

Structural Evolution and Differentiated Pathways of the Provincial-Level Dual Circulation

-- An Empirical Study Using a Four-Quintile Classification based on China's Multi-Regional Input-Output Tables, 1987-2017

Wanqing Liu

School of Statistics and Applied Mathematics, Anhui University of Finance and Economics,
Bengbu, Anhui, China

Abstract

As the new development paradigm of the “dual circulation” is strategically implemented, provinces serve as the core units of implementation. Consequently, the patterns of evolution and distinctive characteristics of each province’s circulation structure naturally provide a crucial lens through which to understand the broader picture. Drawing on the “four-part classification” approach, this paper divides the dual circulation into four categories: intra-provincial, inter-provincial, international, and interactive circulation. Using data from China’s multi-region input-output tables for 1987–2017, the study systematically examines the structural changes and differentiation pathways of provincial-level dual circulation across five dimensions: national, regional, provincial, industrial, and case studies. At the national level, between 1987 and 2017, the share of intra-provincial circulation tended to decline but remained firmly established; inter-provincial circulation rose significantly and benefited a wide range of areas; foreign circulation first rose and then fell; and interactive circulation fluctuated upward. In terms of regional patterns, the eastern, central, western, and northeastern regions exhibited distinct gradients of differentiation. At the provincial level, regions can be categorized into four distinct development models; in terms of industrial structure, a significant trend toward synergy between high-end manufacturing and production-oriented services can be observed. Jiangsu, Zhejiang, Shanghai, and Guangdong have taken different development paths due to variations in their geographical conditions, industrial foundations, and policy environments. This paper provides multidimensional empirical support for the optimization of the provincial dual circulation and offers valuable reference for implementing tailored policies.

Keywords

Dual Circulation; Provincial Economy; Structural Evolution; Differentiated Pathways.

1. Introduction

As we enter a new stage of economic development, the restructuring of global industrial chains has coincided with the rise of anti-globalization sentiments. While domestic market integration deepens, regional development imbalances remain pronounced. Building a new development paradigm centered on the domestic economic cycle, with the domestic and international cycles reinforcing one another, has thus become a critical decision for addressing changes in the external environment and fostering new drivers of growth [1]. Provinces occupy the interface between micro-level markets and macro-level circulation; the implementation of the dual circulation strategy is inseparable from this level. How the circulation structures of individual

provinces evolve and how differences arise directly impact the operational efficiency and effectiveness of the national dual circulation system.

Since the launch of reform and opening-up, China has rapidly accumulated capital and technological capabilities through deep integration into the global value chain, leading to continuous expansion in the scale of production and exports. However, the model of “both ends outside” has also exposed vulnerabilities; fluctuations in external demand, geopolitical shocks, and reliance on others for core technologies could all disrupt the stability of the domestic economic cycle [2]. The global economic and trade landscape is undergoing profound adjustments, and the growth momentum that once relied on external markets is waning. However, what distinguishes China from other East Asian economies is that its economic scale and domestic market are now on a completely different level: in 2022, GDP reached \$18 trillion, with per capita GDP exceeding \$12,000. This massive domestic demand provides a more solid foundation for the economic cycle.

Given that each province differs in terms of resource endowments, geographical conditions, and industrial foundations, the patterns of the dual circulation naturally vary widely. The eastern coastal regions integrated into global production networks at an early stage, exhibit high participation in international circulation, and feature active interprovincial linkages; in contrast, central and western regions rely more on intra-provincial markets and domestic regional cooperation, with relatively low participation in international circulation. The economic cycles of resource-based provinces revolve around the development and export of provincial resources, while emerging manufacturing provinces occupy important positions in domestic industrial chains by leveraging their industrial support capabilities [2-3]. Only by clearly mapping out the evolutionary trajectories and underlying logic of these differences among provinces can we identify appropriate functional roles for them within the national dual circulation system. This is a fundamental task that cannot be bypassed in implementing tailored policies and ensuring precise implementation.

Based on the existing literature, two main theoretical strands have emerged: first, grounded in Marxist political economy, which traces the dual circulation back to theories such as the circulation of capital and the cycle of social reproduction [4-7]; second, rooted in macroeconomics, which involves theories such as economic growth and international trade. Qian Xuefeng and Pei Ting (2021) analyzed the endogenous driving forces of the dual circulation from four dimensions-market, industry, enterprise, and government [8]. In terms of quantitative measurement, mainstream methods can be categorized into two types: one is the value-added decomposition method, which relies on input-output tables to achieve precise quantification. Huang Qunhui and Ni Hongfu (2021) synthesized the approaches of Muradov (2016) and Wang et al. (2013, 2017) to decompose GDP from a global value chain perspective [9-12]; Chen Changbing (2022) decomposed value-added from both the supply-side and demand-side dimensions and verified the dominant role of the domestic cycle [13], while Zhang Shaojun and Fang Yuwen (2022) constructed an index of revealed comparative advantage in interprovincial outflows [14]. An Qi et al. (2024) expanded the decomposition framework of Wang et al. (2017) to analyze provincial participation in the three types of economic cycles [15]; another approach is the dependency ratio method, in which Jiang Xiaojuan and Meng Lijun (2021) constructed an indicator of the share of the external economic cycle based on traditional trade data [16], Chen Quanrun et al. (2022) calculated interdependence at multiple levels based on the World Input-Output Model [17]; Ding Xiaoqiang and Zhang Shaojun (2022) incorporated new indicators such as concentration to achieve a multidimensional characterization [18]; and Zhang Zengkai et al. (2024) proposed a “simple/complex, forward/backward” dual-circulation decomposition framework and revealed its cyclical relationship with economic growth [19].

