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SENTIMENT ANALYSIS OF CPEC ON TWITTER/X: PUBLIC OPINION TRENDS AND PREDICTORS OF SUPPORT

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Abstract

Purpose: *The China–Pakistan Economic Corridor (CPEC), a central component of China's Belt and Road Initiative (BRI), has generated extensive public debate across Pakistan and beyond. While earlier research has focused on economic, geopolitical, and media perspectives, limited empirical work has examined how public sentiment toward CPEC evolves in digital environments. This study analyzes public opinion trends regarding CPEC on Twitter/X using sentiment scoring and time-series analysis to identify patterns, fluctuations, and predictors of support.*

Methods: *The dataset consisted of 680,000 tweets collected via the Twitter Academic API between January 2020 and December 2023 using CPEC-related keywords. A mixed NLP approach was used, including VADER sentiment scoring and a fine-tuned BERT classifier. Sentiment polarity was aggregated over time and analyzed using ARIMA and Granger causality testing to identify event-driven trends. Predictive models, including logistic regression and random forest, examined linguistic and engagement-related predictors of sentiment.*

Results: *Findings show polarized sentiment distribution (positive 41%, negative 36%, neutral 23%) and event-driven fluctuations. Positive sentiment peaks aligned with government announcements and infrastructure milestones, while negative sentiment aligned with security incidents, debt concerns, and regional political tensions. Engagement-related features, including tweet visibility and verified status, predicted supportive sentiment, whereas negative sentiment was strongly associated with sovereignty and security discourse.*

Conclusion: *Public sentiment toward CPEC on Twitter/X is dynamic, polarized, and highly responsive to political and economic events. The results highlight the role of digital platforms in shaping public perception of national megaprojects and underscore the importance of transparent communication and inclusive public discourse. Future research should explore cross-platform analysis, multilingual sentiment models, and public engagement effects.*

Keywords: CPEC; Belt and Road Initiative; Sentiment analysis; Natural Language Processing; Twitter/X; Time-series analysis; Public opinion; Digital politics; Computational social science; Public policy communication

Introduction

The China–Pakistan Economic Corridor (CPEC) represents one of the most ambitious infrastructure and geo-economic cooperation initiatives within China's Belt and Road Initiative (BRI), designed to enhance regional connectivity, trade, and energy security across South and Central Asia (Small, 2015; Wolf, 2020). Encompassing major infrastructure investments including transport networks, energy projects, and industrial zones, CPEC has been portrayed by policymakers as a transformative project capable of revitalizing Pakistan's economy and reshaping regional geopolitics (Javaid, 2016; Husain, 2019). As the project progresses, public

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opinion has become increasingly important, influencing political support, media narratives, and policy decision-making.

Social media platforms—particularly Twitter/X—have emerged as critical spaces for shaping national discourse on political and development issues. Research shows that social media participation plays a central role in public agenda formation, opinion mobilization, and perception construction around large-scale national projects (Hermida, 2010; Castells, 2012). Digital platforms provide citizens with opportunities to express support, dissent, and debate in ways not always reflected in traditional media structures (Kwak et al., 2010). In Pakistan, where social media usage continues to grow rapidly, Twitter has become an influential arena for political communication and policy contestation (Ahmed & Skoric, 2014).

Sentiment analysis using natural language processing (NLP) has gained prominence as a methodological approach to understanding real-time public attitudes toward policy decisions, infrastructure projects, elections, and diplomatic events (Pang & Lee, 2008; Liu, 2012). Applying sentiment scoring and time-series analysis to social media data allows researchers to identify shifts in opinion, external influences such as economic events or political speeches, and predictors of public support or opposition (Pak & Paroubek, 2010; Bollen et al., 2011). Such computational approaches enable more dynamic insights than traditional survey research, particularly in highly politicized contexts.

Despite growing academic interest in CPEC, most existing studies focus on economic impact, geopolitical implications, or media representation in traditional press outlets (Pant, 2017; Wolf, 2020; Sial, 2018). Much less attention has been devoted to understanding public sentiment trends on digital platforms or measuring predictors of public support through large-scale social media analytics. Considering that online political narratives increasingly influence public debate and policymaking, the absence of computational studies leaves an important empirical gap.

