Seasonal dynamics and ARIMA forecasting of China's consumer confidence index (2000-2024): An empirical analysis

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Abstract. China's Consumer Confidence Index (CCI) is a key barometer of household sentiment and a leading indicator of future consumption. This study presents an empirical analysis of China's quarterly CCI from 2000 to 2024, and forecasting its trajectory using seasonal ARIMA modeling. The CCI data were aggregated to quarterly frequency and analyzed with time-series decomposition and Box-Jenkins methods. Key turning points in CCI align with major economic events-for instance, a sharp drop during the 2003 SARS outbreak, a dip in 2008-2009 amid the global financial crisis, and an unprecedented collapse in 2022 under zero-COVID lockdowns. An ARIMA model with seasonal adjustments was fitted to capture the underlying structure; while the model's fit indicates the CCI largely follows a non-stationary downward drift in recent years, it provides a reasonable short-term forecast. Results show consumer confidence remaining subdued into 2025 (forecasted CCI 89-94), suggesting a slow recovery. The study's findings underscore the CCI's value in gauging economic sentiment and the importance of accounting for seasonality and structural breaks, and providing a comprehensive time-series analysis which could help policymakers and businesses understand and anticipate shifts in consumer confidence.

1 Introduction

Consumer spending is the backbone of most economies, and consumer confidence serves as a crucial gauge of future spending behavior. The Consumer Confidence Index (CCI) is a standardized indicator derived from household surveys, reflecting consumers' perceptions of economic conditions and their expectations for the future. It is based on responses about personal finances, general economic outlook, unemployment, and savings, where an index value above 100 indicates optimistic sentiment and expected boost in consumption, while a value below 100 signals pessimism [1]. As timely data, CCI is widely used by economists and policymakers as a leading indicator to predict household expenditure and broader economic trends [2].

China's consumer confidence is of particular interest given the country's rapid economic transformation over the past two decades. Private consumption has grown in importance in

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China's GDP, making consumer sentiment an increasingly vital metric of economic health. High confidence can spur spending sprees, whereas collapsing confidence can presage economic slowdowns. For example, during early 2022 China's CCI plunged from historically high levels (121 in January 2022) to record lows (86 by year-end 2022) amid strict pandemic controls and a property market slump [3]. Such swings have significant implications: persistent weak confidence contributes to sluggish domestic demand and poses challenges for China's growth rebalancing efforts [4].

Despite its importance, research on China's CCI remains relatively limited in academic literature. Much of the existing knowledge on consumer confidence and its predictive power comes from advanced economies. For instance, studies in the United States and Europe have examined whether sentiment indexes help forecast consumption growth. There is a need to bridge the literature gap by focusing on China's consumer confidence over a long horizon, analyzing both its trend and seasonal behavior, and applying rigorous time-series modeling to understand its dynamics. This study addresses the following research questions:

RQ1: How has China's Consumer Confidence Index evolved from 2000 to 2024, and what major economic events correspond to notable changes in confidence?

RQ2: What seasonal patterns are present in China's CCI, and how significant are these seasonal effects?

RQ3: Can a Seasonal ARIMA (SARIMA) model adequately capture the dynamics of China's CCI and provide useful forecasts for the near future?

To answer these questions, it constructs a quarterly CCI dataset spanning 25 years and employ time-series decomposition and SARIMA modeling. The contribution of this study is twofold. First, it provides a comprehensive descriptive analysis of China's consumer sentiment trends and seasonal fluctuations, filling a gap in understanding an indicator that is critical for China's consumption-driven growth strategy. Second, it demonstrates the application of seasonal ARIMA forecasting to consumer confidence, evaluating its performance and limitations in the context of structural changes (such as the 2022 confidence collapse).

The remainder of the paper is structured as follows: Section 2 reviews relevant literature on consumer confidence and its economic significance, with emphasis on findings from prior studies and the Chinese context. Section 3 describes the data and methodology, including the seasonal ARIMA modeling approach in R. Section 4 presents the empirical results, including seasonal decomposition, the estimated ARIMA model, and forecasts, supplemented by tables and figures. Section 5 provides a discussion of the findings in light of the literature, implications for policy and practice, and acknowledges limitations and avenues for future research. Section 6 concludes the paper by summarizing the key insights and their significance for understanding and leveraging consumer confidence in China's economic planning.

