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Comparative Analysis of Quantum Technology Policies in the United States and China: Strategic Directions and Philosophical Foundations

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Abstract

Quantum technology, a critical 21st-century strategic frontier science, has been a key technological competition between China and the U.S. This study employs natural language processing (NLP) techniques and a technology analytical framework to analyze the quantum technology policies of both countries. While the U.S. emphasized free-market innovation and global technological leadership on quantum technology from 2018 to 2024, China prioritized government-led development and socioeconomic stability. Moreover, the Chinese government adopts a systematic top-down approach characterized by government planning and direct intervention. However, the U.S. fosters innovation through market mechanisms and industry-academia collaboration. U.S. policies have gradually shifted from pure technological innovation to national security considerations. On the other hand, China has moved from breakthrough research to industrial deployment and application. These policy differences reflect distinct political systems and governance models, which may also resonate with their respective cultural traditions and philosophical foundations. Our findings fill a critical gap in comparative quantum technology policy research, offering significant insights for policymakers, researchers, and international stakeholders.

Keywords: quantum technology policy; China–U.S. comparison; natural language processing; philosophy of technology; policy analysis

1. Introduction

1.1. Research Background

Quantum technology, a pivotal 21st-century frontier, has transformed global scientific and technological innovation [1,2]. This technology encompasses quantum computing, communication, and sensing. It has also revolutionized computational paradigms and communication security, potentially driving a new industrial revolution [3–5]. Moreover, recent research highlights the convergence of quantum technology with digital twins, such as in healthcare IoT systems, demonstrating its expanding application potential. The strategic significance of quantum technology is becoming increasingly evident as traditional integrated circuit technologies reach their limits [6–10].

The U.S. is a leader in quantum computing investment due to its strong foundation in fundamental research and innovation ecosystems [11,12]. China has achieved notable breakthroughs in quantum communication [13–15]. While both countries allocate

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substantial resources to quantum advancements, their policy orientations and strategies differ significantly [16–18]. Quantum computing is rapidly advancing towards demonstrating "quantum advantage" [19,20], while the parallel progress in quantum communication networks promises improved security for future information systems [21–23]. Grasping the policy differences between China and the U.S. is essential, as these disparities significantly impact the global development of quantum technologies and shape international cooperation.

This study develops three core questions:

(1) What are the key differences between China and the U.S. in the quantum technology policy objectives and implementation strategies?
(2) How might these policy approaches be interpreted through the lens of political institutions and cultural philosophical perspectives?
(3) How do these differences shape future international cooperation and technological competition?

This study addresses these questions by offering valuable insights into global quantum technology governance and international collaboration. These questions extend beyond technological development, as quantum technology will influence international relations and global governance structures. Understanding these policy differences is vital for anticipating the technological trends of other nations.

1.2. Research Status

The U.S. has employed the National Quantum Initiative Act to support quantum technology development, fund fundamental research, talent cultivation, and the construction of a quantum ecosystem [24]. Additionally, the U.S. leverages market-driven mechanisms and multi-stakeholder collaboration to advance quantum technology. However, researchers have gradually shifted towards evaluating quantum technology policy implementation to balance academic research and industrial commercialization [25].

Leading companies like IBM and Google have significantly progressed in qubit development and quantum computing cloud platforms. Previous studies have also analyzed the impact of U.S. quantum computing policies on the global competitive landscape, focusing on key areas such as the commercialization potential of quantum algorithms, commercialization, and intellectual property protection [26–28].

On the contrary, China's quantum technology policy places more emphasis on government-led initiatives. China has developed a hybrid approach that combines top-down governance with region-specific adaptation using national-level strategic planning, such as the Quantum Science and Technology Development Plan [29]. Anhui Quantum Innovation Center is a notable policy-driven industrialization, a government initiative model that facilitates the commercialization of quantum technology [30]. China has recently made significant breakthroughs in quantum communication, with projects like the Micius quantum satellite and the Beijing–Shanghai quantum communication network becoming focal points of international academic research [31]. China also emphasizes the industrialization of quantum technology, integrating socioeconomic impact into long-term development [32].

However, existing studies exhibit significant gaps, lacking systematic comparative studies on U.S. and Chinese quantum technology policies. Existing research also relies primarily on traditional qualitative analysis methods, limiting the use of quantitative data analysis. Therefore, integrating quantitative data analysis with qualitative insights would enhance the robustness and comprehensiveness of research on quantum technology policies. By integrating quantitative and qualitative analytical methods, this research con-

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tributes to a more comprehensive understanding of global quantum technology governance in the U.S. and China.

1.3. Research Objectives and Methods

A systematic comparative analysis was conducted to uncover the core differences in quantum technology policies between China and the U.S. and provide valuable theoretical insights for global quantum technology governance. We employ natural language processing (NLP) to integrate quantitative and qualitative techniques for analyzing U.S. and Chinese quantum technology policies. Keyword extraction and frequency analysis are used in quantitative techniques to identify core concepts within policy documents. Sentiment analysis reveals the emotional tone and attitudinal orientation of policy language. Moreover, time-series analysis tracks key policy priorities' evolution over time. These analytical methods provide robust empirical support for scientific rigor and objectivity.

We also use qualitative analysis to construct an analytical, technological framework within a broader cultural and societal context, focusing on the philosophical foundations of policy decisions. Therefore, fundamental differences in technological development philosophies and governance models are explored between the two countries based on the impact of U.S. Protestant ethics and Confucian thought on China's technology policies.

The study's key contributions are as follows:

First, modern data analysis is integrated with traditional policy research, establishing a more systematic and objective framework for policy comparison, enhancing scientific rigor, and providing a new analytical paradigm for future policy studies.

Second, we establish a comprehensive comparative framework by examining policy objectives, implementation pathways, and resource allocation mechanisms.

Finally, this study offers a diversified perspective on global quantum technology governance through an in-depth analysis of China and the U.S. This framework provides valuable insights into how various governance models coexist. The findings offer practical policy references for other nations for formulating quantum technology strategies, fostering international cooperation, and balancing technological development.

2. Data and Methods

2.1. Data Sources

A comprehensive analysis was conducted on 124 policy documents covering the U.S. and China's quantum technology policies from 2018 to 2024. These documents include national-level strategic plans, local government implementation schemes, and think tank research reports. All records were sourced from official channels or highly credible think tanks to enhance data comprehensiveness and representativeness. These documents were categorized by theme to facilitate a structured and systematic analysis.

