



# Complex System Research on China-EU Trade Based on Bilateral Policy Knowledge Extraction

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**Abstract:** Against the backdrop of reshuffled global economic governance and rising unilateralism, China and the EU, as two core global economies, share bilateral trade ties critical to world economic stability. In 2020, China proposed the dual-circulation new development strategy; meanwhile, the negotiation of the Comprehensive Agreement on Investment (CAI) between China and the EU was finalized, marking a breakthrough in cross-border institutional coordination. Taking China-EU institutional relations as the core explanatory variable, this paper constructs a theoretical framework of “institutional coordination - bilateral trade effect” based on trade gravity model and institutional complementarity theory. Using panel data covering 2001-2024, we quantify institutional coordination intensity via policy text scoring (policy objective score + policy measure score + policy weight). Two-way fixed-effect model, System GMM dynamic panel, mediating effect model and heterogeneous regression are adopted for empirical tests. The results show that: (1) Deepened China-EU institutional coordination significantly expands total bilateral trade, and the conclusion passes multiple robustness and endogeneity tests; (2) Institutional trade dividends show industrial heterogeneity: technology-intensive > capital-intensive > labor-intensive sectors; (3) The dual-circulation strategy positively moderates the trade promotion effect of institutional relations; (4) Institutional coordination boosts trade by two channels: tariff reduction and intermediate goods value chain integration. Finally, differentiated industrial coordination and rule convergence policy suggestions are put forward.

**Keywords:** Policy Knowledge Extraction, Complex Economic System, Dual Circulation Pattern, China-EU Trade, Text Quantification, System Moderation Effect

## INTRODUCTION

### Research Background

In May 2020, China officially put forward the dual-circulation development paradigm, which takes domestic circulation as the mainstay and realizes mutual promotion between domestic and international markets. In 2025, the 50th anniversary of China-EU diplomatic relations witnessed intensified structural complementarity and systemic frictions between the two sides. In 2024, China exported 236GW photovoltaic modules to Europe, accounting for 40% of total PV shipments; however, the EU's Foreign Subsidies Regulation and Carbon Border Adjustment Mechanism created new institutional barriers. The CAI negotiation in 2020 laid a foundation for high-standard rule alignment, yet the implementation gap between bilateral agreements and real trade performance remains unclarified by existing literature. Existing studies mostly focus on tariff or FTA impacts, while few quantify institutional

coordination from original policy texts and discuss its interaction with the dual-circulation strategy. This paper fills this research gap.

## Literature Review

Three strands of relevant literature are sorted out:

**International trade policy coordination:** Viner put forward the trade creation and trade diversion effects of customs union theory [1]. Baldwin's research on global value chains laid a theoretical foundation for analyzing integrated trade agreements [2]. Limão further verified that deep integration clauses can effectively weaken trade diversion effects [3]. Gawande constructed an inverted U-shaped relationship between agreement depth and trade volume, which revised the traditional linear cognition [4]. The OECD quantified implicit tariff costs caused by inconsistent technical standards and verified the efficiency gain of standard mutual recognition [5]. Domestic scholars confirmed that financial opening improves trade coordination efficiency through exchange rate and cross-border payment channels [8].

**China-EU bilateral relations:** Existing studies point out that green and digital industries have great cooperation potential between China and the EU, but the EU's de-risking strategy and divergent technical standards lead to institutional trust deficit [6]. Many studies have analyzed the complementary advantages of wind power, photovoltaic and cross-border e-commerce, yet systemic institutional conflicts restrict the expansion of bilateral trade scale [9].

**Dual-circulation research:** A large number of scholars have interpreted the internal and external linkage connotation of the dual-circulation paradigm. Relevant empirical studies verified that China-Europe Railway Express can smooth the operation of global industrial and supply chains under the new development pattern [7].

**Literature Gap:** Prior literature rarely constructs a continuous institutional coordination index through full policy text quantification. Existing research lacks systematic empirical tests covering the moderating effect of the dual-circulation strategy and industrial heterogeneity, which this paper innovatively makes up for.

## Research Content and Innovations

**Research Framework:** Theoretical deduction → policy text index construction → baseline and heterogeneous regression → mechanism test → policy suggestions.

**Innovations:**

- (1) **Perspective Innovation:** Integrate dual-circulation as a moderating variable into institutional trade research, breaking single-factor trade analysis frameworks.
- (2) **Method Innovation:** Build multi-dimensional institutional coordination index based on summit communiqués, bilateral treaties and MOUs under DESTA framework; adopt System GMM and instrumental variable to alleviate endogeneity.
- (3) **Mechanism Innovation:** Distinguish tariff barrier and value chain two mediating channels, quantify their respective contribution rates to trade growth.

