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Policy Text AI Mining Study —— A Comparative Analysis Based on U.S., U.K., and Chinese Policies

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Abstract. Artificial Intelligence (AI) has become a key strategic area to enhance national competitiveness globally. We adopts a textual analysis methodology, based on the three-dimensional framework of policy tools and the LDA thematic model, to conduct a systematic analysis and comparative study of the AI policy texts of the United States, the United Kingdom, and China. The study aims to reveal the policy stance, strategic planning, and challenges and opportunities faced by the three countries in the field of AI. Through the analysis, the study identifies the major themes in the policy texts of each country and maps them to the three dimensions of supply, demand, and environment of policy tools. The study finds that the US AI policy focuses on international cooperation, fair civil rights, and innovation ecology; the UK emphasizes ethical governance and legal regulation; and China highlights innovation-driven and smart economy development. In addition, all three countries emphasize building a stable, predictable and innovation-supportive policy environment. The study puts forward a series of comprehensive recommendations, including strengthening international cooperation, balancing innovation and regulation, optimizing a supportive innovation ecosystem, improving the legal system, focusing on talent cultivation, and building an AI innovation alliance. These recommendations aim to promote the healthy development of global AI technologies and maximize their positive contributions to the economy and society.

Keywords: LDA Thematic Modeling, Policy tools, AI policy.

1. Introduction

In contemporary society, AI technology is developing at an unprecedented rate and plays a crucial role in many fields such as healthcare and urban management. Its contribution to enhancing productivity, promoting social and economic development, and changing people's lifestyles cannot be ignored. In view of this, AI has become a key strategic area to enhance national competitiveness globally. However, technological advances have also brought new challenges, raising issues such as employment impact and privacy protection, which need to be addressed through new policies to ensure the healthy development of AI technology and maximize its positive effects.

In the globalized AI development strategy, governments have introduced policies to promote their countries' progress and competitiveness in the field. Countries such as the United States (2023), the United Kingdom (2021), and China (2017) have released their own policies in terms of AI strategy, reflecting their strategic layout and planning in terms of AI governance.

We focus on the U.S. Executive Order on the Safe, Secure, and Reliable Development and Use of Artificial Intelligence, a policy document that not only represents the official U.S. statement in the field of AI, but also reflects its strategic planning. The study will also examine the UK's National Strategy for Artificial Intelligence as well as China's New Generation Artificial Intelligence Development Plan to carry out a comparative analysis of AI policies in several countries. Together, these policy documents constitute a multidimensional perspective on global AI governance and development.

The research will focus on how national policies promote risk management while promoting technological innovation in AI, and how these policies reflect considerations of the ethical, legal and social implications of AI. In addition, the study will assess how these policies affect international

cooperation and competition in AI technologies, and how they promote convergence, basic technology research and practical translation of results in the field of AI.

Through an in-depth analysis of these key issues, this study aims to reveal the uniqueness and commonalities of AI policies in different countries, assess the role and potential impact of these policies in global AI governance and development, and provide guidance for the improvement of future AI policies.

2. Review of the Literature

In recent years, Artificial Intelligence (AI) technology has been developing rapidly, and governments have attached great importance to the strategic position and important role of AI and have introduced relevant policies to promote the research and development and application of AI. The research on AI policy is also increasing in the academic world, and various theoretical perspectives and research methods have been used to systematically analyze the content, characteristics, and evolution of AI policy. The research literature on AI policy by scholars at home and abroad in recent years is sorted out. An important aspect of AI policy research is to analyze the content and characteristics of policy texts. Ma Chi Zhu et al [1] put forward suggestions including establishing a regulatory mechanism, clarifying strategic goals, enriching policy tools, supporting basic R&D, improving the data ecosystem and establishing an ethical and legal system to promote the healthy development of AI in China. Zhao Juan et al [2] found that on the technological dimension, the United States has a comprehensive layout in AI technology, while China excels in application layer technology; on the organizational dimension, it emphasizes the synergistic governance of multiple main bodies, including governments, enterprises, research institutions, international organizations and social organizations, etc., and there are differences in the nature and status of the main bodies in different countries; on the policy dimension, the United States and Japan tend to encourage technological innovation, while China and the European Union are more focused on In the policy dimension, the United States and Japan tend to encourage technological innovation, while China and the European Union pay more attention to policy regulation; in the ethical dimension, the ethical norms present soft binding force, and the inclination of different countries and organizations to the ethical value of AI varies.

Analyzing the thematic evolution of AI policies using thematic models and other methods is a hot research topic in recent years. Wang Wen Shu [3] proposed a more complete AI search formula, an evaluation method based on the literature-patent coupling perspective, and a calculation method of inter-topic distance, which provides new perspectives and data support for the future research direction and policy formulation of AI. Su Dan Ni et al [4] used LDA topic model to systematically analyze the semantics, topic characteristics and evolution of China's AI policies. The study found that China's AI policy has experienced the evolution from strategic planning to application landing, presenting the characteristics of rich topics, prominent focus, and complementary measures, but still need to strengthen collaborative governance and strengthen risk prevention. Based on the post-ELSI framework, Bi Xiao Rong [5] systematically combed China's AI policies. The study found that China's AI policies gradually shift from technology research and development to application scenarios, and pay more attention to factors such as ethics, law, and social impact, but still need to strengthen policy coordination and highlight problem orientation. Guendueza and Mettler's [6] study of artificial intelligence (AI) policies in 33 countries showed that governments in AI policies show a trend from initial strategic planning to late application implementation, and these policies exhibit the characteristics of diversity of topics, clear focus, and comprehensive measures.

