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Evolution of Comparative Advantage in China's Information and Communication Technology Goods Exports

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Abstract

This study examines changes in China's export specialization in information and communication technology (ICT) goods and their implications for BRICS cooperation. Using World Bank data sourced from the United Nations Conference on Trade and Development, it compares the five original BRICS members over 2017–2023 through revealed comparative advantage (RCA), revealed symmetric comparative advantage (RSCA), and an accounting decomposition of changes in RCA. China maintains an aggregate comparative advantage throughout the period, although its RCA declines from 2.194 to 1.778 and the share of ICT goods in its merchandise exports falls from 26.32% to 21.34%. India's RCA rises from 0.068 to 0.350 but remains below the comparative advantage threshold. Brazil, South Africa, and Russia in the available years show no aggregate comparative advantage. China's narrowing advantage primarily reflects a lower ICT share in its own export structure, while the world benchmark changes little between the endpoints. These findings do not establish a decline in export value or technological capability. BRICS cooperation may improve export conditions through regulatory coordination, market adaptation, and industrial collaboration, subject to national regulatory differences and firms' capabilities. Policy priorities include reducing duplicate certification, strengthening local service partnerships, and increasing domestic value creation. The analysis is descriptive and does not identify the causal effects of BRICS policies.

Keywords

ICT Goods; BRICS Cooperation; Revealed Comparative Advantage; Export Specialization; Global Value Chains

1. Introduction

Information and communication technology (ICT) goods provide equipment for digital infrastructure and industrial digitalization. China's participation in international production has expanded from product exports toward equipment supply, systems integration, and associated services. This raises two questions: whether export growth translates into a sustained comparative advantage, and how

cooperation with other emerging economies can help maintain that advantage. BRICS provides a platform for economic policy dialogue and industrial collaboration, but its members differ in industrial structure, market demand, and regulatory arrangements. Cooperation opportunities therefore coexist with competition. A discussion of cooperation should begin with evidence on how members' ICT goods export specialization has changed.

Existing research follows two relevant strands. The first examines trade competition and complementarity between China and other BRICS members. Using trade data for mechanical and electrical products, Yang and Wu [1] find that complementarity differs across products with different factor intensities, indicating that cooperation needs to be assessed at the level of specific products and production activities. The second investigates the determinants of ICT goods trade. Liu and Zhi [2], studying countries and regions along the Belt and Road, associate trade patterns with industrial foundations and the business environment. These studies inform the assessment of cooperation opportunities, but mechanical and electrical products and ICT goods have different statistical coverage. Their findings cannot be transferred directly between the two categories. Cross-border intermediate inputs and repeated recording also create a distinction between gross exports and domestic value creation [3]. Export performance alone consequently does not reveal control over core technologies.

This study uses a consistent ICT goods indicator and a fixed sample of the five original BRICS members: Brazil, Russia, India, China, and South Africa. It asks whether China retains an export comparative advantage, how the strength of that advantage changes, whether the other members' specialization patterns shift, and what these changes imply for cooperation. The analysis connects export structure with possible cooperation mechanisms while distinguishing countries' exports to the world from bilateral trade among members. It is a descriptive comparative study and does not estimate the net causal effect of BRICS cooperation.

2. Research Design

2.1. Product Coverage and Sample Selection

ICT products are restricted here to goods included in merchandise trade statistics: computers and peripheral equipment, communication equipment, consumer electronic equipment, electronic components, and other ICT goods. Classification follows their information processing and communication functions and identifies them through specific Harmonized System (HS) commodity codes [4–5]. Entire HS chapters covering machinery, electrical equipment, optical instruments, or toys contain many non-ICT products and cannot be treated as equivalent to ICT goods. Software and other activities delivered as services are excluded; software embedded in goods follows the treatment adopted in the official statistics.

The sample covers China, Brazil, Russia, India, and South Africa from 2017 to 2023. Holding membership constant prevents changes in the composition of BRICS from confounding the country comparison. Enlargement from 2024 onward is outside the measurement period. The findings therefore apply to the original five-country sample and do not evaluate the trade effects of later accessions.