## **THEORETICAL FRAMEWORK AND RESEARCH HYPOTHESES**

### **Core Concepts**

- (1) **Dual Circulation:** A high-standard opening strategy relying on ultra-large domestic market, realizing two-way factor flow between domestic demand and global industrial chains.
- (2) **China-EU Economic and Trade Institutional Coordination:** Continuous rule alignment via summits, bilateral agreements and industrial dialogues, covering market access, IP, green standards and dispute settlement.

### **Theoretical Basis**

- (1) **New-New Trade Theory:** Lower institutional trade costs raise firms' export participation rate and reallocate resources to high-productivity enterprises.
- (2) **Trade Gravity Model:** Institutional coordination shortens "institutional distance" between economies, offsetting geographical trade resistance.
- (3) **Institutional Complementarity Theory:** China's manufacturing scale and EU high-standard rules form functional complementarity to generate trade dividends.
- (4) **International Policy Coordination Theory:** Cross-border rule coordination eliminates policy spillover risks and stabilizes trade expectations.

### **Research Hypotheses**

Amid global value chain restructuring, geopolitical tensions and China's dual-circulation high-quality growth strategy, institutional barriers rather than traditional tariff quotas have become primary constraints on China-EU trade. Synthesizing the four preceding theoretical frameworks, this paper puts forward four core hypotheses concerning overall trade effects, industrial heterogeneous differences, the moderating role of the dual-circulation strategy and dual transmission mechanisms:

- **H1:** Deepened China-EU economic and trade institutional relations exert a significantly positive promoting effect on total bilateral trade volume.

Institutional alignment eliminates policy spillover frictions and reduces cross-border compliance, negotiation and risk costs, which offsets the restraining impact of geographical distance as illustrated by the extended trade gravity model. From a micro perspective, lower trade entry thresholds expand the number of export heterogeneous firms and realize the reallocation of industrial resources toward high-productivity traders, thereby boosting aggregate bilateral trade in line with the logic of New-New Trade Theory. Dynamic System GMM regressions further verify that institutional coordination generates lasting, cumulative trade promotion benefits over the long run.

- **H2:** The trade-promoting effect of institutional relations shows prominent industrial heterogeneity, with the magnitude of effects ranked as technology-intensive industries > capital-intensive industries > labor-intensive industries.

Labor-intensive sectors mainly gain competitiveness from labor cost advantages; the prevailing low baseline tariff rates for manufactured goods leave limited room for marginal cost reduction brought by institutional coordination, resulting in the weakest trade response to institutional alignment.

Capital-intensive sectors feature long value chains and large-scale cross-border capital exposure. Coordinated investment and industrial policies effectively hedge long-cycle operational risks and deliver moderate trade dividends from institutional coordination.

Technology-intensive industries rely heavily on intellectual property protection and unified technical standards. Institutional coordination removes core obstacles to cross-border high-tech transactions and yields the strongest marginal trade growth effects.

- **H3:** The marginal trade promotion effect of economic and trade institutional relations is significantly amplified after the launch of the dual-circulation strategy.

Demand-side logic: China's ultra-large domestic market generates substantial import demand for EU high-end equipment and low-carbon technologies, allowing institutional coordination to stimulate incremental trade growth beyond the existing trade scale.

Supply-side logic: Domestic industrial upgrading strengthens the complementary matching degree with EU advanced manufacturing sectors. Unified institutional platforms facilitate two-way high-tech commodity flows and realize simultaneous expansion in trade volume and quality.

Expectation-side logic: The dual-circulation paradigm signals China's commitment to high-standard institutional opening-up, stabilizes enterprises' long-term investment and trade expectations, and fully unlocks the dividends of bilateral institutional coordination.

- **H4:** Institutional coordination drives bilateral trade growth via two distinct transmission mechanisms: the tariff reduction channel and cross-border intermediate goods expansion channel.

On the tariff channel, synchronized market access rules, harmonized customs certification standards and the phase-out of discriminatory tariff clauses jointly lower the overall tariff barriers between China and the EU, cutting the direct circulation cost of cross-border commodities. On the value chain channel, consistent industrial and investment rules break the segmentation of transnational production links, enable the free flow of intermediate inputs between upstream and downstream firms of both sides, and deepen the integration of China and the EU within global value chains, forming a persistent endogenous driver of bilateral trade expansion. The stepwise mediating effect model confirms that the intermediate goods value chain integration channel contributes a larger proportion of total trade growth than the tariff reduction path, which identifies value chain synergy as the dominant transmission route of institutional trade dividends.