Social network analysis is a new method for policy research in recent years, which analyzes the relationship structure and evolution characteristics of policy subjects, policy tools and other elements by constructing a policy network model. Chen Mei et al [7] found that the digital economy policy presents the characteristics of obvious regional differences, broad and diversified themes, and sectoral division of labor, and the future should strengthen the central and local coordination to promote the

coordinated development of the region. Zhang Yi et al [8] analyzed China's cyberspace governance policy by using LDA and SNA methods. The study found that China's cyberspace governance system has been gradually improved, showing the characteristics of pluralistic common governance and management according to the law, but it is still necessary to strengthen the policy coordination and enhance the governance capacity. Cao Rong et al [9] examined the evolution of cooperation network and thematic hotspot of China's charity policy based on SNA and LDA methods. The study found that China's charity policy is characterized by the participation of multiple subjects and a wide range of topics, but it still needs to improve laws and regulations and innovate social governance. Zhao Qi et al [10] used social network analysis to investigate the structural characteristics of China's emergency management policy network and its evolution. It is found that China's emergency management policy system is constantly improved, characterized by the participation of diversified subjects and increasingly professional functions, but it is still necessary to clarify the responsibilities of departments and enhance the level of coordinated governance.

In summary, AI policy research is a complex topic involving multiple disciplines and perspectives. Existing research mainly focuses on policy content, evolution, network, etc., and adopts a variety of quantitative analysis methods such as thematic modeling, social network, etc., and has achieved rich research results. However, on the whole, the current research still has the following deficiencies: first, the theoretical perspective needs to be expanded, and there is still a lack of research that comprehensively utilizes multidisciplinary theoretical perspectives to conduct an in-depth analysis of AI policies; second, the research methodology needs to be innovated, and the research that combines qualitative and quantitative, and macroscopic and microscopic needs to be strengthened; and third, the comparative perspective needs to be broadened, and the cross-country and cross-regional comparative research is still not in-depth enough to be systematic.

3. Study Design and Data Selection

3.1. Research methodology

This study employs textual analysis methods in order to deeply mine and quantify the information embedded in AI policy texts in the United States, the United Kingdom, and China. Textual analysis methods are particularly well suited for dealing with policy documents that contain rich semantics and specialized terminology, and it allows us to meticulously explore policy tools, goals, and their potential social impacts. This study introduces the ideas of Rothwell and Zegveld [11], and draws on the research frameworks of scholars such as Chen Mei [7] and Lu Zhang Ping [12], which categorize policy tools into three dimensions: supply, demand, and environment, in order to comprehensively analyze how policies affect the innovation and development of AI technologies.

In order to construct a category model of policy themes, this study chooses theme modeling techniques, especially the LDA (Latent Dirichlet Allocation) model, as an auxiliary analytical tool.The LDA model is able to identify co-occurring vocabulary in policy texts and form thematic clusters, thus revealing thematic distribution and evolution in policy texts at the macro level. This approach not only helps to understand the key themes and core concepts in policy texts, but also reveals the changes and evolutionary trends of policy priorities over different time periods, providing a clear understanding of the policy development history. In applying the LDA model, we will first conduct an in-depth analysis of U.S. AI governance policy texts to identify and categorize themes in the policy texts. Subsequently, we extend this analysis to the AI policy texts of the UK and China to reveal the policy stances, strategic plans, and challenges and opportunities faced by the three countries in the field of AI through comparative analysis. Through this comparison, this study aims to reveal the uniqueness and commonality of different countries' policies and assess the role and potential impact of these policies in global AI governance and development. Ultimately, the categorization results of the LDA topic model will enable us to understand the intrinsic meaning of each topic more concretely and to sort out the logical relationships between different topics in the policy text. This will not only help us to deeply understand the inner structure of the US AI governance policy, but

also provide a new perspective and analytical tool for the comparative analysis of the UK and Chinese AI policies, thus providing guidance and suggestions for the improvement of future AI policies.

3.2. Study Sample Selection

The Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence on the U.S. White House portal was selected for this study, with the aim of delving into how the policy text reflects the U.S. official stance in the official position in the field of Artificial Intelligence and to detail its strategic plans for ensuring the safety, security, and trustworthiness of Artificial Intelligence. This policy text was chosen primarily because it provides a direct and unique perspective for understanding how the U.S. guides and regulates the development of AI through executive orders. In addition, the perspective of this study is extended to the UK's National Strategy for Artificial Intelligence and China's New Generation Artificial Intelligence Development Plan, a choice based on several important reasons: first, the United States, the United Kingdom, and China are all important players in the global AI field, and their global influence in technological innovation, industrial application, and policy formulation cannot be ignored; second, these policy documents are all respective Second, these policy documents are all national strategic plans issued by their respective governments, reflecting the strategic positioning and long-term goals of each country in the global AI competition; Third, the diversity of these countries in terms of geographic location, economic development, and cultural background provides a multi-dimensional perspective for comparing the similarities and differences of different countries in AI governance and development; In addition, these policy texts cover three types of policy tools, namely, supply-type, demand-type, and environment-type. In addition, these policy texts cover three types of policy tools, namely supply-based, demand-based and environmental-based, which help to comprehensively analyze how countries promote the development of AI through different policy instruments; finally, these policy documents have had a profound impact on the formulation of national and even global AI policies and have become an important reference for international cooperation and competition. Through in-depth analysis and comparison of these policy texts, this study aims to provide a more comprehensive understanding and insights into global AI governance and development.