2 Literature Review

2.1 Consumer Confidence and Economic Activity - Global Evidence

Consumer confidence indices have long been studied as predictors of household spending and overall economic performance. The prevailing view is that confidence indices encapsulate information about consumers' expectations that can signal turning points in the economy. Empirical studies in various countries support the usefulness of sentiment measures. For example, it found that U.S. consumer confidence indexes contain information that improves forecasts of consumption growth [5]. In Europe, it demonstrated a positive relationship between the CCI and GDP growth in EU countries, suggesting consumer sentiment is an important leading indicator of economic cycles [6]. Similarly, research on emerging economies like Turkey and Brazil have shown that incorporating consumer confidence can enhance the accuracy of consumption and investment forecasts. Indeed, scholars have observed that confidence indices often strengthen consumption estimates, as evidenced in cases ranging from the United States and Canada to Brazil, South Africa, and others.

However, the literature also notes that the predictive power of consumer confidence is not unconditional. Out-of-sample forecasting tests for the U.S. found that while confidence indices can improve short-term consumption forecasts, their incremental value diminishes when other economic and financial variables are already included [7]. It echoed this by showing that after controlling for labor income and wealth, consumer confidence does not add much explanatory power to consumption changes in the United States [8]. These findings sparked debate on whether sentiment indicators contain unique information or simply reflect current economic conditions. Some studies attribute the forecasting ability of confidence to its role as a proxy for other fundamentals or as a composite of forward-looking information available to consumers (such as stock market trends, income prospects, etc.).

2.2 Consumer Confidence in China

Compared to Western economies, academic literature focusing on China’s consumer confidence is relatively sparse. Early 2000s saw the introduction of a consistent consumer confidence survey in China, but the indicator’s behavior has unique aspects due to China’s transitional economy and policy environment. It documented that in transition economies, confidence indices are sensitive to abrupt structural changes and may exhibit different dynamics than in mature markets [9]. In China’s case, the National Bureau of Statistics (NBS) conducts the consumer confidence survey, and the index historically hovered above 100 for most of the 2000-2019 period (indicating overall optimism), even as it tracked cyclical ups and downs. There is evidence that Chinese consumer confidence correlates with key economic variables: a study used machine learning methods to forecast China’s CCI and found it is highly sensitive to shifts in commodity prices, financial conditions, and political developments [10]. It notes that consumer sentiment in China also interacts with stock market performance, hinting at a wealth effect on confidence [11].

2.3 Theoretical Basis

The concept of consumer confidence aligns with theories of consumption that emphasize expectations. In the Permanent Income Hypothesis and Life-Cycle Hypothesis, consumers base their spending not just on current income but on expected future resources. Survey-based confidence indices effectively capture these expectations-when consumers feel confident about future employment and income, they are more likely to spend (and vice versa). Therefore, CCI can be viewed as a summary measure of expected future economic conditions from the consumer’s perspective. A high CCI suggests optimism that often translates into higher consumption and lower saving rates, stimulating economic growth. Conversely, plunges in confidence can signal precautionary saving behavior and cutbacks in discretionary spending, potentially precipitating or exacerbating downturns.

2.4 Research Gap

While the importance of consumer confidence is well-recognized, few studies have explicitly examined the seasonal characteristics and long-run evolution of China’s CCI. Most existing analyses either take a cross-sectional or panel approach (comparing confidence effects across countries) or focus on short-term forecasting during specific episodes. The gap identified is a detailed time-series study of China's consumer confidence covering multiple business cycles. Furthermore, applying a Seasonal ARIMA model to this dataset is helpful for conducting a rigorous analyze both trend and seasonality-aspects that have been occasionally mentioned (for instance, seasonal upticks around Chinese New Year) but not formally modeled in prior research on consumer sentiment. By addressing this gap, the study contributes to a localized understanding of how consumer sentiment behaves in China's context, complementing broader findings from other economies. It also provides a methodological example of using classic time-series techniques (decomposition and SARIMA) to analyze survey-based economic indicators, which can be useful for practitioners and researchers interested in high-frequency indicators of economic health.