### **MEASUREMENT OF CHINA-EU INSTITUTIONAL COORDINATION**

This part analyzes China-EU institutional coordination across four dimensions: coverage areas, operational mechanisms, practical achievements and prevailing challenges. It then

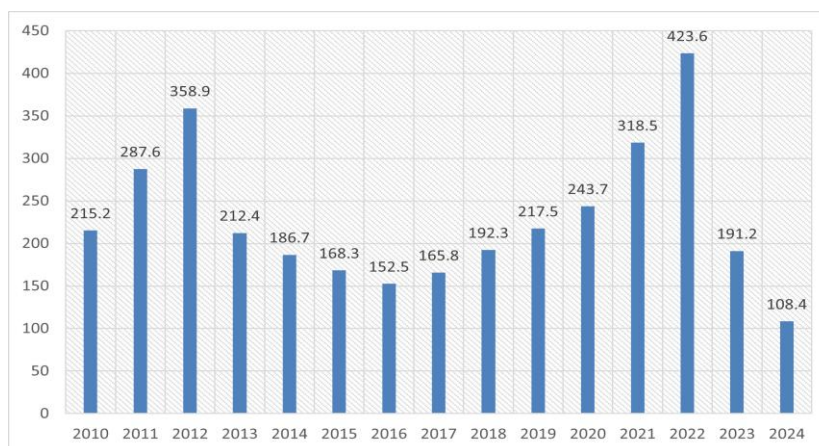
constructs a comprehensive quantitative framework, calculating policy objective scores and policy measure scores to compile the final economic and trade institutional relation index.

## Current Status of China-EU Economic and Trade Institutional Relations

### *Areas of Institutional Coordination*

China-EU institutional alignment has expanded beyond goods trade into an integrated multi-sector framework covering traditional industries, green transition, digital economy and intellectual property.

- (1) **Traditional Trade (Geographical Indications):** The China-EU Geographical Indications Agreement (effective March 2021) established a product quality and market access coordination mechanism, initially mutually recognizing 100 GI products from each side, with a second batch of 175 under negotiation. Four years post-implementation, Zhejiang's 18 listed GI products saw annual output rise 80% to CNY 13 billion, with exports hitting CNY 760 million, verifying tangible industrial trade gains from institutional alignment.
- (2) **Green Energy Transition:** China's photovoltaic manufacturing advantages match EU renewable demand. In 2024, Chinese solar panels constituted 98% of EU imports (EUR 10.9 billion), while Chinese liquid biofuels captured 24% of EU import share. China's 2024 *Digital Economy Work Plan* aligns with the EU Green Deal to advance cross-border green technology R&D and standard mutual recognition.

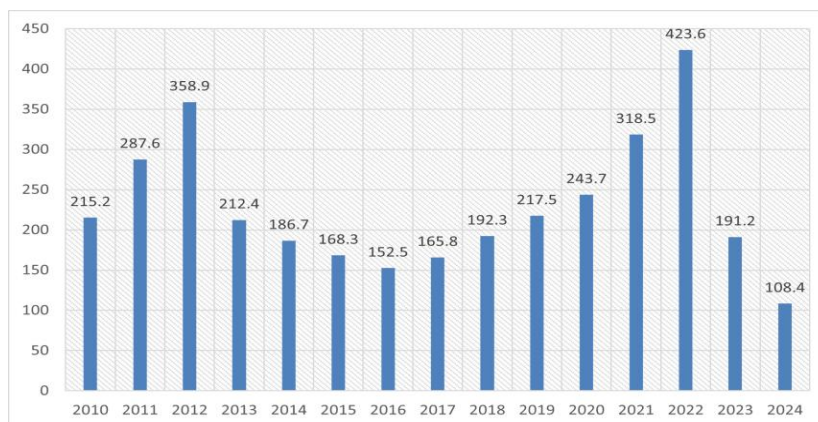


**Figure 1: China's PV Exports to the EU, 2010-2024 (Unit: USD 100 million)**

[Bar chart: X-axis 2010-2024; peak USD 42.36 billion in 2022, falling to USD 10.84 billion in 2024 due to EU trade protection policies and inventory backlogs]

- (3) **Digital Economy Coordination:** Mechanisms including the Beijing Initiative on the Digital Economy under the Belt and Road facilitate dialogue on cross-border data flows and industrial digitalization. The EU Digital Markets Act (fully effective March 2024) provides standardized benchmarks for bilateral digital rule alignment, with platforms like SHEIN leveraging coordinated logistics and customs rules to cut European delivery times to 4-6 working days.

- (4) **Intellectual Property Alignment:** Coordination has evolved from dispute resolution to joint rule-making. China revised patent and trademark laws to converge with EU high standards.



**Figure 2: Number of China-EU IP Dispute Cases, 2010-2024 (Unit: Cases)**

[Bar chart: Peak 184 cases in 2013; decline to 89 in 2019; rebound to 116 in 2024 amid rising high-tech competition]

### ***Institutional Coordination Mechanisms***

A multi-tier system combining high-level leader dialogues, special bilateral agreements and industrial working groups has taken shape:

- (1) **High-Level Leader Summits:** The 24th China-EU Leaders' Meeting (2023) defined coordinated priorities covering strategy, trade, green energy and digitalization. The 2024 Italy-China Comprehensive Strategic Partnership Action Plan (2024-2027) translated strategic consensus into concrete IP and green energy cooperation measures.

