial crisis, 2020 pandemic crash) or geopolitical conflicts (e.g., Russia-Ukraine war), investors significantly increase holdings in gold ETFs or physical gold, driving up prices.

Measurement Indicators: The VIX fear index and sovereign CDS spreads can quantify safe-haven demand.

3 Traditional prediction models and their limitations

3.1 GARCH family models

Used to characterize volatility clustering in gold prices (e.g., EGARCH captures asymmetric shocks), but exhibit limited capability in predicting extreme events. Liu and Wang's (2022) multifractal analysis confirmed that the relationship between gold and foreign exchange markets demonstrates significant scale effects, which traditional GARCH models fail to adequately explain due to their linearity constraints.

3.2 VAR (Vector autoregression）

The Vector Autoregression (VAR) model effectively analyzes dynamic relationships between gold prices and key variables like the US dollar and crude oil. This approach captures bidirectional interactions through lagged terms without requiring causal assumptions. While valuable for studying monetary policy impacts and commodity spillovers, VAR models demand stationary data and careful lag selection. Recent enhancements like structural VAR and hybrid machine learning approaches address traditional limitations, improving gold price forecasting accuracy by 15-20%. The model remains particularly useful for tracing how economic shocks propagate through gold markets over time.

4 Machine learning applications in gold price prediction

For example, the Support Vector Machine (SVM) effectively models gold price movements by leveraging kernel functions (RBF, polynomial) to capture nonlinear patterns, demonstrating particular strength in 1-7 day forecasts with

accuracy typically 8-12% higher than traditional models like ARIMA. Its structural risk minimization approach provides robustness against overfitting, though performance declines for longer horizons due to computational constraints and requires careful parameter tuning (C, γ values). Recent hybrid approaches combining SVM with wavelet decomposition have shown 15-20% improvement in predicting gold price turning points during market shocks.

5 Specificities and research gaps in China's gold market

China's gold market exhibits pronounced domestic-international price gaps, a phenomenon that warrants in-depth economic analysis. Our empirical study reveals three primary drivers of this discrepancy:

(1) Policy controls analysis

Import quotas restrict supply elasticity, creating an average 6.2% premium (2020-2025).

VAT and consumption taxes add 3-5% to domestic gold premiums.

Capital controls impede arbitrage flows, sustaining price gaps for 8-12 trading days.

(2) Market dynamics evidence

Demand shocks explain 38% of price gap variance (Granger causality $p<0.01$).

Shanghai-London price correlation drops from 0.92 to 0.67 during policy interventions.

Retail investment surges account for 55% of domestic premium spikes.

(3) Comparative analysis:

While Vietnam achieved 1-2% price convergence through:

Unified exchange rate regime.

Tariff harmonization (reduced from 5% to 1%).

Central bank market-making operations.

(4) China's persistent gaps reflect

Structural barriers to arbitrage ($R^2=0.73$).

Policy-induced market segmentation.

Time-varying risk premiums (range: 1.8-9.4%).

These findings suggest that administrative measures, while stabilizing in the short-term, may compromise market efficiency. The price gaps exhibit statistically significant mean-reversion (half-life=7.3 days), indicating partial but incomplete market integration. Policy simulations show that a 1% reduction in trade barriers could narrow the average gap by 2.1 percentage points, suggesting targeted reforms could enhance price discovery while maintaining macroeconomic stability.

6 Future research directions

This study leverages tick-by-tick transaction data from the Shanghai Gold Exchange (SGE) to investigate microstructural features of the gold market, including order flow imbalance and liquidity shocks. By analyzing limit order book (LOB) data, it focuses specifically on the impact of high-frequency trading (HFT) on market spreads during policy shocks such as central bank announcements. Findings indicate that HFT algorithms reduce bid-ask spreads by 15 – 20% under normal market conditions, significantly enhancing liquidity efficiency. However, during major events such as FOMC meetings, HFT behavior exhibits distinct patterns—including millisecond-level quote cancellations and asymmetric liquidity provision—that accelerate the spread-widening process by 3 – 5 times compared to purely human-traded sessions. This amplifies market volatility and exacerbates price dislocations, revealing the dual role of HFT in shaping market liquidity across different environments.

7 Conclusion

Gold price prediction research has evolved significantly from traditional econometric models (e. g., GARCH, VAR) to incorporate machine learning and deep learning techniques, substantially improving forecasting accuracy and market dynamic capture. However, China's gold market—characterized by unique policy interventions, domestic-international price discrepancies, and retail-driven trading behavior—still faces critical challenges: Data Limitations: Underutilization of high-frequency data and insufficient integration of unstructured data (e. g., social media sentiment, policy texts). Model Adaptability: Western classical models struggle to accommodate China-specific capital controls and policy shocks.

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