Research on the Thematic Evolution of Business Environment Policies (Postprint)

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Abstract

[Purpose/Significance] To clarify the development trends of China' s business environment policies, reveal the temporal evolution patterns of policy priorities, and provide data support for the formulation and improvement of subsequent policies. [Method/Process] Based on business environment policy texts issued by the central and local governments from 2001 to 2020, using two-year intervals as time slices, we employed a dynamic topic model to obtain the temporal evolution distribution of 30 business environment themes. These themes were then categorized into four dimensions: market environment, government affairs environment, cultural environment, and legal environment, to further investigate the thematic intensity and key development trends of each dimension within business environment policies. [Results/Conclusion] Business environment policies are primarily concentrated on the construction of government affairs environment and market environment, with uneven distribution of policy intensity, and significant differences in the intensity of each dimension across different economic regions. Accordingly, recommendations for business environment policies include: strengthening market orientation, reducing government intervention, introducing legal norms, etc.

Full Text

Research on the Topic Evolution of Business Environment Policies

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Abstract

[**Purpose/Significance**] This study aims to clarify the development trends of China' s business environment policies and reveal the temporal evolution patterns of policy priorities, thereby providing data support for the formulation and improvement of subsequent policies. [**Method/Process**] Based on business environment policy texts issued by central and local governments from 2001 to 2020, we divided the data into ten time slices (two-year intervals) and extracted the temporal evolution distribution of 30 business environment topics using a Dynamic Topic Model (DTM). These topics were then categorized into four dimensions: market environment, government environment, humanistic environment, and legal environment. We subsequently analyzed the thematic intensity and key development trends within each dimension of the business environment policies. [**Result/Conclusion**] The findings indicate that business environment policies have primarily concentrated on the construction of government and market environments, with uneven policy intensity distribution. Moreover, the intensity of each dimension varies significantly across different economic regions. Accordingly, recommendations for improving business environment policies include strengthening market orientation, reducing government intervention, and introducing legal norms.

Keywords: business environment policy; text mining; dynamic topic model; topic evolution

Introduction

The business environment refers to the external conditions that enterprises face throughout their life cycles, determined collectively by factors such as market conditions, government efficiency, infrastructure, and taxation systems [1]. A robust business environment is essential for stimulating market vitality and promoting high-quality economic development. Business environment policies represent the government' s regulatory framework designed to optimize these conditions, serving as an objective record of government actions and policy objectives [2]. These policies exhibit temporal and regional characteristics, and most existing research relies on scholars' qualitative interpretation and analysis based on professional expertise [3-7]. However, with the digitalization of government platforms, policy text data has become large-scale and paperless [8], making purely personal and qualitative analysis insufficient for comprehensive and objective understanding. Therefore, quantitative methods such as big data and text mining should be employed to advance research in this domain.

Currently, scholars have applied machine learning, deep learning, natural language processing, and data visualization to analyze policy texts across various types and domains [9-15], though such applications remain limited in the analysis of business environment policies. This study utilizes Dynamic Topic Models (DTM) to extract dynamic temporal topic chains from business environment policy texts, analyzing policy themes across four dimensions: market environment,

government environment, humanistic environment, and legal environment. We address three core questions: (1) What are the quantitative distribution characteristics of business environment policies across different time periods and regions? (2) How does the intensity of each policy dimension evolve over time, and what similarities and differences exist across different economic regions? (3) What are the frontier trends and improvement priorities for business environment policies within each dimension?

Literature Review

Business Environment Evaluation and Influencing Factors

Business environment policies reflect government intentions to optimize business conditions, and their formulation necessarily targets factors influencing the business environment. Conversely, policy issuance and implementation also shape the business environment. Scholars have analyzed these policies to identify characteristics, trends, and deficiencies, providing recommendations for government optimization. Gu Xueqin et al. [3] examined similarities and differences in business environment policies and government initiatives in the Yangtze River Delta region, evaluating the business environment across multiple dimensions. Hu Shuigen et al. [16] divided China' s business environment policy development into four stages, emphasizing the need for improvement from perspectives such as perfecting legal systems, leveraging technology empowerment, and introducing third-party evaluation. Additionally, policies related to legalizing the business environment [7], intellectual property protection [4], and chattel transfer guarantee regulations [17] have attracted considerable attention.