**Table 1: China-EU Leaders' Meeting Documents, 2001-2020**

| Year | Document Title                                                                      |
|------|-------------------------------------------------------------------------------------|
| 2001 | Joint Press Communiqué, 4th China-EU Summit                                         |
| 2002 | Joint Press Communiqué, 5th China-EU Summit                                         |
| 2003 | Joint Press Communiqué, 6th China-EU Summit                                         |
| 2004 | Joint Statement, 7th China-EU Summit                                                |
| 2005 | Joint Statement, 8th China-EU Summit                                                |
| 2006 | Joint Statement, 9th China-EU Summit                                                |
| 2007 | Joint Statement, 10th China-EU Summit                                               |
| 2009 | Joint Press Communiqué, 11th China-EU Summit; Joint Statement, 12th China-EU Summit |
| 2010 | Joint Press Communiqué, 13th China-EU Summit                                        |
| 2012 | Joint Press Communiqué, 14th & 15th China-EU Summits                                |
| 2013 | China-EU 2020 Strategic Agenda for Cooperation, 16th China-EU Summit                |
| 2015 | Joint Statement, 17th China-EU Summit                                               |
| 2017 | Outcome List, 19th China-EU Summit                                                  |
| 2018 | Joint Statement, 20th China-EU Summit                                               |
| 2019 | Joint Statement, 21st China-EU Summit                                               |
| 2020 | Outcome Document, 22nd China-EU Summit                                              |

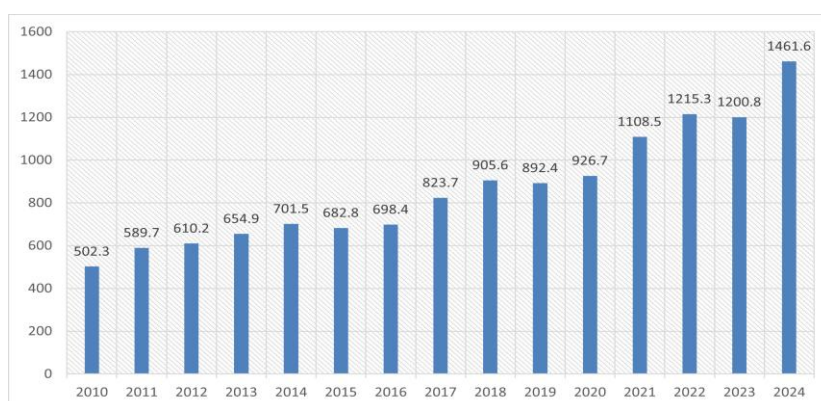
- (2) Special Bilateral Agreements: Beyond the GI treaty, double taxation avoidance, social security and aviation safety agreements form core institutional support.

**Table 2: Selected China-EU Bilateral Agreements, 2010-2023**

| Year | Document Title                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 2012 | Agreement Between China and Denmark for the Avoidance of Double Taxation and Prevention of Fiscal Evasion with Respect to Taxes on Income |
| 2013 | Sino-French, Sino-Dutch Double Taxation Agreements                                                                                        |
| 2014 | Sino-Finnish Social Security Agreement; Sino-German Double Taxation & Property Tax Agreement                                              |
| 2016 | Supplementary Sino-Dutch Social Security Agreement                                                                                        |
| 2017 | Sino-Spanish Social Security Agreement                                                                                                    |
| 2019 | Sino-Italian Double Taxation Agreement; China-EU Civil Aviation Safety Agreement                                                          |
| 2020 | Cultural Property Anti-theft Agreement with Romania; China-EU Geographical Indications Agreement                                          |
| 2023 | Sino-Greece Air Transport Agreement                                                                                                       |

### *Achievements of Institutional Coordination*

Total bilateral trade remains robust with optimized structural composition. In 2024, China ranked the EU's largest import source and third-largest export destination, with EU exports to China at EUR 213.3 billion and imports at EUR 517.8 billion. Intermediate goods trade reflects deep supply chain integration.



**Figure 3: China's Intermediate Goods Exports to the EU, 2010-2024 (Unit: EUR 100 million)**

[Bar chart: Growth from EUR 50.23 billion (2010) to EUR 146.16 billion (2024), 12.0% average annual growth, 21.8% year-on-year rise in 2024]

Green and digital cooperation serve as new growth engines: 2024 EU clean energy imports reached EUR 14.6 billion; joint Sino-EU clean energy R&D investment expanded from EUR 1 billion (2010) to EUR 4.8 billion (2024), accounting for 32% of EU overseas R&D spending across seven shared technology platforms covering solar, wind and energy storage. Cross-border e-commerce platforms like SHEIN expanded European operations via coordinated logistics and digital regulatory frameworks.