4. Policy text analysis based on the three dimensions of policy instruments

Policy instruments are the means or methods used by Governments or other policymaking bodies to achieve their policy objectives. These instruments can be laws, regulations, incentives, financial support, information provision, etc., and are designed to influence societal behavior, solve public problems, or promote the development of specific areas. The choice and application of policy instruments depends on the policy objective, the policy context, the availability of resources and the expected social, economic and environmental impacts. Effective policy instruments should be able to efficiently achieve the intended objectives while minimizing negative impacts and costs. The selection of appropriate policy instruments requires a combination of factors, including policy feasibility, cost-effectiveness, social acceptability, and possible long-term impacts. Effective policy instruments should be able to adapt to changing social and economic environments to ensure the realization of policy objectives. Rothwell and Zegveld argue that governments have an important role to play in promoting technological innovation and industrial development, and that there are a number of policy instruments that can be used to influence and facilitate this process. These policy instruments can be broadly categorized as fiscal incentives, regulations and standards, public procurement, direct R&D support, intellectual property protection, and the establishment of innovation systems and networks.

Based on the policy tools provided by Rothwell and Zegveld, we can refer to the research frameworks of Lu Zhang Ping, Chen Mei, and other scholars, and further divide them into broad categories to form a three-dimensional supply-demand-environment analysis framework, which can be used to analyze and understand how the government can influence and promote technological innovation and economic development through different types of policy tools. Among them, supply-type policies

focus on providing the necessary resources and conditions to support the development of technology and innovation; demand-type policies aim to create market demand and incentivize the private sector to participate in and invest in the development and commercialization of new technologies; and environment-type policies focus on creating a macro-environment that is conducive to innovation and technological development. This division helps policymakers and analysts to better organize and implement policy measures. Table 1 provides a detailed description of these three types of policy instruments.

Table 1. A three-dimensional analytical framework for supply-demand-environment - the example of US AI policy

Tool type	subcategory	Category Description	Specific deployment elements
Supply-side policies	Infrastructure development	Invest in research facilities, laboratories, test beds and other critical infrastructure.	Development of AI-related technology infrastructure, such as data centers and computing resources
	public service	Provision of R&D support services such as technology transfer offices, innovation advisory services, etc.	Supporting the application of AI in public services, such as intelligent transportation systems
	Financial support	Provide funding for research and development, including grants, loans and tax incentives.	Provide financial support for AI project landing R&D, including government-funded research projects and innovation incentives
	information resource	Establishment of databases and information-sharing platforms to provide the necessary scientific and technical information and market data.	Building open AI datasets and knowledge bases for use by researchers and developers
	cultivation of talent	Developing scientific and technical manpower through education and training programs, including higher education courses, vocational training and continuing education.	Training of professionals in the field of AI, including higher education and vocational training
	Science and technology infrastructure	Support the construction and operation of scientific research institutions and provide R&D platforms and technology validation environments.	Support for AI-related research institutions and technology development platforms
Demand-type policies	government procurement	Direct government purchases of new technology products and services to demonstrate and promote their application.	Government as the first customer to purchase and apply AI technology products

	Collaborative Exchanges	Promote cooperation and knowledge exchange within and across industries.	Promote the exchange and cooperation of AI technology at home and abroad
	foreign trade	Supporting the export of new technology products and international market expansion through trade policy.	Supporting international trade and exports of AI products and services
	market mechanism	A healthy market environment is formed through regulations and policy measures, such as standard setting and market access rules.	Forming a healthy AI market environment through policy support
Environmental policies	target planning	Formulation of a long-term strategy and specific objectives for scientific and technological development.	Develop a long-term AI development strategy and goals
	regulatory control	Establish relevant laws and regulations to provide a legal framework for the development, testing and application of new technologies.	Establishing a legal and ethical framework for the application of AI technologies
	financial support	Provide specialized financial products and services to support the process of technological innovation and commercialization.	Providing financial products and services to support the growth and innovation of AI companies

This categorization helps to provide a comprehensive understanding of the diversity of policy instruments and their impact on technological innovation at different stages. In this way, policymakers could more effectively design and implement policies to promote technological progress and economic growth.Rothwell and Zegveld emphasized that effective innovation policies required a combination of these instruments rather than relying on a single policy instrument. They also pointed out that policy design and implementation should be dynamic and needed to be adapted to technological developments and changes in market demand. In addition, they mentioned some challenges in policy implementation, such as policy coherence, coordination between the government and the private sector, and how to assess policy effectiveness. Overall, Rothwell and Zegveld's theory provided a valuable framework for understanding and designing innovation policies, emphasizing the importance of diversity and dynamic adjustment of policy instruments.

5. A three-dimensional policy text analysis framework based on LDA topic modeling

LDA (Latent Dirichlet Allocation) is a statistical model commonly used for topic discovery in document collections or corpora. We will first do a prior analysis on the text of the US AI policy, which is convenient to be applied to the analysis of the policy text of other countries later. The overall flow of the analysis framework is shown in Figure 1.