The U.S. National Quantum Initiative Act of 2018 established the overall framework for quantum technology development. Annual reports released by the White House Office of Science and Technology Policy also provide detailed records of the implementation process of the National Quantum Initiative. Many policy documents on quantum technology development were also collected from key states like California, New York, and Illinois. These documents, sourced from official state government websites and publicly available policy reports, reflect regional strategies for advancing quantum research and commercialization. Additionally, strategic research reports are sourced from renowned think tanks such as RAND Corporation (Santa Monica, CA, USA) and McKinsey & Company (New York, NY, USA).

The Chinese Ministry of Science and Technology issued national-level policy documents such as the Quantum Science and Technology Development Plan and the Quantum

Information Technology Special Plan of the 14th Five-Year Plan. These documents form the top-level design framework for China's quantum technology development. We also delve into key local regions that delve into quantum technology innovation, specifically highlighting Hefei, home to the National Quantum Innovation Center, Beijing, Shanghai, and Guangdong. The analysis includes policy documents from official government websites and bulletins detailing regional development strategies and supportive initiatives. We also incorporate research reports from prominent institutions like the Chinese Academy of Sciences and the China Center for Information Industry Development Think Tank. These reports provide specialized insights into China's quantum technology policies and their implementation outcomes.

The following rigorous document selection process was adopted to enhance the data integrity of quantum technology policies in China and the U.S.:

1. All policy documents are sourced from government agencies or authoritative institutions.
2. Priority is given to reports published by government-affiliated organizations or institutions with high academic credibility.
3. A cross-verification approach was applied to ensure accuracy and consistency across multiple sources.

2.2. Data Processing

A structured data processing workflow comprises three key stages: text cleaning, direct-source language processing, and structured annotation to enhance data consistency and reliability.

For text cleaning, a systematic approach was adopted to standardize and refine policy texts. Redundant symbols and formatting inconsistencies were corrected. Moreover, non-policy content, such as headers, footers, and Reference Sections, was removed to enhance textual clarity. Manual verification was conducted to ensure the accuracy and completeness of the cleaned dataset.

To eliminate translation bias, we adopted a direct-source language processing approach. Sentiment analysis was conducted directly on the original Chinese texts, ensuring that the implicit political connotations and rhetorical nuances were maximally preserved. Policy documents were categorized into national-level policies, local government initiatives, and supporting documents like think tank reports. Key policy dimensions, like objectives, implementation strategies, and technological focus, were annotated following a standardized framework. Two researchers applied a dual-layer annotation mechanism to ensure consistency and mitigate bias. Transforming unstructured policy texts into structured, analyzable data enhances data reliability and reproducibility. Complete backups of all original documents were maintained for verification and cross-checking, further reinforcing the research's credibility.

2.3. Analytical Methods

A mixed-methods approach, combining quantitative and qualitative methods, was adopted to comprehensively understand U.S.–China quantum technology policies.

(a) Quantitative Analysis

To ensure a systematic and objective comparison of the policy landscapes, we employed a Natural Language Processing (NLP) framework to process the corpus. First, word frequency analysis was conducted on the tokenized texts to detect initial thematic divergences between U.S. and Chinese policies. To mitigate the influence of high-frequency stop words and identify technically significant keywords, we applied the Term Frequency-Inverse Document Frequency (TF-IDF) weighting scheme [33]. TF-IDF evaluates the

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importance of a term t within a document d relative to the entire corpus D, defined mathematically as:

$$w_{t,d} = tf(t,d) \times log\left(\frac{N}{df_t}\right)$$

where $tf(t,d)$ is the frequency of term t in document d, N is the total number of documents, and df_t denotes the number of documents containing term t. This transformation highlights policy-specific terminology while suppressing common vocabulary.

Subsequently, sentiment analysis was performed to gauge the tonal stance of the policy narratives. To overcome the limitations of lexicon-based tools in analyzing formal policy discourse and cross-lingual nuances, we adopted a state-of-the-art Large Language Model (GPT-4o-mini) for sentiment scoring. The model was prompted to evaluate the strategic sentiment of each document on a continuous scale from −1.0 (highly defensive/negative) to 1.0 (highly cooperative/positive).

Finally, to move beyond surface-level word frequencies and explore the deep semantic structures of policy themes, we employed Latent Dirichlet Allocation (LDA) [34]. LDA is a generative probabilistic model used to identify latent topics within a large collection of discrete data, such as text documents. By treating each document as a mixture of various topics and each topic as a distribution over words, LDA allows for the identification of thematic clusters that characterize the policy focus of China and the U.S. This method directly addresses the need for a more nuanced understanding of the strategic narratives and hidden priorities that simple frequency counts might overlook.

(b) Temporal Analysis and Policy Evolution Trends

Time-series analysis was employed to track the evolution of quantum technology policies from 2018 to 2024. Sentiment analysis results were used to map shifts in policy tone, such as optimistic, cautious, or neutral. Comparative trend graphs visualize the development of policy focus and sentiment dynamics over time.

(c) Qualitative Analysis

The Philosophy of Technology framework was adopted to interpret U.S. and Chinese policy orientations. This qualitative approach explores the cultural and ideological foundations shaping policy strategies. Technological sublimity was also used to examine how quantum technology was framed as a breakthrough in policy discourse, reflecting national goals of power, security, and global influence.

(d) Key Contributions

The analysis of keyword distribution underscores the policy priorities of various countries, while sentiment trends reflect the underlying attitudes in policy formulation. By investigating the temporal evolution of policies, we highlight emerging trends and shifts in strategic priorities over time. Blending quantitative and qualitative methods offers a comprehensive view of the similarities and differences in quantum technology policies between the U.S. and China, shedding light on their national governance models and technological focuses.

3. Results

3.1. Quantitative Analysis Results

(a) Keyword Analysis

We applied the TF-IDF algorithm to extract high-weight keywords. This method allows for a robust comparison of strategic priorities by weighing terms based on their uniqueness and importance across the corpus. Table 1 presents the top 10 keywords for both nations, ranked by their TF-IDF scores and supplemented by their normalized usage frequency.

Table 1. Comparative Analysis of Top 10 Keywords in Quantum Technology Policies.