3 Methodology

This study utilizes publicly available data on China's Consumer Confidence Index (CCI) from Q1 2000 to Q4 2024. The CCI is compiled by the National Bureau of Statistics of China through monthly nationwide surveys of consumer sentiments which obtained the data from the OECD Main Economic Indicators database (consumer opinion surveys), with 100 as the neutral benchmark (equal optimism and pessimism). For further analysis, it converted the data to quarterly frequency by taking the arithmetic average of the three monthly CCI values in each calendar quarter. This aggregation yields a time series of 100 quarterly observations from 2000:Q1 through 2024:Q4. Table 1 presents a portion of the quarterly CCI dataset, illustrating its evolution over time.

Table 1. China Consumer Confidence Index (CCI), Quarterly Averages 2000–2024.

Year	Q1	Q2	Q3	Q4
2000	110.0	111.0	111.9	112.7
2001	113.1	113.6	113.9	113.3
2002	113.3	113.4	113.5	113.8
2003	114.0	102.3	107.7	110.5
2004	111.2	108.0	106.3	108.0
2005	109.3	109.7	109.9	109.5
2006	110.2	109.6	111.0	113.6
2007	112.8	112.4	113.4	112.7
2008	111.6	109.8	109.0	104.3
2009	100.8	100.6	102.5	103.3
2010	105.7	107.0	107.4	103.4
2011	104.0	106.3	104.1	100.4
2012	102.5	102.8	99.1	103.6
2013	104.5	101.8	98.3	100.7
2014	101.1	103.1	103.7	105.7
2015	107.1	107.7	106.4	104.2
2016	104.3	100.0	105.7	108.5
2017	110.3	112.9	115.4	122.6
2018	122.3	122.9	118.5	121.0
2019	123.7	124.9	123.0	126.6
2020	126.4	117.0	118.5	122.1
2021	123.3	121.5	118.2	119.7
2022	121.5	87.1	87.0	86.8
2023	93.6	87.2	86.7	87.5
2024	89.1	87.3	85.8	86.5

Table 1 shows that the CCI was consistently above 100 (optimistic) from 2000 until 2018, indicating Chinese consumers were largely confident during the high-growth years. Starting in 2019, the index shows increased volatility and, by 2022, plunges well below 100, reflecting a major sentiment shift that will be analyzed in the Results section.

It conducted a seasonal time-series analysis of China's Consumer Confidence Index (CCI) using quarterly data from 2000 to 2024 with R statistical software. The methodology followed five steps. First, exploratory analysis and Augmented Dickey-Fuller (ADF) tests assessed stationarity, confirming the need for differencing due to structural non-stationarity. Second, seasonal decomposition using STL separated trend, seasonal, and residual components, quantifying quarterly seasonal effects. Third, it employed the Box-Jenkins method to identify a Seasonal ARIMA model, guided by autocorrelation (ACF/PACF) plots and AIC criteria using R's auto.arima function. Fourth, the selected SARIMA model was estimated, and residual diagnostics, including Ljung-Box tests, confirmed no significant residual autocorrelation. Finally, it generated out-of-sample forecasts for four future quarters (2025Q-2025Q4) with 95% confidence intervals. The SARIMA approach, which captures trend non-stationarity and seasonal periodicity effectively, focuses solely on historical CCI data without exogenous variables. The analysis assumes past index values and inherent seasonality sufficiently predict future CCI movements.

4 Results

4.1 Seasonal Decomposition of CCI

Figure 1 presents the STL decomposition of the quarterly CCI series from 2000Q1 to 2024Q4 into its observed, trend, seasonal, and remainder components.