Research on provincial-level measurements has evolved “from single-factor to systematic, and from broad-brush to granular.” Early studies mostly focused on individual provinces or localized regions, lacking systematic analysis at the national provincial level and a detailed breakdown of domestic circulation. In recent years, Lu Jiangyuan et al. (2022) used interregional input-output tables to estimate the GDP generated by each province’s participation in the three types of cycles, but failed to conduct an in-depth analysis of the dynamic relationship between intra-provincial and inter-provincial cycles [20,21]; Hua Deyao and Liu Minzheng (2022) conducted a dual-component, four-cycle decomposition using MRIO-IRIOT embedded input-output tables, clarifying the ranking of cycle intensity [22]; Ni Hongfu and Tian Ye (2023) optimized the decomposition method by introducing the perspective of factor national ownership, but did not yet cover an analysis of provincial heterogeneity ([23]); Fang Xiaoping et al. (2023) divided the domestic economic cycle into intra-provincial and inter-provincial cycles, providing valuable insights [24]; Han Zha’an et al. (2024) utilized multi-period interregional input-output data to measure the status of the dual circulation in various provinces and across different industries [2]. Overall, existing research still has three limitations: first, the differences between intra-provincial and inter-provincial levels within the domestic cycle are not sufficiently characterized; second, the distinction between direct and indirect exports in the international cycle is relatively crude; and third, there is a lack of long-time-series, uniformly defined provincial-level data to support the analysis. Zhang Yibing et al. (2024) innovatively expanded the dual circulation framework into four categories—*intra-provincial, inter-provincial, international, and interactive circulation*—and constructed a comprehensive provincial-level measurement indicator system, providing key methodological support for this paper [3].

In light of this, this paper draws on the “four-part classification” decomposition approach proposed by Zhang Yibing et al. (2024) to subdivide the dual circulation into four categories: *intra-provincial, inter-provincial, international, and interactive circulation*. Based on an input-output model, we construct provincial-level measurement indicators and utilize China’s multi-region input-output tables from 1987 to 2017 to analyze differences in circulation characteristics at the national, provincial, and regional levels [25]. By integrating provincial resource endowments, locational conditions, and development models, this study dissects the underlying logic behind these performance differences and their evolution, aiming to provide multidimensional empirical support for selecting optimization pathways and implementing tailored policies for the dual circulation at the provincial level.

2. Research Design

2.1. Core Concepts and Construction Logic of the “Four-Part” Decomposition Framework

The “Four-Part Method” decomposition framework is grounded in a provincial economic perspective, supported by input-output theory, and structured along two dimensions: “spatial decomposition of demand sources” and “identification of production linkages.” On the demand side, total final demand at the provincial level is decomposed according to spatial attributes into three components—*intra-provincial, domestic (outside the province), and foreign*—thereby distinguishing the sources of growth driven by different demand origins; On the production side, using the Leontief inverse matrix and provincial-level segmented inverse matrices, production linkages are categorized into two pathways: “*intra-provincial production linkages*,” which occur solely between sectors within the province, and “*inter-provincial production linkages*,” which occur via sectors across provincial boundaries. By cross-combining these two dimensions, the traditional dual domestic and international circulation is subdivided into four sub-circulations: *intra-provincial, inter-provincial, foreign, and interactive*—thereby forming an

analytical framework capable of accurately depicting the pathways through which different sources of demand drive provincial value-added and reflecting the multidimensional characteristics of provincial economic participation in these circulation patterns.

Among these, the intra-provincial cycle refers to value-added creation driven by the province's own final demand and realized through intra-provincial production linkages, reflecting the internal self-sufficiency of the provincial economy; the inter-provincial cycle refers to value-added creation driven by demand from other provinces within the country or by the province's own demand through inter-provincial production linkages, and is the core manifestation of the domestic grand cycle at the provincial level; the international circulation refers to the creation of value-added directly driven by final demand from abroad and realized through intra-provincial production linkages, representing the form of direct participation by the provincial economy in the international circulation; the interactive circulation refers to the creation of value-added indirectly driven by final demand from abroad and realized through inter-provincial production linkages, representing the form of cross-linkage between domestic and international circulations at the provincial level.

2.2. Regional Input-Output Model

Input-output theory is based on the core logic that "final demand drives production activities." It posits that both total output and value-added in an economic system stem from the pull of final demand, and that changes in demand are transmitted throughout the entire economic chain via inter-sectoral and inter-regional production linkages, forming a complete "demand-production-value-added" cycle. The input-output analysis method can be traced back to François Quesnay's **Tableau Économique**. Through the development and refinement by Leontief (1991), it has gradually become an important tool in academia for analyzing economic development and social production. Input-output models can reflect the relationships among various economic links, such as production, demand, and distribution; interregional input-output models, in particular, contain a wealth of regional information and can further clearly depict the economic circulation links among different regions.

Based on the input-output relationships, we have:

$$X = AX + Y \quad (1)$$

$$X = (I - A)^{-1}Y = LY \quad (2)$$

where X is the total output matrix; Y is the final demand matrix; A is the direct consumption matrix, composed of direct consumption coefficients that reflect the quantity of products or services from each sector directly consumed in the production of a unit of output; and $L = (I - A)^{-1}$ is the Leontief inverse matrix, which reflects the direct and indirect demand for products or services from each sector resulting from an increase of one unit in final demand.

According to input-output theory, changes in final demand are transmitted through the production network to the entire industrial chain, thereby driving systematic adjustments in production activities. For an economic system comprising g regions, core interrelationships—such as the cross-regional flow of intermediate goods, the distribution of final goods, and imports and exports—must be systematically presented using a multi-region input-output table. Its specific structure is shown in Table 1

Table 1. China's Interregional Input-Output Table

		Intermed. Use				Final Use					Total Output
		Prov. 1	Prov. 2	...	Prov. g	Prov. 1	Prov. 2	...	Prov. g	Exports	
Intermed. Inputs	Prov. 1	z_{11}	z_{12}	...	z_{1g}	y_{11}	y_{12}	...	y_{1g}	EX_1	x_1
	Prov. 2	z_{21}	z_{22}	...	z_{2g}	y_{21}	y_{22}	...	y_{2g}	EX_2	x_2
	$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$	
	Prov. g	z_{g1}	z_{g2}	...	z_{gg}	y_{g1}	y_{g2}	...	y_{gg}	EX_g	x_g
	Imports	IM_{11}	IM_{12}	...	IM_{1g}	im_{11}	im_{12}	...	im_{1g}	—	IM_1
		IM_{21}	IM_{22}	...	IM_{2g}	im_{21}	im_{22}	...	im_{2g}	—	IM_2
		$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$	—	...
		IM_{g1}	IM_{g2}	...	IM_{gg}	im_{g1}	im_{g2}	...	im_{gg}	—	IM_g
Value-added		v_1	v_2	...	v_g	—	—	—	—	—	
Total Inputs		x'_1	x'_2	...	x'_g	—	—	—	—	—	