China Keyword (EN)	Original (CN)	TF-IDF	Norm. Freq.	U.S. Keyword	TF-IDF	Norm. Freq.
Quantum	量子	0.295	3.09%	Quantum	0.262	1.78%
Technology	技术	0.241	2.66%	Government	0.211	1.55%
Research	研究	0.149	1.80%	Research	0.176	1.25%
Quantum Comm.	量子通信	0.125	0.92%	Organization	0.085	0.73%
Product	产品	0.118	0.95%	Quantum Security	0.073	1.23%
Quantum Computing	量子计算	0.101	1.06%	Investment	0.067	0.44%
Development	发展	0.093	1.14%	Technology	0.063	0.40%
Quantum Measure.	量子测量	0.092	0.71%	QIS	0.060	0.23%
Application	应用	0.089	1.14%	Information	0.052	0.36%
Quantum Security	量子安全	0.085	0.62%	Technologies	0.051	0.20%

For Chinese policy texts, the analysis reveals a structured framework heavily oriented towards industrial application. The term "Quantum" (TF-IDF = 0.2951) dominates the discourse, followed by specific sub-fields such as "Quantum Comm." (Rank 4), "Quantum Computing" (Rank 6), and "Quantum Measure." (Rank 8). This distribution highlights a comprehensive strategy covering the full spectrum of quantum technologies. Notably, the high ranking of terms like "Product" (Rank 5) and "Application" (Rank 9) underscores China's distinctive emphasis on translating research into commercial products and practical deployment.

In contrast, the U.S. policy discourse is characterized by a top-down focus on governance and security. The list is led by "Government" (TF-IDF = 0.2114) and "Research" (Rank 3), reflecting the federal role in orchestrating a national R&D ecosystem. A critical divergence is observed in the prominence of "Quantum Security" (Rank 5) and "Investment" (Rank 6), which appear significantly higher in the U.S. hierarchy than in China's. This indicates that U.S. policy is primarily driven by national security concerns and the strategic mobilization of financial resources to maintain global competitiveness, whereas China focuses more on the technical realization and industrial output.

As visualized in Figure 1, the log-odds analysis reveals a distinct strategic dichotomy. The U.S. exhibits a strong positive bias towards "Quantum Security" (Log-Odds > 2.0) and "Government," reinforcing its security-centric approach. Conversely, China shows a strong negative log-odds ratio for "Quantum Communication" and "Market," confirming its prioritization of industrial deployment.

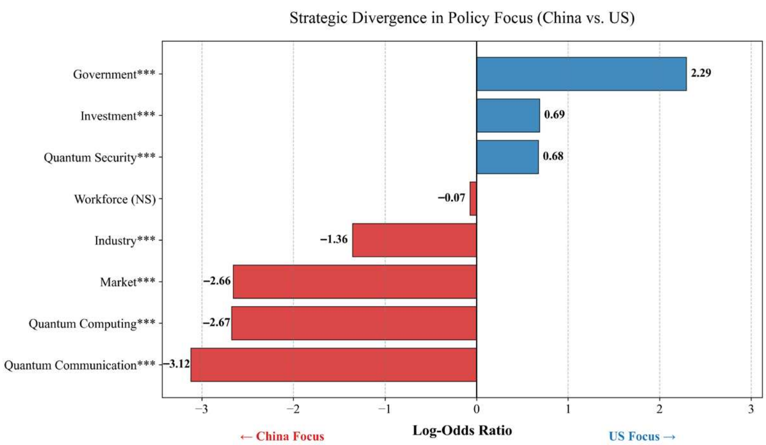

Figure 1. Log-Odds Ratio Analysis of Key Policy Terms. *** indicates $p < 0.001$.

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(b) Technological Pathway Differences

While Table 1 presents the top 10 keywords, an analysis of the top 20 terms reveals further distinct technological pathways. The U.S. emphasizes quantum hardware development, particularly "quantum qubits," reflecting quantum computing infrastructure. However, China prioritizes "encryption" and "network," emphasizing quantum communication and cryptographic security.

Additionally, the U.S. frequently references think tanks like "McKinsey" and "RAND," indicating reliance on expert analysis in policy formulation. In contrast, Chinese policies emphasize terms like "领域" (domain) and "实现" (realization), reflecting a holistic and goal-oriented policy approach. These keyword trends underscore fundamental differences in policymaking. China adopts a systematic, state-led approach that prioritizes large-scale deployment and industrialization.

The U.S. adopts a balanced strategy integrating national security with market-driven investments, incorporating multiple stakeholders. These findings provide insights into how China and the U.S. define quantum technology development strategies, with implications for global technological competition and governance models.

(c) Sentiment Analysis

Sentiment analysis of policy texts reveals key differences in language tone and strategic intent (Figures 2–4). The average sentiment score in China is 0.800, with 96.2% of texts exhibiting a positive sentiment. Policies emphasize cooperation, mutual benefit, and coordinated development, reflecting a consistent, optimistic discourse to foster technological growth and national unity. However, the U.S. average sentiment score is 0.758, with 93.1% of texts showing positive sentiment, while 5.6% exhibit negative sentiment. These sentiment differences stem from distinct policy traditions: China favors consensus-building and clear strategic direction, reinforcing positive messaging to guide national development. The U.S. employs a multifaceted policy discourse, integrating optimism about technological advancements. While sentiment variations are stylistic rather than substantive, they reflect differing communication strategies in national policy frameworks. What is more, to ensure the reliability of the AI-generated scores, we implemented a human-in-the-loop validation process. A subset of documents was manually annotated by domain experts, achieving a strong inter-annotator agreement (Pearson's $r > 0.85$), confirming the model's accuracy in capturing policy tone.

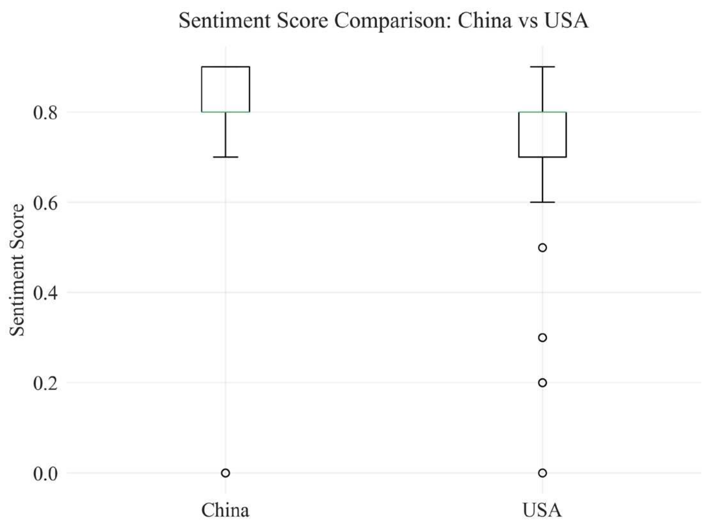

Figure 2. Sentiment Score Comparison: China vs. USA in Quantum Technology Policies.