Regarding business environment evaluation indicators and influencing factors, the World Bank' s "Doing Business" group first proposed ten indicators including starting a business, obtaining construction permits, and paying taxes, primarily focusing on evaluating operational convenience throughout enterprise life cycles [1]. C. Reynolds et al. [18] studied how tax policies affect quality of life and business environment through changes in real estate values and equilibrium wages, finding that tax incentive policies significantly improved regional business environment quality while moderately enhancing personal quality of life. M. Cepel et al. [19] identified and quantified important factors affecting SME business environment quality through surveys, including political, social, and technological factors. Lai Xianjin et al. [5] analyzed panel data from 162 economies in the *Doing Business* report, finding that measures such as property registration had greater impact on economic growth. Tang Hongxiang et al. [11] empirically explored how tax policies optimized for business environment affect enterprise performance, demonstrating that better business environments amplify the positive effects of tax policies on firm performance. Liu Zhe et al. [20] proposed evaluating China' s provincial business environments from "soft environment" and "hard environment" perspectives.

Although current domestic and international research shares some common un-

derstanding of business environment influencing factors, no stable and unified consensus has been formed, leaving room for further exploration. The *Regulations on Optimizing the Business Environment* (hereinafter referred to as the *Regulations*) represents China' s first comprehensive administrative regulation for business environment optimization. Zhang Sanbao et al. [21] constructed a provincial business environment evaluation system based on the *Regulations* and the 13th Five-Year Plan, encompassing four dimensions: market, government, legal, and humanistic environments. This system aligns with China' s business environment development characteristics and carries certain authority. Therefore, this study analyzes existing business environment policies from these four dimensions.

Policy Text Mining Based on Topic Models

The complexity and breadth of business environment influencing factors result in multi-topic, high-dimensional characteristics in current policies. Manual topic induction based on word frequency and content structure rules struggles to objectively cover all aspects of policy texts, while traditional text mining methods such as classification and clustering based on similarity metrics lack interpretability [12]. Topic models can uncover latent topics and content information from both structural and semantic perspectives, achieving dimensionality reduction while preserving structural features of lengthy texts. Text mining refers to the process of discovering implicit and latent information in large-scale unstructured texts [22]. As a commonly used text mining model, topic models have been widely applied to analyze various policy types, including U.S. congressional records [23], government announcements [9], open government data policies [11], SME support policies during public emergencies [10], and climate policies [12].

The most classic topic model is the Latent Dirichlet Allocation (LDA) model proposed by D. M. Blei et al. [24], based on probability calculations. Subsequently, scholars extended topic models to incorporate temporal features, such as Topics Over Time (TOT) [25] and Dynamic Topic Models (DTM) [26]. Considering the temporal and multi-topic characteristics of business environment policies, along with rapid growth in policy text volume and expanding coverage, this study employs DTM to analyze policy texts and explore topic distribution. Building upon this foundation and combining business environment indicator classification theories, we categorize the extracted topics by dimension to examine evolution patterns of intensity and content across business environment policy dimensions.

Research Design and Methodology

This study applies policy 计量 methods and text mining algorithms to business environment policy texts, revealing quantitative distribution and spatiotemporal evolution of thematic intensity. First, we obtain policy text data from the Beida Fabao website, perform data preprocessing including word segmentation, data cleaning, and dictionary construction, and conduct statistical analysis of

issuance volumes. Second, we divide policy texts into ten time slices and employ DTM for topic modeling to obtain relationships between topics and words, as well as topics and documents, thereby mining core content including topic intensity, regional intensity, and topic evolution. Finally, we propose strategies and recommendations for government business environment optimization. The specific research framework is shown in [Figure 1: see original paper].

Dynamic Topic Model

The Dynamic Topic Model (DTM) extends the LDA topic model by incorporating temporal information. The basic idea of LDA [24] represents documents as random mixtures over latent topics, where each topic is characterized by a distribution over words. The process involves: (1) selecting a document of length N~Poisson(β); (2) sampling document-topic distribution ~Dirichlet(α) and topic-word distribution ϕ~Dirichlet(β), where α and β are hyperparameters. For any word n in document d, the topic distribution z=multi( ) and word probability distribution w_{d,n}~Multi(ϕ) are determined, and Gibbs sampling yields distribution matrices for topics Z and words W across all documents, as shown in [Figure 2: see original paper].