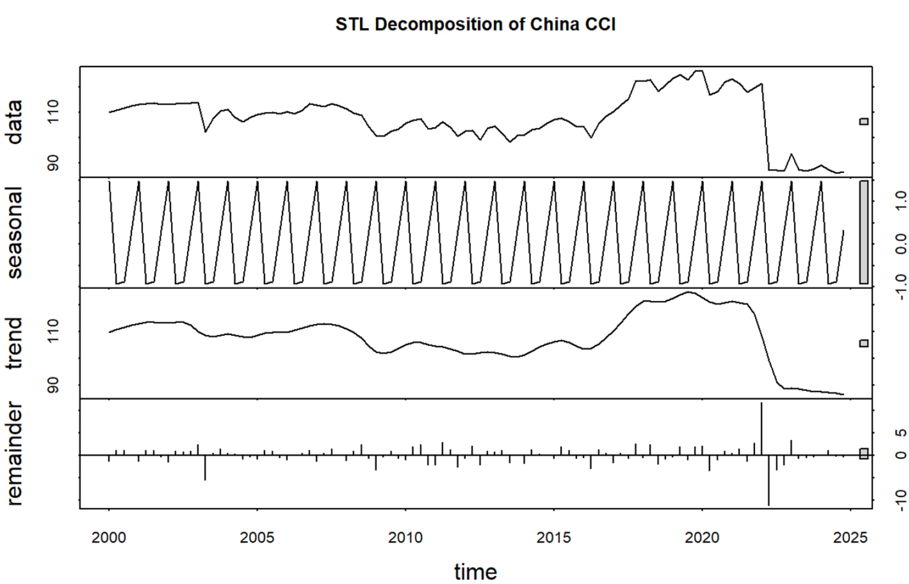

Fig.1. easonal decomposition of China's Consumer Confidence Index (CCI), 2000-2024.

The observed CCI (top panel) is split into a smooth trend-cycle (second panel), a recurring seasonal effect (third panel), and irregular residuals (bottom panel). The decomposition of China's Consumer Confidence Index (CCI) reveals clear insights into its trends and seasonal behavior from 2000-2024. Initially, consumer confidence followed an upward trajectory, peaking around 2007 before sharply declining during the 2008-2009 global financial crisis. Confidence recovered significantly during 2017-2019, reaching historic highs above 120, reflecting robust economic optimism. However, post-2019, a pronounced downward trend emerged, culminating in a dramatic fall in 2022. By 2024, the trend reached record lows in the mid-80s, indicating substantial consumer pessimism.

Seasonally, a recurring annual pattern is evident. The first quarter (Q1), coinciding with the Chinese New Year, consistently shows higher-than-average confidence (+1.37 index points). Conversely, mid-year quarters (Q2 and Q3) typically experience below-average confidence (–0.97 and –0.73 points, respectively), likely due to normalization after festive optimism or economic uncertainties during summer months. A slight recovery occurs in the fourth quarter (+0.33), possibly reflecting year-end optimism.

Residual fluctuations, especially during crises like SARS (2003) and COVID-19 lockdowns (2022), highlight significant irregular shocks not captured by seasonal or trend components alone, underscoring the importance of accounting for such exogenous events in forecasting models.

4.2 ARIMA Model Estimation

Based on the insights above, it is necessary to start fitting a Seasonal ARIMA model to the quarterly CCI series. Stationarity tests confirmed that the series is non-stationary in levels (ADF test statistic -1.87, $p = 0.63 > 0.05$), failing to reject the null of a unit root. However, the first difference of the series appears stationary (ADF test on CCI gave $p < 0.001$). Therefore, include one order of differencing (D=1) in the model.

Examining the differenced series' ACF and PACF suggested the following: the ACF of CCI showed a gradual decay with a notable spike at lag 4 (one year) and lag 8 (two years), hinting at some seasonal autocorrelation. The PACF had a minor spike at lag 1. These clues pointed toward including at least a seasonal MA term. See the figure 2 below.