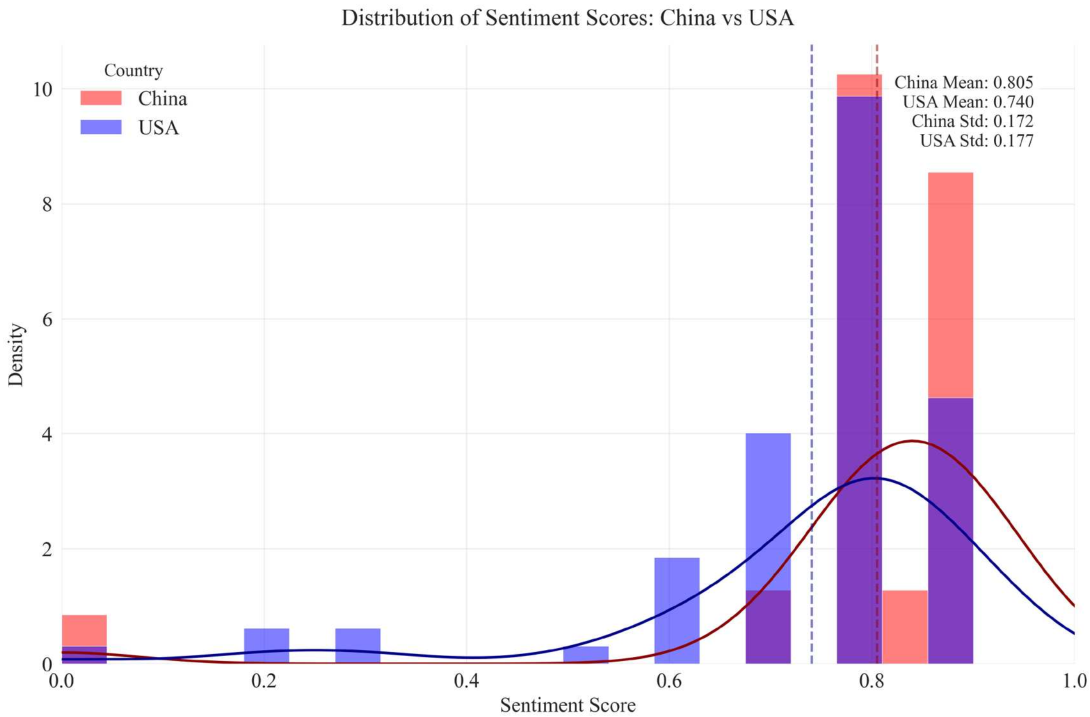

Figure 3. Distribution of Sentiment Scores: China vs. USA in Quantum Technology Policies. The red and blue curves represent the kernel density estimates (KDE) of sentiment scores for China and the USA, respectively, illustrating the probability distribution of emotional tone in quantum technology policy texts. Higher peaks indicate more frequent sentiment values, while the spread reflects variability in emotional expression. The vertical red and blue dashed lines indicate the mean sentiment scores for China (0.805) and the USA (0.740), respectively, highlighting the central tendency of emotional tone in their quantum technology policy texts.

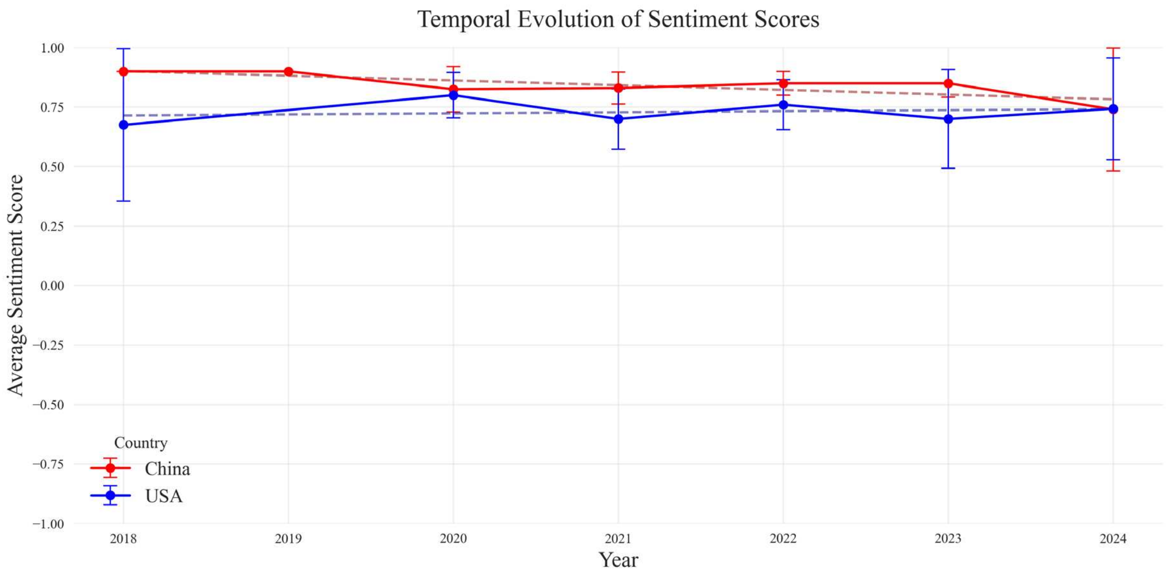

Figure 4. Comparative Sentiment Distribution Between U.S. and Chinese Policies. The horizontal red and blue dashed lines represent the overall mean sentiment scores for China and the USA, respectively, serving as reference baselines to assess year-to-year fluctuations in emotional tone.

(d) Time Series Analysis

A time-series analysis of quantum technology policy keywords from 2018 to 2024 in China and the U.S. reveals significant shifts in national priorities (Figures 5–8). However, the trajectories of policy evolution in the two countries diverge significantly.

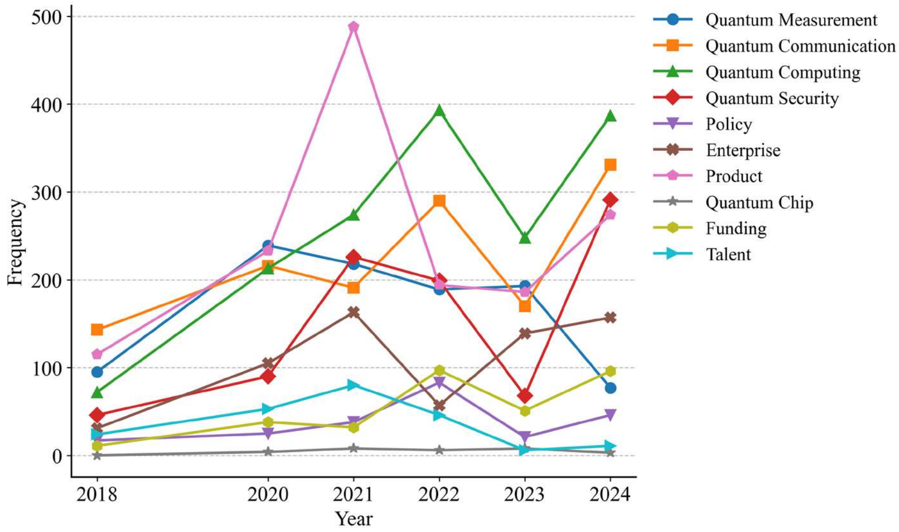

Figure 5. Frequency Trends of Quantum Technology Policy Keywords in China (2018–2024).