DTM builds upon this by linking parameters α and β for each topic across time using a simple dynamic model (see [Figure 3: see original paper]), then sequentially binding a set of topic models to obtain document-topic distribution and topic-word distribution *ϕ{t,k} across t time slices. Parameters* αt and *β{t,k} derive from previous period' s* α{t-1} and β_{t-1,k} [26], as shown in equations (1) and (2):

$\alpha t|\alpha\{t\text{-}1\} \sim N(\alpha\{t\text{-}1\}, \delta^2 I)$ *(1)*

$\beta\{t,k\}|\beta\{t\text{-}1,k\} \sim N(\beta\{t\text{-}1,k\}, \sigma^2 I)$ (2)

In time slice t:

(1) For each document, document-topic distribution is obtained: $\_t_{N(\alpha t,\ \alpha^2 I)}$ *(3)(2) For each word, topic-word dis*

$\beta\{t,k\})$ (4)

Before training, hyperparameters α, β, and topic number K must be determined. α and β serve as initial values for document-topic and topic-word distributions and use default values, while K is determined using topic coherence metrics.

Parameter Determination and Topic Naming

Topic Number Determination

Topic number K is a crucial parameter in DTM. Existing studies often use manual determination or perplexity calculation [11-12,27-28], while Yue Lixin et al. [29] calculated consistency scores. M. Röder et al. [30] argue that similar words tend to appear in similar contexts. If the top N words of a topic are related, the topic is considered coherent. Through comparative verification, the c_v metric demonstrates higher accuracy in determining topic numbers.

Therefore, this study calculates coherence scores for policy texts across different topic numbers.

Assuming W is the set of top N most probable words for a topic, W = {W_1,⋯ ,W_N}, and S_i = (W', W*) represents word pairs formed by matching each word W' W with other words W* W. W' and W* are represented as context vectors through equation (5). The similarity of word pairs is obtained by calculating cosine similarity between vectors under S_i. Summing similarity values across topics yields the text coherence score. As shown in equation (6), we calculate coherence scores for different topic numbers, selecting the K value with the highest score:

argmax_K coherence(K) (6)

Topic Naming

Existing literature predominantly uses manual summarization based on keyword content [9,32], lacking objectivity. Policy titles typically contain key, summarizing information about policy content [32], which can be utilized for topic naming. Document-topic distribution indicates the membership rate of documents to different topics—higher distribution probability suggests policy d' s content aligns more closely with that topic. Topic names are extracted from titles of high-membership documents, as illustrated in [Figure 4: see original paper].

Data Sources and Preprocessing

Data Sources

The concept of "business environment" was first proposed by the World Bank in 2001. Therefore, this study selects business environment policy texts issued by China' s central and local governments from 2001-2020 as the dataset. Data were sourced from the Beida Fabao website' s Business Environment 专栏, which comprehensively collects business environment-related policy documents issued by Chinese governments since 1949, including central regulations and policies from 31 provincial-level administrative regions (excluding Hong Kong, Macao, and Taiwan), covering labor employment, market supervision, commercial arbitration, and other business environment domains. The data exhibit strong representativeness and authority. We collected 22,172 policy texts from 2001-2020, comprising 2,202 central policies and 19,970 local policies. Each text includes metadata such as issuing province, title, issuing authority, effectiveness level, issuance date, and timeliness status (currently effective, expired, or amended).

Temporal Distribution of Policies

Changes in policy issuance volume reflect shifts in central and provincial efforts toward business environment construction. [Figure 5: see original paper] shows annual issuance distribution from 2001-2020, with the blue line representing

central policies and yellow line representing local policies. The trends indicate three developmental phases:

1. **Exploration Phase (2001-2012)**: Business environment construction was newly proposed, with relatively low and fluctuating issuance volumes from both central and local governments, reflecting exploratory characteristics of the initial stage.

2. **Comprehensive Development Phase (2013-2018)**: The 18th National Congress of the Communist Party in 2012 set the goal of comprehensively building a moderately prosperous society and accelerating socialist modernization, promoting comprehensive business environment development [34]. Policy growth became significant. In 2018, the State Council issued the "Circular on Typical Practices for Optimizing Business Environment in Some Localities," marking a new height in business environment construction.