2.2. Data Sources and Processing

The data are drawn from the World Bank's World Development Indicators (WDI), using the indicator 'ICT goods exports (% of total goods exports)', code TX.VAL.ICTG.ZS.UN. The original provider is the United Nations Conference on Trade and Development (UNCTAD) [6]. The five countries and the world benchmark yield 42 country-or-aggregate year records. Russia has no observations for 2022 and 2023, leaving 40 valid records, including 33 country observations and seven world observations. The data were accessed and verified on 18 October 2026; the API reports a database update date of 8 October 2026.

Official values are retained, and each country is compared with the world benchmark for the same year. The world indicator is a weighted aggregate, rather than a simple mean of the five countries' shares. Missing Russian observations are neither replaced with zero nor interpolated, and they are not used to infer recent export changes. Calculations use all precision returned by the source. Export shares are reported to two decimal places and RCA and RSCA to three. Changes in HS classifications and subsequent official revisions may still affect comparability over time [5].

2.3. Comparative Advantage Measures and Interpretation

Balassa's revealed comparative advantage (RCA) index [7] compares a product group's share in a country's exports with its share in world exports. Equation (1) expresses this relationship:

$$\mathrm{RCA}_{it} = \frac{X_{it}^{\mathrm{ICT}}}{X_{it}} \Big/ \frac{X_{wt}^{\mathrm{ICT}}}{X_{wt}} = \frac{s_{it}}{s_{wt}} \tag{1}$$

In Equation (1), X denotes merchandise export value, the superscript ICT identifies ICT goods, i denotes a country, w denotes the world, and t denotes the year. The variable s is the ICT share of merchandise exports. Both shares are expressed as percentages, so their units cancel in the ratio. An RCA above one indicates that ICT goods have a larger weight in the country's export structure than in world exports. An RCA below one indicates that no aggregate comparative advantage is revealed. One is the neutral threshold.

Because RCA is asymmetric around its neutral value, the analysis also uses revealed symmetric comparative advantage (RSCA) [8], defined in Equation (2):

$$\mathrm{RSCA}_{it} = \frac{\mathrm{RCA}_{it} - 1}{\mathrm{RCA}_{it} + 1} \tag{2}$$

RSCA lies between −1 and 1, with zero as its neutral threshold. It is a monotonic transformation of RCA and helps display the direction and strength of specialization. It provides neither an independent source of evidence nor a test of causality.

To distinguish changes in a country's export composition from changes in the world benchmark, Equation (3) decomposes the change in RCA between 2017 and 2023:

$$\ln\left(\frac{RCA_{i,2023}}{RCA_{i,2017}}\right) = \ln\left(\frac{s_{i,2023}}{s_{i,2017}}\right) - \ln\left(\frac{s_{w,2023}}{s_{w,2017}}\right) \quad (3)$$

Here, ln denotes the natural logarithm. Equation (3) is an accounting identity; it does not identify the contributions of technological progress, production relocation, or policy changes. RCA measures export specialization. It does not measure export value, technological capability, the domestic value-added share, or bilateral market penetration. Country rankings in RCA are therefore not used as substitutes for direct measurement of those outcomes.

3. Changes in Export Specialization and Comparative Advantage

3.1. China's Declining Export Share and Persistent Advantage

Table 1 shows that ICT goods accounted for more than 25% of China's merchandise exports during 2017–2020. The share fell to 24.71% in 2021, 22.64% in 2022, and 21.34% in 2023, a decline of 4.98 percentage points from 2017. The world share rounds to 12.00% at both endpoints, although it rose to 12.96% in 2020. China's declining ICT export share thus cannot be attributed solely to a corresponding fall in the global ICT share.

Table 1. ICT goods as a share of merchandise exports, 2017–2023 (%)

Year	China	Russia	India	Brazil	South Africa	World
2017	26.32	0.61	0.81	0.36	1.01	12.00
2018	26.61	0.46	1.14	0.36	0.95	12.13
2019	25.51	0.52	1.90	0.35	0.89	12.16
2020	26.16	0.48	2.01	0.32	0.89	12.96
2021	24.71	0.50	2.18	0.26	0.65	12.52
2022	22.64	—	2.77	0.27	0.71	12.35
2023	21.34	—	4.20	0.23	0.86	12.00

Note: The world series is the official weighted aggregate. An em dash denotes missing data. Source: World Bank WDI, indicator TX.VAL.ICTG.ZS.UN; original provider: UNCTAD [6].