Here, ' Z_{ij} ' represents the intermediate goods flow matrix from the province ' i ' to the province ' j '; ' Y_{ij} ' represents the final goods flow matrix from the province ' i ' to the province ' j '; ' X_i ' represents the output vector for the province ' i '; and ' EX_i ' represents the value-added vector for the province ' i '. Definition:

$$Z = \begin{bmatrix} z_{11} & z_{12} & \dots & z_{1g} \\ z_{21} & z_{22} & \dots & z_{2g} \\ \vdots & \vdots & \ddots & \vdots \\ z_{g1} & z_{g2} & \dots & z_{gg} \end{bmatrix}, Y^w = \begin{bmatrix} y_{11} & y_{12} & \dots & y_{1g} \\ y_{21} & y_{22} & \dots & y_{2g} \\ \vdots & \vdots & \ddots & \vdots \\ y_{g1} & y_{g2} & \dots & y_{gg} \end{bmatrix}, Y^s = \begin{bmatrix} y_{11} & 0 & \dots & 0 \\ 0 & y_{22} & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & y_{gg} \end{bmatrix}$$

where Y^s is the matrix of each province's demand, $EX = \begin{bmatrix} \widehat{EX}_1 & 0 & \dots & 0 \\ 0 & \widehat{EX}_2 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \widehat{EX}_g \end{bmatrix}$, As shown in

the table, the final forms are $Y = Y^w + EX$ and $X = \begin{bmatrix} \widehat{x}_1 & 0 & \dots & 0 \\ 0 & \widehat{x}_2 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \widehat{x}_g \end{bmatrix}$, where the superscript $\wedge$

denotes the diagonalization of a vector. The intermediate input coefficient matrix is $A = ZX^{-1} =$

$$\begin{bmatrix} A_{11} & A_{12} & \dots & A_{1g} \\ A_{21} & A_{22} & \dots & A_{2g} \\ \vdots & \vdots & \ddots & \vdots \\ A_{g1} & A_{g2} & \dots & A_{gg} \end{bmatrix}, \text{ and the multi-region Leontief inverse matrix is } L = (I - A)^{-1} =$$

$$\begin{bmatrix} L_{11} & L_{12} & \dots & L_{1g} \\ L_{21} & L_{22} & \dots & L_{2g} \\ \vdots & \vdots & \ddots & \vdots \\ L_{g1} & L_{g2} & \dots & L_{gg} \end{bmatrix}. \text{ We define } L^s = \begin{bmatrix} L_{11} & 0 & \dots & 0 \\ 0 & L_{22} & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & L_{gg} \end{bmatrix} \text{ as the inverse matrix of the linkages}$$

between sectors within each province, and $V = \begin{bmatrix} \widehat{v}_1 & 0 & \dots & 0 \\ 0 & \widehat{v}_2 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \widehat{v}_g \end{bmatrix} X^{-1}$ as the value-added

coefficient matrix for sectors within each province. We construct $\widehat{V}$ as the diagonal matrix of value-added coefficients and multiply it by output to obtain $\widehat{V}LY$.

$$\begin{aligned} \widehat{V}LY &= \widehat{V}L(Y^w + EX) = \widehat{V}LY^w + \widehat{V}LEX \\ &= \widehat{V}L^s Y^s + \widehat{V}L(Y^w - Y^s) + \widehat{V}(L - L^s)Y^s \\ &\quad + \widehat{V}L^s EX + \widehat{V}(L - L^s)EX \end{aligned} \quad (3)$$

Here, $\hat{V}^S Y^S$ represents the total value-added driven by intra-provincial demand, denoted as the intra-provincial cycle; $\hat{V}^L(Y^W - Y^S) + \hat{V}^L(L - L^S)Y^S$ represents the value-added driven by inter-provincial demand, denoted as the inter-provincial cycle; $\hat{V}^S EX$ represents the total direct value-added in exports, denoted as the foreign cycle; and $\hat{V}^L(L - L^S)EX$ represents the total value-added from other provinces in exports, denoted as the interactive cycle.

2.3. Data Notes

Input-output tables can illustrate the interconnections between industries and the matching of supply and demand, making them a core tool for quantifying and decomposing the dual-circulation pattern. The data used in this paper are drawn from the 1987–2017 China Multi-Regional Input-Output Tables compiled by the Development Research Center of the State Council. These tables are based on input-output data, trade data, and regional data published by the National Bureau of Statistics. Using cross-regional integration techniques, they link the independent input-output tables of each province to form a single multi-regional input-output table (MRIO) that encompasses interprovincial economic linkages ([25]). Compared with other statistical data, this dataset is more comprehensive and detailed in terms of provincial-level input-output information. It can accurately depict interregional industrial linkages and factor flows, and provides a solid data foundation for scientifically measuring the extent of each region's participation in the dual circulation and its underlying mechanisms.

3. Measurement Results and Analysis

Based on the research design outlined above, this chapter systematically analyzes the results of measuring China's provincial-level dual circulation patterns from 1987 to 2017 across five dimensions: the national picture, regional disparities, provincial characteristics, industrial structure, and typical provinces.