Therefore, this research examines public sentiment toward CPEC on Twitter/X using NLP sentiment scoring and time-series analysis. The study identifies sentiment fluctuations over time, explores factors associated with positive or negative sentiment, and evaluates how major events—political decisions, diplomatic summits, or economic announcements—shape public attitudes. By integrating computational social science and political communication perspectives, this study contributes to understanding digital opinion dynamics surrounding national megaprojects and provides insights relevant for policymakers, media practitioners, and international relations analysts.

Literature Review

The China–Pakistan Economic Corridor (CPEC) has generated extensive scholarly interest due to its transformative economic potential and geopolitical implications within the broader Belt and Road Initiative (BRI) (Small, 2015; Wolf, 2020). Most existing research on CPEC has focused on economic outcomes, strategic cooperation, regional trade, and political tensions (Javaid, 2016; Pant, 2017; Ahmed, 2020). Studies have highlighted perceived developmental benefits such as infrastructure expansion, industrial growth, and energy security (Husain, 2019; Sial, 2018), but they have also pointed to concerns around debt sustainability, transparency, local inclusion, and security (Chaziza, 2020; Rana, 2018). While these works illustrate the contested nature of CPEC, they largely rely on policy analysis and traditional media discourse, leaving public sentiment and digital opinion trends underexplored (Adnan et al., 2019; Ahmad et al., 2021; Aslam, Ali, et al., 2020; Aslam et al., 2024; Aslam, Hayat, et al., 2020; Aslam & Ahmad, 2019a, 2019b; Faizullah et al., 2021; Hussain et al., 2021; Riaz et al., 2021).

Social media platforms have become critical environments for public opinion formation, political communication, and civic engagement (Castells, 2012; Hermida, 2010). Twitter/X, in

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particular, functions as a real-time forum where individuals, political actors, journalists, and institutions negotiate competing narratives around national issues (Kwak et al., 2010). Research demonstrates that sentiment expressed online can predict political behavior, financial trends, and major public reactions (Bollen, Mao, & Zeng, 2011). Public policy studies reveal that digital discussion influences public legitimacy and acceptance of megaprojects, shaping governmental decision-making and political support (Jungherr, 2015).

Sentiment analysis, an NLP-based computational method, has grown as a tool for analyzing large social media datasets to assess emotional polarity, attitude trends, and opinion distribution (Pang & Lee, 2008; Liu, 2012). Time-series sentiment research allows for longitudinal tracking of opinion changes and event-driven fluctuations (Pak & Paroubek, 2010). Previous work using sentiment analysis for public projects and international policy debates demonstrates its capacity to uncover underlying support dynamics, polarization, and factors influencing shifts in public sentiment (O'Connor, Balasubramanyan, Routledge, & Smith, 2010; Tsytsarau & Palpanas, 2012).

However, a review of CPEC scholarship indicates a notable gap: little research has utilized computational sentiment analysis to evaluate public opinion trends or identify predictors of support or opposition. While studies examine media framing and elite discourse (Hussain, 2019; Rafiq, 2020), public sentiment expressed through social media remains understudied. Considering that online platforms increasingly shape national development debates and public trust in government initiatives, understanding digital reactions to CPEC is critical for evaluating policy legitimacy and communication strategies.

Therefore, this study contributes to the literature by applying NLP-based sentiment scoring and time-series analysis to examine how public opinion about CPEC evolves over time and identify empirical predictors of sentiment patterns linked to political, economic, and diplomatic events.

Research Questions & Hypotheses

Research Questions

RQ1: What is the overall sentiment trend toward CPEC expressed by users on Twitter/X during the selected study period?

RQ2: How do major political, economic, and diplomatic events influence changes in public sentiment about CPEC over time?

RQ3: What linguistic, thematic, or engagement-based features predict positive or negative sentiment toward CPEC on Twitter/X?

RQ4: Are there identifiable time-series patterns that correspond to key national or regional developments related to CPEC?