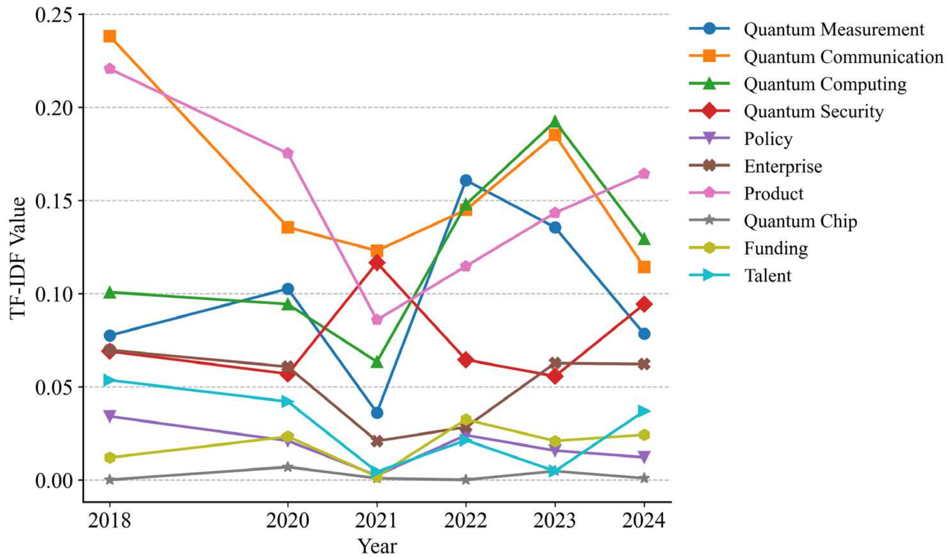

Figure 6. TFIDF-based Keyword Frequency Trends in China's Quantum Technology Policy (2018–2024).

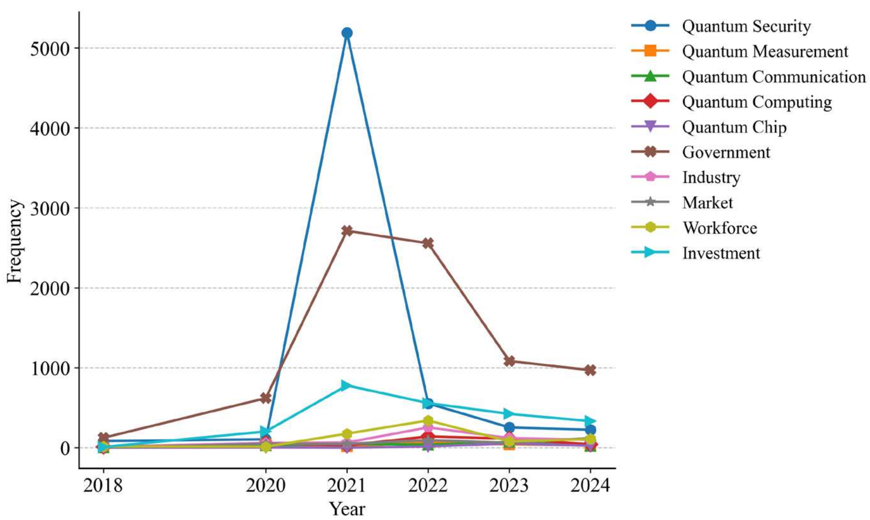

Figure 7. U.S. Quantum Technology Policy Keyword Trends (2018–2024).

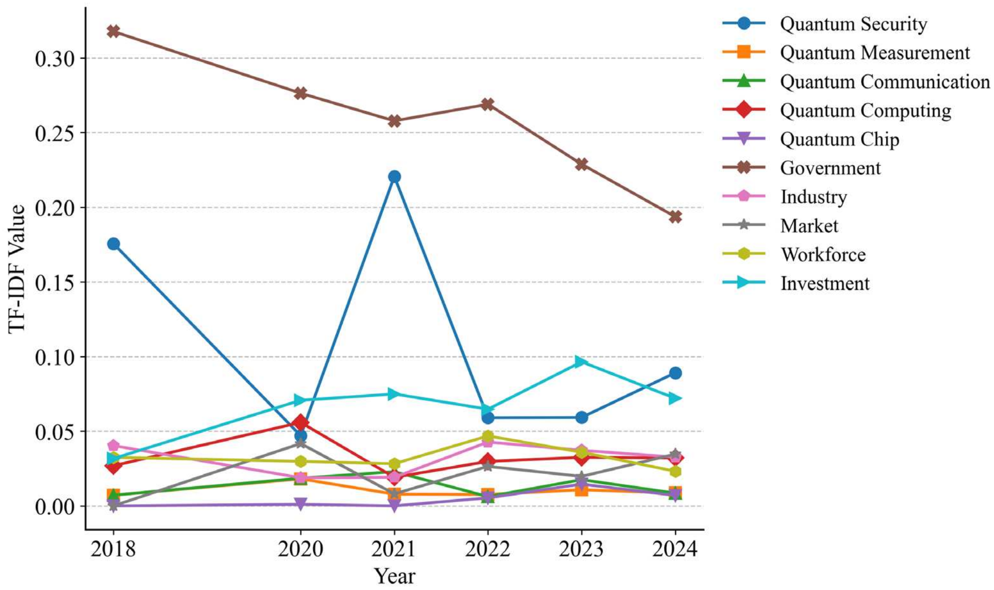

Figure 8. TF-IDF Value Trends of Quantum Technology Policy Keywords in the USA (2018–2024).

U.S. policy has progressively shifted from technological innovation to national security and competitiveness. This transition is evident based on the increased emphasis on quantum security, from 83 mentions in 2018 to 5189 in 2021. Government-related content in quantum technology development exceeded 2500 mentions annually (2021–2022). Rising investment is another key trend, surging from 8 mentions in 2018 to 422 in 2023, highlighting financial and strategic commitments to maintaining the U.S. technological edge.