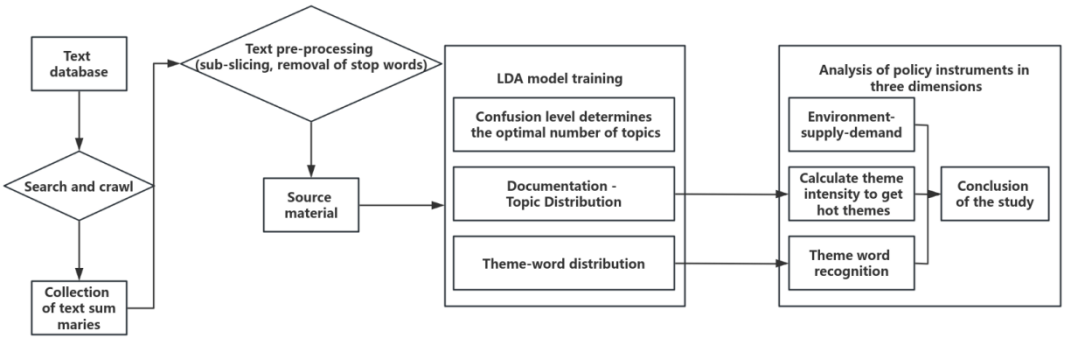


Fig.1 Research idea of hot topic analysis based on LDA model

5.1. Text Preprocessing

A series of text preprocessing steps need to be performed on the input text at the beginning to prepare clean data for natural language processing tasks. First, the text is segmented using word_tokenize, then lexically tagged and filtered for nouns by pos_tag. Next, all words were converted to lowercase and redundant whitespace characters were removed. Immediately after that, English deactivated words, which are very common in the language but often do not carry important information, are removed. After that, word form reduction is performed by WordNetLemmatizer, which converts words to their base form in the lexicon. In addition, the function removes all words with non-alphabetic characters and excludes lowercase Roman numerals to further purify the data. This series of steps is intended to reduce data noise and improve the efficiency and accuracy of subsequent processing steps. Subsequently, it is possible to draw a text word cloud as shown in Figure 2. It can be seen that there are basically no cases of single letters or meaningless words, indicating that the data has been processed almost cleanly.

Fig. 2 Word cloud map after text preprocessing

5.2. Number of themes identified

Choosing the optimal number of topics is an important step when using an LDA model because it affects the interpretability and performance of the model. Perplexity is a metric for evaluating how good a model is. The lower the perplexity, the better the model fits the data. The formula for perplexity can be expressed as:

$$\text{Perplexity}=\exp\{-\frac{\sum_d \log\, p(\mathbf{w}_d|\mathbf{z}_d,\alpha,\beta)}{N}\} \tag{1}$$

where $\mathbf{w}_d$ is the words in document d, $\mathbf{z}_d$ is the corresponding topic assignment, α and β are parameters of the LDA model, and N is the total number of words in the document. In addition, in the LdaModel class of the gensim library, the constructor is used to initialize and train the latent Dirichlet allocation (LDA) model, and Table 2 shows the hyperparameter configuration of the LDA model.

Table 2. LDA hyperparameter values

hyperparameterization	retrieve a value
random_state	40
update_every	1
chunksize	100
passes	10
alpha	0.1

Among them, the random_state parameter is used to set the seed of the random number generator to ensure the reproducibility of the experiments. update_every parameter controls how often the model is updated during iterations, which affects the training speed and model convergence. chunksize parameter defines the size of the batch of documents that are processed in each iteration, which affects the memory usage and computational efficiency. The passes parameter specifies the number of passes through the entire corpus, i.e., the number of iterations, and more iterations usually help the model converge better. alpha parameter is a hyperparameter in the LDA model used to control the sparsity of the topic distribution, and a smaller value will make the topics more concentrated while a larger value will make the distribution more uniform, and we would like to see the topics be more independent of each other, so we take the value of 0.1. Together, these parameters determine how often the model is updated during the training process, which affects the training speed and model convergence. These parameters together determine the training behavior and final output quality of the LDA topic model. The number of topics is taken in order from 2 to 11, and the perplexity curve is shown in Fig. 3. The perplexity curve at the number of topics is 6 reaches a low level, so the number of topics can be tentatively set to 6.

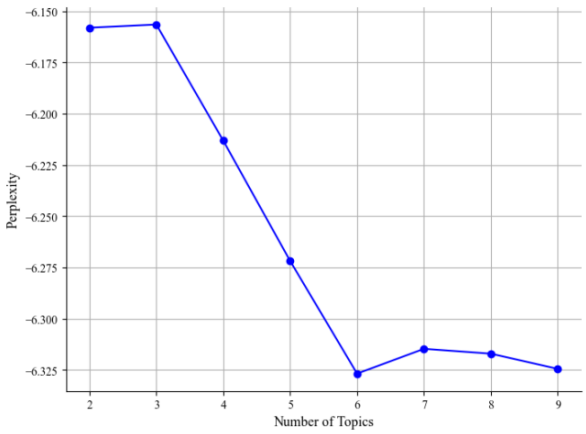


Fig. 3 LDA model perplexity based on different number of topics

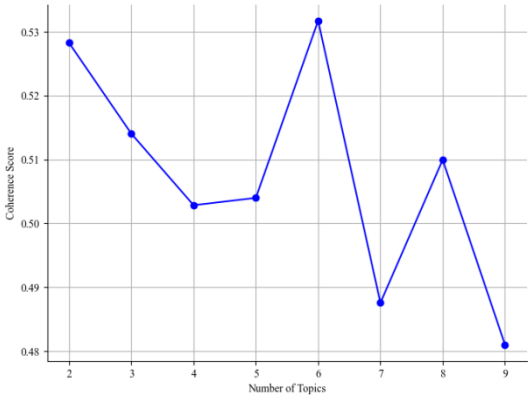


Fig. 4 Consistency of LDA based on different number of topics

The coherence metric of coherence=c_v is generally chosen in the Gensim library, which is a good implementation of the coherence score, proposed by Steyvers and Griffiths [13]. This metric is based on the co-occurrence statistics of words in a topic and calculates the ratio between the probability of pairwise co-occurrence of words within a topic and the probability of random co-occurrence. The number of topics ranges from 2 to 9, and the consistency curve is drawn as shown in Fig. 4. It can be found that when the number of topics is 6, a low level of confusion and a high level of consistency are achieved at the same time. So, we determine to use 6 as the optimal number of topics for the LDA model.

5.3. Visualization of results

LDA modeling was performed on the preprocessed text using the LDA model hyperparameters as shown in Table 2. The results of LDA modeling are then visualized using the pyLDAvis library, as shown in Figure 5. It can be seen that the topics can be well distinguished from each other.