3.1. Analysis of the Evolution of the Overall National Circulation Structure

This paper first examines the evolution trends of the four types of circulation at the national level. It calculates the extent of each Chinese province's participation in domestic and international circulation from 1987 to 2017, as well as the share of the four types of circulation in the nation's total value added during this period and the changes in these shares (as shown in Figure 1). Overall, intra-provincial circulation has consistently held a dominant position, followed by inter-provincial circulation, then international circulation, with cross-circulation consistently ranking last; however, the relative shares of these four types of circulation underwent significant shifts over the course of three decades. Intra-provincial circulation fluctuated downward from 63.03% in 1987 to 47.94% in 2017, a decline of approximately 15 percentage points, indicating that as domestic market integration deepened, provincial economies became less reliant on internal demand. In contrast, the share of interprovincial circulation rose steadily from 24.94% to 37.13%, reflecting increasingly active flows of goods and factors of production between provinces, as well as the gradual deepening of regional division of labor and cooperation. The trajectory of international circulation followed a different pattern—it stood at 9.38% in 1987, peaked at 16.42% in 2007, and subsequently declined to 9.63% in 2017. This pattern of first rising and then falling is related to the pace of China's opening-up policies and was also significantly influenced by changes in the external demand environment following the global financial crisis. The share of cross-circulation has consistently remained low, standing at only 2.65% in 1987 and 5.30% in 2017. Although there was a slight increase, it never exceeded 6%, indicating that the cross-linkage effects formed through interprovincial channels between domestic and international circulation remain relatively limited.

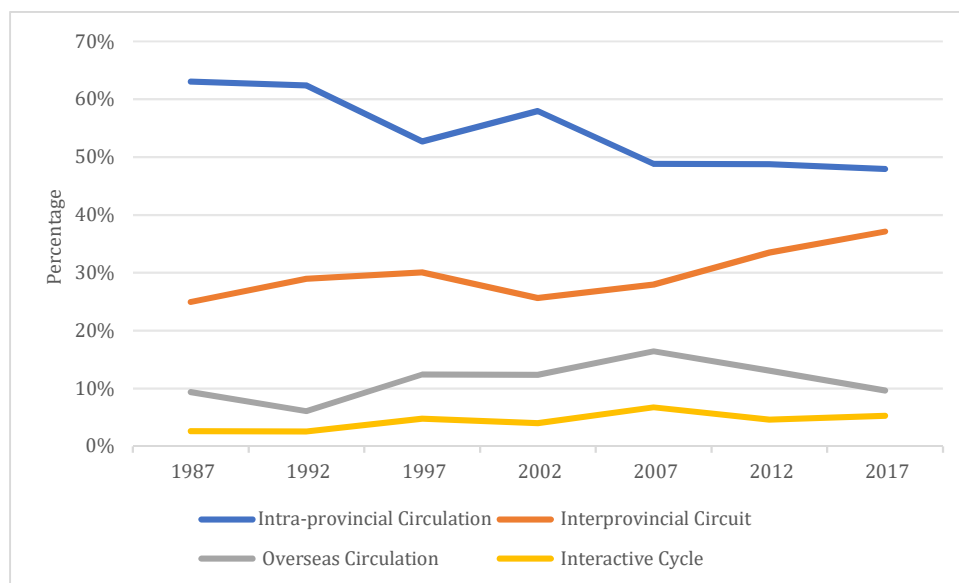


Figure 1. Structure of the National Economic Cycle, 1987–2017

3.2. Analysis of Regional Circulation Differences and Trends

Beyond the overall trend, a clear pattern of divergence among the seven major regions has emerged, which can generally be summarized as “strengthened leadership in the East, fluctuating adjustments in the Central region, continued contraction in the Northeast, and a gradual rise in the West.” These regional disparities are closely linked to each regions resource endowments, policy orientations, and stages of development (as shown in Figure 2).

As the core regions of the East, East China and South China have consistently held a leading position in the linkage between the dual circulation. East China ranked first among the seven major regions in terms of the share of all four types of circulation; in 2017, intra-provincial, inter-provincial, international, and cross-circulation accounted for 38.06%, 34.23%, 53.00%, and 39.14% of the national total, respectively, with its foreign circulation rising from 32.34% in 1987 to 53.31% in 2007 before stabilizing, while the export structure gradually shifted toward high-end manufacturing. The South China region’s international trade flow has long remained at a relatively high level, reaching 32.85% in 1997 before declining to 26.15% by 2017; however, the shares of interprovincial and reciprocal trade flows rose from 5.43% and 4.08% to 12.28% and 11.29%, respectively, indicating that cross-regional industrial linkages have continued to deepen.

North China and Central China, which fall into the middle tier, exhibit different adjustment trends. In North China, interprovincial and reciprocal circulation peaked at 21.87% and 22.37%, respectively, in 2007, but declined to around 16% by 2017; intraprovincial circulation stabilized at around 11.52%, while foreign circulation fell from 13.12% to 7.94%. In Central China, intra-provincial circulation rose to 17.47% in 2017, while inter-provincial circulation actually fell from 14.63% to 10.87%. Outward-oriented circulation has long been relatively weak, and the region’s locational advantages have not yet been fully transformed into a driving force for circulation.

The divergent development trajectories of the Northeast, Southwest, and Northwest regions are even more pronounced. In the Northeast, the shares of all four types of circulation contracted across the board; foreign circulation fell from 18.36% to 2.65%, while intra-provincial, inter-provincial, and cross-regional circulation also saw significant declines. Lagging industrial upgrading has resulted in a marked lack of growth momentum. In the Southwest, the share of intra-provincial circulation remained largely stable between 10% and 12%, while inter-provincial and cross-regional circulation reached 10.19% and 7.96%, respectively, in 2017; in the Northwest, these two types of circulation also gradually increased to 6.69% and

6.91%, respectively. However, foreign circulation in both regions remained below 4%; geographical constraints and a relatively monolithic industrial structure have largely limited the depth of their participation in international circulation.