### Challenges Facing Institutional Coordination

- (1) **Divergent Digital and Green Rules:** The EU Digital Markets Act imposes strict platform compliance burdens on Chinese firms; the CBAM creates mismatched carbon accounting and technical standard frameworks, raising adaptation costs for Chinese exporters.
- (2) **Unilateral Protectionist Measures:** The EU Foreign Subsidies Regulation has forced Chinese firms to withdraw from multiple public procurement bids since July 2023. Past anti-dumping and anti-subsidy duties on photovoltaics, alongside 2023-2024 anti-circumvention investigations, crashed Chinese PV export volumes to the EU from USD 42.36 billion (2022) to USD 10.84 billion (2024).
- (3) **Implementation Delays:** Consensus reached at high-level summits faces slow rollout across individual EU member states; misalignment between central Chinese coordination policies and local implementation hinders full institutional dividend realization.

### Comprehensive Measurement of China-EU Economic and Trade Institutional Relations

#### Measurement Framework

Trade volumes and tariff rates are ex-post economic indicators unable to capture forward-looking policy coordination; official summit communiqués, joint statements and bilateral agreements constitute the most authoritative texts for quantifying institutional alignment. This index integrates three dimensions: policy objective scores, policy measure scores and policy intensity:

- (1) **Policy objectives:** Text mining of 74 2001-2024 summit documents via NVivo, weighted by keyword categories (rule alignment, sector cooperation, institutional mechanisms).
- (2) **Policy measures:** Scoring of CAI, MOUs and bilateral treaties under the DESTA five-domain framework (market access, IP, sustainability, dispute settlement, standards).
- (3) **Policy intensity:** Weighted by document tier and type, following Peng Jisheng and Zhong Weiguo's classic policy measurement framework [10].

**Table 3: Policy Document Tier Weights**

| Tier | Document Type                                                   | Weight Formula                                             |
|------|-----------------------------------------------------------------|------------------------------------------------------------|
| 1    | Joint China-EU official documents                               | 1.0                                                        |
| 2    | Unilateral national strategic documents (China/EU)              | 0.9                                                        |
| 3    | Bilateral ministerial joint documents                           | $0.8n/(0.9n+0.1)$ , $n$ = number of co-issuing departments |
| 4    | Unilateral national ministry / single EU member state documents | 0.7                                                        |
| 5    | Bilateral local / industrial association documents              | $0.6n/(0.7n+0.1)$                                          |
| 6    | Unilateral local implementation circulars                       | 0.5                                                        |

**Table 4: Policy Type Weights (Descending Binding Force)**

| Document Type                             | Weight |
|-------------------------------------------|--------|
| CAI Comprehensive Agreement on Investment | 1.0    |
| Formal bilateral treaties                 | 0.9    |
| Memoranda of Understanding (MOUs)         | 0.8    |
| Summit joint communiqués                  | 0.7    |
| Leaders' meeting outcome bulletins        | 0.6    |

Policy Intensity Formula:

$$PI = PL \times PT, \text{ } PL = \text{document tier weight, } PT = \text{document type weight.}$$

### **Policy Objective Scores**

#### **Step 1: Keyword Classification and Weighting**

**Table 5: Keyword Classification Table**

| Coordination Dimension   | Core Keywords                                                                             | Weight |
|--------------------------|-------------------------------------------------------------------------------------------|--------|
| Rule Alignment           | Mutual recognition, alignment, unified standards, certification, compliance               | 0.4    |
| Sector Cooperation       | Trade & investment, green low-carbon, digital economy, tech innovation, global governance | 0.3    |
| Institutional Mechanisms | Joint, co-build, pilot working groups                                                     | 0.3    |

Single-document objective score formula (10-point standardized TF weighting):

$$\text{Score}_{obj} = TF_{\text{rule}} \times 0.4 + TF_{\text{sector}} \times 0.3 + TF_{\text{mechanism}} \times 0.3$$

#### **Step 2: Measurement Results**

Scores fluctuate cyclically between 8.45 (2002 minimum) and 70.35 (2018 peak), shaped by global events and bilateral strategic shifts:

- 2001-2004: Gradual growth via systematic high-level dialogue establishment, peaking in 2003 with China's first EU policy paper prioritizing comprehensive strategic partnership.
- 2005 and 2009 sub-peaks driven by bilateral member-state treaties and joint financial crisis response coordination.
- 2013: *China-EU 2020 Strategic Agenda* lifted long-term alignment intentions; 2018 historic high from multi-country joint statements on BRI climate and third-market cooperation.
- 2019-2022: Continuous decline amid EU's three-tier China positioning (partner, competitor, systemic rival), bottoming at 7.32 in 2022.
- 2024 Sharp rebound (68.45) from practical action-oriented bilateral action plans with Finland, Italy, Poland and Hungary.