Hypotheses

H1: The majority of sentiment expressed toward CPEC on Twitter/X will be polarized, with clear fluctuations corresponding to major political or economic events.

H2: Tweets during periods of governmental announcements, diplomatic meetings, or project inauguration events will demonstrate significantly more positive sentiment compared to periods of controversy or political conflict.

H3: Engagement features (likes, retweets, follower count) will positively predict supportive sentiment toward CPEC.

H4: Negative sentiment will be associated more strongly with topics related to sovereignty disputes, debt concerns, and security incidents than with infrastructure or economic themes.

H5: Time-series sentiment patterns will show measurable correlations between event-driven peaks and sentiment polarity scores.

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Methodology

Research Design

This study employs a computational quantitative research design using Natural Language Processing (NLP) sentiment analysis and time-series modeling to examine public opinion trends regarding the China–Pakistan Economic Corridor (CPEC) on Twitter/X. Quantitative sentiment analysis enables large-scale measurement of polarity and emotional tone within textual data (Pang & Lee, 2008; Liu, 2012), while time-series analysis supports the identification of temporal changes and event-based fluctuations in public sentiment (Bollen et al., 2011; Tsytsarau & Palpanas, 2012). This design is suitable for analyzing real-time public discourse and predictors of support or opposition expressed through social media.

Data Collection

Tweets were collected using the Twitter Academic API during the period January 2020 to December 2023**,** covering major political and diplomatic events associated with CPEC. The following keywords and hashtags were used for data retrieval:

CPEC, *#CPEC*, *China Pakistan Economic Corridor*, *Gwadar*, *BRI*, *Belt and Road*, *Pak-China Friendship*, *CPEC Investment*, *CPEC Jobs*, *CPEC Security*, *CPEC Debt.*

The initial dataset included approximately 1.2 million tweets, filtered using the following criteria:

- Language: English and Urdu (translated using Google Translate API for consistency)
- Exclusion of spam and bot-generated content through threshold filters on retweet ratios, duplicate text, and abnormal posting frequency
- Removal of advertisements, commercial promotions, and irrelevant content based on keyword context

After cleaning and preprocessing, a final dataset of 680,000 tweets was used for analysis.

Data Preprocessing

Text preprocessing included:

- Tokenization and lemmatization
- Stop-word removal
- Hashtag normalization
- Removal of URLs, emojis, and special characters
- Urdu text transliteration to Roman Urdu where necessary

Preprocessing followed standard NLP procedures, enabling improved sentiment scoring accuracy (Liu, 2012).

Sentiment Analysis Procedure

A combined lexicon-based and machine-learning approach was used:

1. Lexicon-based scoring using VADER sentiment analysis is suited for short social media texts (Hutto & Gilbert, 2014).
2. Machine-learning classification with a pretrained transformer model BERT fine-tuned on sentiment-labelled datasets for improved contextual interpretation.
3. Tweets were scored on a polarity scale ranging from −1 (strongly negative) to +1 (strongly positive), producing three sentiment categories:
    - Positive sentiment (score ≥ 0.05)
    - Neutral sentiment (between −0.05 and 0.05)
    - Negative sentiment (≤ −0.05)

Sentiment values were aggregated by day and week for time-series modeling.

Time-Series Analysis

Time-series evaluation was conducted to identify trends and peaks associated with major events. Analytical methods included:

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- ARIMA and VAR models for trend estimation and event-based forecasting
- Granger Causality Test to identify whether major events predict sentiment shifts
- Peak detection algorithms to capture sentiment spikes around political announcements, diplomatic summits, protests, or violence

External event variables were coded manually based on verified news timelines and government announcements.

Predictive Modeling

To identify predictors of sentiment polarity, the following tweet-level features were included in regression modeling:

- Likes, retweets, hashtags count, follower count, presence of images/videos
- Linguistic features (length, topic keywords)
- Account type (verified vs. non-verified)

Machine-learning models (logistic regression and random forest) were used to analyze predictors of support vs. opposition.

Ethical Considerations

As the dataset is publicly available, no confidential information was accessed. All tweets were anonymized, and no user identification or profile analysis was conducted beyond publicly accessible metadata. The study follows digital research ethics emphasizing privacy protection and non-harm (Townsend & Wallace, 2016).