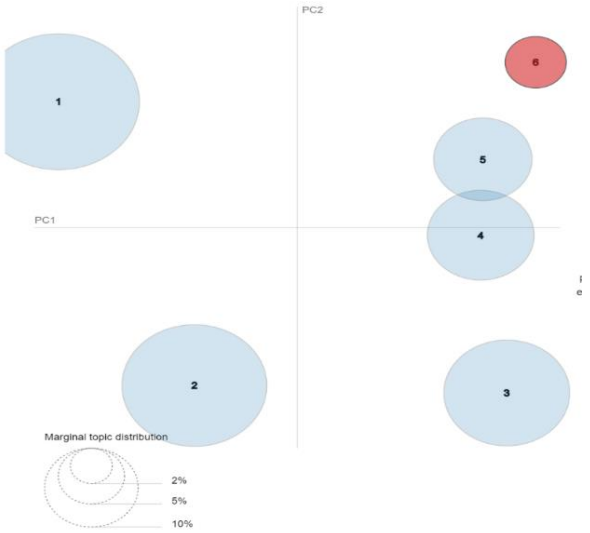


Fig. 5 Map of distances between themes

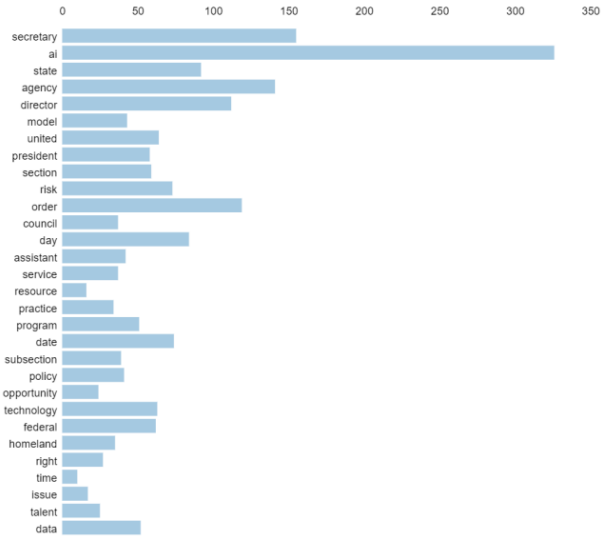


Fig. 6 Top 30 occurrences of thematic feature words

Figure 6 shows the top 30 theme feature words in terms of frequency of occurrence in the policy text. However, only the top 30-word frequencies seem to be generalized, which does not allow us to find out the topic features in depth, and we need to go further into the inner observation of the topic words. pyLDAvis allows us to selectively keep the top few important words when observing the resultant topic-item matrices of the LDA modeling. pyLDAvis library has the parameter lambda (λ) in the "Slide to adjust the "Slide to adjust relevance metric" in the pyLDAvis library uses lambda(λ) as a tuning parameter to balance the frequency of words in a topic against their uniqueness. Originally proposed by Michael Sievert and Kenneth Shirley [14] in their paper, the value of λ usually ranges from 0 to 1. This parameter helps the user to adjust the displayed vocabulary in the visualization interface in order to better understand and interpret the topic: when λ = 1, the ranking of the vocabulary is based solely on the frequency of its occurrence in a given topic. This means that the most frequent words are ranked first, regardless of how often they appear in the rest of the document set. When λ = 0, words are ranked based solely on their distinctiveness or uniqueness within a given topic relative to the rest of the document set. This will highlight terms that are specific to the topic but not common in other topics. By adjusting the λ value, users can find a balance between viewing more representative high-frequency terms and more distinctive unique terms. This balance is important for a deeper understanding of the nature of topics and their role in the overall document set. Table 3 shows the results of the US AI policy topic analysis based on the LDA model.

Table 3. LDA topic modeling results for US AI policy texts

Subject number	thematic	Thematic trait words	Main types of policy instruments used
Topic1	Innovation and competition	innovation, technology, development, startup, semiconductor, artificial, machine	supply
Topic2	Consumer Privacy Protection	model, service, risk, data, information, privacy, safety, management, access	environmental
Topic3	Equity and civil rights	right, opportunity, discrimination, equity, labor, bias, civil, justice	environmental
Topic4	International cooperation and leadership	state, director, agency, united, security, national, defense, nsf, ai, international, engagement, national, global, partnership	environmental
Topic5	AI Security and Responsibility	risk, data, system, issue, information, capability, model, technology, term, security	supply
Topic6	Workers' rights and education	resource, time, provision, joint, screening, sequence, access, occupation, practice, joint	supply

LDA thematic modeling of U.S. AI policy texts reveals six major themes, each associated with a specific type of policy instrument, reflecting the U.S. government's strategic considerations in promoting AI development and adoption. One of the themes, Innovation and Competition, is the theme linked to supply-type policy tools. This theme emphasizes the central role of technological innovation in driving economic growth, particularly by enhancing the supply capacity of the economy through the promotion of new technology development and new product creation. Policy instruments focus on providing funding for R&D, building infrastructure and fostering expertise to support firms' innovative activities and market competitiveness. Consumer privacy protection, on the other hand, is related to the environment category of policy tools, highlighting the importance of protecting consumer privacy in AI applications. Policy tools enhance consumer trust in AI technologies by creating a secure and trusted digital environment through the development of regulations and standards, and by ensuring that AI products and services take privacy protection fully into account at the design and implementation stages. Equity and civil rights are similarly linked to the environment category of policy tools, a theme that focuses on maintaining social equity and civil rights in the design and application of AI to prevent algorithmic discrimination and unfair treatment. The policy tools aim to ensure that the development of AI technology adheres to legal and ethical standards and promotes a fair and non-discriminatory environment for AI applications. The International Cooperation and Leadership theme also matches the Environment category of policy tools, reflecting the U.S. strategic intent to seek leadership in global AI governance. By establishing frameworks and standards for international cooperation, the U.S. hopes to promote cross-border AI governance and policy coordination to address global challenges.AI Security and Responsibility is another theme linked to the Supply category of policy tools, which calls for improving the security of AI products and services and ensuring that they are rigorously tested and evaluated before being brought to market. Policy tools support the research and development of AI safety technologies to reduce potential risks and improve the reliability of AI technologies. Finally, the Worker Rights and Education theme links to the Demand category of policy tools, a theme that recognizes the impact of AI technology development on the labor market and emphasizes the need to upgrade the skills and education of the workforce. Policy tools help the workforce adapt to the changes brought about by AI by providing education and training resources while protecting workers' rights.