3. **High-Quality Development Phase (2019-Present)**: In 2019, the State Council promulgated the *Regulations on Optimizing the Business Environment*, China' s first comprehensive administrative regulation in this domain [21], providing institutional guarantees for standardizing local policies. Thereafter, issuance growth rates slowed for both central and local governments, indicating a shift from quantity to quality emphasis.

Regional Distribution of Policies

Dividing the data into the three phases above and further splitting the second phase into 2013-2015 and 2016-2018 based on different growth rates, we analyzed provincial annual issuance changes across four time periods, shown in [Figure 6: see original paper]. Results reveal that during 2001-2012, provinces with higher issuance volumes were primarily those with special economic zones and economic-technological development areas (e.g., Guangdong, Jiangsu), indicating earlier starts in coastal cities but generally low volumes across all regions. During 2013-2015, issuance growth was significant from coastal to inland areas, forming two centers: coastal provinces represented by Shandong and Guangdong, and southwestern provinces represented by Sichuan and Gansu. In the later second phase (2012-2018), Northeast and Central China strengthened efforts significantly, with Liaoning becoming the province with highest average annual issuance, and central provinces like Anhui and Henan showing rapid growth. Gansu surpassed Sichuan as the western region' s top issuer. In the third phase (2019-2020), coastal provinces (Guangdong, Shandong) and southwestern provinces (Sichuan, Gansu) remained centers, while Northeast and Central China saw slowed growth, suggesting all regions developed their own development rhythms.

Data Preprocessing

The preprocessing workflow ([Figure 7: see original paper]) involves: (1) screening data to remove files with missing data or unclear dates; (2) merging labels

and text into structured format for model training and subsequent analysis; (3) performing part-of-speech tagging, word segmentation, and stopword removal while importing custom dictionaries to improve segmentation quality; (4) using bag-of-words models for dimensionality reduction and adding n-grams based on co-occurrence counts [35].

Results

Topic Modeling Results

Topic Number Determination

We divided 2001-2020 policy texts into ten time slices (two-year windows). First, we performed LDA modeling on the entire dataset using gensim' s CoherenceModel with c_v metric, evaluating coherence scores at intervals of 10 topics. Results showed coherence peaked at K=30 and declined thereafter ([Figure 8: see original paper]), indicating the optimal topic number. Fine-grained evaluation at 5-topic intervals confirmed the optimal range as 25-35 topics. Combining multiple experimental results, we determined the optimal topic number as 30.

Topic Extraction Results

Using K=30 as the DTM parameter, we trained the model on time-sliced policy texts. DTM links each topic's parameters across time through a simple dynamic model, sequentially binding topic models to obtain document-topic distribution and topic-word distribution ϕ_{t,k} across ten time slices.

1. **Document-Topic Distribution**: This represents the probability of each policy document belonging to various topics (). Higher distribution probability indicates content more aligned with a topic. Averaging probabilities across documents in time slice t yields topic k' s intensity in that period.
2. **Topic-Word Distribution and Naming**: Based on topic-word distributions, we extracted the top 10 words with highest probability as topic keywords. Following the naming procedure in Section 3.3.2, we obtained topic names and merged them with keywords. shows the 30 topics and their keywords for time slice t1 (2001-2002) as an example.

Topic Categorization

Based on the above process, we extracted 30 topics from policy texts. However, analyzing each topic individually is challenging. The 13th Five-Year Plan outlines four business environment dimensions: government environment, market environment, legal environment, and humanistic environment [21]. Therefore, we categorized the 30 topics into these four dimensions to enhance extensibility and interpretability.

Combining existing research, we clarified each dimension' s connotations to provide basis for topic categorization: (1) **Government Environment**: Based on "intimate" and "clean" government-business relations [36], including "government

care" and "government integrity," plus "government efficiency" and "government expenditure" from provincial evaluation systems [21]. Since the business environment evaluation system includes "enterprise tax burden" as a secondary indicator of "intimacy," we categorized "taxation" under "government care." (2) **Market Environment**: "Financing," "fair competition," and "resource acquisition" derive from market environment indicators [21], while "technological innovation" distinguishes market-driven innovation from government innovation [37]. (3) **Legal Environment**: Based on legal business environment construction paths [7], including "perfecting legislation,""standardizing law enforcement," and "impartial justice." (4) **Humanistic Environment**: Social culture and concepts affecting enterprise development [38], including "opening-up," "social credit," "ecological concepts," and "humanistic services."