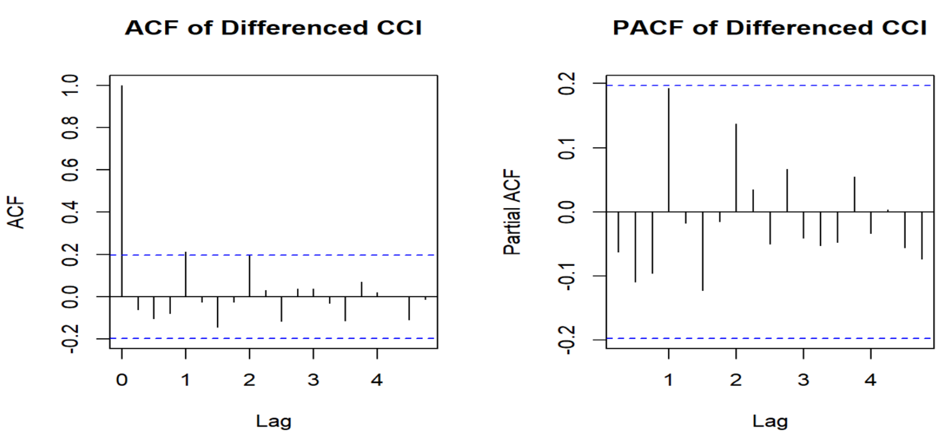

Fig.2. F and PACF of Differenced CCI.

Next, various model structures were tested using the AIC method. An initial automated search with auto.arima proposed a model of ARIMA(1,0,0) with a seasonal MA(2) at annual lag. Table 2 below shows the estimated parameters for the chosen SARIMA model:

Table 2. Estimated Seasonal ARIMA(1,0,0)(0,0,2)[4] Model for China's CCI (2000Q1-2024Q4).

Parameter	Estimate	Std. Error
AR(1)	0.8667	0.0514
SMA(1)	0.212	0.1031
SMA(2)	0.2163	0.0989
Mean	106.7895	4.1413

Ljung-Box Q-test for lag 4 gave Q(4)=0.795, p=0.977

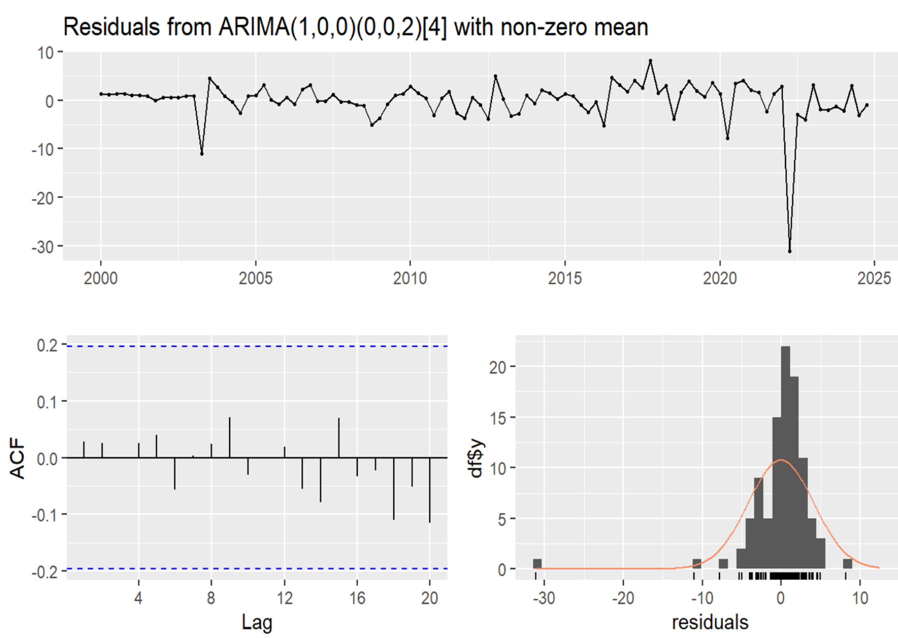

Fig.3. Model Diagnostic.