### Policy Measure Scores

Scoring follows the DESTA five-domain binding strength framework (market access, IP, sustainability, dispute settlement, standards), adopting binary yes/no scoring for non-core agreements and tiered binding weights. 102 MOUs and treaties were filtered to 62 complete valid documents:

- 2001-2004: Predominantly weak-binding MOUs, low scores (0.2825 in 2002); 2004 Sino-Italy IP Agreement marks early formal institutional alignment.
- 2005 All-time peak (1.0410): Mass signing of bilateral investment protection treaties with major EU member states covering market access, fair treatment and investor-state dispute settlement.
- 2010-2017: Expansion into double taxation and social security cooperation; 2014 Sino-Finnish Social Security Agreement establishes mobility institutional breakthrough.
- 2018-2024: 2020 secondary peak (0.6980) driven by the China-EU GI Agreement and finalized CAI text (historic high-standard investment rules); 2021-2022 declines due to CAI ratification suspension; 2024 low score (0.0225) reflects tentative low-sensitivity carbon trading cooperation amid stalled comprehensive treaty progress.

### Economic and Trade Institutional Relation Index

Data source: 74 China-EU summit documents, bilateral treaties and memoranda (2001-2024). Three layers of indicators:

- (1) Policy Objective Score: Classify keywords into rule alignment (0.4 weight), sector cooperation (0.3), institutional mechanism (0.3); calculate standardized TF word frequency score.
- (2) Policy Measure Score: Adopt DESTA five-dimensional scoring system (market access, IP, sustainability, dispute settlement, standards) to measure treaty binding force.
- (3) Policy Intensity ( $PI$ ):  $PI = PL \times PT$ ,  $PL$  = document tier weight,  $PT$  = document type weight.

Final annual institutional coordination index:

$$PC_t = \sum_{j=1}^N PG_j \times PI_j$$

$PG_j$  = objective/measure score of document  $j$ ;  $N$  = number of policies released in year  $t$ .

### Stylized Facts

- (1) Coordination Fields: Traditional GI trade, green energy (PV), digital economy, IP four core sectors. China's PV export to EU peaked at USD 42.36 billion in 2022, then dropped due to EU protective policies.
- (2) Multi-level Coordination Mechanism: Annual leader summits + special bilateral treaties + industrial working groups form a three-tier cooperation system.

- (3) Constraints: Divergent digital regulatory rules, CBAM, foreign subsidy review and delayed domestic implementation of summit consensus hinder coordination efficiency.

## EMPIRICAL DESIGN

### Model Setting

#### *Baseline Two-way Fixed Effect Model*

$$\begin{aligned} LnTrade_{it} = & \alpha + \beta_1 PC_{it} + \beta_2 (PC_{it} \times DC_t) + \gamma_1 LnGDP_{EU,it} + \gamma_2 REER_{ct} \\ & + \gamma_3 GPR_t + \gamma_4 LnFDI_{EU,it} + \gamma_5 TechGap_{ct} + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned}$$

i = EU member state, t = year; DC<sub>t</sub> = dual-circulation dummy (1 for 2020-2024, 0 otherwise);  $\mu_i, \lambda_t$  = country and year fixed effects.

#### *Dynamic Panel Model (System GMM)*

$$\begin{aligned} LnTrade_{it} = & \alpha + \rho LnTrade_{i,t-1} + \beta_1 PC\_stock_{it} + \beta_2 (PC\_stock_{it} \times DC_t) \\ & + \sum \gamma Control + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned}$$

$$PC\_stock_{it} = (1 - \delta) PC\_stock_{i,t-1} + PC_{it}, \quad \delta = 5\% \text{ policy depreciation rate.}$$

#### *Mediating Effect Model*

$$\begin{cases} WMATR_{it} = a_1 PC_{it} + \sum \gamma X + \mu_i + \lambda_t + \varepsilon_1 \\ LnIgTrade_{it} = a_2 PC_{it} + \sum \gamma X + \mu_i + \lambda_t + \varepsilon_2 \\ LnTrade_{it} = c PC_{it} + b_1 WMATR_{it} + b_2 LnIgTrade_{it} + \sum \gamma X + \mu_i + \lambda_t + \varepsilon_3 \end{cases}$$

WMATR = weighted average tariff; LnIgTrade = log intermediate goods trade volume.