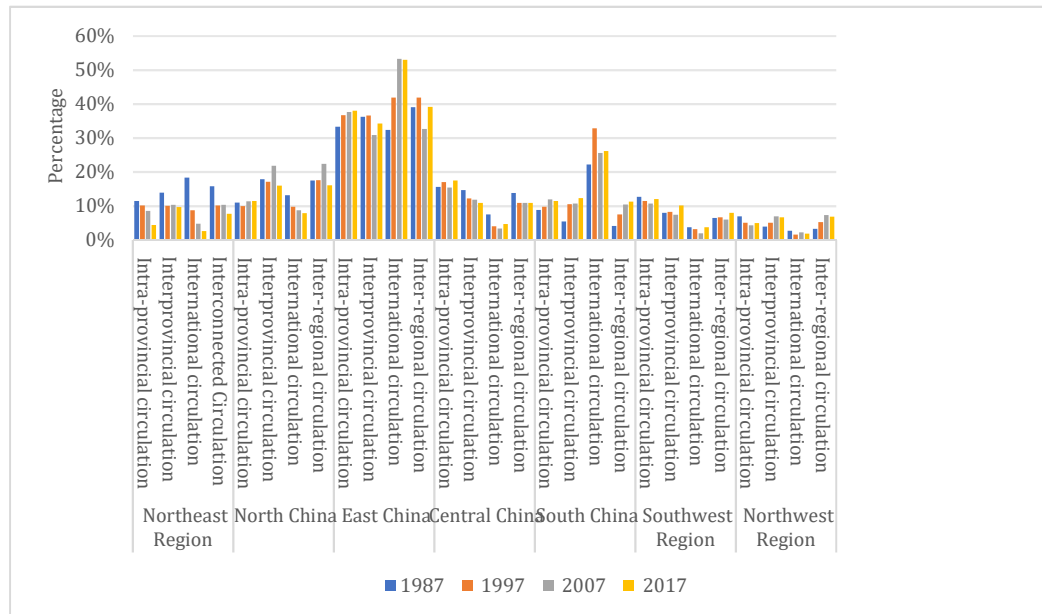


Figure 2. Regional Economic Circulation, 1987–2017

3.3. Analysis of Differences in Circulation Characteristics Across Provinces

There are significant disparities in the distribution of shares across the four types of circulation among provinces (as shown in Table 2). This differentiation is the result of the interplay of resource endowments, locational conditions, policy environments, and stages of development, encompassing both common patterns of evolution and divergent path choices.

The dominant forces driving intra-provincial circulation have shifted from resource-based provinces to those driven by domestic demand. In 1987, resource-rich and agricultural provinces such as Sichuan (8.72%) ranked at the top, exhibiting distinct characteristics of self-sufficiency; By 2017, Shandong, Jiangsu, and Guangdong had surged to the forefront, as urbanization and industrial restructuring expanded the scale of domestic demand. Hubei and Sichuan also completed their role transitions, driven by new urbanization policies, resulting in significantly different driving forces for intra-provincial circulation.

Within the framework of interprovincial circulation, Jiangsu has consistently occupied a central position. As early as 1987, it ranked first with a 9.24% share, a result of its role as a geographic hub in the Yangtze River Delta, as well as its early development of industrial support capabilities and resource absorption capacity; By 2017, Jiangsu still maintained its lead, with industries such as electronics manufacturing and chemicals forming close synergies with Zhejiang and Shanghai; the nature of interprovincial circulation had also shifted from the early days of one-way resource flows to multidimensional industrial collaboration.

The spatial pattern of international trade circulation, meanwhile, underwent a shift from concentration to dispersion. Between 1987 and 1997, Guangdong's share rose from 20.39% to 30.93%, as the Special Economic Zone policy transformed it into a contract manufacturing hub for processing trade exports; By 2017, the landscape had changed significantly: Jiangsu's exports of high-end manufactured goods, Zhejiang's innovations in cross-border e-commerce, and Fujian's expansion of trade with Taiwan collectively shaped a new foreign trade landscape, with the driving force shifting from policy incentives to industrial competitiveness.

The interactive cycle has always centered on Jiangsu. In 1987, its share stood at 12.15%, primarily manifesting as a model where coastal exports drove simple supporting production in inland regions; by 2017, Jiangsu still maintained its dominant position with a 10.25% share, but the nature of this linkage had changed. Industrial synergy and logistics support became the main characteristics, and the cross-linkage between domestic and international cycles is evolving from a simple supporting relationship toward deeper-level synergy.

Table 2. Top Three Provinces by Scale of the Four Types of Circulation in China, 1987–2017

Year	Intra-provincial Circulation		Interprovincial Circulation		International Circulation		Interconnected Circulation	
1987	Sichuan	8.72%	Jiangsu	9.24%	Guangdong	20.39%	Jiangsu	12.15%
	Shandong	8.24%	Shanghai	9.08%	Shanghai	11.20%	Shandong	7.83%
	Jiangsu	8.17%	Henan	6.79%	Heilongjiang	9.02%	Liaoning	7.60%
1997	Shandong	9.34%	Jiangsu	9.53%	Guangdong	30.93%	Jiangsu	13.96%
	Jiangsu	7.90%	Hebei	8.00%	Shandong	8.22%	Hebei	8.60%
	Henan	6.64%	Shandong	7.84%	Shanghai	8.10%	Shandong	7.06%
2007	Shandong	10.79%	Hebei	9.36%	Guangdong	24.73%	Hebei	10.11%
	Jiangsu	9.32%	Guangdong	7.66%	Jiangsu	14.91%	Jiangsu	9.00%
	Guangdong	9.08%	Jiangsu	7.05%	Shandong	11.31%	Guangdong	7.46%
2017	Jiangsu	10.24%	Jiangsu	8.47%	Jiangsu	10.25%	Jiangsu	10.25%
	Shandong	12.15%	Guangdong	7.65%	Zhejiang	8.27%	Zhejiang	8.27%
	Guangdong	9.95%	Zhejiang	6.88%	Guangdong	7.43%	Guangdong	7.43%

3.4. Analysis of Circular Economy Characteristics by Industry

The cyclical pattern across industries exhibits a transition characterized by “a shift from heavy industry dominance to synergy between high-end manufacturing and infrastructure services, and from reliance on a single cycle to adaptation to multiple cycles” (see Table 3).