Figure 1 compares the annual ICT export shares of China and the world.

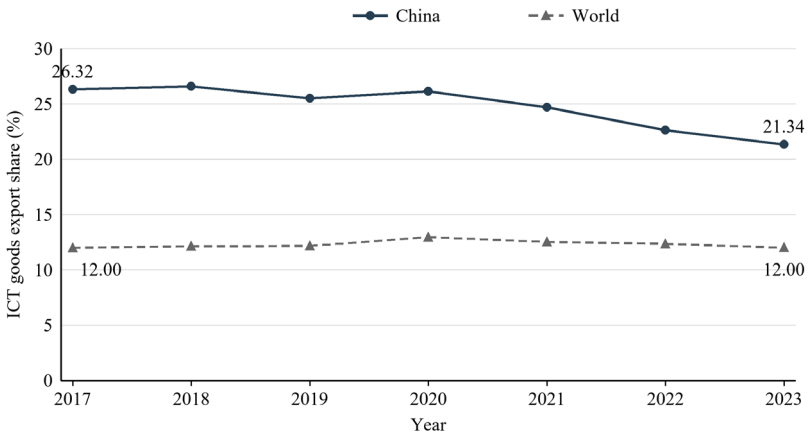


Figure 1. ICT goods export shares in China and the world, 2017–2023

Note: Shares refer to ICT goods as a percentage of the respective total merchandise exports. Source: World Bank WDI; original provider: UNCTAD [6].

A lower export share may result from slower growth or a decline in ICT exports, faster growth in other merchandise exports, or changes in prices and product composition. The share alone cannot establish a fall in the value of ICT exports or a deterioration in the industry's overall technological capability.

3.2. A Sustained but Narrowing Comparative Advantage

Table 2 and **Figure 2** show that China's RCA declined from 2.194 in 2017 to 1.778 in 2023, a cumulative decrease of 18.96%, while remaining above one in every year. It was broadly stable in 2017–2018 and fell from 2019 onward. Although China's ICT export share increased between 2019 and 2020, its RCA declined because the world ICT export share increased faster.

Table 2. RCA and RSCA in the five original BRICS members, 2017 and 2023

Country	RCA 2017	RCA 2023	RSCA 2017	RSCA 2023
China	2.194	1.778	0.374	0.280
Russia	0.051	—	−0.903	—
India	0.068	0.350	−0.874	−0.482
Brazil	0.030	0.019	−0.942	−0.962
South Africa	0.084	0.072	−0.845	−0.866

Note: The neutral thresholds are one for RCA and zero for RSCA. An em dash denotes missing data. Calculations use unrounded source values. Source: Author's calculations using the WDI series in Table 1 [6].