The U.S. Quantum's strategic importance rose from 9 in 2018 to 222 in 2022. Moreover, workforce development expanded significantly from 15 mentions in 2018 to 340 in 2022, prioritizing talent cultivation. Market competitiveness in industry-related areas has also increased steadily from 2020 to 119 mentions in 2024, illustrating a policy agenda integrating national security, research investments, and sustaining U.S. leadership in quantum technology.

On the contrary, China's policy has transitioned from technological planning to large-scale industrial applications. China focused on Fundamental Technologies from 2018 to 2020, with 95 mentions in 2018 and 239 mentions in 2020 in quantum measurement. In the same period, quantum communication was emphasized, rising from 143 to 216 mentions.

In post-2021, policy has shifted toward commercialization and industrialization, with product-related content rising from 115 mentions in 2018 to 488 in 2021. Moreover, enterprise engagement grew from 31 mentions in 2018 to 157 in 2024, integrating quantum technology into industry and private-sector initiatives. Funding support for industrialization also reflects a notable increase, from 11 mentions in 2018 to 97 in 2022, highlighting the government's financial commitment to quantum commercialization. These shifts underscore China's transition from early-stage research to large-scale industrial deployment.

China's policies in quantum computing have also increased from 72 mentions in 2018 to 393 in 2022, aligning with a broader strategy for technological self-reliance and innovation-driven development. Quantum security has also gained momentum, from 46 mentions in 2018 to 291 in 2024, heightening concerns over cybersecurity and data protection in quantum applications.

As a result, U.S. and China's policy trajectories highlight distinct national priorities. The U.S. has evolved from technological innovation to an integrated national security, investment, and workforce development strategy. However, China's policy has shifted from technological planning to large-scale industrial applications, demonstrating a state-driven approach to long-term economic and technological self-sufficiency.

(e) Latent Semantic Analysis

To further validate the strategic orientations identified in previous sections, we conducted an LDA topic modeling analysis. The optimal number of topics was determined based on coherence scores (C_v) and inter-topic distance maps (China: $K = 3, C_v = 0.445$; U.S.: $K = 3, C_v = 0.574$).

In the Chinese context (Figure 9), the discourse is characterized by a "Pragmatic-Industrial" paradigm. Topic 1 (53.4%) represents a "Technology-to-Application" narrative, emphasizing the realization of system-level products. Topic 2 (28.0%) focuses on building an industrial ecosystem, highlighting manufacturing and enterprise roles. Topic 3 (18.6%) underscores secure infrastructure, particularly through Quantum Key Distribution (QKD) networks.

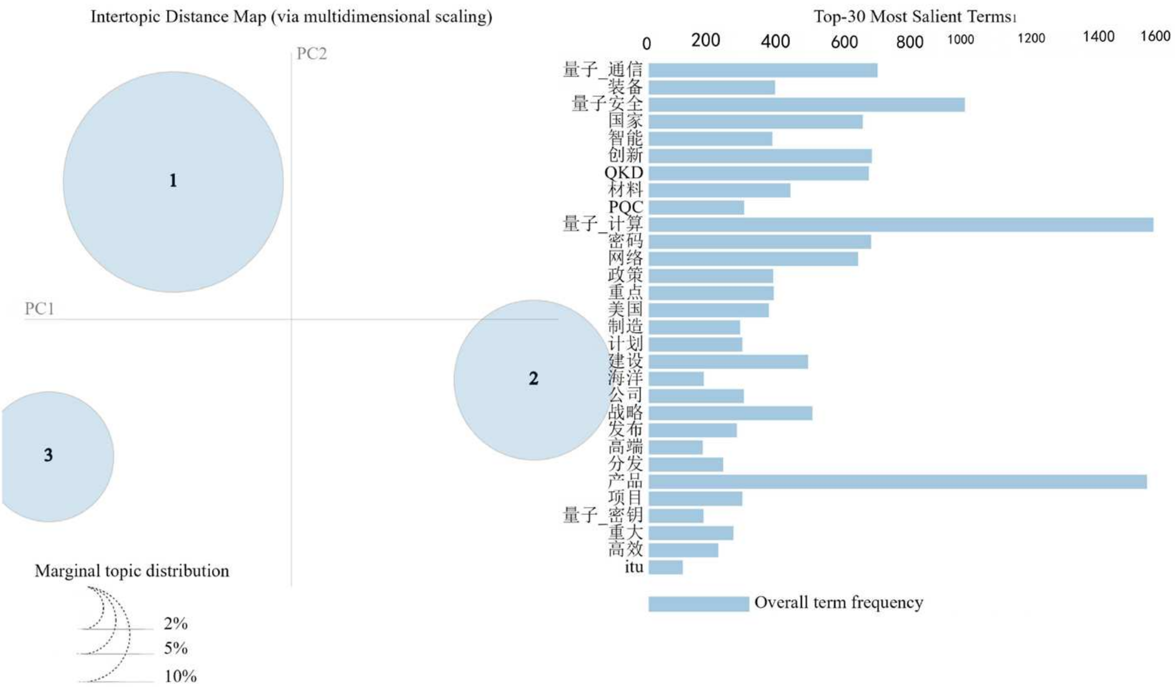

Figure 9. China quantum policy LDA. The following terms are the English translations corresponding to the top-30 Chinese labels in the figure above. 1. Quantum Communication, 2. Equipment, 3. Quantum Security, 4. National, 5. Intelligent, 6. Innovation, QKD (Quantum Key Distribution), Materials, 9. Proof of Concept, 10. Quantum Computing, 11. Cryptography, 12. Network, 13. Policy, 14. Key, 15. United States, 16. Manufacturing, 17. Plan, 18. Construction, 19. Marine, 20. Enterprise, 21. Strategy, 22. Release, 23. High-end, 24. Distribution, 25. Product, 26. Project, 27. Cryptographic Key, 28. Major, 29. Efficient, 30. ITU (International Telecommunication Union).

In the U.S. context (Figure 10), the narrative follows a "Science-Security" dual-track logic. Topic 3 (42.4%) is strictly aligned with foundational scientific R&D and Quantum Information Science (QIS), targeting breakthrough physical metrics like qubits. Topic 2 (32.7%) reveals a highly securitized discourse centered on military authorization and congressional frameworks. Topic 1 (24.9%) addresses the long-term sustainability through STEM education and workforce development.