From 1997 to 2007, intra-provincial circulation was dominated by infrastructure sectors such as non-metallic mineral products and construction, highlighting the policy orientation of using infrastructure investment to drive domestic demand; by 2017, high-end manufacturing and production-oriented services—such as telecommunications equipment and computers—had become the main drivers, forming synergies with traditional heavy industry, reflecting how industrial upgrading is reshaping the structure of domestic demand.

In 1987, intra-provincial circulation was dominated by energy and resource industries such as power supply and petroleum processing, with the core focus on cross-regional resource transportation; from 1997 to 2007, the share of manufacturing support and infrastructure industries increased, shifting toward the supply of intermediate goods along the industrial chain; by 2017, a pattern of “midstream manufacturing support combined with infrastructure services” had formed, led by industries such as metal smelting and chemical products, highlighting the supportive role of domestic industrial chain synergy.

In 1987, the international circulation was dominated by light processing industries such as instruments and meters and wood processing, characterized by exports of primary processed goods; from 1997 to 2007, the rise of infrastructure and midstream manufacturing industries gave rise to new forms such as international engineering contracting and exports of infrastructure materials; by 2017, high-end manufacturing had become the core, forming a “high-end manufacturing exports + infrastructure services support” pattern, with the foreign trade structure upgrading toward “High-end products + services.”

In 1987, the international-domestic cycle was dominated by the energy and resources sector, reflecting a simple linkage where foreign demand drove domestic resource-based industries; from 1997 to 2007, the share of midstream manufacturing and infrastructure sectors increased,

deepening the linkage into a “foreign demand → domestic industrial chain support” model; by 2017, midstream manufacturing and infrastructure sectors jointly dominated, achieving “multi-stage linkage,” with the synergy between domestic and international cycles significantly enhanced.

Table 3. Top Three Industries by Scale Across the Four Circulation Categories in China, 1987–2017

Year	Intra-provincial Circulation	Intra-provincial Circulation	International Circulation	Interactive Circulation
1987	Petroleum Refining	Electricity, Steam, and Hot Water Production and Supply	Manufacture of instruments, meters, and other measuring devices	Electricity, Steam, and Hot Water Production and Supply
	Machinery Industry	Petroleum Processing	Wood Processing and Furniture Manufacturing	Petroleum Processing
	Metal Products Industry	Textile Industry	Metal Products Industry	Metal Products Industry
1997	Non-metallic Mineral Products Industry	Non-metallic Mineral Products Industry	Gas Production and Supply Industry	Non-metallic Mineral Products Industry
	Manufacturing of Instruments, Meters, and Office and Cultural Equipment	Gas Production and Supply Industry	Non-metallic Mineral Products Industry	Metal Smelting and Rolling Industry
	Metal Smelting and Rolling Industry	Manufacture of Instruments, Meters, and Office and Cultural Machinery	Metal Smelting and Rolling Industry	Metal Mining and Beneficiation Industry
2007	Construction	Metal Mining and Beneficiation Products	Water Production and Supply	Metal Mining and Beneficiation Products
	Metal Smelting and Rolling Products	Water Production and Supply	Metal Products	Water Production and Supply
	Instruments and Meters	Other Manufactured Products and Scrap	Non-metallic mineral products	Non-metallic mineral products
2017	Water Production and Supply	Chemical products	Water Production and Supply	Nonmetallic Mineral Products
	Telecommunications Equipment, Computers, and Other Electronic Equipment	Metal Smelting and Rolling Products	Non-metallic mineral products	Metal smelting and rolling products
	Metallurgical and rolled metal products	Metal products	Telecommunications equipment, computers, and other electronic equipment	Chemical Products

3.5. Analysis of Industry Characteristics in Representative Provinces: A Case Study of Jiangsu, Zhejiang, Shanghai, and Guangdong

To thoroughly elucidate the differentiated pathways of the dual circulation at the provincial level, this paper selects Jiangsu, Zhejiang, Shanghai, and Guangdong for a case study analysis. These four regions combine the locational advantages of coastal open areas with high-end manufacturing capacity and substantial foreign trade volumes, and they serve as key hubs for major national regional strategies. As “pioneering testing grounds” for policy-driven optimization of the dual circulation, their industrial structures have all undergone a transformation from a dominance of traditional industries to a synergistic model of high-end manufacturing and services (see Tables 4–7).

Jiangsu exhibits a “synergy between manufacturing and services” model. Its intra-provincial circulation has shifted from being dominated by construction and agriculture to being driven by diversified services; inter-provincial circulation has evolved from the export of heavy

industrial intermediate goods to industrial support and service linkage; international circulation has transitioned from light textiles and machinery contract manufacturing to logistics-enabled high-end manufacturing; and cross-regional circulation has developed from chemical and metallurgical support to cross-chain collaboration in high-end manufacturing. As the core of manufacturing support in the Yangtze River Delta, Jiangsu highlights the value of intermediate goods supply and industrial chain synergy.

Zhejiang has forged a path of “logistics-enabled + digital service synergy.” Its intra-provincial circulation has shifted from being agriculture-led to being driven by urban construction and service upgrades, while its inter-provincial, international, and cross-regional circulations have all transitioned from the export of primary products and low-end support to commercial distribution and logistics hubs empowering manufacturing. This characteristic stems from the vitality of the private sector and the first-mover advantage in digital trade.

Shanghai has completed its transformation from a “traditional industrial center” to a “global service-oriented city.” Its intra-provincial circulation has shifted from being dominated by construction to being led by real estate and public services; its inter-provincial circulation has upgraded from the export of heavy and chemical industries to the export of financial and digital services; and its international and cross-border circulation has evolved from light textile contract manufacturing to an equal emphasis on high-end manufacturing and trade in services, with deep integration between services and manufacturing—a result of both urban functional upgrades and policy guidance.

Guangdong has adopted an “export-oriented economy to lead the dual circulation.” Its intra-provincial circulation has shifted from agriculture and construction to urban consumption and digital services; its inter-provincial circulation has upgraded from the circulation of primary products to serving as a commercial hub and supporting industrial chains; its international circulation has leaped from exports of low-end products to exports of high-end electronic manufacturing; and its interactive circulation has shifted from supporting traditional foreign trade to deep synergy between manufacturing and services. Relying on Special Economic Zone policies and industrial synergy among Guangdong, Hong Kong, and Macao, Guangdong has consolidated its core position in international circulation.