Taken together, the U.S. AI policy themes show a comprehensive focus on innovation promotion, data privacy, social equity, international cooperation, system security, and education and training.

These policy themes reflect the U.S. attempts to maintain a leadership position in global AI development while ensuring the safe and fair application of the technology. Further, we can get the weight of the subject in the whole text by accumulating the probability of the distribution of the subject in each text. Figure 7 shows a radar chart of subject weights.

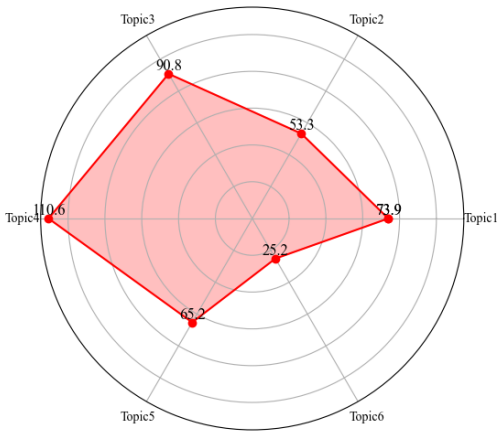
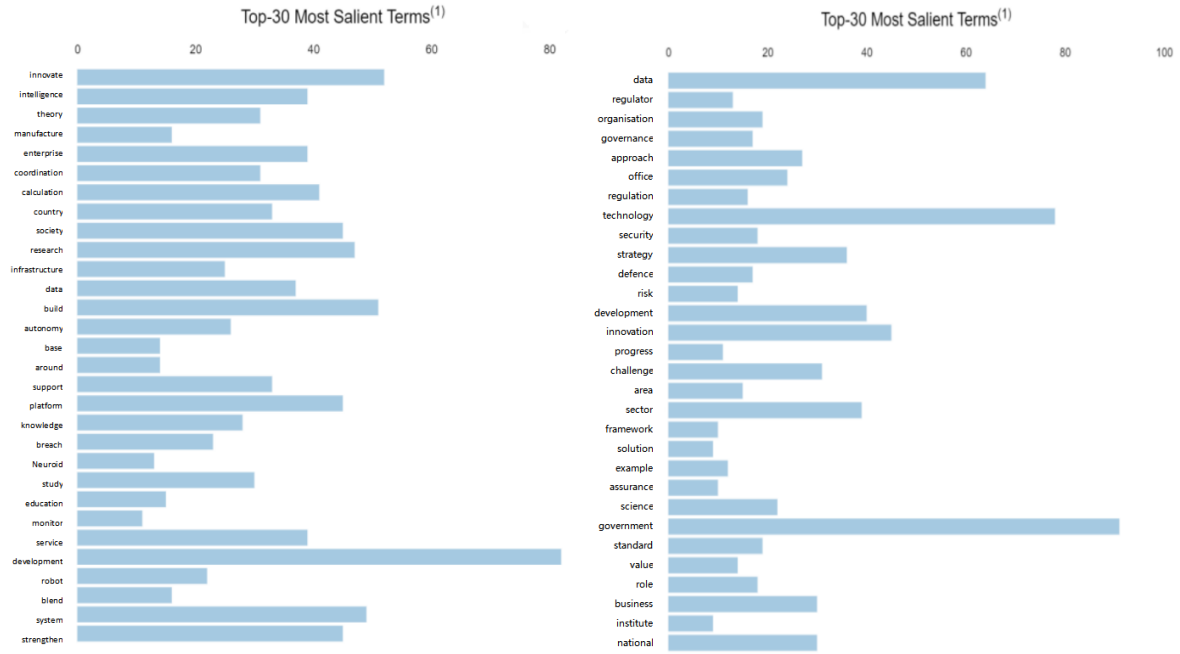


Fig. 7 Comparison of U.S. Policy Theme Weights

The radar chart can be analyzed to derive the weights of the textual themes of U.S. AI policy in the following order: international cooperation and leadership, fairness and civil rights, innovation and competition, AI safety and responsibility, consumer privacy protection, and workers' rights and education.

5.4. Comparison experiment

The following is another controlled experimental analysis of AI policy texts from the UK and China. After the experience of the previous LDA modeling, we use the same approach to get the number of themes. When we analyze the Chinese policy texts, we select 6 themes, while the UK selects 8 themes. Figure 8 is a visualization of the top 30 high-frequency words from the LDA modeling results of the Chinese and English texts. Figure 9 is the radar chart of the weights of each theme.



(a) (b)

Fig. 8 Top 30 high-frequency words visualized by LDA results of Chinese and English policy texts

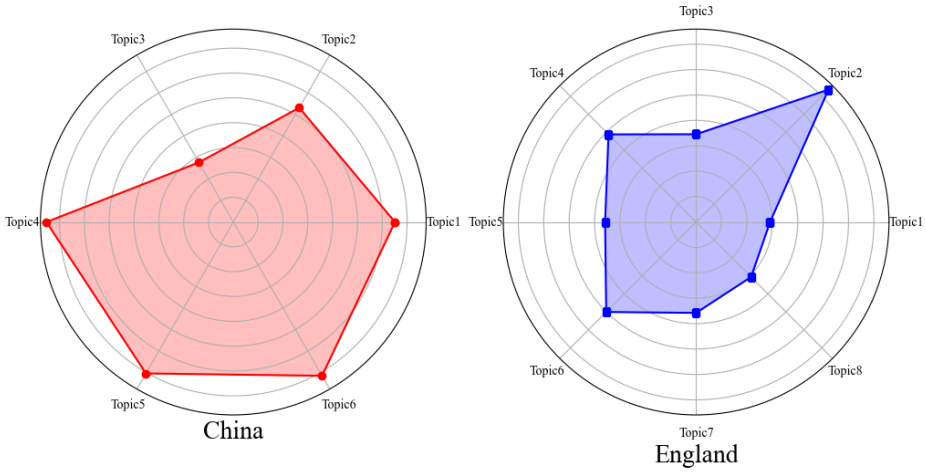


Fig. 9 Radar chart of theme weights of LDA results for Chinese and English policy texts

Tables 4 and 5 show the LDA modeling results of policy texts combined with policy instruments for China and the UK, respectively.