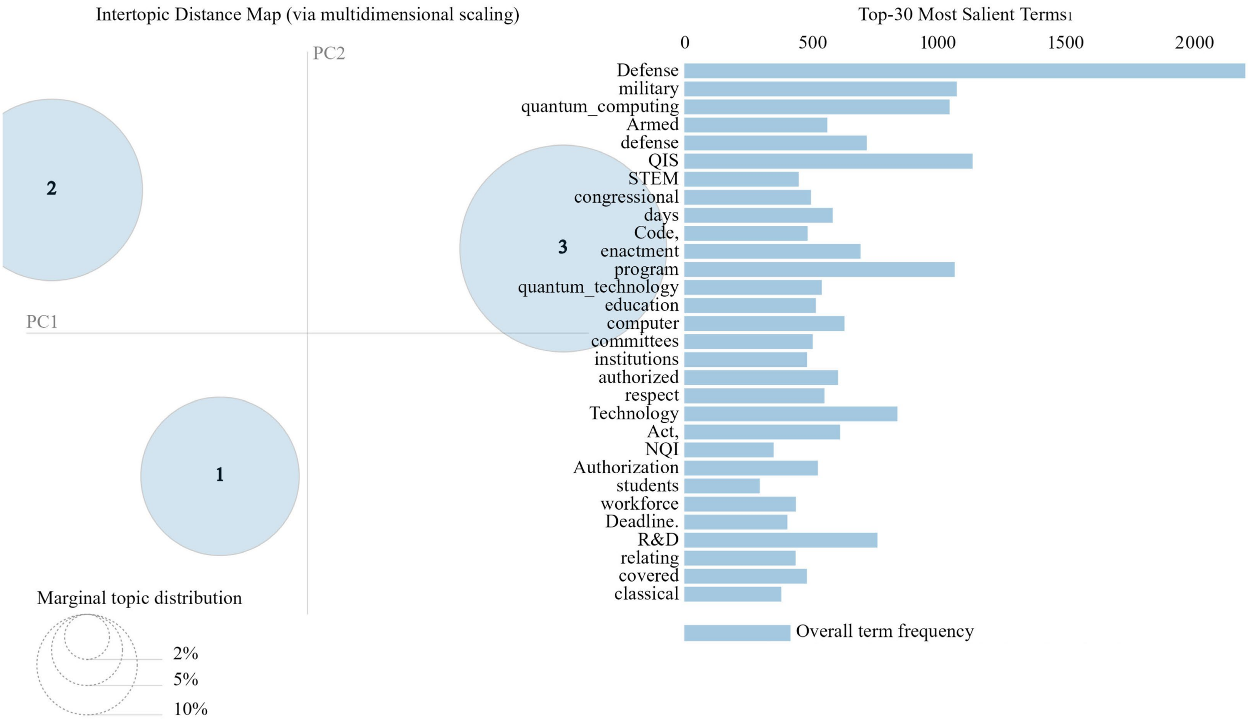

Figure 10. U.S. quantum policy LDA.

3.2. Qualitative Analysis Results

(a) Policy Objectives

The U.S. and Chinese quantum technology policies reveal distinct strategic orientations. For example, the U.S. adopts a market-driven approach, leveraging private sector innovation to advance quantum technology, strengthen intellectual property protection, foster cross-border collaboration, and maintain technological dominance [35]. Key priorities include quantum computing, quantum algorithm optimization, and cloud-based quantum services, emphasizing commercial viability and global leadership [27].

Conversely, China follows a government-led model by integrating quantum technology into national security, communication security, and industrial applications [36]. Policies emphasize fundamental research, large-scale implementation, and economic integration. The government also employs top-down planning to align national and local policy execution with broader financial and security goals. Both countries have refined their quantum policies in response to evolving technological and geopolitical challenges. For example, the U.S. has emphasized quantum cryptography, quantum networks, and defense applications, integrating quantum technologies into biopharmaceuticals, finance, and logistics [37–40]. However, China has shifted toward industrialization and commercialization, supporting quantum technology incubators and private-sector collaboration, facilitating the transition from fundamental research to large-scale market deployment [26].

These transformations highlight that the U.S. has reinforced its technological leadership through market expansion and security applications. China also prioritized commercial integration, leveraging government-private sector partnerships to boost industrial competitiveness.

(b) Policy Logic

Cultural and philosophical traditions shape the differences in policy objectives between the U.S. and China, influencing governance approaches and strategic priorities. The U.S. promotes free-market competition and technological leadership through Protestant ethics. Their policies foster public-private partnerships, ensuring decentralized innovation driven by private enterprises and research institutions. Common policy themes include "innovation-driven," "competitive advantage," and "global leadership," reflecting its emphasis on global technological supremacy [26].

However, China used Confucian principles for quantum long-term planning and coordinated development. The government has also centralized its research priorities, ensuring national alignment with strategic economic and security goals. Standard policy terms include "coordinated development," "national strategy," and "technological breakthroughs," reinforcing a structured, state-led approach. China has also used Confucian Influence to align quantum technology with national development and security objectives. Keywords such as "coordinated development," "collaborative innovation," and "social benefits" reflect a holistic policy framework that integrates research with industrial applications.

The U.S. has employed a market-driven, decentralized approach to shaping policy and innovation, using government agencies, private enterprises, and academic institutions. The country used the bottom-up model to foster competition-driven innovation and enhance global technological leadership. However, China's quantum technology policy has been characterized by top-down planning and strong government resource coordination. National frameworks, such as the Quantum Technology Special Plan under the 14th Five-Year Plan, provide clear implementation guidance for research institutions and enterprises. Additionally, China adopts a coordinated capital allocation strategy to integrate state-owned enterprises and private-sector investments, overcoming technological bottlenecks and accelerating critical technologies.

In comparing the policy models, the U.S. follows a market-driven approach, emphasizing private sector leadership and global competitiveness. Investment in quantum technology is primarily driven by competition and commercialization, ensuring that innovation is aligned with economic growth and national security concerns. In contrast, China employs a state-driven approach, focusing on government planning, national security, and industrial integration. It adopts a long-term approach, prioritizing quantum technology with national economic strategies. Government funding facilitates large-scale research-to-market transitions, contributing to economic transformation and technological self-sufficiency.

3.3. Summary

The variations in policy logic and governance structure are primarily driven by political and economic imperatives, yet they also offer an opportunity to examine how wider cultural and philosophical priorities might influence or justify these strategic choices. The U.S. emphasizes market-driven, competitive innovation, whereas China capitalizes on state planning and resource centralization to foster technological advancements and drive industrial implementation. These differing strategies shape the unique developmental paths of quantum technology in both countries, influencing their roles in the global technological competition.