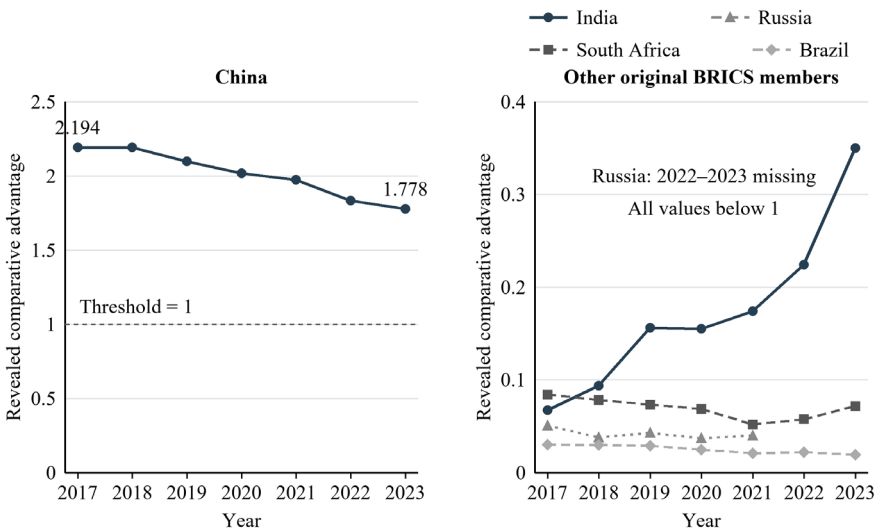


Figure 2. ICT goods export RCA in the five original BRICS members, 2017–2023

Note: The panels use different vertical scales: 0–2.5 for China and 0–0.4 for the other members. All observations in the right panel are below the RCA threshold of one. Russian data are missing for 2022–2023. Source: Author's calculations from WDI [6].

China's RCA of 1.778 in 2023 means that the weight of ICT goods in its merchandise exports was approximately 1.78 times the world benchmark. It does not represent China's share of the world market or growth in exports to BRICS partners. China remained on the comparative advantage side of the threshold, but the strength of that advantage narrowed.

The endpoint accounting comparison yields a ratio of 0.810790 for China's ICT export shares in 2023 and 2017 and 1.000453 for the corresponding world shares. Dividing the former by the latter gives an RCA ratio of 0.810423. At the indicator level, the decline therefore primarily reflects the lower weight of ICT goods in China's own exports; the endpoint change in the world benchmark contributes little. This decomposition locates the arithmetic source of the change but does not explain its economic causes. Export values, prices, product composition, and firm-level information are needed for that purpose.

3.3. India's Rising Specialization and Differences among Members

India's ICT export share rose from 0.81% to 4.20%, an increase of 3.39 percentage points. Its RCA increased from 0.068 to 0.350, approximately 5.18 times its initial value. This is a substantial improvement, but the endpoint remains below one. Rapid growth does not establish an aggregate comparative advantage. The ratio of China's RCA to India's fell from approximately 32.49 to 5.08, indicating a narrower specialization gap. It does not imply that the ratio of their export values fell to 5.08.

Brazil's ICT export share decreased from 0.36% to 0.23%, and its RCA fell from 0.030 to 0.019. ICT goods remained a small part of its merchandise exports. South

Africa's share declined from 1.01% to 0.86%, while its RCA fell from 0.084 to 0.072. Its share recovered in 2023 relative to 2022 but remained below the comparative advantage threshold. Russia's RCA ranged from 0.037 to 0.051 over 2017–2021. Because its final two observations are missing, conclusions are restricted to the years observed.

Figure 3 expresses these differences on the RSCA scale. China remained positive, while India improved substantially but remained negative. Brazil and South Africa had lower endpoint values than initial values. No endpoint change is calculated for Russia. These results restate the same export structure evidence using a symmetric transformation.

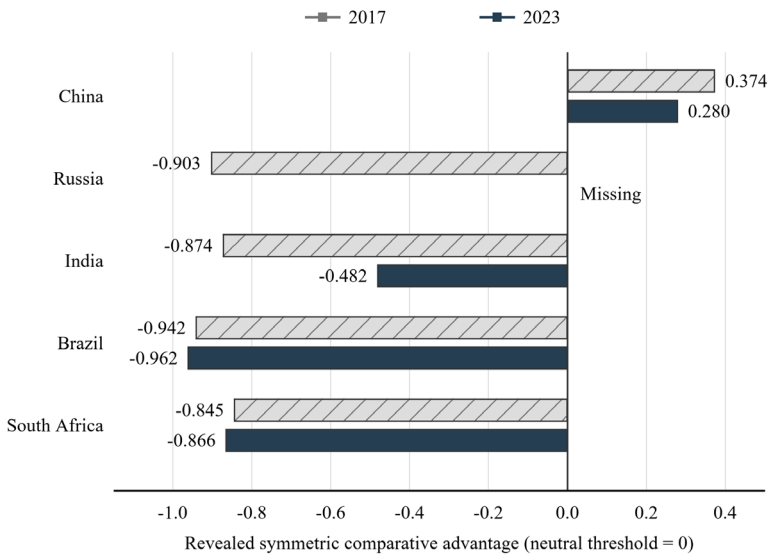


Figure 3. ICT goods export RSCA in the five original BRICS members, 2017 and 2023

Note: Zero is the neutral comparative advantage threshold. Russia has no 2023 observation. RSCA is a symmetric transformation of RCA. Source: Author's calculations from WDI [6].