Limitations

The study acknowledges limitations, including:

- Dependence on Twitter users, excluding populations without social media access
- Potential influence of bots despite filtering procedures
- Language variation affecting Urdu-Roman Urdu NLP accuracy
- Limited ability to measure political persuasion effects or sentiment authenticity

Results

Sentiment Distribution Overview

Analysis of 680,000 tweets collected between January 2020 and December 2023 revealed a **polarized sentiment landscape** surrounding CPEC. Overall sentiment polarity scores indicated the following distribution:

Sentiment Category	Percentage of Tweets
Positive	41%
Negative	36%
Neutral	23%

These results suggest that public discourse about CPEC on Twitter/X is neither uniformly supportive nor dismissive, but reflects strongly divided public opinion. Positive tweets frequently referenced economic development, employment potential, and strategic partnership with China, whereas negative tweets were associated with corruption allegations, debt concerns, security tensions, and issues related to provincial inequality.

Time-Series Sentiment Trends

Time-series analysis demonstrated clear fluctuations in sentiment corresponding to major national and regional events**.** Periods associated with government inaugurations, investment announcements, or diplomatic visits show visible peaks in positive sentiment, such as the inauguration of Gwadar Free Zone Phase II and high-level Pakistan-China strategic dialogues. Conversely, significant declines in sentiment were observed during security incidents, protests against land acquisition, and parliamentary debates surrounding CPEC debt and transparency.

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Negative sentiment spikes also corresponded with India-Pakistan confrontations, border tensions, and political instability.

Sentiment patterns displayed seasonal variation, with the highest volume of tweets occurring around national budget discussions and development summit periods.

Event Impact Analysis

ARIMA and Granger causality analysis confirmed that major political and economic announcements significantly predicted changes in sentiment polarity ($p < .05$). Positive peaks were strongly associated with:

- Investment declarations
- SEZ development announcements
- Diplomatic engagements with China

Negative peaks were linked to:

- Security incidents in Balochistan
- Criticism relating to debt sustainability
- International media controversies regarding BRI

These findings support the claim that public opinion is event-responsive and externally triggered rather than stable.

Predictors of Support: Regression & Machine Learning Findings

Regression and random forest modeling were used to identify features predicting sentiment polarity. The strongest predictors of positive sentiment included:

- Higher tweet engagement (likes and retweets)
- Verified account status
- Use of economic or development-related keywords (e.g., *investment*, *progress*, *employment*)
- Tweets containing images or videos

Predictors of negative sentiment included:

- Keywords related to *debt*, *corruption*, *security*, *sovereignty*, and *Balochistan*
- Higher tweet length and detailed critique
- Tweets associated with journalists and political activists

Engagement metrics showed a statistically significant positive association with supportive sentiment ($\beta = .63$, $p < .01$), supporting H3, whereas negative sentiment showed a stronger association with security and sovereignty themes ($\beta = -.72$, $p < .001$), supporting H4.

Episodic vs. Sustained Sentiment Dynamics

Findings demonstrate that sentiment shifts were primarily episodic and event-driven, confirming H1 and H2. Peaks in polarity were short-lived, indicating rapid volatility rather than persistent long-term trends. Sustained sentiment change was observed only during extended periods of political uncertainty or prolonged diplomatic negotiations.

Summary of Key Results

- CPEC sentiment on Twitter/X is highly polarized rather than neutral.
- Opinion trends are strongly influenced by political, economic, and security events.
- Positive sentiment aligns with development-oriented messaging, while negative sentiment aligns with critique of governance, sovereignty, and security.
- Sentiment shifts are short-term and event-triggered, supporting time-series modeling predictions.
- Engagement metrics and account type significantly predict supportive sentiment patterns.

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These findings reveal the central role of digital platforms in shaping and reflecting public attitudes toward megaprojects and provide valuable insight into opinion dynamics surrounding large-scale geopolitical initiatives.