4. Discussion

4.1. Cultural and Philosophical Roots of Policy Differences

While political systems and economic structures are the primary drivers of policy differences, the divergence in U.S. and Chinese quantum technology strategies can also be analyzed through the theoretical framework of cultural traditions and governance philosophies. These distinctions shape policy objectives, implementation strategies, and global collaboration approaches. The U.S.'s quantum technology policy reflects Protestant ethics and market-driven individualism. Protestant values emphasize personal effort, competition, and innovation, which are evident in policy discourse highlighting "competition," "leadership," and "market advantage." The U.S. government primarily acts as a facilitator, creating an environment where private enterprises drive technological breakthroughs. This free-market approach has historical roots in the country's economic foundation, reinforcing a decentralized model for scientific progress. The U.S. policy approach aligns with "technological sublimity" for global leadership and advanced civilization. Pursuing "quantum supremacy" and other disruptive innovations demonstrates a commitment to securing economic and geopolitical influence through cutting-edge research. In contrast, Confucian collectivism and state-led governance shape China's policy framework using quantum technology to achieve broader economic and national security goals.

In the linguistic structure of policy texts, the U.S. emphasizes competition and leadership, using terms such as "technological advantage," "market-driven innovation," and "global leadership." However, Chinese policies prioritize coordination and national objectives, referencing "collaborative innovation," "industrial synergy," and "economic transformation."

Variations in policy discourse and implementation models impact international cooperation. U.S. policy favors market-driven innovation and competition, while China emphasizes strategic coordination and national development. These contrasting approaches shape their domestic quantum strategies and influence global governance and cooperation dynamics.

4.2. Implications for Global Technology Governance

Through an in-depth comparative analysis of U.S. and Chinese quantum technology policies, we identified two distinct models of technological development. We also uncovered their far-reaching impact on the global technology governance system. These insights provide valuable reference points for building a more inclusive and effective global governance framework for quantum technology. Understanding these differences is vital for harmonizing international cooperation and fostering a governance system that balances diverse policy approaches while promoting technological progress and security on a global scale. As the two primary drivers of global quantum technology development, the differences in policy approaches between the U.S. and China directly impact international technological cooperation.

Reflecting on policy models, the U.S. emphasizes a market-driven, competition-oriented approach, focusing on private-sector innovation and global technological leadership. However, China prioritizes government-led development, aligning quantum technology advancement with national strategic needs and social benefits. This divergence leads to tensions in several critical areas, including standard-setting for quantum technologies, intellectual property protection, talent mobility, and research collaboration. For instance, the two countries frequently face challenges in reaching a consensus on quantum communication standardization, primarily due to their differing technological approaches and security priorities.

Despite these challenges, the diversity of development models presents opportunities for global technology governance. The U.S. market-driven model fosters competition and innovation, accelerating technological breakthroughs, while China's government-led model efficiently overcomes key technological bottlenecks. This pluralistic development approach helps other countries shape their quantum technology policies, allowing greater flexibility in global adoption and governance models.

Therefore, we propose constructing a more inclusive global technology governance framework, encompassing global governance in quantum technology, promoting flexible cooperation, and facilitating communication among governments, businesses, and

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academia. This framework emphasizes key action areas such as establishing inclusive standard-setting mechanisms, developing balanced intellectual property protections, enhancing talent mobility, and helping developing countries bridge the technological divide. The goal is to foster a cooperative and equitable global governance system, innovation, and sustainable technological progress.

By integrating these elements, quantum technology drives technological progress and international collaboration rather than reinforcing existing technological inequalities. As quantum technology makes breakthroughs in communication security and computing power, its impact on society becomes increasingly profound. As a result, establishing global ethical guidelines for quantum technology is vital for humanity. Nevertheless, establishing an inclusive global governance framework policies between the U.S. and China can still facilitate a constructive interaction between technological development and international cooperation.

4.3. Research Limitations and Future Directions

Key limitations are still identified in this research. The analysis covered key policy documents from 2018 to 2024; however, limited access to internal decision-making processes and inconsistent transparency in information may create an imbalance in the collection of policy texts. Additionally, NLP-based sentiment and textual analysis tools may struggle to capture implicit meanings and rhetorical subtleties in policy texts, leading to potential analytical gaps.

Moreover, this study primarily focuses on policy text analysis, with a limited assessment of policy implementation outcomes. Complex socioeconomic factors influence policy effectiveness, and variations in local government enforcement cannot be fully evaluated through textual analysis alone, limiting the ability to assess the real-world impact of quantum policies across different regions.

Future research could explore other emerging technologies, like artificial intelligence, green energy, and biotechnology. Cross-disciplinary analysis would offer more insights into systematic differences in science and technology policies between the U.S. and China.

Moreover, greater emphasis should be placed on policy implementation evaluation. Integrating field research, case studies, and economic data would provide a greater understanding locally, uncovering challenges and best practices that influence their effectiveness.

Methodological advancements should also be pursued. Introducing machine learning algorithms could enhance text analysis accuracy, while improvements in cross-lingual policy analysis frameworks could refine comparative studies of Chinese and English policy texts for greater analytical depth and precision.

Incorporating quantum technology policies in the EU, Japan, and Russia would facilitate a multilateral comparative framework, offering a more comprehensive view of global technology governance dynamics. Finally, considering the long-term nature of quantum technology development, implementing a continuous policy evaluation mechanism would allow more precise assessments of policy strengths and weaknesses. This approach would create a solid foundation for future policy refinements and strategic adjustments.

5. Conclusions

This study reveals significant differences between the U.S. and China policy objectives, language expression, and implementation pathways of quantum technology policies. The quantitative analysis emphasizes the U.S. market competition and security concerns, as evidenced by keywords such as “government” (0.211407), “quantum security” (0.073256), and “investment” (0.067373). On the contrary, Chinese policy places more emphasis on systematic planning and industrial applications, reflecting keywords like "quantum communication" (0.125123) and "product" (0.117773). Time-series analysis indicates that U.S. policy has gradually shifted from technological innovation toward competition and security. However, China's policy has evolved from technological planning to industrial applications.

These differences align with the two countries' distinct political systems and may reflect underlying cultural traditions and governance philosophies. The U.S. Protestant ethic and individualistic values have created a market-oriented development model. However, China's Confucian thought and collectivist traditions have led to coordinated planning. This cultural and philosophical perspective offers a theoretical lens to understand the current differences in policy orientations, complementing political-economic explanations.

Thus, promoting U.S.-China technological cooperation is vital to recognize cultural differences and fully complement the two development models. Other countries can draw valuable lessons from U.S. and Chinese models. For example, developing countries can use China's industrial planning and technological applications. However, developed countries may find the U.S. market-oriented model more suitable. Looking ahead, the global development of quantum technology will increasingly rely on international cooperation. Despite variations in development models between the U.S. and China quantum technology's applications, no single country can independently achieve all technological breakthroughs. Therefore, building an open and inclusive international cooperation mechanism is crucial. Such a framework would foster collaboration across nations, driving progress in quantum technology while ensuring its global benefits.

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