### Variable Definition and Data Source

**Table 6: Variable Definition and Data Source**

| Variable | Definition                                         | Data Source                      |
|----------|----------------------------------------------------|----------------------------------|
|          | Log (1+China-EU bilateral trade, ten thousand USD) | UN Comtrade                      |
|          | Annual institutional coordination index            | Self-calculated via policy texts |
|          | Cumulative institutional stock index               | Self-calculated                  |
|          | Dual-circulation dummy variable                    | Artificial assignment            |
|          | Log GDP of EU member states                        | World Bank WDI                   |
|          | RMB real effective exchange rate (2015=100)        | BIS                              |
|          | Global policy uncertainty index                    | EPU Database                     |
|          | Log China's outward FDI stock to EU                | MOFCOM                           |
|          | China/EU PCT patent ratio                          | WIPO                             |
|          | Weighted average tariff                            | WITS                             |
|          | Log intermediate goods trade (BEC code)            | UN Comtrade                      |

Sample: Balanced panel data of EU member states, 2001-2024, total 613 observations.

## EMPIRICAL RESULTS AND ANALYSIS

### Baseline Regression

**Table 7: Baseline Regression Results**

| Variable   | Pooled OLS      | Random Effect   | Two-way FE      | System GMM      |
|------------|-----------------|-----------------|-----------------|-----------------|
|            | 0.966***(0.207) | 0.778***(0.154) | 0.812***(0.139) | —               |
|            | —               | —               | —               | 0.867***(0.189) |
|            | 0.651**(0.301)  | 0.668***(0.148) | 0.789***(0.089) | —               |
|            | —               | —               | —               | 0.624***(0.059) |
| Controls   | Yes             | Yes             | Yes             | Yes             |
| Country FE | No              | No              | Yes             | Yes             |
| Year FE    | No              | No              | Yes             | Yes             |
| Obs        | 613             | 613             | 613             | 613             |
| AR (2) p   | —               | —               | —               | 0.352           |
| Hansen p   | —               | —               | —               | 0.289           |

Notes: \*\*\*p<0.01, \*\*p<0.05, standard errors in parentheses, same below.

The coefficient of PC under two-way fixed effect is 0.812 and significant at 1%, which verifies H1: institutional coordination significantly promotes bilateral trade. System GMM result proves institutional coordination has persistent long-term cumulative trade benefits. The interaction term PC\times DC is significantly positive, preliminarily supporting H3.

### Industrial Heterogeneity Test

**Table 8: Heterogeneous Regression by Factor Intensity**

| Variable      | Labor-intensive | Capital-intensive | Tech-intensive  |
|---------------|-----------------|-------------------|-----------------|
|               | 0.610***(0.072) | 0.726***(0.059)   | 0.806***(0.103) |
| Controls & FE | Yes             | Yes               | Yes             |
| Obs           | 613             | 613               | 613             |

Notes: \*\*\* p<0.01; standard errors in parentheses; FE denotes fixed effects.

The coefficient ranking: Tech > Capital > Labor, fully confirms H2. Labor-intensive industries rely on labor cost advantages and gain limited institutional dividends; high-tech sectors depend heavily on IP and standard mutual recognition, so coordination brings the strongest trade growth.

### Moderating Effect (Sub-period Regression)

**Table 9: Pre and Post Dual-circulation Regression**

| Variable      | 2001-2019       | 2020-2024       |
|---------------|-----------------|-----------------|
|               | 0.657***(0.062) | 0.781***(0.051) |
| Controls & FE | Yes             | Yes             |
| Obs           | 478             | 135             |

Notes: \*\*\* p<0.01; standard errors in parentheses; FE denotes fixed effects.

Post-2020 coefficient is larger, which indicates dual-circulation amplifies the marginal trade effect of institutional coordination, H3 holds.

### Mediating Mechanism Test

Adopt Baron and Kenny stepwise mediating regression framework [9] for two transmission channels: tariff barrier reduction and intermediate goods value chain integration.

Recursive equations:

$$WMATR_{it} = \alpha_1 + a_1 PC_{it} + \gamma_1 X_{it} + \mu_i + \lambda_t + \varepsilon_{1it}$$

$$IgTrade_{it} = \alpha_2 + a_2 PC_{it} + \gamma_2 X_{it} + \mu_i + \lambda_t + \varepsilon_{2it}$$

$$LnTrade_{it} = \alpha_3 + c PC_{it} + b_1 WMATR_{it} + b_2 IgTrade_{it} + \gamma_3 X_{it} + \mu_i + \lambda_t + \varepsilon_{3it}$$

**Table 10: Mediating Effect Test Results**

| Variable      | (1) WMATR         | (2) LnTrade       | (3) LnIgTrade    | (4) LnTrade      |
|---------------|-------------------|-------------------|------------------|------------------|
|               | -0.252*** (0.047) | 0.591*** (0.084)  | 0.387*** (0.054) | 0.686*** (0.079) |
|               | —                 | -0.547*** (0.112) | —                | —                |
|               | —                 | —                 | —                | 0.642*** (0.098) |
| Controls & FE | Yes               | Yes               | Yes              | Yes              |
| Obs           | 613               | 613               | 613              | 613              |

Notes: \*\*\* p<0.01; standard errors in parentheses; FE = fixed effects; WMATR = weighted average tariff; LnIgTrade = logarithmic volume of intermediate goods trade.