The countries did not follow a common path of ICT goods export specialization. A low RCA may reflect relatively limited ICT exports, a high export weight for other industries, or both. It does not directly imply weak import demand or a lack of capabilities in software, research and development, or particular components. Cooperation proposals derived from aggregate goods indicators should therefore avoid generalizing to the entire digital economy.

4. Mechanisms and Constraints of BRICS Cooperation

4.1. Institutional Coordination and Trading Conditions

One channel through which BRICS cooperation may influence export performance is the cost of cross-border transactions. The 2021 implementation roadmap addresses cooperation on technical regulations, standards, metrology, and conformity assessment, as well as customs cooperation and the compatibility of national single

windows [9]. Greater transparency, procedural coordination, and less duplicate testing may reduce the fixed cost of entering different ICT markets. Because certification, local service organization, and project preparation often precede sales revenue, these costs can be particularly relevant to smaller exporters.

These arrangements do not constitute a common tariff or a unified market. The treatment of individual ICT goods depends on each importing country's commitments, product coverage, and applicable tariff schedule. Under the World Trade Organization (WTO) Information Technology Agreement, tariff elimination obligations are undertaken by participants and applied on a most-favored-nation basis [10]. BRICS membership alone does not create a uniform zero-tariff regime for ICT goods. Policy dialogue can improve trading conditions, but the present data do not demonstrate that BRICS cooperation has caused a particular tariff reduction or increase in RCA.

4.2. Market Adaptation and Industrial Collaboration

ICT equipment must often be adapted to local networks, electricity supply, operating environments, and maintenance systems. China's export specialization provides a basis for supplying equipment and associated solutions, but orders depend on suitability, lifecycle costs, and service capability. BRICS cooperation may connect suppliers and users through specific digital infrastructure and industrial digitalization projects, reducing uncertainty about demand. These are proposed transmission mechanisms, rather than effects directly tested by the aggregate export share data.

India's rising specialization suggests that Chinese firms should consider competition and division of labor together when designing partnerships. Component supply, systems adaptation, and service partnerships can be considered according to local firms' actual capabilities. A rising RCA alone does not demonstrate that a particular production activity is mature. Likewise, low export shares in Brazil or South Africa do not establish market size. Project selection requires additional evidence on imports, procurement demand, and local production capacity to determine whether supply can meet identifiable needs.

4.3. Regulatory Differences and Technological Capabilities

A cooperation platform can expand dialogue but cannot replace national regulatory systems. Differences in technical standards, certification, public procurement, data governance, and intellectual property arrangements affect the time and cost of operating across markets. Reduced customs friction may bring limited benefits if local maintenance networks remain inadequate. The benefits of cooperation thus depend on regulatory coordination and firms' service capabilities improving together.

China's relatively high RCA does not demonstrate complete technological autonomy

in core components. Gross exports may incorporate imported intermediate inputs and repeated recording across production stages [3]. A durable export advantage requires support from domestic research, component supply, and value creation. Restrictions on technology supply, changes in payment conditions, or logistics disruptions may affect delivery, but this study does not attribute annual RCA movements to specific events without direct supporting evidence.

The 2025 Rio de Janeiro Declaration continues discussion of digital economic and trade cooperation and anticipates the next BRICS economic partnership strategy [11]. It provides a policy context for the proposed cooperation pathways. Because the declaration postdates the sample, it cannot explain the observed changes during 2017–2023. Policy objectives, implemented measures, and benefits realized by firms should be distinguished when evaluating cooperation.