From Table 2, all estimated parameters-AR(1)=0.8667 (SE=0.0514), SMA(1)=0.2120 (SE=0.1031), SMA(2)=0.2163 (SE=0.0989), and mean=106.7895 (SE=4.1413)-are statistically significant. The large AR(1) coefficient reflects strong first-order persistence in quarterly changes, while the seasonal MA terms capture meaningful annual and biennial shock effects. The non-zero mean above 100 indicates, on average, consumer sentiment remains optimistic relative to the neutral benchmark. Diagnostic checks confirm the model's adequacy: Ljung-Box Q(4)=0.795 (p=0.977) fails to reject residual whiteness, and residuals approximate normality with only a few outliers tied to major events (for instance, SARS, COVID-19). Overall, the SARIMA(1,0,0)(0,0,2)[4] specification offers a parsimonious yet powerful fit, effectively modeling both immediate and seasonal dependencies in China's Consumer Confidence Index. Model diagnosis is presented in Figure 3.

4.3 Forecasting and Recent Developments

Using the above model, it generated forecasts for the next year (2025Q1 through 2025Q4) to get a sense of expected future sentiment if recent dynamics persist. Figure 4 illustrates the actual CCI through 2024 and the model's forecast for 2025, with 95% confidence intervals.

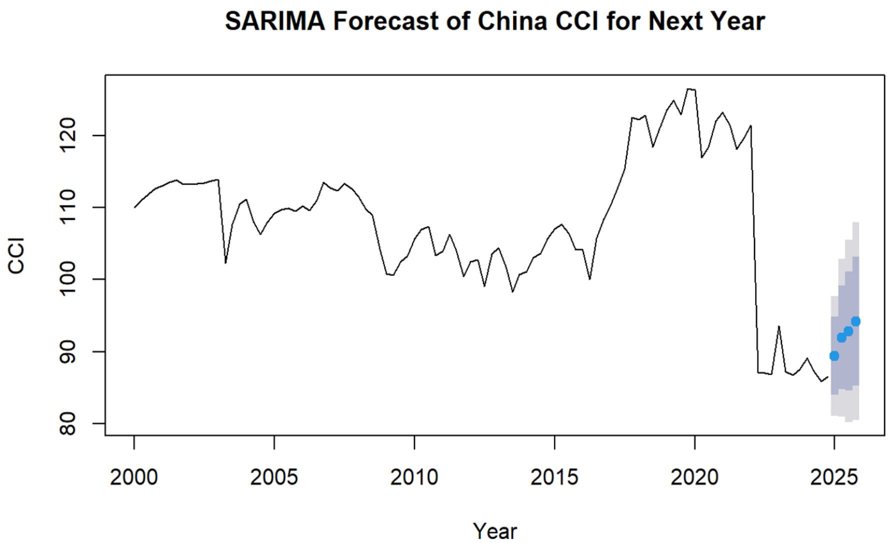

Fig.4. CCI actual values (2000-2024) and SARIMA forecast for 2025.

Applying the fitted SARIMA(1,0,0)(0,0,2)[4] model, the 2025 forecasts are:
Q1: 89.40 (80% CI: 83.96-94.83; 95% CI: 81.09-97.71)
Q2:91.93 (80% CI: 84.74-99.12; 95% CI: 80.93-102.93)
Q3: 92.84 (80% CI: 84.57-101.11; 95% CI: 80.19-105.49)
Q4: 94.21 (80% CI: 85.22-103.21; 95% CI: 80.45-107.97)
Despite a modest seasonal uptick (Q4-Q1 ≈ 4.8 points), all forecasts remain below the neutral 100 mark, signaling continued consumer pessimism. The 80% and 95% intervals