- Path 1: Institutional coordination reduces tariff level, mediating effect accounts for 16.98% of total effect.
- Path 2: Institutional coordination expands intermediate goods trade, mediating effect reaches 30.60%, which is the dominant transmission channel, H4 is verified.

### Test Result Analysis

- (1) Tariff barrier mediating channel: The coefficient of PC in Column (1) is -0.252 and significant at the 1% level, which means the improvement of China-EU economic and trade institutional relations can significantly cut weighted average tariffs. After adding the mediating variable WMATR in Column (2), the coefficient of PC drops from the baseline 0.812 to 0.591 while remaining highly significant, and the coefficient of WMATR is -0.547 at the 1% significance level. This proves the tariff reduction path holds. The mediating effect accounts for 16.98% of the total trade promotion effect of institutional relations.
- (2) Intermediate goods trade mediating channel: The coefficient of PC in Column (3) is 0.387 and significant at the 1% level, indicating deeper institutional coordination greatly expands cross-border intermediate goods trade. After introducing LnIgTrade in Column (4), the coefficient of PC falls to 0.686, and LnIgTrade registers a

significant positive coefficient of 0.642. The mediating effect contributes 30.60% of the total effect, which is the dominant transmission channel of institutional relations boosting bilateral trade.

### **Robustness and Endogeneity**

Three robustness strategies: core index recalculation, crisis year sample deletion, instrumental variable correction for reverse causality endogeneity.

#### ***Core Variable Replacement***

- (1) Alternative institutional index PC\_alt (simplified tier weights without joint department adjustment): TWFE coefficient = 0.792\*\*\*, consistent with baseline results.
- (2) Dynamic panel sensitivity tests with depreciation rates  $\delta=8\%$  and  $\delta=10\%$ : PC\_stock coefficients 0.737\*\*\* and 0.764\*\*\*, both stable and significant, confirming insensitivity to policy decay assumptions.

#### ***Sample Adjustment***

- Exclude 2008-2009 global financial crisis: PC = 0.765\*\*\*
- Exclude 2020 COVID shock year: PC = 0.682\*\*\*

Core coefficients remain significantly positive, proving baseline findings are not driven by extreme crisis outliers.

#### ***Endogeneity Test (IV Two-Stage Least Squares)***

Lagged one-period institutional index L\_PC adopted as valid instrumental variable (meets relevance and exogeneity):

- (1) First-stage regression: L\_PC = 0.687\*\*\*, F-statistic = 48.67 (rejects weak instruments)
- (2) DWH endogeneity test  $p=0.018$  (confirms reverse causality bias exists)
- (3) Second-stage PC coefficient = 0.743\*\*\*, still positive and statistically significant after endogeneity correction, reinforcing H1 robustness.

## **CONCLUSIONS AND POLICY IMPLICATIONS**

### **Main Conclusions**

- (1) China-EU institutional coordination significantly boosts bilateral total trade, with long-term cumulative growth effects.
- (2) Institutional trade dividends show obvious industrial heterogeneity, technology industries benefit most.

- (3) The dual-circulation strategy positively strengthens the trade promotion capacity of bilateral institutional alignment.
- (4) Two transmission channels exist: tariff reduction and intermediate goods value chain integration, and value chain effect dominates.

### Policy Suggestions

- (1) Accelerate cross-border rule convergence: Push CAI ratification and implementation, build regular industrial dialogue platforms for green and digital sectors, realize full mutual recognition of testing standards.
- (2) Implement differentiated industrial policies: For tech industries, jointly build global IP protection systems; for capital industries, optimize cross-border investment guarantee rules; for labor industries, launch targeted tariff relief and employment transition support.
- (3) Expand intermediate goods trade: Rely on China-Europe Railway Express and free trade zones to build intermediate goods circulation platforms, smooth bilateral industrial chain matching.
- (4) Perfect dual-circulation supporting policies: Unify domestic market standards with international high-level rules, link inland opening hubs with EU industrial parks to release dual-market synergies.
- (5) Build policy information service platforms for SMEs, help enterprises cope with EU regulatory changes and cut institutional compliance costs.

### Research Limitations and Future Directions

Limitation: This paper adopts national-level panel data without micro enterprise samples.

Future Research: (1) Use firm-level data to test micro export heterogeneity; (2) Compare institutional coordination effects between China-EU and China-ASEAN; (3) Introduce carbon border tax as exogenous policy shock for quasi-natural experiment analysis.

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