5. Policy Pathways for Maintaining Export Advantages

5.1. Reduce Identifiable Regulatory Frictions

Cooperation should address procedures that create observable costs for firms. For ICT products with substantial exports or costly repeated testing, authorities and industry organizations can compare certification documents, testing procedures, and customs requirements and maintain accessible regulatory information. Where safety requirements and supervisory capabilities are compatible, they can explore recognition of test results or coordination of procedures. Where recognition is not feasible, greater transparency and predictable processing times remain useful. Certification time, duplicate testing costs, and clearance delays offer more informative performance measures than the number of cooperation documents issued.

Tariff dialogue and the management of non-tariff measures require separate work. Firms need to verify commodity codes, rules of origin, and applicable duties for each product, while cooperation platforms can support information sharing and policy discussion. Equipment involving cybersecurity or critical infrastructure should be assessed against local review requirements before bidding, with compliance costs included in project prices. These steps connect general cooperation objectives to workable market entry arrangements.

5.2. Build Local Service Partnerships around Market Demand

Chinese firms should extend export offers to installation, maintenance, spare parts, and training and adapt equipment to local network conditions and use cases. Governments and industry associations can facilitate contact with local operators, integrators, and service providers. Joint testing and demonstration projects can help establish suitability. Market strategies should be supported by procurement demand and project returns, rather than inferred from a country's low RCA.

For partners with rising export specialization, cooperation can be organized around

specific production or service activities while potential competition is monitored. In other markets, project selection can begin with clearly identified infrastructure or industrial needs and then assess logistics, financing, and maintenance conditions. Overseas assembly or production decisions should compare yields, delivery times, infrastructure, and workforce skills alongside wages. Nominal labor costs alone are insufficient to determine an efficient location.

5.3. Connect Export Performance with Domestic Value Creation

China's falling RCA signals a change in export composition, but maximizing the index should not become a policy objective in itself. A lower ICT share can coexist with diversification if other export industries expand more rapidly. Product quality, reliability, and domestic value creation provide more useful objectives for sustaining the capacity to finance research and technological accumulation.

Implementation should identify technological activities that matter for reliable delivery, considering import dependence and existing research capabilities within individual products. Cooperation among firms, universities, and research institutions should have clear application objectives. Overseas projects may supply testing opportunities and operational feedback, but partnerships also need explicit rules for intellectual property, data use, and commercialization. Support should be evaluated against improvements in quality, component supply reliability, and the application of research results, alongside export performance.

5.4. Establish Monitoring and Project Feedback

Monitoring should connect the aggregate, product, and firm levels. Aggregate indicators should track ICT export shares, RCA, and the world benchmark. Product analysis should use six-digit HS data to distinguish final equipment from intermediate goods and examine export value, quantity, unit value, and destination markets. Firm-level records should cover certification expenses, payment periods, service costs, and contract renewal. Together, these sources can help distinguish changes in demand and prices from growth in other exports or deterioration in operating conditions.

Cooperation projects should also incorporate feedback. Before a pilot begins, its objectives should specify the trading costs, delivery reliability, or service coverage to be improved. Subsequent assessment should compare consistently defined observations. Estimating a net policy effect requires a suitable comparison group and controls for common shocks. This would reduce the risk of attributing changes in the global trade cycle entirely to BRICS cooperation and provide more direct evidence for policy adjustment.

6. Conclusions and Limitations

Using consistent ICT goods export shares for 2017–2023, this study finds that China

retained an aggregate revealed comparative advantage within the five original BRICS members. Its RCA nevertheless declined from 2.194 to 1.778. The world benchmark was almost unchanged between the endpoints, so the narrowing advantage primarily reflects a lower ICT weight in China's merchandise exports. This finding describes export specialization and does not establish changes in absolute export value, technological autonomy, or the income captured by domestic producers.

India's export share and RCA increased substantially, although its RCA remained below one. Brazil, South Africa, and Russia in the observed years showed no aggregate comparative advantage. These divergent patterns imply that cooperation should be based on individual products, firm capabilities, and market requirements. Aggregate indices alone cannot establish bilateral complementarity or predict competitive substitution.

BRICS cooperation can support more transparent rules, coordinated certification, local services, and application projects. Maintaining an advantage over time also requires improvements in quality, research capabilities, and domestic value creation. Cooperation projects are more likely to deliver sustainable benefits when trade facilitation is connected to industrial capability development.