The case studies of these four provinces demonstrate that the synergistic alignment of locational advantages, industrial policies, and the process of opening up has collectively shaped the differentiated development paths of provincial dual circulation, providing important empirical evidence for understanding the structural evolution of provincial dual circulation nationwide.

Table 4. Top Three Industries by Scale in Each Type of Economic Circulation in Jiangsu Province

Year	Intra-provincial Circulation	Interprovincial Circulation	International Circulation	Interconnected Circulation
1987	Construction Industry	Chemical Industry	Textile Industry	Textile Industry
	Culture, Education, Health, and Scientific Research	Metal Smelting and Rolling Industry	Machinery Industry	Chemical Industry
	Commerce	Machinery Industry	Paper and Stationery Manufacturing	Metal Smelting and Rolling Industry
2017	Construction	Real Estate	Transportation, Warehousing, and Postal Services	Chemical Products
	Finance	Wholesale and Retail	Nonmetallic Mineral Products	Wholesale and Retail
	Wholesale and Retail	Rental and Business Services	Wood Products and Furniture	Metal Smelting and Rolling Products

Table 5. Top Three Industries by Circular Economy Scale in Zhejiang Province

Year	Intra-provincial Circulation	Interprovincial Circulation	International Circulation	Interconnected Circulation
1987	Agriculture	Agriculture	Agriculture	Textile Industry
	Construction	Textile Industry	Textiles	Agriculture
	Commerce	Chemical Industry	Machinery Industry	Chemical Industry
2017	Construction	Wholesale and Retail	Transportation, Warehousing, and Postal Services	Wholesale and Retail
	Public Administration, Social Security, and Social Organizations	Rental and Business Services	Instruments and Meters	Chemical Products
	Finance	Transportation, Warehousing, and Postal Services	Non-metallic mineral products	Textiles

Table 6. Top Three Industries by Circular Economy Scale in Shanghai

Year	Intra-provincial Circulation	Intra-provincial Circulation	International Circulation	Interconnected Circulation
1987	Construction Industry	Chemical Industry	Textile Industry	Chemical Industry
	Education, Culture, Health, and Scientific Research	Metal Smelting and Rolling Industry	Machinery Industry	Metal Smelting and Rolling Industry
	Commerce	Machinery Industry	Paper and Stationery Manufacturing	Commerce
2017	Real Estate	Finance	Wholesale and Retail	Chemical Products
	Public Administration, Social Security, and Social Organizations	Wholesale and Retail	Communications Equipment, Computers, and Other Electronic Equipment	Wholesale and Retail
	Health and Social Work	Information Transmission, Software, and Information Technology Services	Chemical Products	Transportation, Warehousing, and Postal Services

Table 7. Top Three Industries by Circular Economy Scale in Guangdong Province

Year	Intra-provincial Circulation	Interprovincial Circulation	International Circulation	Inter-regional Circulation
1987	Agriculture	Agriculture	Agriculture	Business
	Construction	Commerce	Paper and Stationery Manufacturing	Freight, Postal, and Telecommunications Services
	Education, Health, and Scientific Research	Food Manufacturing	Textile Industry	Agriculture
2017	Real Estate	Wholesale and Retail	Communications Equipment, Computers, and Other Electronic Equipment	Communication Equipment, Computers, and Other Electronic Equipment
	Finance	Agricultural, Forestry, Livestock, and Fishery Products and Services	Wholesale and Retail	Wholesale and retail
	Information transmission, software, and information technology services	Chemical Products	Electrical machinery and equipment	Chemical Products

4. Conclusion and Implications

From 1987 to 2017, the national dual circulation system underwent an overall transformation characterized by “domestic circulation as the mainstay, with coordinated deepening.” The share of intra-provincial circulation decreased from 63.03% to 47.94%, weakening the “self-sufficient” nature of the system, while the share of inter-provincial circulation rose from 24.94% to 37.13%. regional division of labor and industrial collaboration continued to deepen, while the share of the international circulation first rose and then fell (peaking at 16.42% in 2007 before declining to 9.63% in 2017), reflecting China’s strategic shift from “rapid integration into globalization” to “domestic-oriented with domestic and international linkage.” The share of the interactive circulation rose from 2.65% to 5.30%; although its scale remains small, the cross-linking effects are gradually strengthening.

At the regional level, a tiered pattern emerged characterized by “strengthened leadership in the East, fluctuating adjustments in the Central region, continued contraction in the Northeast, and a gradual rise in the West.” East China and South China led across all four circulation types, while the Northeast experienced contraction across all dimensions due to a rigid industrial structure; the Central and Western regions achieved a gradual upgrade in their circulation tiers by leveraging policy benefits; At the provincial level, regions cluster into four models: export-oriented (Guangdong, Shanghai), manufacturing support (Jiangsu, Zhejiang), resource-dependent (Sichuan, Shanxi), and domestic demand-led (Henan, Hubei). From an industry perspective, these models are deeply tied to industrial upgrading, with all four types having completed a transition from traditional sectors toward high-end manufacturing, service synergy, or deepening of industrial chains.

Typical cases in Jiangsu, Zhejiang, Shanghai, and Guangdong further demonstrate that the synergistic alignment of locational endowments, industrial foundations, and policy orientations has shaped the differentiated development paths of these four regions, providing diverse models for reference to provinces of different types.