Table 4. LDA theme modeling results for Chinese AI policy texts

Subject number	Subject	Thematic trait words	Main types of policy instruments used
Topic1	innovations	Innovation, research, development, science and technology, bases, platforms	supply
Topic2	intelligent economy	Intelligent, Manufacturing, Robotics, Smart, Systems, Controls	supply
Topic3	Social construction and people's livelihood	Applications, Social, Services, Education, Health, Eldercare	demand
Topic4	Security risks and ethical challenges	Safety, Ethics, Legal, Regulatory, Risk, Assessment	environmental
Topic5	Science and Technology R&D and System Building	Construction, synergy, monitoring, technology, knowledge, breakthroughs	supply
Topic6	Resource allocation and policy support	Support, autonomous, training, R&D, national, learning	environmental

The results of the LDA theme modeling of Chinese AI policy texts reveal six themes, each associated with a specific type of policy tool, reflecting the Chinese government's strategic focus in promoting the development and application of AI technology in six areas: security risks and ethical challenges, scientific and technological research and development (S&T) and system construction, resource allocation and policy support, innovation, the smart economy, and social construction and people's livelihood. First, the innovation theme is linked to supply-type policy tools, emphasizing the central role of research and development in promoting scientific and technological progress and industrial upgrading. Supply-type policy tools can enhance the innovation and supply capacity of the economy by providing the necessary resources and support, such as science and technology bases and innovation platforms, to facilitate the creation and provision of new technologies. The Smart Economy theme is also relevant to supply-type policy tools, and this theme focuses on the development of smart products and services to promote the economic structure towards higher-end value chains and facilitate economic transformation and upgrading. The theme of science and

technology R&D and system construction is again related to supply-type policy tools, and this theme focuses on the research and development of basic theories and key common technologies in the field of artificial intelligence. Second, the theme of social construction and people's livelihoods is linked to demand-based policy tools, which are concerned with improving the precision of public services and the quality of people's lives. Demand-based policy tools can promote the application of AI technologies in the field of social services and people's livelihoods by meeting the society's demand for a better quality of life. Finally, the theme of security risks and ethical challenges matches the environment-based policy tools, which recognizes the security risks and ethical challenges that may be encountered during the development and application of AI technologies. This is because environment-based policy tools can create an external environment conducive to AI development by formulating policies and regulations to build a healthy and sustainable development environment that ensures the responsible use of AI technologies. The theme of resource allocation and policy support involves the allocation of fiscal, financial and social capital, as well as the role of policy incentives and market mechanisms, and is similarly linked to environment-based policy tools.

Table 5. LDA topic modeling results for UK AI policy texts

Subject number	Subject	Thematic trait words	Main types of policy instruments used
Topic1	Technology and Innovation	technology, innovation, development, research, algorithm, breakthrough	demand
Topic2	Policy and governance	government, strategy, regulation, framework, governance, rule, policy	supply
Topic3	risk management	risk, safety, harm	environment
Topic4	Regulators and Compliance	regulator, authority, compliance, commissioner, council	supply
Topic5	Data management and privacy	data, privacy, personal data, sensitive personal data	environment
Topic6	Economic development and markets	business, economy, market, investment, trade, industry	demand
Topic7	International cooperation and diplomacy	partner, cooperation, international, diplomacy, alliance	environment
Topic8	Ethics and social responsibility	ethic, fairness, bias, equality, trust, assurance	suppy

The results of the LDA thematic modeling of UK AI policy texts reveal eight themes, each associated with a specific type of policy instrument, reflecting the UK government's strategic focus on promoting the development and adoption of AI technology in the following eight areas: policy and governance, regulators and compliance, economic development and markets, data management and privacy, international cooperation and diplomacy, risk management, ethics and social responsibility, and technology and innovation. 8 aspects. In fact, it is not difficult to find that even though the LDA model gives the best number of topics as 8. However, there are still some similar themes, such as risk management and data management and privacy, both of which match with the environment-based policy tools. The former identifies the assessment of potential risks and the development of mitigation strategies as key components of the policy environment, while the latter relates to the security of information and the protection of civil rights. Additionally, the theme of international cooperation and diplomacy, which emphasizes the impact of international cooperation and diplomatic relations on how countries interact and cooperate on the global stage, also matches the Environment policy

tool. The environment-based policy tool builds a policy environment that protects individual privacy and data security by implementing risk assessment and management measures through privacy protection and data management regulations. Ensure that the development of AI technology does not pose unacceptable risks. At the same time, global AI governance and cooperation is promoted through international agreements and diplomatic efforts. Second, the Policy and Governance theme is also relatively similar to the Regulatory Institutions and Compliance theme, which belongs to the same supply category of policy tools. The former highlights the fundamental role of effective governance structures and policy frameworks in realizing technological innovation and economic growth. The latter emphasizes the role of regulators in setting rules and standards to ensure fair competition in markets and compliance in technological innovation. Also linked to supply-type policy instruments is the theme of ethics and social responsibility, which emphasizes the importance of ethical guidance and social responsibility in technological innovation and application. Supply-type policy instruments provide an ethical framework and institutional safeguards for technological innovation by creating a stable governance environment through the establishment of rules and standards, such as ethical standards and social responsibility guidelines. Finally, the technology and innovation theme and the economic development and market's theme are linked to demand-type policy instruments, with the former emphasizing technological progress and innovation as drivers of social and economic development. The latter considers economic growth and market prosperity as the focus of policymakers' attention. Demand-type policy instruments aim to stimulate economic and market prosperity by promoting business activity, investment and trade through market incentives and investment guidance, promoting new technological solutions and growth opportunities to meet the needs of economic development.