Three limitations qualify the findings. First, the data describe each country's exports to the world, rather than China's bilateral exports to BRICS partners, and cannot estimate regional market shares or bilateral complementarity. Second, aggregate indicators conceal differences among ICT goods; missing Russian observations, HS revisions, and official data updates also constrain comparison. Third, the study neither identifies causal policy effects nor measures domestic value added. Future research should combine disaggregated products and bilateral trade with value-added and firm-level information and evaluate specific cooperation measures using comparable samples.

Conflicts of Interest

The author declares no conflicts of interest.

References

[1] Yang, F.M. and Wu, M.Y. (2019) Trade Competition and Complementarity in Mechanical and Electrical Products between China and Other BRICS Countries. Journal of Industrial Technological Economics, 38(4), 133–143. In Chinese; title translated. https://doi.org/10.3969/j.issn.1004-910X.2019.04.017

[2] Liu, S.C. and Zhi, G.L. (2022) The Analysis of Influencing Factors of ICT Goods Trade in the Context of Digital Economy—A Case Study of Countries (Regions) Along 'the Belt and Road'. Journal of Industrial Technological Economics, 41(1), 78–85. In Chinese. https://doi.org/10.3969/j.issn.1004-910X.2022.01.010

[3] Koopman, R., Wang, Z. and Wei, S.J. (2014) Tracing Value-Added and Double Counting in Gross Exports. American Economic Review, 104(2), 459–494. https://doi.org/10.1257/aer.104.2.459

[4] United Nations Conference on Trade and Development (2018) Updating the Partnership

Definition of ICT Goods: From HS 2012 to HS 2017. UNCTAD Technical Notes on ICT for Development, No. 10, TN/UNCTAD/ICT4D/10. United Nations, Geneva. https://unctad.org/system/files/official-document/tn_unctad_ict4d10_en.pdf (accessed 18 October 2026).

[5] United Nations Conference on Trade and Development (2023) Trade in ICT Goods Statistics: Impacts of the 2022 Update to the Harmonized Commodity Description and Coding System. UNCTAD Technical Notes on ICT for Development, No. 20, TN/UNCTAD/ICT4D/20. United Nations, Geneva. https://unctad.org/system/files/official-document/tn_unctad_ict4d20_en.pdf (accessed 18 October 2026).

[6] World Bank (2026) ICT Goods Exports (% of Total Goods Exports). World Development Indicators, indicator TX.VAL.ICTG.ZS.UN. Data for 2017–2023; original provider: UNCTAD; API database update: 8 October 2026. https://data.worldbank.org/indicator/TX.VAL.ICTG.ZS.UN (accessed 18 October 2026).

[7] Balassa, B. (1965) Trade Liberalisation and 'Revealed' Comparative Advantage. The Manchester School, 33(2), 99–123. https://doi.org/10.1111/j.1467-9957.1965.tb00050.x

[8] Laursen, K. (2015) Revealed Comparative Advantage and the Alternatives as Measures of International Specialization. Eurasian Business Review, 5(1), 99–115. https://doi.org/10.1007/s40821-015-0017-1

[9] BRICS (2021) BRICS Implementation Roadmap on Trade and Investment Related Aspects of the 'Strategy for BRICS Economic Partnership 2025'. BRICS, pp. 1–7. https://www.gov.br/memp/pt-br/assuntos/brics-sme-working-group-1/documents-on-smes/2021-india/brics-implementation-roadmap-on-trade-investment-related-aspects-india-2021.pdf/@@display-file/file (accessed 18 October 2026).

[10] World Trade Organization (n.d.) Information Technology Agreement. World Trade Organization, Geneva. https://www.wto.org/english/tratop_e/inftec_e/inftec_e.htm (accessed 18 October 2026).

[11] BRICS (2025) Rio de Janeiro Declaration of the XVII BRICS Summit. Ministry of Foreign Affairs of the People's Republic of China, 8 July 2025. Chinese full text; title translated. https://www.fmprc.gov.cn/web/zyxw/202507/t20250708_11667461.shtml (accessed 18 October 2026).