Based on this, policy optimization should be advanced from multiple dimensions: at the regional level, the eastern region should focus on enhancing the quality and expanding the reach of high-end manufacturing and trade in services; the central region should deepen collaboration with the eastern region’s industrial chains; the northeastern region should stimulate the momentum for transformation through institutional and mechanism innovation; and the western region should leverage the “Belt and Road” initiative and the New Western Land-Sea Corridor to overcome geographical and industrial constraints; At the provincial level, export-oriented provinces should drive the transformation of exports toward higher quality and strengthen cross-border coordination; manufacturing-support provinces should consolidate their advantages in mid-stream manufacturing and industrial chain collaboration; resource-dependent provinces should extend their resource processing chains and cultivate emerging industries; and domestic-demand-driven provinces should expand domestic consumption and investment while fostering local industrial clusters; At the industry level, traditional resource-based industries will transition toward deep processing and green, low-carbon development; high-end manufacturing will strengthen independent innovation and mastery of core technologies; production-oriented service industries will accelerate cross-regional expansion to support industrial chain collaboration; and public utilities will safeguard the baseline of intra-provincial demand and improve infrastructure networks; At the policy level, efforts should focus on accelerating the construction of a unified domestic market, removing hidden interprovincial trade barriers, optimizing policies for opening up to support the transformation and upgrading of foreign trade and cross-border collaboration, formulating differentiated regional and provincial policies to avoid a “one-size-fits-all” approach, and improving mechanisms for coordinated regional development to promote nationwide synergy.

This will generate a combined force for the dual circulation and help advance the new development paradigm in depth.

References

- [1] Liu, H. (2020, November 25). Accelerating the construction of a new development paradigm with the domestic economic circulation as the mainstay and the domestic and international dual circulations reinforcing each other. *People's Daily*, p. 6.
- [2] Han, Z., Wu, H., & Yun, L. (2024). A study on the measurement of domestic and international dual circulation in China's interprovincial economy and regional differences. *Statistical Research*, 41(9), 21–31.
- [3] Zhang, Y., Li, S., He, J., et al. (2024). Measurement and analysis of the evolutionary characteristics of China's dual circulation pattern from a provincial perspective. *Management Review*, 36(1), 42–52.
- [4] Bian, J. (2022). Understanding the four dimensions of the national economic cycle from a political economy perspective. *China Economic and Trade Guide*, (8), 33–35.
- [5] Han, X., & Ma, L. (2024). Marx's theory of economic circulation and the construction of a new development pattern. *Marxism and Reality*, (5), 101–110+203–204.
- [6] Li, B., Zhao, Y., Feng, Z., et al. (2021). Value circulation, economic structure, and the new development paradigm: A political-economic theoretical framework and international comparison. *Economic Research Journal*, (5), 4–19.
- [7] Ren, J., & Huang, M. (2021). A review of research on the “dual circulation” new development pattern. *Economic Issues*, (4), 7–15.
- [8] Qian, X., & Pei, T. (2021). The new development pattern of dual circulation—Domestic and international: Theoretical logic and endogenous dynamics. *Journal of Chongqing University (Social Sciences Edition)*, (1), 14–26.
- [9] Huang, Q., & Ni, H. (2021). Measurement analysis of the domestic and international dual circulation in the Chinese economy: With a discussion on the essential characteristics of the new development paradigm. *Management World*, 37(12), 40–58.
- [10] Muradov, K. (2016). Structure and length of value chains. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.2814294>
- [11] Wang, Z., Wei, S. J., & Zhu, K. (2013). Quantifying international production sharing at the bilateral and sector levels (NBER Working Paper No. 19677). National Bureau of Economic Research.
- [12] Wang, Z., Wei, S. J., Yu, X., et al. (2017). Measures of participation in global value chains and global business cycles. National Bureau of Economic Research.
- [13] Chen, C. (2022). Measuring China's “dual circulation” and its new development pattern: An analysis based on adjusted and consolidated global input-output (ICIO) tables. *Journal of Beijing University of Technology (Social Sciences Edition)*, 22(5), 123–141.
- [14] Zhang, S., & Fang, Y. (2022). An analysis of comparative advantages in China's dual circulation economy. *Research on Quantitative Economics and Technical Economics*, 39(2), 3–22.
- [15] An, Q., Wu, S., Li, S., et al. (2024). Analysis of the impact and characteristics of China's provinces' participation in the “dual circulation” from the perspective of value-added decomposition. *Statistics and Decision Making*, 40(12), 135–140.
- [16] Jiang, X., & Meng, L. (2021). Domestic circulation as the mainstay, external circulation as an enabler, and a higher-level dual circulation: International experience and Chinese practice. *Management World*, 37(1), 1–19.
- [17] Chen, Q., Xu, J., Xia, Y., & Ji, K. (2022). Measurement methods for the dual circulation of domestic and international economies and an analysis of the evolutionary trends in China's dual circulation pattern. *Chinese Journal of Management Science*, 30(1), 12–19.
- [18] Ding, X., & Zhang, S. (2022). Measurement and analysis of China's dual circulation economy. *The Economist*, (2), 74–85.

- [19] Zhang, Z., & Zhu, K. (2024). A decomposition framework for the domestic and international dual circulation and a study on China's external dependency. *Management Review*, 36(2), 3–13.
- [20] Lu, J., Xiang, W., & Gu, Y. (2022). A synthesis of the “dual circulation” theory and its practical application in China. *Finance and Trade Economics*, 43(2), 54–67.
- [21] Lu, J. (2022). A study on measuring the level of local participation in domestic and international circulation. *Contemporary Economic Management*, 44(5), 8–13.
- [22] Hua, D., & Liu, M. (2022). Structural evolution and growth effects of the dual circulation in provincial economies: A dual-four-circulation decomposition based on the IRIOT-MRIO matrix. *Western Forum*, 32(6), 64–81.
- [23] Ni, H., & Tian, Y. (2023). Dynamic changes and international comparisons of China's dual circulation economy: A new framework for global value chain decomposition incorporating heterogeneity in factor ownership. *Economics (Quarterly)*, 23(5), 1668–1685.
- [24] Fang, X., He, T., Liu, K., et al. (2023). A study on the measurement of provincial economic circulation levels and their spatiotemporal characteristics. *Statistics and Decision Making*, 39(14), 87–92.
- [25] Li, S., He, J., Zhu, K., Xu, Z., Zhang, D., & Zhang, Z. (2023). A multi-region input-output model for China: 1987–2017. *Economic Science Press*.