In summary, the comparative analysis in Tables 4 and 5 shows that China's AI policy focuses more on technological innovation and infrastructure development, while the UK's policy emphasizes more on governance, risk management and ethical issues. Both countries focus on the social application of AI technology and international cooperation to varying degrees.

6. Conclusions and recommendations of the study

6.1. Conclusion of the study

This study provides an in-depth comparative analysis of AI policy texts from the United States, the United Kingdom, and China using text analysis and LDA topic modeling techniques. By categorizing the policy tools into three dimensions: supply, demand and environment, the study identifies the major themes in the policy texts of each country and reveals the strategic focus and policy orientation of different countries in AI governance and development. Based on the analyses presented in the text, we can further develop an explanation of the focus of AI policy in the United States, the United Kingdom and China by.

The United States emphasizes "international cooperation and leadership" and "fairness and civil rights", reflecting the following points: first, the United States hopes to play a leading role in global AI governance, dominate the formulation of international rules and standards, and maintain its dominant position in this field. This reflects the strategic consideration of the United States as a scientific and technological power. Secondly, the United States attaches importance to the social equity and individual rights and interests that may be brought about by the development of artificial intelligence, such as employment impact and privacy protection. The policy focuses on the interests of vulnerable groups and emphasizes the protection of civil rights and the prevention of technological abuse while developing AI. This highlights the values and institutional advantages of the United States.

The UK focuses on "technology and innovation" and "policy and governance", indicating that the UK, as a technologically advanced country, focuses on promoting the research, development and application of AI technology, and regards it as the key to enhancing productivity and national

competitiveness. Policy encourages innovation and creates a favorable environment for technology entrepreneurship. The UK also attaches importance to AI governance and is committed to building a sound policy and ethical framework. This is both to guide the healthy development of AI and to control its risks. This pragmatic and prudent approach is in line with the UK's governance tradition.

China's emphasis on "innovation" and "smart economy" reflects the fact that it regards AI as the core of a new round of technological revolution and an important engine for promoting high-quality economic development. It emphasizes independent innovation, mastery of core technologies and industrial upgrading. This fits the needs of China's economic transformation. China also emphasizes the development of a smart economy, using AI to empower traditional industries and cultivate new business models. The policy promotes the in-depth integration of AI with the real economy to create a new advantage in the digital economy. This is conducive to enhancing the level of intelligence in China's economy.

Overall, the AI policy focuses of the three countries reflect their respective strategic needs and development stages. However, what they have in common is that they all attach great importance to this field, treat it as a major strategic issue concerning the future and destiny of the country, and take pragmatic initiatives to actively respond to it. At the same time, the policies of various countries are characterized by a more comprehensive and balanced approach, focusing on the integration of innovation and development with risk management, economic and social values, and national and global interests. This helps to promote the healthy and sustainable development of artificial intelligence on a global scale.

6.2. Suggestion

We examines the U.S. AI policy text, and also experiments with comparative analysis of British and Chinese AI analysis, and puts forward the following suggestions:

6.2.1. Strengthening international cooperation on AI and promoting global AI governance

Drawing on the theme of "international cooperation and leadership" in United States policy, promote open international dialogue and collaboration to establish shared global standards for artificial intelligence. Consider establishing an international AI policy coordination body to promote cross-border policy coordination.

6.2.2. Balancing AI innovation and regulation with a focus on ethics and social responsibility

With reference to the British policy's focus on "policy and governance", while encouraging AI innovation, strengthen ethical regulation of AI use. Emphasize the "equity and civil rights" emphasized in the United States policy to ensure that technological advances are in line with social justice.

6.2.3. Creating an AI innovation ecosystem and promoting the development of a smart economy

Drawing on the themes of "innovation" and "smart economy" highlighted in China's policies, we will create a supportive innovation ecosystem, provide financial, policy and legal support for the AI industry, and promote the intelligent transformation and upgrading of traditional industries.

6.2.4. Building the AI legal system and strengthening risk management

Update the legal framework to adapt to AI development, especially in terms of data protection, algorithmic transparency and machine ethics, in conjunction with the emphasis on ethical and legal issues in UK and US policies. Draw on US experience to strengthen risk assessment and management of AI technology.

6.2.5. Emphasize AI talent training and standardize the education system

Drawing on China's policy approach, formulate a comprehensive AI education program to enhance the scientific and technological literacy of the entire population. Referring to the experience of the

United Kingdom and the United States, enhance the training of interdisciplinary talents, focusing on key technological areas such as machine learning and data science, and improving the quality of employment in jobs in various fields.

6.2.6. Building AI innovation alliances to promote collaborative governance

Drawing on the commonalities among the policies of the three countries, create a stable, predictable and innovation-supportive policy environment. Promote collaborative governance among governments, enterprises, academics and social organizations, and promote broad participation of stakeholders in AI policy formulation and evaluation.

By fully drawing on the experience and focus of the U.S., U.K. and China in AI policy, and comprehensively balancing innovation and development with risk control, international cooperation with national interests, and economic and social values, we can better promote the healthy and sustainable development of AI globally, so that scientific and technological progress will benefit the whole of mankind.

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