Discussion

The results of this study provide insight into how public sentiment toward the China–Pakistan Economic Corridor (CPEC) evolves within digital environments and how social media users construct and negotiate narratives around national megaprojects. The findings confirm that sentiment on Twitter/X is highly polarized, reflecting a complex mix of optimism and skepticism surrounding CPEC's progress and implications. This supports prior scholarship emphasizing that megaprojects such as CPEC generate both strong expectations of development and concerns around economic dependency, transparency, and geopolitical consequences (Husain, 2019; Chaziza, 2020; Wolf, 2020).

The study demonstrates that sentiment trends are event-driven, with noticeable peaks aligned to major governmental announcements, diplomatic engagements, and infrastructural milestones. This aligns with earlier research showing that digital public opinion responds rapidly to political events and media triggers (Bollen et al., 2011; O'Connor et al., 2010). Likewise, negative sentiment spikes correspond to periods of political instability, security incidents, and controversies over debt burden and regional disputes—consistent with arguments that CPEC has been framed in contested ways within political communication landscapes (Pant, 2017; Rana, 2018).

The strong predictive power of engagement features, such as likes and retweets, indicates that supportive sentiment toward CPEC is amplified by influential accounts and high-visibility content. This aligns with social media diffusion theory, suggesting that emotional and mobilizing messages spread more rapidly than neutral or rational ones (Castells, 2012; Hermida, 2010). Conversely, tweets expressing critique tended to include policy-oriented language and were more frequently produced by journalists, activists, and political commentators, reinforcing earlier findings that opinion leadership shapes the direction of online policy debates (Jungherr, 2015).

The prominence of economic-development keywords in positive sentiment and security-related themes in negative sentiment reflects the broader regional geopolitical discourse about CPEC. While government communication has framed CPEC as a symbol of economic progress and national modernization (Sial, 2018; Ahmed, 2020), counter-narratives highlight debt risk, sovereignty, and the militarization of development (Pant, 2017; Chaziza, 2020). The results thus support the argument that digital platforms function as arenas of ideological conflict, where competing narratives attempt to shape political legitimacy and public support.

Furthermore, the episodic and short-lived nature of sentiment shifts aligns with Iyengar's (1991) theory of event-driven political attention cycles. Rather than sustained debate, public conversation around CPEC is characterized by reactive patterns, indicating that digital opinion may be shaped more by media agenda and political communication timing than by long-term public evaluation.

Finally, the study highlights the critical gap in the representation of local and marginalized communities. As with traditional media analyses (Rafiq, 2020; Hussain, 2019), social media discourse was dominated by elite actors, with citizen-level voices limited. This raises concerns about whether online platforms broaden participation or simply reproduce existing power hierarchies.

Conclusion

This research contributes to computational political communication and CPEC scholarship by providing empirical evidence of sentiment trends and predictors of support using NLP-based

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sentiment scoring and time-series modeling. The study demonstrates that public opinion about CPEC on Twitter/X is highly polarized and significantly shaped by political and economic events, confirming the role of digital communication in shaping perceptions of national development projects.

Findings reveal that while supportive sentiment is driven largely by economic optimism and government messaging, negative sentiment centers on issues of transparency, security, and political conflict. Sentiment fluctuations are short-term and event-responsive, indicating that digital opinion around CPEC may be volatile rather than firmly established. Engagement metrics predict positive sentiment amplification, while policy-oriented critique is more likely to come from journalists and activists.

The study offers several implications. For policymakers, the results underscore the importance of transparent and strategic digital communication when addressing public concerns. For media and civil society, findings highlight the need for more diverse and inclusive discussions about megaproject outcomes. For scholars, the research demonstrates the value of computational approaches for understanding real-time public attitudes about development and geopolitics.

Future research should expand to multilingual datasets, incorporate network analysis of influencer clusters, and examine cross-platform differences between Twitter/X, Facebook, TikTok, and YouTube. Combining computational sentiment analysis with qualitative discourse analysis may provide deeper insight into narrative framing and ideological polarization surrounding CPEC. Ultimately, this work reinforces that CPEC is not merely an infrastructural initiative but a contested public narrative shaped by evolving digital opinion and event-driven sentiment dynamics.

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