Accordingly, we categorized the 30 topics into the four dimensions () for subsequent evolution analysis.

Topic Intensity Evolution

Overall Intensity Evolution Across Dimensions

Overall intensity evolution examines temporal changes across all policies (central and local). Dimension intensity is calculated as the sum of constituent topic intensities, with results shown in [Figure 9: see original paper]. Overall, policy texts emphasize government and market environments, with relatively low attention to legal and humanistic environments. Different phases show distinct characteristics:

- In government and market environments, intensities developed alternately. Before 2003, government environment intensity far exceeded others, indicating policy-driven business environments with insufficient market demand. After China' s WTO entry in 2001, rapid foreign trade development shifted focus toward stimulating domestic demand, raising market environment intensity. During 2005-2012, both environments fluctuated alternately, but market environment generally dominated. After 2013, government efforts intensified again, demonstrating government' s continued leading role.
- In legal and humanistic environments, intensities were far lower than government and market environments, but legal environment attention gradually increased, especially after 2010. The 2019 *Regulations* placed business environment construction on a legal track [7], emphasizing marketization and legalization. Humanistic environment intensity showed no clear upward trend, though recent attention slightly increased compared to earlier years.

Regional Intensity Evolution Across Dimensions

Since local governments have different priorities, we analyzed regional business environment intensity evolution. The National Bureau of Statistics divides

China into four economic regions—Eastern, Central, Western, and Northeastern —based on socio-economic development [39]. We calculated intensity distributions across dimensions for each region, with Beijing and Shanghai (benchmark cities) analyzed separately for comparison ([Figure 10: see original paper]):

1. **Inverse trends between government and market environments**: Regions emphasizing government environment (e.g., Northeastern China) showed lower market environment attention, while Eastern regions like Beijing and Shanghai focused more on market environment construction. Central policies maintained relatively balanced attention, indicating local governments follow central policy concepts but with varying intensity.
2. **Since 2013**, all regions showed declining government environment intensity and rising market, legal, and humanistic environment intensities, indicating a shift from government-driven to multi-dimensional balanced development.
3. **Legal environment**: Shanghai' s intensity curve significantly exceeded other regions and showed an upward trend, approaching central policy levels. This reflects Shanghai People' s Congress' s extensive local regulations on foreign investment and SME development. Central and Western regions, especially Western China, showed insufficient legal environment construction, indicating they remain "followers" with weak legal awareness and incomplete institutional systems.
4. **Humanistic environment**: Central policy intensity significantly exceeded local policies with divergent trends, indicating poor local implementation and expansion of central policies, suggesting humanistic environment improvement warrants greater attention.

Theme Intensity Evolution Within Dimensions

We conducted temporal comparative analysis of theme intensity within each dimension using seaborn visualization:

1. **Government Environment** ([Figure 11: see original paper]): Focus shifted from standardizing administrative approval systems to optimizing management methods and service capacity. "Administrative approval" intensity was high in 2001-2004 but declined with system improvements. "Administrative licensing"remained important, peaking again in 2013 when the State Council issued reform policies. The government environment has reached relative balance, indicating stable progress.
2. **Market Environment** ([Figure 12: see original paper]): Emphasis shifted from policy-driven to market-led measures. Early focus on "deepening economic system reform" and "employment assistance" (especially high in 2009 amid financial crisis) gradually transitioned to encouraging entrepreneurship, industrial transformation, and market-oriented resource allocation. Recent policies emphasize "real estate

registration," "construction projects," and "industrial transformation and upgrading."

3. **Legal Environment** ([Figure 13: see original paper]): Only three topics exist– "handling bankruptcy," "establishing fair competition review system," and "administrative law enforcement" –indicating insufficient policy attention. However, since 2013, awareness of legal business environment construction has strengthened, with all topics showing upward trends. The focus serves government and market environment standardization through legislation, justice, and enforcement.