5 Discussion

Seasonal decomposition confirms a reliable Q1 confidence boost (linked to Chinese New Year) and mid-year dips, reflecting cultural and economic cycles. Trend analysis aligns with China's WTO entry, the 2003 SARS shock, the 2008–09 financial crisis, a 2017–19 optimism peak, and a dramatic 2022 collapse into the 80s. The SARIMA(1,0,0)(0,0,2) model-featuring AR1=0.867 and seasonal MAs of 0.212 and 0.216-captures both immediate persistence and annual shock effects, with diagnostics confirming no residual autocorrelation (Ljung-Box Q_4=0.795, p=0.977) and only modest departures from normality. Forecasts for 2025 (89.4-94.2) remain below the neutral 100 threshold, underscoring entrenched pessimism and high volatility ($\sigma^2 \approx 17.98$). Compared to multivariate machine-learning models, the univariate approach highlights the CCI's intrinsic unpredictability without external inputs. Policymakers should tackle underlying drags-youth unemployment, housing stress, weak safety nets-to rebuild confidence, while businesses can optimize marketing around seasonal peaks. Future work could integrate exogenous variables or regime-switching models to address structural breaks and improve forecast precision.

6 Conclusion

This study offers the first comprehensive seasonal ARIMA analysis of China's quarterly CCI from 2000 to 2024. It documented a consistent Q1-Q3-Q4 seasonal rhythm and traced major trend shifts, culminating in an unprecedented post-2020 decline. The SARIMA(1,0,0)(0,0,2) model fits the series well and projects continued mid-90s confidence in 2025, below the 100 neutral mark. These insights underscore the CCI's role as both an economic indicator and policy barometer. Restoring consumer sentiment will require targeted measures-stronger social safety nets, housing-market stabilization, and clear policy communication. By providing transparent R code and detailed methodology, the study lays the groundwork for future extensions that incorporate additional drivers or advanced time-series techniques, enhancing both forecasting and policy relevance.

References

1. Asian Development Bank. Economic Activity Index for the People's Republic of China. [pdf] Asian Bonds Online. (2025) https://asianbondsonline.adb.org/macroeconomictracker/pdf/PRC_data-info.pdf
2. X. Liu, Understanding consumer confidence evolution in response to adverse shocks and how marketing contributes to business success in economic downturns. Journal of Management Marketing and Logistics, **10**(3), 115-131. (2023) https://doi.org/10.17261/Pressacademia.2023.1818
3. C. Yang, China's middle class feels the squeeze as property slump hits pocketbooks. [online] South China Morning Post. (2025) https://www.scmp.com/economy/china-economy/article/3298995/chinas-middle-class-feels-squeeze-property-slump-hits-pocketbooks
4. T. Huang, How China's property slump is menacing its economy. Global Asia, **19**(4). (2024) https://www.globalasia.org/v19no4/feature/how-chinas-property-slump-is-menacing-its-economy_tianlei-huang
5. B. Desroches, M. A. Gosselin, The usefulness of consumer confidence indexes in the United States (No. 2002-22). Bank of Canada. (2002) https://doi.org/10.34989/swp-2002-22
6. T. U. Islam, M. N. Mumtaz, Consumer Confidence Index and Economic Growth: An Empirical Analysis of EU Countries. EuroEconomica, **35**(2). (2016) https://www.ceeol.com/search/article-detail?id=497994
7. J. Bram, S. C. Ludvigson, Does consumer confidence forecast household expenditure? A sentiment index horse race. Economic Policy Review, **4**(2). (1998) https://ideas.repec.org/p/fip/fednrp/9708.html
8. S. C. Ludvigson, Consumer confidence and consumer spending. Journal of Economic perspectives, **18**(2), 29-50. (2004) https://doi.org/10.1257/0895330041371222
9. M. Kuzmanovic, P. Sanfey, Can consumer confidence data predict real variables? Evidence from Croatia (No. 151). (2012) https://ideas.repec.org/p/ebd/wpaper/151.html

10. Y. C. Lin, B. Sung, S. D. Park, Integrated Systematic Framework for Forecasting China's Consumer Confidence: A Machine Learning Approach. Systems, **12**(11), 445. (2024) https://doi.org/10.3390/systems12110445
11. M. Leippold, Q. Wang, W. Zhou, Machine learning in the Chinese stock market. Journal of Financial Economics, **145**(2), 64-82. (2022) https://doi.org/10.1016/j.jfineco.2021.08.017