4. **Humanistic Environment** ([Figure 14: see original paper]): "Credit system construction" and "cross-border trade" intensities increased overall, reflecting implementation of the 2014 *Social Credit System Construction Planning Outline* and 2019 Free Trade Zone policies. However, "green development" and "smart medical services" remained low, indicating these are not yet priorities.

Discussion and Recommendations

Our topic mining of business environment policy texts reveals:

1. **Temporal and spatial distribution**: China' s business environment policies have experienced exploration, comprehensive development, and are now in a high-quality development phase focused on improvement and standardization. Guangdong, Shandong, and other coastal provinces plus southwestern provinces like Sichuan formed two policy issuance centers with radiating effects, though some Western and Northeastern provinces show weak policy intensity, indicating regional barriers to policy diffusion.

2. **Dimensional intensity evolution**: Government and market environments are the main "battlefields" for improving business environment quality. Since 2013, declining government environment intensity and rising market, legal, and humanistic environment intensities indicate more diversified, balanced development approaches. Significant regional differences exist, particularly in humanistic environment where central-local trends diverge markedly, suggesting insufficient guiding policies and weak central-to-local driving effects.

3. **Theme priorities and trends**: Government environment emphasizes IT empowerment to improve efficiency and reduce institutional transaction costs. Market environment focuses on stimulating vitality and optimizing resource allocation. Legal environment stresses using legal construction to standardize market and government environments. Humanistic environment prioritizes opening-up and credit construction. All dimensions continuously evolve, showing adaptive policy adjustments.

Recommendations:

1. **Coordinate regional policy intensity**: Policy issuance volume reflects regional support strength. Uncoordinated regional efforts widen development gaps. We should leverage advanced provinces' diffusion and radiation effects, encourage cross-provincial circulation of innovative policy concepts, and increase support for less active regions to narrow gaps and enhance coordinated development.

2. **Balance effective market and capable government**: Currently, government environment intensity exceeds market environment intensity, but the trend shows reduced government intervention and strengthened market construction. While government improvements directly enhance convenience, relying solely on government environment has limited effects. Long-term quality improvement requires stimulating market vitality, accelerating factor marketization, and optimizing resource allocation. Regional economic characteristics should be considered to balance government and market policy intensity, addressing weaknesses while consolidating advantages.

3. **Emphasize overarching legal construction**: Legalization and standardization are powerful approaches to improve government and market environment quality [40]. All regions show rising legal environment intensity. At the central level, authoritative business environment laws should be formulated, with effective reform measures legislated and promoted. Locally, especially in Northeastern and Western regions with low legal environment intensity, governments should innovate based on local conditions to improve local regulations.

4. **Leverage technology empowerment and innovation**: Theme intensity analysis shows policy frontiers continuously evolve with socio-economic development. All dimensions should actively innovate according to current needs and key influencing factors. In government environment, digital technology should be applied to advance "decentralization, regulation, and service" reforms, resolving information silos in administrative approval. For market environment, focus should be on core technology control, SME support, and resource optimization to build fair, competitive, and dynamic markets. In legal environment, existing laws should be timely supplemented and adjusted to address new challenges in market and government construction. Humanistic environment policies have substantial development space—green, open, honest, and scientific cultural concepts should be valued for their subtle influences, with continuous innovation and exploration.

Conclusion

This study applies policy 计量 methods and text mining algorithms to analyze business environment policy texts, revealing quantitative distribution and spatiotemporal evolution of thematic intensity. We determined 30 optimal topics

through text coherence calculation, divided policy texts into ten time slices, and obtained document-topic and topic-word distributions. After categorizing topics into four dimensions, we analyzed central-local policy attention changes, dimensional intensity evolution, and content evolution within each dimension. This provides a new perspective for comprehensively reviewing China' s business environment policies and offers fresh insights for governance. Future work should employ text analysis and big data technologies to deeply analyze policy effectiveness, evaluation indicators, and implementation status across regions, exploring implicit patterns in policy formulation, issuance, and execution to enhance business environment construction at both central and local levels.

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Author Contributions:
Liu Kan: Responsible for topic guidance, manuscript writing and revision.
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Peng Hufeng: Research guidance and manuscript revision.
Huang Manyu: Manuscript revision and logical structuring.

Note: Figure translations are in progress. See original paper for figures.